CITY OF ANN ARBOR, MICHIGAN

301 E. Huron St., P.O. Box 8647 ● Ann Arbor, Michigan 48107-8647

October 20, 2025

RE: Public Services Standard Specifications

Dear Users of the Public Services Standard Specifications,

The Public Services Standard Specifications provides standards for public improvements constructed in the City of Ann Arbor. These standards apply to publicly constructed projects as well as private development projects, and include standards for design, materials, construction methods, as well as outlining permit and inspection procedures.

These updated Standards are effective immediately; all plan submittals after this date must comply with these standards to receive plan approval.

It is the responsibility of the Private Sector Engineer, Contractor and/or Developer to ensure that they are using the most current version of the Standard Specifications. Join our email list to receive notice of any updates: visit a2gov.org/standardspecifications and choose the envelope icon in the "Connect with us" section to subscribe. This email list will be notified whenever an updated version of the Public Services Standard Specifications is published to the webpage; we plan on an annual update cycle for the near future. Submit any Standard Specification update requests to StandardSpecifications@a2gov.org.

Sincerely,

City of Ann Arbor
Public Services Area

Jordan C. Roberts
Public Services Area Administrator

Nicholas Hutchinson, P.E.
City Engineer

Public Services Standard Specifications

September 2025 Edition

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I. General

A. Purpose and Guiding Principles

1. These City of Ann Arbor Public Services Area Design Standards and Construction Specifications ("Standards") set minimum standards for the design and construction of Public Improvements (see Section II (Definitions) of this Article) as well as govern the installation of other improvements in public rights-of-way.

2. Where so indicated in these Standards, or where governed by other City Code, these Standards also apply to construction of private improvements such as service leads or elements that may have an impact on public infrastructure.

3. Where standards or specifications are not given, the best practice in design, materials, and workmanship shall be followed and, in all cases, shall be subject to the approval of the Public Services Area Administrator (PSAA).

4. These Standards are intended to set minimum standards for materials and equipment to be furnished and for the installation of all improvements and/or work covered by these Standards. It is the intent of these Standards to cover complete work. Where minor accessories or tools are clearly necessary for satisfactory operation and/or maintenance of the equipment, or to safely and/or properly complete the work, but are not specifically mentioned herein, they are deemed to be included in these Standards.

5. A list of commonly used materials for specific applications is provided; see City of Ann Arbor Material Requirements (Appendix A). Materials provided on the list are deemed acceptable; materials not listed are subject to approval by the PSAA.

B. Detailed Specifications

1. For a particular Public Improvement project, the City reserves the right to prepare Detailed Specifications and Special Details as it deems to be in the City's best interest.

2. Such Detailed Specifications and Special Details shall be utilized where it is necessary to modify or supplement these Standards based on conditions unique to the project.

3. In such cases, the Detailed Specifications and/or Special Details shall supplement and/or supersede these Standards.

C. Variations and Revisions to Standards

1. Minor and Technical Variations and Revisions

a) The PSAA may permit variations to these Standards where unusual conditions or circumstances warrant.

b) As needed, the PSAA will issue general revisions to these Standards that relate to technical aspects of the design and construction of covered improvements or acceptable methods of work.

D. Adoption of Standards and Specifications by Reference

1. Within any particular Article of these Standards, the latest edition of standards and specifications of established organizations such as the MDOT, the AWWA, ASTM, etc. shall be adopted herein by reference.

2. Within any particular Article of these Standards, the latest edition of city adopted plans and policies that guide the City's overall efforts such as the Transportation Plan, the A^2ZERO plan, etc. shall be adopted herein by reference.

3. Work specified in these Standards shall conform to the Public Services Rules and Regulations.

4. Where work is performed in the City of Ann Arbor Downtown Development Authority (DDA) boundary see also Appendix D: Street Design Manual.

II. Definitions

A. Terms and Meanings

1. AASHTO - American Association of State Highway and Transportation Officials.

2. Accessible - A pedestrian facility or element in the public right-of-way that complies with PROWAG guidelines.

3. ADA - Americans with Disabilities Act.

4. ADT - Average Daily Traffic

5. ALTA survey - Specialized survey of a property that adheres to the standards of the American Land Title Association and the National Society of Professional Surveyors.

6. ANSI - American National Standards Institute.

7. ASTM - American Society for Testing and Materials.

8. AWWA - American Water Works Association.

9. B&B – Ball and Burlap root ball for tree planting

10. Building Department - The City of Ann Arbor Construction and Building Department within Planning and Development Services.

11. Building Official - The City of Ann Arbor's Building Official or designee.

12. CIP - Compacted in Place.

13. City - The City of Ann Arbor, Michigan, a Michigan municipal corporation, whose address is 301 East Huron Street, P.O. Box 8647, Ann Arbor, Michigan 48107-8647; when a specific Service Area or Unit name is used, it shall refer to that Service Area or Unit of the City of Ann Arbor.

14. City Administrator - The City of Ann Arbor's City Administrator or designee.

15. City Attorney - The City of Ann Arbor's City Attorney or designee.

16. City Code - The City of Ann Arbor's Code of Ordinances.

17. City Engineer - The City of Ann Arbor's City Engineer or designee.

18. City Project - A project bid and/or managed by, or on behalf of, the City.

19. Contractor - Any individual, partnership, or corporation furnishing, constructing, or installing any improvement covered by these Standards.

20. Civil Construction Plan - A plan, signed and sealed by a professional engineer, for the construction of public utility mains, private service leads inspected by Engineering, public roads, or other improvements covered by these Standards that are part of a Private Development Project.

21. DDA - The Ann Arbor Downtown Development Authority.

22. Detailed Specifications - Modifications to these Standards developed by the City for a particular Public Improvement project.

23. Developer - The individual, partnership, corporation, group or entity (other than the City) causing the construction of any improvement covered by these Standards.

24. Easement - An easement granted by an Owner to the City by using an approved City easement document or by platting as required by the State of Michigan Land Division Act (Act 288 of 1967 as amended) or other applicable law.

25. Edge-of-metal - Edge of pavement at the joint between HMA and concrete curb and gutter.

26. EGLE - The Michigan Department of Environment, Great Lakes, and Energy. Formerly known as MDEQ, The Michigan Department of Environmental Quality.

27. Engineer - The person or persons responsible for the design and preparation of Plans and/or for construction engineering.

28. Engineering Unit - The City of Ann Arbor's Engineering Unit of its Public Services Area.

29. Fire Marshal - The City of Ann Arbor's Fire Marshal or designee.

30. Footing drain - This term shall be as defined in City Code, Title II (Utilities and Services), Chapter 28 (Sewage and Sewage Disposal), Section 2:41.2c. (Definitions).

31. Franchise Utilities - Utilities not owned by the City, including but not limited to privately owned natural gas and electric distribution systems, and telephone, communication, cable, and conduit systems, and all appurtenances thereto.

32. HMA – Hot-Mix Asphalt

33. IEEE - Institute of Electrical and Electronics Engineers.

34. IFC – International Fire Code

35. Inspector - An assigned City of Ann Arbor representative performing inspection related to these Standards.

36. ITE - Institute of Transportation Engineers

37. Land Development Coordinator - The City of Ann Arbor's Land Development Coordinator or designee.

38. Lawn Extension - The area between the back of curb or edge of gravel shoulder on an uncurbed public street, and either the public sidewalk, public shared use path, or property line.

39. Manhole - The industry term for a small covered opening that allows a person of any gender to enter, typically allowing access to underground utilities.

40. MDNR - The Michigan Department of Natural Resources.

41. MDOT - The Michigan Department of Transportation.

42. MIOSHA - Michigan Occupational Safety and Health Administration.

43. MMUTCD - Michigan Manual of Uniform Traffic Control Devices.

44. MNREPA - Michigan Natural Resources and Environmental Protection Act.

45. MOT – Maintenance of Traffic (also referred to as temporary traffic control in the MMUTCD)

46. NACTO - National Association of City Transportation Officials.

47. NFPA – National Fire Protection Association

48. NCPI - The National Clay Pipe Institute.

49. NEC – National Electric Code.

50. NEMA - National Association of Electrical Manufacturers.

51. NSF - National Science Foundation.

52. OSHA - Occupational Safety and Health Administration.

53. Owner - The titleholder of a parcel of real property.

54. Parks and Recreation Manager - The City of Ann Arbor's Parks and Recreation Manager or designee.

55. Pedestrian Access Route - An accessible, continuous, and unobstructed path of travel for use by pedestrians with disabilities within a pedestrian circulation path.

56. Pedestrian and Bicyclist Maintenance Plans - Plans or drawings for the safe maintenance of pedestrian and bicycle access during construction.

57. Planning Commission - The City of Ann Arbor Planning Commission.

58. Plans - Plans or drawings for the construction of any improvement covered by these Standards.

59. Private Development Project - A project funded by a Developer or Owner other than the City.

60. Private Sector Engineer - The person or persons responsible for the design and preparation of Plans and/or for construction engineering on behalf of a Developer or Owner other than the City.

61. Private Storm Sewer or Lead - A storm sewer or lead carrying only stormwater runoff from a parcel (or parcels) of real, private, non-City, property. A private storm sewer or lead terminates at its connection to the public storm sewer.

62. PROWAG – Public Right-of-Way Accessibility Guidelines. Minimum scoping and technical requirements for the accessibility of pedestrian facilities located within the right-of-way.

63. Public Improvement - An improvement that, when completed and accepted by the City, shall be owned and maintained by the City. Such improvements include but are not limited to public utilities, public streets, public sidewalks, public safety paths, public bike lanes, public streetlights, and public parks.

64. PSAA - Public Services Area Administrator. This is the City of Ann Arbor's Public Services Area Administrator or designee.

65. Public Storm Sewer - A storm sewer carrying stormwater runoff from a public right-of-way or from other City-owned land.

66. Public Utilities - City owned, operated, and maintained utilities and their appurtenances including but not limited to systems for sanitary sewer, water, stormwater, communication conduit and cable, streetlights, and traffic control.

67. Public Works Unit - The City of Ann Arbor's Public Works Unit of its Public Services Area.

68. Sanitary Service Lead - A private sanitary sewer pipe serving only an individual building. A building shall be as defined by City Code, Title II (Utilities and Services), Chapter 28 (Sewage and Sewage Disposal), Section 2:41.2a (Definitions). A sanitary service lead terminates at its connection to the wye or tee that has been connected to a public sanitary sewer.

69. Site - All contiguous land under the same ownership.

70. Standards - These, the City of Ann Arbor Public Services Area Design Standards and Construction Specifications.

71. TPAR - Temporary Pedestrian Access Route. A designated, accessible path that allows pedestrians to safely navigate around or through a work zone, construction site, or other area where the regular pedestrian route is blocked or unavailable.

72. Ten States Standards - The recommended standards for water and wastewater facilities as prepared by the Wastewater Committee of the Great Lakes-Upper Mississippi River Board (GLUMRB) of State and Provincial Health and Environmental Managers.

73. Transportation Manager - The City of Ann Arbor's Transportation Manager or designee.

74. UL - Underwriter's Laboratory.

75. U-M - The University of Michigan

76. Urban Forestry and Natural Resources Planning Coordinator - The City of Ann Arbor's Urban Forestry and Natural Resources Planning Coordinator or designee.

77. USDA – United States Department of Agriculture

78. USGS – United States Geological Survey

79. Water Main, Water Service Line, and Water Service Stub - These terms shall be as defined in City Code, Title II (Utilities and Services), Chapter 27 (Water Service), Section 2.21. (Definitions).

80. WATS – Washtenaw Area Transportation Study

81. WCWRC - The Washtenaw County Water Resources Commission.

82. WCRC - The Washtenaw County Road Commission.

III. Content of Plans and Detailed Specifications

A. General Plan Requirements

1. Preparation by Professional Engineer

a) Plans and Detailed Specifications for all Public Improvements shall be prepared by a Professional Engineer licensed in Michigan. The City reserves the right to require that Plans for private improvements in public rights-of-way or on City-owned lands shall also meet this requirement.

b) Each sheet of the Plans, including the cover sheet, shall bear the name and company logo of the firm and of the Professional Engineer who supervised the work. The cover sheet shall be signed and sealed by the Engineer responsible for the Plans and Detailed Specification preparation. It shall be understood that the signed and sealed cover sheet is applied to all plan sheets, details, special details, specifications, special specifications, and any other information prepared in support of the signed and sealed plan set. If a subconsultant assisted in preparation of Plans, that subconsultant must also include their firm name and logo on the plan sheets for which they are responsible as well as the signature and seal of the subconsultant's Professional Engineer.

2. Preparation by Professional Land Surveyor

a) Plan sheets which include a required minimum standard ALTA survey shall be prepared by a Professional Surveyor licensed in Michigan; a survey shall not be prepared more than 6 months prior to submittal. Such sheet(s) shall be signed and sealed by the Professional Surveyor and contain the name and company logo of the firm by whom said Professional Surveyor is employed.

3. Verification of Existing Utilities

a) It shall be the Engineer's responsibility to field verify locations of existing utilities prior to Plan submittal.

4. Plan Sheet Size, Scale, Orientation, and Required Note

a) All drawings for City Projects shall be 22"x 34" and use the current City title block. Plans for Private Development Projects shall be 24" x 36".

b) Scales for plan and profile sheets shall be 1" = 40' (horizontal) and 1" = 4' (vertical) scale or 1" = 20' (horizontal) and 1" = 2' (vertical). Other scales may be used only if approved by the PSAA or if directed by the PSAA for specific areas requiring detailed analysis to verify compliance with published standards such as the ADA or PROWAG.

c) Each Plan sheet shall be oriented such that the north arrow points towards the top of the page, unless impracticable. The order of preference for north orientation: 1. pointing toward the top, 2. pointing to the left, or 3. pointing to the right. It is never acceptable to direct north toward the bottom of the sheet.

d) Plan sheets should be set up to avoid breaking at important design features such as intersections, or curves starting or ending at the beginning or end of a sheet.

e) Sheets on curves should be angled to produce a balanced sheet; the tangent sections shall be near the center of the plan sheet.

f) For City Projects, the following note shall be included on the cover sheet, or the first sheet of Plans: "The construction covered by these plans shall conform to the City of Ann Arbor Public Services Area Design Standards and Construction Specifications (“Standards”). The omission of any standard detail does not relieve the Contractor of their obligation to construct items in complete accordance with those Standards."

g) For Private Development Projects that include Public Improvements, the following note shall be included on the cover sheet or the first sheet of Plans: "The construction of any public improvement shown on these plans that is subject to the City of Ann Arbor Public Services Area Design Standards and Construction Specifications (“Standards”) shall conform to those Standards. The omission of any standard detail does not relieve the Contractor of their obligation to construct items in complete accordance with those Standards."

5. Location Sketch

a) All Plans must include a location sketch(s) that show the project’s location on an overall map of the City as well as an enlarged detail of the project site.

b) If the Plans consists of more than two sheets, a cover sheet with an index of drawings must also be provided.

6. Stationing

a) Stationing shall be shown in both plan and profile views.

b) Where practicable, stationing shall be from left to right.

c) Plan and profile stationing shall begin and end with a station multiple of 100 feet (e.g., station 3+00 or 6+00) and shall match in plan and profile. Cross sections shall be shown as if the observer is looking up station and shall read "up station."

d) Each utility and the roadway shall have its own separate stationing along its respective centerline or the centerline of the right-of-way as directed by the PSAA. All stationing shall begin at 0+00, unless otherwise directed by the PSAA. Stationing of laterals or other auxiliary lines shall also be stationed beginning at 0+00 and shall be tied to the stationing of the utility from which it originates. This stationing shall be clearly detailed on the Plans. For sanitary and storm sewers, station 0+00 shall begin at the downstream connection to the existing main.

7. Elevations and Benchmarks

a) All elevations shown on the Plans shall be referenced to NAVD 88 datum.

b) Benchmark locations and elevations for the work shall be indicated on the Plans. A minimum of two benchmarks are required.

8. Existing Conditions

a) Street names, lot/parcel lines, right-of-way lines, street addresses, and lot/parcel numbers shall be shown on all plan sheets.

b) For special assessment projects, parcel addresses, tax identification numbers, and owners' names and addresses shall also be shown.

c) The location of all existing structures, natural and other features, and site conditions within the influence area of the work and within the public right-of-way including but not limited to all existing utilities, trees, landscaping, drainage swales, topography, bike lanes, pavement markings, street signs, and all other relevant features shall be accurately depicted on the plan view.

B. Public Utility Plans

1. General Requirements for all Utility Plans

a) If an individual proposed Public Utility requires two or more drawings, then an overall utility plan with a 1" = 100' scale, or other approved scale, shall also be provided in the Plans.

b) Profile sheets for sanitary sewer and water mains shall be shown separately on individual sheets; storm sewer, road vertical alignment, edge drain, and curb and gutter may be grouped together on sheets.

c) Plan and profile views shall be required for all Public Utilities. All private service leads connecting to a Public Utility shall be profiled as directed by the PSAA. The City reserves the right to require additional profile views.

d) The plan and profile are to be on the same sheet and shall be vertically oriented. The plan view shall be placed over the profile with the stationing aligned.

e) The profiles of the existing and proposed grades shall be clearly and distinctly shown and labeled on all profile drawings.

f) All existing and proposed utility crossings, including leads, shall be shown, stationed and labeled in the profile view. The label shall include the type of utility crossed.

g) The location of, and construction details for, all connections to existing Public Utilities shall be clearly indicated on the Plan sheets as well as all necessary street restoration or similar details associated with such connections.

h) All rim elevations shall be shown and labeled for both proposed and existing utilities, including valve boxes and manhole covers. All finished grade elevations of proposed fire hydrants shall be shown and labeled in the plan and profile.

i) Trench details, special bedding details, directional boring details, special construction methods, and other additional detailed information where deemed necessary by the PSAA, shall be shown in the profile view where applicable. Where using casing pipe jacked-in-place, starting and ending stations for casing pipe shall be shown and labeled in the plan and profile views.

j) All existing and proposed utility easements, including proposed locations, size, and purpose, shall be shown on the appropriate Plan sheets. Existing utility easements shall be labeled with the Liber and Page numbers of the recorded easement. Proposed easements shall be so indicated.

2. Additional plan information specific to sanitary sewer, water main, and storm sewer plans shall meet the applicable requirement set forth in Article 2 (Sanitary), Section I.A.4. (Plan Information Required), Article 3 (Water), Section I.A.3. (Plan Information Required), and Article 4 (Stormwater), Section I.A.3. (Plan Information Required) of these Standards.

C. Franchise Utility Plans

1. Plans for Franchise Utilities constructed in public rights-of-way shall conform to Private Utilities in the Public Right-of-Way guidelines as set forth on the City's Engineering website.

D. Road Plans

1. General Requirements for Roadway Plans

a) Profile of the existing and proposed centerline of roadway shall be provided. In locations where the pavement crown line is not aligned with the center of the right-of-way, or meanders within the public right-of-way, the profile shall be represented along the pavement crown line (also referred to as the pavement control line) or as directed by the PSAA.

b) Profile of the pavement crown shall label the longitudinal grades and station and elevations of all high and low points, and grade breaks.

c) Profiles where vertical curves are required for grade changes shall station and label the elevations of the Point of Vertical Curve (PVC), Point of Vertical Intersection (PVI), and Point of Vertical Tangency (PVT). In addition, the grades approaching the PVC (g1) and departing the PVT (g2), the length of curve from PVC to PVT (L), and the rate of vertical curvature (K) shall be labeled.

d) Pavement crown elevations along vertical curves shall be indicated at 25-foot intervals in the profile.

e) Curve data for roadway horizontal curves shall be provided in plan view; including, Point of Curve (PC), Point of Tangent Intersection (PI), Point of Tangent (PT), curve radius (R), central angle of curve (Δ), and long chord bearing and distance.

f) Where new or replacement curbs are shown, existing and proposed Top-of-Curb (TOC) elevations shall be provided at 25-foot intervals and tied into the whole stations associated with the pavement control line. In addition, such grades shall be provided at the PVC, PVT, grade breaks, and correspond to appropriate geometry of all horizontal curves in plan view as well as any other unique locations, as required by the PSAA, in order to be able to construct the roadway without detailed computations or computer software.

g) Profile of the TOC shall be provided and show the station and elevations of all high and low points, grade breaks.

h) The horizontal location of the centerline of each existing or proposed cross-street and/or driveway within the construction limits shall be delineated in the plan and profile view.

i) Typical cross sections shall be provided showing the associated street alignment and stations where each section will apply. All integral parts of the roadway and the roadbed shall be shown and dimensioned, including but not limited to: pavement width, paving materials and depth for each pavement layer, base and subbase materials and depth, curb and gutter type and dimension, sidewalks, underdrains, and right-of-way width.

j) For asphalt streets, the typical cross sections shall include a HMA application table. The application table must include the HMA mix, the rate of application, thickness of course, wear index, the performance grade (PG), HMA course, and location remarks. Typical concrete pavement cross sections should indicate the location and type of longitudinal joints and load transfer devices. Location and spacing of joints and design of load transfer devices shall be in accordance with current MDOT Standard Details/Plans, Series R-39 through R-43.

2. Intersection, Eyebrow, and Cul-de-Sac Details

a) Individual plan details including all spot elevations needed to determine compliance with these Standards and ensure constructability shall be provided for all intersections, eyebrows, and cul-de-sacs. Elevations shall be provided at both the pavement crown and corresponding point along the edge of pavement and/or curb and gutter. Computed longitudinal and transverse grades shall also be provided for segments between these points.

b) Preferred detail scale shall be 1”=10’. Maximum detail scale shall be 1”=20’.

c) Detailed grade elevations and jointing shall be indicated as well as Point of Curve (PC), Point of Tangent (PT), and curve radii for all intersection curbing.

IV. Review and Approval of Plans for Private Developments

A. Public Improvements Plan Review Procedure

1. Required Submittal of Plans

a) Following City Council or City Planning Commission final approval of the Site Plan or Final Preliminary Plat for a site, Plans for all required Public Improvements shall be submitted to the PSAA for review and approval prior to construction.

b) One paper set of detailed proposed construction plans, including all calculations and related data, shall be submitted for initial review. Applications for the review of Civil Construction Plans shall be made in the City's online permitting system.

2. Payment of Fees

a) The applicable plan review fees will be calculated once the application process is completed. Payment is due upon receipt of an invoice via the City's online permitting system. Payment shall be made via check, e-check, or cash and remitted to Engineering. Reviews will not begin until payment is received.

3. Review Process

a) The PSAA will review the plans and provide written plan review comments. Red-line markups will be uploaded to the Civil Construction Plan project file in the City's online permitting system when necessary.

b) The Private Sector Engineer shall revise Plans in accordance with the review comments and resubmit them for further review. This process shall continue until such time as the Plans are approvable. Should the number of plan reviews exceed three (3), additional fees will be charged to the project. Further reviews will not occur until the additional fees are paid.

c) After final approval of the Plans, sets of sealed and signed Plans (number to be directed by the City) shall be submitted to the PSAA.

d) Where Plans include proposed public water and/or sanitary sewer improvements which require EGLE permits, applications for such permits shall be prepared by the Private Sector Engineer. The PSAA will submit the permit application(s) and Plans to EGLE for issuance of a permit.

e) If the construction to be inspected by Public Services does not commence within one year of the date of Civil Construction Plan approval, the Civil Construction Plan approval will expire. Future proposed construction shall be subject to resubmission of plans for re-review, and payment of all applicable plan review fees will be required.

B. Required Permits

1. Permits

a) All necessary permits other than those listed in Section IV.A.3.d) (Review Process) of this Article are the responsibility of the Private Sector Engineer, Contractor, and/or Developer.

b) A Civil Construction permit is required to be obtained prior to start of construction. Application for this permit is made through the City's online permitting system through the Civil Construction Plan project.

C. Solid Waste Review

1. Solid waste bin enclosures and access paths for solid waste collection equipment shall be indicated on Plans and shall comply with Article 12 (Standard Details), SD-SW-1 through SD-SW-6B of these Standards.

2. For sites that cannot accommodate a standard dumpster enclosure, the dumpsters may be rolled out of a building or alternate enclosure by the property owner to a proposed collection location to be approved by the PSAA.

3. A collection narrative for recycling and trash collection shall be provided on the site plan.

4. For sites adjacent to a public alley, solid waste trucks are permitted to access the property through the alley if swept path clearance requirements in accordance with Article 12 (Standard Details), SD-SW-4 (Swept Path Requirements for Front Load Solid Waste Vehicle) of these Standards can be provided.

5. Solid waste collection locations must be located within the boundaries of the property unless an alternative location is approved by the PSAA.

V. Survey Review of Final Plats (Subdivisions) and Master Deed Exhibit B (Condominiums)

A. Review Procedure

1. Submittal

a) A copy of the proposed Final Plat for subdivisions and of the proposed Exhibit B for condominium projects shall be submitted in AutoCAD format to the City Surveyor for technical review.

b) All easements, rights-of-way, parks, open spaces, or similar items required in accordance with the Site's approved final preliminary plat (for subdivisions) or final site plan (for condominiums) shall be indicated on the plat or condominium Master Deed Exhibit B.

c) All easements, rights-of-way, parks, open spaces, or similar items shall be clearly indicated as either public or private.

d) The submittal shall include survey closure calculations for the overall plat or condominium boundary and for individual lot or unit boundaries.

2. Technical Review

a) Plans shall be reviewed for consistency with Site's approved final preliminary plat (for subdivisions) or final site plan (for condominiums).

b) All survey calculations will be reviewed for proper technical closure.

VI. Easements and Rights-of-Way for Public Improvements

A. General

1. All required easements and rights-of-way for Public Improvements (including all associated consents and subordinations) must be executed by the Developer, Owner, or other signer with appropriate authority and approved by the City prior to issuance of any Certificate of Occupancy for any building, unit, or lot in a Private Development or approved phase thereof.

2. Easements for Public Improvements shall not be located in areas of unusual topographic conditions or sensitive environmental areas, as defined by the PSAA.

3. Easements for Public Improvements shall, to the extent practicable, be located in areas that contain only pavement or non-landscaped open space such as turf grass. The City will not be responsible for maintenance of improvements in easements and will not repair or restore improvements in the easement that are damaged by the City's permitted activities under the easement, except that the City will restore standard pavement and turf grass if damaged by the City.

4. If a Private Development Project wishes to convey an easement to the City that contains structures or other improvements, (1) the City must first consent in writing, and may withhold its consent if the structure or improvement will substantially interfere with the City's easement rights or if there is a feasible alternative, and (2) the Owner must execute an easement indemnifying the City from all responsibility for the structure or improvement in a form approved by the City Attorney.

5. Access easements may be required by the City where Public Improvements are not directly accessible from a public right-of-way, for example a public utility that runs across the rear of a parcel. To the extent practicable, access easements should be over areas paved for vehicular travel or non-landscaped open space such as turf grass. The City will not be responsible for maintenance or restoration of improvements, including paving or landscaping, in access easements.

6. The City may require easements to be surveyed to a standard determined by the City, depending on the characteristics of the property or proposed development.

7. Easements must be conveyed to the City without any cloud on the title of the subject property and with all consents and subordinations determined necessary by the City.

8. Specific easement and right-of-way widths shall be as set forth in these Standards in appropriate Articles.

B. Public Utility Easements

1. All Public Utilities shall be located in either public rights-of-way or easements granted to the City as described herein. Every effort shall be made to place Public Utilities in public rights-of-way. Such utilities which cannot be placed in public rights-of-way shall be located in public utility easements.

2. Shared Location

    a) Multiple Public Utilities may be constructed in a single utility easement, provided that a 1:1 trench slope from the bottom of the deeper utility does not undermine any shallower utility and that all other requirements of these Standards with regard to utility separation are met.

    b) A public right-of-way may be used in whole or in part to satisfy easement requirements for Public Utilities.

3. Prohibited or Restricted Improvements and Activities

    a) The following are prohibited in public utility easements:

        (1) Permanent structures or other objects with a foundation or footing

        (2) Solid waste enclosures

        (3) Private detention and retention ponds

        (4) Retaining walls

    b) The following are restricted in public utility easements and require approval by the PSAA:

        (1) Rain gardens, bioswales, and bioretention

        (2) Fence

        (3) Any other improvement, object, structure, not approved by the PSAA

        (4) Grade changes

        (5) Burying, obstructing, impairing, or otherwise making inaccessible any manhole, standpipe, valve, grate, drain, vent, or other surface element of the Public Utilities Systems

C. Easement and Right-of-Way Document Approval Process

1. Submittal of Documents

    a) Legal descriptions for all required Public Utility easements and rights-of-way shall be submitted to the PSAA for review and acceptance based on the final approved Plans.

b) A copy of a current commitment for title insurance for the subject Site and the name of the Owner's designated contact person must accompany the legal descriptions.

2. Review by City

a) The PSAA will review the legal descriptions for technical correctness and survey closure as well as for conformance to these Standards and to the approved Plans.

b) A copy of the accepted legal descriptions will then be forwarded by the Public Services Area to the City Attorney along with the commitment for title insurance.

c) The City Attorney will draft the required easement documents (and necessary consents or subordinations for mortgage, lien, and other interest-holders) using the approved descriptions and City standard forms and convey them to the Owner for execution.

d) The Owner, Developer, or other authorized signer shall then execute the documents and return them to the City for final review. The Owner or Developer shall be responsible for obtaining signed consents or subordinations required by the City Attorney.

e) The City Attorney shall then submit the easement to City Council for acceptance.

f) Once approved, the easement will be recorded by the City Attorney.

VII. Franchise Utilities Locations, Easements, and Plan Review

A. Location

1. Where practical, telephone, electric, gas, cable television lines, and other Franchise Utilities shall be located within private easements for public utilities outside of public rights-of-way.

2. Where Franchise Utilities must be located within public rights-of-way, the following guidelines shall apply:

a) Streetlight foundations and associated conduits and direct-bury cables shall be located a minimum of 18 inches behind back-of-curb.

b) All other Franchise Utilities shall be located a minimum of 3 feet behind back-of-curb.

c) Preferred location for proposed conduit shall be under the public sidewalk. Efforts shall be made to minimize the number of sidewalk slabs to be removed and replaced to accommodate boring operation.

B. Depth

1. Minimum depth for Franchise Utilities shall be 3 feet from finished surface.

2. Where Franchise Utilities must be located under trees, they must be installed by directional drilling, and minimum depth of bore and location of bore pits shall conform to Article 12 (Standard Details), SD-L-4 (Tree Tunneling) of these Standards.

C. Separation Distance

1. Minimum horizontal separation distance from other utilities shall be 5 feet unless otherwise approved by the PSAA.

2. Minimum vertical separation distance from other utilities shall be 1 foot.

D. City Review Required

1. Plans for Franchise Utilities proposed within City rights-of-way or Public Utility easements must be reviewed and approved by the PSAA prior to their construction as set forth in Section III.C. (Franchise Utility Plans) of this Article.

2. In addition, all required permits pursuant to Section VIII (Permits) of this Article must be obtained by the Franchise Utility prior to the commencement of any construction activities.

VIII. Permits

A. General

1. Required Prior to Construction

a) All applicable permits must be obtained prior to the commencement of construction activities related to improvements covered by these Standards.

b) All applicable fees, bonds, certificates of insurance, or any other financial guarantees required pursuant to issuance of such permits must also be posted prior to commencement of construction.

2. Permit Applications

a) Permit applications shall be submitted via the City's online permitting system. Contact Customer Service for more information as needed.

3. Display of Permits and Verification of Outside Permits

a) Copies of all City-issued permits are to be located at the construction site at all times and made available for inspection by City personnel when requested.

b) Copies of all permits obtained from outside agencies are to be submitted to the City prior to construction to verify their approval.

B. Permits Required (as Applicable)

1. Code-Required Permits

a) A *Wetland and Watercourse Use Permit* as required by City Code, Chapter 55 (Unified Development Code), Section 5.29.4 (Wetlands Use Permit).

b) A *Grading/Soil Erosion & Sedimentation Control Permit* as required per City Code, Chapter 55 (Unified Development Code), Section 5.29.3C (Grading Permit: Grading Permit Application).

2. Right-of-Way Permit

a) A permit shall be required per City Code, Title IV (Streets and Sidewalks), Chapter 47 (Streets) for any street excavation that occurs within a City right-of-way.

b) In addition to requirements of City Code as set forth above, such permits shall be subject to conditions set forth in Section VIII.B.2.f) of this Article.

c) Activities for which a Right-of-Way Permit is required include but are not limited to repair, replacement, or new construction of the following:

(1) Public Utilities and utility service leads;

(2) Road construction including street cuts performed in accordance with Section XIX (ROW Disturbances) of this Article;

(3) Sidewalk and/or shared use paths;

(4) Drive approaches;

(5) Streetlights; and

(6) Franchise Utilities.

d) The permit applicant must have on file with the City an approved, current certificate of liability insurance that meets the latest City requirements as established by City Code, Title IV (Streets and Sidewalks), Chapter 47 (Streets), Section 4.3(3).

e) An Annual Right-of-way Permit may be issued to Franchise Utility companies or other entities for routine maintenance activities. This Annual Permit only allows maintenance of existing permitted facilities within the City's public right-of-way. This permit does not allow excavation (including cutting pavement, disturbing existing grade, etc.) or installation of new or replacement facilities.

f) The PSAA may attach to the issuance of a Right-of-Way Permit additional conditions as may be reasonably necessary to prevent damage to public or private property, to prevent the operation from being conducted in a manner hazardous to life or property, or in a manner likely to create a nuisance. Such conditions may include, but shall not be limited to:

(1) Limitations on the period of the year or the time of the day in which the work may be performed;

(2) Restrictions as to the size and type of equipment to be used for the work commensurate with the work to be done;

(3) Designation of routes upon which materials or equipment may be transported;

(4) The place and manner of disposal of excavated materials;

(5) Requirements as to the laying of dust control materials, the cleaning of streets, the prevention of noise, and other results offensive or injurious to the neighborhood, the general public, or any portion thereof;

(6) Regulations as to the use of streets in the course of the work; and

(7) Requirements to bore street crossings on arterial, minor arterial, and urban collector streets outside of the earlier stated time restrictions.

g) In no case shall any opening or trench made by a permittee be considered in the charge or care of the City, or any of its officers or employees. No officer or employee is authorized in any way to take or assume any jurisdiction over any such opening, except in the exercise of police power when it is necessary to protect life and property.

3. Other City Permits for Work in Rights-of-Way

a) Permits shall be required in accordance with City Code, Title IV (Streets and Sidewalks), Chapter 47 (Streets), Section 4.21 (Right-of-way occupancy during construction).

b) A *Traffic Control Permit* is required if any traffic on a City street will be obstructed or restricted as a result of the proposed construction activity or a special event.

c) A *Barricade Permit* is required for occupancy of the right-of-way during construction by equipment, dumpsters, scaffolding, barricading, or materials.

d) *Temporary Permission to Reserve Parking Lane for Work-Related Purposes* is required where occupation of existing parking lanes in front of the work area is necessary to perform construction activities.

e) A *Meter Bag Parking Agreement* shall also be required if the area occupied pursuant to another permit impacts use of parking meters.

(1) When properly installed in a timely manner meter bags in conjunction with existing No-Parking signs will enable the Contractor to have use of the curb lane(s) of streets that normally have metered on-street parking.

(2) Requests for Meter Bag Agreements must be made to the DDA's parking operator at least 24 hours prior to the desired enforcement date.

(3) The cost of meter bags where required shall be the sole responsibility of the Contractor.

(4) The City will be unable to enforce the desired "No-Parking Zone" should the Contractor fail to install the meter bags in a proper and timely manner.

(5) The Contractor shall have the sole responsibility for all meter bag rental, placement, and maintenance requirements.

(6) Delays due to on-street parking shall not be cause for any extra payments or extensions of contract time by the City to the Contractor on City Projects.

f) A *Street Tree Permit* is required prior to pruning or removal of any street trees.

4. City-Issued Public Utility Related Permits

a) Plumbing - Water/Sewer/Storm (PWSS) Permit:

(1) A permit is required for the construction, repair, or replacement of any domestic water, sanitary, storm service lead, or fire service lead.

(2) A permit is required for the construction of all private storm sewers.

(3) The applicant must be a licensed plumbing contractor or sewer installer registered with the Planning and Development Services Unit.

(4) A separate permit must be obtained for each address to be connected.

b) *Requests for a Sewer Tap and/or Water Service* are required for any utility service lead connection to a City water or sewer main involving the Public Works Unit. The applicant must obtain a Right-of-Way Permit, a Plumbing-Water, Sewer, Storm (PWSS) Permit, and pay associated fees to Customer Service prior to making these applications.

5. Other Outside Agency Permits (as applicable)

a) For construction activity taking place in a right-of-way under the jurisdiction of MDOT or the WCRC, permits from the governing agency must also be obtained.

b) An *EGLE Part 41 Wastewater Construction Permit* is required for the construction of any public sanitary sewer. The Public Services Area will apply for the permit upon approval of the sanitary sewer construction plans as set forth in Section IV.A.3.d) (Review Process) of this Article.

c) An *EGLE Act 399 Water Supply Systems Permit* is required for the construction of any public water mains. The Public Services Area will apply for the permit upon approval of the water main construction plans as set forth in Section IV.A.3.d) (Review Process) of this Article.

d) An *EGLE/US Army Corps of Engineers Joint Permit* is required for work in or on Inland Lakes and Streams, Wetlands, Floodplains, Dams, and High Risk Erosion Areas.

e) A *WCWRC Drain Use Permit* is required for construction activities in a County Drain or other facility controlled by the Washtenaw County Water Resources Commission.

f) A permit from the railroad owner is required for work in a railroad right-of-way.

6. Other Permits

a) The list above is not intended to be exhaustive. All other permits required by City Code, these Standards, non-City agency, or other applicable law shall also be obtained prior to commencement of any construction activities.

IX. Pre-Construction Meeting

A. Projects Requiring Pre-construction Meeting

1. For any project which includes the construction of Public Improvements, a pre-construction meeting shall be held at least one week prior to commencement of the work.

2. A pre-construction meeting may also be required for projects which include connection to Public Improvements, or which involve significant work in public rights-of-way.

B. Project Schedule

1. Provision of Schedule by Contractor

a) At or before the pre-construction meeting, the Contractor shall submit a proposed work schedule to the PSAA for review and acceptance, as required by contract with the City of Ann Arbor. It shall be in the form of a critical path schedule and shall include but not be limited to milestone dates as established in the contract or as directed by the City, dates on which no work will be allowed (e.g., Holidays, U-M Football Game Days, etc.), all major and/or controlling operations of work, planned durations of each controlling operation, expected number of days each week to be worked, and any other assumptions needed to prepare the schedule. The PSAA may also require other

additional information if it is deemed necessary to the review and acceptance of the proposed schedule.

b) Following the pre-construction meeting, the Contractor shall revise the project schedule as needed based on PSAA comments and meeting discussion and re-submit to the PSAA for approval. This process shall continue until such time as the proposed schedule is accepted by the PSAA.

2. Approval Required

a) Construction activities shall not commence until the Contractor's schedule has been accepted by the PSAA.

X. Materials Certification

A. Provision of Materials List and Required Approval

1. Materials List Approval Process

a) The Contractor shall provide to the PSAA lists of proposed materials to be incorporated into the work as well as names of suppliers and an approved Material Certification.

b) Materials must be reviewed and approved by the PSAA prior to commencement of construction activities.

B. Materials to Be Certified

1. The following materials shall be certified by the manufacturer as having been tested for compliance with these Standards:

a) Water main pipe and appurtenances;

b) Sanitary sewer pipe and appurtenances;

c) Storm sewer pipe and appurtenances;

d) Corrugated metal pipe;

e) Wrapped underdrain pipe;

f) Precast concrete products;

g) Cements, concrete admixtures, and curing materials;

h) Bituminous materials;

i) Steel and fabricated metal;

j) Timber for retaining walls;

k) Modular concrete blocks, geotextile grid, geotextile filter fabric, position dowels, and all related materials for retaining walls or retaining wall systems;

l) Geotextile filter fabric for roadway or underground utility construction;

m) Geotextile stabilization and separator fabric;

n) Geogrid for soil stabilization or other similar uses;

o) Dense-graded aggregates;

p) Granular materials; and

q) Any other materials as required by the contract or PSAA.

C. Basis for Acceptance or Rejection of Materials

1. The PSAA shall accept or reject materials on the basis of standard test results and as specifically set forth in these or other applicable Standards.

2. The PSAA's findings with respect to a proposed material's suitability for its intended use and its substantial conformance to these Standards shall be final.

XI. Shop Drawings

A. Provision of Drawings and Required Acceptance

1. Shop Drawing Acceptance Process

a) The Contractor shall supplement the approved Plans with detailed drawings and data covering any feature to be constructed for which shop drawings are required, e.g., pre-cast, segmental retaining walls, detailed steel reinforcing layouts, special materials, and/or method of construction.

b) The Contractor shall submit to the PSAA detailed plans, calculations, and descriptions of the proposed facilities to be fabricated in accordance with the Michigan Department of Transportation Standard Specifications for

Construction, Section 104.02 (Plans and Working Drawings), and as outlined herein.

c) For each submittal or resubmittal, the Contractor shall allow at least 14 calendar days from the date of the submittal to receive the PSAA's acceptance or request for revisions. The PSAA's comments shall be incorporated into the submitted plans, calculations, and descriptions. The PSAA's acceptance is required before beginning the work. The review of resubmittals may take less than 14 calendar days depending upon the magnitude of revisions requested. On City Projects, required revisions will not be a basis of payment for additional compensation, extra work, or an extension of contract time. The Contractor shall include time for this entire review process in their critical path schedule.

d) This information must be submitted to the PSAA for acceptance with such promptness as to cause no delay in the work.

e) Fabrication shall not be started until the working submittals have been accepted by the PSAA.

f) Acceptance by the PSAA shall not relieve the Contractor of their responsibility for negligence, design, errors in drawings, coordination of the work with sub-contractors, techniques of fabrication or construction processes, or details of the work.

XII. Mix Designs

A. Initial Review Process

1. The Contractor shall prepare and furnish mix designs for all Blended Limestone-Portland Cement (ASTM C595) concrete and/or hot-mix asphalt (HMA) mixes to the PSAA for review and approval.

2. A minimum of 5 working days is required for the review of the mix design.

B. Use of State-Approved Materials

1. Materials for concrete and HMA mixtures shall conform to the applicable MDOT Specifications including fine and coarse aggregates, HMA binder, Recycled Asphalt Pavement (RAP), and concrete as detailed in Article 5 (Streets), Section II (Materials Standards) of these Standards.

C. Changes to Design after Initial Approval

1. A minimum of 5 working days notification to the PSAA is required for any changes that are requested by the Supplier or Contractor to materials for mix design, to allow testing and review of the modified mix design.

2. Based on observed performance of accepted concrete or HMA mix designs, the PSAA may request revisions to the accepted mix designs to bring the material's production into conformance with the project specifications. If revisions are requested by the PSAA, they shall be provided in such a manner as to minimally delay the critical path schedule.

XIII. Elevations, Lines, and Grade

A. Private Development Projects with Public Improvements

1. Horizontal and Vertical Control System

a) Project coordinates shall be based on the Michigan State Plane Coordinate system.

2. Vertical Benchmark Required

a) The Private Sector Engineer shall locate two vertical control points on or adjacent to the site.

b) These vertical control points ("benchmarks") shall be located such that they will not be disturbed by the project's construction.

c) The elevation for these control points shall be established by the Private Sector Engineer, referenced to NAVD 88 datum.

d) The accuracy of the vertical control points shall be established within the tolerances required by the City. Any work found not to be in conformance with these Standards shall be redone by the Private Sector Engineer.

3. Establishment and Protection of Control Lines and Grades

a) The Contractor shall establish control lines and grades as needed to properly construct the work in accordance with approved Plans.

b) The Contractor shall carefully preserve the general control lines and grades.

c) The City reserves the right to request additional construction staking or providing of additional survey points as needed to layout and determine the precise location, both horizontally and vertically, of all items detailed on the approved Plans.

d) If any portion of this construction staking is damaged, buried, or in any other way becomes unusable, the Contractor's construction activities shall be halted until the Private Sector Engineer re-establishes the staking.

4. Cut Sheets

a) Cut sheets for all proposed Public Utilities and other Public Improvements (curb and gutter, drive approaches, sidewalk, etc.) to be inspected by the City must be submitted and approved by the PSAA prior to the commencement of construction of the utility. The initial set of cut sheets shall be submitted and approved at least two full working days prior to commencement.

b) A minimum of 1 full working day is required for the review and approval of subsequently submitted cut sheets.

c) Construction will be allowed only for that portion for which cut sheets have been approved.

d) Cut sheets shall indicate the following information as applicable:

(1) The on-site vertical benchmarks and their elevation;

(2) Invert elevations of sanitary and stormwater pipes;

(3) Top-of-main elevation for water mains;

(4) Hub elevations;

(5) Centerline of road;

(6) Top of curb;

(7) Radius point of return curb for drive approaches;

(8) Cut or fill to the object being constructed;

(9) Offset distance length (maximum 25 feet allowed);

(10) All utility crossings;

(11) Back of sidewalk;

(12) Top-of-casting elevations for all structures noting that for curb inlets elevation shall be at the front of the casting at the edge-of-metal;

(13) Hydrant finish grade elevations; and

(14) Sanitary sewer leads to be inspected by the City including lead length and invert elevations at both the tee/wye and end point.

5. Utility Staking

a) Staking for utilities shall be every 50 feet except as noted in b) following.

b) Water main to be laid in a horizontal curve shall be staked every 25 feet or less if required by the PSAA in order to maintain proper alignment of the proposed pipe.

c) Every manhole, sewer tee, and water main fitting and appurtenance shall be staked and included on the cut sheet.

d) A minimum of two offset stakes as well as a centerline stake shall be used for all manholes, fire hydrants, and gate valves.

e) For storm sewer structures to be located in the curb line, staking shall be placed establishing the back-of-curb line for a minimum of five feet on each side of the storm sewer structure.

f) Curb staking in accordance with e) above is in addition to, and is to be placed at the same time as, the centerline stake and two offset stakes for the structure itself.

g) Sanitary sewer leads are to be staked with dual offset stakes at the termination point of the lead.

h) Copper water services shall be staked with the location of the curb stop box using either straddle or double offset stakes, marked with finished grade.

i) Ductile iron water services shall be staked as detailed above for water main and shall be included on the cut sheet.

6. Paving, Curb and Gutter, Sidewalk and Safety Path, and Drive Approach Staking

    a) Staking for curb and gutter shall be every 25 feet, with horizontal and vertical curves staked every 12.5 feet, or as directed by PSAA.

    b) All low points, high points, grade breaks, PVCs, PVTs, PCs and PTs shall be staked.

    c) The maximum allowed offset will be 5 feet.

    d) For sidewalk, safety path, and/or drive approach work, staking shall be provided by the Private Sector Engineer, to the satisfaction of the PSAA, that establishes the right-of-way line and all property corners for the limit of the work. The beginning and ending points of drive openings shall be able to be determined without calculation. This requirement applies to the elevation of the proposed curb and gutter as well.

7. Establishment of Control Lines and Grades

    a) Construction lines and grades shall be transferred and set by the Contractor from the control lines and grades provided by the PSAA.

    b) The Contractor shall furnish necessary instruments and competent personnel for performing such work and shall be responsible for the accuracy of the transferred lines and grades. The Contractor's personnel shall assist and work cooperatively with the City in establishing interim grade check points for verifying roadway cross-section elements such as subgrade elevation, sand sub-base elevations, and aggregate base course elevations.

    c) The PSAA may check the work at intervals as they deem necessary and the Contractor shall correct errors, if any, at the Contractor's own expense.

B. City Public Improvement Projects

1. The vertical benchmark in accordance with Section XIII.A.2 (Vertical Benchmark Required) of this Article shall be established by the City.

2. Control lines and grades in accordance with Section XIII.A.7 (Establishment of Control Lines and Grades) of this Article shall be established by the City.

3. The Contractor shall provide notice to the PSAA as soon as possible after having observed or having reason to believe that there may be defects in staking.

4. The Contractor is solely responsible for any damage that their operation may cause to construction staking or existing survey monuments provided by the City. The PSAA reserves the right to charge the Contractor for all costs associated with the re-establishment of construction staking once it has been provided.

XIV. Property Markers, Monuments, and Benchmarks

A. Protection of Survey Markers

1. Requirements

a) The Contractor shall take all necessary precautions not to disturb, damage, move or destroy any property irons, monuments, benchmarks, or stakes marking the boundaries of property along or near the work.

b) If disturbance is likely or is unavoidable, the Contractor shall immediately notify the PSAA such that all property markers, monuments, and benchmarks may be properly witnessed and/or protected for later replacement by a professional surveyor licensed in the State of Michigan.

2. Penalty or Right to Charge

a) The Contractor is solely responsible for any damage that their operation may cause to existing survey monuments.

b) If survey monuments have been damaged by the Contractor prior to their being witnessed by the City, Contractor shall be responsible for all costs included in re-establishing these points. It is particularly noted that in the case of survey Section Corners, USGS Control Points, and similar points, the costs associated with re-establishing these points can be substantial and requires specialized equipment and personnel for which the Contractor will be billed the entire cost.

XV. Inspections, Daily Reports, and Materials Delivery Tickets

A. Responsibility for Inspection

1. Public Services Area

a) The Public Service Area will inspect the following types of construction:

(1) Public water mains;

(2) Water services 4-inch diameter or greater to within 5 feet of the building. Note: Domestic water service connections are installed from the main to the curb box or shut-off exclusively by the Public Works Unit of the Public Services Area where such connections are 2-inch diameter or smaller;

(3) Public sanitary sewers;

(4) Sanitary sewer service leads being constructed in conjunction with installation of new public sanitary sewer main on a Private Development Project to 15 feet past the right-of-way line or within 5 feet of the building if the sewer is located in an easement;

(5) Sanitary sewer service leads being constructed in conjunction with installation of new public sanitary sewer main on a City capital project to within 5 feet of the right-of-way line, or as indicated on the Plans;

(6) Public storm sewers;

(7) Public roads;

(8) Backfilling and restoration within City rights-of-way or public access easements for construction;

(9) Streetlight construction within City rights-of-way or public access easements;

(10) Installation of new sidewalks, bike paths, and drive approaches within City rights-of-way or public access easements;

(11) Reconstruction or replacement of existing sidewalks, bike paths, and drive approaches within City rights-of-way or public access easements;

(12) All work pursuant to a Grading/Soil Erosion & Sedimentation Control Permit issued pursuant to City Code, Chapter 55 (Unified Development Code), Section 5.29.3C (Grading Permit: Grading Permit Application); and

(13) Any other construction work in a public right-of-way occurring pursuant to a City issued Right-of-Way Permit.

b) Inspection performed by the Public Services area shall be subject to the following:

(1) Inspection pursuant to Section XV.A. (Responsibility for Inspection), Subsections 1.a)(10)-(12) (Public Services Area) of this Article shall include inspection of the subgrade, forms, and sand subbase for concrete sidewalks, shared-use paths, and drive approaches; and of the subgrade, sand subbase, and aggregate base for asphalt shared-use paths and drive approaches.

(2) No work shall be performed without notifying the PSAA.

(3) The Contractor shall provide the PSAA a minimum of 3 working days' notice prior to the start of construction in order to allow for the scheduling of inspection personnel.

(4) If work is to take place on any Saturday, the PSAA shall be notified no later than 9 a.m. on the preceding Thursday to allow scheduling of inspection personnel.

(5) Once construction begins, it is the Contractor's responsibility to schedule continuing inspection services for further work with the PSAA on a daily basis.

(6) If work on the site ceases for more than two consecutive work days for reasons other than adverse weather, three working days' notice is required prior to restarting the work.

(7) For Private Development Projects, if the Contractor schedules an inspection but does not arrive on the site at the scheduled time, and does not provide sufficient notification to the PSAA, the Contractor will be charged a fee consistent with the current Public Services Fees schedule for each occurrence.

2. Planning and Development Services Area

a) Planning and Development Services Area will inspect the following:

(1) Water service leads from the curb stop box or service gate valve to the building;

(2) Connection of sanitary sewer service leads to existing service lead stubs, having been previously inspected by the Public Services Area;

(3) Sanitary sewer service leads from the existing sewer main tap to the building; and

(4) Private storm sewers.

B. Right to Bill

1. Inspection Charges

a) The applicant shall be billed for all necessary expenses of the Inspector.

C. Inspector's Daily Reports and Quantity Verifications

1. Inspector's Daily Reports (IDRs) will be completed by the City's Inspector in accordance with the latest City guidelines for IDR Content for City and Private Development Projects.

2. For City Projects, the City's Inspector shall review and agree upon construction quantities daily with the Contractor, to the greatest extent possible.

3. All measurements and agreements reported on the City of Ann Arbor IDR are final, and subject only to verification for mathematical accuracy.

D. Materials Delivery Tickets

1. Required Submittals by Contractor

a) Daily delivery tickets, Material Certifications, and/or Bills of Lading shall be furnished by the Contractor to the City Inspector for materials delivered to the site including but not limited to:

(1) Asphalt delivery tickets;

(2) Concrete delivery tickets;

(3) Aggregate Delivery tickets;

(4) Landscape materials, fertilizer, and seeding tickets; and

(5) Any other materials delivered to site for which payment will be requested, i.e. temporary construction signs, plastic drums, and barricades; reinforcing and/or structural steel; and miscellaneous materials and accoutrements needed to properly complete the work.

XVI. Materials Testing

A. Responsibility for Testing

1. City Projects

a) Required testing as described in Section XVI.B. (Required Testing for Public Improvements) of this Article shall be performed by the City and/or its designated testing consultant.

b) Contractor may, at their discretion and sole expense, run duplicate tests. If such tests are conducted, the results will be considered informational only. The Engineer shall determine the applicability of independent test results and shall render a decision as to the proper interpretation of any or all test results. The Engineer's decision regarding test results shall be considered final.

2. Private Development Projects

a) The Contractor is responsible for, and shall pay all fees associated with, all required testing as described in Section XVI.B. (Required Testing for Public Improvements) of this Article for any Public Improvements.

b) Tests shall be performed by a testing firm acceptable to the City.

c) All test reports shall be promptly submitted to the City for review and approval. PSAA may place a hold on initial acceptance of the utilities if testing documentation has not been received.

B. Required Testing for Public Improvements

1. Cohesive Soils, Granular Materials, and Dense-Graded Aggregate

a) Sieve and proctor analyses shall be performed on all granular material and dense-graded aggregates at the supply pit prior to their introduction to the site. The maximum dry density of all soils will be measured against the AASHTO T 180 (Standard Method of Test for Moisture-Density Relations of Soils Using a

4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop) modified proctor value (with the Large Aggregate Correction Factor included).

b) Proctor analysis performed in accordance with the requirements of the AASHTO T 180 will be performed on cohesive soils used in the construction of improvements where their use is either required by the project specifications or desired by the Contractor. Cohesive soils to be incorporated into any project shall be free of frost-textured materials, organic matter, or other deleterious materials, and shall meet the approval of the PSAA.

c) The results of these analyses shall be forwarded to the PSAA prior to the commencement of construction activities.

d) The measured in-place dry density of granular and aggregate materials shall be checked at locations determined appropriate by the PSAA. There will be no limit to the number or location(s) of the tests to be taken. A nuclear densometer will be used to obtain the in-place density readings

e) Additional sieve and/or proctor analyses in accordance with AASHTO T 180 will be required when, in the opinion of the PSAA, the character of the material differs from that previously tested and approved.

2. Bituminous Materials

a) Samples shall be taken from the hauling unit at the asphalt plant to determine conformance of the approved HMA mix design to the applicable MDOT or other standard as set forth in these Standards. The PSAA shall establish the number and timing of samples to be taken on a daily basis for each material being placed.

b) The measured in-place density of bituminous materials will be based upon the Theoretical Maximum Density (TMD or Gmm) value of the material as computed on the material's mix design. There will be no limit to the number or location(s) of the tests to be taken. All density values will be measured against the target TMD and/or Gmm value. A nuclear densometer will be used to obtain the density readings.

c) Bituminous materials may be rejected for use on a project when, in the opinion of the PSAA, the character of the material obviously differs from that previously tested and/or utilized on the project and approved.

d) All bituminous materials placed within public rights-of-way shall be evaluated against the volumetric properties contained on the approved mix design. Price reductions and/or removal and replacement of the bituminous materials may be required depending upon the nature and severity of the material's failure(s).

e) For projects funded in whole or in part through MDOT, with Federal funds, the City shall administer all testing and acceptance of materials incorporated into the project based upon published Federal/MDOT Standards and Specifications and the contract documents for the project.

3. Concrete

a) Temperature, slump, and air content of the plastic concrete shall be tested.

b) Concrete cylinders and flexural strength beams shall be cast for the required acceptance strength testing and open-to-traffic strength as required by the project specifications. Any requested early-strength specimens shall be provided.

c) Steel reinforcing bars shall be tested. The submittal of material certifications from MDOT-approved suppliers, may be approved by the PSAA, in lieu of testing. However, the PSAA reserves the right to perform physical testing at any time during the course of the work in order to ensure all materials meet the requirements of the project specifications.

d) Concrete materials may be rejected for use in the project when, in the opinion of the PSAA, the character of the material obviously differs from that previously tested and/or utilized on the project and approved.

4. Backfill and/or Material Density Testing

a) The City reserves the right to test the density of any materials placed at any location and time it deems necessary in order to ensure compliance with these standards. The performance of the required density testing shall not be considered grounds for a project delay on City Projects should the test results not meet the specification requirements.

XVII. Working Conditions and Good Will

A. General Working Conditions

1. Allowable Hours of Work

a) Hours of work for construction, repair, remodeling, demolition, drilling or excavation work shall be as stated in City Code, Title IX (Police Regulations), Chapter 119 (Noise Control), Article I (Non-Vehicular Noise), Sec. 9.363(5) which presently permits work on Monday through Saturday between the hours of 7:00 a.m. and 8:00 p.m.

b) Such work will not be permitted at other times unless authorized by the Community Services Area Administrator.

c) Contractors shall work ONLY when there is adequate daylight to properly see all elements of the work being performed except when approved by the PSAA.

d) Hours of work on State trunklines are subject to the MDOT-issued permit for said work.

2. Working in the Rain

a) The Contractor shall not work in the rain unless authorized in writing by the PSAA.

b) The Contractor on a City Project shall not be compensated for unused materials or downtime caused as a result of rain.

c) The Contractor is solely responsible for repairing all damage to the work and to the site, including road infrastructure, road subgrades, and any adjacent properties, which are caused as a result of working in the rain.

3. Dust and Noise Control

a) The Contractor shall provide, operate, and maintain adequate (in the opinion of the PSAA) means of noise and dust control during the course of construction 24 hours per day.

4. Good Will

a) The Contractor shall at all times maintain the best possible relations among the City, other public authorities and entities, other Contractors, and the public.

b) The Contractor shall at all times conduct their work such that disturbance to the surrounding community will be minimized.

XVIII. Work in Right-of-way: General

A. Permits

1. Permits and Inspection Required

a) Prior to undertaking any work in a public right-of-way, the Contractor must obtain all required permits in accordance with Section VIII (Permits) of this Article and all work shall be inspected in accordance with Section XV (Inspections, Daily Reports, and Materials Delivery Tickets) of this Article.

b) The PSAA may grant permission to make an emergency street cut or excavation before a permit is issued, if public safety requires immediate action.

B. Responsibility for Utility Location

1. Contractor Responsibility

a) It shall be the Contractor's sole responsibility to locate or have located all existing utilities prior to commencement of construction activities. This shall be performed in accordance with Public Act 174 of 2013, Miss Dig Underground Facility Damage Prevention And Safety Act, MCL 460.721 – MCL 460.733 as amended.

C. Excavation and Trenching

1. Contractor Responsibility

a) Refer to Section VIII (Permits) B.2.g) of this Article.

2. Excavation and Trenching Limitations and Traffic Maintenance

a) At no time shall more than 200 feet of trench be opened and incompletely backfilled during working hours.

b) At the end of each work day, no more than 10 feet of trench may be left open. All remaining trenches and excavations shall have their entire perimeter properly protected with PSAA-approved fencing materials. All protective measures shall be effective.

c) The remainder of the area of trenching operation shall be available for safe vehicular and pedestrian traffic at all times.

D. Existing Signage

1. Temporary Signage

a) Prior to construction, the Contractor shall, as part of the Traffic Control Permit application, detail the temporary covering of conflicting traffic and/or parking signs for review and approval.

2. Damage to Signs

a) Existing City-owned signs damaged by the Contractor during the course of construction will be repaired by the City at the Contractor's expense.

E. Temporary No Parking Signs

1. Areas of Unmetered Parking

a) Certain areas of proposed construction may allow for unmetered on-street parking. In order to perform construction in these areas, the Contractor shall arrange for the placement of No Parking signs and other traffic control devices as necessary with the City Engineering Unit. The placement of the needed No Parking signs and other related control devices for non-City projects shall be placed as directed by the PSAA at the Contractor’s expense. For City Projects, the Contractor will be compensated for this work in accordance with the terms of the contract.

b) Where such No Parking signs have been installed, the Contractor is solely responsible for delays encountered due to vehicles parked on the street. Enforcement of No-Parking Zones can only be performed by the City and only if No Parking signs had been properly placed at least 48 hours prior to the desired enforcement date.

F. Parking Violations

1. Contractor Parking Violations

a) Parking violation citations issued to the Contractor, subcontractors, and material suppliers, including their employees, shall be enforced under the appropriate section(s) of the City Code.

G. Idling Violations

1. Contractor Idling Violations

a) Idling violation citations issued to the Contractor, subcontractors, and material suppliers, including their employees, shall be enforced under Chapter 72 of City Code.

XIX. ROW Disturbances

A. Open-Cut Excavation Restrictions

1. Time Restrictions

a) Partial or complete transverse or longitudinal street cuts of recently paved or resurfaced streets shall be prohibited. Utility main or service lead construction shall be bored or directionally drilled in accordance with these Standards, in lieu of open-cut construction based on the time restrictions per Table A of this Article.

b) The PSAA may waive the time restrictions per Table A of this Article, if maintaining public safety requires immediate action or if other just cause is shown to exist.

Table A
Street Cut Time Restrictions By Treatment Type

Treatment Type	Time Restriction
Reconstruction	10 Years
Resurfacing (new HMA placement greater then 2”)	7 Years
Capital Preventive Maintenance (pavement treatments less than or equal to 2” thick)	3 Years

B. Restoration Requirements for ROW Disturbances

1. Compliance with Standards and City Code

a) All restoration of ROW disturbances shall be performed by the permittee in accordance with these Standards and City Code, Title IV (Streets and Sidewalks), Chapter 47 (Streets).

2. Cut and Removal

    a) Whenever a part of a pavement slab, square, or section of pavement, curb, gutter, sidewalk, or driveway is broken or damaged by the person making any excavation or opening in or under any street, alley, or within any public right-of-way, the entire pavement slab, square, or section shall be removed to the score, groove or saw cut line and be replaced or reconstructed.

    b) Where the line of cut would be less than 2 feet from an existing expansion or plane-of-weakness joint, the concrete shall be removed to that joint.

3. Daily Covering of Openings

    a) All openings within the roadway surface shall be backfilled and temporary pavement placed at the close of each working day. Alternatively, openings shall be covered with a steel plate, held in place by an approved bituminous patching mixture or pegged in place. An exception may be granted by the PSAA for complete reconstruction of a street where traffic is not being maintained on the section of roadway on which work is occurring.

    b) All steel plates shall be coated with a skid-resistant safety coating, per ASTM C1028.

    c) During winter months steel plates are not allowed as temporary covering.

    d) All openings within the ROW, but outside of the roadway surface, shall be covered or protected at the close of each working day. Temporary pedestrian access routes shall provide a firm, stable, and slip resistant surface compliant with PROWAG and ADA, or an approved detour route provided.

4. Contribution to Resurfacing

    a) If the total area of the proposed patching work (or anticipated damaged pavement area) exceeds 25% of the total pavement surfacing in any block, the PSAA may require a negotiated contribution from the permittee for the resurfacing of such street. The permittee will still be required to patch the street either temporarily or permanently, depending on the schedule for resurfacing, at the direction of the PSAA.

b) Such negotiations shall take place and contributions agreed upon prior to issuance of a Right-of-Way Permit or before approval of the Civil Construction Plan, if applicable.

5. Temporary Restoration

a) All openings or trenches across traffic lanes, where it becomes necessary to remove any existing surfacing or pavement, shall be backfilled to within 12 inches of the surface in a manner that complies with these Standards or that otherwise restores the materials removed from the trench.

b) The remaining portion of the trench shall be filled with compacted MDOT 22A or 21AA aggregate base course material and a minimum of 3 inches of bituminous cold-patch material or concrete, as directed by PSAA, until such time as permanent pavement restoration can be made. The bituminous cold-patch material shall be compacted to the point where further settlement or shoving of the material will not occur. The temporary restoration surface shall be flush to the existing pavement.

c) Each party making street openings shall routinely check their temporary pavement. The temporary pavement shall be properly maintained in a safe condition (e.g., ADA-compliant vertical deflection, absence of trip hazards, etc.) at all times by the permittee until permanent pavement is placed.

d) All regulatory pavement markings and any disturbed signage shall be restored in a temporary condition consistent with their prior configuration.

e) All temporary patches made between November 15 and April 15 shall be checked at least every 14 days and repairs made as needed.

6. Permanent Restoration

a) The final pavement surface and seed/sod shall be placed within 14 days of the completion of construction within the right-of-way, as specified herein. HMA mixtures for road patches shall be the equivalent mix as the adjacent roadway.

b) All street cuts and green space/lawn extension disturbances made in the off-season (November 15 to April 15) shall complete permanent restoration before June 1 of the following construction season.

c) All features within the ROW, including but not limited to pavement markings, colored pavement markings, signage, refuge islands, flex posts and bollards, pavers, bike racks, and/or street furnishings shall be restored to their prior condition.

d) Restoration of green space/lawn extension shall be completed per Article 10 (Construction Specifications), Section VI. (Landscaping and Restoration).

C. Restoration Requirements for Pot-holing for Utility Locations

1. Utilities that are located and repaired using the "potholing" method, which consists of coring the pavement and using vacuum excavation to remove subsoil material until the utility in question is found, shall be restored in the following manner:

a) After coring, protect and salvage the removed core for reuse (unless structurally unsound) by either removing it from the work site or storing it in a safe and secure onsite location. The core shall be readily available for reinstatement into the pavement.

b) In the event that the cored pavement cannot be immediately reinstated and will be left unattended, the opening shall be covered as specified in XIX (ROW Disturbances) B.3. of this Article.

c) MDOT 34R (pea stone) shall be placed around all sides of the exposed utility and six inches above and compacted with a tamping rod, taking care not to damage the utilities.

d) The excavation shall be backfilled using a non-structural flowable fill up to the level of the bottom of the surrounding pavement. See Article 5 (Streets), Section II (Materials Standards), Subsection P (Flowable Fill), of these Standards for additional requirements.

e) The pavement surface shall be restored to its original condition using the salvaged pavement core and an approved bonding material that securely bonds the pavement core to the surrounding parent pavement and fills all voids between and below the core.

f) Bonding material shall be designed to be traffic-bearing in approximately 90 minutes and shall, within 30 minutes at a minimum ambient temperature of 70 degrees F, allow an 18-inch diameter core to support a traffic load equivalent to at least two (2) times the AASHTO H-25 standard wheel load.

g) Enough bonding material shall be placed in the core hole opening above the cured flowable fill to allow it to be forced to the surface and fill the annular space and extraction hole when the pavement core is placed in the opening.

h) The reinstated pavement core shall be set flush with surrounding pavement surface and in its original alignment and orientation.

i) Excess bonding material shall be removed from the restored pavement surface.

D. Corrections and Violations

1. Right of City to Deny Permits

a) Any permittee found in violation of these requirements may be denied additional permits until all openings produced by said permittee have been properly repaired.

2. Corrections

a) The permittee is responsible to correct any defect in a permanent or temporary pavement restoration area which occurs within the period of time beginning with the start of the construction activity and ending three years after the date of completion of the permanent restoration.

b) Corrections must be completed within the time specified in the notification from the City.

c) The City may correct such defect(s) if it is determined to be causing damage to the surrounding infrastructure, creating a public hazard, or if the permittee fails to respond in accordance with the time requirement specified herein. Any expense incurred by the City in correcting such defect shall be paid by the permittee and the permittee shall receive no additional permits until such payment is received in full by the City.

XX. Transportation Control and Access

A. Maintenance of Traffic

1. General Contractor Responsibilities

a) Compliance with Agency Standards – MDOT, MMUTCD, NACTO, PROWAG, and Architectural Barriers Act (ABA).

b) Traffic control devices and maintenance schemes shall be in accordance with Sections 104, 812, and 922 of the Michigan Department of Transportation Standard Specifications for Construction (hereafter MDOT Specifications), and be located, furnished, and operated in accordance with Part VI of the MMUTCD or PROWAG, whichever is more stringent.

c) The Contractor shall always maintain local vehicle, bicycle, and pedestrian traffic within the ROW that maintains or exceeds the level of service and accessibility provided prior to disturbance. The Contractor shall maintain adequate, accessible access to all transit stops, sidewalks, real properties, private drives, etc .

d) The Contractor shall furnish, operate and maintain traffic control devices per the approved Plans, and provide appropriately trained personnel to control and direct traffic movement to transit stops, sidewalks, real properties, private drives, etc.

e) Where required, the Contractor shall maintain two-way vehicle traffic and in-line pedestrian and bicycle traffic on major streets, access for local traffic on all adjacent streets, and always keep intersections open to all modes of traffic.

f) The Contractor shall be aware that unless explicitly authorized by the PSAA, during high-impact special events (e.g., U-M home football games, Art Fair, etc.) no work whatsoever will be permitted in any areas impacting traffic to and from the event. All streets and sidewalks in these areas shall be fully opened to vehicular and pedestrian traffic.

2. MOT Submittal Requirements

a) Projects that impact the ROW for less than or equal to one full work week and only impact motor vehicle operations may use a standard MOT plan as defined by MDOT Traffic Typicals.

b) Projects that impact the ROW for less than or equal to one full work week and impact more than one mode of transportation, shall have an MOT plan prepared by a Professional Engineer or a traffic control technician with International Municipal Signal Association (IMSA) work zone, signage, and pavement marking certifications.

c) Projects that impact the ROW for greater than one week shall have an MOT plan prepared by a Professional Engineer.

B. Road Closures

1. Road Closure Requirements

a) While total road closure may be necessary during certain construction operations, this shall be minimized to the greatest extent practicable. The PSAA shall approve any total road closure before Contractor begins any work that requires same. The contractor shall provide notification to the PSAA a full 7 calendar days in advance of a planned full road closure. The duration and timing of any such closures shall only be as authorized by the PSAA.

b) The Contractor shall obtain a Traffic Control Permit in accordance with Section VIII (Permits) of this Article, a minimum of 3 business days in advance of any street closing or restriction of traffic. Certain roadway closures may require additional notification due to the complexity of the closure, duration, importance to the community, or necessary notification and/or coordination with other City departments or outside agencies.

c) Upon issuance of a Traffic Control Permit, the Contractor shall notify each property in writing, at a minimum on the block(s) on which the work is occurring, or within 1,000 feet of where the work is occurring, whichever is less. At the discretion of the PSAA, the Contractor may be required to notify additional properties, depending on the impacts of the work and extents of any detours. The Contractor shall distribute such notices a minimum of 2, and no more than 7, working days prior to the commencement of the work. For City Projects, time for these notifications shall be considered to be included in the Contractor's critical path schedule. A copy of this notice shall be supplied by the City to the PSAA, City Solid Waste, Police and Fire Units, Ann Arbor Area Transit Authority (AAATA), Ann Arbor Public Schools, and U.S. Postal Service, a minimum of 5 working days prior to the closure.

2. Work Zones affecting Pedestrian and Bicycle Facilities

a) As defined in the guidelines published under the "Public Right-Of-Way Accessibility Guidelines (PROWAG)", when pedestrian facilities are impacted due to maintenance or construction, temporary alternate pedestrian routes shall be provided and have at least the minimum accessibility attributes of the disturbed route. Signage, accessibility features and detectable devices, as necessary, shall be maintained along the alternate pedestrian route to direct pedestrians safely through or around the work zone.

b) Pedestrians must be warned prior to coming upon a change in conditions, including options for alternate routes. When pedestrians approach the work area, they must be given guidance on any changes from the normal route such as shifts in the walkway alignment. As pedestrians pass by the work area, their route must be clearly marked, be provided with a suitable surface, and they must be protected from traffic and work operations (including drop-offs). Pedestrians must be guided back to their original route and/or given information on how to proceed, upon exiting the work zone. Marking and signage must be provided to direct pedestrians safely through or around the work zone as shown in Figure 1 (Maintenance of Traffic Flow Chart for Pedestrians), of this Article, and in compliance with Article 12 (Standard Details), SD-TPR-1 through SD-TPR-8 of these Standards.

c) When the normal function of bicycle traffic is disrupted due to maintenance or construction activities, temporary bicycle traffic control or approved alternate routes shall be provided. Alternate bicycle facilities shall be signed in accordance with the MDOT Road Design Manual, Chapter 8 and MMUTCD, Part VI throughout the work zone. Marking and signage must be provided to direct cyclists safely through or around the work zone as shown in Figure 2 (Maintenance of Traffic Flow Chart for Bicyclists), of this Article.

Figure 1: Maintenance of Traffic Flow Chart for Pedestrians

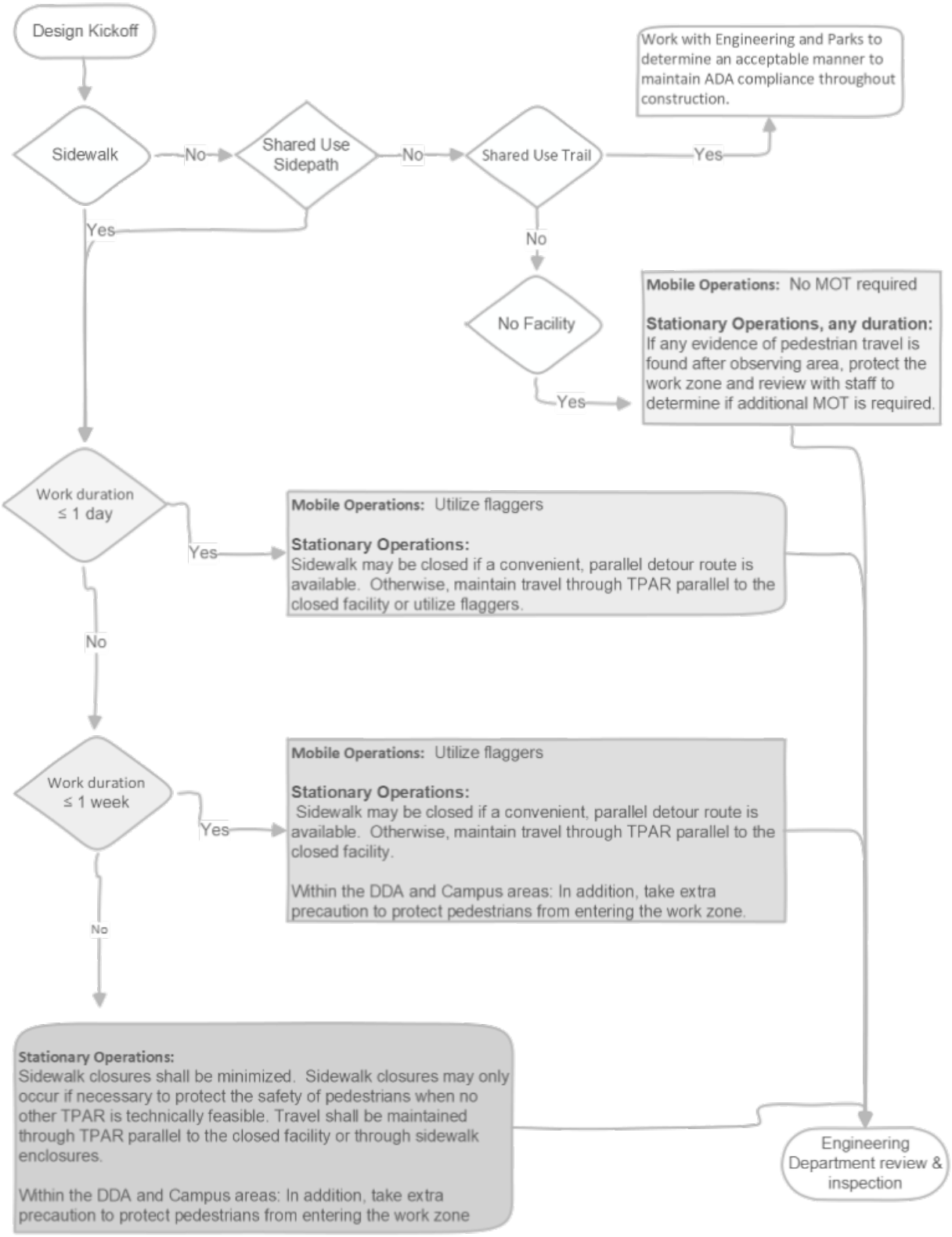
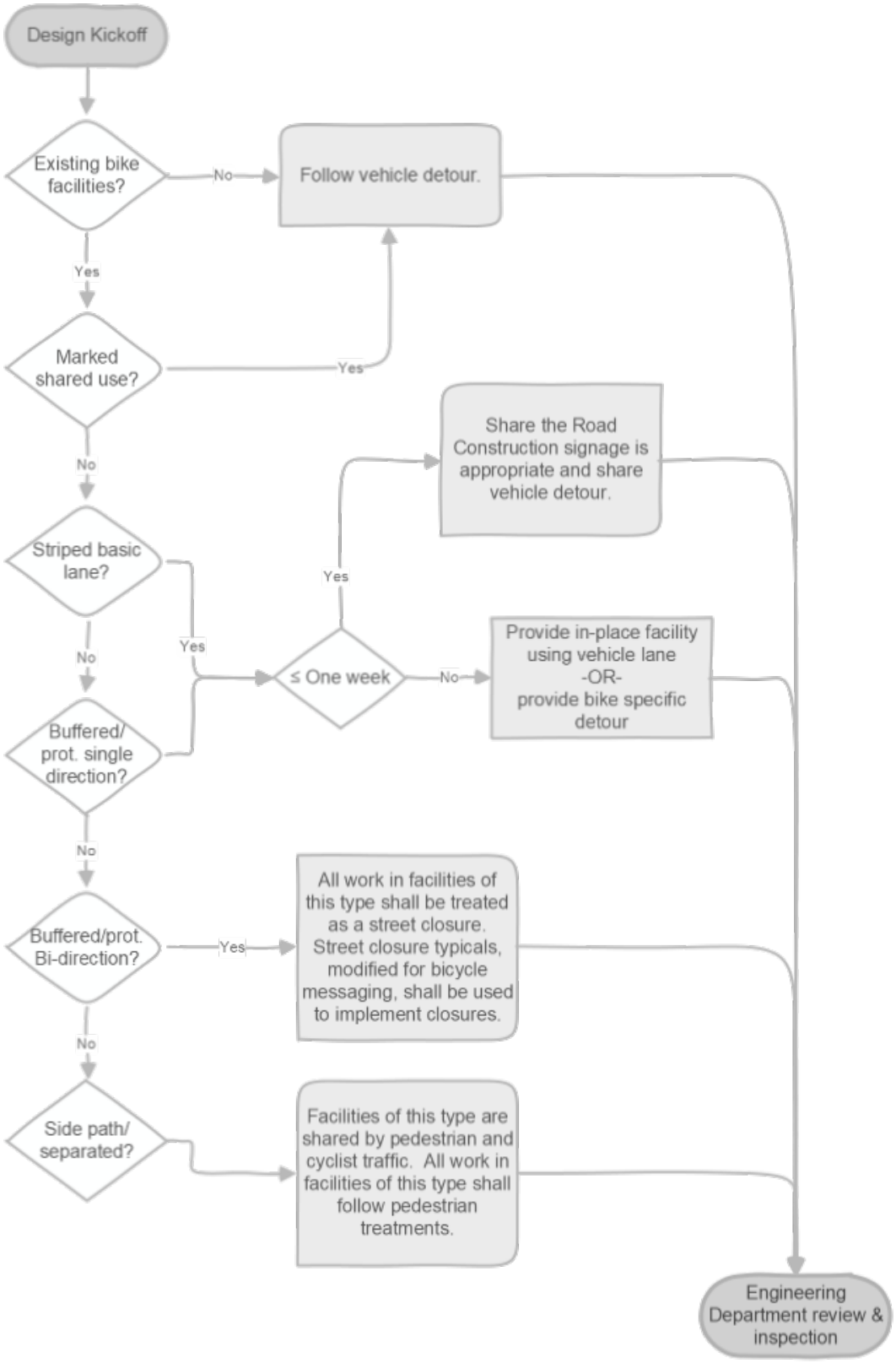


Figure 2: Maintenance of Traffic Flow Chart for Bicyclists



XXI. Handling Excavated and Backfill Materials on Construction Sites

A. Intent of Section

1. The intent of this Section is to ensure that material stored on-site does not impede traffic flows, drainage, or sight distances and that pedestrian and vehicular traffic maintenance is not negatively impacted.

B. Excavation During Construction

1. It is the sole responsibility of the Contractor to coordinate and control the amount of material on-site at any one time and to assure compliance with Section XXI (Handling Excavated and Backfill Materials on Construction Sites) A.1. of this Article.

2. All excavated material that has not been certified for use as backfill material shall be removed from the site immediately.

3. Excavation may be suspended by the PSAA if sufficient equipment for immediate removal of excavated material is not available.

4. Material to be used for backfilling purposes may be stored on-site as allowed by the PSAA, provided all terms of these Standards are met.

5. It may be required that backfill material be moved on the site during a workday or removed from the site at the end of each workday in order to comply with these Standards.

XXII. Material Delivery and Storage

A. Required Notification to City

1. Materials Delivery Notice Requirements

a) The Contractor shall provide the PSAA a minimum of 3 full working days' notice (for the initial delivery of materials to a jobsite) and 1 full working day notice (for subsequent material deliveries) prior to delivery to a jobsite of any materials required for the work to be inspected by Public Services. The Contractor shall also provide notification when the material(s) have arrived at the jobsite.

b) Notice for material delivery will not be acknowledged unless notice to proceed has been granted (for City Projects) and all necessary permits for construction have been approved and all fees have been paid. Any materials delivered

without proper inspection and approval are subject to rejection and removal from the jobsite until such time as the necessary approvals have been granted.

B. Materials Storage

1. Storage practice and location shall be subject to City inspection and approval.

2. The Contractor may store materials on the Site for future incorporation into the work entirely at the Contractor's own risk until the work is accepted in its entirety by the City.

3. Building materials for Private Development Projects shall be stored on the Site and shall not be stored in the public right-of-way unless a barricade permit is obtained by the Contractor.

4. Burning or burying on the site of any materials is NOT permitted.

5. On-site handling and storage of flammable liquids and all other chemicals shall comply with all safety regulations and codes pertaining thereto. Hazardous materials shall not be stored on-site without the express written consent of the PSAA.

XXIII. Temporary Facilities

A. Water Facilities

1. Use of City Water and Hydrants

a) Water will be provided by City personnel at the Contractor's expense from City hydrants when necessary and where available, and only with approval of the PSAA.

b) Contractor shall complete a Hydrant Meter Application, pay the applicable deposit, and comply with stipulations set forth in the application. The City will then install the hydrant meter and backflow preventer.

c) Contractor shall not operate hydrants or valves unless authorized by the PSAA. Unauthorized use of a fire hydrant is a violation of City Code, Title II (Utilities and Services), Chapter 27 (Water Service), Section 2:30 (Hydrant use and valve operation). Violators will be subject to citation by City personnel. The City may request the Contractor's assistance in operating valves and fire hydrants during the prosecution of the work. The Contractor shall cooperate in all reasonable requests made by the City in this regard

d) Hydrant meter shall be supported to ensure horizontal alignment and prevent damage to the hydrant and the meter.

e) Any damage to the hydrant or meter is subject to replacement or repair at the contractor's expense.

f) Between October 1 and April 30 additional cold weather requirements apply as follows:

(1) Hydrants shall be pumped down at the end of each day and the meter removed.

(2) Meter shall be kept at a temperature above freezing.

B. Toilet Facilities

1. Contractor Responsibility

a) The Contractor shall provide temporary chemical toilet facilities for the use of City and its own employees.

b) The Contractor shall properly remove from and dispose of all wastes from chemical toilets off the City's property.

c) All costs for disposal of wastes, and for maintenance of chemical toilets, shall be at the Contractor's own expense.

d) All chemical toilet facilities, and disposal of wastes, shall be satisfactory in every respect to the City's representative and all governing bodies having jurisdiction.

C. Light and Power

1. Contractor Responsibility

a) The Contractor shall provide their own temporary light and power.

D. Temporary Office

1. Contractor Responsibility

a) The Contractor may establish and maintain, at the Contractor's own expense, office headquarters at the site of the work. The Contractor must make all arrangements for such space.

b) Prior to erection or placement of any temporary buildings or facilities, the Contractor shall submit plans of these buildings or facilities to the PSAA for

general approval of materials and appearance. Approval of temporary buildings or facilities may be required from the Building Official.

c) The Contractor must arrange, and pay for if necessary, suitable parking for their employees, sub-contractors, and others who may utilize the facility when establishing temporary office facilities.

E. Removal of Temporary Facilities

1. Contractor Responsibility

a) The Contractor shall remove each temporary facilities provided by it at the termination of their usefulness or the termination of the work, or when requested by the PSAA.

b) The Contractor shall leave the site and all of its elements in a condition that is equal to, or better than, the conditions that existed prior to the establishment of temporary office facilities.

XXIV. Protection of Property and Safety

A. Safety

1. Contractor Responsibility

a) During the progress of the work, the Contractor shall continuously maintain adequate facilities for the protection and safety of all persons involved in the work and its inspection. The Contractor's operations shall not damage or harm any real or personal property during the performance of the work.

2. Barricades and Warning Signs

a) The Contractor shall provide all barricades, warning signs, warning lights, etc., as detailed on the Plans, and/or as required by the MMUTCD or the appropriate MDOT Specifications in compliance with all requirements of the City and of all authorities having jurisdiction.

B. Damages by Contractor

1. Contractor Responsibility

a) All damages or interruptions which occur to property, structures, or facilities as a result of acts or omissions by the Contractor, their subcontractor, or supplier shall be remedied by the Contractor at the Contractor's own expense.

b) Premium wages (if any) required to remedy any such damages or interruptions in the shortest possible time and to the complete satisfaction of the PSAA shall also be at the Contractor's expense.

c) Each item on private property outside the easement limits removed or damaged by the Contractor shall be restored to a condition that is equal to or better than its original condition.

d) All such work to restore the existing conditions to the satisfaction of the property owner or City is the sole responsibility of the Contractor.

XXV. Protection of Trees

A. Required Tree Protection

1. Compliance with Plans

a) Existing trees within the area of the work that are indicated on the Plans to be saved shall be protected in accordance with Article 12 (Standard Details), SD-L-3 (Tree Protection) of these Standards.

B. Damage to City-Owned Trees

1. Contractor Responsibility

a) Damage to City-owned trees by the Contractor's operation, or the operation of the Contractor's subcontractor or supplier, shall be repaired under the direction of the Urban Forestry and Natural Resources Planning Coordinator by an approved forestry contractor retained by the Contractor.

b) Alternatively, at the discretion of the Urban Forestry and Natural Resources Planning Coordinator, such required repairs may be performed by the City with all associated costs being charged directly to the Contractor. Payment of these charges is the Contractor's sole responsibility. On City Projects, in cases of non-payment by the Contractor for said repairs, the City may elect to withhold sufficient funds from the Contractor to cover its cost of repairing any damage created by the Contractor.

c) Any City-owned tree deemed by the Urban Forestry and Natural Resources Planning Coordinator to be damaged beyond repair shall be removed with all associated costs being charged directly to the Contractor. A canopy loss fee determined by the City shall be paid by the Contractor for the loss of canopy.

C. Work Requirements around City-Owned Trees

1. Contractor shall not store or place equipment and/or materials inside the critical root zone of any City-owned tree.

2. Contractor is responsible for properly pruning trees to prevent damage. If branches greater than 2 inches in diameter require pruning, Contractor must contact the City Forestry Department for consultation and evaluation.

3. No roots of City-owned trees greater than 2 inches in diameter are to be cut. If roots are encountered greater than 2 inches in diameter that need to be cut, Contractor must contact the City Forestry Department for inspection and consultation.

4. The contractor shall take care not to cause undue damage to the existing tree, including the roots greater than 1½ inches. Excavation shall be done using hand tools, hydro excavation, or other method as approved by the engineer, as directed by the PSAA

5. Roots requiring pruning shall be pruned cleanly with a saw and not pulled or torn by large equipment.

XXVI. Casing Pipe

A. Required Size

1. The inside diameter of the casing pipe shall be at least 4 inches greater than the largest outside diameter of the carrier pipe joints.

B. Casing Pipe Materials

1. All casing pipe shall be steel.

2. Pipe complying with the following minimum requirements shall be utilized unless more stringent requirements are established by a railroad or other governing entity.

3. Minimum nominal casing diameter and pipe thickness shall be per Table B of this Article.

Table B Casing Pipe Diameter and Wall Thickness	
Nominal Casing Pipe Diameter	**Minimum Wall Thickness**
Less than 12”	0.188”
12” and 14”	0.250”
16”	0.281”
18”	0.312”
20” and 22”	0.344”
24”	0.375”
26”	0.406”
28”	0.438”
30”	0.469”
32”	0.500”
34” and 36”	0.532”
38”	0.562”
40”	0.594”
42”	0.625”
44” and 46”	0.657”
48”	0.688”
Greater than 48”	As directed by Pub. Serv. Area Admin.

4. Pipe shall be non-spiral welded pipe and have a minimum yield strength of 35,000 psi.

5. All joints shall be made leak-proof using full penetration, continuous welds. Welds shall be ground smooth outside and inside (except inside 22 inch diameter and less) to prevent conflict with the soil or carrier pipe placement.

6. Pipe shall meet the requirements of ASTM A53 (Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless), Type E or S, Grade B or ASTM A139 (Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)), Grade B.

7. Spacers and casings shall conform to Article 12 (Standard Details), SD-W-6 (Typical Pipe Casing Detail) of these Standards, unless otherwise approved by PSAA.

XXVII. Blasting

A. Approval Required

1. Blasting for excavation will be permitted only after securing the written approval of the PSAA and only when proper precautions are in place and functional for the protection of persons and property.

2. The hours of blasting will be fixed by the PSAA.

B. Damages

1. All damage caused by blasting shall be repaired by the Contractor at the Contractor's sole expense.

C. Conformance to Codes and Standards

1. The Contractor's methods and procedure in blasting shall conform to all applicable laws, including State, County and City.

XXVIII. Soil Erosion Control

A. Compliance

1. Contractor Responsibility

a) The Contractor shall install and maintain soil erosion and sedimentation control measures as required by applicable laws and these Standards, and as indicated on the Plans.

XXIX. Drainage Maintenance

A. Correction of Drainage Problems

1. Contractor Responsibility

a) All drainage problems resulting from the Contractor's operations shall be corrected by the Contractor at the Contractor's expense within the time frame specified by the PSAA and the Contractor.

XXX. Truck Routes

A. Compliance with City Code

1. Designated Truck Routes

a) Truck traffic within the City must travel on designated truck routes as set forth in City Code, Title X (Traffic), Chapter 126 (Traffic), Article VIII (Miscellaneous Rules), Sections 10.102 (Truck routes).

b) Truck Routes are depicted as a layer on the Transportation Map on the City's City Maps web page under the Transportation heading. Truck Routes shown are designated as such by traffic control orders issued pursuant to City Code as referenced in Section XXX.A.1.a) (Designated Truck Routes) of this Article.

2. Weight Restrictions and Frost Laws

a) Weight restrictions may be set by the City in accordance with City Code, Title X (Traffic), Chapter 126 (Traffic), Article VIII (Miscellaneous Rules), Sections 10.102 (Truck routes) and 10.99 (Weight restrictions).

b) All such weight restrictions shall be enforced by the City Police Services Unit, as authorized by City Code, Title X (Traffic), Chapter 126 (Traffic), Article VIII (Miscellaneous Rules), Sections 10.102 (Truck routes) and Section 257.726b of the Michigan Vehicle Code.

c) Weight restrictions shall be in accordance with load limits established by Michigan Vehicle Code, Section 257.722, except when seasonal weight restrictions ("frost laws") are in effect.

d) Seasonal weight restrictions are typically put into effect by the City when so imposed by the WCRC. These restrictions are generally placed on streets during the months of February, March, and April.

e) Seasonal weight restrictions may, however, be placed on City streets during any month the City determines they are necessary to protect the streets from unnecessary damage.

f) When seasonal weight restrictions are in effect, load limits are reduced by 35% on City-controlled streets.

g) Requests for load limit waivers must be made in writing to the PSAA.

Article 2 Sanitary

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I. Sanitary Sewer Design

A. General

1. Adoption of Standards by Reference

   a) The Ten State Standards shall be followed, except as modified in these standards.

2. Easement Requirements

   a) Sanitary sewer easement widths shall be equal to 2D+10 feet, where D is the maximum depth of the trench on a particular run of sewer. The minimum sanitary sewer easement width shall be 30 feet.

   b) The sanitary sewer shall be located 5 feet from the center of the easement, leaving D feet on one side of the sewer and D+10 feet on the other.

   c) Sanitary sewer easement widths may vary from run to run of sewer, provided that the above requirements are met.

   d) When sanitary sewer mains cannot be located in standard width easements, the easement width and pipe location therein must be approved by the PSAA. In such cases, increased slope, casing pipe, epoxy-lined ductile iron pipe for sanitary sewer use meeting the standards of ASTM A746 (Standard Specification for Ductile Iron Gravity Sewer Pipe), or other special provisions may be required.

3. Sanitary Sewer Location and Required Extension

   a) Sanitary sewers shall not be located in areas of unusual topographic conditions or under stormwater detention basins. Location under bioswales, rain gardens, or other green infrastructure are discouraged and require approval of the PSAA.

   b) See Article 5 (Streets), Section I (Street and Pavement Design), B.13., of these Standards, for utility location requirements.

   c) For Private Development Projects, sanitary sewers shall be extended to the limits of the development to allow for future extension.

4. Plan Information Required

   a) Plans for sanitary sewers shall include the information required in Article 1 (General), Section III (Content of Plans and Detailed Specifications) of these Standards.

   b) In addition, the following information shall be provided:

      (1) A copy of the design calculations for all sanitary sewers.

      (2) The pipe material, size, percent of grade, and length of run between all manholes shall be shown in the profile view. Pipe length shall be measured from center of upstream manhole to center of downstream manhole.

      (3) All existing and proposed pipe invert elevations at all manhole structures shall be shown in the profile view.

      (4) The percent of grade and invert elevation at the terminal end of all sanitary sewer service leads shall be shown in the plan view.

      (5) All service tee or wye locations are to be stationed in the profile view.

      (6) All basement or first floor elevations (whichever is the lowest served by the sanitary sewer) shall be given on both the plan and profile views.

      (7) A casting schedule shall be provided including:

         (a) Manhole number corresponding to the plan view

         (b) Station

         (c) Casting type (manufacturer and catalogue number)

         (d) Top-of-casting elevation

         (e) Manhole invert

         (f) Manhole depth

B. Capacity

1. Sanitary sewer design flow computations shall be submitted for approval with a contour area map showing the tributary area to be serviced. Developmental phases, present and future, with acreages and any offsite areas contributing shall be shown with the number of lots or units included.

2. The Engineer shall submit detailed calculations to establish design flows sufficient for the ultimate tributary population. A copy of the basis of design for the sanitary sewers must be submitted with the construction plans.

3. Once approved, the basis of design shall be included on the plan set.

4. Design flow rates shall be per Appendix B (Sanitary Design Dry Weather Flow Rates) of these Standards. In cases where a proposed Type of Facility or Use is not specifically identified in Appendix B, design flow rate shall be as directed by the PSAA. Sewer capacities (for residential developments) shall be for sewers flowing half-full.

C. Size

1. Minimum size for sanitary sewer mains shall be nominal 8-inch diameter.

2. In no case shall the downstream sewer main diameter be smaller than the upstream diameter.

D. Velocity

1. Minimum design velocity for sanitary sewers shall be 2 feet per second with the pipe flowing full. The PSAA may require a greater minimum velocity where deemed necessary to maintain adequate cleaning velocity through manholes.

2. The maximum design velocity for sanitary sewers shall be 10 feet per second with the pipe flowing full. Special consideration will be given in areas of steep topography.

3. All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second, based on Manning's formula using an "n" value of 0.013. The minimum slopes required for sewers 36 inches or less are provided in Table A. However, slopes greater than these may be required for construction, to control sewer gases or to maintain self-cleansing velocities at all rates of flow within the design limits.

4. The PSAA may require special provisions to avoid scour and protect against displacement including anchoring with concrete anchors or approved equal.

E. Deflection

1. There shall be a minimum of 0.10-foot fall through a manhole where the sewer has a horizontal deflection of up to 30 degrees.

2. For manholes where the sewer has a horizontal deflection from 30 degrees to 90 degrees, there shall be a minimum of 0.20-foot fall.

3. There shall be no more than 90 degrees of horizontal deflection through a manhole.

F. Slope

1. Minimum slope for each sanitary sewer pipe size shall be per Table A below unless otherwise specified herein.

Table A
Minimum Slopes for Sanitary Sewers

Pipe Diameter	Minimum Grade (%)
8”	0.50 *
10”	0.28
12”	0.22
15”	0.15
18”	0.12
21”	0.10
24”	0.08
27”	0.07
30”	0.06
36”	0.05
*A grade of 0.40% may be permitted where special conditions exist. This must be approved in writing by the PSAA.	

2. Caution must be used when designing sewers with minimum grades to insure proper installation.

3. The terminal run of an 8-inch diameter sewer shall be laid at a uniform grade of not less than 0.6% between manholes.

4. Wherever there is an increase in pipe size at a manhole, the grades shall match at the eight tenths flow lines, which is 0.8 of the diameters of incoming and the outgoing pipes, as measured from the inverts.

G. Depth and Cover

1. Sewer depth design shall be deep enough to serve neighboring properties when the sewer is extended at a future date.

2. Sewer depth shall be sufficient to serve proposed basements both onsite and for neighboring parcels. A minimum depth of 10 feet shall typically be necessary. See Article 12 (Standard Details), SD-SN-5 (Sanitary Sewer Depth) of these Standards.

3. If basements are not to be constructed, the finished first floor elevation shall be treated as the "basement" floor elevation for purposes of standards per Article 12 (Standard Details), SD-SN-5 (Sanitary Sewer Depth) of these Standards and the pertinent assumptions regarding the sewer and lead depth below that elevation shall apply.

4. Minimum depth of cover to the top of the pipe shall be 5 feet. The minimum depth may, however, be reduced to 4 feet for short stretches not to exceed 50 feet in length if the reduction is approved in writing by the PSAA.

5. The maximum depth to invert of any sanitary sewer shall not exceed the depth recommended by the manufacturer for each size and class of pipe. Where required depth cannot be achieved with one type of pipe, a suitable alternative pipe shall be used as approved by the PSAA. Alternative material must extend from manhole to manhole.

H. Separation Clearances

1. There shall be a minimum of 10 feet of horizontal clearance and 18 inches of vertical clearance at perpendicular crossings between sanitary sewers and water mains measured outside edge to outside edge of pipe. The PSAA may permit exceptions subject to Ten State Standards and with approval of EGLE.

2. There shall be adequate horizontal separation between sanitary sewers and all utilities to allow a 1:1 trench slope from the bottom of the deeper utility that will not undermine any shallower utility, or a minimum of 5 feet of separation whichever is greater.

3. There shall be a minimum of 1 foot of vertical clearance at perpendicular crossings of sanitary sewers with utilities other than water mains.

I. Manhole Size, Location, and Maintenance Access

1. Manholes shall be placed at the terminus of each line, at every change of grade, direction, and pipe size, at each junction of sewer mains, and at high flow service lead locations where directed by the PSAA.

2. The maximum distance between manholes shall be 400 feet for pipes 15 inches or less in diameter and 500 feet for pipes 18 inches or larger in diameter.

3. Minimum inside diameter of manholes shall be 4 feet. Diameters greater than 4 feet shall be required based on the size, number, and alignment of pipes entering the manhole in accordance with Article 12 (Standard Details), SD-SN-1 (Sanitary Manhole) of these Standards.

4. Minimum access diameter shall be 2 feet.

5. All manholes shall be located such that they will be directly accessible by vehicular maintenance equipment. Manholes shall be located within 10 feet of edge of pavement. Manholes that cannot be located within 10 feet of the edge of pavement shall be designed such that maintenance equipment will be supported.

6. All surfaces to be utilized for manhole access shall be designed to support a fully loaded sewer cleaning vehicle (66,000 pounds).

7. The manhole access route shall have a longitudinal slope no greater than 10%, and a minimum width of 12 feet.

8. Unless approved by the PSAA, manholes shall not be located in areas subject to flooding. If such locations cannot be avoided and are approved, watertight manhole covers and castings or other measures as directed by the PSAA are required.

9. No openings shall be made in precast units which would leave less than 18 inches of undisturbed circumferential wall length, or which would remove more than 40% of the circumference along any horizontal plane.

J. Manhole Drop Connections

1. Outside drop manhole connections shall be permitted only whenever a sewer main enters a manhole at an invert elevation of more than 2 feet above the outlet pipe invert elevation and if approved by the PSAA.

2. Outside drop connections for sewer mains shall be one size smaller than the size of the incoming sewer but in no case less than 8-inch diameter. Larger diameter drop connections may be required as directed by the PSAA.

3. Inside drop connections will not be permitted unless approved in writing by the PSAA.

4. Where drop connections are permitted, a formed channel shall be provided.

K. Pollutant Interceptors and Monitoring Points

1. Grease, oil and sand interceptors and monitoring points shall be provided where required by City Code, Title II (Utilities and Services), Chapter 28 (Solid Waste Management), Section 2.43.1(9) (Prohibited discharges).

L. Sanitary Service Leads and Risers

1. Minimum diameter of new sanitary service leads shall be 4-inch or as determined by Plumbing Code, as adopted per City Code, Title VIII (Building Regulations), Chapter 100 (Construction Code)..

2. Maximum lead size shall be one standard size smaller than the sewer main unless otherwise approved by the PSAA.

3. Construction of sanitary service leads from a new public sanitary sewer main to each fronting parcel that the sewer is designed to serve shall be included with construction of the main.

4. For a Private Development project, the sanitary service lead shall be constructed to 10 feet beyond the public or private right-of-way line.

5. For a City Project, the sanitary service lead shall be constructed to within 5 feet of the right-of-way line.

6. Where sanitary sewer mains are constructed in easements for a Private Development project, the sanitary service lead shall be constructed to within 5 feet of the proposed building.

7. Typical sanitary service lead location shall be at the middle of the lot.

8. Sanitary service leads shall have a minimum of 5 feet of cover.

9. Sanitary service leads may not be tapped into a manhole except as otherwise specified herein or as specifically approved by the PSAA. In such cases, the PSAA may require any other needed modifications to these lead standards.

10. Sanitary service lead connections to an existing sanitary sewer main that are greater than one-half the main diameter shall be made as a cut-in wye.

11. The maximum diameter of a sanitary service lead tap into an existing sanitary sewer main via coring shall be one-half the diameter of the main. All such cored taps shall be performed by the City.

12. For all new leads greater than 6” diameter, a new manhole shall be installed on the main and the new lead tapped into that manhole at the 0.8 line of the sewer and in a formed channel.

13. Location of the wye shall be marked from the downstream manhole and from the nearest property corner on the sanitary sewer record plans. Where leads are not perpendicular to the property line, they shall be dimensioned to the side lot line at the property line.

14. When placed in the same trench as a water service lead, the water service lead shall be a minimum of 18” above the sewer lead and placed on a shelf of undisturbed earth. A minimum horizontal separation of 3 feet shall be maintained between the water and sanitary leads.

15. Minimum grade of sewer service leads shall be ⅛" per foot or 1.0% for 6-inch diameter leads. If a sewer service lead is 8 inches in diameter or greater, the minimum grade of the lead shall be that of the minimum grade of a sewer main of equal size.

16. The maximum allowable grade of sewer service leads shall be 10%.

17. Downspouts, pool backwash, weep tile, footing drains, sump pump discharges, or any other conduit that carries storm or ground water shall not be allowed to discharge into sanitary sewers.

18. All risers shall be tapped at the 10 and 2 o’clock position of the receiving pipe. Connection shall be via a cut-in wye unless otherwise approved by the PSAA.

II. Sanitary Sewer Materials

A. Pipes, Joints, and Sewer Leads

1. Allowable Pipe and Sewer Lead Materials

   a) SDR 26 polyvinyl chloride (PVC) pipe 4-15" conforming to current ASTM D3034, (Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings). Pipe shall have an integral wall bell and spigot.

   b) PS115 PVC pipe 18-48" conforming to current ASTM F679 (Standard Specification for PVC Large Diameter Plastic Gravity Sewer Pipe and Fittings). Pipe shall have an integral wall bell and spigot.

   c) Extra strength vitrified clay pipe conforming to ASTM C700 (Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated). Pipe shall be bell and spigot type and glazed. This material may be required when sewage flows may cause caustic conditions.

   d) Concrete pipe conforming to ASTM C76 (Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe), Class IV or Class V, as required based on depth and loading, is permitted for sizes 18-inch diameter and larger.

   e) Ductile iron pipe for sanitary sewer conforming to requirements of ASTM A746 (Standard Specification for Ductile Iron Gravity Sewer Pipe). Pipe shall be Pressure Class (PC) 350 for 12-inch and smaller, PC 250 for 14-20-inch, and PC 200 for 24-inch or as specified by PSAA. This material may be required by the PSAA in situations such as extreme or insufficient depth, narrow easements, well isolation, etc. Such pipe shall be ceramic epoxy lined.

   f) For any class of pipe, a higher strength or greater thickness of pipe may be substituted for the minimum strength or minimum thickness of pipe specified for that class of pipe.

   g) ASTM specified couplings shall be used for joining dissimilar materials. Couplings shall have a stainless-steel shield designed for resistance to shear forces.

2. Joints and Lubricants

a) Lubricants used in making up joints shall be supplied by the pipe manufacturer, and the joints shall be coupled in accordance with the manufacturer's requirements.

b) Joints for PVC pipe shall be elastomeric gasketed push-on joints conforming to the requirements of ASTM D3212 (Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals). Gaskets shall conform to ASTM F477 (Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe).

c) Joints for reinforced concrete pipe shall meet ASTM C443 (Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets).

d) Joints for vitrified clay sewer pipe and leads shall be premium compression type joints conforming to the requirements of ASTM C425 (Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings).

e) Joints for ductile iron pipe for sanitary sewer shall conform to the requirements of ANSI/AWWA C111/A21.11 (Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings).

3. Pipe Marking

a) The following information shall be clearly marked on each length of pipe:

(1) The pipe designation and class (e.g., C 76, Class IV). For PVC pipe, this shall include the PVC cell classification.

(2) The name or trademark of the manufacturer.

(3) Identification of the manufacturing plant.

(4) The date of manufacture.

(5) Testing lot number or testing lab stamp.

(6) Beveled pipe shall be marked with the amount of bevel, and the point of maximum length shall be marked on the beveled end.

4. Manufacturer’s Certification

   a) All pipe furnished shall be accompanied by the manufacturer's certificate of test showing conformity with the relevant standard specifications. Each certificate shall identify a specific lot number, quantity of pipe, and show actual test results for the lot furnished. These certificates shall be submitted to the PSAA and must be pre-approved prior to the start of construction.

5. Materials Inspection

   a) All pipe furnished shall be subject to inspection on arrival at the job site by the PSAA. The purpose of the inspection shall be to cull and reject pipe or fittings that, independent of physical tests specified under the standard specifications designated herein, fail to conform to the requirements of these Standards.

   b) The Contractor shall notify the PSAA sufficiently in advance so that an Inspector can be on the job site during the unloading of materials. A minimum notice of 24 hours is required for such unloading and inspection.

   c) Rejected pipe shall be plainly marked by the Inspector and immediately removed from the site of the work by the Contractor without cost to the City.

   d) Pipe shall be subject to rejection on account of any of the following:

      (1) Variation in any dimension exceeding the permissible variations given in the material specifications.

      (2) Blistered, fractured, creased, or cracked pipe or fittings.

      (3) Variation of more than $1/16$ inch per lineal foot in alignment of pipe intended to be straight.

      (4) Insecure attachment of fittings.

      (5) Unpigmented or non-uniformly pigmented pipe.

      (6) Defects that indicate imperfect proportioning, mixing, or molding.

      (7) Surface defects indicating honeycombed or open texture.

      (8) Damaged ends where, in the judgment of the PSAA, such damage would prevent making a satisfactory joint.

6. Sewer Service Leads, Risers, and Fittings

   a) Sewer service leads, risers and fittings shall meet the requirements of current City of Ann Arbor Construction Code as adopted per City Code, Title VIII (Building Regulations),Chapter 100 (Construction Code).

   b) Whenever adapters are required to properly connect the pipe with pipe of another material or manufacturer, the adapters shall be manufactured for that specific purpose and nominal inside diameter of same shall be the same size as the nominal diameter of pipe connected thereto.

   c) Adapters shall also be furnished and used as required by the manufacturer and shall conform to Plumbing Code as adopted per City Code, Title VIII (Building Regulations), Chapter 100 (Construction Code).

B. Manholes

1. Manhole Materials

   a) All sanitary sewer manholes shall be constructed of precast reinforced concrete sections and must have an eccentric cone.

   b) Precast reinforced concrete bases, bottom sections, manhole risers, grade adjustment rings, concentric cones, eccentric cones, and flat slab tops shall conform to the requirements of ASTM C478 (Standard Specification for Circular Precast Reinforced Concrete Manhole Sections).

   c) Concrete brick shall conform to the requirements for concrete building brick, ASTM C55 (Standard Specification for Concrete Building Brick), Grade N-1.

2. Joints, Tees, and Radius Pipe Sections

   a) Joints on precast manholes used on all sanitary sewers shall meet ASTM C443 (Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets), rubber O-ring gasket.

   b) Precast manhole tees and radius pipe sections shall conform to requirements for reinforced concrete pipe, ASTM C76 (Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe), Class IV, and shall be approved by the PSAA.

3. Frames and Covers

    a) Cast iron frames and covers for manholes shall conform to the requirements of ASTM A48 (Standard Specification for Gray Iron Castings), Class No. 35, per Article 12 (Standard Details), SD-GU-1 (Standard Casting Schedule) of these Standards.

4. Manhole Steps

    a) Plastic-coated manhole steps shall be injection molded of copolymer, polypropylene, encapsulating a ½" grade 60 steel reinforcing bar.

    b) Steps shall meet the performance test described in ASTM C478 (Standard Specification for Circular Precast Reinforced Concrete Manhole Sections), and shall have an impact resistance of 300 ft.-lbs., with only minor deflection and no cracking or breaking.

    c) Steps shall resist pull-out forces of 1500 lbs.

5. Connections of Sewer Pipe to Precast Manholes

    a) A flexible neoprene rubber boot conforming to ASTM C923 (Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals), securely clamped into a core-drilled or cast pipe port shall be utilized.

    b) Pipe ports shall be core-drilled or cast at the point of manhole manufacture and shall be accurately located within ½" of proposed sewer centerline.

    c) Pipe clamp bands shall be of stainless steel.

6. Chimney Seals

    a) See Article 10 (Construction Specifications), Section II. (Utilities), DD.3. for external chimney seal requirements and specifications.

C. Cured in Place Pipe (CIPP)

1. CIPP shall conform to ASTM F1216 (Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube).

2. Use of CIPP shall require approval of the PSAA.

3. Materials and construction installation shall conform to Article 10 (Construction Specifications) of these Standards.

D. Pipe Bursting

1. Pipe bursting for sanitary sewer replacement shall be permitted with approval of the PSAA. In such cases, all techniques and materials shall be subject to review and approval.

E. Boring and Directional Drilling

1. Boring and directional drilling shall be subject to Article 10 (Construction Specifications) of these Standards.

2. Directional drilling shall only be permitted with approval of the PSAA. In such cases, all techniques and materials shall be subject to review and approval.

3. For directional drilling, a minimum 2% slope shall be required.

4. Casing pipe shall conform to Article 1 (General), Section XXVI (Casing Pipe) of these Standards.

5. A drilling fluid of water and bentonite clay or a polymer shall be used. The fluid shall be inert. The fluid should remain in the tunnel to ensure the stability of the tunnel, reduce drag on the pulled pipe, and provide backfill within the annulus of the pipe and tunnel.

Article 3 Water

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I. Water System Design

A. General

1. Adoption of Standards by Reference

   a) The AWWA Standards, The Ten State Standards, and the Public Services Rules and Regulations shall be followed, except as modified herein.

   b) All materials that will potentially be in contact with City potable water supply must comply with NSF/ANSI Standard 61 (Drinking Water System Components – Health Effects).

   c) All plastic pipe and fittings that will potentially be in contact with City potable water supply shall also comply with NSF/ANSI Standard 14 (Plastics Piping System Components and Related Materials).

   d) The 2015 IFC, or its latest City adopted edition, shall be followed for all fire hydrants and fire appurtenances except as modified herein.

2. Easement Requirements

   a) All water main easements shall be a minimum of 40 feet in width, with the water main centered in the easement.

   b) Where a 40-foot easement cannot be provided due to conflicts such as existing structure or natural features, the water main shall be installed in a casing pipe per Article 1 (General Standards), Section XXVI (Casing Pipe) of these Standards. In such case, mains shall be centered in a minimum 20-foot wide easement.

3. Plan Information Required

   a) Plans shall include all general information required in Article 1 (General Standards), Section III (Content of Plans and Detailed Specifications) of these standards.

   b) In addition, the following information shall be provided:

      (1) Plan and profile shall be provided for all water mains and hydrant leads.

      (2) The pipe material, size, pipe class and lengths between fittings shall be shown and labeled in the water main profile view.

(3) All water main fittings and appurtenances shall be stationed and labeled in both the plan and profile views.

(4) Proper trench detail as set forth in Article 12 (Standard Details), SD-TD-1 through SD-TD-5 of these Standards, shall be specified on the profile with a dimension showing the length each trench type is applicable.

(5) All finished grade elevations of proposed fire hydrants shall be shown and labeled in the plan and profile views.

B. Design Criteria

1. Water Main Location and Required Extension

   a) See Article 5 (Streets), Section I (Street and Pavement Design), B.13., of these Standards, for utility location requirements.

   b) For Private Development Projects, water mains shall be extended to the property limits along all public rights-of-way.

   c) In addition, for Private Development Projects, the City may require additional extensions to other property lines.

   d) Such mains shall be extended by the Developer in like size (or larger as these Standards may require) of those to which the new main connects on adjoining properties.

2. Looping Required

   a) Each Private Development Project shall be either serviced by a double source of water supply ("looped main") or designed to be served by a double source of water supply when adjacent properties are developed, if such design is approved by the PSAA. The location and phasing shall be approved by the PSAA.

3. Terminal Dead-End Water Mains

   a) Terminal dead-end water mains with water service connections are discouraged and will not be allowed without the written approval of the PSAA.

b) Approval for construction of terminal dead-end mains will only be granted if supporting data is furnished to demonstrate that the "average day demand" for the proposed main will result in a complete turnover of the water in the dead-end main within a 7-day period.

c) Maximum proposed dead-end main size and length from the looping water main to which it connects must be in accordance with Table A below.

Table A
Maximum Hydrant Lead Lengths and Dead-End Main Lengths

Size of Existing Looped Main to Which Connection of New Hydrant Lead or Dead-end Main is Proposed	Size of Hydrant Lead or Dead-end Main Proposed to Connect to Existing Looped Main	Zoning of the area to be served is R-1 or R-2	Zoning of the Area to be Served is O, CL, CLB, or RE	Zoning of Area to be Served is R-3, R-4, R5, R6, CLA, CLA/R, C2, C3, D1, D2, M1, M2, ORL, PUD, TC-1, or other Zoning Classifications not Listed
8”	8”	600’	325’	100’
10”	8”	600’	475’	250’
12”	8” 12”	600’ 600’	500’ 500’	290’ 400’
16”	8” 12”	600’ 600’	500’ 500’	300’ 500’

d) All dead-end water mains shall terminate with a complete fire hydrant assembly. This will be the only fire hydrant allowed on the dead-end main.

4. Water Main Size

a) Required minimum size for water mains shall be governed by the underlying zoning classification of the property upon which the mains are being built unless otherwise approved by PSAA.

b) For R1 and R2 Zoning, the standard minimum diameter of water mains shall be 8-inch where it completes a good gridiron, intersecting at lengths of no more than 1,200 feet.

c) For all zoning classifications other than R1 or R2, the standard minimum diameter of water mains shall be 12-inch. However, 8-inch diameter mains shall be permitted in the circumstances as set forth in the following Subsections d) through f).

d) For zoning classifications O, C1, C1B, and RE Zoning, an 8-inch diameter main may be used where the distance between intersecting or looping water mains of larger size is 1,000 feet or less.

e) For zoning classifications, R3, R4, R5, R6, C1A, C1A/R, C2, C3, D1, D2, M1, M2, ORL, PUD, TC-1, or other zoning classifications not listed, an 8-inch diameter main may be used where the distance between intersecting or looping water mains of larger size is 800 feet or less, and where no major fire service connection (4" or greater) can be anticipated.

f) Developer may be required by the PSAA to upsize mains from such standard minimum diameters where the City's water model indicates that fire flow will not be adequate.

5. Water Main Depth and Grade Adjustments

a) Water mains shall be designed and constructed with 5 ½ feet of earth cover.

b) Where changes in finish grade occur subsequent to installation of water mains, all valve boxes, air-relief boxes, curb stop boxes, hydrants, blow off valves, and other water main appurtenances shall be adjusted to the revised grade by the Developer at their expense.

c) Where such changes in finish grade will result in a depth of cover of less than 5 feet or more than 6 ½ feet, the water main shall be re-laid by the Developer at their expense to a depth of cover of 5 ½ feet. No service connection will be made until corrective action is taken.

6. Separation Clearances

a) There shall be a minimum of 10 feet of horizontal clearance and 18 inches of vertical clearance at perpendicular crossings between water mains and sanitary sewers, and between water mains and storm sewers, measured outside edge to outside edge of pipe.

b) There shall be a minimum of 1 foot of vertical clearance at perpendicular crossings of water mains with utilities other than sanitary sewers or storm sewers.

c) A minimum of 5 feet of horizontal clearance shall be maintained whenever possible between water mains and utilities other than sanitary sewers or storm sewers, measured outside edge to outside edge of pipe.

7. Water Valves – General

a) Standard in-line valves shall be resilient seated gate valves in a gate well.

b) Gate boxes will be permitted with the approval of the PSAA where physical constraints or other extenuating circumstances limit the ability to install a gate well.

c) For water mains larger than 16-inch diameter, or where special conditions warrant, the PSAA may require a butterfly valve, check valve, or another appurtenance.

8. Water Valve Spacing and Locations

a) In-line valve spacing, in general, will be regulated by the requirement that in any single case of accident, breakage, or repair, not more than one fire hydrant or the footage of main listed in Sections I.B.8.d) and I.B.8.e) of this Article will be removed from service by the resultant main shutdown.

b) Exception will be allowed in the case of 12-inch and larger water mains, where not more than two fire hydrants may be out of service for such cause, provided that each such hydrant has a backup hydrant available within 500 feet of each such hydrant via an approved fire route.

c) For mains 16-inch diameter and larger, consideration may be given by the PSAA to sharing the added cost of additional in-line valves required to accomplish the requirements of Section I.B.8.e) of this Article.

d) For water mains less than 16-inch in diameter, in-line valves shall be installed so that in any single case of accident, breakage, or repair, an absolute maximum of 800 feet of water main will be removed from service. Within the boundaries of the Downtown Development Authority, this maximum shall be reduced to 500 feet.

e) For water mains 16-inch or larger in diameter, in-line valves shall be installed so that in any single case of accident, breakage, or repair, an absolute maximum of 1,600 feet of water main will be removed from service.

f) In order to obtain the maximum benefit from in-line valves and minimize the effect of any single main shutdown on a development or area, the valve spacing design must take into account the location of major building services.

g) In-line valves shall be spaced such that during a shutdown, a fire service lead will be isolated from the hydrant serving a Fire Department Connection.

h) Valves shall be installed for all water mains extending into cul-de-sacs or dead ends.

i) Valves shall be located on the extension of street right-of-way lines at intersections, or if located mid-block or within an easement, shall be located 5 feet from main tees, preferably hydrant tees.

j) Two valves shall be provided at main line tees and three valves at crosses and 4-leg intersections of water main.

9. Connecting New Water Mains

a) A wet tap using a tapping sleeve and valve in well is the standard method of connection to connect a maximum size pipe of one standard pipe size smaller than the existing main. A wet tap to connect two mains of equal size is prohibited unless approved or directed by the PSAA.

b) A dry tap may be used where approved by the PSAA provided the following minimum standards are met:

(1) Less than 1,600 feet of main will be taken out of service

(2) No research, commercial or industrial customer will suffer a loss of service which would result in the loss of research projects, serious loss of business, or the loss of production

(3) The shutdown will not result in an unacceptable loss of transmission capacity within the existing water system

(4) PSAA may require that such dry taps take place outside of regular business hours or overnight.

c) Where a dry tap is proposed, the PSAA may, as a condition of approval, require the use of a line stop or installation of a permanent in-line valve. The cost for this work shall be borne by the Developer and/or Contractor.

d) Where a dry tap is utilized, a tee fitting and solid sleeve shall be utilized and a gate valve in box or well per Section I.B.7. (Water Valves - General) of this Article shall be installed 5 feet from the tee or at the right-of-way line if so directed by the PSAA.

e) Where the main to be tapped is a concrete or asbestos cement main, all details of such tap are subject to approval of the PSAA.

10. Fire Hydrant Locations – General

a) Hydrants shall be located in highly visible and accessible locations.

b) Hydrants shall be placed such that the total pipe length to the nearest looping main is held to the minimum.

c) Hydrants shall be installed at street intersections 10 feet back from the extended street right-of-way line, offset from the property line, and set to grade.

d) Where hydrant spacing standards set forth in Section I.B.11 (Fire Hydrant Spacing and Coverage) of this Article require intermediate hydrants, they shall be placed on the extension of side lot lines.

e) At intersecting streets where both street rights-of-way are 100 feet or wider and buildings or residences are facing the street, hydrants shall be located alternately on both sides of the intersecting street that does not receive the proposed water main.

f) The centerline of a hydrant must be between 4 feet and 10 feet from the face of a curb or the edge of a paved area unless otherwise approved by the PSAA.

11. Fire Hydrant Spacing and Coverage

a) Hydrants are required at all street intersections and at intermediate locations on looping mains so that hydrants are no more than 500 feet apart via public right-of-way or approved fire route.

b) For Private Development Projects, unless otherwise approved by the Fire Marshal, hydrants shall be located such that all buildings and structures in the development are within a 250-foot radius of a hydrant and the "hose lay" to any external portion of a structure via an approved fire route does not exceed 400 feet. In residential areas zoned R-1 or R-2 the radius requirement is 350-feet and the 400-foot hose-laying requirement does not apply.

c) An accessible hydrant shall be required within 100 feet of a Fire Department Connection (FDC) via an approved fire route. For residential buildings three stories or less in height and for which an internal sprinkler system is installed under NFPA 13R the maximum separation distance shall be increased to within 150 feet of a FDC.

d) Hydrants shall be located at least 15 feet from all structures. A larger separation may be required by the Fire Marshal based on the use and type of the structure.

e) The spacing and coverage outlined in this Section I.B.11. (Fire Hydrant Spacing and Coverage) of this Article are minimum standards. In addition to these requirements, additional hydrants shall be installed as required by the Fire Marshal to comply with the 2015 IFC and any applicable NFPA publications and City Standards.

12. Fire Hydrant Access

a) Hydrants will be placed such that proper access is not restricted by proposed structures and parking.

b) A minimum 20-foot wide approved fire-lane shall be provided up to a hydrant.

c) No parking shall be allowed within 15 feet of each side of a fire hydrant. An exception to parking restrictions may be allowed behind a fire hydrant when the hydrant is located on a landscape island in a parking lot and it does not affect fire access.

d) A clear space shall be maintained around the circumference of hydrants in compliance with the 2015 IFC.

e) Fire routes used for access to hydrants shall be provided and maintained for vehicular travel unless otherwise approved by the Fire Marshal.

13. Fire Hydrant Leads and Valve Openings

    a) All hydrant leads shall be minimum 8-inch diameter.

    b) Maximum allowable lead length shall not exceed that shown in Table A of this Article.

    c) All hydrant leads shall be valved at a point 3 feet from the hydrant and a reducer installed per Article 12 (Standard Details), SD-W-1 (Fire Hydrant Assembly) of these Standards.

14. Domestic Water Service Connections

    a) Domestic water service connections to an existing main shall only be permitted where the water main is adequate to serve the required flow for such a connection.

    b) The City must review and approve service sizes before any domestic water service connection is constructed. For all non-single family uses, a design flow calculation shall be required.

    c) The maximum diameter domestic water service connection permitted shall be one standard size smaller than the diameter of the water main to which it connects.

    d) The Owner is responsible for the installation and maintenance of domestic water service connections from the curb stop or service valve to the building.

    e) Domestic water service connections 2-inch diameter or smaller must be installed from the main to the curb stop exclusively by the Public Works Unit.

    f) Where a domestic water service connection to an existing water main is larger than 2-inch diameter**:**

        (1) The Owner shall submit a plan showing the proposed service and indicating all pertinent details of the installation to the Engineering Unit for review and approval.

(2) Where disruption of service caused by future water main shutdowns, water main breaks, or other such occurrence will create an unbearable inconvenience to the customer, the customer should consider installation of water main isolation valves on each side of their service or double service connections.

g) Such services shall be installed by the Owner's Contractor after obtaining all necessary City permits and approvals.

h) In Private Development Projects where new water main is to be constructed:

i) Domestic water connections 2-inch diameter or smaller will be installed by the Public Works Unit from the main to the curb stop or service valve upon completion of new water main construction, testing, and acceptance, but before street pavement is placed.

j) Domestic water service connections larger than 2-inch diameter shall be constructed to within 5 feet of the serviced building by the Developer and shall be tested in conjunction with the water main that is under construction.

k) Domestic water service connections, once installed, whether located on public or private property, are the property of the City from the main to service valve or curb stop and shall be maintained by the Public Works Unit.

l) Where the water main lies in a public right-of-way, the domestic water service connection shall extend from the water main to a point in the lawn extension between the curb and sidewalk abutting the street, normally 7 feet from the front property line, which shall be the location of the curb stop.

m) Where the water main lies in an easement, the domestic water service connection shall extend approximately 5 feet from the main, unless otherwise determined by the City. The service valve or curb stop must lie within the easement outside of a paved area. Where copper service valves fall within a paved area SD-GU-6 shall be followed.

n) Booster Pumps on Domestic Water Services

(1) In the case of tall buildings where marginal pressure requires the use of a booster pump on a domestic service, the pump shall be of the variable speed-constant pressure type except as noted below.

(2) Fixed speed pumps of not greater than one horsepower are allowed if the PSAA determines the water main development will support such an installation without undue interference with other customers.

(3) Fixed speed pumps must be equipped with receiver tanks which ensure cycling of not more than 10-15 times per hour. Such tanks shall be equipped with a sight glass to insure against waterlogging and also with a means of adding compressed air.

(4) All boosted water systems shall include pressure gauges and a low-pressure cut-off switch which will discontinue operation of the boosted system if the pressure of the City water main is lowered 10 psi from its normal static pressure, or to a pressure of 35 psi, whichever pressure is greater.

(5) A person proposing to use a booster pump shall, prior to installation, submit pump, piping, and installation data to the PSAA for approval.

(6) Failure to receive approval of a boosted water system prior to use shall constitute grounds for discontinuance of water service by the City.

(7) Pressure loss resulting from deterioration of an existing service connection shall not be considered justification for installation of a domestic service booster pump.

15. Domestic Water Service Separation

a) When under a single ownership, separate houses, buildings, living or business quarters on the same parcel may be served at the option of the Owner either through a separate service connection and meter to each or any unit/building, or through a single service connection and meter to the entire parcel.

b) The responsibility for payment of water charges for all service furnished to multiple units, supplied through a single service connection, must be assumed by the Owner.

c) Separate parcels shall be supplied through individual service connections and meters.

16. Fire Service Connections

a) The maximum fire service connection size shall be one standard size smaller than the water main to which it connects.

b) Fire system water supply must have an in-line check valve and/or fire pump and check valve and must be maintained at a pressure sufficiently greater than system pressure to ensure that the check valve remains closed at all times except in case of fire.

c) Fire system pressure shall be maintained by use of a metered by-pass booster pump (jockey pump) with appurtenances installed in accordance with Article 12 (Standard Details), SD-MT-2 (Fire Service Metering - Fire Pump System) of these Standards. Alternatively, a metered detector check valve may be used. Fire pumps shall have a low-pressure alarm bell and light, which will indicate when the pressure on the suction side of the fire pump reaches 20 psi or less.

d) The applicant shall submit for approval to the City, proposed plans and specifications covering the fire service connection, gate valves, check valves, pipes, and appurtenances, along with certified pump curves.

e) Fire service connections 2-inch diameter or smaller must be installed from the main to the service valve or curb stop exclusively by the Public Works Unit.

f) Where a fire service connection to an existing water main is larger than 2-inch diameter**:**

(1) The Owner shall submit a plan showing the proposed service and indicating all pertinent details of the installation to the Engineering Unit for review and approval.

(2) Where disruption of service caused by future water main shutdowns, water main breaks, or other such occurrence will create an unbearable inconvenience to the customer, the customer should consider installation of water main isolation valves on each side of their service or double service connections.

g) Such services shall be installed by the Owner's Contractor after obtaining all necessary City permits and approvals.

h) Plans for all internal fire systems must be reviewed and approved by the Fire and Building Departments.

17. Water Meters

a) All premises using City water shall be metered.

b) All domestic services shall be metered with a meter furnished and installed exclusively by the City.

c) Prior to any meter being set, all water connection related charges must be paid in full according to the latest Public Services Area Schedule of Fees. The meter remains the property of the City.

d) The City reserves the right to size and to determine the type of meter to be set for each meter installation based on maximum domestic flow rates.

e) Single-family dwellings and other small buildings being served by a 1-inch diameter water service qualify to receive a ¾" x ¾" short lay length meter.

f) For premises to be served by a 1 ¼ inch diameter or larger service, the builder, plumber, or their agent, shall provide to the City a complete itemized building fixture count and maximum flow rate needed (in gallons per minute) for use in the sizing of the meter and service.

g) For large diameter non-residential meters, the City offers a meter specifications and requirements packet to assist builders and plumbers and their agents and works to coordinate meter drop off for installation by those parties.

h) Meter horns and/or meter flanges for 2-inch diameter and smaller meters are required for meter installations. The meter horns and/or meter flanges are available at Customer Service and are to be installed by the plumber prior to requesting the meter installation.

i) Premises served shall only be allowed one domestic meter per service or a combination of one domestic meter and one water-only meter, except as allowed in Section B. 17. j) of this Article. To assist with their internal billing for multi-family dwellings, Owners may purchase sub-meters which are not read by the City.

j) Domestic service may be sub-metered only in mixed-use buildings that are under a single ownership and tied to one Parcel ID. In such cases, two City meters may be installed within the same building, one serving residential or multi-family use and the other serving non-residential commercial use. This would include one domestic water service lead from the public main, which would be split inside the building.

k) Water meters shall be set in basements, utility rooms, or boiler or mechanical rooms. The meter shall be positioned a maximum of 2 feet from the service entrance outside wall and located a minimum of 18 inches to a maximum of 48 inches above the basement or lowest floor.

l) Unmetered connections or taps are not permitted upstream of the meter assembly.

m) The meter shall always be set in an easily accessible area that is heated and protected from the weather. The setting of water meters in such areas as crawl spaces and under kitchen sinks, etc., is not considered an easily accessible area.

n) Nothing shall be stored or placed in the area of the meter which would hinder a meter reader or repair person from walking up to the meter for the purpose of reading, inspecting, repairing, or replacing it. New meter installations shall provide a minimum of 36 inches of clear space in front of the meter. Persons desiring to box-in, finish off, or camouflage the meter installation may do so only with written City approval.

o) Each water meter installed shall be sealed by the City. No person except a City employee shall break or injure the seal or change the location of, tamper with, alter or interfere in any way with the water meter under penalty of the City Code.

p) Required routine maintenance or replacement of water meters shall be performed by City personnel. Meters requiring replacement or repairs due to hot water damage, freezing, or vandalism shall be made at the customer's expense.

q) All new meter installations shall be equipped with a remote readout furnished as part of the service expense.

18. Tracer Wire

    a) A detectable tracer wire adequate for future location efforts shall be installed the entire length of water mains and shall terminate in the gate wells located at each end of the water main installation, or as directed by the City Engineer.

    b) Tracer wire shall be extended to all hydrants, blowoffs, dead ends, and post indicator valves, or as directed by the City Engineer.

    c) Tracer wire terminations shall be located at a maximum spacing of 600 feet, or as directed by the City Engineer. If an additional termination is required, a ground level tracer wire access point shall be installed.

19. Pipe Bursting and Water Main Lining

    a) Pipe bursting and water main lining shall be permitted as rehabilitative techniques only with approval of the PSAA. In such cases, all techniques and materials shall be subject to review and approval.

20. Sacrificial Anodes

    a) Sacrificial anodes shall be placed at the direction of the PSAA when any existing water main is exposed during construction. For 12" and larger water mains, 32 LB anodes shall be used. For under 12" water mains, 17 LB anodes shall be used.

II. Water Materials

A. Water Main Pipes, Joints, and Fittings

1. Allowable Water Main Pipe Materials

    a) Ductile iron pipe conforming to requirements of ANSI/AWWA C151/A21.51 (Ductile-Iron Pipe, Centrifugally Cast). Pipe shall be a minimum of Pressure Class (PC) 350 for 12-inch and smaller, PC 250 for 14-20-inch, and PC 200 for 24-inch or as specified by PSAA.

b) Polyethylene pressure pipe conforming to requirements of AWWA C906, (Polyethylene (PE) Pressure Pipe and Fittings, 4 in. Through 65 in. (100 mm Through 1,650 mm) for Waterworks), shall be permitted only for bored applications and if approved by the PSAA. If approved, pipe shall be PE-4710, SDR 11. All pipe shall be Ductile Iron Outside Diameter (DIOD) sized.

c) Ductile iron pipe crossing under a railroad, river, or interstate highway shall be Special Thickness Class 56.

2. Coatings and Wrapping for Ductile Iron Pipe and Fittings

a) Ductile iron pipe and fittings shall be manufactured with a cement-mortar lining (cement lined CL) with seal coat conforming to ANSI/AWWA C104/A21.4 (Cement-Mortar Lining for Ductile-Iron Pipe and Fittings).

b) Ductile iron pipe and fittings shall be coated outside conforming to ANSI/AWWA C151/A21.51 (Ductile-Iron Pipe, Centrifugally Cast).

c) Ductile iron pipe and fittings shall be wrapped with polyethylene meeting the requirements of ANSI/AWWA C105/A21.5 (Polyethylene Encasement for Ductile-Iron Pipe Systems).

3. Pipe Joints, Joint Restraint, Fittings, and Lubricants

a) Ductile Iron Pipe

(1) Ductile iron pipe joints shall be push-on rubber gasket joints conforming to the requirements of ANSI/AWWA C111/A21.11 (Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings), unless otherwise specified herein.

(2) All ductile iron pipe joints for diameters 16 inches and larger shall be restrained push-on rubber gasket joints conforming to the requirements of ANSI/AWWA C111/A21.11 (Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings), unless otherwise specified herein..

(3) All ductile iron fittings, of any pipe diameter, shall utilize restrained push-on rubber gasket joints for all ductile iron fittings, unless otherwise specified herein.

(4) The required length of restrained joint pipe shall be determined using the Ductile Iron Pipe Research Association's Thrust Restraint Design Procedure for Ductile Iron Pipe, or other approved method. A copy of these design calculations shall be submitted with the construction plans. The limits of restrained joints at tie-in locations to existing mains shall meet the required calculated restrained length.

(a) Where concrete thrust blocks are required refer to Article 10 (Construction Specifications), Section II. K. (Installation of Water Main) Subsection 5, of these standards.

(5) Ductile iron fittings shall conform to requirements of ANSI/AWWA C110/A21.10 (Ductile-Iron and Grey-Iron Fittings), or ANSI/AWWA C153/A21.53 (Ductile-Iron Compact Fittings).

(6) Mechanical joints, where required, shall conform to the requirements of ANSI/AWWA C111/A21.11. (Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings). Mechanical joints may be used, subject to approval of Engineer, at tie-in locations to facilitate the constructability and to ensure water-tight joints upon pressurization. Such fittings shall be restrained with a retainer gland and utilize high strength, low alloy, ceramic-filled fluorocarbon resin coated bolts only. The use of retainer glands with set screws is expressly prohibited.

(7) For ductile iron river crossing pipe per Section II.A.1.c) (Allowable Water Main Pipe Materials) of this Article, a push-on boltless flexible ball and socket joint with rubber gasket shall be utilized. The joint shall be capable of a 15-degree full turning deflection without separation, leakage, or restriction of the pipe flow. Joint restraint shall be provided by a boltless means that is locked against accidental disengagement of the restraining component.

(8) For pipe in contaminated soils, special gaskets such as fluorocarbon or acrylonitrile butadiene gaskets may be required by the PSAA depending on the nature of the contaminant.

c) Polyethylene pressure pipe

(1) Polyethylene pressure pipe joints and fittings shall be as recommended by the pipe manufacturer and shall conform to requirements of AWWA C906.

d) Lubricants

(1) Lubricants used in joints shall be supplied by the pipe manufacturer and such joints shall be coupled in accordance with manufacturer's requirements.

4. Pipe and Fittings Marking

a) Ductile iron pipe shall be marked in conformance with the requirements of ANSI/AWWA C151/A21.51 (Ductile-Iron Pipe, Centrifugally Cast).

b) Ductile iron pipe fittings shall be marked in accordance with the requirements of ANSI/AWWA C110/A21.10 (Ductile-Iron and Grey-Iron Fittings) or ANSI/AWWA C153/A21.53 (Ductile-Iron Compact Fittings).

c) Polyethylene pressure pipe shall be marked in accordance with the requirements of AWWA C906 (Polyethylene (PE) Pressure Pipe and Fittings, 4 in. Through 65 In. (100 mm Through 1,650 mm) for Waterworks). It must also be marked in accordance with NSF/ANSI Standard 14 (Plastics Piping System Components and Related Materials).

5. Manufacturer's Certification

a) All pipe furnished shall be accompanied by the manufacturer's certificate of test showing conformity with these Standards.

b) Each certificate shall identify a specific lot number, quantity of pipe, and show actual test results for the lot furnished.

c) These certificates shall be submitted to the City Engineer and must be pre-approved prior to the start of construction.

6. Materials Handling and Inspection

a) All pipe furnished shall be subject to inspection on arrival at the job site by the PSAA. The purpose of the inspection shall be to cull and reject pipe or fittings that, independent of physical tests specified under the standard specifications designated herein, fail to conform to the requirements of these Standards.

b) The Contractor shall notify the PSAA sufficiently in advance so that an Inspector can be on the job site during the unloading of materials. A minimum notice of 24 hours is required for such unloading and inspection.

c) Rejected pipe shall be plainly marked by the Inspector and immediately removed from the site of the work by the Contractor without cost to the City.

d) All pipe shall be stacked on pallets on flat grade and restrained to prevent rolling. The ends of the pipe shall be bagged.

e) All polyethylene pressure pipe shall be stacked on pallets on flat grade, restrained to prevent rolling, and protected from ultraviolet exposure with light-colored opaque tarps. The ends of the pipe shall be bagged.

f) All water pipe material shall be subject to rejection for any of the following reasons:

(1) Variation in any dimension exceeding the permissible variations given in the material specifications.

(2) Any signs of physical damage or poor manufacturing that might render the material unsuitable for its intended use.

(3) Variation of more than $1/16$ inch per lineal foot in alignment of pipe intended to be straight.

(4) Damaged ends where, in the judgment of the PSAA, such damage would prevent making a satisfactory joint.

(5) Improper handling during delivery, unloading, or installation.

g) In addition to the general grounds for rejection listed in Subsection f) above, ductile iron pipe or fittings shall be subject to rejection for any crack or defect in the lining which, in the opinion of the PSAA, is non-repairable, including but not limited to loose, uneven, or “hollow” lining.

h) In addition to the general grounds for rejection listed in Subsection f) above, polyethylene pipe and fittings shall be subject to rejection for any scratches, blisters, chips, fractures or cracks.

B. Valves, Boxes, and Gate Wells

1. Resilient wedge gate valves shall conform to requirements of AWWA C509 (Resilient-Seated Gate Valves for Water Supply Service), or C515 (Reduced Wall, Resilient-Seated Gate Valves for Water Supply Service), and shall have an operator for buried service with 2-inch square operating nut, opening right.

2. Joints shall be restrained single gasket push-on joints conforming to the requirements of ANSI/AWWA C111/A21.11 (Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings), unless otherwise specified herein.

3. Where required, butterfly valves and operators shall conform to requirements of AWWA C504 (Rubber-Seated Butterfly Valves), and shall have an operator for buried service with 2-inch square opening nut, operating right.

4. Valve boxes shall be Size D, screw type, 3-piece, 5 ¼ inch shaft with a #6 base for valves 8-inch diameter or less, and a #8 base for valves 12-inch diameter or larger.

5. The word "Water" shall be cast in raised letters on the valve box cover.

6. Curb stop boxes shall be Buffalo type, Size 95E, screw type, 2-piece, 2 ½ inch shaft, extendable from 4 ½ feet to 6 ½ feet.

7. All valves and boxes must be marked, certified, and inspected per Section II.A.4.-6 of this Article.

8. See Article 10 (Construction Specifications), Section II. (Utilities), DD.3. for external chimney seal requirements and specifications for gate wells.

C. Tapping Sleeves and Valves

1. Tapping sleeves and valves shall be designed for water service with a minimum working pressure of 150 psi.

2. Stainless steel tapping sleeves shall conform to ANSI/AWWA C223, (Fabricated Steel and Stainless-Steel Tapping Sleeves). For size-on-size water taps, where approved per Section I.B.9. (Connecting New Water Mains) item d of this Article, sleeve shall be as directed by PSAA.

3. Tapping valves shall meet the requirements for resilient seated gate valves as set forth in Section II.B.1. (Valves, Boxes, and Gate Wells) of this Article and shall have a mechanical joint outlet.

D. Fire Hydrants

1. All fire hydrants shall conform to ANSI/AWWA C502 (Dry Barrel Fire Hydrants), and shall have a minimum working pressure of 250 psig.

2. Hydrants shall have one 3 ⅜ inch threaded Ann Arbor standard pumper connection with 7 ½ threads per inch and 4.05-inch outside diameter and one 5-inch Storz pumper connection.

3. A 1 ⅜ inch pentagon operating nut and cap nuts shall be utilized (1 ⅜ inch point-to-flat at top and 1 $^{7}/_{16}$ inch point-to-flat at base) and shall open left.

4. A breakable traffic flange shall be utilized.

5. All hydrants shall have a 6-inch hydrant valve opening with traffic flange.

6. No barrel drain shall be utilized.

7. Push-on rubber gasket joints conforming to the requirements of ANSI/AWWA C111/A21.11 (Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings), shall be required for fire hydrant assemblies.

8. Hydrants shall be painted red unless separated from the distribution system by an approved backflow prevention device.

9. Depth of bury from finished grade to the bottom of the hydrant lead pipe shall generally be 6 feet but may vary depending on specific conditions.

10. The pumper nozzle shall be 21 inches ±3 inches above finished grade.

11. The breakable traffic flange shall be between finished grade and 8 inches above finished grade.

12. Fire hydrant extensions used shall be as furnished by manufacturer.

13. All fire hydrants shall be certified for compliance with NSF/ANSI Standard 61 (Drinking Water System Components – Health Effects).

E. Casing Pipe

1. Casing pipe shall conform to Article 1 (General), Section XXVI (Casing Pipe) of these Standards.

F. Tracer Wire

1. General Requirements

    a) All tracer wire shall have HDPE insulation intended for direct bury, color coded blue per APWA standard.

    b) Direct bury wire connectors shall be 3-way twist-lock or lock-down connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion and shall prevent exposure of uninsulated wire.

2. Access Points

    a) Hydrant access points shall be blue polypropylene two-terminal access points with a jumper connection available for connection to the grounding wire. The access point shall have integral mounting system to a standard hydrant flange bolt and be designed to connect to 1-inch rigid PVC conduit.

    b) Tracer wire ground level access points shall be designed to be installed at grade and consisting of an ABS rigid plastic base with cast iron top section for pavement installation and a total depth of at least 14-inches. Access point shall include a blue locking cover labeled water with pentagon head bolt, integral two-terminal connection with grounding switch and an encapsulated magnet for detection by a ferrous metal detector.

3. Grounding

    a) An 18-inch long magnesium grounding rod with AWG 12 connecting wire shall be installed at all hydrants and ground level access points along the proposed tracer wire. Grounding rod connection shall be made at the identified (or bottom) terminal at all access points

4. Open Trench Application

    a) Tracer wire to be used on open cut pipe shall be AWG No. 12 copper clad steel tracer wire with blue 30 mil HDPE insulation suitable for direct burial installation. Tracer wire shall have a minimum average break load of 450 lbs and minimum conductivity of 21%.

5. Directional Drilling/Boring Application

    a) Tracer wire to be used on directional drill pipe shall be AWG No. 10 extra high strength copper clad steel tracer wire with blue 45 mil HDPE insulation suitable for direct burial installation. Tracer wire shall have a minimum average break load of 2,000 lbs and minimum conductivity of 21%.

6. Pipe Bursting

    a) Tracer wire to be used with pipe bursting shall be 7 x 7 stranded copper clad steel tracer wire with blue 50 mil HDPE insulation suitable for direct burial installation. Tracer wire shall have a minimum average break load of 4,700 lbs and minimum conductivity of 21%.

G. Sacrificial Anodes

1. Anodes shall be high potential magnesium anode ingots with packaged backfill. Anode ingot shall meet or exceed ASTM B843, GRADE M1C for high-potential magnesium anodes.

2. Anode shall come furnished with minimum 10 feet of coiled #12 AWG solid copper lead wire with TW, THHN or THWN insulation, firmly attached to the galvanized steel core of the anode. The core cavity shall be filled with electrical sealing compound to assure a fully insulated and protected connection. Magnesium anode and backfill shall be pre-packaged into a single unit in a permeable cloth bag.

3. Connection of anode lead wire to cast iron or ductile iron pipe or fittings shall be made by the thermite weld method. Thermite weld materials shall consist of wire sleeves, weld mold and weld cartridges according to the weld manufacturer’s recommendations for the specific wire and pipe sizes and materials. Weld materials from different manufacturers shall not be interchanged. Weld molds shall be graphite molds. Ceramic "one -shot" molds will not be acceptable.

Article 4 Stormwater

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I. Design

A. General

1. Stormwater Management Facilities

   a) Stormwater Management facilities shall be designed and permitted in compliance with City Code, Chapter 55 (Unified Development Code), Section 5.22 (Stormwater Management and Soil Erosion), which also adopts standards of the WCWRC by reference.

   b) Stormwater management design plans shall include required data as set forth in City Code, Chapter 55 (Unified Development Code), Section 5.29.6 (Site Plans.

   c) Stormwater management facilities must be located such that they do not impede maintenance of public improvements.

2. Easement Requirements

   a) Storm sewer easement widths shall be equal to 2D+10 feet, where D is the maximum depth of the sewer trench on a given run of sewer. The minimum storm sewer easement width shall be 30 feet.

   b) The storm sewer shall be located 5 feet from the center of the easement, leaving D feet on one side of the sewer and D+10 feet on the other.

   c) Storm sewer widths may vary from run to run of sewer provided that the above requirements are met.

   d) When storm sewers cannot be located in standard width easements, the easement width and pipe location therein must be approved by the PSAA. In such cases, increased slope, casing pipe, alternate pipe material, or other special provisions may be required.

e) For stormwater management facilities which are designed to be Public Improvements, easements of sufficient width shall be provided for maintenance purposes. A maintenance access easement from a public or private right-of-way to the stormwater management facility shall also be provided. Such access will be on a slope of 5:1 or less and shall be constructed to withstand the passage of heavy equipment and provide access to all components of the facility.

f) Where stormwater discharge from a Public Improvement is designed to flow through a private stormwater management facility, easements and/or flow-through rights shall be provided.

3. Plan Information Required

a) Plans shall conform to the requirements of Article I (General), Section III (Content of Plans and Detailed Specifications) of these Standards.

b) In addition, the following information shall be provided:

(1) A copy of the design calculations for all storm sewers.

(2) The pipe material, size, percent of grade, and length of run between all manholes or other structures shall be shown in the profile view.

(3) All existing and proposed pipe invert elevations at all manholes and other structures shall be shown in the profile view.

(4) The percent of grade and invert elevation at the terminal end of all storm sewer service leads shall be shown in the plan view.

(5) The hydraulic gradient shall be indicated in the profile view.

(6) All service connections are to be stationed in the profile view.

(7) A casting schedule shall be provided including:

(a) Structure number corresponding to the plan view

(b) Station

(c) Casting type (manufacturer and catalogue number)

(d) Top-of-casting elevation

(e) All structure invert elevations (including edge drain)

(f) Structure depth

4. Public Street Stormwater Management Guidelines

a) Public street construction and reconstruction projects, and utility projects disturbing at least half width of the street's subsoil/full road base, shall conform to the Policy Statement on Public Street Stormwater Management Guidelines, available under the Construction heading of the Engineering and Contractor Resources webpage.

B. Pipe Capacity Design

1. Sewer capacities shall be based upon storm runoff computed by the Rational Method formula Q=CIA, for a 10 percent annual exceedance probability (AEP) storm with a 24-hour duration, where:

a) Q= total storm runoff flow, in cubic feet per second (cfs)

b) C= runoff coefficient

c) I = rainfall intensity rate

d) A = total drainage area (acres)

2. Rainfall intensity rate (I) shall be determined by the formula I = 175/(t+25), where, t = the concentration time (in minutes) of the portion of the site being developed (the time, in minutes, for runoff to be contributed to the point of concentration from the entire area of the site being developed).

3. The time of concentration and runoff coefficient shall be subject to the approval of the PSAA.

4. The Engineer shall submit the storm sewer basis of design computation and a map outlining the various areas which drain to the points of inlet used for design, including offsite upstream areas. The design computation sheet shall be sealed by the Professional Engineer who supervised the computations.

5. Sufficient capacity is to be provided in the storm sewer system to handle upstream drainage areas into the system, including allowance for future full development of upstream areas per current or anticipated zoning based on the City's land use comprehensive plan, whichever projects greater flow.

C. Hydraulic Gradient

1. The hydraulic grade line shall be kept within the storm sewer pipe.

2. Unusual conditions will be reviewed on an individual basis, and variances from this requirement must be approved by the PSAA, but in no case shall the hydraulic grade line be less than 2 feet below storm casting rim elevation.

D. Pipe Size

1. Minimum size for public storm sewers, including inlet/catch basin leads, shall be 12-inch diameter if the sewer is receiving surface stormwater.

2. 8-inch and 10-inch diameter pipe may be used for public storm sewers if the only contributing flow into the sewer is through a service lead connection (e.g., sump pump, footing drain).

3. Minimum size and grade for private storm sewer leads shall be 6-inch diameter at 1.0% grade.

E. Design Velocity

1. Minimum design velocity for storm sewers shall be 3 feet per second with the pipe flowing full.

2. This velocity is to be considered an absolute minimum, and higher velocities are encouraged for better self-cleansing action.

3. Maximum design velocity for storm sewer shall be 10 feet per second. Special consideration for higher velocities will be given in areas of steep topography.

F. Slope and Grade

1. Minimum and maximum percent slope for public storm sewers shall conform to Table A below where n= 0.013 for concrete pipe and 0.012 for PE pipe (see Section II.A. (Pipes, Joints, and Leads) of this Article).

Table A Storm Sewer Minimum Slopes				
	Concrete Pipe n=0.013		PE Pipe n=0.012	
Pipe Diameter	Min. Grade (%)	Max. Grade (%)	Min. Grade (%)	Max. Grade (%)
8”	0.75	8.30	0.64	7.10
10”	0.56	6.20	0.33	5.33
12”	0.44	4.85	0.26	4.15
15”	0.33	3.63	0.19	3.08
18”	0.26	2.85	0.15	2.43
21”	0.21	2.30	0.12	1.98
24”	0.17	1.93	0.10	1.65
30”	0.13	1.43	0.08	1.23
36”	0.10	1.13	0.06	0.95
42”	0.08	0.90	0.05	0.78
48”	0.07	0.78	0.04	0.65
Note: Public 8” and 10” pipes allowed only for sump pump or footing drain discharge				

2. Caution must be used when designing storm sewers with minimum grades to ensure proper installation.

3. Wherever there is an increase in pipe size at a manhole, the grades shall match at the eight tenths flow lines, which is 0.8 of the diameters of incoming and the outgoing pipes, as measured from the inverts.

G. Depth and Location

1. Storm sewer depth design shall be based on the contours of the land being served. Storm sewers in public rights-of-way shall be deep enough to serve neighboring properties as the storm sewer is extended at a future date.

2. Minimum depth of storm sewer shall be 3 ½ feet from finish grade to the top of the pipe, including inlet/catch basin leads.

3. The maximum depth to invert of any storm sewer shall not exceed that recommended by the manufacturer for each size and class of pipe.

4. See Article 5 (Streets), Section I (Street and Pavement Design), B.13., of these standards, for utility location requirements.

H. Separation Clearances

1. There shall be a minimum of 10 feet of horizontal clearance and 18 inches of vertical clearance at perpendicular crossings between water mains and storm sewers, when measured from outside edge to outside edge of the pipes.

2. There shall be adequate horizontal separation between storm sewers and all other utilities to allow a 1:1 trench slope from the bottom of the deeper utility that will not undermine any shallower utility, or a minimum of 5 feet of separation whichever is greater.

3. There shall be a minimum of 1 foot of vertical clearance at perpendicular crossings of storm sewers with utilities other than water mains.

I. Sump Pump Discharges and Footing Drains

1. Sump pump discharges shall comply with City Code, Title VIII (Building Regulations), Chapter 100 (Construction Code), Section 8.122 (Sump pump discharges - footing drain).

2. Sump pump discharge lines shall be designed such that the discharge enters the public storm system via gravity.

J. Curb Drain

1. The curb drain is generally installed between 2-6 feet in depth.

2. Curb drain pipe shall be 6-inch HDPE, DR17 with green stripe or approved equivalent. HDPE curb drain pipe shall meet AWWA C906 and ASTM D3350 standards. All HDPE pipe used for curb drain purposes will be ductile iron pipe size (DIPS).

3. HDPE pipe must be produced from resins meeting the requirements of ASTM D1248 designation PE4710, ASTM D3350 cell classification 445474C, and will meet the requirements of AWWA C906. Material taken from HDPE pipe will meet the minimum stability requirements of ASTM D3350. Pipe will be legibly marked at intervals of no more than five feet with the manufacturer's name, trademark, pipe size, HDPE cell classification, appropriate legend such as DR 11, ASTM D3035, AWWA C906, date of manufacture and point of origin. Pipe not marked as indicated above will be rejected.

4. HDPE fittings shall be made from material meeting the same requirements as the pipe. Fittings shall be molded or fabricated by the manufacturer of the pipe. Where applicable, fittings shall meet the requirements of AWWA C906. Molded fittings shall be manufactured in accordance with either ASTM D2683 (socket fused) or ASTM D3261 (butt fused) and shall be marked accordingly.

K. Manholes

1. Manholes shall be placed at the end of each line, at every change of grade, direction, and pipe size, and at each junction of storm sewer mains.

2. The maximum distance between manholes shall be 400 feet for pipes 36-inch or less in diameter and 500 feet for pipes 42-inch or larger in diameter.

3. Minimum inside diameter of manholes shall be 4 feet. Diameters greater than 4 feet shall be required based on the size, number, and alignment of pipes entering the manhole in accordance with Article 12 (Standard Details), SD-ST-1A (Standard Storm Manhole - Separate Base) and SD-ST-1B (Standard Storm Manhole - Precast and Leaching Bases) of these Standards.

4. Minimum manhole access diameter shall be 2 feet.

5. All manholes shall be located such that they will be directly accessible by vehicular maintenance equipment. Manholes shall be located within 10 feet of edge of pavement. Manholes that cannot be located within 10 feet of the edge of pavement shall be designed such that maintenance equipment will be supported.

6. All surfaces to be utilized for manhole access shall be designed to support a fully loaded storm sewer cleaning vehicle (66,000 pounds).

7. The manhole access route shall have a longitudinal slope no greater than 10%, and a minimum width of 12 feet.

8. No openings shall be made in precast units which would leave less than 18 inches of undisturbed circumferential wall length, or which would remove more than 40% of the circumference along any horizontal plane.

L. Inlets and Catch Basins

1. Maximum design flow to be accepted by a single inlet or catch basin shall be less than or equal to 2.5 cfs.

2. Inlets or catch basins shall be placed in the curb line at the following locations:

   a) All vertical road profile low points.

   b) At the point of curvature (spring point) of intersection radii unless the intersection contains a crosswalk with ramps in which case the structure shall be upstream of such crosswalk.

   c) At locations deemed necessary by the PSAA to provide proper site or public street drainage.

3. High capacity shall be used at all low points on streets.

4. Inlets and catch basins shall be designed with a 2-foot deep sump.

II. Materials

A. Pipes, Joints, and Leads

1. Allowable Storm Sewer Pipe Materials

   a) Concrete pipe conforming to ASTM C76 (Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe), Class IV or Class V, as required based on depth and loading.

   b) Corrugated, smooth interior, polyethylene pipe (PE) or high-density polyethylene pipe (HDPE) conforming to AASHTO M294 (Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter), or ASTM F2306 (Standard Specification for 12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications), is permitted for areas more than 5 feet from the edge of a street.

c) Corrugated metal pipe may be used for single family residential driveway culverts with approval of the PSAA. Where approved, pipe shall conform to AASHTO M36 (Standard Specification for Corrugated Steel Pipe, Metallic Coated for Sewers and Drains), Type I (Circular) or Type II (Arch).

d) For any class of pipe, a higher strength or greater thickness of pipe may be substituted for the minimum strength or minimum thickness of pipe specified for that class of pipe.

2. Joints and Lubricants

a) Lubricants used in making up joints shall be supplied by the pipe manufacturer, and the joints shall be coupled in accordance with the manufacturer's requirements.

b) Joints for PE pipe shall be gasketed water-tight joints meeting ASTM D3212 (Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals). Gaskets shall conform to ASTM F477 (Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe).

c) Joints for reinforced concrete pipe shall meet ASTM C443 (Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets).

d) Joints for corrugated metal pipe shall be made with coupling bands which conform to AASHTO M36 (Standard Specification for Corrugated Steel Pipe, Metallic Coated for Sewers and Drains).

3. Pipe Marking

a) The following information shall be clearly marked on each length of pipe:

(1) The pipe designation and class (e.g., C 76, Class IV). For PE pipe, this shall include the PVC cell classification.

(2) The name or trademark of the manufacturer.

(3) Identification of the manufacturing plant.

(4) The date of manufacture.

(5) Testing lot number or testing lab stamp.

(6) Beveled pipe shall be marked with the amount of bevel, and the point of maximum length shall be marked on the beveled end.

4. Manufacturer's Certification

   a) All pipe furnished shall be accompanied by the manufacturer's certificate of test showing conformity with the stated Specifications. Each certificate shall identify a specific lot number, quantity of pipe, and show actual test results for the lot furnished. These certificates shall be submitted to the PSAA and must be pre-approved prior to the start of construction.

5. Materials Inspection

   a) All pipe furnished shall be subject to inspection on arrival at the job site by the PSAA. The purpose of the inspection shall be to cull and reject pipe or fittings that, independent of physical tests specified under the standard specifications designated herein, fail to conform to the requirements of these Standards.

   b) The Contractor shall notify the PSAA sufficiently in advance so that an Inspector can be on the job site during the unloading of materials. A minimum notice of 24 hours is required for such unloading and inspection.

   c) Rejected pipe shall be plainly marked by the Inspector and immediately removed from the site of the work by the Contractor without cost to the City.

   d) Pipe shall be subject to rejection on account of any of the following:

      (1) Variation in any dimension exceeding the permissible variations given in the material specifications.

      (2) Blistered, fractured, creased, or cracked pipe or fittings.

      (3) Variation of more than one-sixteenths inch ($1/16$") per lineal foot in alignment of pipe intended to be straight.

      (4) Insecure attachment of fittings.

      (5) Unpigmented or non-uniformly pigmented pipe.

      (6) Defects that indicate imperfect proportioning, mixing, or molding.

      (7) Surface defects indicating honeycombed or open texture.

      (8) Damaged ends where, in the judgment of the PSAA, such damage would prevent making a satisfactory joint.

6. Storm Sewer Service Leads and Fittings

   a) Storm sewer pipes and fittings for building storm sewers shall meet the requirements of the State of Michigan Plumbing Code as adopted per City Code, Title VIII (Building Regulations), Chapter 100 (Construction Code). Materials for any portion of a storm sewer lead in the public right-of-way may be required to conform to standards per this Article for public storm pipes at the discretion of the PSAA.

   b) Whenever adapters are required to properly connect the building storm sewer pipe with storm sewer main pipe of another material or manufacturer, the adapters shall be manufactured for that specific purpose and nominal inside diameter of same shall be the same size as the nominal diameter of pipe connected thereto. Such adaptors shall be provided with a stainless-steel shear ring or equivalent device approved by the Engineer to ensure pipe alignment is positively maintained.

   c) Such adapters shall also be furnished and used as required by the manufacturer and shall conform to the State of Michigan Plumbing Code.

B. Manholes and Drainage Structures

1. Manhole and Drainage Structure Materials

   a) Storm manholes and drainage structures for new construction shall be constructed of precast reinforced concrete sections. Manholes must have an eccentric cone and be constructed per Article 12 (Standard Details), SD-ST-1A (Standard Storm Manhole - Separate Base) and SD-ST-1B (Standard Storm Manhole - Precast and Leaching Bases) of these Standards. In reconstruction or other situations where it is not possible to install a precast structure, concrete block structures conforming to Article 12 (Standard Details), SD-ST-5 through SD-ST-7 of these Standards may be utilized upon approval of the PSAA.

   b) Precast reinforced concrete bases, bottom sections, manhole risers, grade adjustment rings, concentric cones, eccentric cones, and flat slab tops shall conform to the requirements of ASTM C478 (Standard Specification for Circular Precast Reinforced Concrete Manhole Sections).

   c) Concrete block for manholes, where permitted, shall conform to ASTM C139 (Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes), and shall be laid with Type M mortar.

d) Concrete brick shall conform to the requirements for concrete building brick, ASTM C55 (Standard Specification for Concrete Building Brick), Grade N-1.

2. Joints, Tees, and Radius Pipe Sections

a) Joints on precast manholes and drainage structures shall meet ASTM C443 (Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets), rubber O-ring gasket.

b) Precast manhole tees and radius pipe sections shall conform to requirements for reinforced concrete pipe, ASTM C76 (Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe), Class IV, and shall be approved by the PSAA.

3. Frames and Covers

a) Cast iron frames and covers for manholes and drainage structures shall conform to the requirements of ASTM A48, Class No. 35, per Article 12 (Standard Details), SD-GU-1 (Standard Casting Schedule) of these Standards.

4. Manhole Steps

a) Plastic-coated manhole steps shall be injection molded of copolymer, polypropylene, encapsulating a ½" grade 60 steel reinforcing bar.

b) Steps shall meet the performance test described in ASTM C478 (Standard Specification for Circular Precast Reinforced Concrete Manhole Sections), and shall have an impact resistance of 300 ft.-lbs., with only minor deflection and no cracking or breaking.

c) Steps shall resist pull-out forces of 1500 lbs.

5. Connections of Storm Pipe to Precast Manholes

a) If a flexible neoprene rubber boot is utilized, it shall conform to ASTM C923 (Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals), and be securely clamped into a core-drilled or cast pipe port.

b) Pipe ports shall be core-drilled or cast at the point of manhole manufacture and shall be accurately located within ½" of proposed pipe centerline.

c) Pipe clamp bands shall be of corrosion-resistant stainless steel.

6. Chimney Seals

    a) See Article 10 (Construction Specifications), Section II. (Utilities), DD.3. for external chimney seal requirements and specifications.

C. Cured in Place Pipe (CIPP)

1. CIPP shall conform to ASTM F1216 (Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube).

2. Use of CIPP shall require approval of the PSAA.

3. Materials and construction installation shall conform to Article 10 (Construction Specifications) of these Standards.

Article 5 Streets

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I. Street and Pavement Design

A. General

1. Adoption of Standards by Reference

    a) ADA/PROWAG shall be followed for all street designs.

    b) AASHTO and NACTO design guidelines shall be followed for all street designs.

    c) Where work is performed in the DDA boundary see also Appendix D: Street Design Manual.

2. Plan Information Required

    a) Copies of all calculations and drawings verifying compliance with these Standards are to be submitted to the PSAA for review. Plans shall include all elements per Article 1 (General), Section III.D (Road Plans) of these Standards.

B. Design Criteria for New Public Streets

1. Geometric Design

    a) Geometric design requirements for public streets vary site-by-site and must be established with the PSAA.

2. Calculation of Estimated ADT

    a) The estimated ADT for a street shall be determined by traffic studies and by applying the ITE Trip Generation Handbook average trip generation for each type of existing or expected development.

3. Classification of Streets and Associated Design Speed

    a) Street classifications are based on Michigan Public Act 51 and National Functional Classification (NFC).

    b) Streets shall be classified as either Local, Major Local, Local Collector, Major Collector, Minor Arterial, or Principal Arterial and meet the design requirements as specified in Table A of this Article.

    c) All streets will be sized for the appropriate land use and achieve the function as specified below:

(1) Local or Major Local - The primary function of these streets is to provide access to immediately adjacent properties. These streets provide access to land with little or no through movement, for example short, looping streets or cul-de-sacs.

(2) Minor or Major Collector - The primary function of these streets is to serve traffic between local and arterial streets, and provide access to immediately adjacent residential and non-residential properties.

(3) Minor or Principal Arterial - The function of these streets is to serve as the principal carrier of high-volume traffic flow, connecting areas of principal traffic generation. They should form a reasonably continuous and integrated system, and should help define residential neighborhoods, industrial sites and commercial areas.

4. Right-of-Way and Street Width

a) The minimum right-of-way width and street width as measured from edge-of-metal to edge-of-metal shall be per Table A of this Article.

b) Each street classification shall provide sufficient ROW width to design for all modes of transportation as identified in Article 6 (Drive Approaches, Active Transportation Facilities, & Lawn Extensions).

Table A
Right-of-Way Widths and Design/Posted Speeds

<table>
<tr><th>National Functional Classification</th><th>Act 51</th><th>Minimum Right-of-Way Width</th><th>Design/Posted Speed</th></tr>
<tr><td rowspan="2">Local</td><td>Local</td><td rowspan="4">66’</td><td>25 mph design, not generally posted</td></tr>
<tr><td>Major</td><td rowspan="3">25 mph</td></tr>
<tr><td rowspan="2">Collector</td><td>Local</td></tr>
<tr><td>Major</td></tr>
<tr><td>Minor Arterial</td><td>Major</td><td colspan="2" rowspan="2">Varies dependent on use</td></tr>
<tr><td>Principal Arterial</td><td>Major</td></tr>
</table>

5. Street Drainage Design: General

a) The street drainage design shall conform to the requirements of Article 4 (Stormwater) of these Standards and, for new construction and reconstruction of streets, shall conform to the the Policy Statement on Public Street Stormwater Management Guidelines, available under the Construction heading of the Engineering and Contractor Resources webpage.

b) All streets shall be designed to include 6-inch diameter, flexible, wrapped, perforated, PVC edge drains as indicated in Article 12 (Standard Details), SD-TD-5 (Typical Edge Drain Trench) of these Standards. Edge drains shall be connected to drainage structures and shall extend a minimum of 100 feet upgrade.

c) Additional edge drain may be required by the PSAA based on the topography of the area, existing water table or soil type(s), condition of the subgrade, or other factors that may affect the long-term stability of the pavement structure. The grade of the edge drain is to match the road grade, but in no case shall it be installed at a grade of less than 0.50% or at a depth of less than 3 feet as measured from the top of existing/proposed pavement.

6. Vertical Alignment

a) Longitudinal street grades shall meet the requirements of Table B of this Article.

b) The pavement's transverse crown line shall be centered in the cross-section or located along a longitudinal pavement joint (as directed by the Engineer) and shall meet the requirements of Table B of this Article.

Table B
Longitudinal Street and Transverse Crown Grades

Street Classification	**Minimum Longitudinal Grade**	**Preferred Longitudinal Max. Grade**	**Max. Longitudinal Grade for Special Conditions***	**Transverse Crown** (centered in cross section)
Minor Local and Local	1.0%	7.0%	8.0%	2.5%
Residential Collector	1.0%	5.0%	7.5%	2.5%
Commercial/Ind. Collector	1.0%	4.0%	7.0%	2.0%
Arterial	1.0%	4.0%	6.5%	2.0%
*Required approval of PSAA				

c) Vertical curves are required at all intersecting grades where the change in grade exceeds 1.0%.

d) The lengths of all vertical crest and sag curves shall meet the requirements of AASHTO.

e) Grades within a street intersection shall not exceed 3.0% for a distance of 100 feet from the intersection of the street centerlines.

f) The curb grades may be separated (from the longitudinal roadway centerline grade) as they approach an intersection to meet this requirement.

7. Horizontal Alignment

a) The use of superelevation of horizontal curves is not allowed unless required by unusual conditions and approved by the PSAA.

b) "Broken-back" curves (having a short tangent between two curves in the same direction) are not allowed. Rather a compound curve shall be used. In this compound curve, the radius of the flatter circular arc, R1, shall not be more than 1.5R2, where R2 is the sharper circular arc.

c) Tangents are required between all reverse horizontal curves. The minimum tangent length shall be defined by Table C of this Article for horizontal curves without superelevation.

d) The radius to the center of the inside lane of all horizontal curves (for multi-lane pavement sections), and tangent lengths between reverse horizontal curves, shall meet the minimum requirements per Table C of this Article. The curve radius may be measured to the centerline of roadway for two-lane roads. Radii are derived from the formula: $f = (V^2/15R)-0.01e$ where f = side friction factor(Fig. 3-4, AASHTO); V = design speed, mph; R = radius length, ft; e = crown (Table C is based on e = 2% and e = 2.5%). Minimum radii required are shown in Table C.

Table C **Horizontal Curve Radius and Tangent Minimum Lengths**			
Design Speed (mph)	**Crown**	**Min. Radius Length** (ft.) **to Center of Inside Lane**	**Minimum Tangent Length** (ft.)
25	2.5%	166	110
30	2.5%	266	132
35	2.5%	408	154
35	2.0%	418	154
40	2.0%	661	176
45	2.0%	892	198

8. Stopping Sight Distance

a) A continuous minimum stopping sight distance along the vertical and horizontal alignment of all streets shall be provided. Minimum distances for level streets and streets with downgrades or upgrades shall meet the requirements of Table D of this Article (based on Tables 3-1 and 3-2 of AASHTO). Design values for speeds or grades not shown in this table shall be calculated per AASHTO stopping sight distance standards.

Table D **Stopping Sight Distance**							
Design Speed (mph)	**Stopping Sight Distance** (Ft.)						
	Level to Less than 3%	Downgrades			Upgrades		
		3%	6%	9%	3%	6%	9%
25	155	158	156	173	147	143	140
30	200	205	215	227	200	184	179
35	250	257	271	287	237	229	222
40	305	315	333	354	289	278	269
45	360	378	400	427	344	331	320

b) This continuous line of vision shall be measured from a point 2.0 feet above the pavement (height of object) to assumed driver's eye height of 3.5 feet above the pavement.

c) There shall be no objects or structures located within this line of vision.

9. Intersection Sight Distance

a) At any uncontrolled intersection (no yield signs, stop signs, or traffic signals) an unobstructed approach sight triangle shall be provided in accordance with AASHTO (Approach Sight Triangles (Uncontrolled or Yield Controlled)).

b) For such uncontrolled intersections, the minimum length of each leg of the sight triangle shall be based on the design speed for each leg of the intersection. These minimum lengths shall be in accordance with Table E of this Article, based on AASHTO's *Length of Sight Triangle Leg—Case A, No Traffic Control*. Where the longitudinal grade along an intersection approach leg exceeds 3 % lengths provided in Table E shall be modified in accordance with AASHTO's *Adjustment Factors for Intersection Sight Distance Based on Approach Grade.*

Table E
Intersection Sight Distance Sight Triangle Leg Lengths

Design Speed (mph)	**Distance** (Ft.)
25	115
30	140
35	165
40	195

c) Where streets with two different classifications intersect and the lower classification street is stop controlled, the minimum stopping sight distance on the street with the lower classification shall be provided in accordance with AASHTO, Section 9.5.3.2 (Case B-Intersections with Stop Control on the Minor Road) and Tables 9-7 (Design Intersection Sight Distance-Case B1, Left Turn from Stop), Table 9-9 (Design Intersection Sight Distance-Case B2, Right Turn from Stop), and Table 9-11 (Design Intersection Sight Distance-Case B3, Crossing Maneuver).

d) Design intersection sight distance lengths for other intersection configurations or movements not addressed in preceding Sections I.B.9.a)-b) (Intersection Sight Distance) of this Article shall be in accordance with AASHTO, Section 9.53 (Intersection Control), as set forth for Cases C1 through G.

e) For skewed intersections, modifications to the sight distance parameters shall be as governed by AASHTO, (Effect of Skew).

f) The point of vision shall be located from the driver's eye position of the secondary street at a point 3.5 feet above the proposed street grade, to 3.5 feet above the major street grade at locations as depicted in AASHTO, Section 9.5 (Intersection Sight Distance).

g) Commercial and multi-family drive approaches shall meet decision sight distance requirements. Single-family drive approaches shall meet stopping sight distance requirements.

h) When developing intersections on streets with separated bike facilities cyclist sight triangles shall adhere to NACTO guidance.

10. Intersection Design

a) Street intersections shall be as near to a 90-degree angle as possible, but in no event less than 80 degrees.

b) Vertical road grades at an intersection shall comply with those specified in Section I.B.6. (Vertical Alignment) of this Article.

c) Intersections shall be designed such that the sight distances shall comply with those specified in Section I.B.9. (Intersection Sight Distance) of this Article.

d) Intersection curb radii shall be derived from the formula: $f = (V^2/15R)-0.01e$ where f = side friction factor(Fig. 3-4, AASHTO); V = design speed, mph; R = radius length, ft; e = crown (Table C is based on e = 2% and e = 2.5%). Design speed for intersection curb radii shall not exceed 15 mph.

e) At the discretion of the PSAA, truck/bus aprons may be allowed to achieve the turning speed while accommodating larger vehicles.

f) Intersection radii may be modified in accordance with NACTO where it can be demonstrated that the radius is adequate.

g) The minimum percent of grade around the intersection radii at the edge-of-metal shall be 1.0%.

h) At the intersection of a street with a street of a higher classification, the 2.0% crown of the major street is to be carried through the intersection.

i) The construction of low points within intersections shall be avoided to the greatest extent possible. If it is necessary to construct a low point within an intersection, it shall only be done after approval by the PSAA. Drainage structures shall be located at the point of curvature (PC). Additional structures within the curb line of the intersection may be permitted with the approval of the PSAA only where proper drainage for a curb ramp requires the addition.

j) A detail drawing of each intersection is to be submitted with the road plans. This plan shall provide adequate spot elevations to verify and ensure that the pavement and gutters will drain properly and will meet the requirements of these Standards.

11. Cul-de-sac Design

a) Cul-de-sacs shall be limited in length to 600 feet as measured along the center of the cul-de-sac from the right-of-way line extended of the cross street to the right-of-way line at the end of the cul-de-sac bulb.

b) At the bulb of the cul-de-sac, the right-of-way and pavement radii (to the edge of metal/pavement) shall be 60 feet and 45 feet respectively for streets with a 66-foot right-of-way at the stem, and 70 feet and 55 feet respectively for those with a 70-foot right-of-way at the stem.

c) A landscape island centered in the cul-de-sac bulb with a radius of 20 feet (to the back of the curb) will be allowed, provided that an established association (e.g. condominium association) will maintain the island through a recorded agreement approved by the City.

d) The pavement in the cul-de-sac bulb shall have a minimum pavement cross grade of 2.5%, and the curb around the bulb shall have a minimum grade of 1.0%.

e) A detail drawing of each cul-de-sac bulb is to be submitted with the road plans. Such plan shall provide adequate spot elevations to verify and ensure that the pavement and gutters will drain properly and will meet the requirements of these Standards.

12. Pavement Design

a) A copy of the pavement design calculations shall be submitted with the road plans for review and approval in accordance with Section I.A. (General) of this Article. Documentation justifying the reasons for selecting the parameters and values used to determine the pavement design are to be submitted along with the calculations and are subject to the approval of the PSAA.

b) The following minimum parameters are to be included in the submitted pavement design calculations:

(1) Design Life shall be 20 years.

(2) Original Serviceability Index (Pp) shall be 4.5 for all new street construction.

(3) Terminal Serviceability Index (Pt) shall be 2.0 for Minor Local, Local and Residential Collector streets and 2.5 for Arterial and Commercial/Industrial Collector streets.

(4) Reliability (R) shall have a default value of 90%. If a different value is warranted, justification for the proposed value shall be submitted for review and approval.

(5) Standard Deviation (So) shall have a default value of 0.45 for flexible (asphalt) pavements and 0.34 for rigid (concrete) pavements. If a different value is warranted, justification for the proposed value shall be submitted for review and approval.

(6) Drainage Coefficients are to be proposed based on the availability and location of edge drains and storm sewers. These drainage coefficients shall be subject to the approval of the PSAA.

(7) Traffic Estimate/Land Calculations shall be based on the following:

(a) Use a 20-year projection for traffic volume.

(b) Determine traffic in one direction only.

(c) Assume that 80% of truck traffic travels in the design lane.

(d) Determine total equivalent 18-kip axle loads in design lane (EAL) for the 20-year pavement design life.

(e) A traffic growth rate based on the WATS model and verified by the City.

(8) Effective Resilient Modulus of Existing Subsurface Soils (MR) (for flexible pavements) and Effective Modulus of Subgrade Reaction (k) (for rigid pavements) shall be determined by the Engineer based on the laboratory analysis of existing soil conditions. Soil conditions shall be determined from soil borings obtained along the proposed roadway at distance intervals and at depths sufficient to provide an accurate overall soils profile. Copies of these soil borings shall be submitted for review with the design calculations.

(9) Material Properties.

(a) For flexible pavements, a required structural number (SN) shall be determined using the equivalent single axle loading (ESAL), the effective resilient modulus (MR), the design serviceability loss (Po-Pt), the reliability (R), the overall standard deviation (So), and an accepted software program. The layer thicknesses used to achieve the required SN shall be determined using the drainage coefficients and layer coefficients, which have the following default values unless different values are warranted. If the design Engineer believes the use of different values are warranted, they shall submit in writing the reasons supporting the differing values for consideration by the City.

(i) Hot-Mix Asphalt (HMA) wearing course: 0.45

(ii) HMA base or leveling course: 0.35

(iii) Gravel: 0.14

(iv) Sand: 0.11

(b) For rigid pavement, a Modulus of Rupture (SC), Modulus of Elasticity (EC) and Load Transfer Coefficient (J) shall be determined for the proposed concrete pavement. Justification for the values shall be submitted in writing for review and approval.

(10) Flexible Pavement Minimum Thickness Requirements

(a) Minimum thicknesses for flexible pavement shall be per Table F of this Article.

Table F Flexible Pavement Minimum Thickness			
Street Classification	**Min. Asphalt Thickness**	**Min. Aggregate Base Thickness**	**Min. Sand Subbase Thickness**
Minor Local	4”	8”	8”
Local	4”	8”	8”
Residential Collector	4”	8”	8”
Commercial/Industrial Collector	6” *	8”	10”
Arterial	6” *	8”	10”
*Additional depth shall be as required per design calculations			

13. Utility Locations

    a) Utility locations for streets classified as Minor Local, Local, and Residential Collector streets shall, insofar as possible, conform to the standard locations shown in Article 12 (Standard Details), SD-GU-9 through SD-GU-11 of these Standards as appropriate for the specific right-of-way width.

    b) Utility locations for streets classified as Commercial/Industrial Collector or Arterial will be reviewed on an individual basis by the PSAA.

14. Concrete Curb and Gutter

    a) All new streets are to be designed with concrete curb and gutter.

    b) Concrete curb and gutter shall conform to Article 12 (Standard Details), SD-CG-1 through SD-CG-4 of these Standards based on the type applicable.

II. Materials Standards

A. General

1. All materials shall conform to the Michigan Department of Transportation Standard Specifications for Construction (hereafter MDOT Specifications), except as herein modified. Where MDOT-authored Special Provisions related to a specified MDOT Specifications Section have been issued, same shall be incorporated by reference.

B. Steel Reinforcement

1. Reinforcing steel shall conform to MDOT Specifications, Section 905 (Steel Reinforcement).

2. Welded steel wire fabric shall conform to MDOT Specifications, Section 905.

C. Structural Steel

1. Structural steel shall conform to MDOT Specifications, Section 906 (Structure Steel).

2. High-strength steel bolts, nuts, and washers for joining structural steel shall conform to MDOT Specifications, Section 906.

D. Miscellaneous Metal Products

1. Longitudinal and transverse tie bars for concrete pavement shall conform to MDOT Specifications, Section 914 (Joint and Waterproofing Materials).

2. Anchor bolts, nuts, washers, and all other related materials shall conform to MDOT Specifications, Section 908 (Miscellaneous Metal Products).

E. HMA Mixtures

1. HMA mixtures shall be provided and mixed in conformance with the requirements specified in MDOT Specifications, Section 501 (Plant Produced Hot Mix Asphalt).

2. Mixture and binder selection shall conform to MDOT Local Agency Programs Hot-Mix Asphalt Selection Guidelines with the exception that 4C is specifically prohibited and other listed Marshall design method mixtures shall also be prohibited unless specifically authorized by PSAA. All mixtures and binders and their use shall be subject to the approval of the PSAA.

F. Aggregate for HMA

1. Aggregate in Superpave HMA mixtures shall conform to MDOT Specifications, Section 902 (Aggregates) with the exceptions noted in Section II.F.3. of this Article.

2. Aggregate in Marshall HMA mixtures, where permitted by the PSAA pursuant to Section II.E.2. of this Article shall conform to MDOT Special Provision for Marshall Hot Mix Asphalt Mixture with the exceptions noted in Section II.F.3. of this Article.

3. Aggregate containing crushed concrete or furnace slag may not be used.

G. Asphaltic Materials for HMA

1. Asphalt binder shall conform to MDOT Specifications, Section 904 (Asphaltic Materials).

2. Where HMA, High Stress mixtures are shown on the plans, increase the high temperature binder by one grade and add the polymer.

H. Aggregate Base Course for HMA or Concrete Roadways

1. Dense-graded aggregate shall be MDOT Class 21AA or 22A in conformance with MDOT Specifications, Section 902 (Aggregates).

I. Subbase for HMA or Concrete Roadways

1. Subbase materials shall be granular materials, 2NS or Class II, in conformance with MDOT Specifications, Section 902 (Aggregates).

J. Embankment Materials

1. Embankment materials shall be granular materials, Class II or III, or cohesive soils that are free of frost-textured materials (sound earth) conforming to MDOT Specifications, Section 902 (Aggregates) or Section 205 (Roadway Earthwork) respectively.

2. Excavated material, if used as embankment material, shall consist of clay, sand, gravel, or other similar material, provided all material is free of cinders, ashes, refuse, vegetable or organic matter, boulders, rocks greater than 4 inches measured in any one direction, broken concrete or other matter which, in the PSAA's judgment, is unsuitable as fill material.

K. Riprap

1. Stone for riprap shall conform to MDOT Specifications, Section 916 (Erosion and Sedimentation Control Materials) except that broken concrete shall not be permitted.

L. Concrete Pavement and Curb and Gutter Mixtures

1. Concrete mixtures for roadways and curb and gutter shall be mixed in conformance with the requirements specified in MDOT Specifications, Section 1004 (Concrete Mixtures).

2. MDOT Grade 3500 concrete in conformance with MDOT Specifications, Section 1004 shall be utilized. MDOT Grade 3500HP concrete may be specified by PSAA where deemed appropriate.

3. MDOT Grade P-NC concrete in conformance with MDOT Specifications, Section 1006 (Patching, Repair, and Overlay Mixtures) may be required for concrete repairs or patches where high early strength is, at the direction of the PSAA, deemed necessary.

4. The maximum slump for MDOT Grades 3500 or P-NC concrete shall be 3 inches without the use of a mid-range water reducing admixture.

5. The maximum water-cement ratio by weight for Grades 3500 or P-NC concrete shall be 0.45.

M. Aggregate for Concrete Pavement and Curb and Gutter

1. Aggregate for mixtures shall conform to MDOT Specifications, Section 902 (Aggregates) with the exceptions noted in II.F.3. of this Article.

N. Cement for Concrete

1. Cement shall be Blended Limestone-Portland Cement (ASTM C595) and shall not be Type 1.

O. Concrete Curing Material

1. Concrete curing material shall conform to MDOT Specifications, Section 903 (Admixtures and Curing Materials for Concrete). White curing compound shall be utilized.

P. Flowable Fill

1. Flowable Fill shall consist of one of the following mixes:

    a) Cement, fly ash, and water

    b) Cement, granular material, fly ash, and water

    c) Fly ash, granular material, and water

2. All flowable fill after having set up is intended to be removed by conventional mechanical excavation methods.

3. All materials to be used in flowable fill shall meet the requirement per Table G of this Article.

Table G **Acceptable Mixtures for Flowable Fill**		
Mixture	**Ingredients**	
FF Mix Number One: Cement Stabilized Fly Ash Mixture (Class F Fly Ash)	Portland Cement	100 lbs/yd³
	Fly Ash (Class F)	2000 lbs/yd³
	Water	Sufficient water to produce the desired flowability (approx. 80 gal/ yd³)
FF Mix Number Two: Controlled Density Fill Mixture (Class F Fly Ash)	Portland Cement	50 lbs/yd³
	Fly Ash (Class F)	500 lbs/yd³
	Granular Material	2600 lbs/yd³
	Water	Sufficient water to produce the desired flowability (approx. 50 gal/yd³)
FF Mix Number Three: Controlled Density Fill Mixture (Class C Fly Ash)	Fly Ash (Class C)	300 lbs/yd³
	Granular Material	2600 lbs/yd³
	Water	Sufficient water to produce the desired flowability (approx. 50 gal/yd³)

Article 6 Drive Approaches, Active Transportation Facilities, & Lawn Extensions

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I. Driveway Approaches, Curb Cuts, and Openings

A. Design

1. General

a) Adoption of Standards by Reference

b) ADA/PROWAG shall be followed for all street designs.

c) AASHTO and NACTO design guidelines shall be followed for all street designs.

d) Where work is performed in the DDA boundary see also Appendix D: Street Design Manual.

e) Definitions of “approach,” “curb cut,” and “opening” as used herein shall be as defined in the most current version of City Code, Chapter 55 (Unified Development Code), Article VIII (Definitions).

f) All approaches, curb cuts, and openings to public streets or rights-of-way are subject to City Code, Chapter 55 (Unified Development Code), Article IV (Development Standards), Sections 5.21.1 (Applicability) and 5.21.2 (Curb Cuts and Driveway Approaches).

g) Dimensions for driveway approaches, curb cuts, and openings shall match approved site plan dimensions if part of a site planned Private Development Project.

h) Plans shall include spot elevations on both sides of drive approaches at the right-of-way line, sidewalk ramp/sidewalk crossing, beginning of return curb, and end of return curb. Additional spot elevations are required at the midpoint of the drive approach for each location listed above.

2. Location of Driveway Approaches and Openings

a) Location of all driveway approaches and openings are subject to the review and approval by the PSAA.

b) No opening serving a single family or two-family use shall be closer than 15 feet to the right-of-way line of an intersecting street or extension of the street right-of-way of a street ending at the intersection, provided that no part of any approach shall encroach on any intersection turning area.

c) In general, for all other uses, no opening shall be closer than 50 feet to the right-of-way line of an intersecting street or extension of the street right-of-way of a street ending at the intersection, provided that no part of any approach shall encroach on any intersection turning area.

d) In general, no opening shall be closer than 10 feet from the right-of-way line of an intersecting alley.

e) No opening shall be closer than 5 feet to the adjacent property line. No approach shall be so constructed that any part of same extends in front of property belonging to another person unless both property owners sign a joint application for a permit.

f) No opening shall be closer than 10 feet to another opening, with the exception of openings for existing driveways on residential property. If the minimum 10 feet separation between openings cannot be met, then access management shall be evaluated such that the two drive approaches do not negatively impact safety.

g) All openings and driveway approaches shall be so located as to provide adequate vertical and horizontal sight distances for safe access to the street in accordance with the design standards for sight distance per Article 5, Section I.B. (Design Criteria for New Public Streets) of these Standards.

3. Allowable Opening Widths, Curb Cut Widths, and Turning Radii

a) Minimum and maximum allowable opening and curb cut widths and allowable turning radii shall conform to Table A of this Article.

Table A Permitted Driveway Approach Opening Widths, Curb Cut Widths, and Radii					
Use	Minimum Opening Width	Maximum Opening Width	Maximum Curb Cut Width	Minimum Turning Radius: Type M Opening	Maximum Turning Radius: Type M Opening
Single or Two Family	10’	22’	42’	5’	10’
All Other Uses: 2 Way	22’	30’	60’	5’	15’
All Other Uses: 1 Way	11’	20’	50’	5’	15’
Note: See Article 12 (Standard Details), SD-DS-2 and SD-DS-3 of these Standards for modifications to radii for Type M Modified and Type L Openings.					

b) Upon a finding that transportation conditions would otherwise cause unnecessary congestion or practical difficulties, the PSAA may permit one driveway approach on each abutting street to be channelized with a separating island a minimum of 10 feet in width to create separate entrance and exit lanes, provided that the total of both lanes shall not exceed the maximum permitted opening width.

4. Driveway Approach Type

a) On streets with mountable curb, driveway approaches shall be Type L as shown in Article 12 (Standard Details), SD-DS-3 (Type L Drive Approach for Streets with Mountable Curb) of these Standards.

b) On asphalt streets with barrier curb, driveway approaches shall be Type M as shown in Article 12 (Standard Details), SD-DS-1 (Type M Drive Approach for Asphalt Streets with Barrier Curb) of these Standards.

c) On concrete streets with barrier curb, driveway approaches shall be Type M modified as shown in Article 12 (Standard Details), SD-DS-2 (Modified M Drive Approach for Concrete Streets with Barrier Curb) of these Standards.

5. Angle of Approach

    a) The centerline of the driveway approach shall be perpendicular to the street centerline unless otherwise approved by the PSAA.

6. Slope

    a) Driveway approaches shall be sloped from the right-of-way line toward the street unless otherwise approved by the PSAA.

    b) Slope from right-of-way line to street edge of sidewalk shall be a maximum grade of 2% per ADA/PROWAG.

    c) Slope from street edge of sidewalk to gutter pan shall be between 3% and 13%. Deviations from this standard range may be approved by the PSAA where topographic or other restraints exist.

7. Drainage of Driveway Approaches

    a) Provisions shall be made to ensure that, in the determination of the PSAA, excessive quantities of stormwater do not drain across the driveway approach from the site into the public right-of-way. All stormwater management shall comply with City Code, Chapter 55 (Unified Development Code), Section 5.22 (Stormwater Management and Soil Erosion).

    b) These provisions shall be subject to the approval of the PSAA and may include inlet structures at the back of the public right-of-way or grading of the driveway approach onto the site away from the right-of-way.

B. Materials

1. Minimum requirements for single family residential or two-family concrete approaches shall be 6-inch thick, non-reinforced MDOT Grade 3500 concrete in conformance with MDOT Standard Specifications for Construction, (hereafter MDOT Specifications in this Article), Section 1004 (Concrete Mixtures) on a 6-inch base of MDOT Class II granular material or MDOT 21 AA dense-graded aggregate in conformance with MDOT Specifications, Section 902 (Aggregates). An existing compacted aggregate base may be utilized where approved by the PSAA.

2. Minimum requirements for driveway approaches for all other uses shall be 8-inch thick non-reinforced MDOT Grade 3500 concrete in conformance with MDOT Specifications, Section 1004 (Concrete Mixtures) on a 6-inch base of MDOT Class II granular material or MDOT 21 AA dense-graded aggregate in conformance with MDOT Specifications, Section 902 (Aggregates). An existing compacted aggregate base may be utilized where approved by the PSAA.

3. The PSAA may require the use of MDOT Grade P-NC concrete in conformance with MDOT Specifications, Section 1006 (Patching, Repair, and Overlay Mixtures) where deemed necessary.

4. Asphalt approaches are not permissible unless approved in writing by the PSAA. In such cases, minimum requirement shall be 3 inches of MDOT 13A or MDOT EL hot mix asphalt placed in two lifts on a base of MDOT 21AA dense-graded aggregate in conformance with MDOT Specifications, Section 902 (Aggregates). Minimum base thickness shall be 6 inches for single family or duplex use and 8 inches for all other uses.

5. Approaches on gravel roads shall be MDOT 22A or MDOT 23A dense-graded aggregate in conformance with MDOT Specifications, Section 902 (Aggregates. Minimum depth of aggregate shall be 6 inches for single family or two-family and 8 inches for all other uses.

6. For Type M approaches, epoxy-coated No. 4 reinforcement bars shall be required in curb and gutter section per Article 12 (Standard Details), SD-DS-1 (Type M Drive Approach for Asphalt Streets with Barrier Curb) of these Standards.

II. Sidewalks and Sidewalk Ramps

A. Design

1. Sidewalks within the DDA shall conform to Article 12 (Standard Details), SD-DDA-1 through SD-DDA-8 of these Standards. Sidewalk cross-section outside the DDA shall conform to Standard Detail SD-DS-5 (Sidewalk Cross Section) of these Standards.

2. Plans

a) Plans shall indicate spot elevations where private sidewalk intersects public sidewalk, on the front and back edge of the sidewalk. Where a private walk intersects the public sidewalk, a turning space (level landing) is required on the public walk. Spot elevations are required at all corners of a turning space.

3. Requirement to Install Sidewalks

   a) For new commercial, office, industrial, and site planned residential developments, the installation of sidewalk shall be required.

   b) For new single-family and two-family homes on gravel streets, sidewalk shall not be required.

   c) For new single-family and two-family homes on paved streets:

      (1) If the parcel is adjacent to a parcel with existing sidewalk, (i.e., the new sidewalk would extend an existing sidewalk) OR more than 50% of the frontage on the block contain sidewalks, the installation of sidewalk shall be required.

      (2) If there are no existing segments of sidewalk on adjacent parcels AND fewer than 50% of the frontage on the block contain sidewalks, the installation of sidewalk will be encouraged where practical, but not required.

      (3) The PSAA may waive the sidewalk installation requirement in situations where the sidewalk would be considered unsafe or present an undue burden to the property owner (e.g., extensive grading requirements, construction of large retaining walls, etc.).

4. Location

   a) Sidewalks outside of the DDA shall be located such that the outside edge is positioned 1 foot inside the right-of-way line. The PSAA may, in their sole discretion, approve a variation to this requirement if the PSAA determines that the requirement is technically infeasible; or that the variation will provide a substantial public benefit, such as protection of landmark trees, substantially beneficial slopes or grading, or substantially reduced maintenance costs and that any curve in the sidewalk has a minimum 15-foot radius and the minimum lawn extension width is 3 feet.

5. Sidewalk ramps

   a) Sidewalk ramps shall be constructed at street intersections as directed by the PSAA and shall comply with the requirements of MDOT Standard Plan/Special Detail R-28 (Curb Ramp and Detectable Warning Details).

6. Required Sidewalk Width

    a) Sidewalks outside the DDA shall be a minimum of 5 feet wide. The PSAA may, in their sole discretion, approve a variation to this requirement if the PSAA determines that the requirement is technically infeasible or that the variation will provide a substantial public benefit.

    b) The standard width shall be increased to a minimum of 8 feet where sidewalk must be placed against back of curb on all streets.

7. Slope

    a) Sidewalks shall have a minimum 1.0% and maximum 2.0% transverse grade and drain toward the street. Where this grade cannot be achieved at locations of new sidewalk meeting existing sidewalk a transitional section outside of these parameters may be used.

    b) The maximum allowed longitudinal grade for sidewalks shall be 5.0%. This shall not be exceeded unless the road grade is of a steeper grade, in which case the longitudinal sidewalk grade shall not exceed the road grade.

8. Joints

    a) Expansion and contraction joints shall be installed as shown in Article 12 (Standard Details), SD-DS-4 (Sidewalk and Curb & Gutter Joints) of these Standards.

B. Materials

1. Sidewalks outside the DDA and not crossing driveway approaches shall be minimum 4-inch thick MDOT Grade 3500 concrete in conformance with MDOT Specifications, Section 1004 (Concrete Mixtures) placed on a 4-inch base of MDOT Class II granular material or MDOT 21AA dense-graded aggregate in conformance with MDOT Specifications, Section 902 (Aggregates).

2. For replacement of existing sidewalk slabs, the concrete may be placed on native material provided that the material is stable and free of organic or other deleterious material.

3. For sidewalks crossing driveway approaches, concrete and bedding shall meet the requirements of Section I.B. (Materials) of this Article.

III. Shared Use Paths and Bike Facilities

A. Design and Location

1. General Requirements

a) Shared use paths and bike facilities shall be in accordance with the City's Transportation Plan to achieve the bike route network as specified in the Transportation Plan.

b) Shared use paths shall be located in a manner that best protects and saves trees and minimizes slopes.

2. Required Width and Easements

a) Shared use paths shall be 10 feet minimum in width, or as required by PSAA.

b) 2 foot wide shoulders shall be provided each side at a typical 6:1 maximum slope.

c) Where a shared use path is located outside of the public right-of-way, and not within City property, permanent easements shall be provided. Easements shall be centered on the path and be a minimum of 30 feet in width. The PSAA may, in their sole discretion, approve a minimum easement width of 20 feet if the PSAA determines that the requirement is technically infeasible or there are exceptional circumstances.

d) A dedicated street right-of-way or roadway easement may be used in whole or in part to satisfy easement requirements for shared use path easements when approved by the PSAA.

3. Barrier Free Access

a) A shared use path must meet all ADA/PROWAG requirements for its entire length.

b) Ramps shall be constructed at street intersections as directed by the PSAA and shall comply with the requirements of MDOT Standard Plan/Special Detail R-28 (Curb Ramp and Detectable Warning Details).

4. Landscaping of Easement Area

    a) If the easement area of a shared use path is not naturally landscaped, it shall be topsoiled, seeded and mulched in accordance with Article 8 (Soil Erosion) of these Standards to establish a grass turf within the easement area.

B. Materials

1. Concrete shared use paths not crossing driveway approaches shall be minimum 4-inch thick MDOT Grade 3500 concrete in conformance with MDOT Specifications, Section 1004 (Concrete Mixtures) concrete placed on a 4-inch thick base of Class II granular material or 21AA dense-graded aggregate in conformance with MDOT Specifications, Section 902 (Aggregates).

2. For concrete shared use paths crossing driveway approaches, concrete and bedding shall meet the requirements of Section I.B. (Materials) of this Article.

3. For asphalt shared use paths, minimum requirement shall be 4 inches of MDOT 5EML hot mix asphalt placed in two lifts of 2 inches each on a base of 21AA dense-graded aggregate . Minimum base thickness shall be 8 inches.

IV. Lawn Extensions

A. Design

1. Within the DDA, facilities within the lawn extension, commonly known as the Amenity Zone, shall conform to Article 12 (Standard Details), SD-DDA-1 through SD-DDA-18 of these Standards as applicable. Outside the DDA, design of the lawn extension shall be per items IV.A.2 (Width) and IV.A.3 (Slope) of this Article.

2. Width

    a) Standard lawn extension width shall be 11 feet or greater.

    b) Minimum lawn extension width shall be 3 feet. A greater minimum width will be required by the PSAA on Arterial Streets.

3. Slope

    a) The lawn extension shall be graded to drain toward the street.

b) From the edge of a sidewalk or shared use path for a minimum of 1 foot, the lawn extension grade shall be 3%.

c) The remaining lawn extension shall have a minimum grade of 3% and a maximum grade of 33%.

4. Retaining Walls within Lawn Extensions

a) The construction of a retaining wall in a public right-of-way must be approved by the PSAA and a licensing agreement shall be required.

b) Construction plans for the proposed retaining wall shall be prepared by a Professional Engineer licensed in the State of Michigan and submitted to the PSAA for review and approval.

c) The PSAA may require specific materials (i.e., modular precast block) for any retaining wall to be placed in the right-of-way.

B. Materials

1. Allowable materials within the DDA shall conform to Article 12 (Standard Details), SD-DDA-1 through SD-DDA-18 of these Standards as applicable.

2. For all other locations, allowable materials in the lawn extension shall conform to Article 9 (Landscaping), Section III (Landscaping Vegetation in Public Rights-of-Way) of these Standards.

Article 7 Streetlights

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I. Streetlight Design

A. General

1. Adoption of Standards by Reference

    a) The NEC shall be followed except as modified in these standards.

2. Design Plans Required

    a) Design plans shall be submitted to the PSAA for review and approval prior to construction. No work shall begin until approval has been obtained.

    b) Design plans shall:

        (1) Indicate location of poles, cables, conduit, photocells, handholes, disconnect cabinet, and transformers.

        (2) Indicate depth and distance of conduit and cable from the curb.

        (3) Provide luminaire and pole size, manufacturer, and model number.

        (4) Show cable and conduit sizes.

        (5) Contain a note stating: “The City of Ann Arbor Public Works Unit must be contacted prior to and during construction. Final inspection and approval must be made by the Public Works Unit.”

        (6) Plans shall also be furnished to power supply company for review to assure that adequate power is supplied.

3. Photometric Analysis Required

    a) A photometric analysis shall be performed and an IES file for the proposed luminaire submitted to demonstrate that lighting standards will be achieved.

4. As-Built Plans Required

    a) As-built drawings shall be submitted to the Public Works Unit prior to acceptance by the City.

B. Streetlight Location and Spacing

1. Location Requirements

    a) Streetlights shall typically be located as shown in Article 12 (Standard Details), SD-GU-9 through SD-GU-11 (Utility Location Plans) of these Standards.

    b) Streetlights designed to illuminate mid-block pedestrian crosswalks shall typically be located 10 feet prior to the crosswalk in each direction of travel.

2. Spacing

    a) Spacing of streetlights shall not exceed 190 feet except in the DDA district where spacing shall be 45 feet apart. In all cases, spacing shall be such that required street lighting levels are met per Section I.H. (Required Lighting Levels) of this Article.

C. Cable and Conduit

1. General Requirements

    a) All cable is required to be in conduit.

2. Conduit Size and Number of Conduit Runs

    a) The minimum allowed conduit size shall be 3-inch diameter except where larger size is required as set forth following.

    b) Where required to adequately contain necessary cables, a larger diameter conduit may be required by the PSAA.

    c) The City may determine that a spare conduit shall be provided. In such cases, a nylon pulling line shall be pulled through the conduit for future use.

3. Material Requirements

    a) All pipe used for Directional Drill must be Schedule 80 polyethylene pipe (HDPE).

D. Photoelectric Control

1. A master street lighting disconnect/lighting controller shall be furnished and capable of handling the electric load on the designed circuit.

2. Wiring shall be in parallel and not in series.

E. Handholes

1. General Location and Spacing Requirements

    a) Handholes shall be located such that the maximum distance between any two handholes, or a handhole and the adjacent streetlight, is 100 feet.

    b) Handholes shall be placed at all junctions of conduit pipes.

    c) Handholes shall be required at every streetlight.

    d) Wherever possible, handholes shall be placed outside of walking surfaces.

2. Sizing and Placement Requirements

    a) Handholes shall be in conduit runs.

    b) Handhole size shall be 17 inches by 30 inches by 18 inches.

    c) Smaller handhole sizes, 13 inches by 24 inches by 18 inches, may be approved by the PSAA where needed due to space constraints such as some downtown areas.

    d) Larger handhole sizes, 24 inches by 36 inches by 18 inches, may be required by the PSAA.

3. Requirements within the DDA district

    a) Handholes are to be placed in the edge of existing concrete walk, out of brick pavers.

    b) The concrete walk shall be saw cut and a section removed that is large enough to facilitate the installation of the proposed handhole. Minimum removal shall be one flag of sidewalk.

F. Disconnect Cabinet

1. The lighting system shall have a disconnect mounted in a cabinet adjacent to and as close as possible to the power supply.

2. Cable entering the breaker must be minimum #8 or larger as required to adequately handle circuit load.

G. Transformer

1. Transformer location(s) shall be determined by power company.
2. The transformer pad shall be as specified by power company.
3. All work associated with the transformer(s) shall be coordinated with power company.

H. Required Lighting Levels

1. Public street lighting levels are to be achieved per Table A of this Article:

Table A
Required Lighting Levels

Use	Foot-candles: Average Maintained	Uniformity Ratio: Average to Minimum
Residential	0.4	6:1
Intermediate	1.0	3:1 to 6:1
Commercial	2.0	3:1

II. Materials

A. General

1. All material and equipment furnished under this Section shall fully comply with the latest IEEE, NEMA, and ANSI Standards, for that class of equipment and these Standards.

B. Conduit

1. Conduit shall bear the manufacturer's name and trademark.
2. Conduit sizes shall be as shown on the construction drawings.
3. All conduit connections shall be watertight.
4. Conduit for service pole risers shall be rigid galvanized steel for the first 10 feet above ground and of the size required by the NEC. Plastic may be used above 10 feet.

5. For rigid galvanized steel conduit:

    a) Conduit shall comply with the latest revision of Article 346 of the NEC and shall be hot-dip galvanized inside and out.

    b) The zinc coating shall be continuous and throughout and shall not scale or blister or be removable by any reasonable process of handling or erection.

    c) All connections to rigid galvanized steel shall be threaded.

6. For plastic conduit:

    a) Conduit shall comply with the latest revision of Article 347 of the NEC.

    b) All plastic conduit shall be Schedule 80 PVC or HDPE SDR11.

C. Cables

1. All poles must have a three-wire system, including dead ends.

2. Cable in poles must be marked to indicate connection to power source (using typical red/blue marking). Color identification shall be repeated at all connections.

3. Cable size shall be as shown on the approved electrical plans.

4. Underground cable shall be 600V, XLPE, U.L. listed USE.

5. Cable may be either 3 single cables in parallel or triplex cable.

6. For direct bury, cable shall be copper, no smaller than #6 AWG.

7. #4 AWG copper cable may be used as a neutral.

8. The conductor coding shall adhere to covering and not be readily removed by rubbing.

D. Cable Connectors

1. The connection of conductors from size #12 AWG and larger to terminal parts or other conductors shall be made with heavy-duty cast alloy solderless connectors of the pressure double indent type.

2. Tap connectors at lighting standards shall be multiple aluminum with four positions for #2 AWG copper and a fifth position for #12 AWG or larger fixture wire.

3. Electrical connections in streetlight pole handholes should be made with aluminum terminal blocks (Connector Cable Tap Alum #8-1/0) and covers (Cover Plastisol F/Utilco SLC4-0), as approved by PSAA.

4. Wire brush and approved corrosion inhibiting compound shall be applied to all connections.

5. All splices shall be accessible through the handhole of the pole and shall extend a minimum of 6 inches outside the handhole. No splices will be allowed which are inaccessible inside the pole.

E. Tape

1. Where Utilco connections are not used, all joints in outlet or junction boxes shall be taped in such manner that the insulating value of the joint or splice will be at least equal to the insulating value of the conductor to which it is applied.

F. Disconnect Cabinet or Box

1. Cable entering the breaker shall be #8 AWG or larger.

G. Lighting Fixtures

1. All threaded fittings shall be lubricated with an anti-seize grease.

2. Luminaire Specifications:

   a) Allowable luminaires shall be LED.

   b) Luminaires shall be dark sky compliant unless a luminaire with cutoff shield is approved by the PSAA.

   c) Luminaires shall be compliant with Illuminating Engineering Society standards IES RP-8.

H. Poles and Foundations

1. Poured concrete foundations shall conform to Article 10 (Construction Specifications) of these Standards.

2. Precast foundations may be permitted with approval by the PSAA. In such case, flowable fill must be poured to the bottom of the conduit entrance and shall conform to Article 5 (Streets), Section II.P (Flowable Fill) of these Standards.

3. Screw-in base foundations may be permitted with the approval of the PSAA. In such cases, material verification must be provided to verify that the foundation is compatible with and capable of properly supporting the pole.

4. Anchor Bolts

    a) Contractor shall furnish and install anchor bolts as furnished by the pole manufacturer.

5. Pole and Luminaire Wiring

    a) Pole and luminaire shall be factory prewired and tested.

    b) Wires shall be #12 AWG stranded Black, White, and Green.

    c) Grounding screws shall be provided in pole base and luminaire.

6. Photoelectric controls

    a) Photoelectric controls shall be subject to the approval of the PSAA.

7. Luminaire Fuses

    a) Fuses shall be furnished and mounted within post compartment.

    b) All LED luminaire fuses shall be FNQ % ampere fuses.

    c) One fuse shall be furnished per luminaire.

    d) The fuse-holder shall be rated at 600 volts.

    e) The fuse holder may use crimp-type tubular terminals or set screw type connectors.

    f) Insulating boots shall be used with the fuse holder to cover connections. Taping will not be permitted.

I. Handholes

1. Handholes shall conform to current Appendix A (Material Requirements) of these Standards and Article 12 (Standard Details), SD-E-1 (Communications Handhole Assembly) and SD-E-3 (Electrical Handhole Assembly).

Article 8 Soil Erosion

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I. General

A. Purpose

1. In accordance with the Michigan Soil Erosion and Sedimentation Control Act (Public Act 451, Part 91, 1994, as amended), the City has adopted City Code, Chapter 55 (Unified Development Code), Section 5.22 (Storm Water Management and Soil Erosion). As such, all construction activities shall be performed in accordance with the Ordinance.

B. Necessity of Grading/Soil Erosion & Sedimentation Control Permit

1. The necessity for a Grading/Soil Erosion permit shall be as established per City Code, Chapter 55 (Unified Development Code), Section 5.29.3A (Grading Permit: Applicability) subject to exemptions in Section 5.29.3B (Grading Permit: Exemptions).

C. Grading/Soil Erosion & Sedimentation Control Permit Application and Required Data

1. A Grading/Soil Erosion permit application shall be submitted pursuant to City Code, Chapter 55 (Unified Development Code), Section 5.29.3C (Grading Permit: Grading Permit Application).

2. The permit application and plans shall contain all information as set forth in City Code, Chapter 55 (Unified Development Code), Section 5.29.D (Grading Permit: Application Data Required). Visit the Permit Applications website, and link to the City's online permitting system to access the Grading/Soil Erosion Permit Application..
3. All construction plans (other than single or two-family family residential) requiring soil erosion control measures shall contain the City's standard Soil Erosion and Sedimentation Control Notes per Article 12 (Standard Details), SD-SESC-6 of these Standards and an approved Sequence of Soil Erosion Measures developed in compliance with SD-SESC-7.

D. General Soil Erosion Control Design Standards

1. The following general guidelines should be followed for any type of development (public or private):

   a) The development plan should be fitted to the soils and topography to create the least erosion potential.

   b) Wherever feasible during construction, natural vegetation should be retained and protected. Where inadequate vegetation exists, temporary or permanent vegetation should be established, per the approved Landscape Plan.

   c) Where land must be stripped of vegetation during construction, exposed area should be limited to the smallest practical size at any one time and the duration of exposure should be limited to the shortest practical amount of time.

   d) Critical areas exposed during construction should be protected with temporary vegetation and/or mulching per Section II.A of this Article.

   e) Permanent vegetation and improvements such as streets, storm sewers or other features of the development capable of carrying storm runoff in a safe manner shall be installed as early as possible.

   f) Provisions should be made to control the increased runoff caused by changed soil and surface conditions both during and after development.

   g) Temporary sediment basins to remove suspended soil particles from runoff waters from land undergoing development should be constructed and maintained wherever erosive conditions indicate they are needed to prevent off-site damages.

   h) Diversions, grassed waterways, grade stabilization structures, and similar mechanical structural control measures required by the site shall be installed as early in the development of the area as possible.

II. Soil Erosion Control Protective Measures and Materials

A. Vegetative Protection and Mulching

1. Dates, kinds and rates of temporary seed required shall be dependent on the time of year as provided for in Table A of this Article. Other temporary seed mixes shall be used only with approval of the PSAA.

Table A Planting Dates for Temporary Vegetation Cover Types			
Plant Type	Planting Dates	Seeding Rate	
		Pounds Per 1,000 Square Feet	Pounds Per Acre
Oats	4/1 to 9/15	2	96
MDOT TSM 6/24	4/15 to 10/10	2	100
Buckwheat	6/1 to 7/15	2	75
Sudangrass	6/1 to 7/15	1	40
Cereal Rye	8/1 to 10/15	3	120
Wheat	9/20 to 10/15	3	120
Source: USDA NRCS, 2018 and MDOT 2020 Standard Spec.			

2. Mulching shall be used with all seeding on disturbed soil areas to provide erosion protection and promote the growth of vegetation.

3. During months unfavorable to seeding, an anchored mulch blanket shall be installed for temporary use without seeding per Article 12 (Standard Details), SD-SESC-4 (Mulch Blanket) of these Standards, unless otherwise approved by the PSAA. All blanket and staking materials shall be biodegradable.

B. Silt Fence

1. Silt fence shall be required as a perimeter control device to protect downslope surface waters and adjacent properties by removing suspended solids from runoff prior to leaving a site.

2. Silt fence should be installed at the downstream edge of disturbed areas along a line of equal elevation i.e. parallel to contour lines and at all locations as shown on the Plans.

3. Whenever possible, silt fence shall be placed in flat areas at least 10 feet from the toe of the slopes.

4. Maximum contributing drainage area is one-half acre per 100 lineal feet of silt fence.

5. Materials and properties for silt fence construction shall comply with Table B of this Article.

Table B Silt Fence Materials					
Woven Geotextile Fabric Width (in.)	Min. Hardwood Post Length (in.)*	Min. Grab Tensile (lbs.) per ASTM D4632	Min. Trapezoidal Tear Strength (lbs.) per ASTM D4533	Min Permittivity (sec^{-1}) per ASTM D4491	Max. Apparent Opening Size (mm.) per ASTM D4751
24	36	100	45	0.1	0.6
36	48	100	45	0.1	0.6
*Hardwood posts shall be a minimum of 1.5 inches x 1.5 inches					

6. Minimum post spacing shall be 6 feet and maximum post spacing shall be 10 feet.

7. Silt fence shall be installed in accordance with Article 12 (Standard Details), SD-SESC-3 (Silt Fence) of these Standards and as set forth below.

8. A trench 6 inches deep shall be constructed by machine or, if equipment cannot be operated on the site, by hand.

9. Post installation shall start at the center of the low point (if applicable) with the remaining posts spaced 6 feet apart.

10. Posts shall be installed with at least 1 foot of bury in the ground. Where 1 foot cannot be achieved, the posts shall be adequately secured to prevent overturning of the fence due to sediment loading.

11. Filter fabric shall be attached to posts by staples unless otherwise approved by the PSAA.

12. Filter fabric shall be installed such that 6 inches of fabric is left at the bottom to be buried and fabric shall be wrapped around posts per Article 12 (Standard Details), SD-SESC-3 (Silt Fence) of these Standards.

13. Fabric shall be installed in the trench such that 4 inches lie against the side of the trench and 2 inches across the trench bottom in the upstream direction.

14. The trench shall then be backfilled and compacted to prevent any flow from passing under the fence.

15. During installation, the fabric will be rejected if it is found to have defects, rips, holes, flaws, deterioration, or damage.

16. Filter fabric shall be removed and replaced whenever it has deteriorated to such an extent that it reduces the effectiveness of the silt fence.

17. Contractor shall remove and properly dispose of accumulated sediment when it reaches 1/3 to 1/2 the height of the silt fence above ground elevation.

18. Silt fence shall be maintained by the Contractor until the project is accepted or until the fence is removed at the direction of the PSAA.

19. Whenever possible, silt fence shall be placed in flat areas at least 10 feet from the toe of the slopes.

20. Maximum contributing drainage area is one-half acre per 100 lineal feet of silt fence.

21. Silt fence shall be installed in accordance with Article 12 (Standard Details), SD-SESC-3 (Silt Fence) of these Standards.

C. Mud Mats

1. Mud mats shall be installed at every point where construction traffic leaves a site with disturbed soils.

2. Mud mat materials shall conform to the following:

    a) 2-inch to 3-inch diameter open-graded aggregate (stone or crushed concrete) shall be utilized.

    b) Non-woven geotextile fabric (8-12 oz./yd^2) shall be placed as an underlay.

3. The following specifications shall be utilized unless other approved by the PSAA:

    a) Minimum mud mat length shall be 50 feet.

    b) Width shall be at least 2 feet wider than the width of the largest vehicle or piece of equipment expected to utilize the egress point with additional width as needed for turning radius. In no case shall the width be less than 10 feet.

    c) Minimum thickness shall be 6 inches. Greater thickness shall be utilized where necessary to maintain mat integrity.

d) Side slopes should be no steeper than 2 horizontal to 1 vertical.

e) Mud mats shall be constructed in accordance with Article 12 (Standard Details), SD-SESC-5 (Mud Mat) of these Standards.

D. Inlet Protection

1. Storm inlet protection measures shall be provided to temporarily pond runoff before it enters the storm sewer, allowing sediment to settle, or to remove sediment by filtering.

2. Storm inlet protection measures shall be comprised of a sack-type style with an overflow built in. Inlet protection materials shall be appropriately fitted to the size and shape of the drainage structure. Installation must conform to the manufacturer requirements.

3. Storm inlet protection measures shall conform to Article 12 (Standard Details), SD-SESC-1 (Inlet Protection) of these Standards, for inlets with flat castings or SD-SESC-2 (Stone Filter), for inlets with beehive castings.

E. Other Soil Erosion Measures

1. In addition to the materials and measures set forth above in Section II. A-D of this Article, measures such as sedimentation basins, bank erosion protection measures, and diversion channels, may be required to adequately control soil erosion and sedimentation during construction activities.

2. In such cases, appropriate individuals BMPS as set forth in the Michigan Nonpoint Source Best Management Practices Manual shall provide direction for design of such measures. Such design shall be subject to the approval of the PSAA.

Article 9 Landscaping

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I. Plant Materials - General

A. Plant materials shall conform to the species and sizes shown on the approved Landscape Plan as required per City Code, Chapter 55 (Unified Development Code), Section 5.29. F.4.i (Landscape Plan), or on final Plans for City Projects, and shall be sound, healthy, vigorous, and free from plant diseases and insect pests or their eggs.

B. Plants shall have normal, healthy root systems, and be of the specified measurements such as spread, ball size, caliper, height, quality designations, etc.

C. All plant materials shall be in accordance with ANSI Z60.1 (American Standard for Nursery Stock).

D. The Contractor shall furnish a written list of the proposed sources (i.e. grower, not broker) of nursery stock. City may reject a proposed source if their stock is not grown in USDA hardiness zone 5 or 6 as determined by the Agricultural Research Service, U.S. Department of Agriculture, Plant Hardiness Zone Map.

E. Artificial mulch, plants or trees shall not be used.

F. Any plant listed on the "City of Ann Arbor Invasive Plant List" as set forth on the City's Invasive Plants website may not be used.

G. When proposing or using a native or prairie planting, the selection of plant species must be diverse and similar to native plant communities present in the Ann Arbor area. The City of Ann Arbor's Natural Area Preservation Program maintains a Native Plants website.

H. Caliper of trees shall be measured 6 inches above the ground for nursery stock.

I. To assure plant material quality, the following procedures shall be utilized:

1. All plant material shall be subject to final approval by the PSAA.

2. The Contractor shall provide a Michigan Department of Agriculture and Rural Development certificate of inspection (or other similar documentation for out- of-state grown plants) to assure that the materials supplied fully comply with these Specifications.

J. Plant substitutions to those shown on an approved Landscape Plan required per City Code, Chapter 55 (Unified Development Code), Section 5.29. F.4.i (Landscape Plan) shall be permitted only pursuant to City Code, Chapter 55 (Unified Development Code), Section 5.20.9 (Plant Substitutions).

K. Plant substitutions on City Projects shall be permitted only with the authorization of the PSAA. The request for substitution shall be submitted in writing prior to installation. Proposed substitutions shall consist of the nearest equivalent size and variety of plants. All requests for pay adjustments due to substitutions shall also be submitted in the request.

L. Due to the overpopulation of Maple species (Acer spp.) within the City, their use should be limited.

II. Street Trees

A. Trees planted in the public right-of-way (commonly called "street trees") shall conform to the latest version of the "Approved Street Tree List By Size" or "Approved Street Tree List with Characteristics" as set forth on the City's Tree Care and Planting website.

B. Tree planting in the public right-of-way shall be under the sole authority of the City Administrator per City Code, Chapter 55 (Unified Development Code), Section 5.20.10 (Trees in the Public Right-of-Way).

C. Evergreen trees shall not be permitted in the public right-of-way.

D. At planting, trees planted in the public right-of-way must be single stem, minimum caliper of 1.75 inches, and have a clear stem of at least 5 feet except within sight triangles where clear vision shall be provided for a vertical height of 8 feet above the roadway per City Code, Chapter 55 (Unified Development Code), Section 5.20.8 (Sight Triangles and Intersections).

III. Landscaping Vegetation in Public Rights-of-Way

A. All vegetation in public rights-of-way shall conform to height restrictions per City Code, Chapter 55 (Unified Development Code), Section 5.20.12 (Weeds and Grass on Public Land and Private Land), City Code, Chapter 55 (Unified Development Code), Section 5.20.8 (Sight Triangles and Intersections), and Chapter 40 (Trees and Other Vegetation.

B. Such landscaped areas may be covered with turf grass, biodegradable mulch (minimum 2 inches in depth), ornamental grasses, forbs, native prairie plants, native wetland plants, or other perennial herbaceous or shrub plantings. Stone or aggregate shall not be accepted to meet this requirement per City Code, Chapter 55 (Unified Development Code), Section 5.20.7.H (Material and Design Standards).

C. Permanent irrigation is not permitted in public rights-of-way.

IV. Plant Placement Near Utilities

A. Plant material shall be placed to allow full access to fire hydrants and public utility systems per City Code, Chapter 55 (Unified Development Code), Section 5.20.7.R (Material and Design Standards).

B. A 5-foot space clear of vegetation greater than 6 inches tall shall be maintained around the circumference of fire hydrants, as well as any access point to a public utility system such as a water main valve, water shutoff valve box, sanitary manhole, or storm sewer manhole per City Code, Chapter 55 (Unified Development Code), Section 5.20.7.R (Material and Design Standards).

V. Berms and Bioretention

A. Landform berms shall have side slopes no greater than 1 vertical foot for each 3 horizontal feet, shall have at least 2 feet of flat area on top, and shall have adequate protection to prevent erosion per City Code, Chapter 55 (Unified Development Code), Section 5.20.7.N (Material and Design Standards).

B. When areas are used for bioretention or rain gardens, the ponding area should be a minimum of 6 inches and maximum of 18 inches deep and planted per approved Landscape Plan or Final Plan per City Code, Chapter 55 (Unified Development Code), Section 5.20.7.P (Material and Design Standards).

Article 10 Construction Specifications

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I. General

A. Permits

1. Prior to the start of construction, the Contractor shall obtain all necessary permits as set forth in Article 1 (General), Section VIII (Permits) of these Standards.

2. For City Projects, fees for permits will be paid by the capital project for "Right-of-Way," "Grading," "Street Tree," and "Traffic Control" permits.

B. Standard Details

1. Construction shall conform to Article 12 (Standard Details) of these Standards. Such Details shall, for purposes of this Article, be referred to hereafter as Standard Details.

C. Transportation Control and Maintenance

1. All work shall conform to, and all permitted road closure notifications be issued, in accordance with Article 1 (General), Section XX (Transportation Control and Access), of these Standards.

2. The Contractor shall furnish, erect, maintain, and upon completion of the work, remove all traffic control devices within the project and around the perimeter of the project for the safety and protection of all traffic regardless of travel mode. This includes, but is not limited to: temporary advance, regulatory, and warning signs for vehicular traffic, bicycle traffic, and pedestrians; traffic regulator control; barricades, barrels, cones, and channelizing devices at intersections, streets, sidewalks, trails, and pathways; temporary signals and warning devices; arrow boards; temporary pavement markings; and moving traffic control devices for construction operations. Pedestrian channelizing devices shall be ADA/PROWAG compliant.

3. All traffic control devices shall be in place prior to beginning the work.

4. Traffic shall be maintained in accordance with Sections 104 (Control of the Work), 812 (Temporary Traffic Control for Construction Zone Operations), and 922 (Temporary Traffic Control Materials), of MDOT Specifications, and in accordance with the MMUTCD, NACTO, PROWAG, ABA and City Plans and Specifications

including Figures 1 and 2 Maintenance of Traffic Flow Charts for Pedestrians and Bicyclists provided in Article 1 (General), Section XX (Transportation Control and Access), Subsection B. 2, of these Standards.

5. When lane closures or lane shifts are in place the Contractor shall completely cover all conflicting warning, regulatory and guide signs in accordance with MDOT Specifications, Subsection 812.03.D.2 (Sign Covers), and all applicable details therein.

6. When lane closures or lane shifts are in place the Contractor shall remove or completely cover all conflicting pavement markings and install temporary pavement markings in accordance with the approved MOT plan.

7. The Contractor shall place temporary pavement markings, as directed by the PSAA, and in accordance with the requirements of the MMUTCD and the Plans, when the final pavement markings are not placed prior to opening to traffic. These markings shall be removed prior to the installation of the final pavement markings.

8. All temporary traffic control devices furnished by the Contractor shall remain the property of the Contractor. The City shall not be responsible for stolen or damaged signs, barricades, barricade lights, or other traffic maintenance items. The Contractor shall replace missing traffic control devices within 24 hours of notification.

9. The Contractor shall maintain traffic such that no driver, cyclist, or pedestrian shall be able to enter active work zones or staging areas.

10. The Contractor shall maintain access for emergency vehicles at all times in accordance with Plans and Specifications.

11. Where the Contract Documents identify certain areas within the construction limits, such as sidewalks, drives, buildings, and trails that must be kept open for the public or the City's use during construction, the Contractor shall be responsible for protection and maintenance of these areas as well.

12. The City will provide, install, control and relocate temporary signals on span wires or mast arms and poles as required for the various phases as indicated on the Plans or as otherwise required. The Contractor shall coordinate their work with Detroit Edison and City of Ann Arbor Signs and Signals.

13. To coordinate such signal modifications, the Contractor shall notify City of Ann Arbor Signs and Signals at least 5 working days (Monday - Friday) in advance of when the signal modifications will need to be completed.

14. It is the responsibility of the Contractor to ensure that City of Ann Arbor Signs and Signals is scheduled, kept apprised of the progress of construction, and notified within 4 working hours prior to altering the traffic control.

15. No additional or extra compensation will be paid for any delays caused by City of Ann Arbor Signs and Signals.

16. The Contractor will remove and store warning, regulatory and guide signs in conflict with construction. After construction is complete, but before opening any roadway to traffic, City of Ann Arbor Signs and Signals will reinstall all signs in their proper, permanent location.

17. To coordinate sign installation, the Contractor shall notify City of Ann Arbor Signs and Signals at least 5 working days (Monday-Friday) in advance of when the sign work will need to be completed.

18. It is the responsibility of the Contractor to ensure that City of Ann Arbor Signs and Signals is scheduled, kept apprised of the progress of construction, and notified a second time 24 working hours prior to the need to complete the sign work.

19. It is the responsibility of the Contractor to provide Traffic Regulator Control, as directed by the PSAA. Flag Persons performing this work must have adequate professional experience and safety training to perform the work of directing and managing the movement of pedestrians, vehicles, and other sidewalk and street users in a manner that protects the safety of all those present on the job site.

20. As necessary during construction, the Contractor shall be responsible for logging the legend and location of any signs not shown on the Plans that:

    a) Must be removed to facilitate the construction process;

    b) Are to be permanently removed; or,

    c) Are to be permanently relocated.

D. Safety, Security, and Protection of Property

1. The Contractor shall carry out their operations and secure the site in strict accordance with the requirements of MDOT Specifications, Subsection 104.07 (Contractor Obligations) and all pertinent regulatory agencies, including, but not limited to OSHA, MIOSHA, ADA/PROWAG, and all applicable manufacturer's safety requirements.

2. The Contractor shall perform all work in accordance with the Construction Safety Standards as adopted by the Michigan Department of Labor Construction Safety Standards for Occupational Health adopted by reference and cross referenced under authority of Sections 19 and 21, Act No. 154 of the Public Act of 1974, as amended, being 408.1021 of the Michigan Compiled Laws.

3. Prior to beginning any work, the Contractor shall submit a proposed Safety Plan to the PSAA detailing their safety plan and procedures and identifying all competent persons. The plan shall include a description of a daily safety program for the job site, Contractor's safety program for confined space entry in accordance with current OSHA and MIOSHA requirements, and all emergency procedures to be implemented in the event of a safety incident. All work shall be performed in accordance with the Contractor's submitted Safety Plan.

4. The Contractor shall designate a qualified and experienced safety representative at the site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs. The Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work.

5. The Contractor, including subcontractors, shall comply with all applicable laws and regulations and the City's safety programs, if any, relating to safety.

6. Prior to entry into any confined space, the Contractor shall submit to the PSAA a copy of their "daily" entry permit in accordance with current OSHA and MIOSHA requirements.

7. During non-working hours, the Contractor shall properly secure any open trench, excavation, or structures with protective fencing and temporary cover(s). Temporary covers over excavations or chambers shall be capable of withstanding the weight of a human and other wildlife such as deer.

8. Damages to property by Contractor shall be governed by Article 1 (General), Section XXIV (Protection of Property and Safety), Subsection B (Damages by Contractor) of these Standards.

E. Work Restrictions and Site Access and Control

1. Hours of work shall be as stated in the City Code, Title IX (Police Regulations), Chapter 119 (Noise Control), Article I (Non-Vehicular Noise), Sec. 9.363(5), Monday through Saturday, between the hours of 7:00 a.m. and 8:00 p.m.

2. Per City Code, Title IX (Police Regulations), Chapter 119 (Noise Control), Article I (Non-Vehicular Noise), Sec. 9.364 through Sec.9.367, all noise generated by construction activities shall not exceed the specified decibel limits for areas beyond the property line of the property on which the work is being conducted. The Contractor shall provide screening, noise absorption, and Level II sound attenuation as required on equipment to meet the noise limitations set therein. Any "off-hour" work will require a temporary exemption from the City of Ann Arbor City Administrator and any other affected entities (U-Mas applicable). A temporary exemption may be granted in accordance with each respective entities' code of ordinance.

3. Work shall be conducted in accordance with Article 1 (General), Sections XVII (Working Conditions and Good Will), and Section XVIII (Work in Right-of Way: General) of these Standards.

4. Under special circumstances the Contractor may perform work at night or on Sundays if there is an emergency or special need and the work is approved by the PSAA. All non-emergency requests to work during off hours shall be included in the Contractor's progress schedule and submitted to the PSAA for approval a minimum of 5 working days prior to beginning the work.

    a) Where paving and/or underground utility work at night is required and approved in advance by the PSAA, the night work shall be lighted to an average intensity of 10 foot-candles minimum. Sufficient light sources shall be provided to achieve this illumination requirement. The lighting shall allow the inspector to clearly see and inspect all work and operations. Lighting systems may be fixed, portable, or equipment mounted. A power source shall be supplied with sufficient capacity to operate the lighting system. The PSAA shall suspend all night work except for traffic control if lighting is inadequate on any nighttime work operation.

b) All floodlighting shall conform to the current edition of the MMUTCD. In no case shall floodlighting be permitted to glare, shine, or be directed into the eyes of oncoming drivers. The adequacy of flood light placement and elimination of potential glare can best be determined by driving through and observing the floodlight area from each direction on the main roadway after initial floodlight setup.

5. Material storage and delivery and handling of excavated materials shall be in accordance with Article 1 (General), Sections XXII (Material Delivery and Storage), and XXI (Handling Excavated and Backfill Materials on Construction Sites) of these Standards. The Contractor may store materials and equipment in the staging areas along the designated portions along the Project as indicated on the Plans. The Contractor shall store materials in an orderly arrangement allowing maximum access and unimpeded drainage and traffic. Material storage shall at no time impede pedestrian or emergency vehicle access. The storage of hazardous materials onsite shall not occur without the express approval of the PSAA.

6. Trees and shrubs in the staging and storage areas shall be protected per Article 1 (General), Section XXV (Protection of Trees) of these Standards and in conformance with Article 12 (Standard Details), SD-L-3 (Tree Protection) of these Standards.

7. All necessary measures shall be taken to prevent spillage of fuel, oil, chemicals, and hazardous materials. In the case of any fuel, oil, chemical, or hazardous material spill, the Contractor shall notify the PSAA and the EGLE Pollution Emergency Alerting System (PEAS) at (800) 292-4706. The Contractor shall be responsible for cleaning up the spill and remediating the site in accordance with EGLE requirements and as approved by the PSAA at no additional cost to the project.

8. Secondary containment shall be provided for diesel generators, equipment containing oil or grease, and storage of hazardous materials, in accordance with governing authorities or agencies.

9. Storage and work areas shall be kept clean with no accumulation of scrap, debris, waste material, and other items required for construction of the work.

10. The Contractor shall inspect the site daily, and more often if necessary, to ensure the site is maintained in a neat and orderly condition and that required controls for maintenance of traffic are in place. The Contractor shall also inspect storage areas weekly, and more often if necessary, to ensure the storage areas are maintained in a neat and orderly condition. One nighttime inspection shall be performed to insure proper retro-reflectivity of maintenance of traffic measures.

11. If the Contractor fails to correct unsatisfactory conditions within 24 hours after due notification, the PSAA may arrange for such work to be performed by other means at the Contractor's expense.

12. Any and all necessary measures required to avoid interruption in mail delivery and solid waste pick-up shall be taken by the Contractor including temporary relocation of mailboxes where required by the PSAA. Contractor shall also, in coordination with the Ann Arbor Area Transportation Association (AAATA), be responsible to maintain/make provisions for bus stops impacted by construction.

13. Mailboxes requiring relocation due to construction shall be removed and reset immediately by the Contractor in a temporary location approved by the PSAA.

14. The Contractor shall coordinate their operations with all utilities, contractors and/or subcontractors performing work on this and other projects within, or adjacent to, the Construction Influence Area (hereafter CIA).

15. A minimum of one driveway and one pedestrian access route shall be maintained at all times to all residences and businesses. Entrances to buildings shall not be blocked.

16. Undercuts or excavations immediately adjacent to active traffic lanes shall be restricted to a 1:4 slope from the edge of the roadway at the end of each working period. If this condition is not met, a nighttime shoulder closure shall be established according to MDOT Specifications, Subsection 812.03.G (Maintaining Traffic along Project). The cost of the shoulder closure will not be paid for separately but shall be deemed to be included in the cost of the work being performed.

17. All Temporary Facilities shall conform to Article 1 (General), Section XXIII (Temporary Facilities) of these Standards.

F. General Conditions

1. This work shall consist of performing all needed preparatory work and operations needed to begin the work of the project. All elements of this item of work are to be performed in accordance with these Standards, as shown on the plans, and as directed by the PSAA.

2. This item shall include all work described and required by the Plans and Specifications for which no item of work is listed in the Bid Form, including but not limited to:

    a) Scheduling and organization of all work, subcontractors, suppliers, material testing, inspection, and construction surveying and staking;

    b) Coordination of, and cooperation with, other contractors, agencies, departments, and utilities;

    c) Coordination with City forces to stockpile and load used castings, hydrants, and signs onto City vehicles;

    d) Protection and maintenance of all existing utilities, including support, protection, capping, repair, replacement, connection or re-connection of existing pipes, and utilities damaged by the Contractor's operations;

    e) Maintaining and removing all soil erosion and sedimentation controls (as specified herein or as shown on project plans) for which no pay item exists;

    f) Maintaining the site, and all areas within the CIA, in a well-graded and drained state at all times during the course of the project including de-watering and drainage of all excavations as required to maintain a stable, open hole;

    g) The continuous maintenance of the temporary road surface within the CIA throughout the duration of the construction. This includes any needed grading to maintain the surface in a smooth condition free of potholes, ruts, bumps, or other objectionable conditions.

    h) Temporary sheeting, bracing, and shoring of excavations in accordance with the applicable MIOSHA Standards;

i) Maintaining driveway openings, sidewalks, bike paths, mail deliveries, and solid waste/recycle pick-ups. This includes the placement and maintenance of maintenance aggregate in driveway openings and across sidewalk ramps all as needed and as directed by the PSAA;

j) Using quantities of dust palliative, maintenance aggregate, and hot patching mixture for use as temporary base, surfacing, and dust control at utility crossings, side roads and driveways;

k) Storing all materials and equipment off lawn areas;

l) Temporary removal/relocation, storage, and re-installation/re-setting of existing mailboxes, newspaper tubes, etc. which conflict with the proposed construction;

m) Site clean-up on a daily basis during the course of the project's construction including daily sweeping of paved areas to remove soil and construction spoils;

n) Coordination efforts to furnish the various required HMA mixtures as directed by the PSAA;

o) Coordination efforts to furnish and operate various-size vehicles and equipment as directed by the PSAA;

p) Furnishing and operating vacuum-type street cleaning equipment a minimum of once per week, or more frequently, if directed by the PSAA;

q) Noise and dust control in accordance with the applicable City of Ann Arbor Ordinances;

r) Mobilization(s) and demobilization(s) of all needed materials, equipment, and personnel;

s) Furnishing of all required shop drawings, informational submittals, and material certifications for all needed materials and supplies incorporated into the project;

t) The proper off-site disposal of all excavated materials and debris;

u) Removal of shrubs, brush, and trees less than 6" diameter (DBH) as shown on the plan sheets or as directed by PSAA;

v) Fencing to protect excavation over 1 foot in depth during non-work hours. The fencing must be a minimum of 36 inches high, be constructed of orange HDPE material, and reasonably secured to prevent unwanted access;

w) All miscellaneous and incidental items such as overhead, insurance, and permits, and;

x) Meeting all requirements relating to Debarment Certification, Davis Bacon Act, and Disadvantaged Business Enterprise, and providing the necessary documentation.

G. Project Clean-up and Restoration

1. The project site shall be left in a condition that is clean and free of all project-generated debris and to the satisfaction of the Engineer. This work shall consist of removing and disposing of miscellaneous packing materials and debris, soil erosion control fences, protective fences, fallen timber, logs, brush, rocks, boulders and any rubbish generated from the Contractor's operations within the project limits, or areas impacted by their operations. All utility structures shall be inspected to verify that no construction debris is present and cleaned by the Contractor as directed.

2. The Contractor shall perform final restoration and establish the turf areas as described in Section VI. B (Turf Establishment) of this Article.

3. The re-restoration of disturbed areas shall be performed in accordance with the applicable project specifications and as directed by the Engineer. Grade, spread topsoil, remove rocks over 2 inches in diameter, place additional topsoil (as needed), place permanent seeding, and furnish, place, and anchor erosion control straw mulch blanket in all areas disturbed by the Contractor's operations.

4. Damage to seeded areas resulting from erosion or subsequent construction activities shall be repaired by the Contractor at the Contractor's expense. Scattered bare spots in seeded areas will not be allowed over 3 percent of the area nor greater than 6- by 6-inch in size.

5. Clean existing culverts, ditches, depressions, or other areas that contain sediment or debris from the work operations.

6. Neatly fill any ruts or depressions resulting from removal of soil erosion control materials with existing materials after their removal. Maintenance of silt fencing and other soil erosion control materials until such time as they are no longer needed, then removal and proper disposal of them from the site, shall be included in the bid price for the related soil erosion control device.

H. Digital Audio-Visual Coverage

1. The Contractor shall furnish 2 copies of the completed digital audio-visual coverage to the PSAA at, or prior to, the Preconstruction Meeting. An index of the recording, which will enable any area of the project to be easily found on the recording, shall be included. The Contractor shall retain a third copy of the recording for their own use.

2. Any portion of the recording determined by the PSAA to be unacceptable for the documentation of existing conditions shall be recorded again, at the Contractor's sole expense, and submitted to the PSAA prior to mobilizing onto the site.

3. The digital audio-visual coverage shall be:

    a) Of professional quality, providing a clear and accurate audio and visual record of existing conditions;

    b) Prepared during the 3-week period immediately prior to the Preconstruction Meeting; and

    c) Furnished to the PSAA a minimum of 2 weeks prior to bringing any materials or equipment to the site.

4. The digital audio-visual coverage shall be completed in accordance with the following minimum requirements:

    a) The digital audio-visual coverage shall be performed using equipment that allows audio and visual information to be recorded simultaneously and in color. The recording shall be provided on a USB Flash Drive or portable drive in DVD format. The quality of the recording shall be equal to or better than the standard in the industry. The recording shall not be edited.

b) To ensure proper perspective, the distance from the ground to the camera lens shall not be less than 12 feet and the recording must proceed in the general direction of travel at a speed not to exceed 48 feet per minute (0.55 miles per hour). Pan and zoom rates shall be controlled sufficiently so that playback will ensure quality of the object viewed.

c) The recording equipment shall have transparent time and date stamp and digital annotation capabilities. The final copies of the recording shall continuously and simultaneously display the time (hours:minutes:seconds) and the date (month/date/year) in the upper left-hand corner of the frame. Accurate project stationing shall be included in the lower half of the frame in standard station format (i.e., 1+00). Below the stationing, periodic information is to be shown, including project name, name of area shown, direction of travel, viewing direction, etc.

d) Locations relative to project limits and landmarks must be identified by both audio and video means at intervals no longer than 100 feet along the recording route. Additional audio commentary shall be provided as necessary during the recording to describe streets, buildings, landmarks, and other details, which will enhance the record of existing conditions.

e) The recording shall be performed during a time of good visibility. The recording shall not be performed during periods of precipitation or when snow, leaves, or other natural debris obstruct the area being recorded.

5. The digital audio-visual coverage shall include the following:

a) This general criterion shall apply to all recording and shall include all areas where construction activities will take place or where construction vehicles or equipment will be operated or parked, and/or where materials will be stored or through which they will be transported. The recording shall extend an additional 50 feet outside of all areas. The recording shall include all significant, existing man-made and natural features such as driveways, sidewalks, utility covers, utility markers, utility poles, other utility features, traffic signal structures and features, public signs, private signs, fences, landscaping, trees, shrubs, other vegetation, and other similar or significant features.

b) All private property that may be utilized by the Contractor in conjunction with this project shall be recorded. These project areas must be disclosed by the Contractor prior to using them for the work of this project.

c) The digital coverage shall:

(1) Extend to 50 feet outside of the right-of-way and easements area as indicated on the Drawings.

(2) Extend 50 feet outside the construction limits on all streets, including side streets.

(3) Record both sides of each street.

d) Recording of all areas bordering the project where work is scheduled to occur or where construction traffic could damage the private property. This is to include buildings, hydrants, pavements, curbs, driveways, decks, landscaping, trees, and all other similar features.

e) The Contractor shall record, at their sole expense, other areas where, in their opinion, the establishment of a record of existing conditions is warranted. The Contractor shall notify the PSAA in writing of such areas.

f) The PSAA may direct the recording of other minor areas not specified herein at the Contractor's sole expense.

I. Project Supervision

1. The Contractor shall designate a full-time Project Supervisor to act as the Contractor's agent/representative, and to be responsible for scheduling and coordination of all subcontractors, suppliers, other governmental agencies, and all public and private utility companies.

2. The Project Supervisor shall not be an active crew member of the Contractor, shall not be an active member or employee of any subcontractor's work force, and shall not perform general or specialized labor tasks. The Project Supervisor shall be a full-time employee of the General Contractor and shall have all needed authority to make binding decisions on behalf of the Contractor in all matters pertaining to performance and execution of the work of the project.

3. The Project Supervisor shall work exclusively on this project and shall put forth full effort into the organization and coordination of the work of this project.

4. One week prior to the pre-construction meeting, the Contractor shall designate a proposed Project Supervisor by name, and shall furnish the PSAA with a current, thorough, detailed summary of the proposed Project Supervisor's work history, outlining all previous supervisory experience on projects of a similar size and nature. The detailed work history shall include personal and professional references (names and phone numbers) of persons (previous owners or agents) who can attest to the qualifications and work history of the proposed Project Supervisor. Proposed candidates for Project Supervisor shall have a demonstrated ability to work harmoniously with the PSAA, the City, the public, subcontractors, and all other parties typically involved with work of this nature. The PSAA will have the authority to reject a proposed Project Supervisor who, in the opinion of the PSAA, is deemed unqualified.

5. The Project Supervisor shall be available 24 hours-per-day to provide proper supervision, coordination and scheduling of the project for the duration of the Contract. The Contractor shall furnish the City with telephone numbers of the Project Supervisor in order to provide 24 hour-per-day access during business and non-business hours, including weekends and holidays.

6. The Project Supervisor shall be equipped by the Contractor with a “smart” mobile telephone with data and text capabilities to provide the City with 24 hour-per-day access to said Project Supervisor during daily construction activities, during transit to and from the construction site, and during all non-business hours including weekends and holidays.

7. The Project Supervisor shall be equipped with assistants as necessary to provide project supervision as specified herein, and in accordance with the Contract.

8. The Project Supervisor shall work harmoniously with the PSAA, the City, the public, subcontractors, and all other parties typically involved with work of this nature.

9. The Project Supervisor shall have a thorough, detailed understanding and working knowledge of all construction practices and methods specified elsewhere herein, as well as the handling, placement, testing and inspection of aggregates, aggregate products, bituminous concrete, Portland cement concrete materials, and other such materials and products related to the work of this project.

10. The Project Supervisor shall be responsible for all of the work of all of the Contractor's, subcontractors' and suppliers' work forces.

11. The Project Supervisor shall be responsible for proper and adequate maintenance (emissions, safety, and general operation) of all of the Contractor's, subcontractors' and suppliers' equipment and vehicles. The Project Supervisor shall make all needed diligent and good-faith efforts to ensure that all equipment utilized in the performance of the work is properly maintained, safe, and complies with all legal and environmental requirements of the work as set forth in MDOT Specifications, Subsection 107.15 (Compliance with Laws; Environmental Protection).

12. The Project Supervisor shall be responsible for the legal, proper and safe parking/storage of all of the Contractor's, subcontractors' and suppliers' equipment, work vehicles, and employee's vehicles.

13. The Project Supervisor shall schedule and coordinate the work of all parties involved in the project, including utility companies, testing agencies, governmental agencies, all City departments (such as Utilities and Transportation), and City inspectors.

14. The Project Supervisor shall coordinate and schedule the work of any independent survey crews that may be retained by the PSAA or City to witness and reset existing and new geographic/benchmark monuments. Failure to have existing monuments witnessed and reset may result in delays to the Contractor's work. Costs for such delays will be the Contractor's sole responsibility. The Project Supervisor shall also schedule and complete all needed survey request forms that are needed in order to schedule the services of survey personnel to properly layout all elements of the project work in accordance with these Standards and MDOT Specifications.

15. The Project Supervisor shall coordinate, and schedule inspection performed by the City and Consultants (including material testing firms) in a timely manner, to assure proper and timely testing and inspection of the work.

16. The Project Supervisor shall submit to the PSAA an updated, detailed schedule of the proposed work on a weekly basis, and an update of all proposed changes on a daily basis.

17. The Project Supervisor and all subcontractors shall attend a weekly progress meeting chaired by the PSAA to discuss the work. Upon the completion of each meeting, the PSAA shall prepare and distribute, to all present, a written summary of the meeting's minutes. Those in attendance shall review the minutes and, if necessary, comment on any deficiencies or errors prior to or at the next scheduled progress meeting.

18. If, in the sole opinion of the PSAA, the Project Supervisor is not adequately performing the duties as outlined in this specification, the following system of notices will be given to the Contractor with the associated penalties:

    a) A warning will be issued in writing to the Contractor detailing the deficiencies in the Project Supervision. The Contractor must respond within 7 calendar days in writing with a plan to correct the stated deficiencies. Failure to respond within 7 calendar days will result in the issuing of a second notice.

    b) A second warning will be issued in writing to the Contractor further detailing the deficiencies in the Project Supervision. The Contractor must respond within 7 calendar days in writing with a plan to correct the stated deficiencies. Failure to respond within 7 calendar days will result in the issuing of a third notice. At this time, the PSAA reserves the right to meet with personnel with the necessary authority within the Contractor's organization to discuss the deficiencies in the Project Supervision.

    c) A third notice will be issued in writing to the Contractor further detailing the deficiencies in the Project Supervision and the Project Supervisor shall be removed from the project and replaced immediately with another individual to be approved by the PSAA.

19. Should, in the sole opinion of the PSAA, the Project Supervisor fail to perform their duties and responsibilities as described herein to such a degree that the successful completion of the project is put in jeopardy, the above system of notices may be waived, and the Contractor shall immediately replace the Project Supervisor upon receipt of written notice. Failure to provide adequate project supervision, as determined by the PSAA, shall be considered basis for the PSAA to suspend work without extension of contract time or additional compensation.

J. Exploratory Excavation

1. This work consists of conducting a vertical exploratory investigation to expose an existing culvert, sewer, utility/utility service, or the existing pavement section to verify the location, condition, size, material, alignment and/or composition; allowing the PSAA to document the necessary information; and backfilling the excavation. It includes providing necessary lane, shoulder and/or sidewalk closures required to perform the work.

2. The intent of “Exploratory Excavation” is not to provide a means for the Contractor to locate each existing utility throughout the project, but for those that appear to conflict with the proposed work and where their location is unclear or unknown. The use of “Exploratory Excavation” shall only be as directed and approved by the PSAA. The Contractor is responsible for “using reasonable care to establish the precise location of the underground facilities in advance of construction” (Public Act 174 of 2013 - Miss Dig Law) as a part of the overall project contract.

3. The owner of any sewer or utility to be exposed will not take the facilities out of service during the exploratory investigation. Contractor shall contact utility owners in accordance with MDOT Specifications, Subsection 107.12 (Contractor’s Responsibility for Utility Property and Services).

4. Necessary lane, shoulder and/or sidewalk closures required to perform work shall be established.

5. The exploratory excavation shall be advanced using hydro excavation, hand digging, conventional machine excavation, or a combination thereof subject to approval of the PSAA. The PSAA shall be allowed access to document the necessary information. If the technique used to advance the excavation causes any damage to the existing facilities, Contractor shall immediately contact the utility owner and cease all work until PSAA approves of an alternate method.

6. Care shall be taken to protect any exposed culvert, sewer or utility from damage during construction. Any culvert, sewer or utility, damaged during exploratory excavation shall be repaired or replaced in accordance with the standards of the utility owner and as approved by the PSAA. Contractor shall contact the owner of such utility to coordinate the repair.

7. The Contractor is responsible for all costs associated with the repair work and out of service time of all broken or damaged existing culverts, sewers or utilities resulting from any action by the Contractor.

8. In between time of completing excavation and backfilling, excavation shall be barricaded, plated, or fenced. The PSAA's approval shall be obtained before backfilling the excavation. Backfilling shall be completed no later than 24 hours after approval. Backfilling shall be in accordance with MDOT Specifications, Subsection 204.03.C (Backfilling). Excess material shall be disposed of in accordance with those Specifications.

K. Hand Dig or Hydro Excavation

1. Remove miscellaneous materials covering the tree root system using hand tools or hydro excavating machinery, or other methods as approved by the engineer, in a manner that reveals, without damaging, tree roots 1½-inch or greater in diameter for pruning operations.

2. All excavated material which is unsuitable for backfill shall be immediately removed from the site by the Contractor.

3. Hand dig or hydro excavate to achieve rough grades or removals, as shown on plans.

4. Tree roots exposed during construction that are 1½-inch or greater in diameter must be pruned. All pruning operations shall be reviewed and approved by the Engineer. All root pruning shall be performed with sharp tools and shall provide clean cuts that do not unnecessarily damage the remaining bark or root. The Contractor shall not perform any backfilling operations until all root maintenance has been performed.

5. Perform removals and backfill with Class II granular material unless otherwise specified to rough grade as specified.

6. Any damage to trees within the areas designated for hand digging due to the Contractor's activities, including subcontractors or suppliers, shall be repaired under the direction of the City Forester. The costs of these repairs shall be the sole responsibility of the Contractor.

7. Should the Contractor's operations damage a plant's roots to the extent that it must be removed, the Contractor shall either replace the plant with a commensurate number of plants, 2½-inch caliper trees of the species as determined by the City or compensate the City of Ann Arbor for the cash value of the plant or tree as determined by the City of Ann Arbor's Forester. The City of Ann Arbor shall be solely responsible for determining which compensation method is used.

L. Work in Railroad Right-of-Way

1. Railroad Company shall be notified a minimum of 10 calendar days (or more if required by Railroad) prior to beginning any work within the railroad right-of-way.

2. Contractor shall obtain, at Contractor's sole expense, the insurance required by the Railroad. For purposes of compliance with this specification, any provision of the Railroad Company that indicates that the permittee and/or its Contractor shall either perform work or provide documentation shall be interpreted as being the sole responsibility of the Contractor.

3. The Contractor shall be responsible for procuring all required insurance coverages required by the Railroad Company. Insurance required shall be considered primary with respects to any other valid or collectible insurance that the City may possess, including any self-insured retentions the City may have; and any other insurance the City does possess shall be considered excess insurance only and shall not be required to contribute with this insurance. Further, the Contractor agrees to waive any right of recovery by its insurer against the City.

4. Contractor shall coordinate with the Railroad the scheduling of railroad inspectors, flaggers, etc. This is to be arranged at time of notification.

5. Contractor shall fully comply with all Railroad permit requirements for working within the railroad rights-of-way or areas covered by its requirements for the Project.

6. Contractor shall provide any Railroad Company training for each person involved in the work as described in the Railroad Company documents.

7. Contractor shall provide coordination with the Railroad needed to complete the work of the Project.

8. Work within or adjacent to the railroad rights-of-way shall not proceed until all approvals from the Railroad Company have been granted.

M. Required Submittals and Resubmittals

1. For each required submittal or resubmittal per these Specifications, the Contractor shall allow at least 14 calendar days from the date of the submittal to receive the PSAA's acceptance or request for revisions.

2. The PSAA's comments shall be incorporated into the resubmitted plans, calculations, and descriptions. The PSAA's acceptance of the submittal is required before beginning the work.

3. Resubmittals shall be reviewed and returned to the Contractor within 14 calendar days. Required revisions will not be a basis of payment for additional compensation, extra work, or an extension of contract time. The Contractor shall include time for this entire review process in their schedule.

II. Utilities

A. Work Required of Contractor - General

1. Contractor shall furnish all materials, equipment, tools, and labor necessary to do the work required by this Section, and unload, haul, distribute, store, and install all pipe, castings, fittings, valves, manholes, hydrants, and accessories as specified or as shown on the Plans.

2. Trenches, pits and other excavations shall be excavated to the dimensions as required to complete the work per MIOSHA safety regulations.

3. The excavation and adjoining ground or structures shall be sheeted, braced, and supported in accordance with federal, state, and local requirements.

4. The pipes, castings, fittings, valves, manholes, hydrants, and accessories shall be installed and tested as specified.

5. All excavations shall be backfilled and compacted, surfaces restored, surplus materials removed and disposed of offsite, work site cleaned, and the adjoining street or other surfaces maintained as specified.

6. All materials, equipment, tools, and labor required to alter existing connections to water mains or sewers and to reconfigure sewers, service lines, conduits, ducts, pipes, or other structures shall be furnished in accordance with the Plans and Specifications.

B. Materials

1. All utility materials shall conform to specifications as set forth in these Standards in:

   a) Article 2 (Sanitary), Section II (Sanitary Sewer Materials);

   b) Article 3 (Water), Section II (Water Materials);

   c) Article 4 (Stormwater), Section II (Stormwater Materials); and

d) Any other applicable material specifications and Standard Details of these Standards.

2. Manufacturer's Certifications shall be submitted for all pipe to be used on the Project per the cited Sanitary, Water, and Stormwater Materials sections of these Standards (hereafter collectively Utility Materials Standards).

3. Pipe Marking and Material Handling shall be in conformance with the Utility Materials Standards.

4. All pipe materials are subject to Material Inspection per the Utility Materials Standards and may be rejected as set forth therein.

5. Backfill Materials

   a) All material to be used as backfill shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways.

   b) Hydrants, manholes, valve boxes, curb stop boxes, call boxes, and other utilities or facilities shall not be obstructed by backfill materials.

   c) Streets and gutters shall be kept clear or other provisions shall be made for street drainage; natural water courses shall not be obstructed.

C. Excavation - General

1. Excavation shall include the clearing of the site, and the removal and disposal of all material, including rock, boulders, or buried obstructions necessary to be removed to construct the work.

2. Contractor shall determine location of underground facilities and comply with MISS DIG 811 utility notification system requirements. Damages to utilities by the Contractor's operations shall be repaired by the utility owner at the Contractor's expense.

3. Excavation normally shall be by open cut from the surface except as otherwise specified, or in special cases where crossing under trees, pavements, or structures. The Contractor may use tunnel methods if permitted in writing by the PSAA, provided Contractor's method of backfill is such, in the judgment of the PSAA, as to avoid any present or future injury to the tree, pavement, or structure.

4. Excavation shall be in such manner to provide adequate room for the construction and installation of the work to the lines, grades and dimensions shown on the Plans.

5. The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures, both known and unknown, may be determined, and the Contractor shall be held responsible for the repair of such structures when broken or otherwise damaged.

6. When in the opinion of the PSAA it is necessary to explore and excavate to determine the location of existing underground structures, the Contractor shall make explorations and excavations for such purposes.

7. Hand methods for excavation shall be employed in locations as shown on the Plans. In other locations the Contractor may use appropriate equipment or employ hand methods.

8. In excavating for pipe installation, the excavation shall always be finished to the required grade in advance of laying the pipe, but not more than 50 feet of trench shall be open at one time. Incompletely backfilled trenches shall not be left open without written permission from the PSAA.

9. At the end of each day, no more than 10 feet of trench may be left open, and access to all drives shall be restored. Excavation shall be plated or surrounded by fencing and lighted barricades. All other areas shall always be available for safe vehicular and pedestrian traffic.

10. All excavated material approved by the PSAA as backfill material and any imported backfill material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. All excavated material which is unsuitable for backfill shall be immediately removed from the site by the Contractor.

11. Fire hydrants, manholes of any kind, valve boxes, curb stop boxes, fire and police call boxes, traffic signals, and other utility controls shall be left unobstructed and accessible until the work is completed unless directed otherwise by the PSAA. Gutters shall be kept clear, or other satisfactory provisions made, for street drainage, and natural water courses shall not be obstructed.

D. Trenching

1. Trench Widths and Depths

   a) Trench shall be of sufficient width to provide adequate working space to permit the installation of the pipe and the compaction of the bedding material under and around the pipe. However, for rigid pipe, the width of the trench from below the pipe bedding to 12 inches above the top of the pipe shall not exceed the dimensions per Table A of this Article:

Table A
Trench Width

Diameter of Pipe	Width of Trench
6-inch thru 12-inch	30 inches wide
15-inch thru 36-inch	outside diameter plus 16 inches
42-inch thru 60-inch	outside diameter plus 20 inches
over 60-inch	outside diameter plus 24 inches

   b) For each size of pipe, the minimum trench width shall provide clearance of 4 inches on each side of the bell of the pipe or fitting or 6 inches on each side of the pipe barrel, or as recommended by the manufacturer, whichever is greater.

   c) The maximum trench width shall be in keeping with good construction practice, such that existing structures are not undermined.

   d) The trench shall be excavated to a minimum of 4 inches below the final location of the pipe. For reinforced concrete pipe 66 inches or larger in diameter, the trench will be excavated to a minimum of 6 inches below the pipe. This cut shall be filled to the level of the bottom quadrant of the pipe with Class II granular material as specified herein, shaped and compacted to the pipe barrel.

2. Trench Shoring and Bracing

   a) Where required to support the surfaces of adjacent roadway, structures, or excavations, or to protect the construction work, adjacent work, or workers, sheeting, bracing, and shoring shall be provided. The placing of such supports shall not release the Contractor from the responsibility for the sufficiency and integrity of the trench.

b) In the removing of sheeting and bracing after the construction has been completed, special care shall be taken to prevent any caving of the sides of the excavation and injury to the completed work or to adjacent property.

c) Sheeting, bracing, and shoring shall not be left in place after completion of the work, except as required by the PSAA. In such cases, shoring and bracing shall be cut off a minimum of 4 feet below the established surface grade.

E. Trench Dewatering

1. The Contractor shall take all necessary precautions to keep the trenches and other excavations entirely clear of water and sewage during construction of pipelines and structures.

2. Where existing sewers, drains, or ditches are encountered in this work, adequate provisions shall be made for diverting their flow, so that the excavation will be kept dry. Upon completion of the construction work, the existing sewers, drains, or ditches shall be restored as directed by the PSAA.

3. Any water that may accumulate in any excavations shall be removed by well points, pumping, bailing, or other acceptable methods.

4. The Contractor shall be responsible for the complete design of all structures and methods proposed for dewatering the project site, including the implementation of all materials, tools, and equipment proposed for use in the work. Temporary wiring associated with the de-watering shall comply with the applicable portions of the National Electric Code.

    a) Dewatering system(s) shall be designed by a Professional Engineer registered in the State of Michigan with a minimum of 7 years of documented experience in the design, installation, and operation of de-watering systems and as specified.

    b) Electrical power shall be provided from the local utility provider or portable generators. Stand-by power and any other required auxiliary dewatering equipment shall be provided to assure continuous de-watering capability. De-watering, where required, shall be continuous.

    c) Dewatering shall not be stopped during work stoppages without the approval of the PSAA. Construction operations shall be coordinated to minimize duration and extent of de-watering required.

d) Dewatering wells are to use properly designed filters to prevent migration of soil fines into the well.

e) Sumps and wells used as a part of the dewatering system shall be strongly sheathed and braced to protect the construction while in use. Tops of well casings shall be covered to prevent animals and debris from entering and shall be 2 to 3 feet above ground level. Sumps and wells, when abandoned, shall be backfilled and compacted, or grouted in place, to the satisfaction of the PSAA.

f) Methods used in drilling wells associated with dewatering systems shall be the responsibility of the Contractor and shall be acceptable to the PSAA. Drilling methods shall insure proper placement of well materials and shall not involve displacement of earth formations.

5. Equipment for pumping and pumping methods associated with dewatering systems shall be the responsibility of the Contractor and shall be acceptable to the PSAA. The Contractor shall furnish and construct adequate discharge piping systems to conduct and dispose of the water so as to prevent damage to existing structures or property. Pumping equipment shall be of proper type and size for the work, be in good working condition, and be properly maintained throughout the life of the project until it is no longer needed. The Contractor shall provide all anchors and supports for pumping equipment.

6. All water that is removed from excavations, or directed away from work areas, shall be directed to existing storm sewers or other water courses as approved by the PSAA. In areas of known ground water contamination or as shown on the plans, water shall be directed to sanitary sewer after the Contractor obtains a permit from the Wastewater Treatment Plant. In handling and directing this water, the Contractor is required to comply with all applicable local, state, and federal requirements regarding soil erosion and sedimentation control and shall provide filters, filter bags, check dams, or any other measure that is necessary in order to comply with the applicable laws and ordinances. No drainage ditches shall be placed within the area to be occupied by any structure except as permitted in writing by the PSAA.

7. Upon completion of dewatering work for the project, all holes, trenches, ditches and other earth excavations created by the work of this Section and not scheduled to remain shall be filled. All filling, backfilling, grouting, and grading to restore excavations and earth banks shall be performed to the lines and grades as indicated

on the Plans and as determined by the PSAA. All earth fills shall be compacted to 95% of the material's maximum unit weight outside of roadway pavement influence or compacted to 98% of the material's maximum unit weight within roadway pavement influence.

8. Any and all method(s) of dewatering proposed by the Contractor shall be effective. The Contractor is responsible for de-watering the site in an effective, timely, manner, that will not unduly delay the work of the project. Delays due to dewatering efforts will not be a basis of payment for additional compensation, extra work, or an extension of contract time. The PSAA's acceptance of a particular method of dewatering shall not relieve the Contractor of their responsibility of performing the work in a manner that meets the requirements of the specifications, the Contract Documents, and all other local, state, and federal requirements.

9. Newly placed concrete thrust blocking or other concrete shall be adequately protected from injury resulting from ground water or sewage.

10. The Contractor shall always have sufficient pumping equipment ready for immediate use on the work site to carry out the intent of this Section.

F. Crossing Existing Structures & Facilities

1. During construction it may be necessary to cross under or over other utility structures and facilities. The Contractor shall make every effort to prevent damage to such underground structures and facilities. The Contractor shall not intentionally damage or break existing structures or facilities and repair them in order to expedite the main installation process.

2. Wherever such structures or facilities may inadvertently be disturbed or broken, they shall be restored to a condition that is equal to, or better than, that was encountered prior to the damage; and to the satisfaction of the utility owner at Contractor's expense.

3. Contractor shall maintain minimum vertical and horizontal clearance between facilities as specified in Separation Clearance Sections in Article 2 (Sanitary), Section I.H, Article 3 (Water), Section I.B.6, and Article 4 (Stormwater), Section I.H. of these Standards.

G. Pipe Undercut

1. In locations where, in the opinion of the PSAA, the soil at the bottom of the trench is unsuitable, e.g., organic soils, frozen material, debris, highly compressible soils or other deleterious material which would cause differential settlement of the pipe trench, the Contractor shall excavate below the trench bottom to such depth as directed by the PSAA and shall backfill with compacted 6A coarse-graded aggregate to the springline of the pipe, per Article 12 (Standard Details), SD-TD-2 (Utility Trench - Type 2) of these Standards.

2. If backfill with compacted coarse-graded aggregate is required during sanitary or storm sewer construction, it shall be placed for the entire sewer run from manhole to manhole.

H. Pipe Bedding

1. Pipe Bedding is described as the material from 4 inches below the pipe (or 6 inches below the pipe for reinforced concrete pipe 66-inch diameter or larger) up to the top of pipe.

2. The pipe bedding shall be in conformance with Article 12 (Standard Details), SD-TD-1 through SD-TD-5 of these Standards (hereafter Trench Details). The Trench Detail Type shall be specified on the Plans. MDOT Granular Material Class II shall be compacted to 95% of its maximum dry density in maximum lifts of 12 inches.

3. After the pipe is laid, the bedding shall be continued to the top of pipe. Care shall be taken to assure filling and tamping all spaces under, around and above the top of the pipe.

4. A continuous, uniform, and compacted bedding shall be provided in the trench for all buried pipe.

5. Bedding material shall be compacted as specified in this Section. Each lift shall be thoroughly compacted by hand tamps, pneumatic "pogo-sticks, hoe packs, or other approved methods, to its specified dry density at optimum moisture content. Each lift shall extend the full width of the space between the pipe and trench wall, and the bedding shall be brought up evenly on both sides of the pipe. The bedding under the haunches of the pipe shall be consolidated by the use of a tee-bar.

I. Pipe Backfill

1. Pipe backfill is the material from the top of pipe to the surface restoration cross section, as specified elsewhere. Material shall be in conformance with Trench Details.

2. Backfill of MDOT Class II sand shall be compacted to 95% of its maximum dry density. If machine tamping includes manually-operated vibrating plate compactors or self-propelled vibrating rollers, the backfill material shall be compacted in lifts not exceeding 12 inches, loose measure. If a backhoe-mounted compactor is employed, the backfill material shall be compacted in lifts of 36 inches, loose measure.

3. In cases where backfill of native material is approved by the PSAA; pipe bedding shall extend to 12 inches above the top of pipe and native material backfill shall be uniformly spread and compacted to 90% of its maximum dry density.

4. Backfilling shall not be done in freezing weather except by written permission of the PSAA, and it shall not be made with frozen material. No fill shall be made where the material already in the trench is frozen.

5. No trench backfill shall contain debris or organic material within 24 inches above the top of pipe.

6. Approval to use a particular compaction method will be withdrawn by the PSAA if the method causes injury to the pipe or adjacent structures or movement of the pipe. The PSAA may consider written permission to increase the thickness of the lifts specified in this paragraph if satisfactory compaction is achieved and no undesirable side effects occur.

7. When directed by the PSAA, Flowable Fill shall be used as backfill for the pipe installation. Where flowable fill is called for as pipe backfill or bedding, care shall be used to avoid displacing the pipe due to fluid pressure or the buoyancy effect.

J. Laying Pipe - General

1. Each pipe shall be inspected for defects prior to being lowered into the trench. The inside of the bell and outside of spigot shall be cleaned of any earth or foreign matter.

2. Proper implements, tools, and facilities satisfactory to the PSAA shall be used for the safe and convenient execution of the work.

3. All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench by means of slings, cables, or other suitable tools or equipment as recommended by the manufacturer, in a manner to prevent damage to them and their protective coatings and linings. Under no circumstances shall materials be dropped or dumped into the trench.

4. The Contractor shall take every precaution to prevent foreign material from entering the pipe while it is being placed. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

5. When pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug. This provision shall apply during the noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

6. No pipe shall be laid until a cut sheet for that pipe has been approved by the PSAA.

7. The Contractor shall excavate for all bell holes and shall place the bell of the pipe in the excavated bell hole. Pipe shall be laid on the prepared trench bottom with the bell ends facing the direction of laying, unless otherwise directed by the PSAA.

8. Pipe shall be jointed as specified elsewhere herein. The pipe shall be secured in place with approved backfill material tamped under it except at the bells.

9. Gasket lubricant shall only be applied immediately before connection to the next segment of pipe. Pipe with lubricant applied shall not come in contact with the ground. If the lubricated portion of the pipe end contacts the ground, it shall be thoroughly cleaned to the satisfaction of the PSAA, prior to its installation.

10. Each section of pipe, when placed to grade and line, shall have firm bearing on the trench bedding throughout its length between bell holes. All pipe shall be laid at the correct line and grade as indicated by the grade stakes and offset line.

K. Installation of Water Main

1. All ductile iron pipe, fittings, and valves shall be fully wrapped with polyethylene per ANSI/AWWA C105/A21.5 (Polyethylene Encasement for Ductile Iron Pipe), Method A. Service taps, bends, tees and other connections made to polyethylene encased pipe shall be in accordance with Section 4.4.6 of said AWWA C105.

2. Cutting cast iron or ductile iron pipe for inserting valves, fittings, or closure pieces shall be performed in a neat and workmanlike manner without damage to the pipe or cement lining and to leave a smooth end at right angles to the longitudinal axis.

3. Where the type of pipe joint in use is such that it employs push-on assembly to affect the joint seal, the outside of the cut end shall be tapered back ⅛ inch with a coarse file or a portable grinder at an angle of about 30 degrees. The tapering must remove all sharp and/or rough edges which might injure the gasket.

4. Mechanical means shall be used for pulling home all rubber-gasket pipes regardless of trench condition where manual means will not result in pushing and holding the pipe home.

5. For pipe of any diameter, all plugs, caps, tees, hydrants, and 90 degree horizontal bends shall be provided with 3500 psi concrete thrust blocks per Article 12 (Standard Details), SD-W-2 (Thrust Block) of these Standards, in addition to restrained push-on rubber joint gaskets as specified in Article 3 (Water), Section II. A. 3. a) (Ductile Iron Pipe).

    a) Thrust blocks shall be placed between unexcavated solid ground and the fitting to be anchored. The thrust blocks shall be placed so that the pipe and fitting joints will be accessible for repairs. This shall include adequate protection of any bolts from direct contact with the concrete.

    b) Metal harnesses of tie rods or clamps may not be used instead of concrete thrust blocks. Mechanical joint restraint systems and restrained, push-on joint, pipe shall be used where connections to existing lines require immediate pressurization. These instances shall be reviewed prior to approval.

    c) If the PSAA determines a change in the thrust blocks, anchorage or design is required due to unsuitable earth conditions, changes may be ordered by the PSAA.

6. Wherever it is necessary to deflect ductile iron pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions, to plumb valve stems, or where long-radius curves are permitted, the amount of deflection shall not exceed that allowed. Amount of deflection shall be approved by the PSAA and shall not exceed amount as recommended by the manufacturer and AWWA C600.

7. The tapping of water mains, the installation of all corporation stops, and the operation of valves and hydrants is reserved for City personnel. The Contractor is required to assist in valve and hydrant operation.

8. Tracer wire shall be provided in compliance with Article 3 (Water), Sections I.B.18 and II.F (Tracer Wire) of these Standards. Tracer wire shall be placed on top of the pipe at the centerline of the pipe longitudinal axis. Wire shall be extended to all hydrants, blowoffs, dead ends, and post indicator valves.

9. For open cut construction, the tracer wire shall be installed at a height of not more than six inches above the main line pipe.

10. For directional drilling or pipe bursting, the tracer wire shall be installed at the same time as the pipe.

11. Tracer wire shall be brought to grade, leaving enough excess material to avoid loss or damage to the wire during construction and subsequent activities. Wire shall be properly terminated at access points following pipe installation.

12. Tracer wire terminations shall be made by one of the following methods:

    a) Tracer wire shall be terminated at hydrants with an access point terminal installed directly to the hydrant flange. Hydrant access points shall include 2-terminal connections with ground connection made within the terminal. Rigid PVC conduit from the access point shall extend to a minimum of 24-inches below grade.

    b) Gate well terminations shall be made by running the tracer wire through a maximum 3/8-inch drilled hole sealed with epoxy in the upper section of the precast structure and up the wall leaving the stub accessible a maximum of 18-inches below the casting. Wire shall be terminated in an 18-inch long blue polyethylene tube with aluminum cap that acts as a connection point. The cap shall include dielectric gel to seal the wire connection. Wire and termination tube shall be fixed to the gate well wall with stainless steel wire clamps.

c) Terminations at existing water mains without tracer wire or a dead end shall be made at the nearest hydrant or gate well as outlined above. If no hydrant or gate well is available, a ground level tracer wire access point shall be installed.

d) Tracer wire terminations shall be located at a maximum spacing of 600 feet. If an additional termination is required, a ground level tracer wire access point shall be installed.

13. An 18-inch long magnesium grounding rod with AWG 12 connecting wire shall be installed at all hydrants and ground level access points along the proposed tracer wire. Grounding rod connection shall be made at the identified (or bottom) terminal at all access points.

14. Contractor shall test tracer wire for continuity after backfilling is complete and before the water main is placed in service. Continuity test to consist of locating all water main with an electronic-type pipe locator. If test for continuity fails, repair or replace as necessary to achieve continuity.

15. Underground utility caution tape shall be placed one foot above the pipe as the pipe is backfilled.

L. Water Main Testing

1. All water mains shall be bacteriological tested, pressured tested, and approved by the PSAA prior to being connected to existing water main facilities. Flushing, chlorination and bacteriological testing must precede pressure testing when it is connected to the main. Where mains can be totally isolated from existing facilities with air gaps or double valves, pressure testing may precede chlorination and bacteriological testing. All testing shall be in accordance with AWWA C600 and C651.

2. The normal sequence and time requirements for water main testing are provided in Table B of this Article:

Table B Water Main Testing Sequence		
	Isolated (Gapped) Water Main	**Connected Water Main**
Step 1	Fill main	Flush and Swab*
Step 2	Pressure test	Chlorinate
Step 3	Connect one end of main	Wait; 24 hours
Step 4	Flush and Swab*	Flush **
Step 5	Chlorinate	Wait; 24 hours
Step 6	Wait; 24 hours	Bacteriological Samples
Step 7	Flush**	Wait; 24 hours
Step 8	Wait; 24 hours	Bacteriological Samples
Step 9	Bacteriological Samples	Wait; 48 hours
Step 10	Wait; 24 hours	Pressure Test (If both sets of sets of bacteriological samples pass)
Step 11	Bacteriological Samples	Flush*
Step 12	Wait; 48 hours	Wait; 24 hours
Step 13	Make Final Connection(s) - Place in Service (If both sets of bacteriological samples pass)	Bacteriological Samples
Step 14		Wait; 24 hours
Step 15		Bacteriological Samples
Step 16		Wait; 48 hours
Step 17		Place in Service (If both sets of bacteriological samples pass)
*Collect flush water in operable stormwater retention/detention facility **Discharge flush water into approved sanitary sewer		

3. The Contractor shall give the City 48 hours prior written notice of intent and desire to test water mains.

4. The water main shall be disinfected and tested by the Contractor in the presence of the PSAA in accordance with the requirements below. The Contractor shall furnish all piping, pumps, hoses, gauges, RPZ backflow preventer (if unavailable from Public Works), and other materials and equipment required to carry out the tests using water from the City's water mains.

5. All chlorinated water shall be discharged directly to the sanitary sewer and will not be allowed to be discharged to the ground or any surrounding water course.

6. The City shall furnish and install 1-inch corporation stops at all necessary locations, at the expense of the Contractor.

7. Flushing, Chlorination and Bacteriological Testing:

   a) After completion of water main installation, water main shall be cleaned using a high-density poly-pig (2 lbs/ft^3 density) swab and flushed.

   b) New mains, valves, hydrants and appurtenances shall be flushed completely as acceptable to PSAA. The pipe shall be flushed until the water runs clear for a minimum of 15 minutes or until two full pipe volumes have been flushed (whichever is longer).

   c) Prior to final approval of the system, Contractor shall pump down all fire hydrants and verify that the hydrant valve is properly seated to prevent the hydrant standpipe from filling with water.

   d) After the water mains have been acceptably flushed, they shall be disinfected in accordance with AWWA C651, (Disinfecting Water Mains), and these Specifications.

   e) All new mains and fittings, and any existing mains contaminated by the Contractor, shall be chlorinated to a minimum residual of 50 parts per million (ppm) with commercial liquid chlorine solution (sodium hypochlorite - pool type). Other forms of chlorination and disinfection methods of water mains may be presented by the Contractor and shall receive prior approval in writing by the PSAA before being used.

   f) During the chlorination process, the proper level of chlorination must be achieved throughout the entire length pipe. Chlorine levels shall be checked at intermediate locations as directed by the PSAA and the Contractor shall add chlorine until such time as the required levels are achieved at all points.

   g) The minimum recommended dosage of sodium hypochlorite shall conform to Table C of this Article (based on 10% available chlorine):

Table C **Recommended Minimum Chlorine Dosage to Disinfect 100 L.F. of Pipe**	
Pipe Diameter (inches)	**10% Chlorine Solution** (gallon)
6	0.153
8	0.272
10	0.426
12	0.613
16	1.090
20	1.703
24	2.452

h) The chlorinated water shall remain in the mains for a minimum of 24 hours, at the end of which period the chlorinated water at all parts of the main must show free available chlorine residual of at least 25 ppm.

i) If less than 25 ppm residual is shown at the end of the first 24-hour period, additional chlorine shall be added until a residual of 25 ppm is achieved in all parts of the system after a 24-hour period.

j) The chlorinated water shall then be removed from the mains and disposed of into an existing, approved City sanitary sewer main, or other location as approved in writing by the PSAA. The mains shall then be left full of potable water ready for bacteriological testing.

k) The City will obtain bacteriological samples of the water in the mains for analysis from testing blow-offs, corporations, or other sampling points as determined acceptable by the City.

l) The water samples will only be bacteriologically tested at the City's Water Treatment Plant Laboratory. The use of other laboratories or testing locations shall not be allowed under any circumstance.

m) No samples will be deemed acceptable until they meet all City requirements.

n) If the newly constructed water main is connected at one end to an in-service section of the City water main, and the chlorination precedes pressure testing, the City will also take samples after satisfactory pressure testing.

o) Two sets of samples shall be taken. 24 hours must elapse between flushing of the main and drawing of the first samples. The second samples will be drawn 24 hours after the first samples were drawn. For each sample, a minimum of 48 hours is required to obtain test results. All samples must pass the bacteriological test.

p) If a new water main fails two consecutive sets of bacteriological tests, the PSAA may require the Contractor to re-swab the water main as described above.

8. Water Main Pressure Testing

a) As much as possible, mains shall be pressure tested between valves. The maximum length of water main to be tested in any one test shall be 1500 feet.

b) The section of main to be tested shall be slowly filled with potable water, the entrained air within the pipe removed or absorbed, and water main pumped up to a pressure of 150 psi (or other pressure if specified).

c) The test period shall start immediately thereafter. The lines shall be maintained under a test pressure of 145-155 psi for a continuous period of three hours by pumping chlorinated (25 ppm) water into the line at frequent intervals.

d) The volume of water so added, referred to as the makeup water, shall be measured and considered to represent the leakage from the line under test during the interval.

e) Visible leaks shall be repaired regardless of test results.

f) The makeup water under the conditions of the test shall not exceed the values shown in Table D of this Article. If one side of a double disc gate valve is under test pressure, that seat shall count as four joints.

Table D
Hydrostatic Testing Allowance per 1,000 ft at 150 psi Avg. Test Pressure

Pipe Diameter (in)	6	8	10	12	16	20	24	30	36
Makeup Water (gal/hr)	0.50	0.66	0.83	0.99	1.32	1.66	1.99	2.48	2.98

g) If the makeup water exceeds the maximum allowable as specified, the joints in the line shall be carefully inspected for leaks and repaired where necessary. Any pipes or fittings found to be leaking shall be removed and replaced with new pieces by the Contractor. After this work has been performed, all tests shall be repeated.

M. Tapping Existing Water Mains

1. New water main construction shall not be connected into the existing system until it has been tested and accepted by the PSAA.

2. The Contractor may not operate City water main valves. For valve operation, contact City of Ann Arbor Public Services Area personnel. The City personnel will direct the operation of all valves by Contractor personnel. It is recommended that the Contractor request that the existing valves, which will need to be operated in order to perform the water main work, are checked in advance of the work to ensure that they operate properly. If the Contractor elects not to request the operation of the valves in advance of any required water main operation, then a request for extension of contract time will not be allowed.

3. All pipe materials and appurtenances in contact with potable water after the water service reconnections shall be disinfected with a strong chlorine solution prior to installation. This includes the pipe section to be tapped, the two halves of the sleeve, gaskets, and the gate valve.

4. Where proposed water mains or fittings connect with existing water mains or fittings, the possibility exists that some of the existing water mains may have been constructed using oversized, cast iron, pipe. Where tie-ins or interconnections are specified and the existing main is found to be oversized, the Contractor shall furnish and install Tyler Dual Sleeve 5-146L, or Smith-Blair 441 Coupling Sleeves. These sleeves are to be present on the jobsite prior to the excavation for the water main connection, or the work will not be allowed to commence.

5. Wet Taps

   a) Prior to the installation of a tapping sleeve, the section of pipe to be tapped shall be cleaned of all foreign material and wire brushed to a smooth surface. The two halves of the sleeve shall be placed around the pipe with the gaskets installed per the manufacturer's instructions. Bolts shall be tightened evenly

from the center toward the ends. The bolts shall be tightened to the manufacturer's specified torque.

b) When performing a wet tap in a prestressed concrete cylinder pipe (PCCP), grout is to be placed under the tapping saddle whether or not the saddle is epoxy coated.

c) Prior to installation of the end gaskets, the sleeve shall be blocked with cement bricks such that the outlet is in proper position. The end gaskets shall be installed with an overlap as specified by the manufacturer.

d) The glands shall be assembled on the pipe. The bolts around the gland shall be tightened evenly, causing the gaskets to uniformly compress.

e) The valve shall be installed on the sleeve following the manufacturer's instructions.

f) Prior to tapping, the assembly shall be tested using the test plug tap in the sleeve with the valve closed, or by placing a tapped plug on the outlet of the valve with the valve open. The assembly shall be pressurized to 150 psi and hold the pressure fifteen minutes. After the pressure test is complete, the pipe shall be tapped.

6. Dry Taps

a) When a connection to an existing water main is to be made in the dry, the existing main to which a connection is to be made shall be isolated by the closing of the existing valves, and the water from the existing main shall then be pumped out or removed by other means so that the connection may be made in the dry.

b) Due to the size and length of pipe being shut down and leaking valves, large amounts of water may need to be removed from the excavation. Where possible, the water shall be run directly into nearby storm sewer inlets via pumps and hose.

c) It is possible that the valves which need to be operated to facilitate a shutdown will not close entirely, thereby allowing water to leak past the valve into the area of the shutdown. The Contractor shall provide the necessary labor, material, and equipment to enable work to be completed regardless of water leaking past the valves. Under no circumstances shall the Contractor be

compensated for “downtime” associated with water main valve or appurtenance failure or its inability to properly operate or close fully. An extension of contract time may be allowed if the Contractor has requested that the water main valves have been exercised in advance of the intended water main shutdown.

d) The Contractor shall have all pipe, fittings and appurtenances required to complete the water main connection prior to the excavation for the connection, or the work will not be allowed to commence.

e) The Contractor shall complete the water main work in a manner which minimizes the disruption of water service to the greatest extent possible.

f) The City must notify all businesses and residents 48 hours in advance of a water main shut- down. To give the City an opportunity to provide such notification, the Contractor shall schedule the water main shutdowns at least 72 hours in advance, and preferably a full 4 or 5 days in advance, of the water main shut-down.

g) No water main shutdown shall take place after 12:00 p.m. (noon), unless written permission has been granted by the PSAA and the Contractor has sufficient lighting equipment to provide a safe and efficient work area for working after dark. No water main will be shut down until the main has been exposed and cleaned and is ready to be cut.

h) There shall be no gap larger than ¼ inch left in the existing water main as a result of the tie-in. If needed, a closure piece ("thrust ring") of such size to meet this requirement shall be installed.

N. Water Main Directional Drilling

1. A minimum of 14 calendar days prior to beginning actual drilling operations, the Contractor shall submit a Directional Drilling Plan for review and acceptance by the PSAA. The Plan shall indicate entrance and exit locations, stationing, depth of cover, and curve data. The plan shall also describe the method to be used for handling drilling fluid and emergency procedures for containing fluids in cases of accidental discharge. Work shall not commence on any directional drilling activities until such time as the Directional Drilling Plan has been accepted by the PSAA. Contract time shall continue during the review period of the Directional Drilling Plan.

2. As the drilling proceeds, the Contractor shall create an accurate as-built record of the alignment and elevation of the pipe with stationing.

3. Prior to beginning drilling operations, the Contractor shall prepare the entrance and exit locations and provide adequate supplies of drilling fluid, dewatering equipment, drill rods, and boring equipment to ensure a continuous operation when drilling begins.

4. The Contractor shall be responsible for any sheeting and shoring, dewatering with well points where necessary and determining types of subsurface materials which may be found, and determining their effect on subsequent construction operations.

5. The minimum depth of cover at any location shall be 5½ feet and the maximum depth of cover at any location shall not exceed 15 feet. Depth of cover is measured from the finished grade to the top of the pipe.

6. All HDPE pipe joints shall be fusion welded butt joints.

7. The method of installation shall consist of drilling or jacking a steerable rod with equipment capable of continuous, accurate monitoring of the drill bit location. Upon reaching the exit point, the Contractor shall attach a cone or wing cutter to the rod which, when pulled back, will obtain the required diameter.

    a) Each joint fusion shall be recorded and logged by an electronic monitoring device (data logger) affixed to the fusion machine. Joint fusion data shall be submitted to the PSAA in accordance with this specification.

8. The diameter of the cone or wing cutter shall not exceed the diameter of the HDPE pipe by more than 1½ times. When the diameter of the cone or wing cutter is more than 2 inches larger than the pipe diameter, flowable fill shall be pumped into the void between the pipe and the drill hole to displace the drilling fluid. The method of placement of the flowable fill shall be approved prior to the issuance of the permit to place pipe.

9. The HDPE pipe shall be connected to the rods per the manufacturer's specifications to be pulled back through the hole.

10. Due to the fact that linear dimensions will vary with temperature change, connections to HDPE pipe shall not be made until it has reached an equilibrium temperature with its surrounding environment.

11. Restrained connections to conventional ductile iron water main, valves, or appurtenances shall be made using a mechanical joint adaptor with a stainless-steel stiffener inserted, unless otherwise shown on the plans.

12. Connections of HDPE pipe to existing water mains shall consist of a full-circle Flex Restraint Collar fused to the HDPE pipe embedded in a 30-inch x 30-inch concrete thrust block poured to undisturbed earth placed a maximum of 5 feet from the connection point.

13. All HDPE pipe shall be properly aligned at all transitions to conventional ductile iron pipe. The detectable trace wire installed in conformance with Article 3 (Water), Section II.F (Trace Wire) of these standards, shall be installed the entire length of the pipeline and shall terminate in the gate wells located at each end of the water main installation, or as directed by the PSAA.

14. After completion of each run, the HDPE pipe shall be hydrostatically tested by the Contractor in the presence of the PSAA after it has reached equilibrium temperature with the surrounding environment and prior to connections with conventional ductile iron pipe. The Contractor may elect to test both the HDPE and the Ductile Iron Pipe simultaneously. However, the Ductile Iron Pipe shall then be required to meet the testing requirements of the HDPE.

15. Pressure testing shall comply with AWWA C906 (Polyethylene (PE) Pressure Pipe and Fittings, 4 in. Through 65 In. (100 mm Through 1,650 mm) for Waterworks). Testing shall be in accordance with Section II.L (Water Main Testing) of this Article. The makeup water allowance for fused HDPE pipe joints is zero. The makeup water allowance for ductile iron pipe is as noted in the Water Main Testing section.

16. Disinfection and bacteriological testing shall be in accordance with AWWA Standards and as noted in the Water Main Testing section.

O. Temporary Water Main Line Stops

1. The existing mains upstream and downstream of the proposed line stop(s) cannot be shut down or taken out of service. To ensure that the entire operation shall be accomplished without interruption of service or flow, the installation shall be accomplished by Contractor personnel skilled and experienced in the procedures specific to line stops of the required size(s).

2. The work shall include, but not be limited to; pavement saw cutting; excavation and disposal of excavated material; the furnishing, installation, and removal of sheeting and/or shoring where needed; the furnishing, placement and compaction of approved bedding and backfill materials; furnishing and placing suitable, clean, gravel to create a stable working surface at the bottom of the excavation; de-watering; pipe cleaning, measuring, and performing all advance work necessary to prepare for the performance of the line stop; nighttime lighting as required; the removal of all materials and equipment associated with the work when no longer needed; and, any other items needed to complete the work as detailed on the plans and as specified herein.

3. The Contractor shall submit to the PSAA 2 sets of drawings, furnished by manufacturers, fully and distinctly illustrated and describing the Line Stop fittings proposed to be furnished. Work shall not commence until such time as the drawings have been reviewed and accepted by the PSAA.

4. The equipment shall consist of a cylindrical plugging head that contains a flat, expandable elastomer sealing element. The plugging head shall be advanced into and retracted from the main by means of a linear actuator. When retracted, the plugging head and carrier are housed in an adapter bolted pressure tight between the tapping valve and the actuator.

5. The sealing element shall be monolithically molded from a suitable polyurethane compound. The element shall be flat in a plane perpendicular to the flow in the main. Minimum thickness of the element shall be 4 inches. The bottom of the element shall be semi-circular to conform to the bore of the main.

6. Drilling equipment shall be in good working condition, equipped with power drive to ensure smooth cutting, and to minimize shock and vibration. Cutting equipment shall be carbide tipped and capable of being replaced without removal from the jobsite.

7. The diameter of the cylindrical plugging head shall be slightly smaller than the bore of the line stop nozzle. The plugging head shall have a suitable circumferential gasket to seal against the shoulder in the line stop nozzle. This gasket shall also seal against the sealing element to prevent bypass flow around the line stop.

8. The semi-cylindrical bottom of the plugging head shall be designed to break and dislodge tuberculation and other deposits in the bore of the main which might interfere with a satisfactory line stop.

9. Installation of proposed line stops in mains will require work in close proximity to existing utilities. This must be taken into consideration when the Contractor determines the required trench safety requirements. All excavation shall conform to MIOSHA Standards. The Contractor is solely responsible for determining all excavation and trench safety requirements.

10. If necessary, The City will reduce the pressure to 100 psi or less for the duration of the installations. The entire operation of installing the line stop shall be accomplished without reduction of water pressure in the main(s) below 100 psi. It shall be the responsibility of the Contractor to verify pressure prior to commencing the installation.

11. Prior to ordering material, Contractor shall excavate at each proposed location and carefully measure the outside diameter of the water main with calipers along at least 4 locations to determine ovality and the critical outside diameter of the water main. The Contractor shall determine main wall thickness, uniformity, and structural integrity by means of ultrasonic testing. Data shall be taken to determine extent of internal deposits, tuberculation, etc.

    a) In addition, the Contractor shall anticipate that exterior main conditions, bells, service connections, or presence of adjoining utilities may require relocation of proposed line stop.

    b) If the PSAA determines that Contractor's data is not adequate, the PSAA may direct Contractor to make one or more pressure taps on main to obtain test pipe coupons for the PSAA's evaluation. The minimum size of the test coupon shall be 5 inches in diameter, drilled through a nominal 6-inch valve. Pressure tapping saddles and other materials used for inspection taps shall conform to the City’s requirements. The Contractor shall anticipate that heavy interior corrosion and/or tuberculation exists within the water main.

    c) If in PSAA's opinion the proposed location is unsatisfactory based on measurements of the existing pipe at the locations of the proposed line stops, the PSAA will direct excavation at another site.

12. Because of possible internal corrosion and deposits in existing water mains, a "bottle-tight" shut down may not occur. A satisfactory shutdown which allows the work to be accomplished (i.e. valve replacement, water main tie-in, etc.) using drainage pumps to dewater excavations, with workers wearing boots and raingear, if necessary, must be obtained. The Contractor will not be allowed to proceed with further work until an acceptable shutdown is achieved. The Contractor shall be aware that this may require the halting of work and re-scheduling of all work operations.

13. Contractor shall power wire brush and grind the exterior of the water main to remove any debris, corrosion deposits, or other surface irregularities that might interfere with proper seating and sealing of each line stop fitting against each main. Any structural defects in the water main, service connections, appurtenances, adjacent utilities, etc., that could interfere with the line stop installation shall be immediately reported to PSAA.

14. All line stop fittings and appurtenances shall be cleaned and disinfected in accordance with current AWWA Standards prior to bolting any of the line stop fittings in place or commencing any pipe cutting.

15. Contractor shall fit upper and lower saddle plate assemblies to main, thoroughly checking for proper fit to main. Under no circumstances shall Contractor attempt to force, reshape, or bend saddle plates by excessive tightening of saddle studs while the line stop fitting is assembled around the main. Any required retrofitting shall be accomplished with the fitting removed from the main. Any damage to fitting, accessories, or main shall be repaired at Contractor's expense to the satisfaction of PSAA.

16. Upper and lower saddle halves shall be drawn together by bolt assemblies and the saddle plates shall be bolted together in the horizontal position.

17. All line stop work shall be performed in accordance with the equipment manufacturer’s approved work procedures and installation guidelines.

18. Final closure of the water main shall be accomplished by insertion of a manufacturer-approved completion plug. The Contractor shall test the completion plug sealing through the use of a bleed off assembly in the machine housing.

19. The Contractor shall remove the temporary valve and the installation of a blind flange shall be completed.

20. The Contractor shall place polyethylene encasement meeting these Standards around the upper and lower saddle halves, the blind flange, and to a point at least 1 foot on either side of the saddle halves. All polyethylene encasement shall be securely taped to the water main such that water entry is minimized to the greatest extent possible.

P. Installation of Storm Sewer

1. All storm sewer pipe and pipe joints shall be the class, type, and size as shown on the Plans or specified and shall conform to Article 4 (Stormwater), Section II (Stormwater Materials) of these Standards. Bedding and backfill shall be as specified elsewhere in this Section.

2. The Contractor shall dig up and expose all utility crossings prior to laying any storm sewer pipe. This will allow the PSAA to adjust the grade of the storm sewer, if possible, to avoid the existing utilities. The PSAA may require that some exploratory excavation be performed out of the current construction stage or phase where the storm sewer work is taking place in order to aid in alignment decisions.

3. Should the storm sewer conflict with abandoned sewers or water mains, the conflicting section of abandoned sewer or water main shall be removed, and the remaining sections shall be bulk headed or capped.

4. All pipes shall be bed on the proper thickness of compacted pipe bedding material unless pipe undercutting is required. Any required pipe undercutting shall be performed as directed by the PSAA.

5. Bell holes shall be provided in the trench bottom at each joint to permit the joints to be made properly.

6. Each pipe shall be inspected for defects prior to being lowered into the trench. Inside of pipe and outside of spigot shall be cleaned of any earth or foreign matter.

7. Proper implements, tools, and facilities satisfactory to the PSAA shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, manhole bases, manhole sections, and other similar items shall be carefully lowered into the trench piece by piece by means of suitable tools or equipment as recommended by the manufacturer, in such a manner as to prevent damage to them and their protective coatings and linings. Under no circumstances shall materials be dropped or dumped into the trench.

8. Storm sewer pipe may not be cut when the cut end will be used in making a pipe joint. Cut ends may only occur in situations such as a manhole or headwall. Cut ends shall be carefully and neatly made with a saw, pipe cutter, or other approved means.

9. Construction of storm sewers shall begin at the outlet end and proceed upstream. Pipe shall be laid on the prepared subgrade with the bell ends facing the direction of laying, unless otherwise directed by the PSAA.

10. The Contractor shall take every precaution to prevent foreign material from entering the pipe while it is being placed in the line. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug. This provision shall apply during the noon hours as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

11. Pipe shall be jointed as specified elsewhere in this Section.

12. No pipe shall be laid until a cut sheet for that pipe has been approved by the PSAA. All pipe shall be laid at the correct line and grade as indicated by the grade stakes and offset line.

    a) The correct line and grade shall be maintained by the use of a laser alignment system. Each pipe, as laid, shall be checked by the Contractor to ensure that this result is obtained. The grade as shown on the Plans is that of the pipe invert for sewers and the work must conform to this profile.

    b) A variation of ¼ inch from this profile grade will be deemed sufficient reason to cause the work to be rejected and re-laid. Storm sewer pipe alignment shall be maintained so as to not vary more than one-half inch from the correct line on pipes up to 36 inches in diameter nor more than 1 inch on pipes 42 inches in diameter and larger. Any pipe found out of line shall be re-laid properly by the Contractor.

13. Mechanical means shall be used for pulling home all rubber-gasketed pipe regardless of trench condition where manual means will not result in pushing and holding the pipe home. When a trench box or liner is used, a cable shall be used to pull the joints home and hold them in position.

14. Where work is performed in wet trenches or trenches with running sand, the Contractor shall provide and use mechanical means for pulling the pipe home in making up the joint and for holding the pipe joints tight until completion of the line. Mechanical means shall consist of a cable placed inside or outside of the pipe with a suitable winch, jack, or come-along for pulling the pipe home and holding the pipe in position.

15. Where not required by these Standards, manual means will be acceptable only if the joints can be pushed home and hold themselves securely in place.

16. Pipe bedding shall be in conformance with Section II.H (Pipe Bedding) of this Article.

17. All storm sewers shall be television inspected by the Contractor in accordance with Section II.X (Cleaning and Televising of Sewer) of this Article.

Q. Curb Drain Installation

1. Connections to the curb drain from sump pump discharge lines shall be made with thermally welded HDPE saddles. Saddle size shall match existing discharge line size and as directed by the Engineer. Transition from HDPE to existing discharge line shall be with stainless steel reinforced Fernco couplings or approved equivalent.

2. All drilling mud and other excavated materials shall be prevented from entering the storm sewer system by using silt capturing devices on all storm structures which may be impacted. Prior to pulling the curb drain into place, relief excavations shall be installed on either side of each driveway, driveway extension or sidewalk intersecting with the proposed run. All drilling mud discharged from the relief excavation shall be immediately removed using vacuum methods.

3. Curb drain runs installed using trenching (open cut) construction methods as shown on the plans shall have a minimum grade of one-half (1/2) inch per ten (10) feet of run. Bellies and non- sloped sections will not be allowed. Suitable back fill for bedding of the pipe will consist of four (4) inches crushed limestone.

4. Following curb drain installation, water shall be placed into the curb drain through the cleanout and televised (by Contractor) to determine if any bellies or non-sloped sections exist. Copies of these videos will be provided to construction management team for review, and each installation must be approved before payment can be made on the corresponding invoice.

5. If bellies or non-sloped sections are found, they shall be corrected and televised again to gain approval. Corrections may include, but are not limited to, exposing the pipe, re-grading, and adding or removing backfill around or below the pipe. An approved tracing/locating wire (12 gauge wire w/ green HDPE coating) is required to be placed during installation. Tracer wire shall be placed intact (no cutting or splicing) from the cleanout, where it is to be coiled around the end of the pipe to the storm water connection, below ground level, where it is to be wrapped around a self-tapping screw into the wall of the structure.

6. Contractor shall install a cleanout for video inspection and cleaning purposes on the upstream end of the 6-inch HDPE curb drain, as directed by the Engineer. This work will include installing a long sweep 90-degree elbow (6-inch, fabricated) with a threaded, removable end cap and sufficient magnets securely fastened (using both glue and screw, or other mechanical connector) to the cap to allow for ease in locating with a magnetic locating device. The top of cleanout cap will be installed at a depth of 4 inches below the existing ground surface. The maximum distance between cleanouts or an existing stormwater structure shall not exceed 300 feet.

7. All HPDE Pipe and Fittings shall be fused as outlined in ASTM D2657, Standard Practice for Heat Fusion Joining Polyolefin Pipe and Fittings.

8. Connections to the curb drain from sump pump discharge lines shall be made with thermally welded saddles. Units shall be a HDPE 6x2 or 6x4 (direction will be provided by the PSAA regarding which size per location) Branch Saddle or Approved Equivalent.

R. Installation of Sanitary Sewers

1. Installation must conform to ASTM D2321 for PVC pipe and ASTM C12 for rigid pipe.

2. New sanitary sewer construction shall be plugged at the outlet and not be connected into the existing system until the new sewer been tested and accepted. Construction of sanitary sewers shall begin at the outlet end and proceed upstream, unless otherwise directed by the PSAA. Pipe shall be laid on the prepared trench bedding with the bell ends facing the direction of laying.

3. The Contractor shall take every precaution to prevent foreign material from entering the pipe while it is being placed in the line. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug. This provision shall apply during the break period as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

4. All pipe shall be laid at the correct line and grade as indicated by the grade stakes and offset line. The correct line and grade shall be maintained using an internal pipe laser. The staking shall be provided by the PSAA. No pipe shall be laid until a cut sheet for that pipe has been approved by the PSAA.

5. The grade as shown on the Plans is that of the pipe invert for sewers; the work must conform to this profile. A variation of ¼ inch from this profile grade will be deemed sufficient reason to cause the work to be rejected and re-laid. Sanitary sewer pipe alignment shall be maintained so as to not vary more than ½ inch from the correct line on pipes up to 36 inches in diameter, nor more than 1 inch on pipes 42 inches in diameter and larger. Any pipe found out of line or grade shall be re-laid properly by the Contractor.

6. Due to conditions in the field, changes to the proposed vertical and horizontal alignment of the proposed sanitary sewer may become necessary. The Contractor shall, when directed by the PSAA, excavate up to 60 feet in advance of the pipe laying operation to expose existing underground facilities thereby enabling the PSAA to make changes to alignment decisions. The Contractor is required to realign (re-lay) the sanitary sewer up to 2 feet vertically and/or horizontally as directed by the PSAA. The excavation in advance of the pipe laying is intended to help eliminate the need for re-laying pipe.

7. Making Joints:

    a) Mechanical means shall be used for pulling home all rubber-gasket pipe regardless of trench condition where manual means will not result in pushing and holding the pipe home. When a trench box or liner is used, a cable shall be used to pull the joints home and hold them in position.

b) Where work is performed in wet trenches or trenches with running sand, the Contractor shall provide and use mechanical means for pulling the pipe home in making up the joint and for holding the pipe joints tight until completion of the line. Mechanical means shall consist of a cable placed inside or outside of the pipe with a suitable winch, jack, or come along for pulling the pipe home and holding the pipe in position.

c) Where not required by these Standards, manual means will be acceptable only if the joints can be pushed home and held.

8. The pipe shall be secured in place with approved bedding material tamped under it except at the bells. Pipe and fittings which do not allow proper and uniform space for joints shall be removed and replaced with pipe and fittings of correct dimensions to insure such uniform space. Precautions shall be taken to prevent dirt from entering the joint space.

9. Sanitary sewer pipe may not be cut when the cut end will be used in making a pipe joint. Cut ends may only occur in situations such as a manhole. Cut ends shall be carefully and neatly made with a saw, pipe cutter, or other approved means.

10. Wyes and Tees

    a) One 6-inch wye shall be provided for each lot or parcel that is served by the sewer unless otherwise indicated on the Plans or determined by the PSAA. In all cases, it shall be the responsibility of Contractor to see that the wyes are so placed.

    b) Wyes to developed lots or parcels shall be placed at the location nearest the existing sanitary service lead.

    c) Wye openings shall be closed with a 6-inch stopper, as recommended by the manufacturer, to make a watertight closure.

11. Risers and Building Leads

    a) Risers shall be installed where the sewer is more than 12 feet below the established grade or future grade and carried to between 9 and 10 feet of the established grade or future grade, unless otherwise determined by the PSAA.

    b) Riser openings shall be closed with a stopper, as recommended by the manufacturer, to make a watertight closure.

c) Building leads shall conform to Article 2 (Sanitary), Section I.L (Sanitary Service Leads) and depth requirements per Section I.G (Depth and Cover), of these Standards.

d) Each building lead shall be closed with a stopper, as recommended by the manufacturer, to make a watertight closure.

e) Unless otherwise determined by the PSAA, prior to the backfilling of a wye, riser, or building lead, a 2-inch x 2-inch (minimum cross section) wooden marker shall be placed at a point immediately in front of the service connection to 1 foot below the finish ground surface. Do not rest the marker on any portion of the service connection or stopper.

S. Manholes, Drainage Structures, and Gate Wells

1. Sanitary manholes shall conform to Article 2 (Sanitary), Section II.B. (Manholes) and Article 12 (Standard Details), SD-SN-1 (Sanitary Manhole) of these Standards.

2. Stormwater manholes, catch basins, and inlets shall conform to Article 4 (Stormwater), Section II.B. (Manholes and Drainage Structures) and to applicable stormwater Standard Details of these Standards.

3. Gate wells shall conform to Article 12 (Standard Details), SD-W-3 (Precast Gate Well (Watermains 16 inch and Smaller)) of these Standards, or SD-W-4 (Precast Gate Well (Butterfly Valves)) as indicated on Plans.

4. Concrete block construction shall only be allowed for storm sewer manholes and inlets where specifically approved by the PSAA and shall be built of the size and dimensions shown on the Plans. The block shall be clean, laid in a full bed of mortar, and thoroughly bonded by completely filling the vertical end grooves with mortar so as to interlock with the adjacent block.

   a) The mortar beds and joints shall not exceed ¾ inch thickness. The vertical joints are to be completely filled with the joints on the inside face rubbed full of mortar and all joints struck smooth as the manhole, inlet or structure is built up.

b) The entire inside and outside faces of the structure shall receive a ½ inch thick mortar coat and struck smooth. All masonry materials, sand, and water shall be heated to over 50° F during freezing weather, and the completed work shall be covered and protected from damage by freezing. Backfilling shall not occur until the exterior mortar coating has cured.

5. All structures shall be designed to accommodate HS-20 Live Load requirements as determined by a Professional Engineer licensed by the State of Michigan, regardless of where they are to be installed.

6. Manholes, gate wells and drainage structures shall be constructed within 2-½ inches of plumb.

7. Sewer pipes shall extend into structures a minimum of ½ inch and a maximum of 3 inches.

8. Flow channels for sanitary sewer shall be full depth pipe diameter.

9. Flow channels for sewer structures shall be finished in accordance with the Standard Details. All flow channels shall be screeded and floated to a smooth, uniform surface and troweled to a hard surface finish.

10. Stubs for future sewer connections shall be furnished and placed by the Contractor as shown on the Plans or as directed by the PSAA. Connections shall be properly supported and braced when not resting on original ground so that any settlement will not disturb the connection. Stubs shall consist of 1 length of sewer pipe, of the size indicated on the Plans, with a watertight plug.

11. As soon as practicable after a precast structure has been set, forms and debris have been removed from the structure, and the structure has been inspected and approved, the excavated area around the structure shall be backfilled up to the specified grade with MDOT Granular Material, Class II. No boulders, rocks, stones, masonry, lumber, or debris shall be allowed within the backfill. Backfill shall be compacted to 95% of its maximum unit weight.

12. An exterior drop connection, in accordance with the Article 12 (Standard Details), SD-SN-2 (Drop Manhole Connection) of these Standards, shall be provided where a branch sanitary sewer is brought into a manhole more than 24 inches above the invert elevation in the manhole.

13. Connections to existing manholes shall be made in accordance with the Plans. If tapping an existing manhole, an opening shall be cored into the receiving structure of the proper size to allow the installation of an approved boot.

    a) The Contractor shall take care not to cause undue damage to the existing manhole while coring the new opening. Repair or replacement of existing manhole(s) damaged by Contractor operations during tapping shall be at the Contractor's expense.

    b) Any taps into a lined manhole shall be restored to ensure warranty compliance at the Contractor's expense.

T. Reconstruct Structures

1. Removing and disposing of portions of existing brick or block masonry drainage structures, and rebuilding drainage structures of concrete block masonry shall be done in conformance with MDOT Specifications, Section 403 (Drainage Structures) except as specified herein. Water main gate wells and gate box covers shall be considered to be included in this item of work.

2. Structures to be reconstructed shall be as called for on the Plans or as determined by the PSAA. Reconstruction of structures shall apply where the elevation of the casting must be raised in excess of 12 inches, lowered in excess of 6 inches, or to rebuild portions of the existing structure which are deteriorated.

3. For structures in existing pavement, the pavement shall be saw cut a minimum of 6 feet by 6 feet unless otherwise shown on the plans. Saw cutting, removal and replacement of concrete and bituminous pavement, and aggregate base course, shall be incidental to the reconstructing the structure unless otherwise noted in the Contract Documents.

4. The existing frame and cover shall be carefully removed and stored and shall be reinstalled on the same structure unless a new frame and cover are called for on the Plans.

5. The existing ring and chimney/corbel entrance sections shall be removed along with any additional brick courses or precast concrete sections necessary to achieve the amount of reconstruction called for on the Plans or as determined by the PSAA.

6. The necessary brick work and precast concrete sections shall be installed to meet the design grade.

7. Manhole steps, where required, shall be furnished and shall be installed, as necessary, so that maximum spacing is 16 inches.

8. Brick or concrete adjustment rings shall be set in mortar or installed as shown on the Plans and as determined by the PSAA.

9. The outside surface of any new brick or block structures shall receive a masonry plaster coat, a minimum of ½ inch thick. The structure shall be properly backfilled with Class II granular material, compacted in place, and meeting the approval of the PSAA.

10. The flow in the entire system shall be maintained, at the Contractor's expense, while performing the Work. The manhole structure shall be cleaned, and all unsuitable material shall be disposed of at the Contractor's expense.

U. Structure Adjustment

1. Manhole covers, water valve boxes and all other public utility underground access or control point covers shall be adjusted to conform to the finished surface section and elevation, including excavation, backfill, compaction and patching.

2. After the removal of the casting, the structure's opening shall be covered by a steel plate. The plate shall be properly placed in order to avoid any slippage due to traffic or construction machinery movements. The opening shall be covered to prevent construction debris from entering the structure. The plate shall be covered with MDOT 21AA gravel to existing surface elevation or as directed by PSAA. Steel plates shall be sufficiently strong and thick enough to carry the traffic and construction equipment without any deflection. Steel plates shall also be pegged as shown on the Plans and Details in order to prevent their shifting and/or moving. Steel plates are the property of the Contractor and shall be removed by the Contractor upon completion of the work.

3. The PSAA shall be given the opportunity by the Contractor to witness all survey monuments prior to their being disturbed and/or adjusted.

4. For concrete pavement, prior to placement all structures shall be raised to grade . The structures shall be adjusted prior to paving.

5. Either of the following methods shall be used for for bituminous pavement, per Article 12 (Standard Details), SD-GU-5 (Structure Cover Adjust):

a) All covers shall be adjusted to grade after the initial leveling, base course(s), and/or patching course has been placed, but before the placement of the wearing course. Prior to the leveling or base course(s) being placed, the structures shall have their covers and castings removed and the structures covered by a steel plate. This plate will be removed, and the structure adjusted after the completion of all base and leveling courses.

b) All covers shall be adjusted to grade (by coring, and not saw cutting) after the placement of the wearing course. Prior to the bituminous pavement being placed, the structures shall have their covers and castings removed and the structures covered by a steel plate.

6. The frame and cover shall be set in MDOT P-NC concrete per Article 12 (Standard Details), SD-GU-5A (Structure Cover Adjust), SD-GU-5B (Structure Cover Adjust), and SD-GU-6 (Valve and Monument Box Adjustment) of these Standards and checked by using a 10-foot straight edge parallel with the pavement centerline.

7. All structures are to be adjusted to a level that results in their surface being flush with the finished grade. Failure to meet these conditions will result in the readjustment of the structure and finish patching of the area as directed by the PSAA at the Contractor's expense.

8. Frames shall be pointed with mortar on the interior of the structure to a smooth brushed finish.

9. All non-public utility structures (Electric, Gas, Telephone, Cable TV, etc.) shall be adjusted by the Utility Company or their contractor. It is the sole responsibility of the Contractor to give adequate notice to the Utility Company and to arrange for and coordinate any adjustment of structures or valves by the Utility Company.

10. The Contractor shall replace frames and covers as directed by the PSAA.

11. All salvaged frames and covers (of any type) shall be returned by the Contractor to the City's Public Works yard within two days from the date of their removal.

V. Drainage Structure Covers

1. Drainage structure covers shall conform to Article 12 (Standard Details), SD-GU-1 (Standard Casting Schedule) of these Standards.

2. All cast iron covers, frames, adjusting rings, and anchors shall be furnished by the Contractor and installed to the elevation indicated on the Plans.

3. The covers shall be set flush with pavement or ground surfaces. In gravel streets, covers shall be set 6 to 8 inches below finished gravel surface.

W. Testing Sanitary Sewer

1. All sanitary sewers, including leads, less than 36-inch diameter shall be air tested by the Contractor. All sanitary sewers 36-inch diameter or greater shall be infiltration or exfiltration tested by the Contractor. Infiltration testing is appropriate where the groundwater is two feet above the top of the pipe. Below that level, exfiltration testing should be conducted .

2. All sewers, except 4-inch and 6-inch leads, shall be television inspected by the Contractor. All PVC sanitary sewer mains shall be deflection tested.

3. All sewers must successfully complete each test, in order (deflection testing, air or infiltration/exfiltration testing, television inspection), before the next test is performed.

4. The Contractor shall furnish all labor, equipment and materials necessary for testing. Only after all tests have been successfully completed and acknowledged by the PSAA in writing, may the sewer be placed in service.

5. Air Test:

    a) The air test can be dangerous. Lack of understanding, carelessness, or an improperly prepared line must be avoided. It is extremely important that the plugs be installed in such a way as to prevent blowouts. Sudden expulsion of a poorly installed or partially deflated plug can cause serious injury or damage. As a safety precaution, pressurizing equipment must include a relief valve set at not more than 10 psig. No one will be allowed in the manholes during testing.

    b) In areas where ground water is known to exist and the sewer is to be air tested, the Contractor shall install a ½-inch diameter by approximately 10-inch long pipe nipple, through the manhole wall above one of the sewer lines entering the manhole. The pipe nipple shall be capped on the inside of the manhole at the time the sewer line is installed. Backfill around the outside of the pipe nipple shall be large sized, open graded course aggregate.

c) Immediately prior to the performance of the air test, the ground water level shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground to clear it, and then connecting a clear plastic tube to the pipe nipple. The tube shall be held vertically and a measurement of the height in feet of water above pipe centerline shall be taken after the water stops rising in this plastic tube. The height in feet is divided by 2.31 to establish the average ground water pressure (in psig) over the pipe.

d) The normal sequence and time requirements for air testing are:

(1) After a manhole-to-manhole section of line has been backfilled and cleaned, it shall be plugged at each manhole with pneumatic plugs. The design of the pneumatic plugs shall be such that they will hold against the line test pressure without requiring external blocking or bracing. There shall be 3 hose connections to the pneumatic plug. One hose shall be used only for inflation of the pneumatic plug. The second hose shall be used for continuously reading the air pressure rise in the sealed line. The third hose shall be used only for introducing low pressure air into the sealed line.

(2) Low pressure air shall be introduced into the sealed line until the internal air pressure reaches 4.0 psig greater than the average ground water pressure over the pipe. At least 2 minutes shall be allowed for the air pressure to stabilize. After the stabilization period, the pressurization hose shall be disconnected to prevent air from entering or escaping from the line.

(3) There shall be a pressure gauge for reading the internal pressure of the line being tested. The gauge shall be capable of showing pressure as low as 0 psig up to no greater than 20 psig. In the 0-10 psig range, the gauge shall be both calibrated and accurate to one-tenth of one pound and the gauge dial shall cover at least one-half of the complete dial range. This gauge shall have a tee fitting to allow simultaneous pressure reading by a City gauge.

(4) The time requirement for the pressure to decrease from 3.5 to 2.5 psig (greater than the average ground water pressure over the pipe) shall not be less than the time given in Table E of this Article:

Table E Pressure Holding Table			
Pipe Size (inches)	**VCP & RCP Sewers**	**PVC Sewers**	
	Minimum Holding Time (seconds/100ft. pipe)	**Holding Time** (Seconds)	**Minimum Holding Time** (min:sec)
4	18	0.380 x Length	3:46
6	42	0.854 x L	5:40
8	72	1.520 x L	7:34
10	90	2.374 x L	9:26
12	108	3.418 x L	11:20
15	126	5.342 x L	14:10
18	144	7.692 x L	17:00
21	180	10.470 x L	19:50
24	216	12.674 x L	22:40
30	288	21.366 x L	28:20
36	360	30.768 x L	34:00
Comply with ASTM F1417 for PVC, ASTSM C828 for VCP, and ASTM C924 for RCP			

6. Infiltration Test

   a) The Contractor shall place temporary weirs for testing purposes in such manholes as necessary to measure the amount of infiltration. Test sections shall be no longer than 1,200 feet.

   b) The allowable amount of infiltration shall not be more than 100 gallons per inch of pipe diameter per mile of sewer per 24 hours, including manholes. The Contractor shall repair all visible leaks regardless of the results of the infiltration test.

   c) If the allowable limit of infiltration is exceeded on any test section, the Contractor shall reconstruct or repair the defective portion of the sewer, and re-test.

7. Exfiltration Test

    a) The standpipe method will be used from manhole to manhole for the length of pipe to be tested. A hydrostatic head of 10 feet above the sewer's average centerline elevation will be required, with adjustments for external submergence due to water in the trench. The PSAA will establish time durations and procedures for each test. The maximum allowable exfiltration rate will be 200 gallons per inch of pipe diameter per mile of sewer per 24 hours including manholes. Upon completion of this test on a sanitary sewer, the Contractor shall pump all water out of the downstream manhole and discharge it to a storm sewer.

8. Deflection Testing/Mandrel Testing

    a) All PVC sanitary sewer pipe shall be tested for deflection, but no sooner than 30 days following the backfilling of the pipe.

    b) Maximum allowable deflection (reduction in vertical inside diameter) shall be 5 percent.

    c) Locations with excessive deflection shall be excavated and repaired by re-bedding and/or replacement of the pipe.

    d) Device options for testing include a deflectometer, or a properly sized "go, no go" mandrel. Mandrel shall have a minimum of 9 legs. Mandrel calibration shall be verified by PSAA on-site before use.

X. Cleaning and Televising Sewer

1. The Contractor shall provide a detailed sewer cleaning and televising plan to the PSAA for review and acceptance prior to beginning the work. This plan must include descriptions outlining all provisions and precautions to be taken by the Contractor regarding the handling of existing flow.

2. The cleaning plan and televising must be specific, including such items as schedules, locations, type of equipment, details on water source, plans for disposal, and all other incidental items necessary and/or required to ensure proper protection of the facilities and surroundings, including protection of the access locations from damage, and compliance with the requirements and permit conditions specified in Contract Documents.

3. No work shall begin until all provisions and requirements have been reviewed and accepted by the PSAA.

4. The PSAA's comments shall be incorporated into the resubmitted plans, calculations, and descriptions. The PSAA's acceptance of the plan is required before beginning the work. Resubmittals shall be reviewed and returned to the Contractor within 14 calendar days. Required revisions will not be a basis of payment for additional compensation, extra work, or an extension of contract time. The Contractor shall include time for this entire review process in their schedule.

5. Sewer cleaning and televising plan and submittals shall include at a minimum:

    a) Copy of PACP/MACP Certifications for sewer televising personnel and manhole inspection personnel;

    b) Proof of PACP/MACP certified software;

    c) Safety program for confined space entry;

    d) Information on equipment, trucks, tanks, etc., including, but not limited to, dimensions, required turning radius, fuel type, any special requirements, etc.;

    e) Staging areas for equipment, trucks, tankers, etc.;

    f) Schedule for cleaning and televising of pipe lines, manholes, and chambers;

    g) Planned hours of operation, including equipment idling, etc.;

    h) Number, size, material, and location of hose/piping;

    i) Information on cleaning equipment;

    j) Siphon dewatering plan;

    k) Sludge and debris dewatering, transportation, and disposal procedure and location;

    l) Environment protection including equipment and pipe containment, leak detection, and/or remediation plan; and,

    m) Method of noise control for all equipment.

6. The Contractor shall carry out their operations in strict accordance with all MIOSHA and manufacturer's safety requirements.

7. The Contractor shall be solely responsible for safety of all those involved with the work during the performance of all work. The Contractor shall not enter into any sewer segment where hazardous conditions may exist until such time as the source of those conditions is identified and eliminated by the Contractor. The Contractor shall perform all work in accordance with the latest OSHA confined space entry regulations. The Contractor shall coordinate their work with local fire, police, and emergency rescue unit.

8. The Contractor shall be responsible for any damage to public or private property resulting from their televising and cleaning activities and shall repair or otherwise make whole such damage at no cost to City and owner of the property.

9. The Contractor shall provide for the transfer of main line flow around the section or sections of pipe that are to be cleaned and televised, as required to complete cleaning, televising, and inspection work. The diverting and lateral bypass pumping work shall be performed in accordance with this Article and as directed by the PSAA.

10. If the Contractor chooses to only divert part of the flow during their sewer cleaning operations, the Contractor must indicate that in their submittal, including which plugs would be installed. Contractor to note that all plugs, level sensors, and lateral bypass pumping system shall be in operation for the new sewer televising, manhole inspections, and chamber inspections.

11. Sewer Cleaning

    a) Each sewer section shall be cleaned to a degree sufficient to allow video inspection The Contractor shall take precautions to protect the sewer lines from damage. The Contractor shall assume the sewer will require heavy cleaning with unlimited passes to achieve a clean sewer and that rodding and root cutting shall be required and the costs are included in the Work.

    b) For CIPP pipe, the Contractor must adhere to the requirements of ASTM F1216 (Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube), or ASTM F1606 (Standard Practice for Rehabilitation of Existing Sewers and Conduits with Deformed Polyethylene (PE) Liner), for the following types of cleaning: hydraulic cleaning, high velocity hydro-cleaning, and mechanical cleaning.

c) Dirt, grease, rocks, sand, roots, and other solid or semisolid materials and obstructions shall be removed from the sewer line and manholes. Cleaning shall be of the entire reach between manholes and/or chambers.

d) It shall be the responsibility of the Contractor to clear the line of obstructions such as solids, dropped joints, debris from collapsed pipe, sediment deposits, mineral deposits, stalactites, and all major blockages that would prevent sewer rehabilitation work from being performed.

e) The sewers shall be cleaned by using a high-pressure water cleaning machine with minimum capability of 5,000 pounds per square inch (psi) at 80 gallons per minute (gpm).

f) A high-pressure hose with a jet nozzle shall be introduced into the sewer so that a spray shall scour and clean the sewer line without applying internal pressure and damaging the pipe.

g) This will require an unlimited number of passes of the jet nozzle, or other cleaning measures, to remove all debris. The hose shall be self- propelled by a minimum water pressure of 1,000 psi. Cleaning pressures to 5,000 psi may be required to remove heavy tuberculation and adhered debris from the pipe interior.

h) The jet nozzle hose, upon withdrawal, will scour the pipe (invert, walls, and crown), flushing all materials into the downstream manhole for removal.

i) For major blockages where cleaning cannot be completed, the Contractor shall notify the PSAA for review and approval before proceeding.

j) Material removal shall be performed at the manholes identified for access for the cleaning operation. At no time during cleaning shall material be allowed to enter or flow in the sewer past the downstream access manhole. Passing material from manhole section to manhole section shall not be permitted. All debris and waste material shall be completely removed from the sanitary sewer system and shall be disposed of by the Contractor in accordance with federal, state and local requirements.

k) Mechanical root cutting shall be performed with powered equipment. The Contractor shall furnish suitable power machinery which shall be used to remove tree roots and deposits remaining after jet cleaning that prevent passage of television inspection equipment or prevent the lining of the sewer.

l) The Contractor shall provide high quality digital video in a digital format approved by the PSAA that verifies that the sewer is clean and free of sediment and debris to the satisfaction of the PSAA. If any sewer is not satisfactorily cleaned, it shall be promptly cleaned and reinspected by closed circuit television camera and video provided to the PSAA for review and approval.

m) If the sewer has material and debris that prevents the proper installation of the CIPP, prohibits video inspection, or is not cleaned to the satisfaction of the PSAA, the sewer shall be re cleaned and re-televised at the Contractor's sole expense.

n) The sewer shall not be lined until such time as the cleaning operations have been approved in writing by the PSAA. Field Inspection personnel shall not be allowed to authorize the Contractor to begin installation of the CIPP sewer liner.

o) Extensions of contract time will not be granted for delays associated with recleaning and re-televising the sewer.

p) Fire hydrants used, when permitted by the PSAA as additional source of water during the cleaning operation shall be provided with PSAA-approved device to meter water usage and prevent backflow into the potable water system. The backflow and metering equipment shall be furnished and installed by Public Works.

12. Manhole Cleaning

a) The manhole structures shall be cleaned below their invert elevations with a power vacuum, or other PSAA approved method, to remove all sediment to allow for the inspection of the bottom of the structures.

b) The Contractor shall assume the manholes and chambers require heavy cleaning with multiple passes to achieve a clean manhole. Manhole and chamber cleaning shall be incidental to the sewer cleaning and no additional payment shall be provided.

c) If the preliminary inspection of walls determines that any additional work in the manhole will compromise the integrity of the walls or structure, all cleaning of the manhole or chamber shall immediately stop. The PSAA will instruct the Contractor on how to proceed.

d) If the preliminary inspection determines cleaning of the walls may proceed, the structure cleaning shall remove all sediment, sand, grease, debris and unsound or loose material, old coatings, and other deleterious materials from the floor, walls, and roof. Cleaning equipment may include high pressure water (3,500 psi or greater), abrasive blasting, grinding, or acid etching. Use of detergents and/or hot water may be required to remove fats, oils, and grease. The removal of the spalling on the walls shall be performed as directed by the PSAA during the inspection. The Contractor shall take care as not to damage the steel reinforcement in the walls.

e) The Contractor shall identify any surface material that cannot be removed using conventional equipment or methods listed above and submit to the PSAA for review.

f) The Contractor is to note the chambers may also contain weirs and internal walls that need to be cleaned as well.

13. Television Inspection of Sewer

a) All sewer television inspections shall conform to NASSCO CCTV inspection performance specifications published at the time of Contract award unless otherwise specified herein.

b) The Contractor shall furnish all labor, equipment and materials necessary for the television inspection. The PSAA shall be given 24-hour notice so that an Inspector may witness the television inspection. All sewer lines are to be thoroughly cleaned prior to television inspection by jetting of the lines or other approved methods.

c) Television inspection shall consist of wetting the invert of the section by pouring clean water in the upstream manhole until it appears in the downstream manhole, and then, after the water has stopped flowing, passing a television camera through the section of sewer. The television camera shall be passed through the section of pipe from the downstream to upstream end. Any runs of sewer not televised in this manner shall be re-televised at the Contractor's expense.

d) Lighting for the camera shall be adequate to allow a clear picture of the entire periphery of the sewer and shall be varied as required to be effective for all pipe diameters inspected. Remote control of lighting brilliance, camera focus, and camera movement shall be from a control panel inside the mobile recording studio. Cables and equipment used to propel the camera shall not obstruct the camera view or interfere with the documentation of the sewer conditions.

e) The camera shall be moved through the sewer line at a uniform rate, maximum 30 feet per minute. Whenever possible, the camera shall move in an upstream direction. The camera shall be stopped for no less than 10 seconds at the manhole entrances, each service lateral, exit manholes, and at all points where the sewer is damaged or deficient. The camera shall pan and tilt to provide full view of each service lateral, and at all points where the sewer is damaged or deficient.

f) If the camera fails to pass through a pipe section, the Contractor shall reset the equipment and attempt to perform the inspection coming back from the next upstream, identified for access, manhole. If the inspection cannot be completed from the next manhole, the inspection shall be considered complete and the PSAA will provide written instructions to the Contractor describing how to proceed with the work in that reach of sewer.

g) The camera shall be connected to a monitor and a digital video recorder capable of generating high quality digital format video on a video format approved by the PSAA. The video inspection record shall indicate the date, the section tested, and the actual distance from the beginning manhole to the ending manhole and shall note any and all visible defects, tees and wyes and their direction, and any other features; with a distance measurement to the nearest 1⁄10 foot. Defect coding shall be the most recent NASSCO version or that published at the time of contract award as approved by the PSAA.

h) The Contractor shall supply the PSAA with two electronic copies of the entire and final televised program conforming to NASSCO guidelines, including PACP database, MACP database, video pipe recordings, defect photos, and reports in a format approved by the PSAA. The submittal format may be physical (e.g., external hard drive, flash drive) or digital (e.g., a shared folder accessible by the PSAA). Digitals submittals shall remain accessible at least three years after the end of the Contract. The data shall be provided within 15 working days of

completion of field work. The information for individual databases, sewer segments, and recordings shall not be split into several drives. The flash drives or portable hard drives and information within it shall become the property of the City.

i) The Contractor shall provide to the City inspection reports listing the location in relation to adjacent manholes of: each infiltration point; service leads; unusual conditions; roots; sewer connections; collapsed sections; presence of scale and corrosion; cracked pipe; wide joints; and other discernible features.

j) The reports shall indicate size and type of pipe material, length of line from manhole, and direction of sewage flow, if present. The reports shall also indicate the time and date of recording. Each report shall be named with the pipe inspections from starting manhole to terminus manhole for each stretch of sewer. All reports shall be in accordance with NASSCO, PACP, and MACP standards, outlined above.

k) The Contractor shall provide color photographs of sewer laterals and all problem areas.

l) The television inspection will be deemed satisfactory if no visible defects, including, but not limited to, dips or low spots, high spots, deviations in horizontal or vertical alignment, offset joints, leaks, cracks, standing water greater than ¼ inch, or debris are present. Only after all tests have been successfully completed and acknowledged by the PSAA in writing, may the sewer be placed into service.

Y. Sewer Flow Control

1. The work covered by this Section shall consist of furnishing all labor, supervision, tools, equipment, appliances, materials, incidental items, and the installation, operation, and maintenance needed to perform all operations in connection with the diversion of flow and bypass pumping of sanitary sewage for cleaning and inspecting of sewers and manholes, and sewer repairs, and sewer rehabilitation. The purpose is to provide uninterrupted sewerage service and to prevent sewage overflows.

2. The design, installation, and operation of the temporary sewer flow control system shall be the Contractor's sole responsibility.

3. When working inside manholes or sewer, the Contractor shall exercise caution and comply with OSHA and City requirements for working in confined spaces.

4. The Contractor shall manage, plan, and execute their operations such that there will be no backups, leaks, or unauthorized discharges of sewerage. The Contractor shall be completely responsible for the proper clean up and any environmental remediation as may be required by the City or the Michigan Department of Environment, Great Lakes, and Energy (EGLE) for any backup, leak, spill, or sanitary sewerage overflow.

5. The Contractor shall provide a detailed Sewer Flow Control Plan to the PSAA for review and acceptance prior to the start of any flow control work. This plan must include descriptions outlining all provisions and precautions to be taken by the Contractor regarding the handling of existing flow.

6. The Sewer Flow Control Plan must be specific, including such items as schedules, locations, elevations, capacities of the equipment, materials, and all other incidental items necessary and/or required to ensure proper protection of the facilities, including protection of existing structures and pipes, and compliance with the requirements and conditions specified in these Contract Documents.

7. No construction shall begin until all provisions and requirements have been reviewed and accepted by the PSAA.

8. For each submittal and resubmittal, the Contractor shall allow at least 14 calendar days from the date of the submittal to receive the PSAA's acceptance or request for revisions. The PSAA's comments shall be incorporated into the resubmitted plans, calculations, and descriptions.

9. Resubmittals shall be reviewed and returned to the Contractor within 14 calendar days. Required revisions will not be a basis of payment for additional compensation, extra work, or an extension of contract time. The Contractor shall include time for this entire review process in their schedule.

10. Sewer Flow Control Plan submittal shall include at a minimum:

    a) Overall flow control plan and sequence of construction;

    b) Flow control schedule including times when the flow control system shall be temporarily shut down and flow allowed to return to normal operations;

c) Overall plan for removal of flow control system during wet weather events and/or emergency situations;

d) Plan for providing redundancy for all aspects of the system especially the plugs;

e) Safety Program for confined space entry and procedure for entering manholes and installing plugs under live flow conditions;

f) Emergency clean-up plan should a spill occur or backups in the system occur. The plan should include contact names and 24-hour phone numbers;

g) Procedure for continuous (24 hour) monitoring of system, including verifying that plugs are sealed, and lateral bypass pumping system is operating. The plan is to include type and location of level sensors, method of installation, set elevations of sensors, and continuous monitoring system;

h) Maintenance of traffic plan for plug installation and removal in public roadways;

i) Sewer plug types, method of installation and removal, anchors and restraints, and hydraulic head limits;

j) Lateral bypass pump sizes, capacities, power requirements, and number of each size to be provided at each manhole including redundancy;

k) Calculations giving flow capacity provided by each pump given the system's Total Dynamic Head (TDH), including the calculations that are used to derive the system TDH. This data should also include the calculations determining what the Net Positive Suction Head available is in comparison to the Net Positive Suction Head required by each pump.

l) Pump curves;

m) Number, size, material, and location of lateral bypass pumping suction and discharge piping, procedure for protecting lines, and location of bypass pumping discharge manhole;

n) Lateral bypass pumping system flushing and drainage plan;

o) Buried bypass pipe locations and details;

p) Environment protection including pump containment and leak detection;

q) Method of protecting discharge manholes or structures from erosion and damage;

r) Method of noise control for each pump; and,

s) Design plans for access to bypass pumping locations indicated on the Drawings.

11. Contractor shall provide materials and equipment suitable for, and known to be reliable to meet, the flow diversion requirements as shown on the Drawings and as needed for the Contractor's operations. Equipment used for bypass pumping shall be sufficient to handle anticipated average and peak flows from each sewer. The Contractor shall maintain sanitary sewer flows within their bypass pumping system, including all wet weather flows. Specific equipment requirements include:

    a) Pipe plugs shall be a temporary plug that allows for quick removal in case of emergency or wet weather situation and reinstallation after wet weather event has passed. Plugs shall be capable of withstanding minimum static head pressure of 15 feet. Plugs shall include form or bracing, anchoring, or restraint to keep plugs properly installed. Plugs should be of the type capable of being installed under live flow conditions and in depths as shown on the Drawings. Plugs should be able to be installed in either the incoming or outgoing pipe in a manhole and allow for quick removal under surcharged conditions.

    b) Pressure gauges shall be installed with the plugs to continuously monitor the plugs and adjust the air pressure as needed to maintain full blockage of flow.

    c) Ultrasonic level sensors shall be installed, at a minimum, at the locations as necessary to monitor the head conditions in the sewer. The Contractor shall be responsible for the installation and maintenance of the sensors. The level sensors shall provide continuous level readings that the Contractor shall be able to review remotely to monitor the level in the system during flow diversion. The level sensors shall provide notifications and alarms to allow the Contractor time to remove the plugs should an emergency or a wet weather event occur.

    d) The pumps must be capable of passing a minimum of a 3-inch solid. All pumps must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows.

    e) The Contractor shall take into account seasonal variations and include a safety factor above the indicated peak flow values in sizing pumping equipment.

f) For sanitary sewerage, bypass piping shall be PVC Schedule 80, or equivalent, with solvent welded joints, or HDPE with butt fused joints. The Contractor shall perform hydrostatic testing of bypass pump discharge pipes in accordance with ASTM F2164 (Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure), latest addition, for HDPE or ASTM F2261 (Standard Test Method for Pressure Rating Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 and 80 Socket-Type), for PVC pipe, prior to operating bypass pumping system to ensure structural integrity of pipeline. Any defects or leaks found during testing shall be repaired and the pipeline shall be re tested until results are satisfactory in accordance with the ASTM standard, and as acceptable to the PSAA.

12. The Contractor shall have redundant flow diversion equipment including, but not limited to, plugs and level sensors, available for immediate use at the job site at all times in the event of a failure.

13. Any damage to the Contractor's equipment, sewer system, or delays to the Contractor's operations due to equipment or plug failure/leakage shall be the Contractor's sole responsibility and no additional payment shall be made for these occurrences. The Contractor shall take all necessary precautions to verify that the plugs and flow diversion plan is operational prior to performing the work.

14. The Contractor shall have redundant lateral bypass pumping equipment installed and ready for immediate operation and use in the event of an emergency or primary system breakdown or failure. The standby system shall be capable of pumping dry weather and peak flow.

15. The standby pump(s) shall not be considered as any part of the primary system as designed for peak flow. The Contractor shall also furnish and have available onsite, and ready for operation, redundant pumping ancillary equipment in case of any failure of the pumping system including piping, electrical equipment, pipe appurtenances, etc. Redundant pumping facilities shall also include having a backup power generator in case the primary power source fails.

16. The Contractor shall not obstruct flows in the sewer unless the primary and redundant equipment is onsite and in operable condition and authorization has been granted by the PSAA.

Z. Sewer Main and Service Lead Repairs

1. If a sewer repair is required as a result of damage during construction operations or television inspection failure, the Contractor shall expose the sewer pipe and perform the required correction(s), as specified herein and as directed by the PSAA.

2. If the repair is required due to the pipe being out of alignment or off grade, the pipe shall be adjusted to place it in proper alignment and grade. 6-A coarse-graded aggregate material shall be carefully placed under the haunches of the realigned pipe and compacted with a tee-bar. From the haunches of the pipe, backfilling shall be performed in accordance with the requirements for backfilling as outlined in Section II.I (Pipe Backfill) of this Article.

3. If the pipe cannot be satisfactorily realigned or an open joint satisfactorily closed, or if the pipe is cracked, broken, or permanently deflected, the affected pipe shall be removed and replaced with the same pipe material or other similarly performing pipe material as approved by the PSAA. The pipe to be removed is to be sawed on each side of the damaged section in a neat and workmanlike manner without damage to the adjacent pipe. The replacement pipe section shall fit flush to the remaining pipe at each end. These sawed joints shall be coupled using a PSAA-approved flexible pipe coupling and stainless-steel shear ring. The remaining pipe backfill shall be performed in accordance with the applicable requirements for backfilling as outlined in Section II.I (Pipe Backfill) of this Article.

AA. Abandonment and Removal of Sewers and Drainage Structures

1. Sewers, manholes, and drainage structures designated to be removed, shall be removed and disposed of off-site in such a manner as not to damage any new work, or work or material which is to remain in-place.

2. Abandonment of all storm and sanitary sewers shall include placing flowable fill the full length and cross section of the abandoned sewer or removing the entire run of sewers. The Contractor's method to accomplish this will be subject to approval of the PSAA. See Article 5 (Streets), Section II.P (Flowable Fill), of these Standards for additional requirements.

3. The Contractor is responsible to provide all needed materials and appurtenances to properly introduce the flowable fill into the pipe being abandoned. The Contractor shall also provide the needed vent device(s) in order to remove air that becomes trapped during the grouting operations. All measures provided by the Contractor for the introduction and venting of the grouting operations shall be effective.

4. The resulting hole left in a structure from a removed or abandoned sewer shall be bulkheaded with bricks and mortar to provide a watertight seal and constructed such that the remaining flow in the structure is not impeded.

5. Abandoning structures shall include completely removing the top part of the structure to 4 feet below finished grade. The remaining portion of the structure shall be backfilled in a manner approved by the PSAA to the top of the portion of the structure left in place.

6. Within 2 days of their removal, the Contractor shall stockpile on-site, in a location that is mutually agreeable to the PSAA and Contractor, the existing structure frames and covers. The Contractor shall deliver the frames and covers to Public Works within this 2-day period. The Contractor shall provide the equipment and manpower to unload the castings at the Public Works yard at a location indicated by City staff.

7. If located within public rights-of-way, railroad rights-of-way, or within the influence of paved surfaces, the hole or trench resulting from the removal or abandonment of any manhole, sewer, or drainage structure shall be backfilled with MDOT Granular Material, Class II, in maximum lifts of 12 inches, and be compacted to 95% of its maximum unit weight. Otherwise, backfill shall be PSAA approved native material, compacted to 90% of its maximum unit weight, in lifts of 12 inches or less.

BB. Abandoning and Removal of Water Main and Appurtenances

1. The Contractor shall abandon water mains where shown on the Plans. This includes, but is not limited to:

    a) Cutting the main at each end;

    b) Plugging the live main at the end(s) with push-on joint plug(s) and thrust block(s);

    c) Plugging the abandoned main at its end(s) with brick and mortar, concrete, or mechanical joint plug;

d) Breaking down any gate wells or valve boxes (removing frame and cover, and the top 4 feet of the gate well structure, and backfilling as specified herein) in the abandoned line;

e) Removing and salvaging any valves and fittings, as directed;

f) Removing and salvaging all fire hydrants, unless otherwise directed;

g) Plugging the pipe in manholes with brick and mortar, concrete, or mechanical joint plug; and

h) Abandoned water main in MDOT ROW, or where directed, shall be filled with flowable fill, the Contractor is responsible to provide all needed materials and appurtenances to properly introduce the flowable fill into the full length and cross section of the pipe being abandoned. The Contractor shall also provide the needed vent device(s) in order to remove air that becomes trapped during the filling operations. The ends of an abandoned water main shall be capped or bulkheaded with bricks and mortar to provide a watertight seal such that any remaining pipes in the structure are not impeded. Method of filling water main is subject to approval by the PSAA. See Article 5 (Streets), Section II.P (Flowable Fill), of these Standards, for additional requirements.

2. In locations as shown on the Plans or where abandoned water main, valves, or valve wells are within 30 inches of the proposed subgrade, the pipe, valves or valve wells shall be removed completely. If located within the public rights-of-way, railroad rights-of-way, or within the influence of paved surfaces or structures, the resulting hole or trench shall be backfilled with MDOT Granular Material, Class II, in maximum lifts of 12 inches, and be compacted to 95% of its maximum dry density. Otherwise, backfill shall be PSAA approved native material, compacted to 90% of its maximum dry density, in lifts of 12 inches or less.

3. Abandoned (salvaged) or removed valves, gate well castings and covers, and fire hydrant assemblies shall be neatly stacked on-site in a single location and delivered to Public Works within 2 days of removal. The Contractor shall provide the equipment and manpower to unload the salvaged components at the Public Works yard at a location indicated by City staff.

4. When abandoning asbestos concrete water main pipes, the pipe shall be kept wet at all times while cutting or crushing operations are occurring. High-speed friction saws shall not be used to cut the pipe. Asbestos concrete pipe shall be abandoned by capping it on both ends and burying it in the trench. At no time shall any asbestos concrete pipe be removed from the site unless specifically directed to do so in writing by the PSAA.

CC. Removal and Disposal of Contaminated Soil

1. The Contractor shall be aware that soils within the City of Ann Arbor and Washtenaw County contain levels of naturally-occurring, regulated, elemental metals. The City of Ann Arbor has completed testing on numerous projects and levels of these naturally–occurring, regulated, elemental metals that may be encountered within the City of Ann Arbor and have found that they generally correspond to concentrations presented in the 2005 State of Michigan Background Soil Survey approved by EGLE on October 4, 2019 for the Huron-Erie glacial Lobe.

2. All excavated material generated on the project shall become the property of the Contractor. Any excavated material that cannot be incorporated into the project work, in accordance with the material requirements of the work being performed, must be properly disposed of off-site by the Contractor.

3. Consequently, excavated soils that do not exhibit odors, discoloration, or other indications of contamination, and meet the definition of an inert material in accordance with Part 115 Solid Waste Management of the Michigan Natural Resources and Environmental Protection Public Act 451 of 1994 (MNREPA Act 451), are not required to be disposed of in a landfill. These soils shall be disposed of by the Contractor by the method of their choice.

4. The City of Ann Arbor suggests a disposal method that minimizes future human contact with the soil or the soil's contact with a water course or ground water sources, due to the possibility of elevated concentrations of naturally-occurring, regulated, elemental metals. The Contractor shall be responsible for any disposal or relocation methods that they chose to employ in the disposal of these soils.

5. The Contractor's excavation of soil on the project shall be considered prima facie evidence that they have considered these facts and have included all necessary resources to perform all work of this project and to properly dispose of excavated soils from this project off-site.

6. If the Contractor encounters soil suspected of containing contaminated constituents other than those of naturally-occurring, regulated, elemental metals it must be tested and classified prior to transport and disposal in accordance with EGLE Waste Characterization Guidance.

7. Contaminated soil characterized as non-hazardous or hazardous may not be reused on-site within the project area.

8. Non-hazardous, non-Resource Conservation and Recovery Act (RCRA) contaminated material shall be managed in accordance with Part 201 Environmental Remediation of the MNREPA Act 451. RCRA hazardous material shall be managed in accordance with Part 111 Hazardous Management of the MNREPA Act 451.

9. Soils containing elevated levels of naturally-occurring, regulated, elemental metals that are determined to be above EGLE-regulated background levels are excluded from the definition of "Contaminated Soil." During the performance of work on a City project, if such soils are found or determined to exist after a course of testing and characterization, the off-site disposal of those soils shall not be paid.

10. Contaminated soil shall be placed in a vehicle equipped to carry the class of the material on public roads to the disposal site in accordance with applicable federal, state, or local regulations applicable to such soil, whether it is non-hazardous or hazardous.

11. The Contractor shall be responsible for all sampling and analysis required for the disposal of contaminated material. Refer to EGLE Waste Characterization Guidance for guidance on the type of analysis required.

12. If the results of the analysis show the material to be non-hazardous or hazardous as defined by Part 111, of the Natural Resources and Environmental Act, Act 451, P.A. 1994, the PSAA shall be notified immediately. The material shall then be disposed of at a licensed Type I or Type II landfill as required by the applicable EGLE guidance.

13. This work shall be performed in accordance with MDOT Specifications, Subsections 104.07.B (Contractor Obligations) and 107.01 (Laws to be Observed), and Sections 204 (Removing Miscellaneous Structures and Materials) and 205 (Roadway Earthwork), except as modified herein or as directed by the PSAA. The Contractor shall have all manifests signed by its representative, the PSAA's representative, the authorized representative of the waste hauler and the waste disposal facility.

14. Excavated non-hazardous or hazardous contaminated soil which is to be temporarily stockpiled shall be placed on plastic sheeting or tarps having a minimum thickness of 6 mils or in trucks, roll-off boxes, or other containers, such that no liquid may escape from the containment. At the end of each work day, the contaminated material shall be covered securely with plastic sheeting of 6 mils thickness or greater.

15. Excavated hazardous or non-hazardous material shall be disposed of as soon as approval is received from the disposal site. In no case shall this material be stockpiled for longer than 30 days prior to disposal.

16. The Contractor is responsible for the necessary coordination such that Contractor's work activities are not adversely impacted by the stockpiling of contaminated soil. Stockpiled soil shall not impair sight distance or drainage. Time extensions shall not be granted by the PSAA for delays in receiving approval for the disposal of contaminated material at the appropriate landfill or other similar circumstances.

17. Disposal of non-hazardous contaminated soil shall be at a licensed Type II sanitary landfill. Disposal of hazardous contaminated soil shall be at a licensed Type I hazardous waste landfill. The Contractor shall submit at the pre-construction meeting the name of the Type II or Type I landfill to be used for disposal, the sampling and analysis requirements of the landfill, and verification that the use of the proposed landfill will meet the requirements of the County solid waste plan.

18. The disposal facility must be acceptable to the City of Ann Arbor and therefore approval must be obtained from the PSAA prior to commencing disposal operations. Prior to obtaining approval for the disposal from the City, the Contractor shall provide a copy of the laboratory analysis to the PSAA.

DD. CIPP Sewer Lining

1. Description

   a) This work shall consist of rehabilitating pipelines by the insertion of a resin impregnated flexible lining and cured in place to form a pipe. The cured in place pipe (CIPP) shall be saturated with a thermosetting resin, styrene free unless otherwise approved by the PSAA, and inserted into the existing pipeline. Curing shall be accomplished by a method approved by the PSAA to harden the resin into a hard, impermeable pipe. When cured, the hardened CIPP shall be a tight-fitting watertight pipe within a pipe. The CIPP shall be continuous from manhole to manhole with no circumferential joints or seams.

   b) All work shall be performed in accordance with these Standards and as directed by the PSAA.

   c) For a CIPP system to be considered acceptable, the CIPP system must have at least 2,000,000 lineal feet of successful, documented installations, a minimum of 250,000 lineal feet of which shall have been in the Midwestern United States or Canada. Newer CIPP systems may be approved at the discretion of the PSAA.

   d) When requested by the PSAA, the Contractor shall submit test results from previous field installations of the same resin system and tube materials as proposed for this installation. The test results must verify that the CIPP physical properties specified in this specification have been achieved in the field.

   e) The lining operation shall not begin until the sewer has been cleaned and video inspected in accordance these Standards and authorization to begin by the PSAA has been granted.

   f) Cleaning and television inspections of sewers for CIPP Lining shall not be paid for separately but shall be included in the cost for the CIPP Lining.

2. Design Considerations

   a) The required structural CIPP wall thickness shall be based, at a minimum, on the physical properties of the cured composite and per the design of the Professional Engineer. The finished liner shall be designed per ASTM F1216 (Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube), Appendix X1, for the following condition:

Condition .....Fully deteriorated gravity pipe
Safety Factor.....2
Ovality.....As measured by Contractor during sewer inspection; assume 2% for bidding purposes
Soil Density .....130 pounds per cubic foot (lbs/cft)
Soil Modulus .....700 pounds per square inch (psi) for pipe inverts up to and including 15 feet deep, 1,000 psi for pipe inverts greater than 15 feet deep
Groundwater Depth As field verified
Surcharge Loading HS 20 (Highway) when any part of the sewer is under any major street, county road, or state highway; E 80 (Railroad) when under any railroad

b) The Contractor shall determine the liner thickness and resin quantity for this project per ASTM F1216, Appendix X1. Liner thickness, resin, and resin quantity shall be furnished to the PSAA for review and approval prior to beginning work. The design calculations for wall thickness shall be completed by a Professional Engineer proficient in the design of pipeline systems, licensed in the State of Michigan, with design calculations signed and sealed. The CIPP design shall assume no bonding to the original pipe wall.

c) The Contractor shall submit, prior to installation of the lining materials, certification of compliance with these specifications. Certified material test results shall be included that confirm that all materials conform to these specifications. Materials not complying with these requirements will be rejected.

3. Material

a) All materials shipped to the project site shall be accompanied by test reports certifying that the material conforms to the latest ASTM standards listed herein. Materials shall be shipped, stored, and handled in a manner consistent with written recommendations of the CIPP system manufacturer to avoid damage. Onsite storage locations shall be as indicated on the Drawings and approved by the PSAA.

b) Preliner Tube

(1) The preliner shall be a polyethylene material compatible with the lining system, and shall be utilized where necessary to accommodate infiltration, damaged, or missing pipe.

c) Felt Tube Liner

(1) The tube shall consist of one or more layers of absorbent, flexible felt material. The tube shall be capable of carrying the specified resin, constructed to be able to withstand installation pressures and curing process, have sufficient strength to bridge missing pipe and stretch to fit irregular pipe sections at all pipe locations, and be compatible with the resin used.

(2) The outer tube coating shall consist of an impermeable, flexible membrane that contains the resin and allows for visual inspection and verification of proper resin impregnation ("wet out") procedure. The coating shall hold the resin inside the tube without leakage, accommodate installation, and stretch to the size and shape of the existing sewer, and shall not delaminate before, during, or after curing.

(3) The tube shall have a uniform thickness that when compressed at installation pressures will meet, or exceed, the design thickness.

(4) The tube shall be fabricated to a size and length that when installed will fit sufficiently tight within the existing pipe so as to not leak at manholes, at service connections, or through the wall of the installed pipe. The tube shall be properly sized to the diameter of the existing pipe and the length to be rehabilitated and be able to stretch to fit irregular pipe sections and negotiate bends.

(5) The Contractor shall determine the minimum tube length necessary to effectively span the designated run between manholes. The Contractor shall verify the lengths in the field prior to impregnation of the tube with resin, to ensure that the tube will have sufficient length to extend the entire length of the run. The Contractor shall also measure the inside diameter of the existing pipelines in the field prior to ordering liner so the liner can be installed in a tight fitted condition. Allowance for circumferential stretching of the tube during insertion shall be made as per manufacturer's recommendations. Overlapped layers of felt in the

longitudinal seam that cause lumps in the final product shall not be utilized.

(6) The tube shall be homogeneous across the entire wall thickness and contain no intermediate or encapsulated elastomeric layers. No material shall be included in the tube that may cause delamination in the cured CIPP. No dry or unsaturated layers shall be evident.

(7) The wall color of the interior pipe surface of the CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made. The hue shall be dark enough to distinguish a contrast between the fully resin saturated felt fabric and dry or resin-lean areas.

(8) Seams in the tube shall be stronger than the un-seamed felt and shall meet the requirements of ASTM D5813 (Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems). Where the length of the tube to be installed requires joining along the circumference of the tube, the sewn joint shall not be perpendicular to the long axis but spirally formed and sewn.

(9) The outside of the tube shall be marked for distance at regular intervals along its entire length, not to exceed 5 feet. Such markings shall include the manufacturers name or identifying symbol. The tubes must be manufactured in the USA.

(10) The length of the tube shall be that deemed necessary by the Contractor to effectively carry out the insertion and seal the pipe at the inlet and outlet points, plus that amount required to run in and run out for the installation process. The Contractor shall verify the lengths in the field before cutting the tube to length. Lengths of sewer shall be lined over one or more access points as shown on the Plans.

d) Resin

(1) Thermoset, non-styrene resin shall be a polyester, enhanced polyester, vinyl ester, or epoxy system including all required catalysts, initiators, or hardeners that when cured within the tube creates a composite that satisfies the requirements of ASTM F1216 and ASTM F1743 (Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe Systems

(CIPP)), the physical properties herein, and those which are to be utilized in the design of the CIPP for this project. Resin selected shall be resistant to the chemical composition of the sewage and comply with the structural requirements of this specification.

(2) The resin shall be thermosetting resin that is compatible with the lining process and shall meet the requirements of ASTM F1216 except as otherwise specified in this specification. The resin shall be able to cure in water with an initiation temperature for cure as required by the liner manufacturer, but not greater than maximum temperatures required under ASTM F1216. The cured resin/felt system shall be suitable for the expected conditions within the existing sanitary sewer.

(3) The Contractor is responsible for choosing a resin system that is capable of meeting the physical and cured-in-place properties and performance requirements as detailed in this specification.

4. Construction

a) The completed liner as installed and fully cured-in-place shall meet the minimum physical properties for short term flexural modulus and flexural strength as specified herein.

b) Fiber optic probes shall be installed to monitor the average temperature along the entire length of the tube as it cures. Devices shall be provided by VeriCure or a PSAA-approved equal.

c) The Contractor shall carry out their operations in strict accordance with all OSHA, MIOSHA, and manufacturer's safety requirements. The Contractor shall be solely responsible for safety during the performance of all work. The Contractor shall not enter into any sewer segment where hazardous conditions may exist until such time as the source of those conditions is identified and eliminated by the Contractor and/or the City. The Contractor shall coordinate their work with local fire, police, and emergency rescue unit.

d) The Contractor shall be responsible for any damage to public or private property resulting from their sewer lining or televising activities and shall repair or otherwise make whole such damage at no cost to the City.

e) Prior to rehabilitation of any sewer, it shall be the responsibility of the Contractor to remove all internal deposits from the pipeline. This shall include dirt, debris, mud, bricks, grease or oils, mineral deposits, root masses, pieces of broken pipe, etc.

f) Inspection of pipelines shall be performed after the pipe has been cleaned by experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television.

g) The interior of the pipeline shall be carefully inspected to determine the location and extent of any structural failures. The location of any conditions which may prevent proper installation of lining materials into the pipelines shall be noted so these conditions can be corrected as specified in this specification.

h) It shall be the responsibility of the Contractor to clear the line of obstructions such as solids, dropped joints, root masses, protruding branch connections, or broken pipe that will prevent proper insertion of the liner in accordance with these Standards.

i) The Contractor shall provide for the transfer of main line and/or lateral flow around the section or sections of pipe that are to be cleaned, televised, and rehabilitated. The work shall consist of diverting, pumping, and bypassing flow in the existing sewers as directed by the PSAA and in accordance with Section II.Y (Sewer Flow Control) of this Article.

5. Installation of Resin Impregnated Tube

a) The Contractor shall designate a location where the uncured resin in the original containers and the unimpregnated liner will be resin impregnated prior to installation. The Contractor shall allow the PSAA to inspect the materials and procedure.

b) A resin and catalyst system compatible with the requirements of this specification shall be used. The quantities of the liquid thermosetting materials shall be provided in accordance with manufacturer's standards to provide the cured liner properties specified. Sufficient resin shall be used to fill the volume of air voids in the liner with additional allowance for polymerization, shrinkage, and loss of resin through cracks and irregularities in host pipe wall. The Contractor shall ensure the proper amount of resin is uniformly distributed throughout the entire length of the tube.

c) The wetting out, installation, and curing of the resin impregnated tube shall be in accordance with ASTM F1216 and per manufacturer's specifications. The tube shall be inserted through existing manholes by means of an inversion process, the application of a hydrostatic head sufficient to fully extend the liner to the next manhole, or other means as approved by the PSAA.

d) The process will be adjusted as necessary to ensure a complete lining without overstressing or tearing the lining, with sufficient pressure to hold the liner snug to the pipe wall, and to produce dimples at side connections and flared ends at the entrance and exit access points. The use of a lubricant is recommended and, if used, such lubricant shall be compatible with the rehabilitation process.

e) The manufacturer's standards shall be closely followed during the elevated curing temperature so as not to over stress the felt fiber and cause damage or failure of the liner prior to cure.

6. Curing

a) Hot water curing is required for full length liners. After installation of the resin impregnated liner is completed, the Contractor shall supply a suitable heat source and water recirculation equipment as necessary to cure the liner. The equipment shall be capable of delivering hot water to the far end of the liner through a hose which has been perforated per manufacturer's recommendations, to uniformly raise the water temperature in the entire pipe above the temperature required to affect a cure of the resin. This temperature shall be determined by the resin/catalyst system employed.

b) All water necessary for the cleaning and lining operations shall be furnished by the City at agreed access places. Hydrants used by the Contractor shall be pumped down by the Contractor to prevent freezing. Frozen hydrants that were used by the Contractor and not properly closed or pumped down shall be repaired by the Contractor at no additional cost.

c) For quality control during the CIPP lining operation, the Contractor shall utilize remote temperature sensing devices placed between the host pipe and the liner to continuously monitor the liner cure incrementally every 18 inches or less to verify that an exothermic reaction has occurred and that a full cure has taken place along the full length of the CIPP liner. Measuring temperatures at the liner endpoints only will not be permitted. The cure information must be taken from the bottom third of the pipe liner. Cure parameter information shall be provided by the resin manufacturer.

d) Liner and/or host pipe interface temperature shall be monitored and logged during curing of the liner. The monitoring system must have the ability to be remotely viewed live by the PSAA. Data collected shall be provided to the PSAA in Excel spreadsheet and graphical viewer formats at the same time as the post-lining inspection videos are provided.

e) Initial cure shall be deemed to be completed when the remote sensing devices reflect that the cure temperature, as recommended by the resin/catalyst system manufacturer, have been achieved. The cure period shall be of a duration recommended by the resin manufacturer, as modified for site specific conditions, during which time the recirculation of the water and cycling of the heat exchanger to maintain the temperature in the liner shall continue.

f) The Contractor shall cool the CIPP in accordance with the CIPP manufacturer's recommendations to a temperature below 100°F before relieving the static head in the liner. Temperatures and curing data shall be monitored and recorded by the Contractor throughout the installation process to ensure that each phase of the process is achieved in accordance with the CIPP manufacturer's recommendations.

g) Cool down may be accomplished by the introduction of cool water into the liner to replace water being drained from the downstream end. Care shall be taken in the release of the static head such that a vacuum will not be developed that could damage the newly installed liner. The cooled water shall be released to the existing sanitary sewer at a rate that is approved by the PSAA and the City of Ann Arbor's Wastewater Treatment Plant (WWTP) superintendent.

7. Completion of Liner

    a) The cured liner shall be continuous over the entire length of an insertion run and be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes, and delamination. The lining shall be impervious and free of any leakage.

    b) Any defects which will affect the integrity of the liner, or any deficiencies in required strengths or thicknesses, shall be repaired or removed and replaced at the Contractor's expense, in a manner acceptable to the PSAA.

    c) A seal, consisting of a hydrophilic sealing gasket compatible with the installed CIPP, shall be installed at each manhole/pipe wall interface. The seal shall be a seamless molded tubular design that swells in the presence of water. The seal shall be secured in place by a retaining ring.

    d) The completed liner shall be television inspected and color videotaped, by the Contractor, in accordance with these Standards.

    e) After the liner has been cured, the Contractor shall reconnect the existing service connections. This shall generally be done without excavation and, in the case of non-man entry pipes, from the interior of the pipeline by means of a television camera and a cutting device that re-establishes them to operational capacity.

    f) Reconnection of services shall begin immediately after curing of the CIPP has been completed. No service shall be interrupted for more than 12 hours unless otherwise approved by the PSAA.

    g) Each lateral shall be fully reopened as much as possible without damaging the host pipe. Brushing of all lateral connections shall be completed to remove all rough and burned edges.

    h) The Contractor shall have a second robotic cutting device as a backup unit for reinstating the service connections on site prior to commencing the installation of the CIPP.

8. Acceptance Tests

    a) The PSAA shall perform Acceptance Testing in accordance with ASTM F1216 (including appendices) and ASTM D5813.

b) The Contractor shall prepare plate test samples to be cured with the CIPP operation. The Contractor shall capture and prepare 10 sample specimens of the liner for the Acceptance Testing to be performed by the PSAA for each section of sewer lined in accordance with Section 8 of ASTM F1216, for testing flexural strength and delamination.

c) The Contractor shall prepare the samples for shipment to the laboratory, including cutting samples to proper length and width as described in the applicable ASTM test procedures. Samples shall be labeled for date, diameter, section of sewer, and delivered to the PSAA for testing. The cost of the sample postage, shipping, and testing will be paid for by the City.

d) When tested, each sample shall meet the physical properties for flexural modulus and flexural strength used in the design calculations.

e) Air testing on isolated sections of sewer (minimum of 2 to 3 feet in length) shall be required if post-rehabilitation inspection indicates leaks in the liner. Air testing shall be performed on longer sections or multiple sections of sewer as required to identify the location(s) and full extent of defects. Such testing shall be performed by the Contractor at no additional expense to the project.

f) CIPP wall thickness shall be verified in accordance with Section 8.6 of ASTM F1216 and using test methods consistent with Section 8.1.2 of ASTM D5813.

g) The PSAA will have all flexural and delamination testing performed by an independent, ASTM certified testing laboratory. The testing laboratory shall submit all test results directly back to the PSAA within 14 calendar days. The PSAA will provide a written copy of the test results to the Contractor within 3 business days of receiving them from the laboratory.

h) The Contractor may elect to restore flow in the mainline sanitary sewer during this period of time. However, if the test results indicate that the liner fails to meet the Project requirements and that remedial work is required to be performed, the Contractor shall perform any required cleaning in order to allow the remedial work to be performed at no additional cost to the project.

i) Should the test results indicate that the liner fails to meet the required physical properties as specified herein, the work shall be rejected. The Contractor shall have up to 10 calendar days to propose a repair/replacement plan consistent with the requirements of this specification for the PSAA's review and acceptance. The Contractor's repair/replacement plan shall include the following elements.

j) The Contractor shall outline specific repair or replacement procedures for potential defects that may occur in the installed liner, in accordance with recommendations by the liner system manufacturer.

k) The manufacturer shall provide a detailed step by step repair procedure, resulting in a finished product meeting the estimated life cycle of the component and requirements of these specifications. For the purposes of these Standards the lifecycle of this rehabilitation shall be considered to be 50 years.

l) Should a potential issue be unrepairable, in the opinion of the PSAA, the Contractor, together with the manufacturer, shall define the best recommended procedure for the total removal and replacement of the system.

m) The Contractor shall receive no additional compensation for the repair or replacement of systems deemed non-conforming to the requirements of the Contract Documents and unacceptable by the City.

n) While repair/replacement work is performed, the Contractor shall continue to be responsible for maintaining flows in the mainline and lateral sanitary sewers in accordance with the requirements of this Section. The Contractor will not be allowed any increase in the contract unit price due to the repair or replacement of defective any materials or faulty workmanship.

o) The Contractor shall remove and replace or repair any defects in the installed liner to the satisfaction of the PSAA at no additional cost to the project. Contract time will continue during the period of time from the receipt of failing test results to the completion of the repairs.

9. Warranty

a) The materials used for the project shall be certified by the manufacturer for the specified purpose. The Contractor shall warrant the liner material and installation for a period of 2 years.

b) During the Contractor warranty period, any defect which may materially affect the integrity, strength, function, and/or operation of the pipe, shall be repaired at the Contractor's expense in accordance with procedures described in this specification, and as recommended by the manufacturer.

c) The Contractor shall conduct warranty CCTV inspection of sewers which were lined. This work shall be completed at the Contractor's expense, no sooner than 2 months prior to the expiration of the original warranty period.

d) The televising shall be performed in the presence of the PSAA. Television inspection that is not performed within the presence of the PSAA will not be accepted and shall be performed again at the Contractor's sole expense. Any areas that do not meet the requirements of this specification will be repaired or re lined at no additional cost to the City.

EE. Sanitary Manhole Rehabilitation

1. At all times proper measures are to be implemented to protect debris and materials from falling into the flow channel; all debris and materials shall be removed promptly.

2. Internal Chimney Seal

   a) A plural component, urethane or other PSAA approved material, internal manhole frame-chimney sealant, as specified herein shall be applied in all assigned manholes within the areas included in the project. If excavation is required to repair, rebuild, or replace a manhole, or if manhole linings or coatings are required, the sealant shall be applied after that work has been completed.

   b) The manhole frame-chimney sealant shall be designed to prevent leakage of water through the above-described portions of the manhole throughout its design life.

   c) The manhole frame-chimney sealant shall remain flexible and bonded to the inside surfaces of the manhole frame and masonry throughout its design life.

   d) Manhole frame-chimney sealant material and application methods shall meet current ASTM standards and consist of a PSAA-approved plural component, spray applied, quick setting urethane material conforming to the following requirements:

(1) Viscosity

(a) Part A, 12,000-17,000 cps @ 25C, 20 RPM per ASTM D2393 (Test Method for Viscosity of Epoxy Resins and Related Components)

(b) Part B, 300-510 cps @ 25C, 300 RPM per ASTM D4287 (Standard Test Method for High-Shear Viscosity Using a Cone/Plate Viscometer)

(2) Weight

(a) Weight/Gallon Part A, 8.90-9.20 lb/gal per ASTM D1875 (Standard Test Method for Density of Adhesives in Fluid Form)

(b) Weight/Gallon Part B, 9.60-9.75 lb/gal per ASTM D1875

(c) Weight/Gallon Mixed, 9.25-9.48 lb/gal per ASTM D1875

(3) Processing

(a) Mix Ratio by Weight, 100:107

(b) Mix Ratio by Volume, 100:100

(c) Cure Schedule, Hours, 4-5 hours @ 25C

(4) Gel Time

(a) Gel Time, Seconds, 0-15 seconds @ 25C, 100 grams per ASTM D3056 (Standard Test Method for Gel Time of Solventless Varnishes)

(5) Cured Properties

(a) Hardness, Shore A, 95-100 per ASTM D2240 (Standard Test Method for Rubber Property—Durometer Hardness

(b) Elongation, 379-473% per ASTM D638 (Standard Test Method for Tensile Properties of Plastics) or ASTM D412 (Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension)

(c) Tensile Strength, 2616-3216 psi per ASTM D638 or ASTM D412

(d) Peel Strength, 30.8-46.8 PLI (AL to AL) per ASTM D1876 (Standard Test Method for Peel Resistance of Adhesives (T-Peel Test))

e) All concrete and masonry surfaces must be clean. Grease, organic matter, roots must be completely removed.

f) The Contractor shall have the manufacturer's recommended plural cartridge dispensing tool and all other equipment/tools necessary to prepare the surfaces of the manhole and apply the manhole frame-chimney sealant.

g) All loose and protruding mortar and brick that would prevent proper application of the seal, shall be removed and the appropriate areas of the manhole frame, chimney and or cone/corbel cleaned and prepared. All areas to be sealed shall be free of surface contaminates and be dry and free of any excessive voids or defects.

h) If an adequate sealing surface does not exist on the masonry, cementitious grout or other PSAA approved material shall be used to fill voids and profile the chimney area of the manhole.

i) Cementitious grout shall be a premixed, non-metallic, high strength, non-shrink grout which meets the requirements of ASTM C191 (Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle) and ASTM C827 (Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures) as well as Corps of Engineers CRD-C-588 (Nonshrink Grout) and CRD-C-621 (Non-shrink Grout). When mixed to a mortar or "plastic" consistency, it shall have minimum 1 day and 28-day compressive strength of 6,000 and 9,000 psi, respectively.

j) All surface preparation shall be completed in strict accordance with the frame-chimney sealant manufacturer's published instructions.

k) The internal frame-chimney sealant shall be applied to cover the entire circumference of the chimney section regardless of depth at a minimum thickness 100 mils.

3. External Chimney Seal

a) This specification includes the materials and procedures required for the wrap or external sealing of the entire chimney area of all sanitary manholes.

b) Manhole chimney shall be sealed in full, from the exterior using a wrap seal.

c) All surface preparation shall be completed in strict accordance with the frame-chimney sealant manufacturer's published instructions.

d) Manholes shall be excavated, backfilled, and restored as specified herein.

e) The manhole frame shall be clean, dry and free from surface rust and foreign objects. Abrade and/or prepare the surfaces strictly according to manufacturer's recommendations.

f) Contractor shall ensure that the sleeve is in full contact with the substrate, that there are no cracks or holes in the polyethylene backing and no voids are present below the sleeve, and that the adhesive has flowed beyond the sleeve edges.

g) Manufacturer shall provide complete installation guides with clear illustrations enclosed in each factory carton of sleeves. Installer shall follow all manufacturer's procedures to ensure proper application.

h) Wrap Seal shall be wrapped tightly around casting and adjustment rings. Seal must extend a minimum of 3 inches onto casting and 3 inches below top of cone section with a 6-inch overlap.

4. Chemical Grouting of Manholes

a) Grouting manhole defects may include corbel, wall, pipe connections, manhole joints, and/or bench/trough. The PSAA will determine areas of the manhole designated to be grouted. If entire manhole is scheduled for grouting, grouting shall include corbel, wall, pipe connections and bench/trough. Pipe connections grouting shall include all pipe connections in the specified manhole and grouting of the specified manhole including the bench/trough to the maximum height of 18 inches above the crown.

b) Materials, additives, mixture ratios, and procedures utilized for the grouting process shall be in accordance with manufacturer's recommendations or PSAA approved equal. A list of currently approved chemical sealing materials can be found in Appendix A (Material Requirements) of these Standards.

c) The following properties shall be exhibited by the grout:

(1) Documented service of satisfactory performance in similar usage.

(2) Controllable reaction times and shrinkage through the use of chemicals supplied by the same manufacturer. The minimum set time shall be established so that adequate grout travel achieved.

(3) Chemical resistance to most organic solvents and to mild acids and alkali.

(4) The chemical shall be essentially non-toxic in a cured form.

(5) Sealing material shall not be rigid or brittle when subjected to dry atmosphere. The material shall be able to withstand freeze/thaw and moving load conditions.

(6) Acrylate grouts may not be used.

d) Mixing and handling of chemical grout, which may be toxic under certain conditions shall be in accordance with the recommendations of the manufacturer and in such a manner to minimize hazard to personnel. It is the responsibility of the Contractor to provide appropriate protective measures to ensure that authorized personnel handle chemicals or gels in the proper manner. All equipment shall be used in accordance with the manufacturer's specifications. Only trained personnel thoroughly familiar with the handling of the grout material and additives shall perform the grouting operations.

e) Manholes to be grouted may be of brick, concrete, or fiberglass construction.

f) Manhole grouting shall not be performed until the repair of the manhole frame and grade rings or any other structural manhole repairs are complete.

g) The Contractor shall cut and trim all roots within the manhole.

h) The Contractor shall seal all unsealed lifting holes, unsealed step holes, or voids larger than approximately ½ inch in thickness.

i) All cracked or deteriorated material shall be removed from the area to be patched and replaced with a waterproof quick setting mortar in accordance with manufacturer's specifications.

j) The Contractor shall perform the Expanded Gasket Placement (EGP) technique to control in-flowing water in larger cracks, joints or pipe to manhole boots by soaking dry Oil Free Oakum (AV-219) with (AV-202) Multigrout and forcing the Oakum/Resin plug into opening until it sets. (See: Avanti EGP Technical Manual for details.)

k) The Contractor shall perform the EGP to seal intruding drop or lateral connections, slip line terminal seals, and open joints in RCP manholes.

l) The Contractor shall perform the EGP to seal between the corbel and grade rings, and between the manhole frame and grade rings.

m) Normal grouting operations shall be performed in accordance with manufacturer's recommendations.

n) Drilling and injecting grout shall be performed as follows:

(1) Injection holes shall be drilled through the manhole wall at locations as recommended by the manufacturer.

(2) Grout shall be injected through the holes under pressure with a suitable probe. Injection pressure shall not cause damage to the manhole structure or surrounding surface features.

(3) Grout shall be injected through the lowest holes first. The procedure shall be repeated until the manhole is externally sealed with grout.

(4) Grouting from the ground surface shall not be allowed.

(5) Grout travel shall be verified by observation of grout to defects or adjacent injection holes. Provide additional injection holes if necessary to ensure grout travel.

(6) Injection holes shall be cleaned with a drill and patched with a waterproof quick setting mortar for brick and concrete manholes.

5. Testing Rehabilitated Manholes

a) If exfiltration or vacuum testing is used, usually 10 percent of the sealed manholes, as chosen by the PSAA, are tested. Manholes that fail are reworked and retested by the Contractor.

b) If more than 5 percent of the manholes tested fail the initial test, an additional 10 percent of the sealed manholes are tested. This process continues until the testing is satisfactory, or until all manholes have been tested.

c) Limitations and considerations include recognizing that exfiltration and vacuum testing may be impractical or cost-prohibitive for all manholes; therefore, the use of either method of testing is subject to the determination of the PSAA.

6. Cementitious Manhole Liner

   a) Sanitary sewer manhole cementitious liner consists of spray-applied or centrifugally cast light-weight structural reinforced concrete. The cementitious liner shall be applied on the manhole base, bench, walls, corbel/cone, and chimney of brick, block, or precast manholes.

   b) Contractor must demonstrate a minimum of 3 years of recent documented experience in successfully applying cementitious manhole liners.

   c) Contractor shall submit the following to the City for review and acceptance at least 14 days prior to starting manhole cementation:

      (1) Manufacturers' Certificate of Compliance certifying compliance with the applicable Specifications and Standards. The certifications shall list all materials furnished under this Section.

      (2) Certified copies of factory tests required by the applicable Standards, the Manufacturer, and this Section.

      (3) Manufacturer's handling, storage, and installation instructions and procedures.

   d) The materials used shall be designed, manufactured, and intended for sewer manhole rehabilitation and the specific application in which they are used.

   e) The materials shall have a proven history of performance in sewer manhole rehabilitation. The materials shall be delivered to the job site in original unopened packages clearly labeled with the manufacturer's identification and printed instructions.

   f) All materials shall be stored and handled in accordance with recommendations of the manufacturer.

   g) All materials shall be mixed and applied in accordance with the manufacturer's written instructions.

   h) The material applied to the surface of the manhole shall be a cementitious blend of calcium aluminate cement and manufactured calcium aluminate aggregates for constructing a liner that is impervious to the flow of water, is resistant to sulfide attack, and restores structural integrity to existing manhole walls.

i) A monolithic liner shall be formed which covers all interior manhole surfaces and shall have the following minimum requirements at 28 days:

(1)	Compressive Strength (ASTM C579)	3,000 psi
(2)	Tensile Strength (ASTM C496)	300 psi
(3)	Flexural Strength (ASTM C293) (Modified)	600 psi
(4)	Shrinkage (ASTM C596)	0% at 90% R.H.

j) Contractor will perform preliminary cleaning of the structure with high-pressure water-blasting at a minimum of 4000 psi and 4 gpm to obtain the desired Concrete Surface Profile (CSP) of 3 or greater. If the desired CSP is not achieved by high-pressure water-blasting, other methods of obtaining the surface profile such as abrasive blasting and acid etching shall be used.

k) The Contractor shall remove all the existing manhole steps. The metal portion of all steps will be removed to within ½ inch of the manhole interior wall surface. The remaining protruding metal portion of the step shall be covered with a cementitious material to provide a smooth surface on and around the protrusion for the liner to bond.

l) All open joints, voids, holes, cracks, and missing bricks larger than 3 inches in diameter or equivalent shall be patched with a cementitious material to provide a smooth surface for the cementitious liner to bond.

m) All roots, loose, cracked or disintegrated material shall be removed from the area to be patched exposing a sound substrate. The cementitious patch material shall be allowed to cure according to the manufacturer's specifications before continuing with the cementitious liner installation process.

n) Benches shall be sloped so that water will flow back into the flow channel.

o) When the flow channel is required to be lined, the Contractor shall plug the inlet pipe, inspect for infiltration leaks around the inlet and outlet pipes and in the channel. All leaks present shall be stopped by the use of chemical grout injection and/or by the use of fast-setting cement.

p) The final prepared surface shall have a concrete surface profile of 3 or greater and have a smooth uniform appearance.

q) The finished cementitious liner shall be continuous over the entire length of the structure from the cover seat to the invert, including the flow channel. Liner shall be bonded to the structure, as required by design, and in such a way as to not allow any water to flow behind the liner and enter back into the waste stream.

r) The liner shall be visually inspected from inside the structure for any defects that may affect performance of the liner. All defects shall be fixed to conform with these specifications.

s) Contractor shall clean up the entire project area after the work is completed and all testing accepted and shall remove and dispose of all excess material and debris not incorporated into the permanent installation.

t) Manufacturer and Installer of the liner system shall provide a 10-year warranty on materials and labor.

7. Synthetic Manhole Liner

a) Contractor shall Install a synthetic manhole liner including flexible polyurea and closed cell foam. See Appendix A (Material Requirements) for additional detail.

b) The use of specialized equipment combined with rigorous surface preparation requirements shall be used to apply the products without the use of solvents. The equipment adds high heat and pressure the monolithic surfacing system resulting in a high build and quick set of the completed system. When working near the flow channel, the Contractor shall plug the inlet pipe, inspect for infiltration leaks around the inlet and outlet pipes and in the channel. All leaks present shall be stopped by the use of chemical grout injection and/or by the use of fast-setting cement.

c) Product application requirements and procedures described herein include surface preparation, mixing application, material handling and storage, qualification of the applicator and application quality control.

d) The Contractor shall submit the following information to the PSAA for approval prior to beginning the installation of the protective coating:

(1) Manufactures data sheets for the coating materials.

(2) Third party test results verifying that the physical properties of the coating materials meet or exceed the requirements of these specifications.

(3) Applicator's procedures for preparing the surface of the structure and installing the coating system.

(4) Documentation that the applicator of the coating has been trained and certified by the manufacturer and meets the experience requirements of these specifications.

e) The coating system shall be a spray-applied 100% solids epoxy monolithic surfacing system for use in coating new manholes, wet wells, lift stations, treatment plants, and other structures. All products seeking approval from the PSAA shall submit the following information:

(1) Documentation that the proposed product meets the above minimum physical characteristics including results of testing performed by a bonded, third-party testing company.

(2) An affidavit attesting to the successful use of the product as a protective coating for concrete or masonry structures for a minimum continuous period of 5 years in wastewater conditions recognized as corrosive or otherwise detrimental to concrete and masonry.

(3) A verifiable list of references that document the successful installation and use of the product in a minimum of 750,000 square feet of sanitary sewer structures.

f) An approvable product must have the following minimum physical characteristics as measured by the applicable ASTM Standards referenced herein.

(1) Minimum Compressive Strength: 12,000 psi

(2) Minimum Tensile Strength: 7,000 psi

(3) Minimum Flexural Strength: 11,000 psi

(4) Minimum Bond Strength: 500 psi

(5) Minimum corrosion resistance suitable for environments with pH of 0.5 or higher.

g) Installer Qualifications

(1) All products must be installed by an Installer that has been trained and certified by the manufacturer.

(2) The Installer must provide verifiable documentation of the above certification and the successful installation of 250,000 square feet of the product in sanitary sewer structures.

(3) The Installer must provide verifiable documentation of the above certification and the successful completion of prior installation.

h) Quality Control Assurance

(1) Applicator shall initiate and enforce quality control procedures consistent with applicable current ASTM standards.

(2) Applicator shall use an adequate number of skilled workers who are thoroughly trained and experienced in the necessary crafts. These workers shall be completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

(3) Applicator shall use approved specialty equipment adequate in size, capacity, and number sufficient to accomplish the work of this Section in a timely manner.

i) Surface Preparation

(1) Applicator shall inspect all surfaces specified to receive the monolithic surfacing system prior to surface preparation. Applicator shall promptly notify the PSAA of any noticeable disparity in the surfaces that may interfere with the proper preparation or application of the monolithic surfacing system.

(2) All concrete that is not sound or has been damaged by chemical exposure shall be restored to a sound concrete surface. All contaminants including all oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, roots or other contaminants shall be removed.

(3) Surfaces to receive protective coating shall be cleaned to produce a sound concrete or masonry surface with adequate profile and porosity to provide a strong bond between the monolithic surfacing system and the substrate. Surface preparation methods shall be based upon the conditions of the substrate and the requirements of the monolithic surfacing system to be applied, but as a minimum, shall be in accordance with the procedures listed below. Discharges of contaminants and cleaning chemicals to storm sewer is prohibited; such materials shall be captured and properly disposed of.

(a) All surfaces shall be cleaned with high pressure water to remove all loose or contaminated debris. Other equipment and methods may be required to remove all unsound material.

(b) When all loose, contaminated, and unsound debris has been removed, the surface shall be etched with a solution of 20% muriatic acid to clean and open the pores of the substrate.

(c) The surface shall be washed again, and the wash water shall contain a dilute solution of chlorine to diminish microbiological bacteria growth and to kill any bacteria residing on the surface.

(d) The surface shall be tested with litmus paper at various points throughout the structure to ensure that the pH is within acceptable limits (not to exceed 8.5). If the surface does not meet the pH requirements, the above steps shall be repeated until the surface pH is within acceptable limits. All tests results will be retained for review by the PSAA.

(e) Active water infiltration shall be stopped by using a cementitious water plug that is compatible and suitable for top coating with the specified monolithic surfacing system.

(f) If pre-installation inspection reveals infiltration (defined as visible and consistent movement of water) though the wall of the structure, a collapse in an area of the wall, a bench needing to be rebuilt/repaired, a necessity for sandblasting or anything that will require more than typical preparation of the structure, the Contractor shall notify the PSAA. Such extra work will be approved in writing between the Owner and the Contractor prior to the

commencement of the work and shall be considered as a separate pay item.

j) Application

(1) The interior surfacing system shall be applied to the chimney, walls, bench, and flow channel of all manholes and to the specified surfaces of all other structures.

(2) The interior surfacing system shall be continuously bonded to all brick, mortar, concrete, chemical sealant, grout, pipe and other surfaces inside the manhole according to ASTM C882 (Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear) testing and therefore shall be designed for hydrostatic loading.

(3) The cured surfacing shall be monolithic with proper sealing connections to all unsurfaced areas and shall be placed and cured in conformance with the recommendations of the monolithic surfacing system manufacturer.

(4) When cured, the system shall form a continuous, tightfitting, hard, impermeable surfacing that is suitable for sewer system service and chemically resistant to any chemicals, bacteria or vapors normally found in domestic sewage.

(5) The system shall effectively seal the interior surfaces of the manhole and prevent any penetration or leakage of groundwater infiltration.

(6) The system shall be compatible with the thermal conditions of the existing sewer manhole surfaces.

(7) Heated, plural component, specially designed equipment for use in the spray or spin-cast application of the specified system approved for use by the monolithic surfacing system manufacturer shall be utilized for each coat of the system.

(8) Application procedures shall conform to the recommendations of the interior surfacing system manufacturer, including material handling, mixing, and environmental controls during application, safety, and equipment.

(9) The equipment shall be specially designated to accurately ratio and apply the specified materials and shall be regularly maintained and in proper working order.

(10) An approved installer of the monolithic surfacing system must apply the specified materials.

(11) The walls, bench, and flow channel of the structure shall be lined with the monolithic surfacing system to provide a thickness as previously specified based on the condition of the existing structure.

(12) The cured surfacing shall be monolithic with proper sealing connections to all unsurfaced areas and shall be placed and cured in accordance with the recommendations of the monolithic surfacing system manufacturer.

(13) The minimum coating thickness shall be per manufacturer recommended minimum thickness.

k) Warranty

(1) All approved products must provide a ten-year performance limited warranty that the installed product will:

(a) Stop deterioration of the lined surfaces by sewer gas induced corrosion.

(b) Prevent infiltration of ground water into the collection system through the lined surfaces.

(c) Stop root intrusion through the lined surfaces.

8. Reconstruct Flow Channel

a) This work shall consist of reconstructing flow channel in accordance with MDOT Specifications, Section 403 (Drainage Structures) and as specified herein.

b) Manhole bases and flow channels shall be formed of fast setting ready mix concrete such as Quickrete Fast Setting Concrete Mix, Product No. 1004-50, or PSAA approved equal.

c) The use of PVC SDR-26 may be used to establish and form the flow channel as approved by the PSAA.

d) All concrete and masonry surfaces must be clean. Grease, organic matter, loose bricks, mortar, unsound concrete, roots and other materials must be completely removed.

e) Contractor shall thoroughly clean existing flow channel and remove any accumulated sediment, debris, and broken or loose concrete and properly dispose of all materials removed from the flow channel.

f) Where the process requires interruption of flow, the Contractor shall provide all necessary diversion or bypass pumping equipment in accordance with this Article to handle the flow for the duration of the flow channel rehabilitation, including curing times where applicable.

g) Contractor shall form and place the concrete mix, meeting these Standards, to create new flow channel up to the springline of the flow channel.

h) Contractor shall install concrete flow channel to the springline of the pipe with a ¾-inch to 1-inch gap at pipe ends provided to maintain joint flexibility.

i) Changes in direction of the sewer and entering branch or branches shall be laid out in smooth curves of the longest possible radius which is targeted to the centerlines of adjoining pipelines. Regardless of differences in entrance and exit elevations, flow channels for all pipes are to be formed to present a smooth transition of flow and shall be subject to the approval of the PSAA.

j) Flow channels and surface surrounding it for sewer structures shall be built and finished in accordance with City Standard Details. All flow channels shall be properly consolidated and hand-trowel finished to a hard finish.

k) All necessary adjustments required to accommodate encountered field conditions for reconstructed flow channel, including all necessary dewatering, shall be included in the cost of the flow channel reconstruction and will not be paid for separately.

III. Street Construction and Repair

A. General

1. The Contractor shall furnish all materials, equipment, tools, and labor necessary to perform the work required by this Section. The Contractor shall also: remove pavement as specified; properly handle all drainage or ground water; provide traffic and pedestrian control, barricades, guards, and warning lights; fill and consolidate the pavement area(s); restore the surface; remove and dispose of surplus excavated material; clean the site of excess materials and construction debris; and maintain the street or other surfaces as specified.

2. All work shall be in accordance with MDOT Specifications except as specified herein.

3. The Contractor shall segment the pavement construction as necessary to satisfactorily complete the work and to safely maintain traffic in accordance with the MMUTCD and PROWAG, or as indicated on the Plans. This includes pavement gapping at drives and intersections if required by the PSAA, to complete the work. This work shall also include the installation and removal of dust palliative, maintenance aggregate, and cold patching mixtures as required.

4. Utility lines may become exposed at, above, or below, the subgrade elevation during machine grading or subgrade undercutting operations. If this occurs, the Contractor shall excavate around, above and/or below the utility lines, as directed, to complete the machine grading or subgrade undercutting work.

5. The Contractor shall remove, and properly dispose of off-site, all abandoned cables, conduit, and pipe encountered at, or above the bottom of any earthwork excavation or undercut. Where the inverts of abandoned conduits or pipe are less than 16 inches below the bottom of any earth excavation or undercut, the conduits and/or pipe shall be removed, and the resulting void filled with material as approved by the PSAA. The fill material shall be compacted to 95% of its maximum unit weight in lifts not exceeding 12 inches.

6. All sewers, and structures, including manholes, gate wells, valve boxes, inlet structures and curbs shall be protected from damage and contamination by debris and construction materials. Structures shall be kept clean and properly covered during the construction. The Contractor shall immediately clean any structures and/or sewers that become fouled with construction debris. The Contractor shall

be responsible for all damages which are caused by sewers or structures which do not operate properly due to the Contractor's operations.

B. Maintaining Traffic and Site Control

1. Traffic maintenance and control shall conform to Section I.C (Transportation Control and Maintenance) of this Article.

2. The Contractor shall use dust palliative and maintenance aggregate to maintain local and emergency access at all locations where pavement has been temporarily removed.

3. The Contractor shall maintain ADA/PROWAG-compliant pedestrian crossings and walkways.

C. Temporary Pedestrian Facilities

1. The Contractor shall construct the TPAR in accordance with PROWAG, MMUTCD, Plans, Article 12 (Standard Details) SD-TPR 1-8, as directed by the Engineer, and the following:

   a) Usable surface of the path shall be a minimum of 48 inches wide with a maximum cross slope of 2 percent. The path, including transitions to the adjacent surface at both ends, shall be free of vertical discontinuities greater than 1/4 inch. Any vertical discontinuities greater than 1/4 inch up to 1/2 inch shall be eliminated or beveled with a slope not steeper than 1:2. If a vertical discontinuity greater than 1/2 inch or a running slope greater than 1:20 occurs on the project, a Temporary Pedestrian Ramp (paid for separately) is required.

   b) If not constructed with asphalt materials, the surface material shall be firm, stable, and anti-slip.

   c) If the surface of the path is constructed from oriented strand board (OSB), plywood, or dimensional lumber, the Contractor shall securely connect all sections with appropriate fasteners to provide a continuous, uniform, flat surface that does not deflect due to pedestrian traffic and materials shall support the weight of pedestrians as well as motorized scooters and wheelchairs.

d) The temporary pedestrian path shall include passing spaces at intervals of 200 feet maximum. The passing spaces shall be of the same material as the rest of the temporary pedestrian path. Passing spaces shall be dimensioned with a minimum width of 60 inches and minimum length of 60 inches. Passing spaces are not required if the path is already 60 inches wide.

e) Clear all debris and construction material from the path throughout its use. Remove snow and ice; use of an approved de-icing agent may be required.

f) Repair or replace the path, or segments thereof, if it becomes uneven, unstable, or displaces due to weather events, construction activities, or other causes.

g) Following the use of the temporary path, the Contractor shall remove and dispose of all materials used to construct the path, and restore the area.

2. Temporary Pedestrian Ramp

a) Within the TPAR, use temporary pedestrian ramps to facilitate pedestrian travel on accessible facilities over curbs or other uneven terrain features with a vertical difference of 1/2 inch or greater.

b) Construct the temporary pedestrian ramp in accordance with the manufacturer's recommendations (if applicable), PROWAG, ADA, MMUTCD, the plans, and the following:

(1) Usable surface of the ramp shall be 48 inches wide and does not deflect due to pedestrian traffic. Apply an anti-skid surface treatment to the useable area of the ramp if it is not made from asphalt materials. The maximum cross slope of the ramp is 2 percent. Both ends of the ramp shall smoothly transition to the adjacent surface, with 1/4 inch or less vertical difference.

(2) Construct the ramp to maintain a longitudinal slope from 1:10 to 1:12 where possible. Otherwise, a longitudinal slope from 1:8 to 1:10 may be used for a maximum rise of 3 inches. Temporary pedestrian ramps with longitudinal slopes greater than 1:8 are prohibited.

(3) Provide a handrail on both sides of the ramp, if required, as stated herein. The top of the handrail shall be between 34 and 38 inches above the surface of the ramp. A minimum width of 36 inches shall be maintained between the handrails, with a minimum clearance of 1.5 inches behind and 18 inches above. When the ramp is exposed to traffic, in lieu of handrails, use a protective edge 2.5 inches minimum height above the ramp surface or 1:10 flare on both sides of the ramp.

(4) Construct the handrail such that the stress applied by a bending moment created by a 250-pound force is less than the allowable stress for the materials and the construction of the handrail. Construct the handrail to withstand the shear stress induced by a 250-pound force. Ensure all fasteners, mounting devices and support structures are also able to withstand shear stress induced by a 250-pound force.

(5) Construct a detectable edging anytime a handrail is required, and anytime the path changes direction. This includes a turn onto the ramp from the path. Detectable edging must begin at a maximum of 2.5 inches above the ramp surface and extend at least 6 inches above the ramp surface.

(6) Provide a clear space (minimum 48 inches by 48 inches) above and below the ramp.

(7) Ramps shall not be located in areas of drainage collection, ponding or running water, which can produce slippery or unsafe conditions. If the ramp is located over a gutter pan or other drainage structure, provide features to facilitate water movement around or under the ramp as approved by the Engineer.

(8) Clear all debris and construction material from the path throughout its use. Remove snow and ice; use of an approved de-icing agent may be required

(9) Repair or replace the ramp if it becomes uneven, unstable, or displaces due to weather events, construction activities, or other causes as directed by the Engineer.

3. Temporary Pedestrian Channelizers

   a) Guide pedestrians along a temporary non-motorized facility and create separation of pedestrians from construction areas near existing facilities by using a temporary pedestrian channelizer. Replace damaged temporary pedestrian channelizers.

   b) Where required, provide a temporary pedestrian channelizer that is crashworthy in accordance with the National Cooperative Highway Research Program Report 350 (NCHRP 350) or Manual for Assessing Safety Hardware (MASH), in addition to meeting the following requirements:

      (1) Design the channelizer to interconnect to maintain continuous delineation along the entire installation; this includes provisions to accommodate non-linear alignment as well as variations in elevation.

      (2) The top surface of the channelizer shall function as a hand-trailing edge and have a height between 32 and 38 inches. The top surface shall have a 2-inch horizontal gap between the top edge and the support (if so equipped), to allow for continuous hand-trailing without obstructions. The bottom edge of the bottom rail shall be a maximum of 2 inches above the surface or the channelizer may have a solid continuous face. Finally, all features on the front face of the channelizers (the face in contact with pedestrians) shall share a common vertical plane.

      (3) Equip both sides of the channelizer with bands of alternating 6-inch-wide orange and white vertical stripes of reflective sheeting. Two bands of sheeting 6 inches tall and a minimum of 36 inches long containing at least two orange and two white stripes each are required. One band placed near the top and one near the bottom if the channelizer section has a solid face. If the channelizer consists of two rails, affix one band of sheeting to each rail. Stripes of reflective sheeting shall be aligned vertically and meet or exceed the requirements of ASTM D4956, Type IV sheeting.

4. Temporary Pedestrian Type II Barricade

   a) Provide a temporary pedestrian Type II barricade that meets the requirements of National Cooperative Highway Research Program Report 350 (NCHRP 350) or Manual for Assessing Safety Hardware (MASH), in addition to meeting the following requirements:

(1) Provide barricade sections at least 43 inches wide, interconnected to provide a continuous accessible tactile barrier. The connection shall include provisions to accommodate non-linear alignment as well as variations in elevation at the installation area.

(2) The top surface of the barricade shall function as a hand-trailing edge and have a height between 32 and 38 inches. The bottom edge of the bottom rail shall be a maximum of 2 inches above the surface or the channelizer may have a solid continuous face. All features on the front face of the barricade (the face in contact with pedestrians) shall share a common vertical plane.

(3) Equip both sides of the barricade with bands of alternating 6-inch-wide orange and white vertical stripes of reflective sheeting. Two bands of sheeting 6 inches tall and a minimum of 36 inches long containing at least two orange and two white stripes each are required. One band placed near the top and one near the bottom if the barricade section has a solid face. If the barricade consists of two rails, affix one band of sheeting to each rail. Stripes of reflective sheeting shall be aligned vertically and meet or exceed the requirements of ASTM D4956, Type IV sheeting.

D. Temporary No Parking Signs

1. This work consists of installing, maintaining and removing of "No Parking" signs and posts as outlined herein and as referenced on the plans. Install "No Parking" signs in accordance with the section 812 of the Michigan Department of Transportation (MDOT) 2012 Standard Specifications for Construction Standard Specifications and the 2011 Michigan Manual of Uniform Traffic Control Devices (MMUTCD).

2. The City will furnish "No Parking" signs to the Contractor at no cost. The Contractor will furnish the sign support and mounting hardware materials in accordance with those specified in section 919 of the MDOT 2012 Standard Specifications for Construction.

3. Place temporary “No Parking” signs prior to the commencement of any construction activity as directed by the Engineer. Obtain a permit for “Temporary Permission of Reserve Parking Lane for Work Related Purposes” from the City’s Engineering Unit. Obtain this permit a minimum of five (5) business days prior to the posting of “No Parking” signs.

4. Securely bolt the signs to the sign supports as directed by the Engineer. Imbed all sign supports at least two feet into the ground and ensure that installations are stable and safe. Provide a minimum six feet and maximum seven feet of clearance between the bottom of the installed sign and the ground. Place signs at intervals no greater than 75 feet, and as necessary to eliminate parking in the construction area.

5. Install temporary "No Parking" signs be in accordance with the permit, as directed by the Engineer, and at least 48 hours prior to the proposed start-of-work/enforcement date. Cover temporary "No Parking" signs to allow for on-street parking until 48 to 24 hours prior to the start of the work. Cover temporary "No Parking" signs during non-working periods longer than 72 hours. Prior to beginning work and during construction, cover existing/permanent "No Parking" signs having messages that conflict with those that are temporary. Remove temporary "No Parking" signs and posts upon the completion of work at each location. Return signs to the City upon completion of all contract work, and/or when no longer needed.

E. Pavement Removal

1. General

   a) The Contractor shall saw cut and remove pavement as shown on the Plans, as marked in the field, and as directed by the PSAA.

   b) The Contractor shall remove and properly dispose of all excavated material and debris, including all asphalt and concrete in conformance with these Standards. The Contractor shall not stockpile excavated materials overnight on or adjacent to the site.

   c) In areas where pavement removal is to be performed adjacent to existing pavement that is to remain in place, the pavement shall be saw cut prior to removal. Backhoe teeth, jackhammers equipped with spike points, milling machines, and backhoe mounted wheel cutters shall not be used.

   d) Damage to adjacent pavement, pavement base, subbase, curb, curb and gutter, sidewalk, utility structures, or other site features, due to removal operations, shall be repaired by the Contractor at the Contractor's expense, as directed by the PSAA.

   e) The Contractor shall remove pavements full depth unless otherwise shown on the plans or directed by the PSAA.

f) Paving bricks within the right-of-way shall be salvaged and neatly stacked/stockpiled by the Contractor. Paving bricks not being reinstalled shall be delivered by the Contractor to a City-owned facility as directed by the PSAA.

g) At various times throughout the work, the PSAA may direct the Contractor to use smaller and/or lighter equipment, or to defer certain work tasks in order to protect the grade and/or adjacent areas.

2. Bituminous Pavement Cutting and Removal

a) The proper disposal of asphalt, concrete and all other excess excavated material shall be the responsibility of the Contractor. At no time shall the Contractor stockpile excavated material overnight on or adjacent to the site.

b) All pavement cuts shall be made full depth and perpendicular to, or parallel with, the centerline of the pavement.

c) For utility construction patches or repair, the existing pavement shall be removed to provide for a replacement of not less than 1 foot wider and longer than the utility trench on each side. All patches shall be rectangular (four-sided in shape) and performed in accordance with Section III.M (Patching) of this Article. If these removals will result in existing pavement less than 5 feet wide from the patch to a lane line, gutter line, edge-of-metal, or existing patch, this existing pavement shall also be removed to the lane line, gutter line, edge-of-metal, or existing patch.

d) The pavement shall be removed full depth unless otherwise specified on the Plans.

e) Butt joints must be saw cut straight (if not already straight), cleaned, and bond coated just prior to bituminous paving.

3. Cold-Milling for Concrete Curb and Gutter Reveal

a) This work consists of cold-milling existing concrete curb and gutter areas overlaid with HMA material to fully reveal the curb and gutter.

b) The bituminous surface shall be removed to the depth, width, grade and cross section as indicated on the Plans. Following the initial cold-milling specific to the curb and gutter reveal, and ahead of mainline cold-milling, Contractor shall complete subsequent handwork and/or necessary machine work to remove remaining HMA overlay material from the gutter pan and dispose of this material properly. Upon completion of the work, a safety edge of 1 on 2 shall be established along the edge of metal.

c) Completion of this work shall allow for a condition inspection in advance of curb repair or replacement.

d) The equipment for removing the bituminous surface shall be capable of accurately removing the bituminous material having a thickness of up to 4 inches with precise and variable depth control, in one or more passes, to the grade and cross section shown on the Plans. The equipment shall also have an effective means for removing excess material from the surface and for preventing any dust resulting from the operation from escaping into the air. Cold-milling machines shall have complete automation for slope control when required by the PSAA.

e) The bituminous surface removal shall be completed without excessive damage to concrete gutter pan below.

4. Cold-Milling of Bituminous Pavement

a) The bituminous surface shall be removed to the depth, width, grade and cross section as indicated on the Plans.

b) The equipment for removing the bituminous surface shall be capable of accurately removing the bituminous material having a thickness of up to 4 inches, in one or more passes, with precise and variable depth control to the grade and cross section shown on the Plans. The equipment shall also have an effective means for removing excess material from the surface and for preventing any dust resulting from the operation from escaping into the air. Cold-milling machines shall have complete automation for slope control when required by the PSAA.

c) After milling, locations may exist where it is necessary for the Contractor to remove and/or reshape and recompact the existing roadbed materials. When these areas are encountered, the Contractor shall provide the necessary personnel and equipment to properly construct the roadway to the cross-section as indicated on the Plans or as directed by the PSAA. This may require the use of a blade grader and vibratory roller, or equivalent equipment to accurately grade and compact the roadbed to the required cross-section and density as shown on the Plans, as detailed in the Specifications, or as determined by the PSAA. Further, additional materials may be required to be added or removed in order to properly complete the work.

d) Where material is removed below the grade specified, the resulting void or depressions shall be backfilled with bituminous patching material and compacted by the Contractor in accordance with MDOT Specifications, Subsection 501.03.C.9 (Hand Patching). This work shall be done at the Contractor's expense.

e) After initial milling, the finished work will be inspected by the PSAA. The PSAA may choose to have additional bituminous milling performed by the Contractor, as Cold-Milling HMA Surface, Plunge Cut. This work may be repeated more than once to achieve satisfactory results where applicable.

f) The number of intersections and areas to be milled may be increased or decreased by the PSAA as necessary to complete the work.

g) Where Cold-Milling HMA Surface, Plunge Cut is required, areas less than the width of the on-site paver equipment shall be restored by hand patching.

5. Concrete Pavement, Curb & Gutter, Sidewalk, and Drive Removal

a) The limits of removal of concrete pavement, curb, gutter, sidewalk, sidewalk ramps, drive openings and drives shall be as specified on the Plans and as determined by the PSAA.

b) The removal of pavement, curb & gutter of any type, sidewalks, sidewalk ramps, drive openings and drives shall include saw cutting at the removal limits as indicated on the Plans and as determined by the PSAA. All cuts shall be made at the locations as determined and/or marked by the PSAA.

c) Concrete pavement to be removed as a result of utility construction shall be removed to the nearest joint to provide for a replacement of not less than 1 foot wider and longer than the utility trench on each side. If the concrete pavement has a bituminous overlay, the bituminous removal limits shall be as required in Section III.E.2 of this Article (Bituminous Pavement Cutting and Removal).

d) Where existing concrete curb or curb & gutter is to be replaced on a street with a concrete (or brick) base, the PSAA may direct the Contractor to remove a 1-foot to 2-foot wide, full-depth section of pavement and pavement base from immediately in front of the curb & gutter. As part of this pavement/base removal, the Contractor shall perform additional (double) full-depth saw cutting along the entire removal limits and shall take sufficient care so as not to damage and/or disturb any adjacent pavement, pavement base, and/or any other amenities. The removals shall be a sufficient width and depth to allow for the placement and removal of the curb and gutter formwork. After the removal of the formwork, the Contractor shall replace the concrete base to its original thickness and elevation(s).

e) Curb and gutter, sidewalk, sidewalk ramps, drive openings and drives shall be replaced within 2 working days of their removal. Areas that have been excavated and are not yet up to finish grade shall be adequately protected with lighted barricades or fencing.

f) Removed materials not incorporated into the work shall become the property of the Contractor and shall be properly and immediately disposed of off-site by the Contractor at the Contractor's expense. Removed materials may not be stockpiled overnight on or adjacent to the site.

g) The removal of subbase or subgrade, not authorized by the PSAA, shall be replaced and compacted by the Contractor at the Contractor's expense, with materials as specified by the PSAA.

F. Subbase and Base Removal and Replacement

1. All unsuitable subbase and/or base material beneath areas of bituminous or concrete pavement, shall be removed for the full depth of the unsuitable material at the direction of the PSAA.

2. The unsuitable material shall be replaced with new material as specified by the PSAA and compacted to the required density.

3. The removal of subbase or subgrade, not authorized by the PSAA, shall be replaced and compacted by the Contractor at the Contractor's expense with materials specified by the PSAA.

G. Underdrain Installation

1. Geotextile wrapped underdrain shall be installed as shown on the Plans or as directed by the PSAA. The installation of underdrain shall occur after establishment of final subgrade and shall precede normal road construction activities including, but not limited to; construction of sand subbase, aggregate base course, curb and gutter placement/replacement, and road paving.

2. The underdrain shall be installed at the line, grade, and depth as shown on the Plans. The Contractor shall maintain line and grade by means of an automatic grade and alignment control system or string control.

3. Underdrain trench shall be in conformance with Article 12 (Standard Details), SD-TD-5 (Typical Edge Drain Trench) of these Standards.

4. Bedding and backfill shall be compacted-in-place to not less than 95 percent of its maximum unit weight, as determined by the AASHTO T 180 (Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop).

5. The trench shall be constructed to have a minimum width of 18 inches. The underdrain shall be placed on a 3-inch thick bedding, with subsequent lifts placed at a maximum thickness of 12 inches to the bottom of the aggregate base course grade.

6. Upstream ends of the pipe shall be closed with manufactured caps to prevent entrance of foreign material. All couplings, tees and other fittings shall be manufactured for the intended purpose and shall be installed to prevent any infiltration of trench backfill material. Geotextile wrap shall be pulled over the end of the underdrain, overlapped and taped.

7. During the construction of underdrain, it may be necessary to terminate construction due to conflicts with buried obstructions or for other reasons. The PSAA will review conflicts on a case-by-case basis and shall decide where to continue or terminate underdrain runs.

8. All downstream ends of the underdrain shall be tapped into a storm sewer structure as shown on the Plans or as determined by the PSAA.

H. Subgrade, Subbase, and Base Construction

1. Pulverizing Bituminous Pavement

   a) Equipment used for pulverizing shall have continuously variable depth control adjustments and shall be capable of pulverizing, in a single pass, up to 4 inches of bituminous material. The cutting drums shall be enclosed and shall have a sprinkling system around the reduction chamber for pollution control and for preventing any dust resulting from the operation from escaping into the air.

   b) The bituminous pavement shall be scarified and uniformly pulverized to a maximum size of 1½ inches, and to the depth indicated on the Plans or as specified by the PSAA. The pulverized material shall be graded, shaped and compacted to the line and grade specified on the Plans or as determined by the PSAA. Excess material not incorporated into the finished work shall become the property of the Contractor and shall be removed and immediately disposed of off-site by the Contractor at the Contractor's expense.

   c) The Contractor shall perform final grading, compaction and proof rolling of the pulverized material.

   d) Prior to placing a bituminous overlay over a pulverized bituminous pavement, the entire surface shall be compacted to not less than 98% of its maximum unit weight as determined by the AASHTO T 180 test, or as determined by the PSAA.

2. Machine Grading

   a) The Contractor shall maintain access to all drives and entrances within the construction limits at all times.

b) Contractor shall grade around mailboxes, trees, light poles, power poles, and other similar items that are to remain in place. The Contractor shall be responsible for any damage caused to such structures. Work shall be coordinated with utility companies and any others that need to complete work within the project limits.

c) Earth grades shall be constructed by saw cutting and excavating and disposing of existing bituminous pavement, concrete pavement, sidewalks, curbs, gutters, culverts, soil, rock, vegetation (including trees, stumps, brush, shrubs, roots, and logs) or other deleterious materials; removing and salvaging or disposing of topsoil; and by placing and compacting existing approved fill material or imported MDOT Class II Granular Material.

d) The Contractor shall shape and prepare the subgrade to the grades and cross-sections indicated on the Plans or as directed by the PSAA.

e) Contractor shall proof roll the subgrade and perform all other work necessary to prepare for the placement of the sand subbase, aggregate base, underdrains and all other items to be constructed. The subgrade shall be prepared to ensure uniform support for the pavement structure.

f) All areas of the work shall be kept graded and well drained at all times. All areas of the work that become damaged as a result of rain shall be repaired by the Contractor at the Contractor's expense.

g) In areas where the existing grade is to be cut to achieve the proposed subgrade elevation (cut-sections), rubber-tired equipment including scrapers, wheel loaders, and graders may be used but only to within 2 feet above the subgrade elevation.

h) After the grade has been cut to within 2 feet above the subgrade elevation, all proposed underground utilities and underdrains within the 1:1 influence of the proposed pavement section shall be installed.

i) Following the installation of utilities, the remaining cutting shall be performed using only tracked equipment. The Contractor shall only excavate an amount of the "grade" that the Contractor can maintain and protect and keep well drained at all times.

j) In areas where the existing grade is to be filled to achieve the proposed subgrade elevation (fill-sections), filling shall not take place until all proposed underground utilities within the 1:1 influence of the proposed pavement have been installed. However, if the existing grade does not provide the required minimum cover for a portion of any utility, filling for the road subgrade shall be performed to provide such minimum cover. This filling shall be for the entire width of the roadway (to 1 foot behind the curb) at a length as determined by the PSAA.

k) Fill sections shall be constructed using suitable approved material obtained from the site where available or imported MDOT Class II Granular Material.

l) Fill shall be placed only after topsoil and other unsuitable material, as determined by the PSAA, has been removed from the area to be filled.

m) Fill shall be placed in 6-inch lifts and compacted to 95% of the maximum unit weight as determined by the AASHTO T 180 test.

n) The Contractor is advised there may be imbalances between the amount of earth cut which is suitable for reuse as fill, and the amount of earth needed to construct the subgrade to the lines and grades shown on the Plans or as determined by the PSAA. The Contractor shall make provisions for such imbalances and shall include all cost of importing, furnishing, placement and compaction of either MDOT Class II Granular or approved clay/cohesive soil as directed by the PSAA as well as the cost of all stockpiling and re-handling of imported and/or on-site materials as necessary to complete the work of constructing the subgrade to the cross-section as shown on the Plans.

o) The finished subgrade shall be graded as shown on the Plans or as determined by the PSAA. A tolerance that allows for gradual, isolated variations of no more than ¾ inch above or 1 inch below the specified grade will be allowed. Variations will be corrected with the placement of compacted granular subbase. The tolerances for the pavement structure strata are not additive.

p) The entire subgrade, whether in cut or fill sections, shall be compacted to not less than 95% of the maximum unit weight as determined by the AASHTO T 180 test, to a depth of at least 9 inches.

q) If in the opinion of the PSAA, the subgrade cannot be compacted to 95% as specified above, the PSAA may authorize or direct the use of other methods to attain compaction such as subgrade manipulation, scarifying, plowing, disking, subgrade undercutting or other repair method such as subgrade stabilization fabric.

r) Immediately following the completion of the grading and compaction of the subgrade as required above, the Contractor shall notify and allow the PSAA to inspect the finished subgrade for soft or uncompacted areas, and for areas of unsuitable and deleterious soils. The Contractor shall proof roll the grade or other surfaces as directed by the PSAA.

s) Equipment for proof rolling shall be a pneumatic-tired roller and shall have suitable body for ballast loading with such capacity that the gross load may be varied between 25 and 40 tons. The Contractor may use an appropriately loaded single axle or tandem axle dump truck in lieu of the specified roller to achieve the loads specified above.

t) The proof rolling vehicle shall be operated at walking speed. The proof roller shall make one or more passes to complete coverage of the completed subgrade. Where proof rolling shows the subgrade to be unstable, such areas shall be undercut and repaired as determined by the PSAA.

u) Following the completion and approval of all undercuts required as a result of the proof rolling, the subgrade shall be considered "established."

v) The PSAA shall issue to the Contractor a "Permit to Place" for the aggregate base. If the Contractor does not immediately place the aggregate base, the Contractor shall be solely responsible for the protection of the subgrade and shall conduct operation(s) and provide the necessary equipment to ensure the satisfactory completion of the work without damaging the subgrade. This may require the transportation and movement of materials over additional distances in lieu of driving upon the unprotected or partially unprotected, subgrade

w) The Contractor shall not operate rubber-tired equipment on the "established" subgrade unless specifically authorized in writing by the PSAA.

x) The Contractor shall be responsible for the maintenance of the subgrade. Any damage to the subgrade due to the Contractor's activities or the activities of its subcontractors, shall be repaired by the Contractor at the Contractor's expense including any additional undercuts required after the subgrade had been established.

y) The PSAA shall have the authority to suspend the work wholly or in part for any periods of time as may be deemed necessary due to unsuitable weather or such other conditions which are considered unfavorable for the prosecution of the work or for any other condition or reason deemed to be in the best interest of the project. The Contractor shall not suspend work without giving prior written notification to the PSAA.

3. Subgrade Undercutting

a) After the Contractor has completed rough grading the subgrade, the PSAA shall inspect the grade and witness the proof rolling to determine if undercutting is needed and identify the limits of any such undercutting.

b) After the Contractor has excavated the undercut area to the depth determined by the PSAA, the excavated area shall be evenly graded and recompacted to not less than 95% of the soil's maximum unit weight as determined by the AASHTO T 180 test. Any excess removed material shall become property of the Contractor and shall be properly and immediately disposed of off-site by the Contractor at the Contractor's expense.

c) Undercuts required as a result of the Contractor's failure, in the opinion of the PSAA, to provide proper drainage or protect the subgrade once it has been "established" (as described in this Section) shall be completed by the Contractor at the Contractor's expense.

d) Subgrade Undercutting-Type I shall be backfilled with selected clay or other similar approved material as approved by the PSAA.

e) Subgrade Undercutting-Type II shall be backfilled with MDOT Class II Granular Material or other material(s) as approved by the PSAA. Type II Undercuts shall be constructed such that they are drained by available underdrain.

f) Subgrade Undercutting-Type III shall be backfilled with MDOT 21AA dense-graded aggregate.

4. Construction of Subbase and Base Courses

   a) Prior to the placement of the granular subbase and/or the aggregate base course, the Contractor must obtain a "Permit to Place" from the PSAA. This "Permit to Place" shall be issued once subgrade has been compacted and graded and approved by the PSAA.

   b) The base, subbase and subgrade shall be shaped to the specified crown and grade and maintained in a smooth condition. If the Contractor's equipment should cause any rutting or other damage in the base, subbase or subgrade, the equipment will be immediately restricted from the grade and the Contractor shall restore the area to the satisfaction of the PSAA at the Contractor's expense.

   c) The subbase and base course material shall be placed in uniform layers to such a depth that when compacted, the material will have the grade and cross section as shown on the Plans or as determined by the PSAA. The loose measure of any layer shall not be more than 9 inches nor less than 4 inches.

   d) The granular subbase or aggregate base course shall not be placed when there are indications that the mixture may become frozen before the specified density is obtained. At no time shall the material be placed on frozen subbase or subgrade.

   e) All materials shall be handled and/or stockpiled on-site in a manner that minimizes segregation. Base course aggregate shall be deposited from trucks or through a spreader in a manner approved by the PSAA that will minimize segregation of material. Should it be necessary, the Contractor may be required to wet the materials prior to and/or during placement to minimize segregation and to aid in compaction of the material.

   f) Except for the use of vibratory rollers, the granular subbase shall be placed and finished with the use of tracked equipment. The finished granular subbase shall be constructed to the grade and cross section as shown on the Plans or determined by the PSAA. A tolerance that allows for gradual isolated variations of the top surface of no more than ½ inch above or below the specified grade will be allowed. These variations will be corrected with the placement of the successive aggregate base. The tolerances for the pavement structure strata are not additive. The granular subbase shall be compacted to 95% of its maximum unit weight as determined by the AASHTO T 180 test.

g) The aggregate base shall be placed and rough-graded with the use of tracked equipment. Fine grading may be performed with the use of either tracked equipment or a rubber-tired blade grader. The finished aggregate base shall be constructed to the grade and cross section as shown on the Plans or determined by the PSAA. A tolerance that allows for gradual, isolated variations of the top surface of no more than ¼ inch above or ½ inch below the specified grade will be allowed. The aggregate base shall be compacted to 98% of its maximum unit weight as determined by the AASHTO T 180 test.

h) No pavement course, concrete curb and gutter, concrete driveway or driveway opening shall be placed until the subbase has been compacted to not less than 95 percent, and aggregate base course to not less than 98 percent of their respective maximum dry densities and until a "Permit to Place" has been issued by the PSAA.

i) Manholes, valve boxes, monument boxes, inlet structures and curbs shall be protected from damage. All utility structures of any type shall be properly covered at all times during the construction. All inlet structures shall have inlet filters installed and properly maintained. Upon completion of each days' work, any extraneous material in manholes, water valve boxes, inlets, catch basins or any other utility structure resulting from the Contractor's operations shall be removed and properly disposed of. The Contractor may be charged for cleaning and damages resulting from accumulated construction debris in the utility structures.

j) The Contractor shall comply with the requirements as specified in Section V (Soil Erosion and Sedimentation Control) of this Article.

5. Geotextile Fabrics

a) Geotextile fabrics consist of geotextile separator fabric, geotextile stabilization fabric, or geotextile filter fabric and shall meet the requirements as shown on the Plans or as Specified elsewhere. Geotextile fabric shall be placed as shown on the Plans or as determined by the PSAA.

b) Geotextile fabric shall be wrapped in a heavy duty covering which will protect the fabric from direct sunlight, ultraviolet rays, temperatures greater than 140° F, mud, dirt, dust, debris and the elements.

c) Prior to installation of any geotextile fabric, Contractor shall verify that the surfaces to receive fabric are prepared to relatively smooth grades, free of obstructions, depressions, debris and soft or low-density pockets of material. All defects and/or deficiencies shall be corrected prior to installation of fabric so that fabric will not be damaged.

d) Prior to installation, Contractor shall inspect all geotextile fabric for defects, rips, holes, contamination, or deterioration and replace all defective geotextile fabric as directed by the PSAA.

e) Mechanical or manual laydown equipment capable of handling full rolls of fabric and laying the fabric smoothly, without wrinkles or folds shall be used. The equipment shall be in accordance with the fabric manufacturer's recommendations or as approved by the engineer.

f) Geotextile fabric shall be placed on the prepared subbase in the manner and at the locations shown on the Plans. Fabric shall be laid smooth and free of tension, stress, folds, wrinkles or creases.

g) The fabric strips shall be placed to provide a minimum overlap of 24 inches for each joint. Fabric shall be placed so that the upper strip will overlap the next lower strip. Securing pins with washers shall be installed through both strips of overlapped fabric along a line through the midpoint of the overlap at center to center spacings as recommended by manufacturer unless otherwise indicated on the Plans. Washers shall bear against fabric to secure firmly to subbase.

h) Geotextile shall be folded and cut to conform to the shape of the curves. The fold or overlap shall be in the direction of construction and held in place by pins, staples, or piles of subbase or aggregate. Additional pins shall be installed as necessary to prevent slippage of the fabric.

i) Securing pins shall be steel, 3/16-inch minimum size, pointed at one end, of lengths as recommended by manufacturer unless otherwise indicated on the Plans, but not less than 18 inches long. Washers shall have an outside diameter of not less than 1½ inches.

j) Work shall be scheduled so that fabric is covered with materials specified within two days maximum after placing fabric. Fabric shall be protected from damage until placing other material.

k) Geotextile fabric shall be inspected prior to covering to ensure that the geotextile has not been damaged (i.e., holes, tears, rips) during installation. Damaged geotextiles, as identified by the PSAA, shall be repaired immediately. The area shall be covered with a geotextile patch that covers entirely and extends beyond the damaged area approximately 3 feet.

l) Placement procedures shall be modified to eliminate further damage from taking place (i.e., increase initial lift thickness, decrease equipment loads, etc.). Repair or replacement of all damaged geotextile shall be at Contractor's expense.

I. Concrete Curb & Gutter, Sidewalk, and Drive Construction

1. General

a) Concrete curb, curb and gutter, sidewalks and driveways shall be constructed as shown on the Plans and Standard Details.

b) Concrete mixtures and curing compound shall meet the Materials requirements of Articles 5 (Streets), and 6 (Drive Approaches, Active Transportation Facilities, & Lawn Extensions) of these Standards.

c) Prior to placing any concrete, the subbase and/or aggregate base shall be completed within the limits of the work area in accordance with Section III.H (Subgrade, Subbase, and Base Construction) of this Article.

d) The subbase and/or aggregate base shall be trimmed to final elevation before placing the curb, curb and gutter, or driveways. The curb, curb and gutter, and driveways shall not be placed on a pedestal or mound.

e) The subbase and/or aggregate base and adjacent concrete shall be wet down prior to placement of concrete to prevent water loss through the road base. If a construction joint is required, the existing concrete surface is to be cleaned with compressed air to expose the aggregate in the concrete.

f) Sidewalk and curb and gutter joints and spacing shall be constructed in accordance with current MDOT Ramp Detail R-28 and Article 12 (Standard Details), SD-DS-4 (Sidewalk and Curb & Gutter Joints) of these Standards.

g) Water shall not be added to the concrete surface to aid in finishing.

h) After finishing operations have been completed on the freshly placed concrete, and immediately after the free water has left the surface, the surfaces shall be completely coated and sealed with a uniform layer of white membrane curing compound, unless otherwise specified. This curing compound shall meet the requirements of MDOT Specifications, Section 903 (Admixtures and Curing Materials for Concrete), and shall be applied in accordance with MDOT Specifications, Subsection 602.03.M (Curing).

i) The concrete items being placed shall not be opened to construction or vehicular traffic until the concrete has reached 85% of its design flexural strength in accordance with ASTM C293 (Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)). Sampling, molding test specimens, curing, and testing shall meet the approval of the PSAA.

2. Concrete Curb & Gutter

a) All curb and gutter shall be constructed prior to placement of street pavement unless integral with a concrete pavement. A minimum 7-day cure of the concrete curb and gutter shall be required before paving of adjacent bituminous or concrete pavement.

b) Concrete curb and gutter shall be finished in a neat and workmanlike manner with a light broom finish. The top-of-curb or edge-of-metal shall not vary by more than 3/16 inch in 10 feet when checked with a 10-foot straight edge. The balance of the exposed surfaces shall not vary more than ⅜ inch from the Plan elevations, alignment and typical cross section. Variation from these requirements will be grounds for rejection and replacement of the curb and gutter.

c) Any curb and gutter which cracks (other than at joints), is marked by graffiti, or otherwise damaged before it has been accepted by the PSAA, shall be replaced by the Contractor at the Contractor's expense.

3. Concrete Sidewalk and Ramps

a) All concrete sidewalks outside of the Downtown Development Authority (DDA) limits must be constructed in accordance with Article 12 (Standard Details), SD-DS-5 (Sidewalk Cross Section) of these Standards.

b) Sidewalks within the DDA shall be constructed in accordance with Article 12 (Standard Details), SD-DDA-1 through SD-DDA-8 of these Standards.

c) Sidewalk ramps shall be constructed in accordance with MDOT Standard Detail R-28.

d) The concrete sidewalk shall be finished in a neat and workmanlike manner with a light broom finish.

e) The Contractor is responsible to construct all sidewalk, sidewalk ramps, curbs, and all other concrete items within current ADA/PROWAG guidelines and standards.

f) The detectable warning surface for sidewalk ramps shall be colored as Federal Number 22144 (frequently referred to as "Colonial Red" or "Brick Red"). The detectable warning tiles shall meet the following material properties, dimensions, and tolerances using the most current test methods:

(1) Water Absorption: Not to exceed 0.35% when tested in accordance with ASTM D570 (Standard Test Method for Water Absorption of Plastics).

(2) Compressive Strength: 18,000 psi minimum, when tested in accordance with ASTM D695 (Standard Test Method for Compressive Properties of Rigid Plastics).

(3) Tensile Strength: 10,000 psi minimum, when tested in accordance with ASTM D638 (Standard Test Method for Tensile Properties of Plastics).

(4) Flexural Strength: 24,000 psi minimum, when tested in accordance with ASTM D790 (Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials).

(5) Flame Spread: 25 maximum when tested in accordance with ASTM E84 (Standard Test Method for Surface Burning Characteristics of Building Materials).

(6) Gardner Impact: 50 in.-lbs. minimum, when tested in accordance with Geometry "GE" of ASTM D5420 (Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact).

(7) Accelerated Weathering of Tile when tested by ASTM G155 (Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials) or ASTM G151 (Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources) shall exhibit the following result: $\Delta E<6.0$ as well as no deterioration, fading or chalking of surface when exposed to 3000 hours minimum exposure.

(8) Wheel Loading: The cast-in-place tile shall be mounted on a concrete platform with a ½-inch airspace at the underside of the tile top plate then subjected to the specified maximum load of 10,400 lbs., corresponding to an 8,000 lb. individual wheel load and a 30% impact factor. The tile shall exhibit no visible damage at the maximum load of 10,400 lbs.

(9) Salt and Spray Performance of Tile and Adhesive System when tested to ASTM B117 (Standard Practice for Operating Salt Spray (Fog) Apparatus) not to show any deterioration or other defects after 100 hours of exposure

g) Any sidewalk which cracks (other than at joints), is marked by graffiti, or otherwise damaged before it has been accepted by the PSAA shall be replaced by the Contractor at the Contractor's expense.

4. Concrete Drives

a) Concrete drives shall be finished in a neat and workmanlike manner, with a light broom finish.

b) Concrete drives shall conform to Article 12 (Standard Details), SD-DS-1 through SD-DS-5 of these Standards, as appropriate.

c) Concrete drive approaches shall be placed on either aggregate base course or a sand subbase as shown on the Plans or as directed by the PSAA.

d) The method of forming joints shall be approved by the PSAA prior to construction.

e) Any drive that cracks (other than at joints), that is marked by graffiti, or otherwise damaged before it has it has been accepted by the PSAA, shall be replaced by the Contractor at the Contractor's expense.

J. Bituminous Pavement Construction

1. Cleaning

   a) Before placing the bond coat, the existing pavement surface including joints, cracks and edges shall be thoroughly cleaned to a minimum depth of 1 inch with compressed air, vacuum cleaning type equipment, or other approved mechanical or hand methods to remove all dirt, debris, and all foreign material. The equipment shall have an effective means for preventing any dust resulting from the operation from escaping into the air.

   b) The Contractor is required to spray an approved vegetation killer on all vegetation, prior to placement of bituminous overlay.

2. Bituminous Placement

   a) The materials for this work shall meet the requirements of Article 5 (Streets), Section II (Materials Standards) of these Standards. The job mix design formula must be submitted to, and approved by, the PSAA prior to commencement of paving operations.

   b) Prior to the placement of the bituminous pavement, the Contractor must obtain a "Permit to Place" from the PSAA. This "Permit to Place" shall be issued once the base course section has been approved by the PSAA as to its compaction and grading. In addition, the final structure adjustments must be approved by the PSAA prior to issuance of the "Permit to Place" for the wearing course.

   c) The Contractor shall apply a bond coat material at an application rate as approved per MDOT Specifications, Subsections 501.02 (Materials) and 501.03 (Construction), on all areas to be paved, except the gravel base, prior to the placement of bituminous material. Care shall be taken to apply a uniform bond coat on all surfaces that are to be paved and to avoid covering the face of curbs, sidewalk or other surfaces that are not to be paved. After September 15, the bond coat shall not be diluted by more than 25%.

   d) The Contractor is not permitted to place bond coat or pave when rain is threatening or when the moisture on the existing surface would prevent satisfactory bonding. Paving operations shall be halted at any time of the day if rain starts. Any quantity of unused bituminous material is the complete responsibility of the Contractor.

e) The Contractor shall schedule the paving operation to avoid longitudinal cold joints. In all cases, the Contractor shall pave the primary road's through-traffic lanes ("main line") first, from the point-of-beginning to the point-of-ending. All other paving including but not limited to acceleration and deceleration lanes, intersection approaches, and center left-turn lanes shall be paved following completion of the main line paving, unless authorized by the PSAA prior to pavement placement.

f) The Contractor shall have a 10-foot long straight edge on every paver. Complete automation shall be required on all main line pavers. In addition to all MDOT Specification requirements, the Contractor may be required by the PSAA to use two 30-foot grade referencing skis at any time during main line paving. The use of rubber-tired pavers must be approved by the PSAA except for bituminous patching and shared use path paving.

g) The rate of the paver shall be such that the paving operation will be continuous, resulting in no transverse cold joints, but shall never exceed the rate of 50 feet per minute. The Contractor shall coordinate the paving operation so as to have enough trucks available to keep the paver(s) moving continuously at all times.

h) Wearing and leveling courses shall be placed in lifts of 1½ inches to 2 inches in thickness, and base material in lifts of 2 inches to 3 inches in thickness, as indicated on the Plans or as directed by the PSAA. The wearing course shall be placed with a ¼-inch lip at the gutter edge-of-metal.

i) If the PSAA directs the Contractor to place a feather joint, it shall be constructed so as to vary the thickness of the asphalt from zero inches to the required paving thickness of approximately 1½ inches over a distance of 10 feet. The Contractor shall rake the larger pieces of aggregate out of feather joints prior to compaction.

j) All bituminous thickness dimensions shall be compacted in place depth.

k) The Contractor shall carefully observe the paving operation for signs of faulty mixtures. Points of weakness in the surface shall be removed or corrected by the Contractor prior to paving any subsequent lift of bituminous material. Such corrective action may include removal and replacement of thin or contaminated sections of pavement including sections that are weak or unstable.

l) Once the Contractor or Contractor's representative is notified by the PSAA that the material being placed is out of allowable tolerances, or that there is a problem with the paving operation, the Contractor shall stop the paving operation at once and the Contractor will not be permitted to continue placing bituminous material until again authorized by the PSAA.

m) In-place density of each layer of bituminous mixture shall be compliant with MDOT Special Provision for Acceptance of Hot Mix Asphalt Mixture on Local Agency Projects.

n) No traffic shall be allowed on newly placed asphalt surfaces until rolling has been satisfactorily completed and the surface has cooled sufficiently to prevent damage from traffic. This is to be accomplished by traffic regulators (flaggers) and by relocating traffic control devices to prevent traffic from entering the work area until such time that traffic can be safely maintained without damaging the new construction. The Contractor shall provide flaggers in sufficient number to maintain traffic as required to keep traffic off sections being surfaced and provide for safe travel at all times as determined by the PSAA.

o) HMA shall be placed in compliance with MDOT Specifications, Subsection 501.03.I (Weather Limitations).

p) HMA shall comply with the QA/QC requirements as defined by the MDOT Special Provision for Acceptance of Hot Mix Asphalt Mixture on Local Agency Projects.

K. Bituminous Finish Wedging

1. The material shall meet the requirements of Article 5 (Streets), Section II (Materials Standards) of these Standards, with specific HMA mix as directed by PSAA.

2. The Contractor shall construct bituminous finish wedges as shown on the Plans and at all drive approaches, sidewalk ramps, and other areas where wedging is needed to make a good vertical and/or horizontal transition between old construction and the new pavement surface and/or to eliminate areas of standing water in the wearing surface.

3. Prior to placement of wedging material, the surface shall be cleaned with compressed air or vacuum cleaning type equipment.

4. The Contractor shall complete the wedging of driveway approaches within 2 days after the placement of the finished wearing course.

5. The Contractor shall construct feather joints at all wedges (including the raking out of large pieces of aggregate) to provide a high-quality riding surface and appearance.

L. Concrete Pavement Construction

1. Concrete Placement

   a) Concrete pavement may be constructed adjacent to new or existing concrete curb, curb and gutter, or with integral curb and gutter.

   b) Where the new concrete pavement is to be constructed adjacent to curb of any type, the Contractor shall install epoxy-coated lane ties or deformed bars in accordance with MDOT Specifications, Subsection 602.03. F (Constructing Joints).

   c) The Contractor shall perform all concrete placement operations in weather that is suitable for the successful placement and curing of the concrete materials. Concrete shall not be placed during periods of active precipitation.

   d) The Contractor shall complete all needed formwork, base and/or sub-base preparation, and any other related items that are deemed necessary for the proper completion of the work.

   e) Concrete raised devices (e.g., speed hump, speed table, raised intersection) shall be installed per Article 12 (Standard Details), SD-VT-1 through SD-VT-7, of these Standards, at locations identified in the plan set or field marked by the PSAA. Contractor shall saw cut the full depth of existing pavement at the device limit for removal and placement. Remove existing pavement and shape base aggregate to maintain minimum thickness as specified, compacted to 95% of its maximum dry density. Place form at the device limit and install device as specified. Broom finish and place curing compound.

   f) The Contractor shall not commence the placement of concrete until they receive a "Permit to Place" for the pavement from the PSAA. The PSAA's approval of the Contractor to place concrete shall not relieve the Contractor of their responsibility for the proper placement and protection of the concrete materials or its long-term performance.

g) During periods when precipitation is threatening, Contractor shall provide durable plastic sheeting, approved by the PSAA, in sufficient quantity to cover and protect all freshly placed concrete such that precipitation does not come into contact with the concrete. The Contractor shall arrange the placement of the plastic sheeting such that the surface of any freshly placed concrete is not marred by contact with the plastic. Any seams in the plastic sheeting shall be watertight. The Contractor shall place adequate supports along and over the freshly placed concrete to prevent contact of the plastic and concrete.

h) The Contractor shall ensure that sufficient dams or barriers are placed along the edges of the freshly placed concrete to prevent erosion of the underlying materials or damage to the edges of the freshly placed concrete.

i) Any concrete damaged by precipitation shall be removed and replaced at the Contractor's expense. The PSAA shall decide if the concrete has been damaged and the limits of removal and replacement.

j) Concrete shall only be placed when the rate of surface evaporation at the site is less than 0.20 pounds per square foot per hour, according to MDOT Specifications, Figure 706-1 (Surface Evaporation for Concrete). The Contractor shall provide approved equipment for determining the relative humidity and wind velocity at the site.

k) Water shall not be added to the placed concrete in order to aid finishing. Any water added to the concrete for slump adjustments shall be done by adding water to the mixing unit and thoroughly re-mixing the concrete for 30 revolutions of the mixing unit at mixing speed. Water shall not be added such that the design water-to-cement ratio of the concrete mixture or the design slump of the concrete mix is exceeded.

l) Concrete curing shall be performed in accordance with MDOT Specifications, Subsection 602.03.M (Curing). Curing operations shall take precedence over texturing operations and continued concrete placement. All curing compound applied shall provide uniform coverage over the entire surface being protected.

m) The placement of curing compound shall be free of spots, blotches, or uncovered or non-uniformly covered areas. Should any such non-uniformly covered areas be determined to exist by the PSAA, the curing compound shall be immediately reapplied by the Contractor at no additional cost to the project.

n) The Contractor shall take all precautions when placing concrete to protect it from damage due to the elements.

o) Concrete shall be protected from weather and temperature according to the requirements of MDOT Specifications, Subsection 602.03.T (Weather and Temperature Limitations). Concrete shall not be placed when the temperature of the plastic concrete mixture itself is greater than 90˚F.

p) In conditions where low temperature protection is required, the Contractor shall cover the concrete with insulated blankets or other means as approved by the PSAA to protect the concrete from damage.

q) The concrete shall remain protected until it has reached a compressive strength of at least 1000 psi, or as directed by the PSAA.

2. Cleaning and Sealing Joints

a) The Contractor shall clean, plow, and hot seal Portland cement concrete pavement joints and cracks at the locations specified by the PSAA.

b) All joints and cracks shall be sandblasted (vertical face) to a minimum depth of 1 inch and a minimum horizontal surface width of 1 inch on both sides of the crack or joint. The joints and cracks shall be plowed and blown out by using compressed air as necessary to remove all dirt, vegetation and old seal material. Compressed air shall be applied at a minimum pressure of 90 psi, at a rate of 150 cubic feet per minute at the nozzle.

c) The Contractor shall completely fill joints and cracks with rubber-asphalt, hot-applied sealing compound in conformance with ASTM D6690 (Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements). The PSAA shall inspect all sealed joints and cracks for low spots and may direct the Contractor to reseal low spots with additional rubber asphalt material.

M. Patching

1. Bituminous Pavement Patching and Repair

a) The material used for this work shall meet the requirements of Article 5 (Streets), Section II (Materials Standards) of these Standards.

b) The pavement shall be removed full depth unless otherwise specified on the Plans. If additional aggregate or clay base is removed without written approval of the PSAA, it shall be replaced and compacted by the Contractor, with MDOT 21AA aggregate or other material as directed by the PSAA.

c) Prior to placing the bituminous patching mixture, the sand subbase and aggregate base shall be evenly graded, trimmed and compacted to 95% and 98% respectively, of their maximum unit weights as determined by the AASHTO T 180 test (Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop). The surface of all pavement cuts shall be cleaned with compressed air or vacuum cleaning equipment and then covered with approved MDOT bond coat applied at a rate of .05 gallons/s.y. The bond coat shall be applied with a power distributor hand sprayer.

d) Prior to filling the excavated areas with patching material, if the base has become damp/wet due to rain or due to the Contractor's operation, it shall be dried by the Contractor by aerating or other approved method(s). Prior to patch placement, the excavation(s) shall be cleaned with compressed air to remove dirt and loose material. The Contractor shall use an air source that provides a minimum 90 psi and 150 cubic feet per minute of air at the nozzle. The base shall then be recompacted with a vibratory plate compactor or other approved method.

e) The exposed bituminous edges of each patch shall be sprayed with bituminous bond coat by a power sprayer.

f) Bituminous patching mixture shall be placed in lifts not exceeding 2 inches (approximately 2½ inches loose). Each layer of bituminous mixture shall be compacted to at least 97% of the control density, as determined by using the MDOT Modified Marshall Test.

g) All areas excavated in one day shall be prepared, patched, compacted and opened to traffic in that same day.

h) The Contractor shall use an asphalt paver or spreader box to place the asphalt patching material. The Contractor shall not use a grader or front-end loader or similar device for placing the bituminous patching material.

i) For small areas, where approved by the PSAA, the Contractor may place the material by hand directly in the area intended to be patched. Under no circumstances shall the Contractor place bituminous material on adjacent pavement surfaces.

j) All patches shall be compacted with an approved roller, unless it is impossible to use a roller due to the patch size, in which case, the Contractor may use a vibratory plate compactor on the patch.

k) All patching shall be performed so as to provide a smooth riding surface.

l) For patching in bike lanes, patching shall be the full width of the bike lane.

m) Pavement markings disturbed due to pavement cuts or construction related activities shall be restored as directed by PSAA.

n) All joints in patches made in streets under the street cut moratorium described in Article I, Section XIX (ROW Disturbances) of these Standards, shall be sealed with an approved asphaltic sealant.

2. Concrete Pavement Patching and Repair

a) The Contractor shall patch existing concrete pavements in accordance with the Plans and Details and in accordance with MDOT Specifications, Subsection 603.03 (Construction) and MDOT Standard Plan R-44 and in accordance with Section III.E.5 (Concrete Pavement, Curb & Gutter, Sidewalk, and Drive Removal) of this Article.

b) Prior to placement of concrete, the Contractor shall install deformed tie bars as specified elsewhere in this Section.

c) The road base and adjacent concrete shall be wet down prior to placement of concrete to prevent water loss through the road base, and to form a better bond between old and new concrete. If a construction joint is necessary, the existing concrete surface shall be cleaned with compressed air to remove loose and unsound concrete and to expose the aggregate in the concrete.

d) During the placement of concrete for the pavement repair, the Contractor shall use a high-frequency mechanical vibrator to consolidate the concrete to insure even placement and to prevent voids or pockets of air from forming. The vibrator shall not be used to move the concrete within the patch limits. The vibrator shall be used minimally to avoid segregation of the aggregate.

3. Brick Pavement Patching and Repair

   a) The brick patch shall match the existing brick material and pattern.

   b) MDOT Class II Granular Material subbase shall be placed from the bottom of the excavation to 8 inches below the bottom of the brick pavement and compacted to 95% of its maximum unit weight as determined by the AASHTO T-180 test.

   c) A concrete base of matching the existing thickness or 7 inches, whichever is greater, shall be placed on the evenly graded, trimmed and compacted subbase. The brick pavement shall then be placed on top of the concrete base and set in a minimum 1-inch thick dry mortar leveling bed (one part Portland Cement, four parts MDOT Class II granular material).

N. Pavement Markings

1. Removal of Pavement Markings

   a) Inappropriate or conflicting pavement markings shall be removed by the Contractor at locations as shown on the Plans or as directed by the PSAA prior to any change in traffic patterns. If permanent pavement markings on an open roadway are removed more than 24 hours in advance of a change in traffic pattern, temporary markings shall be placed before the end of the workday.

   b) The removal of pavement markings shall be accomplished in a manner and by methods meeting the approval of the PSAA. Methods which can provide acceptable results are: sandblasting using water or air; high-pressure water; steam or superheated water; or mechanical devices such as grinders, sanders, scrapers, and wire brushes.

   c) Pavement markings shall be removed in such a manner as to cause as little damage as possible to the surface texture of the pavement.

   d) Sand or other material deposited on the pavement as a result of removing pavement markings shall be removed and disposed of as the work progresses. Accumulations of sand or other material which might interfere with drainage or which may constitute a hazard to traffic will not be permitted and shall be removed by the Contractor immediately.

e) Where blasting is used for the removal of pavement markings or for the removal of objectionable material, and such removal operation is being performed within 10 feet of a lane occupied by public traffic, the residue (including dust) shall be removed immediately as work progresses. Such removal shall be by a vacuum attachment operating concurrently with the blast cleaning operation or by other equally effective methods meeting the approval of the PSAA.

2. Temporary Pavement Markings, Type R

a) The Contractor shall place temporary removable-type pavement markings (Type R), as shown on the Plans and as directed by the PSAA.

b) Temporary pavement markings for bituminous surfaces over which traffic is to be maintained shall be made with reflective marking tape. Markings which lose their reflectorizing properties shall be removed and replaced.

c) Temporary pavement markings shall be placed after each day's paving, or as directed by the PSAA.

d) All markings shall have a nominal width of 4 inches and shall be either white or yellow in accordance with the MMUTCD or as directed by the PSAA.

e) Temporary longitudinal pavement markings shall be in accordance with MDOT PAVE 904 Pavement Marking Special Details. Markings less than 4 feet in length shall be removed and replaced by the Contractor at the Contractor's expense.

f) Markings shall be applied so that they adhere adequately to the pavement surface. The Contractor shall clean the pavement surface as necessary to affix the marking tape.

3. Temporary Pavement Markings, Type NR

a) The Contractor shall place temporary non-removal (Type NR) pavement markings, as shown on the Plans and as directed by the PSAA.

b) Temporary pavement markings for bituminous surfaces over which traffic is to be maintained shall be made with reflectorized marking tape or paint. Markings which lose their reflectorizing properties shall be removed and replaced.

c) Temporary pavement markings shall be placed after each day's paving or as directed by the PSAA.

d) All markings shall have a nominal width of 4 inches and shall be either white or yellow in accordance with the MMUTCD or as directed by the PSAA.

e) Temporary longitudinal pavement markings shall be in accordance with MDOT PAVE 904 Pavement Marking Special Details. Markings less than 4 feet in length shall be removed and replaced by the Contractor at the Contractor's expense.

f) Markings shall be applied so that they adhere adequately to the pavement surface. The Contractor shall clean the pavement surface as necessary to affix the marking tape or paint.

4. Permanent Pavement Markings

a) Furnish all labor, equipment, and materials necessary to install pavement markings at the locations specified on the Plans, and with the materials and widths specified on the Plans, in accordance with MDOT Specifications, Sections 811 (Permanent Pavement Markings) and 920 (Permanent Pavement Marking Materials) except as specified herein.

b) Where applicable, pavement markings shall conform to the current requirements of the MMUTCD issued under provisions of the Michigan Vehicle Code, Act 300, PA 1949, as amended.

c) Prior to the placing of any pavement markings, Contractor shall examine the limits of the new work and ascertain that the existing surfaces are adequate to receive the material to be installed.

d) Layout work necessary for the location and placing of markings, as specified on the Plans or as determined by PSAA, shall be the responsibility of Contractor and shall be at his expense. Layout shall be approved by PSAA prior to final placement of pavement markings.

e) Pavement marking shall be performed during the period May 1 to November 1, unless otherwise approved in writing by PSAA. No markings shall be applied when the air temperature is less than 50 degrees Fahrenheit, unless otherwise approved by the PSAA.

f) Surfaces must be thoroughly dry and free from dirt, loose paint, oil, grease, wax and other contaminants before pavement markings are applied.

g) Markings shall not be placed when rain is threatening or when the surface to be painted is wet.

h) The Contractor shall be responsible for removal of any deposits or materials detrimental to the application of durability of the pavement markings.

i) Markings shall be applied so that they adhere adequately to the surface.

j) New markings and/or retraced markings shall be placed, with reasonable tolerance, in their proper locations.

k) Incorrect or misplaced markings shall be obliterated and re-marked in accordance with PSAA's instructions. Costs incurred to obliterate and remark incorrect or misplaced markings will be at Contractor's expense.

l) Protection of the uncured pavement markings shall be the responsibility of Contractor, and all costs incurred to provide the protection will be at Contractor's expense.

m) Permanent pavement markings shall be applied in compliance with MDOT Subsection 801.03. D. (Application, Temperature, and Seasonal Restrictions).

n) Permanent longitudinal pavement markings shall be in accordance with MDOT PAVE 905 Pavement Marking Standards. Markings less than 4 feet in length shall be removed and replaced by the Contractor at the Contractor's expense.

O. Brick Unit Paving

1. One sample of each shape and color of paver shall be submitted for approval to the PSAA. Where necessary, additional pavers showing extreme range of color and texture for specified items shall be submitted.

2. Brick used in areas subject to traffic shall meet ASTM C1272 (Standard Specification for Heavy Vehicular Paving Brick), Durability Type F, and Appearance Application PS.

3. Mockups shall be built to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

4. Mock-ups will be 40 square feet minimum in size, utilizing the pattern and joints required for the project. The approved mock-up shall be considered a minimum standard of workmanship to be matched or bettered throughout the Project.

5. The mock-up may be constructed as part of the Project and, if approved, will be accepted as part of the Work. However, should the mock-up fail to meet PSAA's approval, the area shall be removed and reconstructed until approved.

6. Frozen materials or materials mixed or coated with ice or frost shall not be used nor shall a frozen subgrade or setting beds be built upon. Any unit paver work damaged by frost or freezing shall be removed and replaced.

7. Each type of unit paver, joint material, and setting material shall be obtained from a single source with resources to provide materials and products of consistent quality in appearance and physical properties.

8. Surfaces to receive unit paving shall be inspected for compliance with requirements for installation tolerances and other conditions affecting performance. Installation shall proceed only after unsatisfactory conditions have been corrected.

9. Prepared subgrade shall be proof rolled according to requirements in this Article to identify soft pockets and areas of excess yielding. Contractor shall proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive subbase and base course for unit pavers.

10. Sand Setting Bed

    a) The sand shall be of uniform moisture content when screeded and shall be protected against rain when stockpiled on site prior to screeding. For installation, the moisture content shall be in the range of 4 to 8 percent.

    b) The bedding sand shall be spread loose in a uniform layer to give a depth after compaction of the paving units of a maximum ¾-inch thickness as required to achieve design grades.

    c) The spread sand shall be carefully maintained in a loose condition and protected against pre-compaction by traffic or rain both prior to and following screeding. Under no circumstances shall the sand be screeded in advance of the laying face to an extent to which paving will not be completed on that day.

    d) Any screeded sand which is pre-compacted prior to laying of paving unit shall be brought back to profile in a loose condition. Neither pedestrian nor vehicular traffic shall be permitted on the screeded sand.

e) The Contractor shall screed the bedding sand using either an approved mechanical spreader or by the use of screed guides and boards.

11. Placing Pavers

    a) Pavers with chips, cracks, voids, discolorations or other defects shall not be installed.

    b) The pavers shall be laid in the pattern as specified on Plans or as determined by the PSAA.

    c) Paving units shall be installed from a minimum of three bundles simultaneously drawing the paver vertically rather than horizontally.

    d) Joint spacing shall be consistent and of approximately ⅛ inch unless noted otherwise. This spacing must also be provided for the first row abutting the edge restraint and/or concrete sidewalk.

    e) String lines or chalk lines on bedding sand should be used to hold all pattern lines true.

12. Cutting Pavers

    a) Contractor shall make all efforts to use full bricks to the maximum extent possible. Where cutting of brick is required to achieve the desired pattern, brick shall be cut to leave a clean edge to the traffic surface using a mechanical hydraulic cutter, guillotine cutter, or masonry saw.

    b) Discontinuities in patterns will not be permitted. Pavers shall be laid out in all areas so as to eliminate slivers at edges.

    c) Pavers shall be carefully placed by hand in straight courses with hand-tight joints and uniform top surface. Good alignment shall be maintained and provide the pattern indicated.

    d) Radius section curb segments shall be utilized as supplied by manufacturer and that most closely match the existing road curb radii. Where the manufacturer does not provide radius sections to match the existing road curb radii, Contractor may cut pavers in half or thirds (as determined by PSAA) to more closely follow the existing curb line.

e) To prevent depressions and protect paver alignment, Contractor shall protect newly laid pavers at all times by panels of plywood, on which the installer stands, which can be advanced as work progresses. However, plywood protection shall be kept in areas which will be subjected to continued movement of materials and equipment.

f) If additional leveling of the pavers is required, and before sweeping in joint filler, pavers shall be rolled with a power roller after sufficient heat has built up in the surface from several days of hot weather.

g) After sweeping and prior to compaction, the paved area shall be inspected by the PSAA to ensure satisfactory color blending. Areas deemed poorly blended shall be removed and re-installed in order to achieve satisfactory color distribution.

13. Compaction of Pavers

a) After inspection of the pavers, they shall be compacted to achieve consolidation of the sand bedding and brought to design levels and profiles by not less than 3 passes of a suitable plate compactor.

b) Compaction shall be accomplished by the use of a plate compactor capable of a minimum of 5,000-pound compaction force.

c) Initial compaction should proceed as closely as possible following installation of the paving units and prior to acceptance of any traffic or application of jointing sand.

d) Care shall be taken not to damage pavers or surface finish during compaction.

14. Joint Treatment

a) Jointing sand shall be spread over the pavement after initial compaction has been completed. The jointing sand shall be spread as soon as is practical after initial compaction and prior to the termination of work on that day. The Contractor shall not use wet sand.

b) The jointing sand shall be broomed to fill the joints. Excess sand shall then be removed from the pavement surface and the pavers shall be compacted again to settle the jointing sand.

c) This operation shall be repeated a minimum of 2 times.

15. Final Compaction

    a) After jointing sand has been installed and the pavement surface swept clean, final compaction shall be accomplished by not less than 2 passes of the plate compactor.

    b) Final compaction should proceed as closely as possible following installation of jointing sand and prior to the acceptance of any traffic.

16. Proof Rolling

    a) The completed installation shall be proof rolled with pneumatic tire equipment which replicates anticipated service traffic. Contractor shall subject each individual paver to at least 1 passage of load.

    b) Equipment and procedures are subject to approval by the PSAA and proof rolling will be observed and recorded by the PSAA.

    c) Units cracked or otherwise damaged by proof rolling, shall be removed and replaced.

17. Allowable Tolerances

    a) Finished surface of pavement shall be smooth, even, and true to the lines, grades and cross section indicated. Maximum deviation when tested with a 10-foot straightedge parallel to the centerline of the surfaced area shall be ¼ inch in 10 feet.

    b) Maximum offset from flush from paver surface to paver surface, or from paver surface to a fixed flush edge shall be 1/16 inch.

    c) Finished walk shall be sloped for drainage without any ponded water on the finished surface.

18. Repair, Cleaning and Protection

    a) Paver surface shall be cleaned of all debris, dirt, and sand.

    b) Pavers which are chipped, broken, stained or otherwise damaged or which do not match adjoining units shall be removed and replaced. New units shall be provided to match adjoining units and installed in the same manner as original units and with same joint treatment to eliminate evidence of replacement.

c) Final protection of pavers shall be provided until Substantial Completion in a manner acceptable to the PSAA.

d) Finished area shall be free of bumps or depressions, evenly graded to levels shown, and shall be guaranteed against defects of materials and workmanship for a period of two years from the date of Substantial Completion.

P. Micro-Surfacing

1. Materials and equipment shall be in accordance with MDOT Specifications except as otherwise noted in Materials Specifications elsewhere in these Standards.

2. Preparation of pavement, furnishing and installing surfacing mixture, rut filling, and all other work shall be done in accordance with MDOT Specifications, Section 504 (Micro-Surfacing), as directed by the PSAA, and as described herein.

3. A vacuum style pick-up sweeper shall be used to perform any sweeping required to prepare the existing surface.

4. Extreme care shall be taken not to place micro-surface mixture on any concrete curb and gutter.

Q. Chip Seal

1. Preparation of pavement, furnishing and installing chip seal and all other work shall be done in accordance with MDOT Specifications, Section 504 (Micro-Surfacing), as directed by the PSAA, and as described herein.

2. Immediately prior to placing the chip seal, all pavement markings shall be removed using an abrasion method.

3. Asphalt emulsion shall be applied at a rate within the range of 0.39 - 0.41 gallons per square yard. The Job Mix Formula (JMF) target rate for the asphalt shall be 0.40 gallons per square yard. Asphalt emulsion shall be applied at a minimum temperature of 290°F, followed by a uniform application of coarse aggregate.

4. MDOT Class 34CS aggregate shall be placed at a rate within the range of 18-20 pounds per square yard. The JMF target rate for the asphalt shall be 19 pounds per square yard.

5. If the target rates are not the optimum application rates due to the gradation of the coarse aggregate or due to existing surface conditions of the pavement, the Contractor shall notify the PSAA. The Contractor shall then submit new rates and a new JMF for approval by the PSAA prior to work commencing.

6. Coarse aggregate shall be rolled before the asphalt emulsion has set. No more than 150 feet of unrolled cover material shall be left at any time. No cover material shall be left unrolled for more than 5 minutes.

7. A minimum of 2 complete rolling trips shall be completed over the cover aggregate. A complete trip is one pass, forward and backward, over the same patch. Each trip shall overlap the previous trip.

8. Coarse aggregate shall be rolled sufficiently to embed it into the asphalt emulsion. If the PSAA determines that the rolling procedures are not sufficiently embedding the aggregate into the emulsion, then the Contractor will submit modifications for improving the rolling procedures to the PSAA for approval.

9. Cover (course) aggregate shall not be placed on asphalt emulsion after the asphalt emulsion "breaks."

10. An initial sweeping on the final surface shall be performed before the end of each day's work or within 24 hours of application with the approval of the PSAA. Initial sweeping shall begin within 3 hours after application unless otherwise directed by the PSAA.

11. Temporary raised pavement markings shall be placed prior to the application of the chip seal, at intervals specified below, or as directed by the PSAA:

    a) On tangent sections of roadway and on gentle curvatures of roadways, markers shall be placed at 50-foot intervals.

    b) On severe curvatures of roadways, markers shall be placed at 25-foot intervals.

12. Temporary raised pavement markings shall be installed no more than 24 hours prior to the placement of the chip seal. Markings shall be offset from the centerline or lane line(s) to facilitate placement of the first pass of the micro-surfacing. Markings under the lane closure of the adjacent pass shall be removed, and temporary pavement markings placed upon completion of the micro-surfacing to ensure they are always present.

IV. Streetlights and Signals

A. General

1. All streetlight design, Plans, construction, and materials shall conform to Article 7 (Streetlights) and Appendix A (Material Requirements) of these Standards.

2. The Contractor shall furnish all materials and equipment required to install and place in operation Street Light Fixtures. All electrical components shall be furnished new and be listed by, and bear the label of Underwriter's Laboratories, Inc.

3. Prior to beginning construction, the Contractor shall submit to the PSAA product data sheets and shop drawings for all light standards including luminaires, poles, bases, bracket arms, and fixtures to be used in the project and Manufacturer's certifications of all wiring, splices, lamps, rods, base plates, anchor bolts, and other parts used in the construction of the light pole assembly.

4. Certifications shall indicate that all materials meet the minimum requirements of these Standards.

5. For each submittal or resubmittal, the Contractor shall allow at least 14 calendar days from the date of the submittal to receive the PSAA's acceptance or request for revisions. The PSAA's comments shall be incorporated into the submitted plans, calculations and descriptions. The PSAA's acceptance is required before beginning the work.

6. Resubmittals shall be reviewed and returned to the General Contractor within 14 calendar days. Required revisions will not be a basis of payment for additional compensation, extra work, or an extension of contract time. The Contractor shall include time for this entire review process in their critical path schedule.

7. The PSAA reserves the right to request standard production model fixture samples for inspection and to require such tests as deemed necessary to ensure complete compliance with the Specifications. Luminaires that do not meet these tests or those luminaires with improper or inadequate light distribution will be subject to rejection.

8. All costs associated with submitting and testing of replacement luminaires or lamps due to rejection of submitted luminaires shall be paid by the Contractor.

9. One manufacturer, responsible for coordination of fixtures, poles, brackets, luminaires, and all other appurtenances as shown on the drawings or detailed in the specifications, shall provide all required lighting elements.

10. Connections to equipment, lighting standards, contactors, etc., shall be made in accordance with the shop drawings and rough-in measurements furnished by the manufacturer of the equipment. Any and all additional connections not shown on the Plans but called for by the equipment manufacturer's shop drawings or required for the successful operation of the particular equipment furnished, shall be installed by the Contractor as part of his Contract with no additional compensation.

11. Contractor must provide adequate storage space for all electrical equipment, conduit, and materials delivered to the job site under a weather-protected enclosure. Location of the space must be approved by the PSAA. Equipment set in place in unprotected areas must be provided with temporary protection.

12. The Contractor shall be responsible for maintenance of, and repair of damage as a result of accident or vandalism to, the light fixtures, bases, luminaries, and all other materials installed, or to be installed, related to, or necessary for the light fixture installation on the project. This shall remain the Contractor's responsibility until the installation is complete, tested, and accepted by the PSAA.

13. All trenching and backfilling to install electrical work shall be by the Electrical Contractor. When backfilling the trenches and around streetlight foundations, the earth must be compacted in place in 12-inch layers to 95% of the material's maximum dry density.

14. During backfilling of trenches continuous underground-line warning tape shall be installed directly above line at 6 to 8 inches below finished grade. Multiple tapes shall be used where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

15. Any excess excavated material shall be disposed of offsite at no additional cost.

16. Upon completion of the underground work, the Contractor shall grade the work area smooth, fill any trench settlements, eliminate any large piles of earth, and clean up any debris or leftover construction materials, disposing of it offsite in an approved manner and at an approved location.

17. Areas disturbed by trenching, storing of dirt, cable laying, and other work shall be restored. Vegetation shall also be restored and shall include necessary topsoil, fertilizer, seed, sod, and mulch in conformance with Section VI (Landscaping and Restoration) of this Article.

18. All factory-finished equipment shall be cleaned at the completion of the work by the Contractor. Equipment showing mars or rust shall be refinished by the Contractor in a manner acceptable to the PSAA.

B. Foundation

1. Concrete foundation shall be installed as indicated on the Plans. Approved forms shall be constructed and placed so they will not move or deflect upon placement of concrete and will not leak. All concrete work shall be properly cured as required and, upon removal of forms, exposed concrete surfaces shall be pointed and troweled smooth.

2. Concrete for foundations shall be immediately and carefully placed after mixing and shall be vibrated during and immediately after the pouring to prevent voids and assure a dense concrete structure. The exact location of all concrete bases shall be staked by the PSAA prior to digging.

3. Anchor bolts shall be set according to templates furnished by pole manufacturer.

C. Poles

1. Areas and conditions shall be examined, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

2. Poles, luminaire-mounting devices, lowering devices, and pole accessories shall be examined before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.

3. Roughing-in for foundation and conduit shall be examined to verify actual locations of installation.

4. Installation shall proceed only after unsatisfactory conditions have been corrected.

5. Pole foundations and poles shall be aligned for optimum directional alignment of luminaires and their mounting provisions on pole.

6. The following minimum horizontal distances of poles from surface and underground features shall be maintained unless otherwise indicated on Plans:

    a) Fire Hydrants and Water Piping: 5 feet.

    b) Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.

    c) Trees: 15 feet from tree trunk.

7. Pole shall be mounted with leveling nuts and top nuts tightened to torque level according to pole manufacturer's written instructions.

    a) Anchor bolts and nuts used shall be selected to resist seismic forces defined for the application and approved by manufacturer.

    b) Lubricant may be used on threads, in compliance with manufacturer specifications.

    c) Base covers shall be installed unless otherwise indicated.

8. Poles shall be installed in paved areas with a minimum 6-inch wide unpaved gap between the pole or pole foundation and the edge of the adjacent pavement. The unpaved ring shall be filled with pea gravel inserted to a level 1 inch below top of adjacent pavement.

9. Pole shall be raised and set using web fabric slings (not chain or cable) at locations indicated by manufacturer.

10. Luminaire shall be installed square, level, and plumb with finish grade and shall be fastened to structural support as follows:

    a) Sized and rated for luminaire weight.

    b) Able to maintain luminaire position after cleaning and re-lamping.

    c) Supports luminaires without causing deflection of finished surface.

    d) Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

11. Receptacles and other devices shall be installed as called for on the plans.

D. Service Disconnect

1. The Contractor shall furnish and install disconnect box mounted in a cabinet meeting the requirements of Article 7 (Streetlights) of these Standards. Also included is all labor, material and equipment necessary to furnish, install, and coordinate with the Detroit Edison Company for installation of secondary electrical power to the disconnect box.

2. At the disconnect cabinet, the Detroit Edison neutral, the disconnect cabinet, and the ground mat system shall all be permanently grounded together. The resistance of the ground rod to ground shall not exceed 25 ohms when tested with a megger. In case the resistance is more than 25 ohms, additional or longer ground rods shall be installed.

3. A master photelectric controller meeting the requirements of Article 7 (Streetlights) shall be furnished and capable of handling the electric load on the designed circuit.

E. Handholes

1. Handholes shall be installed level and plumb and with orientation and depth coordinated with connecting duct to minimize bends and deflections required for proper entrances. An extension shall be used if required to match depths of duct, and seal joint between handhole and extension as recommended by manufacturer.

2. Unless otherwise indicated, units shall be supported on a level bed of crushed stone or gravel, graded from ½-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

3. In paved areas and trafficways, cover shall be set flush with finished grade. For other areas, covers shall be set 1 inch above finished grade.

4. Handholes shall be installed with bottom below frost line, 42 inches below grade.

5. Removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, shall be installed as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

6. Openings for duct shall be field cut according to enclosure manufacturer's written instructions. Wall of enclosure shall be cut with a tool designed for material to be cut. Holes shall be sized for terminating fittings to be used, and seal around penetrations after fittings are installed.

F. Conduit and Wiring

1. All excavation for main electrical runs shall be of a depth to leave at least 30 inches from the top of the electrical run (conduit encasement, buried rigid conduit, or direct buried cable) to the grade of the top of pavement or surrounding terrain. The trench shall be graded to handhole and pole location so that the finished conduit run will contain no pockets where water might accumulate or drain into a handhole or pole.

2. Layout and installation of duct, duct bank, manholes, handholes, poles, and boxes shall be coordinated with final arrangement of other utilities, site grading, and surface features as determined in the field. PSAA shall be notified if there is a conflict between areas of excavation and existing structures or other material to remain.

3. Elevations of duct and duct-bank entrances into manholes, handholes, and boxes shall be coordinated with final locations and profiles of duct and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Locations and elevations shall be revised as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes.

4. Conduit shall be cut with a hacksaw or other approved tool. The ends shall be square after cutting and the conduit shall be reamed.

5. All conduits must be securely fastened to boxes with locknuts and bushings of an approved make, care being taken that the full number of threads project into the bushings. Rigid galvanized conduit shall be assembled by means of approved threaded galvanized coupling, unions, and fittings. PVC conduit shall be assembled by means of approved threaded or solvent-welded fittings.

6. Sleeves shall be installed with mechanical sleeve seals for penetrations through concrete slabs or walls unless core-drilled holes or formed openings are used. Sleeves shall be installed during erection of slabs and walls.

7. Sleeve seals of type and number of sealing elements recommended by manufacturer for cable material and size shall be used. Cable shall be positioned in center of sleeve.

8. Mechanical sleeve seals shall be assembled and installed in the annular space between cable and sleeve. Bolts shall be tightened against pressure plates that cause sealing elements to expand and make a watertight seal.

9. Conduits which are installed underground or concealed in concrete, foundations, or other structures, shall be cleared of foreign material and obstructions after installation and before conductors or pull wire are drawn in.

10. Leather-washer-type duct cleaner, with graduated washer sizes, shall be pulled through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Rubber duct swab shall follow for final cleaning and to assist in spreading lubricant throughout ducts.

11. Conduits shall be cut a minimum of 1 inch above the light pole base and a maximum of 2 inches above the base.

12. Manufacturer-approved pulling compound or lubricant shall be used where necessary. The compound used must not deteriorate conductor or insulation. Manufacturer's recommended maximum pulling tensions and sidewall pressure values shall not be exceeded.

13. Cable shall be pulled into ducts using a proper cable grip for the purpose. The cable shall be so handled that it is not subjected to excessive strain or kinked when pulled through the conduit.

14. Damaged or kinked cable shall not be used. Where more than one cable is to be installed in a duct, all cables shall be pulled through simultaneously. Splices in ducts will not be permitted.

15. Pulling means to be used, including fish tape, cable, rope, and basket-weave wire/cable grips, shall be such as not to damage cables or raceway.

16. Conductors shall not be installed in conduit until all work which might cause damage to the conduits or cables has been completed.

17. Conductors shall be installed in continuous lengths from light to light with connections in the base of lights or streetlight pull boxes.

18. Cables shall be neatly racked and identified on cable racks in all handholes after being formed to their final position. Cables shall be racked slightly higher than the duct entrances so that they will not rest on the edges of the duct.

19. All splices and connections shall be made as described herein and as shown on the Plans and Plan details. Where cable is installed but not immediately spliced, the cable ends shall be thoroughly sealed and racked out of the way of possible danger.

20. All splices shall be accessible through the handhole in the pole and shall extend 4 inches to 6 inches outside the handhole. No splices will be allowed which are inaccessible inside the pole. Street lighting splices required in ground handholes shall be terminated using splice kits that insulate, seal, and protect the splices.

21. All connections shall be per the manufacturer's recommendation. Electrical connectors and terminals shall be tightened according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, Contractor shall use those specified in UL 486A (Wire Connections and Soldering Lugs for Use with Copper Connectors) and UL 486B (Standard for Safety Wire Connectors for Use with Aluminum Conductors).

22. Splices and taps shall be compatible with conductor material and possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.

23. All connections shall be wire brush and applied with approved corrosion inhibiting compound.

24. Cables shall be properly tagged in all handholes and poles. For street light circuits, printed color code phase identification shall be repeated at all connections. The printing of the conductor coding shall adhere to covering and not be readily removed by rubbing.

25. Identity of each item shall be verified before installing identification products.

26. Installation sequence shall then be as follows:

    a) Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

    b) Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

c) Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

d) Apply color coding tape in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

e) Colors for 208/120-V Circuits shall be:

(1) Phase A: Black.

(2) Phase B: Red.

(3) Phase C: Blue.

G. Conduit Directional Drilling

1. Shall comply with Section II. N (Water Main Directional Drilling), items 1-4, 6-7 and 9-10 of this Article.

2. The minimum depth of cover at any location shall be 3 feet. Depth of cover is measured from the finished grade to the top of the pipe.

3. Inject drilling fluid through reamer to stabilize bore and lubricate pipe. Ratio of reaming diameter to pipe outer diameter is a maximum of 1.5.

H. Grounding

1. Work shall comply with the latest National Electric Code, IEEE C2 grounding requirements and with details as shown on the Plans.

2. Work shall comply with National Fire Protection Agency (NFPA) 780 (Standard for the Installation of Lightning Protection Systems) and UL 96 (Standard for Lightning Protection Components) when interconnecting with lightning protection system.

3. Electrical power system ground shall be bonded directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Bonding conductor used shall be sized the same as system grounding electrode conductor and installed in conduit.

4. Pressure-type connectors shall be used to connect the ground cable to poles and electrical equipment. The cable shall be properly attached to the ground rods.

5. Exothermic-welded connectors shall be used for outdoor locations. If a disconnect-type connection is required, a bolted clamp shall be used.

6. Insulated equipment grounding conductors shall be installed with all feeders and branch circuits. Grounding conductors shall be routed along shortest and straightest paths possible unless otherwise indicated or required by Code.

7. Obstructing access or placing conductors where they may be subjected to strain, impact, or damage shall be avoided.

8. Ground rods shall be copper clad steel and shall be either 2½-inch diameter round by 6-feet long rods, or 1 and five-eighths inch diameter round by 8-feet long rod. Rods shall be driven until tops are 2 inches below finished floor or final grade unless otherwise indicated.

9. Ground rods shall be interconnected with grounding electrode conductor below grade and as otherwise indicated. Connections shall be made without exposing steel or damaging coating if any.

10. For grounding electrode system, at least three rods shall be installed, spaced at least one rod length from each other and located at least the same distance from other grounding electrodes and connected to the service grounding electrode conductor.

11. Manholes and handholes shall be grounded by driving a ground rod through the manhole or handhole floor, close to wall, and rod depth shall be set so that 4 inches will extend above finished floor.

12. If necessary, ground rod shall be installed before manhole is placed and No. 1/0 AWG bare, tinned-copper conductor provided from ground rod into manhole through a waterproof sleeve in manhole wall.

13. Ground rods shall be protected passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Floor opening shall be sealed with waterproof, non-shrink grout.

14. All fixtures and poles shall be thoroughly and permanently grounded at each location. A grounding electrode and a separate un-insulated equipment grounding conductor shall be installed in addition to grounding conductor installed with branch-circuit conductors.

15. Completed grounding system shall be tested at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Tests at ground rods shall be made before any conductors are connected. Testing shall include the following:

    a) Measure ground resistance no fewer than 2 full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

    b) Perform tests by fall-of-potential method according to IEEE 81 (Guide for Measuring Earth Resistivity, Ground Impedance, And Earth Surface Potentials of a Grounding System).

    c) Report measured ground resistances that exceed the following values:

        (1) Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

        (2) Manhole and Handhole Grounds: 10 ohms.

        (3) Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.

        (4) Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

        (5) Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).

I. Street Light Fixture - Luminaire

1. The street light fixture and pole assembly shall be as shown on the Plans. The catalog numbers as provided may not be complete to designate all the accessory parts and appurtenances required for the particular use or function. The light fixtures shall be complete, fitted with LED assembly and driver, fuses, support brackets, etc. Contractor shall arrange with the manufacturer for the purchase of all items required for the complete installation.

2. The Contractor shall examine all fixtures delivered to jobsite prior to installation to ensure all specification requirements and shop drawing notes and comments have been incorporated by manufacturer. Installation of fixtures signifies Contractor's acceptance and approval of fixtures from manufacturer.

3. Fasteners and hardware sized and rated for luminaire weight shall be used and shall be able to maintain luminaire position after cleaning and re-lamping.

4. Streetlight fixtures shall be provided complete with wiring from the base to the luminaires including pole base fuse holders. All wire within the streetlight fixture and pole assembly shall be copper.

J. Rectangular Rapid Flashing Beacon Assembly

1. This work shall consist of furnishing and installing wireless solar-powered, Rectangular Rapid Flashing Beacon (RRFB) assemblies at the locations shown in the Plans. Each RRFB assembly includes lightbar(s), solar panel(s), battery(s), controller enclosure, control circuit, on-board user interface, wireless communication, pedestal, pole, pushbutton, signs, stainless steel mounting hardware, and all associated material required to complete the work. RRFBs shall be bi-directional (two-sided) unless otherwise specified on the Plans.

2. Materials shall be provided conforming to MDOT Specifications, Sections 918 (Electrical and Lighting Materials) and 921 (Permanent Traffic Signal Materials) and in conformance with the following:

   a) Controller Enclosure

      (1) Construction shall be NEMA 3R aluminum housing with lockable tamperproof hinged door.

      (2) Solar batteries, on-board user interface, and wireless communications shall be housed within the enclosure.

   b) On-board User Interface (OBUI)

      (1) The OBUI shall have an adjustable auto-scrolling LED display, and include the following selectable features:

         (a) Flash duration, adjustable from 10 - 60 seconds, in one-second increments

(b) Ambient auto-adjust

(c) Night time dimming

(d) Update configuration settings to other units in the system

(e) Channel Selection

(f) System test, status, and fault detection

(g) Activation data reporting

c) Lightbar

(1) Lightbar housing must be black powder-coated aluminum, measuring 24" x 4.5" x 1.5"

(2) A lightbar shall consist of two forward-facing primary beacons:

(a) Each beacon must have an array of eight amber LEDs, each array measuring 7” x 3”

(b) Beacons must meet SAE J595 Class 1 intensity, and SAE J578 chromaticity

(c) LEDs must meet 90% lumen maintenance (L90) based on IES LM-80

(3) The lightbar must include side-mounted pedestrian amber LED beacons which flash concurrently with the primary beacons.

(4) The mounting assembly shall allow the lightbars to pivot 40 degrees horizontally in order to aim the lightbar independent of the wire hole location on the pole.

(5) A bi-directional RRFB shall consist of two lightbars mounted back to back, which can pivot independently from each other.

(6) The lightbar assembly shall open for access to the wiring connections for the LED modules. LED modules shall be rated to MIL-STD-810F, Method 506.4 for ingress protection.

d) Beacon operation meeting the following requirements:

(1) The RRFB is dark until pedestrian actuation

(2) Initiates operation upon pedestrian actuation and ceases operation at a predetermined time after actuation. This predetermined duration of operation shall be set as indicated in the Plans or as determined by the Engineer.

(3) Simultaneously begins (upon actuation) and ends (after the predetermined duration) the operation of all RRFB's associated with a given crosswalk within 150 milliseconds of activation.

e) Solar/battery system meeting the following requirements:

(1) Underwriters Laboratories Incorporated (UL) approved solar panel, solar engine, and battery system. Solar panel and battery system sized for use north of the 40th parallel, including the state of Michigan.

(2) The system shall include one 50-watt solar panel supplied with mounting hardware. The controller enclosure shall house one 35 Ah sealed valve-regulated lead-acid battery. The battery shall be readily available from multiple suppliers and non-proprietary. Solar panel and battery system shall be 12 Volt DC (nominal).

f) Pushbutton and Signs

(1) The pushbutton housing shall be cast aluminum with a yellow powder coat finish, with watertight O-ring seals. The housings shall be a minimum 14”H, 5½”W, 2 ½”D and contain the sign, arrow, speaker and LED’s.

(2) The pushbuttons shall be provided with a two-inch diameter adjustable arrow indication to indicate the direction of travel.

(3) The signs shall include the following:

(a) One pushbutton housing sign, “Push Button to Turn on Warning Lights”

(b) One W11-2, measuring 30” x 30”

(c) One W16-7PL, measuring 24” x 12

(d) One W16-7PR, measuring 24” x 12

(4) The pushbuttons shall be ADA/PROWAG compliant, with visual LED, audible location tone, and an audible voice message.

(5) The message shall be repeatable while the crosswalk lights are active. The pushbuttons shall be provided with a standard message "Cross street with caution, vehicles may not stop" or a custom message as required by the engineer.

(6) Each pushbutton shall be provided with a locating tone with a selectable repeat rate. The locating tone and message shall be capable of having maximum and minimum limits set.

(7) Each pushbutton shall be provided with an automatic volume adjustment to compensate for changes in ambient noise levels.

(8) The pushbutton shall come complete with the sign, mounting hardware and control unit for mounting on the pedestal and pole.

g) Pedestals and Poles

(1) Pedestal bases shall be aluminum square conforming to the following specifications. Bases shall accommodate bolt circles from 12 inches to 14 ½ inches. The bases shall be designed to accommodate (4) four anchor bolts from 5/8 inch to 1 inch in diameter. There shall be slots in the bottom of each base to allow adjustment for anchor bolt placement.

(2) The bases shall be fabricated from aluminum, nominally 15 inches tall by 14 inches square. The bases shall be provided with an accessible hand-hole opening and a cast aluminum door with one stainless steel set screw. The collar of the base shall be provided with a stainless steel hex head bolt.

(3) Poles shall consist of 6061-T6 aluminum alloy, poles textured for a uniform rough grain pattern that is perpendicular to the axis of the pole for the full length of the pole. The poles shall have a length of 14-feet, wall thickness of .237 inches, and an O.D. of 4.5 inches. The poles shall be provided with four inches of NPT (National Standard Taper Pipe Thread).

(4) The threaded end of the poles shall have a protective cap installed to prevent thread damage. A cardboard sleeve shall cover the entire length of the shaft to protect the surface finish during shipment.

h) Warranty

(1) A manufacturer's warranty, transferable to City of Ann Arbor, that the supplied materials are free from all defects in material and workmanship shall be provided. The warranty, other applicable documents from the manufacturer, and a copy of the invoice showing date of shipment to the Engineer shall be furnished prior to acceptance.

3. Construction

a) Shop drawing approval from the Engineer shall be obtained prior to installation of units.

b) The predetermined duration of operation of the RRFBs shall be set as indicated in the Plans or as specified by the Engineer.

c) The RRFB assemblies shall be mounted per manufacturer's requirements and as specified, in locations directed by the Engineer.

V. Soil Erosion and Sedimentation Control

A. General

1. All construction activities and soil erosion and sedimentation control measures and materials shall be accordance in Article 8 (Soil Erosion) of these Standards and as indicated on Plans.

2. Temporary soil erosion measures shall be put in place prior to disturbance of surface cover.

3. All Soil Erosion and Sedimentation Control Devices shall be constantly maintained in an effective functioning condition during the course of the Project.

4. Soil Erosion control measures shall be inspected by the Contractor a minimum of once per week and within a minimum of 24 hours after every rainfall. Any soil erosion control measures damaged or rendered ineffective shall be immediately repaired or removed and replaced at no additional cost.

5. Temporary soil erosion control measures shall be maintained until permanent measures have been established. Temporary measures shall be removed when permanent measures have been established.

6. If erosion or sedimentation occurs due to non-compliance with these requirements, Contractor shall remove deposited sediment or restore eroded areas at no additional cost.

B. Mulch Blankets

1. Mulch blankets shall conform to Article 12 (Standard Details), SD-SESC-4 (Mulch Blanket) of these Standards.

C. Mud Mats

1. The gravel surface on mud mats shall be removed and replaced when it becomes clogged with mud and dirt and ineffective.

D. Check Dams

1. Check dams, if required, shall be constructed as detailed on the Plans.

2. Check dams shall be installed immediately after ditch/channel stabilization (i.e., seeding and mulching or installation of rolled erosion control products).

3. Check dams shall be installed all the way across the ditch or channel, perpendicular to the flow.

4. Check dams shall be configured so the sides extend up the bank slopes, with the overflow in the middle.

E. Riprap

1. Riprap shall conform to Article 5 (Streets), Section II.K (Riprap) of these Standards.

2. The Contractor shall provide a sample of the stone to the PSAA for review upon request.

3. Riprap shall be placed in accordance with MDOT Specifications, Subsection 813.03.E (Riprap) to the elevations, thickness and lateral limits shown on the Plans.

4. Brush, trees, stumps and debris shall be cleared from areas to be protected by riprap.

5. All grades shall be shaped to the required cross section, including excavation for toe and header.

6. Geotextile liner, as shown on the Plans, shall be placed on the prepared grades and in a manner that ensures installation does not damage the geotextile liner.

7. When placing riprap under structures, Contractor shall ensure there is no damage to the existing substructure and superstructure elements. The Contractor is solely responsible for determining and utilizing suitable methods of preparing the area for riprap placement and placing the riprap such that the material is placed in accordance with the requirements of the Plans and specifications.

8. The use of hand methods to prepare areas for riprap placement and placing riprap may be necessary and/or required. Any damage to the existing structure resulting from the placement of riprap under structures shall be repaired as directed by the PSAA at no additional cost to the City.

F. Gabions

1. The Contractor shall be solely responsible to determine a suitable method of construction and construction sequence such that flow in a creek or channel is maintained during the performance of the work. The requirements of any EGLE and U.S. Army Corps of Engineers (USACE) Permits shall be followed by the Contractor during the performance of the work.

2. The Contractor shall perform all necessary excavation in accordance with all applicable MIOSHA requirements. The Contractor shall also perform de-watering as needed to complete the work and to maintain a safe working environment and provide a stable surface on which to place the gabion baskets.

3. Additional requirements regarding the performance of the work are detailed as follows.

4. Assembly and erection of the baskets shall be in accordance with the manufacturer's recommendations and as approved by the PSAA.

5. The coconut fiber blanket shall be attached to the front face of the unit such that there is an overlap of 12 inches at the top and bottom of the unit.

6. The units shall be assembled and carried to the job site and placed in their proper location. For structural integrity, all adjoining empty baskets shall be connected along the perimeter of their contact surface in order to obtain a monolithic structure.

7. Baskets shall be filled with rock (50% minimum) and topsoil (unless otherwise specified on the Plans) carefully placed by hand or machine to assure alignment and avoid bulges with a minimum of voids. Along all exposed faces and edges, the outer layers of stone shall be carefully placed and packed by hand, ensuring a neat, compact, square appearance. Care shall be taken when placing fill material to ensure that the sheathing on PVC coated baskets is not damaged.

8. Gabions shall be filled in three layers. The cells in any row shall be filled in stages so that local deformation is avoided, that is, at no time shall a cell be filled to a depth exceeding 12 inches more than the adjoining cell. Compacted backfill material shall be placed behind the units simultaneously with the gabion filling operation.

9. The last layer of stone shall be leveled with the top of the basket to assure proper closing of the lid and provide an even surface for the next course. The last layer of stone shall be overfilled a minimum of 2 inches from the top of the basket to allow for settlement and provide an even surface for the next course.

10. Once the baskets are completely full, the lids shall be pulled tight using a lid closer until the lid meets the perimeter edges of the basket. The lid shall be closed with an approved lid closure tool to minimize mesh deformation. Single point tools (stakes or pry bars) are not permitted. The lid shall then be tightly laced and/or fastened along all edges, ends, and tops of diaphragm(s) as described above.

11. Where shown on the Plans or otherwise directed by the PSAA, the basket mesh shall be cut, folded and fastened together to suit existing site conditions. The mesh must be cleanly cut and the surplus mesh folded back and neatly wired to an adjacent gabion face. The cut edges of the mesh shall be securely fastened together with lacing wire or fasteners in the manner described herein. Any reshaped gabion shall be assembled, installed, filled, and closed as specified in the previous sections.

12. Vegetation shall be incorporated into the gabions where shown on Plans.

G. Dewatering Filters

1. Should it be necessary for the Contractor to do any dewatering during the course of construction, the Contractor shall filter all discharge through a discharge filter bag or other sediment control device that will filter all discharge water. No dewatering discharge shall be allowed to flow unfiltered from the construction site.

VI. Landscaping and Restoration

A. Plant Materials and Layout

1. Plant Materials, Street Trees, and Landscaping Vegetation in Public rights-of-way shall conform to Article 9 (Landscaping) of these Standards.

2. Locations of all plantings shall be established by the Contractor according to Plans. The PSAA shall approve all planting layouts prior to commencing any planting activities.

3. Herbaceous plug, live stake, and cultivated perennial zones shall be laid out by paint.

4. Locations for balled and burlapped trees, 1-gallon trees, 3-gallon shrubs, 1-gallon shrubs and plug shrubs shall be identified with stakes. Different species shall be clearly labeled and marked with different color ribbon, paint or permanent marker on the stake.

5. The Contractor shall notify the PSAA when staking and layout is completed and allow 2 working days for modifications and notice to proceed with planting.

B. Turf Establishment

1. General

   a) The Contractor shall restore all lawn areas disturbed by construction to a condition better than or equal to their original condition. This includes the placement and compaction of topsoil, seed/sod, fertilizer and mulch. Restoration shall also include the replacement of any brickwork, decorative stone, or other adjacent materials. Visible germination of seed or establishment of sod shall be evident across the majority of the disturbed area.

   b) Immediately after completion of construction phase or segment, the Contractor shall clean the entire area within the influence of construction, including but not limited to all pavement, sidewalks, lawn areas, and underground utility structures, of all materials which may have accumulated prior to or during the construction.

c) All holes and ruts resulting from the work operations shall be filled with PSAA-approved material. All backfill materials shall be compacted, and ruts and holes restored to the surrounding contour as directed by the PSAA.

d) The existing earth bed shall be graded such that the placement of topsoil will meet the final Plan grades. Grading, soil preparation, and removal and disposal of excess or unsuitable materials shall be considered as part of the restoration work. All rocks larger than 1-inch shall be removed from the seed bed. All lumps and clods greater than 1-inch shall be pulverized and raked into the seed bed before planting

e) A minimum of 4 inches of topsoil shall be placed on all areas that are to be restored with seeding or sodding.

f) Prepared area shall be moistened before planting if soil is dry. Surface shall be watered thoroughly and allowed to dry before planting. Muddy soil shall not be created.

g) Before planting, PSAA's acceptance of finish grading shall be obtained. Planting areas shall be restored if eroded or otherwise disturbed after finish grading.

h) Restoration must be performed upon the completion of each stage of work, to prevent erosion, and not as one single operation at the completion of the entire project.

i) If, in the judgment of the PSAA, adequate site restoration efforts are not being expended, then the City will take the necessary steps to perform such restoration and shall charge the Contractor for all the costs until restoration is completed satisfactorily.

j) The Contractor shall maintain all lawn areas until they have been accepted by the PSAA. Lawn maintenance shall begin immediately after the grass seed or sod is in place and shall continue until final acceptance.

k) Lawns shall be protected and maintained by watering, mowing, and reseeding as necessary, until the period of time when the final acceptance and payment is made.

l) The Contractor shall establish a uniform, dense, vigorous, and weed-free stand of specified grasses.

m) Maintenance includes but is not limited to: deposition of additional topsoil; re-seeding; watering; fertilizing; mowing, and any other work as required to correct all settlement, erosion, germination, and establishment issues until the date of final acceptance by the PSAA.

n) When the above requirements have been fulfilled, the PSAA will accept the lawn.

2. Seeding

a) Seed shall be sown at the rate of 250 lbs/acre with spreader or seeding machine. Seeds shall not be broadcast or dropped when wind velocity exceeds 5 mph. Seed shall be evenly distributed by sowing equal quantities in two directions at right angles to each other.

b) Seed shall be lightly raked into top ⅛-inch of soil, rolled lightly, and watered with fine spray.

c) Seeded areas with slopes exceeding 1:4 shall be protected with erosion-control blankets installed and stapled according to manufacturer's written instructions.

d) Seeded areas with slopes not exceeding 1:4 shall be protected by spreading straw mulch uniformly at a minimum rate of 2 tons per acre to form a continuous blanket 1½ inches in loose thickness over seeded areas.

e) Seed shall be spread by hand, blower, or other suitable equipment.

f) Straw mulch shall be anchored by crimping into soil with suitable mechanical equipment.

g) Any portion of a seeded area that fails to show a uniform germination shall be reseeded. Such reseeding shall be at the Contractor's expense and shall continue until a dense weed-free lawn is established in a growing and vigorous condition.

h) Damage to seeded areas resulting from erosion shall be repaired by the Contractor at the Contractor's expense. Scattered bare spots in seeded areas will not be allowed over three (3) percent of the area nor greater than four (4) square inches in size.

3. Sodding

a) Contractor shall submit copies of Sod Growers Certificate to the PSAA indicating nursery from which sod was taken, grass species, and percentage in accordance with the Michigan State Department of Agriculture Regulations.

b) Prior to commencement of sodding operations, the PSAA shall be notified of the off-site sources from which sod is to be furnished. The PSAA may elect to inspect the sod at the off-site source.

c) Sod shall be delivered to the project site on suitable wooden pallets in manageable rolls. The amount of sod delivered shall not exceed that which can be installed in one 24-hour period. Sod that has been damaged during delivery will be rejected.

d) Sod shall be lifted from trucks or storage piles and placed on a moist earth bed by hand, making close joints without overlapping. All gaps between sections of sod and openings at angles shall be plugged with sod.

e) When placing sod on slopes, the work shall begin at the base of the slope and progress upward by carefully placing the sod on the smooth slope, in rows, with the lengths running at right angles to the slope.

f) The transverse joints of sod strips shall be staggered, and the sod carefully laid to produce tight joints.

g) When the tops of slopes are reached, the sod shall be carried back at least 2 feet over the crest and trimmed to a line which is parallel to the top of the bank. The areas back of the crest shall have been previously graded and the surface of the sod, when placed, shall be 2 inches below the level of this area and covered with a layer of topsoil at least 2 inches in depth and thoroughly compacted in a manner that will conduct the surface water from runoff over the edge of the sod.

h) No frozen sod shall be laid nor shall sod be laid on frozen soil.

i) On slopes steeper than 1:3, unless otherwise specified, the sod shall be staked with wooden pegs. There shall be at least 1 peg in each piece of sod with a maximum between pegs of 2 feet.

j) Pegs shall be driven flush with the surface of the sod. Laying and staking of the sod shall be done simultaneously. Where sod may be displaced during sodding operations, workmen shall work from ladders or treaded planks.

k) Rolling of the sod shall be done after initial watering and after the water has sufficiently soaked into the ground so that distortion of the sod surface and excessive compaction of the sod and the soil will not occur.

l) The roller used shall be a water-filled type at least 3 feet wide and 30 inches in diameter and shall weigh approximately 300 pounds. Roller shall be adequate to cause sod to make firm contact with the soil.

m) A tamper, acceptable to the PSAA, shall be used to press the sod firmly in place in areas not accessible to a roller. After tamping or rolling, the sod shall present a smooth, even surface, free from bumps or depressions.

n) Damaged, deteriorated or otherwise defective sod will be rejected by the PSAA and except as otherwise provided herein, removed from the Project.

o) Sod which has been permitted to dry out or become otherwise injured during transportation, handling, storage or placing shall be rejected. Where permitted by the PSAA, rejected sod, if suitable, may be pulverized and used for filling, where necessary.

p) After laying, the sod shall be watered until saturated. Sod shall be watered whenever excessive drying is evident during the period set for establishment. Sufficient water shall be applied to wet the sod completely and to wet at least 2 inches of the sod bed each time watering is required. Watering shall be done in a manner that will prevent erosion due to the application of large quantities of water.

q) The watering equipment shall be of a type that will prevent damage to the finished surfaces of topsoil and sod. The sod shall be watered as required until firmly knit in place and in a vigorous growing condition.

r) The establishment period shall extend for a period from the time of sodding until the sodded area have received final acceptance of the entire work covered by the Contract. The minimum period shall be 45 days.

C. Tree Removal

1. Only trees identified for removal on the Plans and that have been approved by the City (and U-M where applicable), may be removed. No additional trees shall be removed without the written permission of the PSAA (and U-M where required). The Contractor shall be aware that the request for removal of additional trees to facilitate the work may not be allowed and may require substantial additional time for review of the request.

2. Prior to removal of any street trees, Contractor must submit a ROW Street Tree Permit.

3. The Contractor must clearly mark the trees for removal at least 1 week prior to the date of their intended removal.

4. Only the removal and disposal of trees greater than 6 inches in diameter, as indicated on the Plans, shall be paid for. The cutting, removal, and disposal of trees less than 6 inches in diameter, bushes, brush, or the trimming of trees will not be paid for separately and shall be considered as incidental to the Project.

5. Trees shall be cut and felled in a manner so as not to damage surrounding areas, fences, features, and adjacent trees designated to remain.

6. Stumps and roots shall be grubbed and removed. All resulting holes or excavations shall be backfilled with PSAA-approved material and all debris disposed of before ending the day's work.

7. Burning of any removed materials is strictly prohibited.

8. All trees, branches, brush and debris cut and removed as part of the work completed for this project shall be removed from the property and properly disposed of unless otherwise requested by the City. All wood requested by the City shall be cut into logs approximately 10 feet in length and placed at a location onsite as designated by the PSAA.

D. Tree Planting

1. Tree planting shall be conformance with Article 12 (Standard Details), SD-L-1 (Tree Planting) of these Standards.

2. Balled and burlapped (B&B) trees shall be dug with solid balls of standard size, the balls securely wrapped with non-synthetic, untreated, biodegradable burlap, and tightly bound with non-synthetic, biodegradable rope or twine.

3. Alternatively, B &B trees may be placed in a wire basket lined with non-synthetic, untreated, biodegradable burlap and tightly bound with non-synthetic, biodegradable rope or twine. Plants balled with plastic burlap will not be accepted.

4. Planting for trees shall be performed after April 1st and before June 1st; or, after October 1st and before December 1st or until the ground freezes unless otherwise approved by the PSAA.

5. Material delivery for trees shall be the same day as planting. No trees shall be stored at the site without permission of the PSAA.

6. Trees shall be carefully loaded and unloaded so as not to damage branching or root mass. Dropping of material will not be allowed.

7. Trees in full leaf shall be thoroughly wetted down and completely covered with a wet tarpaulin during transportation.

8. All tree roots must be kept in a moist condition.

9. Trees which are poorly packed, or which arrive with the roots in a dry condition, as a result of improper packing, delay in transit, or from any other cause, will not be accepted.

10. Stock shall be handled in such a manner that the roots shall remain intact, the branches unbroken, and the bark intact and not loosened from the wood.

11. Stock shall be protected from drying and from temperatures below 50° F and in excess of 90° F prior to planting.

12. The sides and bottoms of all tree planting beds, trenches and pits shall be scarified and shall receive a minimum of 6 inches of topsoil if planted in severely disturbed soil or building rubble.

13. Trees shall be planted such that when settled, they will bear the same relation to finish grade as they did before being transplanted. No filling will be permitted around trunks or stems before or after settling.

14. All non-biodegradable materials shall be removed from the root balls prior to planting. Burlap and string shall be removed from around the root ball to the extent possible without damaging roots or disturbing the root ball. If a wire basket has been provided, the wire basket shall be removed to a depth of 10 inches.

15. Mulch shall be placed on the soil surface over the root ball of the tree and to the lateral extent as shown on Plans and Details. Mulch shall not touch the root collar of the tree trunk.

16. Mulch depth is to be no less than 2 and no more than 3 inches.

17. The Contractor shall be responsible to keep trees adequately watered during the warranty period, as necessary, to ensure their survival. At minimum, trees shall be watered twelve (12) times during the warranty period.

E. Plugs, Shrubs and Live Stakes Planting

1. Planting for herbaceous plugs shall be performed after May 1st and before June 15th or, after August 15th but before September 15th, or as otherwise approved by the PSAA.

2. Live stake plant stock shall be kept stored in field, cool, and sheltered from drying effects of direct sunlight and prevailing winds. Plant stock stored in field or in a refrigerated locker shall not be subjected to freezing, drying, or warming. Adequate water shall be supplied to maintain plant stock in a healthy condition.

3. Shrub and live stake planting shall be subject to the following:

    a) All containers and packaging material shall be removed before planting and removed from site;

    b) Plants shall be set plumb;

    c) Root structure shall not be damaged;

    d) Root matter shall be thoroughly soaked with water; and

    e) Where shrubs and/or plugs are planted in areas of mulch blankets, planting shall be through the mulch blanket after its installation.

4. Live Stake Planting shall be subject to the following:

    a) A minimum of 2 to 4 inches and two live buds (bud side pointing up) of the live stake shall be exposed above the stone fill or soil layer.

    b) In areas where both live stakes and mulch blanket are present, live stakes shall be planted through the blanket after its installation.

    c) Live stakes shall be cut to a point on the basal end for insertion in the ground.

    d) For ditches or creek side area, live stake shall be installed at an angle slightly downstream.

    e) A dead blow hammer shall be used to drive stakes into the ground. The hammer head should be filled with shot or sand. A dibble, iron bar, or similar tool shall be used to make a pilot hole to prevent damaging the material during installation.

    f) When possible, soil shall be tamped around live stakes.

    g) Care shall be taken not to damage the live stakes during installation. Those damaged at the top during installation shall be trimmed back to undamaged material.

    h) The Contractor shall be responsible to keep the live stakes adequately watered, if necessary, to ensure their survival.

F. Rain Garden and Bioswale Planting

1. Establishment of a dense stand of wet meadow perennial grasses and/or flowers as specified in Plans is the responsibility of the Contractor. Any part of the area that fails to thrive shall be re-planted until a dense planting in these areas is established.

G. Acceptance and Warranty

1. The Contractor, prior to requesting a letter of Provisional Acceptance from the PSAA shall submit 2 copies of a maintenance schedule detailing the work items identified under the Contract.

2. This schedule shall include a 52-week table covering the 1-year warranty period, identifying all weekly site visits and the tasks to be performed during each visit.

3. The schedule shall show that no maintenance will occur between the periods of October 15th and April 1st, unless otherwise required by related specification.

4. After planting zone/type is finished, the PSAA and Contractor shall perform a site evaluation to determine if planting is complete. After any additional changes have been performed by the Contractor, the PSAA will issue a written Provisional Acceptance letter, after which the Maintenance and Warranty Periods will commence for 1 full year.

5. Acceptance of Native Seeded Areas

    a) Provisional Acceptance shall be granted when 20% of the native species and 80% total cover with no bare areas as large as 4 square feet exist as determined by the PSAA. The PSAA will utilize a meander/search method for reviewing the area(s).

    b) Final Acceptance for Native Seeded Areas shall be granted when 40% of the native species and 90% total cover with no bare areas as large as 1 square foot exist as determined by the PSAA. The PSAA will utilize a meander/search method for reviewing the area(s).

6. Acceptance of Rain Garden and Bioswale and Adjacent Planting Areas

    a) Provisional Acceptance shall be granted when 90% total cover with no bare areas as large as 4 square feet exist as determined by the PSAA. The PSAA will utilize a meander/search method for reviewing the area(s). Bare areas as large as 4 square feet shall be “re-plugged” by the Contractor without additional compensation. Ditch/creek side re-vegetation areas only planted in riprap with no plugs will not allow bare areas as large as 1.5 square feet to exist as determined by the PSAA.

    b) Final Acceptance shall be granted when no bare areas as large as 1.5 square feet exist as determined by the PSAA. Bare areas as large as 1.5 square feet shall be “re-plugged” by the Contractor without additional compensation.

H. Landscape Maintenance and Guarantee (for Projects with this requirement)

1. General

    a) Maintenance shall include all measures necessary to establish and maintain plants in a vigorous and healthy growing condition.

b) Maintenance of plantings shall begin immediately after Provisional Acceptance is granted and shall continue as required until Final Acceptance at the end of the warranty period.

c) Maintenance required prior to Provisional Acceptance shall be incidental to the Project. Provisional Acceptance may be granted for different planting zones/types (e.g. B&B trees, ditch planting, etc.) within the project based on project schedule constraints.

d) The Contractor shall submit to the PSAA copies of all field reports prepared by the maintenance supervisor identifying the date of each visit and work items completed during each visit.

e) The Contractor shall inspect the plantings at least once per week during the warranty period and promptly perform needed maintenance.

f) Weekly maintenance shall be conducted for 1 full year after Provisional Acceptance is granted.

g) During the warranty period, the Contractor shall replace at Contractor's sole expense plant materials that are dead or that are, in the opinion of the PSAA, in an unhealthy or unsightly condition. Rejected plant materials shall be removed from the site and legally disposed of by the Contractor at their sole expense.

h) The Contractor shall be aware that plants may need to be replaced more than once during the warranty period should the plants be deemed to be in an unhealthy or unsightly condition by the PSAA. The Contractor shall provide the necessary resources in the unit price bid for the work to cover the cost of any needed replacements.

i) Plants shall be replaced no later than the next succeeding planting season. Areas damaged by replacement operations shall be fully restored by the Contractor at Contractor's expense.

j) All damaged guys and stakes shall be repaired during the warranty period.

k) All stakes, guys, labels and support material shall be removed at the end of the warranty period and removed from site.

l) The Contractor shall remove and replace dead and unacceptable plants as their condition becomes apparent at Contractor's sole expense.

m) Planted area shall be protected from traffic and erosion. Safety fences and/or silt fence with appropriate signage may be used at the Contractor's expense until the grasses and flowers are fully established.

2. Watering

a) Water shall come from a source approved by the PSAA.

b) All plants shall be monitored during site visits for signs of stress due to lack of adequate moisture in the root zone.

c) Plants shall be watered as required to keep them in optimum condition (1 inch of total water per week, including rainfall) and maintain an optimum supply of moisture within the root zone. Recurring overly dry or wet conditions shall be grounds for rejection of plant material.

d) Watering of all deciduous plants and trees shall be performed using the probe method and by the use of water reservoir bags.

e) Each balled and burlapped tree shall receive its own individual water reservoir bag.

f) Water shall not be applied with a force that will displace mulch or cause soil erosion and shall not be applied so quickly that the mulch and plants cannot absorb it. Water shall be applied in such a manner that it will penetrate down into root zone of plant.

g) Herbaceous plugs in the deepest ponding area may require more watering than other planting areas.

h) If newly planted bioswales (within first 3 months of planting) have 3 inches of standing water or more for over 12 hours, the Contractor shall pump the affected area(s) out to ensure the survival of the planting. The pumping activities shall occur within 24 hours of the overwhelming rain event.

3. Weeding/Cultivating

a) Weeds shall be removed by hand and include removing the entire root mass of the weed. Before application of any herbicide, the Contractor shall receive approval of the PSAA. A selective herbicide shall be applied according to manufacturer's directions.

b) Herbicides shall only be used when and where necessary as approved by the PSAA. Manufacturer's directions and precautions must be followed rigorously. Excess herbicides shall be properly removed from the site.

c) The posting of signs as a public notification of herbicide application will be required 24 hours before and maintained for 48 hours following application.

d) Weeding of all planting areas shall occur with each maintenance visit and in no instance shall they be allowed to propagate such that invasive weed species (Sweet Clover, Burdock, Wild Carrot, Purple Knapweed, Canada Thistle, Queen Anne's Lace, Purple Loosestrife, Phragmites, Bindweed, Crab Grass, Lamb's Quarters, non-native honeysuckle, buckthorn, autumn olive, Norway maple, bindweed, barnyard grass, etc.) may set their seed. Additional weeding activities may need to be performed as determined by PSAA.

e) Post-planting management procedures for bioswales and adjacent planting areas, ditch/creek side re-vegetation and native seed planting areas may consist of, but are not limited to, the following:

   (1) Pulling invasive weed species to remove the entire root mass;

   (2) Spring or fall dormant seasons application of a non-selective herbicide to control invasive weeds as directed by the PSAA;

   (3) Summer application of a selective herbicide to control invasive weeds as directed by the PSAA. City of Ann Arbor signage requirements for herbicide application shall be followed; and

   (4) Initial mowing of the native seed areas (using flail mower) may occur after one season of growth when the weeds are 10 inches high or prior to invasive weeds setting seed. Mowed height shall be 5 inches. Weeds on slopes 1:3 or greater shall be mowed with a hand-held flail mower or common weed whacker.

f) Herbicide applications for aggressive weeds shall conform to the following guidelines:

   (1) Invasive grasses such as crabgrass, smooth brome, reed canary, barnyard or other invasive grass shall be spot-controlled beginning in May on an on-going basis with an appropriate herbicide through the end of the second growing season and/or before the plants set seed.

(2) Invasive forbs such as purple knapweed, purple loosestrife, garlic mustard, Queen Anne's Lace, Canada thistle, bindweed, lamb's quarters, phragmites or other invasive forbs shall be spot controlled on an on-going basis beginning in June with an appropriate herbicide through the end of the second growing season and/or before the plants set seed.

(3) Invasive woody plants such as non-native honeysuckle, buckthorn, autumn olive, Norway maple, shall be spot controlled beginning in June on an on-going basis with an appropriate herbicide through the end of the second growing season and/or before the plants set seed.

(4) Planting areas adjacent to open water that contain invasive weeds shall be spot controlled beginning in June with an appropriate Herbicide until the end of the first full growing season and/or before the plants set seed.

4. Mulching

a) All mulch beds shall be reviewed in June and September for each Maintenance and Warranty Period. Any beds that do not meet the following conditions shall be replenished:

(1) Depth shall be a minimum of 2 inches and a maximum of 3 inches throughout the mulch saucer for individual trees.

(2) Depth shall be 2 inches throughout a bioswale areas.

(3) Mulch shall be kept away from root collar of trees.

5. Disease and Insect Control

a) Monitoring for diseases and insects shall be the responsibility of the Contractor. The Contractor shall monitor all plants at all times for disease and insect problems.

b) Treatment shall take place in accordance with common Integrated Pest Management (IPM) practices.

c) Pesticides shall only be used when and where necessary as approved by the PSAA. Manufacturer's directions and precautions must be followed rigorously. Excess pesticides shall be properly removed from the site.

d) The posting of signs as a public notification of pesticide application will be required 24 hours before and maintained for 48 hours following application.

6. Pruning

a) All dead wood shall be pruned at the first live lateral bud in accordance with standard horticulture practices using sharp instruments cleaned frequently. Pruning shall enhance plant development and ornamental qualities.

b) Terminal leaders and branch tips shall not be pruned.

c) A plant's natural form shall not be compromised by any pruning activities.

d) Additional pruning may be required at the request of the PSAA in order to decrease public liability factors.

e) All standing dead material shall be removed from perennials and grasses at the earliest spring maintenance visit.

f) Immediately after pruning, all dead, broken and diseased growth and other pruning debris from the site shall be removed and disposed of in an environmentally sensitive manner.

g) Plant material that is "topped" by the Contractor shall be replaced at the Contractor's expense.

7. Fertilizing

a) Maintenance fertilizer application for lawn shall occur during the period of May through October as needed to establish and maintain healthy, vigorous, turf during the Acceptance and Warranty Periods.

b) For spring seeding, commencement of maintenance fertilizer shall begin during the first growing season. For Fall seeding, commencement of maintenance fertilizer shall begin the subsequent spring.

c) Fertilizer for lawns shall be spread at a rate of 1 pound of nitrogen per 1,000 square feet.

d) Maintenance Fertilizer application for woody plants shall occur in November of the Second Maintenance and Guarantee Period. Topdressing shall be at a rate of 1 pound of nitrogen per 1,000 square feet.

e) The final inspection of all planting work, or phase of planting work, will be made by the PSAA and the Contractor just before the final warranty period expires. All plant replacements shall be completed, and the site shall be cleaned-up, prior to the inspection.

f) The final acceptance inspection of plantings or material planted during recognized planting seasons will be made during September for fall planting and by June for spring planting.

g) Planted areas which do not meet the contract requirements, shall be replanted to the original project specifications and within acceptable planting dates as directed by the PSAA.

I. Protecting and Preserving Irrigation Systems

1. The Contractor shall locate, save, and protect from damage irrigation systems within the Project limits. This includes the removal and replacement of irrigation system components as necessary and ensuring the proper operation of the irrigation system as determined by the PSAA.

2. The Contractor shall perform the necessary investigations to determine the precise location of the irrigation systems, and all affected components, prior to the commencement of construction operations.

3. The Contractor shall take all actions necessary to maintain the original functionality of the system to the greatest extent possible throughout the duration of the Project.

4. The Contractor shall contact all property owners prior to the commencement of the work in order to determine the impacts to the irrigation systems and coordinate the project's work with them to ensure satisfactory operation of the irrigation systems during construction.

5. All work shall be approved by the PSAA and the affected property owner(s) at the conclusion of the project's work.

J. Underground Sprinkling Systems, Restore

1. Restore existing privately owned underground sprinkling systems within the project site as described herein. This work shall be paid with an allowance for the actual work required to restore and modify existing privately owned underground sprinkling systems. The Contractor shall take care to avoid disturbance of existing underground sprinkling systems within the project site. These typically will be encountered in the parkway adjacent to the roadway.

2. Materials used to restore or modify existing underground sprinkling systems shall be of the same brand, model and specifications as the removed or damaged portion(s) of the sprinkling system and shall be compatible with the rest of the system.

3. The Contractor shall take precautions to prevent or minimize damage and disruption to private lawn sprinkling systems, including, but not limited to, completing visual inspections of the project site to determine areas in which lawn sprinkling equipment exists. This work of inspection shall be considered incidental to the disturbing work in the project area.

4. The Contractor shall repair or replace all lawn sprinkling systems disturbed by their operations and shall contact and coordinate any necessary work with the appropriate owners of such sprinkling systems. The Contractor shall obtain written permission from property owners prior to completing any work outside the right-of-way on private property and shall provide copies of these documents to the Engineer for the project file.

5. The Contractor shall employ an underground sprinkling specialist to make necessary repairs or modifications to the affected underground sprinkling systems. During construction activities, the disturbed portions of the system shall be isolated and/or removed in such a way that the undisturbed portions of the system remain operational until the entire system is completely restored. The existing underground sprinkling systems shall be restored or modified so that spray from the sprinkler heads does not spray over sidewalks or into driving lanes of the road.

K. Chain Link Fencing

1. The Contractor may be required to submit shop drawings, manufacturer's catalog cuts with printed specifications, framework, and fabric samples to the PSAA for review and approval a minimum of 14 days prior to the proposed delivery of materials.

2. The shop drawing submittal shall include complete details of fence construction, fence height, post spacing, dimensions and unit weights of framework, and concrete footing details. The framework sample shall include one 12-inch long piece of each size. The fabric sample shall be one 12-inch square piece of fabric.

3. Fence installation shall be in accordance with ASTM F567 (Standard Practice for Installation of Chain-Link Fence), except as modified herein.

4. The fence shall be installed at the height indicated on the Plans.

5. Where “Salvage and Re-erect” is called for on the Plans, the Contractor may utilize new or salvaged zinc-coated chain link fencing materials, posts, and all related hardware meeting the requirement of MDOT Specifications, Subsection 907.04 (Steel Chain Link Fence). Salvaged fencing materials and posts shall be free from significant defects, bends, kinks, old concrete, or corrosion that will compromise the performance of the fence. Fencing materials and posts shall be in a condition such that they do not contain large (greater than 1 square foot) or unsightly defects in the fence fabric or posts. The PSAA will decide if the defects in the materials are significant.

6. All vinyl-coated materials shall be handled with care. Any damage to the vinyl coating shall be repaired by the Contractor to the satisfaction of the PSAA, or, at the PSAA's direction, the damaged item(s) shall be replaced by the Contractor, all at the Contractor's expense.

7. The fence shall be stepped at all grade changes. The fence shall not be stepped on any wall or barrier.

8. Terminal, turning, gate, and line posts shall be set plumb in concrete footings as indicated on Plans Details. Plumb shall mean 1 inch in 6 feet.

9. The top of the concrete footing shall be 2 inches above the adjacent finish grade and shall be sloped so as to direct water away from the post.

10. Terminal, turning, and gate posts shall be braced back to adjacent line posts with horizontal brace rails and diagonal truss rods.

11. Caps shall be provided that fit snugly over posts to exclude moisture. Cone-type caps shall be used for terminal, turning, and gate posts. Loop-type caps shall be used for line posts.

12. The top rail shall be installed through the line post loop caps and fastened at the terminal posts. Sections shall be connected with sleeves to form a continuous rail between terminal posts.

13. The sleeves shall be spaced 20 feet center-to-center, with every fifth sleeve containing a heavy spring to take up expansion and contraction of the top rail.

14. The middle and bottom rails shall be joined to the line posts with boulevard clamps. The brace rails and truss rods shall be installed and adjusted prior to the stretching of the fabric.

15. A top and bottom tension wire shall be provided, and stretched between the terminal, turning, and gate posts, 6 inches above the finish grade (bottom wire), and threaded through the top row of the fabric diamonds (top wire). They shall be securely fastened to the outside of all line and terminal posts.

16. The top and/or bottom tension wire may be omitted when a top or bottom rail is provided, respectively, unless otherwise specified.

17. The fabric shall be pulled taut to provide a smooth, uniform appearance, free from sag. The bottom selvage shall be 2 inches above the finish grade.

18. The fabric shall be fastened to the terminal, turning, and gate posts with tension bars threaded through the fabric and secured with tension bands at maximum 15-inch intervals, including one at the top and bottom of the fabric.

19. The fabric shall also be tied to the line posts with tie wires spaced at maximum 12-inch intervals, including one at the top and bottom of the fabric.

20. The fabric shall be tied to all horizontal rails with tie wires spaced at maximum 24-inch intervals.

21. The fabric shall be attached to the bottom tension wire (if applicable) with hog rings at maximum 24-inch intervals.

22. Nuts for fittings, bands and hardware bolts shall be installed on the inside of the fence. The ends of the bolts shall be peened, or the threads scored, to prevent their removal.

23. Gates shall be hung and adjusted to operate properly. The bottom of the gate frame shall be 2 inches above the finish grade. The top of the gate shall align with the top rail of the fence.

24. The finished fence shall be substantially true to line, taut, and solid at all points. All surplus excavated material and other debris resulting from the construction shall be promptly removed from the jobsite and properly disposed of off-site.

L. Removal of Fence

1. Fences shall be removed and replaced or shall be removed as indicated on the Plans. If any of the existing material is damaged or destroyed, the Contractor shall replace the material at his expense.

2. Where fencing is encountered during construction, and its removal was not called for on the Plans, it shall be replaced or restored, at the Contractor's expense, to a condition comparable to that prior to construction.

3. After the fence removal or relocation operations are complete, all surplus material shall be removed and disposed of by the Contractor, at Contractor's expense, unless otherwise called for in the Contract Documents.

M. Protective Fence and Tree Protection

1. Contractor shall install protective fence at the limits of the construction area as shown on the Plans or as directed by the PSAA.

2. Posts for protective fencing shall be driven a minimum of 42 inches into the earth and be spaced close enough to maintain a taut fabric between posts. At no time shall fence fabric protrude into the pedestrian pathway. If steel bases are used, Contractor shall constantly monitor spacing to ensure fabric remains taut. Fabric shall be attached utilizing a minimum of 4 wire clamps or other methods as approved by the PSAA.

3. The Contractor shall not operate equipment within the tree protection fence of any existing tree without the approval of the PSAA.

4. Construction material, supplies, or equipment shall not be stockpiled or stored within the limits of the tree protection fence.

5. Vehicles and personnel are not permitted within the limits of the tree protection fence.

6. The Contractor shall not attach chains, cables, ropes, nails, or other articles to any tree at any time.

7. Tree roots exposed during construction that are 1½ inches or greater in diameter must be pruned. All pruning operations shall be reviewed and approved by the PSAA.

8. All root pruning shall be performed with sharp tools and shall provide clean cuts that do not unnecessarily damage the remaining bark or root. The Contractor shall not perform any backfilling operations until all root maintenance has been performed.

9. Any trees owned by the City of Ann Arbor or other trees designated to be protected that are damaged due to the Contractor's activities or activities of the Contractor's subcontractors or suppliers, shall be repaired under the direction of the Urban Forestry and Natural Resources Planning Coordinator or by an approved forestry specialist. The costs of these repairs shall be the sole responsibility of the Contractor.

10. Should the Contractor's operations damage a plant's roots to the extent that it must be removed, the Contractor shall either replace the plant with a commensurate number of plants, 2½-inch caliper trees of the species as determined by the City, or compensate the City of Ann Arbor for the cash value of the plant or tree as determined by the Urban Forestry and Natural Resources Planning Coordinator. The City of Ann Arbor shall be solely responsible for determining which compensation method is used.

11. The Urban Forestry and Natural Resources Planning Coordinator shall supervise the replacement of any trees at the sole expense of the Contractor.

12. Contractor shall remove tree protection fence when directed by the PSAA.

Article 11 Pay Items

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I. General

A. Unit Prices for Pay Items

1. The unit price for the Contract Items of work (Pay Items) as listed below shall include all labor, material, and equipment costs required to perform all the work specified in these Standards.

B. Pay Item Numbers

1. Pay Item numbers shall be as set forth in Appendix C (Pay Item Numbers) of these Standards.

II. Pay Item Descriptions

A. General Conditions

1. Work shall be as described in Article 10 (Construction Specifications), Section I.F. (General Conditions) and Section I. I (Project Supervision), of these Standards.

2. The completed work as measured for the following pay item shall be paid for at the contract unit price for the following contract item (pay item).

Contract Item (Pay Item)	**Pay Unit**
General Conditions, Max. $_____	Lump Sum
Project Supervision, Max. $_____	Lump Sum

3. "General Conditions, Max. $" will be paid on a pro-rata basis at the time of each progress payment. Measurement will be based on the ratio between work completed during the payment period and the total contract amount. When all of the work of this Contract has been completed, the measurement of this item shall be 1.0 Lump Sum, minus any deductions incurred for inadequate performance as allowed by the contract. This amount will not be increased for any reason, including, but not limited to: extensions of time, agreed-upon extra costs, additional work added to the contract; adjustments to unit prices; and all similar additions to the contract.

4. "Project Supervision, Max. $____" will be paid for on a pro rata basis at the time of each progress payment. Measurement will be based on the ratio between work completed during the payment period and the total contract amount. When all of the work of this Contract has been completed, the measurement of this item shall be 1.0 Lump Sum, minus any deductions incurred for inadequate performance as described herein. This amount will not be increased for any reason, including extensions of time, extras, and/or additional work. The unit price for this item of work shall include all labor, material, and equipment costs to perform all the work specified.

B. Project Cleanup and Restoration

1. The completed work as measured for the following pay item shall be paid for at the contract unit price for the following contract item (pay item):

Contract Item (Pay Item)	**Pay Unit**
Project Clean-Up and Restoration	Lump Sum

2. The lump sum price for "Project Clean-Up and Restoration" shall include all remaining project clean-up and restoration work, including all labor, material, and equipment costs required to complete the work as specified herein.

C. Audiovisual Recording

1. Work shall be as described in Article 10 (Construction Specifications), Section I.H. (Digital Audio-Visual Coverage), of these Standards.

2. The completed work as measured for the following pay item shall be paid for at the contract unit price for the following contract item (pay item):

Contract Item (Pay Item)	**Pay Unit**
Digital Audio Visual Coverage	Lump Sum

3. Payment will be made for "Digital Audio Visual Coverage" following the review and acceptance of the recording by the PSAA. Within 14 days following the receipt of the recording, the PSAA will either accept it and authorize payment, or require that any discrepancies in the recording be addressed prior to making payment.

4. In the event that construction has already begun if re-recording of project areas is required, the Contractor shall be responsible for any extra costs or issues associated with re-recording the required areas due to lack of access, difficulty of access, inability to use the originally planned audiovisual equipment, or any other related costs.

D. Tree Protection Fence

1. Work shall be as described in Article 10 (Construction Specifications), Section VI.M. (Protective Fence and Tree Protection), of these Standards.

2. The completed work as measured for the following pay item shall be paid for at the contract unit price for the following contract item (pay item):

Contract Item (Pay Item)	**Pay Unit**
Tree Protection Fence	Foot

3. "Tree Protection Fence" will be paid for at the contract unit price per linear foot of fence installed for protection of trees. Price paid shall be payment in full for all labor, materials, and equipment needed to accomplish this work. No additional payment will be made for maintenance or reinstallation of fence during the construction period.

E. Tree, Remove

1. Work shall be as described in Article 10 (Construction Specifications), Section VI.C. (Tree Removal), of these Standards.

2. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
Tree, Rem, 6 In. - 12 In.	Each
Tree, Rem, 13 In. - 19 In	Each
Tree, Rem, 20 In. - 29 In	Each
Tree, Rem, 30 In. - 39 In	Each
Tree, Rem, 40 In. and larger	Each
Stump, Rem	Each

3. Removal of trees and stumps shall be paid for at the Contract Unit Price for each tree or stump removal. The tree removal pay item includes respective stump removal.

4. Removal of trees and stumps shall include backfilling the resulting hole with MDOT Class II Granular material compacted to 95% of its maximum dry density to the level of the existing ground surface before the stump was removed if the area(s) will be under, or within the 1:1 influence of a paved surface of any type

5. The unit price paid shall be payment in full for all labor, material, and equipment costs necessary for the complete removal and disposal offsite of each tree or stump in accordance with the schedule of sizes.

6. The size of trees shall be determined by the diameter of tree trunk measured at a point 4-½ feet above the ground. The size of the stumps shall be determined by the diameter of the stump measured at the top of the stump.

7. The removal and disposal of all stumps, hedges, brush, shrubs, roots, and trees having a diameter of less than six (6) inches shall be considered to be incidental to the Project and will not be paid for separately.

F. Abandoning and Removal of Storm Pipe and Drainage Structures

1. Work shall be as described in Article 10 (Construction Specifications), Section II.AA (Abandonment and Removal of Sewers and Drainage Structures), of these Standards.

2. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
Storm Sewer Pipe, ___In. Dia., Abandon	Foot
Storm Sewer Pipe, ___In. Dia., Rem	Foot
Storm Sewer Structure, Abandon	Each
Storm Sewer Structure, Rem	Each
Storm Sewer Drop Structure, Rem	Each

3. Payment for “Storm Sewer Pipe, ___In. Dia., Abandon” includes complete filling of the sewer with flowable fill in accordance with these Standards.

4. Payment for “Storm Sewer Structure, Abandon” includes all work to bulkhead the existing holes/sewers, breaking down the top 4 vertical feet of the structure, breaking out the bottom of the structure as required by the specifications, and filling the structure with flowable fill or compacted granular material as specified.

5. Payment for pay items “Storm Sewer Pipe, ___ In. Dia., Rem” and “Storm Sewer Structure, Rem” and “Storm Sewer Drop Structure, Rem” includes the complete excavation and removal of the entire sewer/structure and furnishing, placing, and backfilling the excavation per these Standards.

G. Abandonment and Removal of Water Main Pipe and Appurtenances

1. Work shall be as described in Article 10 (Construction Specifications), Section II.BB. (Abandoning and Removal of Water Main and Appurtenances), of these Standards.

2. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
Water Main Pipe, ___In. Dia, Abandon	Foot
Water Main Pipe, Abandon, Modified	Lump Sum
Water Main Pipe, ___In. Dia, Rem	Foot
Gate Valve in Box, ___In. Dia, Abandon	Each
Gate Valve in Box, ___In. Dia, Rem	Each
Gate Valve in Well, ___In. Dia, Abandon	Each
Gate Valve in Well, ___In. Dia, Rem	Each
Fire Hydrant Assembly, Rem	Each

3. Payment for “Water Main Pipe, ___In. Dia, Abandon” and “Water Main Pipe, ___In. Dia, Rem” shall be measured and paid for by length in lineal feet and shall include all labor, materials, and equipment costs necessary to abandon or remove the pipe including, but not limited to; excavation; cutting of pipe; furnishing and installing push-on joint plugs or caps and thrust blocks; constructing brick and mortar bulkheads; the furnishing, placement, and compaction of approved granular backfill material, as required; and, the removal and proper disposal off-site of all excess materials. Also included is all work for complying with the appropriate environmental and worker safety laws and requirements regarding the removal/abandonment of asbestos pipe. Payment for “Water Main Pipe, ___In. Dia, Abandon” also includes filling the water main with flowable fill where specified.

4. Payment for "Water Main Pipe, Abandon, modified" shall include all labor, materials, and equipment costs necessary to abandon and remove pipe as necessary including, but not limited to; excavation; cutting of pipe; furnishing and installing push-on joint plugs or caps and thrust blocks; constructing brick and mortar bulkheads; the furnishing, placement, and compaction of approved granular backfill material, as required; and, the removal and proper disposal off-site of all excess materials. Also included is all work for complying with the appropriate environmental and worker safety laws and requirements regarding the removal/abandonment of asbestos pipe.

5. Pay items for Abandoning and Removing Gate Valves in Wells, Gate Valves in Boxes, and Fire Hydrant Assemblies shall include all labor, materials, and equipment costs necessary to completely abandon (salvage) or remove the valve or fire hydrant and companion valve, including removing and salvaging the valve, valve boxes, gate well frame and covers, and fire hydrant assemblies, neatly stack on-site and deliver to Public Works, including unloading, within 2 days of removal. Also included is the removal of the top 4 feet of valve wells; breaking out the valve well base; filling the structure with flowable fill; furnishing, placement, and compaction of approved granular backfill material, as required; stockpiling valves for future use by City; and the removal and proper disposing off-site of all excess materials.

H. Abandonment and Removal of Sanitary Sewer Pipe and Structures

1. Work shall be as described in Article 10 (Construction Specifications), Section II.AA. (Abandonment and Removal of Sewers and Drainage Structures), of these Standards.

2. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
Sanitary Sewer Pipe, ___In. Dia., Abandon	Foot
Sanitary Sewer Pipe, ___In. Dia., Rem	Foot
Sanitary Sewer Structure, Abandon	Each
Sanitary Sewer Structure, Rem	Each

3. Payment for "Sanitary Sewer Pipe, ___In. Dia., Abandon" includes filling the sewer with flowable fill and bulkheading.

4. Payment for “Sanitary Sewer Structure, Abandon” includes all work to bulkhead the existing holes/sewers, breaking down the top 4 vertical feet of the structure, and filling the structure with flowable fill.

5. Payment for pay items “Sanitary Sewer Pipe, ___In. Dia., Rem” and “Sanitary Sewer Structure, Rem” includes the complete excavation and removal of the entire sewer/structure and furnishing, bulkheading, placing, and backfilling the excavation per these Standards.

I. Removing Pavement and Concrete Items

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
HMA, Any Thickness, Rem	Square Yard
HMA Surface, Rem	Square Yard
HMA Patch, Rem	Square Yard
Concrete Pavt, Any Thickness, Rem	Square Yard
Curb, Gutter, and Curb and Gutter, Any Type, Rem	Foot
Sidewalk, Sidewalk Ramp, & Driveway Approach, Any Thick, Rem.	Sq. Foot
Cold-Milling HMA Surface	Square Yard
Cold-Milling HMA Surface, Plunge Cut	Square Yard
Cold-Milling HMA Surface, Modified	Ton
Cold-Milling for Concrete Curb and Gutter Reveal	Square Yard

2. The full-depth saw cutting required for all removals shall be included in the unit price of the item of work being performed will not be paid for separately.

3. Composite pavement will be paid for as “Concrete Pavt, Any Thickness, Rem” based on the area of pavement removed, regardless of thickness.

4. Payment for pay items “HMA, Any Thickness, Rem”, “HMA, Surface, Rem”, “HMA Patch, Rem”, “Concrete Pavt, Any Thickness, Rem”, and “Sidewalk, Sidewalk Ramp, & Driveway Approach, Any Thickness, Rem” will be based on the area of pavement, sidewalk, or drive removed. The removal area shall be based upon the average length and width measurements as determined in the field by the PSAA.

5. "HMA Surface, Rem” will be measured by the area in square yards and would typically be used for removing all the HMA surface from a composite road.

6. "HMA Patch, Rem" will be measured by the area in square yards and would typically be used for removing wedged HMA surfaces on driveways.

7. Payment for pay item "Curb, Gutter, and Curb and Gutter, Any Type, Rem" shall be based upon the length removed.

8. Damage to the surrounding and/or supporting material(s) designated to remain in place shall be repaired at the sole expense by the Contractor in accordance with the direction of the PSAA.

9. "Cold-Milling HMA Surface" will be measured by the area in square yard.

10. "Cold-Milling HMA Surface, Plunge Cut" will be measured by the area in square yard to be applied to areas of bituminous material having a thickness of up to 4 inches, as identified by the PSAA for milling after the first pass of HMA surface removal is complete.

11. "Cold-Milling HMA Surface, Modified" will be measured by the weight in tons.

12. "Cold-Milling for Concrete Curb and Gutter Reveal" will be measured by the area in square yard, from edge of metal to face of curb, to be applied to areas of bituminous material having a thickness of up to 4 inches. This item will not be paid if the work is performed at the same time as the overall road cold-milling operation. Completion of a safety edge is required and will not be paid separately.

13. "Cold-Milling HMA Surface," "Cold-Milling HMA Surface, Plunge Cut," "Cold-Milling HMA Surface (Modified)" and "Cold-Milling for Concrete Curb and Gutter Reveal" unit costs include the cost for all labor, equipment and materials required to remove, load, haul, and dispose of the cold milled material, protecting existing improvements, milling around (not lowered) structure covers including those used for storm, sanitary, and water structures, gate and monument boxes, other private utility structures, and other features specified on the plans or as identified in the field, cleaning the remaining HMA or concrete pavement surfaces, and, if applicable, cleaning the cold milled edges and bottom of milling surface. The Engineer will not pay for material picked up by cleaning after cold-milling. Also included in the unit price shall be the complete removal and disposal of all miscellaneous unremoved areas that remain after the initial cold-milling operation has been completed or thin sections of HMA that remain on surfaces that are to remain in place.

J. Earthwork

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
Machine Grading, _____	Square Yard
Machine Grading, _____ , Modified	Station
Hand Dig, _____	Square Yard
Earth Excavation	Cubic Yard
Embankment	Cubic Yard

2. "Machine Grading" will be measured in square yards for the area as shown on the plans or as necessary in the field to construct the Work.

3. "Machine Grading, Modified" will be measured by length in 100-foot long stations, or portions thereof, along the centerline of the road or feature being constructed (including sidewalks); and includes work on both sides of the road or centerline being measured.

4. Payment for "Machine Grading" or "Machine Grading, Modified" shall include all labor, material and equipment necessary to grade and compact the site, including, but not limited to, the removal and offsite disposal of any surplus or unsuitable materials, and the furnishing from off-site of any additional PSAA approved fill materials necessary to construct the embankment and subgrade to the contours and cross-sections as shown on the plans.

5. Payment for pay item "Earth Excavation" includes all labor, material, and equipment necessary for excavation to the lines and grades shown on the plans and includes stripping and stockpiling topsoil; all excavation and disposal of all unsuitable material including but not limited to all rocks, earth, and large stones; protecting existing improvements; filling holes and voids with compacted granular backfill; the excavation and disposal of other items exposed in excavating to the subgrade; fine grading and compacting subgrade; and proofrolling.

6. Payment for pay item "Embankment" includes all labor, material, and equipment required to construct the embankment to the lines and grades shown on the plans and includes stripping and stockpiling topsoil; providing, placing, and compacting the fill material; and all necessary subgrade preparation.

7. Payment for pay items “Earth Excavation” and “Embankment” will be per cubic yard. The quantity of earth excavation and embankment was calculated from existing and proposed grades. The quantity paid will be plan quantity unless there is a field change which affects the plan quantity. No field measurement for payment of these items will be done at the time of construction.

8. Payment for pay items “Hand Dig,____” shall include all labor, material, and equipment costs required to complete the excavation, and root pruning as required, to the designed rough grade or removal limits as shown on plans and/or directed by PSAA.

K. Subgrade Undercut

1. The completed work as measured for the following pay item shall be paid for at the contract unit price for the following contract item (pay items):

Contract Item (Pay Item)	**Pay Unit**
Subgrade Undercutting, Type ___	Cubic Yard

2. Payment includes excavation and proper disposal off-site of all unsuitable material, as determined by the PSAA, below the proposed subgrade elevation, including providing, placing and compacting the undercut backfill material. In fill areas, payment includes undercut excavation and disposal of all unsuitable material, as determined by the PSAA, below the existing ground elevation (after removal of all topsoil and organic materials) including providing, placing and compacting the undercut backfill material to its required dry density to existing grade.

3. Measurement for “Subgrade Undercutting, Type __” will be determined by field measurement as directed by the PSAA.

L. Exploratory Excavation

1. The completed work as measured for the following pay item shall be paid for at the contract unit price for the following contract item (pay item):

Contract Item (Pay Item)	**Pay Unit**
Exploratory Excavation, SD-TD- __, (0-10’ deep)	Each
Exploratory Excavation, SD-TD- __, Additional Depth	Foot

2. Pay items for Exploratory Excavation includes all costs for all labor, equipment and materials necessary to complete the work, including all costs associated with repair or replacement of damaged items resulting from the Contractor's activities. Work includes excavation, furnishing of approved backfill materials, placing and compacting of backfill materials, and proper off-site disposal of all unsuitable material for exploratory excavations to locate the desired miscellaneous utilities or objects. Also included is the furnishing and installation of any required sheeting, shoring, bracing, dewatering and barricading required to perform the work in a manner in accordance with all relevant safety standards.

3. Pay items for Exploratory Excavation, Additional Depth shall be measured by the vertical foot from top of existing grade vertically to the bottom of the excavation beyond 10 feet in depth for a 4-foot maximum diameter hole, or as approved by the Engineer. The measurement and payment for the excavated depth of each 4-foot maximum diameter hole shall paid separately. An individual excavation will be paid only once regardless of the number of utilities or objects that are located if they are contained within the 4- foot diameter excavation.

M. Non-Hazardous Contaminated Material Handling and Disposal

1. The completed work as measured for the following pay item shall be paid for at the contract unit price for the following contract item (pay item):

Contract Item (Pay Item)	**Pay Unit**
Non-Hazardous Contaminated Material Handling and Disposal	Cubic Yard

2. Payment shall include all costs for materials, labor and equipment needed for storage, loading, transportation, and disposal of the non-hazardous contaminated material. Disposal costs shall include all documentation required by the landfill. Payment for this item shall be the same, regardless of whether the Contractor temporarily stores the contaminated material or immediately removes it from the jobsite. The Contractor shall not be paid for re-handling of the material due to construction staging, stockpiling, or other related activities.

3. "Non-Hazardous Contaminated Material Handling and Disposal" will be measured by volume in cubic yards, loose measure, as contained in the hauling unit. Under no circumstance will the Contractor be paid for quantities of this material that have not been approved for payment by the PSAA and as measured and tracked by the PSAA and the Contractor. The Contractor will not be paid "standard amounts" that have been determined by the disposal facility; only measured volumes as computed by the PSAA will be paid. Prior to payment, the PSAA shall be given receipts from the disposal facility for the number of cubic yards disposed of at that facility.

N. Dewatering

1. The completed work as measured for the following pay item shall be paid for at the contract unit price for the following contract item (pay item):

Contract Item (Pay Item)	**Pay Unit**
Dewatering	Lump Sum

2. Payment for "Dewatering" shall include all labor, material, and equipment required for furnishing, installing, maintaining, and operating, complete dewatering systems as necessary to complete the work in dry conditions. Dewatering shall include, but not be limited to: the preparation of shop plans, design drawings, and calculations; all deep wells, well points, header tubing, discharge tubing, and suction tubing; pumps, generators, electrical lines and service; special well backfill; grouting of wells when they are no longer needed; removal of well casings and all appurtenances; protection of existing or proposed improvements; miscellaneous restoration; furnishing, maintaining, and removing all soil erosion and sedimentation control devices associated with dewatering; complying with all applicable local, state, and federal environmental and soil erosion and sedimentation control measures; and, all other items necessary to complete the work, whether specifically mentioned or implied.

O. Erosion Control

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
Erosion Control, Check Dam	Foot
Erosion Control, Inlet Protection, Fabric Drop	Each
Erosion Control, Silt Fence	Foot
Erosion Control, Mud Mat	Square Yard

2. Payment for "Erosion Control, Check Dam" includes all labor, material and equipment costs necessary to furnish, install and maintain check dams. Also included in the unit price for this item of work is furnishing and installing rock, furnishing and placement of the required geotextile fabric, and any other miscellaneous work needed to properly complete the work. Also included in the unit price for this item of work is the removal and proper disposal offsite of the check dam upon project completion.

3. Payment for "Erosion Control, Inlet Protection, Fabric Drop" includes all labor, equipment, and material costs needed to furnish, install, maintain, clean and remove the device, and re-install and/or replace the inlet filter as needed when directed by the PSAA.

4. Payment for "Erosion Control, Silt Fence" includes all labor, material and equipment costs to furnish, trench, install, toe-in, maintain, and remove when no longer needed erosion control silt fence. The unit price for his item of work shall also include maintaining the erosion control silt fence in a fully operational manner in accordance with the applicable details. All erosion control silt fence that is damaged by the Contractor's operations, for any reason, shall be replaced at the Contractor's sole expense.

5. Payment for "Erosion Control, Mud Mat" includes all labor, material and equipment costs necessary to furnish, install and maintain mud mats. Also included in the unit price for this item of work is the removal and proper disposal offsite of mud mat upon project completion.

P. Subbase

1. The completed work as measured for the following pay item shall be paid for at the contract unit price for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
Subbase, CIP	Cubic Yard

2. Payment includes all labor, material and equipment needed to furnish, place, and compact the subbase material of the type specified on the Plans or in these Standards. Material paid for by Cubic Yard will be calculated using the nominal width and depth of the subbase as indicated on the plans.

3. No allowance will be made for material the Contractor places outside area indicated on the plans to aid in the Contractor's operations.

Q. Aggregate Base Course and Surface Courses

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	Pay Unit
Aggregate Base, ___In., 21AA, CIP	Square Yard
Aggregate Base Course, 21AA, CIP	Cubic Yard
Aggregate Surface Course, ___In., 23A, CIP	Square Yard
Aggregate Surface Course, 23A, CIP	Cubic Yard
Aggregate Shoulder, Cl I, 22A	Ton
Aggregate Shoulder, Cl I, 21AA	Ton
Aggregate Shoulder, Cl II, 23A	Ton

2. Payment includes all labor, material and equipment needed to furnish, place and compact the aggregate base course or surface course material to the thickness designated on the Plans.

3. Material paid for by Cubic Yard will be calculated using the nominal width and depth of the aggregate base course or surface course as indicated on the plans.

4. No allowance will be made for material the Contractor places outside area indicated on the plans to aid in the Contractor's operations.

R. Geotextile Fabric

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	Pay Unit
Geotextile Separator Fabric	Square Yard
Geotextile Stabilization Fabric	Square Yard

2. Payment includes all labor, material and equipment costs required to furnish and install geotextile fabric. Measurement will be in square yards for the material as indicated on the Plans. No allowance will be made for overlaps or splices as required by the material manufacturer or as specified herein. Any material damaged by the Contractor's operations, shall be removed and replaced by Contractor at no additional cost to the project.

S. Storm Sewer and Culvert

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
____In., PE Storm Sewer, SD-TD-2	Foot
____In., CL ___RCP Storm Sewer, SD-TD-1	Foot
____In., CMP Storm Sewer, SD-TD-2	Foot
____In., PE End Section	Each
____In., CL ____RCP End Section	Each
____In., CMP End Section	Each
Storm Sewer Tap, ____In., Dia	Each
Pipe Undercut & Backfill, Storm	Cubic Yard

2. Storm Sewer and Culverts shall be paid for by the length of pipe actually installed from end-of-pipe to end-of-pipe. Payment of the unit price for this item of work shall include all labor, material, and equipment costs, including excavation, furnishing and placement of backfill, proper disposal off-site of all surplus material, video inspection, and all other needed items to properly complete the work as shown on the plans, as detailed in the Specifications, and as directed by the PSAA.

3. Payment for “End Sections” shall include all labor, material and equipment costs necessary to furnish and install end section on new or existing culverts in accordance with the applicable trench detail.

4. Storm Sewer Tap shall be paid for new connections or new hole not an existing connection. When tapping an existing pipe or structure, a minimum opening of the entering pipe’s outside diameter plus 6 inches (150 mm) shall be cut into the receiving structure. A minimum 3 inch (75 mm) mortar layer shall be packed completely around the entering pipe and struck smooth with the inner wall of the pipe or structure. Pipe passing through the pipe or structure shared is to be cut flush to conform to the inner wall. The entering pipe on the outside portion of the connection shall be encased to provide sufficient bearing under the pipe. Payment of the unit price for this item of work shall include all labor, material, and equipment costs.

5. Payment for “Pipe Undercut & Backfill, Storm” will be based on cubic yards as measured compacted in place. Payment will include the additional excavation, placement of backfill material compacted in place, and all related work. Measurement for the backfill width will be the outside diameter of the pipe plus 2 feet. Measurement for depth will be from the bottom of the excavation to the bottom of the pipe barrel.

T. Drainage Structures

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
Storm Manhole, ___In. Dia., (0-8’deep)	Each
Storm Manhole, ___In. Dia., Additional Depth	Foot
Storm Inlet-Junction, __In. Dia., (0-8’ deep)	Each
Storm Inlet-Junction, ___In. Dia., Additional Depth	Foot
Storm Single Inlet, ___In. Dia., (0-8’deep)	Each
Storm Single Inlet, ___ In. Dia., Additional Depth	Foot
Storm High Capacity Inlet, ___ In. Dia., (0-8’deep)	Each
Storm High Capacity Inlet, ___ In. Dia., Additional Depth	Foot
Storm Manhole with Weir, ___ In. Dia., (0-8’ deep)	Each
Storm Manhole with Weir, ___ In. Dia., Additional Depth	Foot
Storm Manhole Over Existing (“Doghouse”), ___In. Dia.	Each
Storm Structure Cover	Each
Storm Structure Cover, Adjust	Each
Storm Structure Adjust, Additional Depth	Foot
Storm Structure, Reconstruct	Foot

2. Payment for drainage structures (Storm Manholes, Inlet-Junction, Single Inlets, and High Capacity Inlets) includes furnishing the labor, equipment, and materials for all necessary excavation; disposing of surplus excavated material; backfilling, frame and structure cover; and constructing the structure complete, including pipe connections and structure cleaning. A standard depth drainage structure shall be considered to be 8 feet or less in depth from the inside bottom of the structure (including sump) to the top of the cover.

3. Payment for “Additional Depth” for drainage structures includes furnishing the labor, equipment, and materials for all necessary excavation, disposing of surplus excavated material, backfilling, and constructing the structure complete, including pipe connections and structure cleaning, for the portion of the structure which is deeper than 8 feet (including sump).

4. Payment for “Storm Manhole Over Existing (“Doghouse”), __ In. Dia” shall include all work required to design and construct the manhole structure over and around the existing sewer pipe, including but not limited to: field investigation of existing sewer pipe, design of the manhole structure and appurtenances, submitting shop drawings to the PSAA for review and approval, fabricating and constructing the doghouse style manhole structure over and around the existing sewer pipe, constructing a concrete base for the manhole structure, furnishing and installing the manhole access riser structure with frame and cover, removal of portions of the existing sewer pipe within the new manhole structure, benching, connections into the manhole structure for storm outlet pipes with associated flow channels, temporary or final grade adjustments of the manhole riser structure, and all associated earthwork and backfill.

5. Payment for “Storm Structure Cover” of the type specified shall include all labor, materials and equipment needed to furnish and install the drainage structure cover, exclusive of the structure frame.

6. Payment for “Structure Cover, Adjust” shall include all labor, material and equipment necessary to raise a structure frame and cover not more than 6 inches or lower them not more than 12 inches. Adjusting covers includes saw cutting, removing and replacing pavement; furnishing and installing a structure frame; reuse of the existing cover; and furnishing, installing and compacting granular backfill material as necessary. Payment for furnishing a new structure cover will be paid for as “Storm Structure Cover.”

7. Payment for “Structure, Reconstruct” includes all labor, materials and equipment required to rebuild deteriorated portions of existing structures as determined by the PSAA. Reconstructing structures includes saw cutting, removing and replacing pavement; furnishing and installing a structure frame; reuse of the existing cover; and furnishing, installing, and compacting granular backfill material. Measurement for Reconstruct Structure will be in vertical feet from the bottom of the frame to the top of the existing masonry that was not removed. Structures paid for as “Structure, Reconstruct” will not be paid for as “Structure Cover, Adjust”. In a case where the existing structure cover cannot be reused, payment for furnishing a new structure cover will be paid for as “Storm Structure Cover.”

U. Underdrain

1. The completed work as measured for the following pay item shall be paid for at the contract unit price for the following contract items (pay items):

Contract Item (Pay Item)	Pay Unit
Underdrain, Subgrade, __ In.	Foot
Underdrain, Subbase, __ In.	Foot
Underdrain, Edge, __ In.	Foot
Underdrain, Outlet, __In.	Foot
Underdrain, Outlet Ending, __ In.	Each

2. Underdrain will be paid for at the contract unit price per length in feet and shall be payment in full for all labor, equipment and material needed to accomplish this work.

3. The unit price shall include the cost of the 6-inch perforated pipe, geotextile wrap, pipe fittings and/or plugs, furnishing bedding and backfill material (as specified), trenching, compaction of the trench backfill, taps to new and existing drainage structures, all excavation, final trimming required to meet the dimensions of the typical and specific cross-sections, and the proper disposal offsite of all surplus excavated materials. The unit price for Underdrain, Outlet would also include the cost of the following: 1. Locating installed outlets; 2. Maintaining the end of the outlet pipe or end section clear of obstructions; and 3. Providing and installing temporary tie-downs.

4. In addition to above, the unit price for Underdrain, Outlet Ending also includes the cost of the following: 1. Excavating the area at the end of the outlet; 2. Providing and placing the concrete ring, steel end section, or concrete end section; and 3. Disposing of surplus excavated material.

V. Curb Drain

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	Pay Unit
Curb Drain, HDPE DR 17, HDD, 6 inch	Foot
Curb Drain, HDPE DR 17, SD-TD-2, 6 inch	Foot
Curb Drain, Tap	Each
Curb Drain, Cleanout	Each

2. Measurement and payment for pipe installation shall be made per linear foot of installed pipe by measuring the distance from center of cleanout cap to the connection point of downstream storm structure.

3. Curb Drain Tap shall be paid for making the connection to the downstream Catch Basin or storm structure. Curb Drain Tap shall also be paid for making the connection to existing sump pump discharge lines, with up to five feet of HDPE or PVC pipe, and saddle, shall be included to make the proper connection.

W. Bituminous Pavement

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
HMA, ___	Ton
HMA Approach	Ton
HMA, High Stress	Ton
HMA Base Crushing and Shaping	Syd
Hand Patching	Ton

2. Payment includes all labor, material and equipment required to furnish and install HMA Pavement of the type and thickness specified, providing the required Contractor Quality Control services, including furnishing and applying prime and bond coat, compacting the mixture, protection of existing improvements from damage during placement and compaction operations, and protecting installed pavement until cooled.

3. Unused HMA remaining in trucks after the work is completed shall be returned to the plant and re-weighed, and the corrected weight slip shall be provided to the Engineer. No payment will be made for the unused HMA material. All weight slips must include the type of mixture (codes are not acceptable), as well as vehicle number, gross weight, tare weight and net weight.

4. "HMA Base Crushing and Shaping" shall include costs for all labor, equipment and materials necessary to complete the work. The Contractor, at its sole expense, will remedy, as directed by the Engineer, any damage to the foundation, pathway, or roadway embankment or subgrade caused by traffic or its operations. The Engineer will not pay additional compensation or allow extensions of contract time for additional measures required to protect the grade as specified. The Engineer will not pay additional compensation or allow extensions of contract time for tree trimming measures and coordination of this work with City forces. The Engineer will pay for the trimming and pruning of trees by an authorized subcontractor, if necessary, as extra work.

5. "HMA, High Stress" shall include all labor, material and equipment required to furnish and install HMA Pavement of the type and thickness specified with a higher Performance Graded binder. The difference between the High Stress HMA Mixture and the typical HMA pay item is the Performance Graded binder.

X. Micro-Surfacing

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	Pay Unit
Chip Seal	Square Yard
Micro-Surfacing	Square Yard

2. "Chip Seal" will be measured by the area in square yards. Price includes the cost for all labor, equipment and materials required to prepare the existing surface and furnish and install chip seal material.

3. "Micro-Surfacing" will be measured by the area in square yards. Price includes the cost for all labor, equipment and materials required to prepare the existing surface and furnish and install micro-surfacing mixture.

Y. Concrete Pavement

1. The completed work as measured for the following pay item shall be paid for at the contract unit price for the following contract item (pay item):

Contract Item (Pay Item)	Pay Unit
Conc Pavt, Non-Reinf, ___ In.	Square Yard
Conc Pavt With Integral Curb, Non-Reinf, ___ In.	Square Yard
Conc Pavt Repair (MDOT Detail 8)	Foot
Joint, Contraction, ___	Foot
Joint, Expansion, ___	Foot
Joint, Plane-of-Weakness, W	Foot
Conc, Speed Hump	Square Yard
Conc, Speed Cushions	Square Yard
Conc, Speed Table	Square Yard
Conc, Raised Crosswalk	Square Yard
Conc, Raised Intersection	Square Yard

2. Payment includes all labor, material and equipment required to furnish and install Concrete Pavement, including ensuring concrete durability, curing, pavement gapping, and protection against rain, and hot and cold weather.

3. Measurement and payment of “Conc Pavt Repair (MDOT Detail 8)” shall be in feet measured along the centerline of the repair joint or crack, and shall include saw cutting full depth, removal, lane tie placement, furnish and placement of concrete, and curing compound.

4. Payment for “Joint, ___” includes the cost of transverse end-of-pour joints and transverse plane-of-weakness joints per Standard Detail. The City will pay for other transverse joints by the length, based on plan dimensions, for the type of joint required. The unit price for the transverse contraction, transverse expansion, transverse plane-of-weakness, and intersection joints include the cost of the following: 1. Providing required joint materials such as load transfer assemblies, expansion joint fillers, and joint seals or sealants; 2. Providing a joint layout detail plan, if required; 3. Sawing, forming, and cleaning the joints; 4. Providing and applying bond breaker, if required; and 5. Providing and placing poured joint sealant. The unit prices for other pay items include the cost of internal and external longitudinal joint.

5. “Conc, Speed Hump,” “Conc, Speed Cushions,” “Conc, Speed Table,” “Conc, Raised Crosswalk,” and “Conc, Raised Intersection” includes all labor, equipment, MDOT 21 AA aggregate base, compaction effort, concrete, curing compound, forms and materials to complete the work. Saw cutting and removing exiting pavement will be paid for separately under pay item “HMA, Any Thickness, Rem;” pavement markings will paid for separately under the appropriate pay item.

Z. Concrete Curb and Gutter

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
Conc, Curb or Curb & Gutter, All Types	Foot
Conc, Driveway Opening, Type ___	Foot
Conc, Driveway Opening, Type ___, Modified	Foot
Conc, Driveway Opening, Type ___, High Early	Foot

2. Payment for the following items of work includes all labor, material and equipment cists required to furnish and install “Conc, Curb and Gutter, All Types” or “Conc, Driveway Opening, Type ___/Modified/High Early” including, but not limited to: performing the specified concrete durability tasks, curing the concrete for the required time period; and protection of the newly placed concrete against rain, wind, and temperature conditions that are adverse to the proper curing of the newly placed concrete as specified.

3. At curb openings for sidewalk ramps, the concrete curb and gutter (without the curb face) will be measured and paid for at the contract unit price for curb and gutter of the type being installed.

AA. Concrete Drives and Sidewalks

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
Conc, Sidewalk, __ In.	Square Foot
Conc, Sidewalk, Drive Approach, or Ramp, ___ In.,	Square Foot
Conc, Sidewalk, Drive Approach, or Ramp, __ In., High Early	Square Foot
Brick Pavers, Sidewalk, Rem and Reinstall	Square Foot

2. Payment for the subject items includes all labor, material and equipment costs required to furnish and install concrete sidewalk and drive approaches including but not limited to: installing driveway base material as specified; performing the specified concrete durability tasks; curing the concrete for the required time period; and, protection of the newly placed concrete against rain, wind, and temperature conditions that are adverse to the proper curing of the newly placed concrete as specified.

3. Excavation for placement of driveway base material shall be included in the item of work "Machine Grading, ____, ____" and shall not be paid for separately.

4. Detectable warning surfaces that are cast-in-place, shall be paid for separately.

5. Payment for “Brick Pavers, Sidewalk, Rem and Reinstall” includes all labor, material, and equipment costs to removal and stockpile existing pavers, furnishing and installing edge restraint, leveling bed and joint sand, compacting pavers, and replacing pavers that could not be salvaged.

BB. Detectable Warning Surface

1. The completed work as measured for the following pay item shall be paid for at the contract unit price for the following contract item (pay item):

Contract Item (Pay Item)	Pay Unit
Detectable Warning Surface	Foot

2. Payment includes all labor, material and equipment required to furnish and install Detectable Warning Surface in accordance with current ADA requirements.

CC. Fence

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	Pay Unit
Fence, Rem	Foot
Fence, Chain Link, __ In.	Foot
Fence, Salvage and Re-Erect	Foot

2. "Fence, Rem" includes removal and disposal, or removal and salvaging of fence posts and appurtenances, and filling holes and voids with compacted granular material. This does not apply to removal of silt fence or tree protection fence.

3. Payment for chain link fence and gates includes all labor, material and equipment required to furnish and install Fence and gates of the size and type specified.

4. "Fence, Salvage and Re-Erect" shall include all labor, material and equipment costs necessary to remove, store and protect the fence fabric until it is ready for use, salvage and protect fence posts from damage during the removal process, remove any existing concrete from salvaged fence posts, and re-erect salvaged posts and stretch salvaged fence fabric as required by the specifications. Also included in this work is installation of new MDOT 3500 concrete footings and furnishing and installing any new fabric, posts, and hardware as necessary that could not be salvaged.

DD. Pavement Markings

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	Pay Unit
Pavt Mrkg, Type NR, Paint, __ In., ___	Foot
Pavt Mrkg, Type NR, Paint, ___	Each
Pavt Mrkg, Wet Reflective, Type __, ____, ____In., ____	Foot
Pavt Mrkg, Wet Reflective, Type __, ____, ____	Each
Pavt Mrkg, Ovly Cold Plastic, ____, _____	Each
Pavt Mrkg, Polymer Cement Surface, ____, ____	Each
Pavt Mrkg, Polymer Cement Surface, ____, ____	Square Foot
Pavt Mrkg, Polyurea, ____, ____	Each
Pavt Mrkg, Polyurea, ____In.,____	Foot
Pavt Mrkg, Sprayable Thermopl,___In., ___	Foot
Pavt Mrkg, Thermopl,___In., ___, ___	Foot
Pavt Mrkg, Thermopl,___In., ___, ___	Each
Pavt Mrkg, Preformed Thermopl, Accessible Sym	Each
Pavt Mrkg, Waterborne, ___In., ____	Foot
Pavt Mrkg, Longit, Remove	Foot
Pavt Mrkg, Transverse, Remove	FootPavt Mrkg, Symbol or Legend, Remove Each
Pavt Mrkg Cover, Type R, Black	Foot
Recessing Pavt Mrkg, _____	Foot
Rem Curing Compound, _____	Foot
Rem Curing Compound, for Spec Mrkg	Square Foot
Rem Spec Mrkg	Square Foot

2. Payment for these items of work includes all labor, material and equipment costs necessary for installing the specified pavement markings in place, and shall include pavement cleaning, complete removal of any dead animals in the pavement marking track, furnishing and placing glass beads, all required layout to precisely place the markings in their intended location(s), all traffic control required to safely install the intended pavement markings, and all site cleanup once the work has been completed. Skip pavement markings will only be measured for lines actually placed. Payment for Temporary Pavement Markings includes the removal and proper off-site disposal of all markings when they are no longer needed.

3. Removal of permanent pavement markings, where shown on the plans, will be paid for each item removed or for each per foot as specified on the Plans or as directed by the Engineer.

EE. Traffic Maintenance and Control

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	Pay Unit
Sign, Type B, Temp, Prismatic, Furn and Oper	Square Foot
Sign, Type B, Temp, Prismatic, Special, Furn and Oper	Square Foot
Sign, Rem, Salv	Each
Lighted Arrow, Type __, Furn and Oper	Each
Sign, Portable, Changeable Message, Furn and Oper	Each
Plastic Drum, High Intensity, Lighted, Furn and Oper	Each
Barricade, Type __, High Intensity, Lighted, Furn and Oper	Each
Barricade, Type __, High Intensity, Double Sided, Lighted, Furn and Oper	Each
Temporary Pedestrian Surface, Furn & Oper	Foot
Temporary Pedestrian Ramp, Furn & Oper	Each
Pedestrian Type II Barricade, Temp, Furn & Oper	Each
Pedestrian Channelizer Device, Furn & Oper	Each
Channelizer Cone, High Intensity, 42 In., Furn & Oper	Each
Traffic Regulator Control	Lump Sum
Traffic Regulator Control, Modified	Hours

2. Payment for temporary signs shall be on a per square foot basis and shall include all labor, material and equipment costs necessary to furnish and install temporary signs as specified. This includes moving, re-installing, and operating devices as necessary as the work progresses and removing devices at the completion of the Project.

3. Sign, Rem, Salv includes the cost of removing attaching or fastening hardware if shown on the plans; and removing signs from supports; storing signs after removal, loading, transporting, and unloading the salvage sign to a location shown on the plans or as directed by the Engineer.

4. Payment for traffic control devices, measured as each, shall include all labor, material and equipment costs necessary to furnish, install, operate, maintain, relocate, and remove each traffic control device as specified. This includes moving, re-installing, and operating devices as necessary as the work progresses and removing devices at the completion of the Project.

5. “Traffic Regulator Control” and “Traffic Regulator Control (Modified)” shall include the cost of the following: a. Providing dedicated flagging personnel for actively managing traffic; b. Providing and operating equipment; and c. Providing traffic regulator training in accordance with OSHA standard 1926.201(a) and conforms to Part 6 of the Manual of Uniform Traffic Control Devices (MUTCD).

6. The use of construction team staff, supervisors, and operators for incidental, short term traffic control is not included in this pay item and will not be compensated for separately from the work being undertaken.

7. “Temporary Pedestrian Surface, Furn & Oper” includes all costs related to installation, maintenance, restoration, and removal of the surface and disposal of all associated materials throughout the life of the contract. Temporary Pedestrian Surface will be measured along the centerline of the pedestrian route for the maximum length used project wide. Temporary passing spaces are considered a part of the pedestrian surface and are included in this pay item.

8. “Temporary Pedestrian Ramp, Furn & Oper” includes furnishing, installing and removing a temporary pedestrian ramp at the locations shown on the plans or where directed by the Engineer, as well as all costs for maintaining, clearing debris, deicing, reconfiguring, and relocating the temporary pedestrian ramp throughout the life of the contract.

9. For temporary pedestrian ramps that are fabricated and reusable, payment shall be for the maximum quantity used at any one time. Ramps that are constructed at each location with suitable material that cannot be relocated, such as HMA, shall be paid for at each location.

10. “Pedestrian Channelizer Device, Furn & Oper” includes delivering, installing, maintaining, relocating and removing rails or wall sections, supports, ballast, and hinge points at the locations shown on the plans. Payment will be made on delivery for the quantity delivered to the project site by each (up to 5 ft wide unit), for the maximum used project wide, up to plan quantity. Any amount delivered exceeding plan quantity will not be paid unless approved by the Engineer. This includes all railing or wall sections, supports, ballast, hinge points, and miscellaneous hardware needed to construct the channelizer or system of channelizers.

11. “Pedestrian Type II Barricade, Temp, Furn & Oper” includes delivering, installing, maintaining, relocating, and removing a temporary pedestrian Type II barricade section as identified in the proposal or on the plans. One pedestrian Type II barricade is defined as a barricade section at least 43 inches wide, including all supports, ballast, and hardware.

12. All TPAR facilities furnished by the Contractor shall remain the property of the Contractor. The City shall not be responsible for stolen or damaged ramps, mats, channelizers, or other TPAR items. The Contractor shall replace missing TPAR facilities immediately, at no additional cost to the City.

FF. Temporary No Parking Signs

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contact Item (Pay Item)	**Pay Unit**
Temporary "No Parking" Sign	Each

2. Measure Temporary "No Parking" Sign individually in place by the unit each and pay for it at the contract unit price, which price includes all cost for labor, equipment and materials necessary to complete the work. Signs will be provided by City. Measurement will be for the maximum number of signs installed on a project location at any one time. The unit price also includes the removal and return of "No Parking" signs to the City upon completion of the project, and the covering of any existing/permanent "No Parking" signs.

3. The City will back charge the Contractor for replacement costs associated with damaged and/or unreturned signs.

GG. Minor Traffic Control

1. The completed work as measured for the following pay item shall be paid for at the contract unit price for the following contract item (pay item):

Contract Item (Pay Item)	**Pay Unit**
Minor Traffic Control, Max $	Lump Sum

2. Payment for "Minor Traffic Control, Max $" includes all labor, material and equipment costs necessary for:
   a) The furnishing and operating of miscellaneous signs, warning devices, traffic regulators, temporary concrete barriers, and cones as required for the entire duration of the project;
   b) Installing, maintaining and removing additional signs furnished by the City;
   c) Furnishing and installing meter bags (where required by the Plans);
   d) Coordinating with the City to have meter heads removed and reinstalled (where required by the Plans);

e) Coordinating with the City on signal timing and phasing changes;
f) Maintaining pedestrian traffic in accordance with the requirements of PROWAG, ADA, ABA, and City Code;
g) Temporarily covering conflicting traffic controls with Engineer-approved covers;
h) Temporarily covering conflicting existing signs as directed by the PSAA with approved sign covers; and,
i) Any and all other miscellaneous and/or incidental items that are necessary to properly and safely perform the work.

3. Payment for Minor Traffic Control will be paid on a pro-rata basis at the time of each progress payment. Measurement will be based on the ratio between work completed during the payment period and the total contract amount. When all of the work for this Contract has been completed, the measurement of this item shall be 1.0 Lump Sum.

4. The Contractor shall maintain vehicular and pedestrian traffic during the work by the use of traffic regulators, channelizing devices, and signs as necessary, as determined by the PSAA, and in accordance with MMUTCD. Traffic Regulator Control shall be paid as specified in Section EE (Traffic Maintenance and Control), of this Article.

HH. Slope Protection

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
Riprap, Grouted	Square Yard
Riprap, Plain	Square Yard
Riprap, Heavy	Square Yard
Gabions, Stone Fill	Cubic Yard

2. Payment for Riprap items shall include all labor, material and equipment costs required to furnish the riprap, clear and prepare the subgrade, furnish and place geotextile liner, grout (where type requires) and to place the material to the designated thickness as shown on the plans and as directed by the PSAA. Riprap, Heavy will be measured in place by the square yard.

3. "Gabions, Stone Fill" will be measured by the cubic yard based on plan dimensions of the baskets installed. No adjustments to the calculated volume will be made to account for voids in the fill material. This item of work shall include all labor, materials, and equipment costs necessary to provide a complete installation of the gabions as detailed on the plan sheets.

4. Vegetation to be incorporated into the gabions (if specified on the Plans) shall be paid for separately.

II. Protecting and Preserving Irrigation Systems

1. The completed work as measured for the following pay item shall be paid for at the contract unit price for the following contract item (pay item):

Contract Item (Pay Item)	**Pay Unit**
Irrigation System, Protection and Preserving	Lump Sum

2. Payment includes all labor, material and equipment costs required to investigate, locate, save and protect from damage, ensure continued and proper operation during the performance of the project work, re-establish operation as necessary, and upon completion of all project work, ensure that all existing sprinkler systems located within the project limits, or those affected by the project, are functioning in a satisfactory manner as determined by the PSAA.

JJ. Underground Sprinkling Systems, Restore

1. The completed work shall be paid for at the contract unit price for the following contract item (pay item) which shall include all materials, equipment and labor required to complete this work.

Contract Item (Pay Item)	**Pay Unit**
Underground Sprinkling System, Restore	Dollar

2. Payment for Underground Sprinkling System, Restore will be paid for as an allowance after all disturbed sprinkling systems have been repaired and/or replaced, whichever occurs later. The Contractor shall supply the Engineer with actual invoices from the underground sprinkling specialist for this work effort and may add up to 5% markup.

3. The Contractor waives all claim for damages or delay which they may suffer by reason of the presence of lawn sprinkling equipment within the project site and understands that no extra compensation will be paid to them due to any lawn sprinkling equipment encountered.

KK. Trees and Shrubs

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
Tree, Medium, B&B	Each
Tree, Large, B&B	Each
Plant, Gal	Each
Plant, Live Stake	Each
Plant, Plug	Each

2. Measurement and payment for these items shall include: excavation and preparation of the planting areas and individual planting locations; removal and proper off-site disposal of plant containers, packaging materials, and other related items; all materials necessary to install the plants as shown on the drawings and as detailed herein; transporting and furnishing to the jobsite all plants; preparing the existing soil and planting mixture; removing weeds; furnishing and placing shredded hardwood bark mulch as shown on the Plans; bracing/staking plant materials if needed and approved by the Engineer; water and watering; and, all labor and equipment necessary, completing all necessary tasks to maintain a healthy stand of plants, and Balled and Burlapped (B&B) Trees, as shown on the plans and as described herein, for a complete installation.

3. Tree planting shall include and Tree Drip Irrigation Bags and Watering and Cultivating. Tree Drip Irrigation Bags shall be Treegator Original 20-gallon slow-release watering bags, or approved substitution.

4. Fertilizer shall be slow release, at minimum 50% derived from a natural, organic source, 12-0-6 or approved substitution.

5. The Contractor shall submit a minimum size sample of ½-gallon sized container of structural soil and topsoil for approval prior to installation.

6. Tree and plant types shall be as shown on the Drawings. Trees selected from a table shall have no more than 20% of the quantity of a single species. This is to promote a diversity of species. The Contractor shall submit to the PSAA sources for all plant material. Plant stock submittal shall include: (a) Certificates from supplier(s): name, address, and contract information; (b) Botanical name, including cultivar, and common name; (c) Quantity; (d) Size; (e) Type (B&B, Container, Bare Root…etc.); and (f) Origin (Location grown)Tree Size, shall be 1.75 inch Caliper for Medium and 3 inch Caliper for Large, as defined by the ANSI Z60.1 (American Standard for Nursery Stock) Section 2.

7. Plant Size, Gal, shall have a minimum number of 3 canes, as defined by the ANSI Z60.1 (American Standard for Nursery Stock) Section 2.

8. Plant, Live Stake, shall have a range of diameters between ½ inch to 1 ½ inch and be at least 2 ft long. Harvested during dormant season and kept moist between harvest and planting.

9. Plant, plug, shall be 2" diameter and a depth adequate for the plant type.

10. Backfill soil for planting pits shall consist of 50% excavated material and 50% imported topsoil and shall be finely divided, loose, and free of clods. Lumps, stone, litter, and other foreign non-organic material larger than 1 inch shall be removed. Non-desirable organic matter, including plants, roots, weeds, and perennial rhizomes shall also be removed. If additional soil is required, topsoil shall be used.

11. After all plants have been installed, an inspection for Provisional Acceptance will be made by the Contractor and PSAA. After any necessary changes have been made by the Contractor, the PSAA will issue a letter of Provisional Acceptance after which the Landscape Maintenance and Warranty period will begin for one full calendar year according to the terms of the Landscape Maintenance and Warranty specifications.

12. The final inspection of all planting work under the Contract will be made by the Contractor and PSAA at the end of the maintenance and establishment periods. The Contractor shall remedy any noted deficiencies with the plants and planting area(s) within fourteen (14) calendar days of being notified of the deficiencies. Before final acceptance is given all terms of plant establishment shall be met.

LL. Landscape Maintenance and Warranty

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	Pay Unit
Landscape Maintenance and Warranty, 1 Year	Lump Sum
Landscape Maintenance and Warranty, 2nd Year	Lump Sum

2. Payment includes all labor, material and equipment costs required to: maintain plant materials in a healthy, thriving, condition; remove weeds (include roots) throughout the warranty period; and, meet all other performance requirements outlined in the specifications.

3. Payment for maintenance during the warranty period shall be based on the lump sum contract amount divided by the number of maintenance visits identified in the maintenance schedule supplied by the Contractor prior to issuance of Provisional Acceptance. The warranty period commences at the time of Provisional Acceptance. Payments will only be made for maintenance performed and verified through field reports submitted by the Contractor with each pay request. Also included in these items of work is the restoration of any area damaged by the Contractor during their maintenance or during replacement planting operations.

MM. Turf Establishment

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	Pay Unit
Turf Restoration	Square Yard
Hydroseeding	Square Yard
Sodding	Square Yard
Mulch Blanket	Square Yard
Mulch, High Velocity	Square Yard

2. Payment includes all labor, material and equipment costs required to furnish and install PSAA-approved topsoil, approved seed mixtures, hydroseeding, sod, fertilizer and mulch, including grading of the area to receive the topsoil, preparing the earth bed, spreading and raking the topsoil to provide a uniform surface free of large clods, lumps, rocks, brush, roots, or other deleterious materials, as determined by the PSAA.

3. The hydroseeding shall be placed on all lawn areas as called for on the Plans, and shall include furnishing and installing hydroseed, fertilizer, and all required watering necessary for the establishment of the turf. Watering will not be paid for separately.

4. Any damage or soiling to signs, fences, trees, pavements, or structures caused by turf establishment work shall be repaired and/or cleaned by the Contractor at the Contractor's sole expense.

5. After initial placement of the topsoil and hydroseed mixture(s), fifty (50) percent of the total quantity placed for each item will be certified for payment. Payment for the remaining fifty (50) percent of the total quantities will be held by the City until such time as all lawn areas have been established and accepted by the City.

6. Final acceptance shall occur no sooner than June 15 of the year after the year in which the lawn areas were initially planted during the previous spring planting season; or, final acceptance will occur no sooner than November 1 of the year after the year in which the lawn areas were initially planted during the previous summer planting season. In no case shall lawn areas be accepted in the same year in which they were planted.

NN. Street Lighting and Electrical

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
Conductors, No. __ AWG	Foot
Conduit, Schedule __ PVC, __ In.	Foot
Conduit, Schedule __ PVC, __ In., Qty 2	Foot
Conduit, Schedule __ PVC, __ In., Directional Drill	Foot
Conduit, Schedule __HDPE, __ In., Directional Drill	Foot
Handhole, Rem	Each
Handhole Assembly, __ In. x __ In. x ___ In.	Each
Cabinet, Type ____	Each
Foundation, Light Pole	Each
Foundation, Light Pole, Rem	Each
Foundation, Streetlight Cabinet	Each
Foundation, Streetlight Cabinet, Rem	Each
Light Pole, ____	Each
Light Pole, ____, City Furnish	Each
Light Pole, Rem	Each
Light Pole, Rem and Salvage	Each

Light Pole, Reinstall ..... Each
Light Fixture, ____ ..... Each
Light Fixture, ____, City Furnish..... Each
Light Fixture, Reinstall ..... Each
Light Fixture, Rem ..... Each
Light Fixture, Rem and Salvage ..... Each
Streetlight Disconnect Box, Complete..... Each
Photoelectric Control ..... Each

2. Conductors shall be paid for at the contract unit price per foot and shall include all labor, materials and equipment costs necessary for furnishing and installing conductors. Also included is furnishing and installing all miscellaneous electrical devices, fuses, connections, splices, grounding, testing, excavation, backfill, proper disposal off-site of all excess excavated material, and all other miscellaneous electrical work required for a complete and functioning system as required per the specifications, electrical code or as determined by the PSAA.

3. "Conduit Schedule __ PVC, __ In.; Conduit, Schedule __ PVC, __ In., Qty 2; Conduit, Schedule __ PVC, __ In., Directional Drill" will be measured by length in feet and shall include all labor, material and equipment costs required to furnish and install conduit; and shall include, but not be limited to, excavation, backfill, fittings, elbows, sweeps, pull strings, end caps, sleeves, tracer wire, expansion couplings, conduit spacers, concrete, and other work necessary for installation of as shown on the plans or specified. "Conduit, Schedule __ PVC, __ In., Qty 2" when more than 1 conduit, conduit shall be placed side by side.

4. "Conduit, Schedule __ PVC/HDPE, __ In., Directional Drill" will be measured by length in feet and shall include all labor, material and equipment costs required to furnish and install conduit; and shall include, but not be limited to, excavation, bore pits, trench sheeting and shoring, directional drilling, assembly, dewatering, spoils removal, backfill, compaction, fittings, elbows, sweeps, pull strings, end caps, sleeves, tracer wire, expansion couplings, conduit spacers, concrete and other work necessary for installation of as shown on the plans or specified.

5. "Handhole, Rem" shall be paid for at the contract unit price each and shall consist of furnishing all labor, materials and equipment necessary for removing existing handhole boxes and covers and backfilling if needed.

6. “Handhole Assembly, __ In. x __ In. x __ In.” shall be paid for at the contract unit price each and shall consist of all labor, materials and equipment costs necessary for furnishing and installing electrical handhole boxes and covers as specified on the Plans or as directed by the Engineer. Also included in this work are: the excavation and proper off-site disposal of all excess excavated materials; furnishing, installing and compacting MDOT Class II sand; and all work related to connecting handholes to new and existing conduits.

7. “Cabinet, Type” shall be paid for at the contract unit price and shall include all labor, material, and equipment costs required to complete the work as specified herein. Scheduling and coordinating this work with Detroit Edison shall also be included for large cabinets. The Contractor shall also be responsible for any fees charged by Detroit Edison associated with the installation of the disconnect box.

8. “Foundation, Light Pole” and “Foundation, Streetlight Cabinet” shall be paid for at the contract unit price each and shall include all labor, materials and equipment costs necessary for installing light pole foundations or cabinet foundations, as detailed on the Plans and as required by these Standards, or as directed by the Engineer. The pay item shall also include excavation and proper offsite disposal of materials, furnishing, installing and compacting bedding and backfill, and all work related to connecting foundation to new and existing conduits as required by these Standards or as directed by the Engineer.

9. “Foundation, Light Pole Remove” and “Foundation, Streetlight Cabinet, Remove” shall be paid for at the contract unit price each and shall consist of all labor, materials and equipment costs necessary to completely remove the existing foundation and associated appurtenances to the foundation to allow for installation of a new foundation. Payment shall include all excavation, clean-up and disposal off-site. Separate payment shall apply for each foundation that is removed.

10. "Light Pole, ___" shall be paid for at the contract unit price each and shall include all labor, material and equipment costs including but not limited to: luminaire-supporting structure including tower used for large-area illumination; any other materials required for complete installation of light pole on the existing or proposed foundation; all required testing; and placing pole assemblies into service, as shown on the plans and as detailed in the Specifications, or as directed by the Engineer. This item shall also include all labor, materials, and equipment necessary to reinstall all signs, electrical cabinets, or other objects attached to the pole.

11. “Light Pole, ____, City Furnish” shall be paid for at the contract unit price each and shall include all labor and equipment costs required for complete installation of light pole on the existing or proposed foundation; all required testing; and placing pole assemblies into service, as shown on the plans and as detailed in the specifications, or as directed by the PSAA. This item shall also include all labor, materials, and equipment necessary to reinstall all signs, electrical cabinets, or other objects attached to the pole. Light pole and associated materials for this pay item will be City furnished. The Contractor shall coordinate with the City to obtain stockpiled light poles. Any damage caused by Contractor’s operations to City furnished light poles will require a new light pole be purchased at Contractor’s cost.

12. “Light Pole, Remove” shall be paid for at the contract unit price each and shall consist of all labor, materials and equipment costs necessary to remove and properly dispose of the existing streetlight pole from existing foundation. This item shall also include all labor, materials, and equipment necessary to remove, salvage, and temporarily store all signs, electrical cabinets, or other objects attached to the pole.

13. “Light Pole, Remove and Salvage” shall be paid for at the contract unit price for each pole removed and salvaged. Payment includes all labor, materials, and equipment costs necessary to remove from existing foundation, salvage, protect, and store the existing pole until reinstallation.

14. “Light Pole, Reinstall” shall be paid for at the contract unit price each and shall include all labor, material and equipment costs necessary to reinstall a salvaged pole. Payment includes: luminaire-supporting structure including tower used for large-area illumination; any other materials required for complete reinstallation of light pole on the existing or proposed foundation; all required testing; and placing poles assemblies into service as shown on the Plans and as detailed in the specifications, or as directed by the PSAA. Separate payment for removing, salvaging, storing, and protection of light pole shall be made as “Light Pole, Remove and Salvage.” Any damage caused by Contractor’s operations to City furnished light poles will require a new light pole be purchased at Contractor’s cost.

15. “Light Fixture, ___” shall be paid for at the contract unit price each and shall include all labor, equipment, and materials, including, but not limited to: all lamps; supports; hangers; brackets; globes and all other parts and devices necessary for complete operation and installation, as shown on the Plans and detailed in these specifications, or as directed by the PSAA.

16. “Light Fixture, ___, City Furnish” shall be paid for at the contract unit price each and shall include all labor and equipment costs necessary for complete operation and installation, as shown on the Plans and detailed in specifications, or as directed by the PSAA. Fixture and associated materials for this pay item will be City furnished. The Contractor shall coordinate with City to obtain existing stockpiled fixtures. Any damage caused by Contractor’s operations to City furnished fixture will require a new fixture be purchased at Contractor’s expense.

17. “Light Fixture, Reinstall” shall be paid for at the contract unit price each and shall include all labor and equipment costs necessary for reinstallation of existing fixture and shall assume removal, storing, protecting, and reinstallation of the fixture complete. Any damage to existing fixture will require a new fixture to be purchased at Contractor’s expense.

18. “Light Fixture, Remove” shall be paid for at the contract unit price each and shall consist of all labor, materials and equipment costs necessary to remove and properly dispose of the existing streetlight fixture from existing streetlight pole. This item shall also include all labor, materials, and equipment necessary to remove.

19. “Light Fixture, Remove and Salvage” shall be paid for at the contract unit price each and shall consist of all labor, materials and equipment costs necessary to remove and properly dispose of the existing streetlight fixture from existing streetlight pole. This item shall also include all labor, materials, and equipment necessary to remove, salvage, protect, and store the existing fixture until reinstallation.

20. “Streetlight Disconnect Box, Complete” shall be paid for at the contract unit price and shall include all labor, material, and equipment costs required to complete the work as specified herein. Scheduling and coordinating this work with Detroit Edison shall also be included. The Contractor shall also be responsible for any fees charged by Detroit Edison associated with the installation of the disconnect box.

21. “Photoelectric Control” shall be paid for at the contract unit price each and shall include all labor, equipment, and materials, including, but not limited to: supports; hangers; brackets; and all other parts and devices necessary for complete operation and installation, as shown on the Plans and detailed in these specifications, or as directed by the PSAA.

OO. Water Main and Appurtenances

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
___In., PC ___ DIP w/ polywrap, SD-TD-1	Foot
___In., Class 56 DIP w/ polywrap, SD-TD-1	Foot
___In., HDPE Pressure Pipe Water Main, Directional Drill	Foot
___In. ___° DIP Bend	Each
___In. x ___In. DIP Reducer	Each
___In. x ___In. x ___In. DIP Tee	Each
___In. x ___In. DIP Cross	Each
Gate Valve in Box, ____In.	Each
Gate Valve in Well, ____In.	Each
Tapping Sleeve & Valve in Box, ___In.	Each
Tapping Sleeve & Valve in Well, ___In.	Each
Fire Hydrant Assembly, Complete	Each
Fire Hydrant, Extension	Foot
Excavate & Backfill for Water Service Tap and Lead	Foot
Water Structure Cover	Each
Water Structure Cover, Adjust	Each
Sacrificial Anode, ___-pound	Each
Curb Box, Adjust	Each
Gate Box, Adjust	Each
Gate Box Cover	Each
Monument Box, Adjust	Each

2. Payment for ___In., Class __ DIP w/ polywrap, SD-TD-___", "___In., Class ___ DIP w/ polywrap, SD-TD-__" includes all labor, material and equipment costs required to furnish and install water main and includes trench excavation and backfill, removing and properly disposing off-site of all excavated material, pipe bedding, connections to existing water main, testing, thrust blocks, and polyethylene encasement. Also included is all required costs associated with night time work, furnishing and operating supplemental lighting, and all other required elements of the work.

3. Payment for "____In., HDPE Pressure Pipe Water Main, Directional Drill" shall include all labor, material and equipment costs required for fusion welding, excavation, dewatering (including well points where needed), bore pit and/or trench sheeting and shoring, directional drilling, assembly, furnishing proper backfill material, compaction, proper disposal off-site of excess excavated material and drilling fluid, disinfection, testing, flushing, and placing new mains into service. Payment shall be measured in place by length in lineal feet along the centerline of the main with no reductions for fittings or valves. Payment for thrust blocks, restrained joints, plugs, or any other special fittings shall be considered as having been included with this pay item and will not be paid for separately.

4. Fittings, other than those specifically listed as separate contract items, such as blow-off assemblies, hoses, restrained joint pipe and gaskets, special gaskets, etc., shall not be paid for separately, but shall be considered included in the payment for Water Main.

5. Tees, Bends, Crosses, and Reducers and other fittings specifically listed as separate contract items (pay items), shall be paid for at the contract unit price for each unit installed. Payment for fittings for ductile iron pipe shall include polyethylene encasement.

6. Payment for "Gate Valve in Well, ___In." includes all labor, material and equipment costs required to furnish and install the gate valve in well; frame and structure cover; backfill the specified valve; furnish and install pre-cast concrete gate well including the concrete base, straight pre-cast concrete sections, and transition sections; and the adjustment of the well structure cover to finish grade. No separate payment will be made for adjusting the structure covers on new gate valve in wells.

7. Payment for "Gate Valve in Box, ___In." includes all labor, material and equipment costs required to furnish and install the gate valve; frame and structure cover; backfill the specified valve; and the adjustment of the box structure cover to finish grade. No separate payment will be made for adjusting new gate valve in boxes.

8. "Tapping Sleeve and Valve in Well" includes all labor, material and equipment costs required to furnish and install the tapping sleeve and valve; frame and structure cover; backfill the specified valve; furnish and install pre-cast concrete well including the concrete base, straight pre-cast concrete sections, and transition sections; connection to existing water main; and the adjustment of the well structure cover to finish grade. No separate payment will be made for adjusting the structure covers on new tapping sleeve and valve in wells.

9. “Tapping Sleeve and Valve in Box” includes all labor, material and equipment costs required to furnish and install the valve; frame and structure cover; backfill the specified valve; and the adjustment of the box structure cover to finish grade. No separate payment will be made for adjusting new gate valve in boxes.

10. “Fire Hydrant Assembly, Complete” includes all labor, material and equipment costs required to furnish and install the hydrant; the 6-inch gate valve in box; 3 feet of 6-inch pipe; the thrust block; and 5.5 ft depth of bury bottom of barrel to breakaway flange. Extensions required due to extra depth of water main, and as approved by PSAA, shall be paid for as “Fire Hydrant, Extension”, vertical foot, as installed in the field.

11. “Fire Hydrant, Extension” shall include all labor and material(s) to extend hydrant as necessary to meet finish breakaway flange. Extensions required due to extra depth of water main, and as approved by PSAA.

12. Payment for “Excavate and Backfill for Water Service Tap and Lead” shall include, but not be limited to; all labor, material, and equipment costs necessary to excavate, backfill, and compact the water service trenches; expose and backfill the new water main; and proper properly dispose off-site of all excess excavated materials. Also included is the Work required to schedule and coordinate with City of Ann Arbor personnel for transferring and/or installing new water services. Measurement will be in lineal feet for the length from the new or existing water main, to the curb stop and box or the location where the water services are to be reconnected to the existing water service.

13. Payment for “Water Structure Cover” of the type specified shall include all labor materials and equipment needed to furnish and install the structure cover, exclusive of the structure frame.

14. Payment for “Water Structure Cover, Adjust” shall include all labor, material and equipment necessary to raise a structure frame and cover not more than 6 inches or lower them not more than 12 inches. Adjusting covers includes saw cutting, removing and replacing pavement; furnishing and installing a structure frame; reuse of the existing cover; and furnishing, installing and compacting granular backfill material as necessary. Payment for furnishing a new structure cover will be paid for as “Water Structure Cover.”

15. Payment for “Sacrificial Anode, __- pounds” includes all labor, material, and equipment costs to install the item as specified in Article 3 (Water), of these Standards.

16. Payment for “Monument Box, Adjust”, “Curb Box, Adjust” and “Gate Box, Adjust” shall include all labor, material and equipment necessary to adjust the box which may include 2 ft diameter saw cutting, removing and replacing pavement; furnishing and installing a structure frame; reuse of the existing cover; and furnishing, installing and compacting granular backfill material as necessary. Payment for furnishing a new gate box cover will be paid for as “Gate Box Cover.”

17. Payment for “Gate Box Cover” of the type specified shall include all labor materials and equipment needed to furnish and install the gate box cover.

PP. Line Stops

1. The completed work as measured for the following pay items shall be paid for at the contract unit price for the following contract item (pay item):

Contract Item (Pay Item)	**Pay Unit**
Temporary Water Main Line Stop, __ In.	Each
Temporary Water Main Line Stop, Additional Rental Day	Each

2. All work shall be paid in full at the contract unit prices which shall include all the labor, materials, and equipment required to perform the work as detailed herein. This shall also include all required costs associated with night time work, furnishing and operating supplemental lighting, and all other required elements of the work.

3. The work shall include, but not be limited to; pavement saw cutting; excavation and proper disposal off-site of excavated material; the furnishing, installation, and removal of sheeting and/or shoring where needed; the furnishing, placement and compaction of approved bedding and backfill materials; furnishing and placing suitable, clean, gravel to create a stable working surface at the bottom of the excavation; de-watering; pipe cleaning, measuring, and performing all advance work necessary to prepare for the installation of the line stop; the removal of all materials and equipment associated with the work when no longer needed; and any other items needed to complete the work as detailed on the plans and as specified herein.

4. Temporary line stops include removing line stop at completion, all barricading and traffic control; and furnishing and installing backfill.

5. The temporary line stop, additional day rental shall commence after the first 24-hours of line stop usage, and paid for each 24-hour period thereafter.

QQ. Sanitary Sewer

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
___In., SDR 26 PVC Sanitary Sewer, SD-TD-2	Foot
___In., ES VCP Sanitary Sewer, SD-TD-2	Foot
___In., CL _ RCP Sanitary Sewer, SD-TD-1	Foot
___In., PC ___ DIP Gravity, SD-TD-1	Foot
___In., SDR 26 Sanitary Service Wye	Each
___In., CL__RCP Sanitary Service Wye	Each
___In., ES VCP Sanitary Service Wye	Each
___In., SDR 26 PVC Sanitary Service Lead, SD-TD-2	Foot
Sanitary Manhole, ___ In. Dia., (0-8'deep)	Each
Sanitary Manhole, ___ In. Dia., Additional Depth	Foot
Sanitary Manhole Over Existing ("Doghouse"), __ In. Dia.	Each
Sanitary Manhole Drop Connection, ___In.	Foot
Sanitary Structure Cover	Each
Sanitary Structure Cover, Adjust	Each
Sanitary Sewer Tap, ____ In. Dia	Each
Pipe Undercut & Backfill, Sanitary	Cubic Yard

2. Sanitary Sewer as specified shall be measured in place by length in lineal feet (LF) from center of manhole to center of manhole. Sanitary Service Leads as specified shall be measured in place by length in lineal feet (LF) from service wye to tie-in. Payment will include, but not be limited to; excavation; furnishing the pipe; risers and fittings; all labor, material, and equipment needed for furnishing and installing sewer; removal and proper off-site disposal of all excess or unsuitable excavated material; any needed sheeting, shoring and bracing; the installation of water-tight plugs; protection of all existing utilities and service connections; furnishing and installing pipe bedding and backfilling as specified herein; furnishing an approved geotextile separator where specified; cleaning; video inspection; and testing.

3. "___ In. Dia., _____ Sanitary Service Wye," shall be paid for based on each wye installed. The payment for the service wye will include the material, equipment and labor costs for the connection of the riser or lead to the wye. Also, the payment for the service wye will include the material, equipment and labor costs for: the excavation, removal, and proper disposal off-site of all excess or unsuitable excavated material; any needed sheeting, shoring and bracing; the installation of water-tight plugs; protection of all existing utilities and service connections; pipe bedding; by-pass pumping; backfilling; cleaning; testing; placing the plug or cap placed on the wye, riser or lead; and, the required wooden stake to locate the riser or lead in the future.

4. "Sanitary Manhole, ___ In. Dia., (0-8'deep)" will be paid for at the Contract unit price for each unit installed. Payment includes but is not limited to furnishing the labor, equipment and materials for all necessary excavation; any needed sheeting, shoring and bracing; properly disposing off-site of all surplus or unsuitable excavated material; backfilling and compaction; frame and structure cover; and, constructing the structure complete, including pipe connections and structure cleaning, up to 8 feet of structure depth. A standard depth sanitary manhole shall be considered to be 8 feet or less in depth from the inside bottom of the structure to the top of the cover.

5. Payment for "Sanitary Manhole, ___ In. Dia., Additional Depth" includes, but shall not be limited to furnishing the labor, equipment, and materials for all necessary excavation; any needed sheeting, shoring and bracing; disposing of surplus excavated material; backfilling and compaction; and constructing the structure complete, including pipe connections and structure cleaning, for the portion of the structure which is deeper than 8 feet. Payment for adjusting of manhole frames and covers shall be included in payment for ""Sanitary Manhole, ___ In., Dia., (0-8'deep)" and the manhole frames and covers will be paid for separately.

6. Payment for "Sanitary Manhole Over Existing ("Doghouse"), __ In. Dia" shall include all work required to design and construct the manhole structure over and around the existing sewer pipe, including but not limited to: field investigation of existing sewer pipe, design of the manhole structure and appurtenances, submitting shop drawings to the PSAA for review and approval, fabricating and constructing the doghouse style manhole structure over and around the existing sewer pipe, constructing a concrete base for the manhole structure, furnishing and installing the manhole access riser structure with frame and cover, removal of portions of the existing sewer pipe within the new manhole structure, benching, connections into

the manhole structure for sanitary outlet pipes with associated flow channels, temporary or final grade adjustments of the manhole riser structure, and all associated earthwork and backfill.

7. Payment for "Sanitary Manhole Drop Connection, ___In.," shall be based on vertical feet (Ft) installed from the invert of the drop connection pipe in the manhole to the invert elevation of the upper pipe in the same manhole. Payment includes but shall not be limited to: furnishing all labor, equipment and materials for all necessary excavation; any needed sheeting, shoring and bracing; proper removal and disposal off-site of surplus and unsuitable excavated material; pipe, fittings, and concrete; backfilling and compaction; and, connections needed to complete this item of work.

8. Payment for "Sanitary Structure Cover" of the type specified shall include all labor, materials and equipment needed to furnish and install the structure cover, exclusive of the structure frame.

9. Payment for "Sanitary Structure Cover, Adjust" shall include all labor, material and equipment necessary to raise a structure frame and cover not more than 6 inches or lower them not more than 12 inches. Adjusting covers includes saw cutting, removing and replacing pavement; furnishing and installing a structure frame; reuse of the existing cover; and furnishing, installing and compacting granular backfill material as necessary. Payment for furnishing a new structure cover will be paid for as "Sanitary Structure Cover."

10. "Sanitary Sewer Tap, ___In. Dia.," shall be paid for new connections or new hole to an existing structure. When tapping an existing structure, a minimum opening of the entering pipe's outside diameter plus 6 inches shall be cut into the receiving structure. A minimum 3-inch mortar layer shall be packed completely around the entering pipe and struck smooth with the inner wall of the pipe or structure. Pipe passing through the pipe or structure wall shall extend into structures a minimum of ½ inch and a maximum of 3 inches. The entering pipe on the outside portion of the connection shall be encased to provide sufficient bearing under the pipe. Payment of the unit price for this item of work shall include all labor, material, and equipment costs.

11. Payment for “Pipe Undercut & Backfill, Sanitary” will be based on cubic yards (CY) as measured compacted in place. Payment will include the additional excavation, placement of backfill material compacted in place, and all related work. Measurement for refill width will be the outside diameter of the pipe barrel plus two feet. Measurement for depth will be from the bottom of the excavation to the bottom of the pipe barrel. Undercut quantities shown on the Bid Form are estimates only; the quantities of undercut may vary significantly more or less depending on field conditions at the time of construction. No adjustment in Contract Unit Price will be allowed for any increase or decrease in the quantity of undercut and refill actually constructed.

RR. Sewer and Manhole Rehabilitation

1. The completed work as measured for the following pay items shall be paid for at the contract unit prices for the following contract items (pay items):

Contract Item (Pay Item)	**Pay Unit**
Clean Sanitary Sewer, ___In. Dia.	Lineal Foot
Televise Sanitary Sewer, __ In. Dia.	Lineal Foot
CIPP Liner ___In. Dia., Sanitary Sewer	Foot
Preliner ___In. Dia., Sanitary Sewer	Foot
Internal Chimney Seal	Each
External Chimney Seal	Each
Chemical Grouting	Gallon
Cementitious Manhole Liner	Vertical Foot
Epoxy Manhole Liner	Foot
Reconstruction Flow Channel	Each

2. Payment for “Clean Sanitary Sewer, ___In. Dia.” includes accessing the manhole, cutting and removing roots and mineral deposits, cleaning and removing all deposits, and removal and disposal of all debris.

3. Payment for “Television Inspection, Sanitary Sewer, ___In. Dia.” includes closed circuit television inspection of sewer from manhole to manhole including reverse setup when required due to obstruction.

4. Measurements shall be from manhole to manhole, and shall take place with both the ENGINEER and the CONTRACTOR (or their agents) present. Measurements shall be recorded and logged on a daily basis.

5. Rehabilitation of sanitary sewer will be paid for at the contract unit price per lineal foot. The contract unit price paid shall be payment in full for all labor, material, and equipment required for rehabilitation of existing sanitary sewers by insertion of a CIPP liner and shall include, but is not limited to; furnishing, transporting, preparing, and installing the structural pipe liner and CIPP end seals; furnishing and installing remote temperature sensing devices; reconnecting existing sewers or leads; performing any needed liner repairs; gaining access to work site; removal and replacement of site improvements; pre- and post-lining sewer television inspection; all required warranty work; and all other work and items necessary to complete the Work.

6. Internal and External Chimney Seal includes all excavation, preparation of surface, furnishing and installing sealing materials, cleanout of structure, and cleanup and restoration of the site of the work.

7. Payment for Chemical Grouting of manholes will be per gallon of chemical grout pumped thru the manhole wall to seal the manhole. Payment includes all preparation, patching, sealing, injecting grout, and cleanup.

8. Manhole Liner of the type specified includes all preparation of surface, sealing and stopping leaks, furnishing and installing liner materials, and cleanup and restoration of the site of the work.

9. “Reconstruction Flow Channel” includes all labor, material and equipment necessary to remove existing loose, deteriorated, or broken concrete; preparation of surface; and construction of new flow channel.

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TYPE OF CASTING	MDOT DESIGNATION	EJ CASTING NO.	NEENAH CASTING NO.
MANHOLE AND GATE WELL FRAME AND COVER	Q/B	1040Z W/ TYPE A COVER*	R-1642 W/ TYPE C COVER*
BARRIER CURB INLET FRAME AND COVER	K	7045Z W/ TYPE M1 GRATE	R-3031-B W/ TYPE S GRATE
BARRIER CURB LOW POINT INLET FRAME AND COVER	K	7035Z W/ TYPE M2 GRATE	N/A
GUTTER INLET FRAME AND COVER	R	5080Z W/ TYPE 5000M2 GRATE	R-3448C, W/ TYPE S GRATE
HIGH CAPACITY INLET FRAME AND COVER		7034Z W/ TYPE M GRATE	N/A
MOUNTABLE CURB INLET ASSEMBLY		7065	N/A
YARD DRAIN (BEE HIVE) FRAME AND COVER	G	1040Z, TYPE 02 GRATE	R-2560-E1
WATER VALVE BOX ASSEMBLY IN PAVEMENT		8560	N/A
MONUMENT BOX ASSEMBLY		8360	N/A
ADA COMPLIANT		5000Z4 W/ TYPE M5 GRATE	

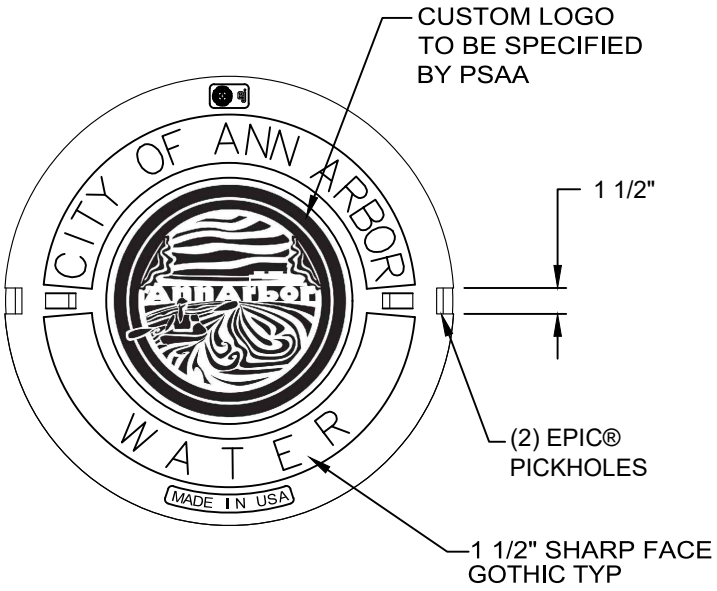
NOTES:
*EACH COVER SHALL HAVE "SANITARY", "STORM", OR "WATER" CAST IN THE SURFACE, WHICHEVER IS APPLICABLE. SANITARY SEWER COVERS SHALL BE GASKETED IN FLOOD PRONE AREAS AS SHOWN ON THE PLANS OR AS DIRECTED BY THE PSAA. FRAMES AND COVERS MUST HAVE MACHINED BEARING SURFACES.

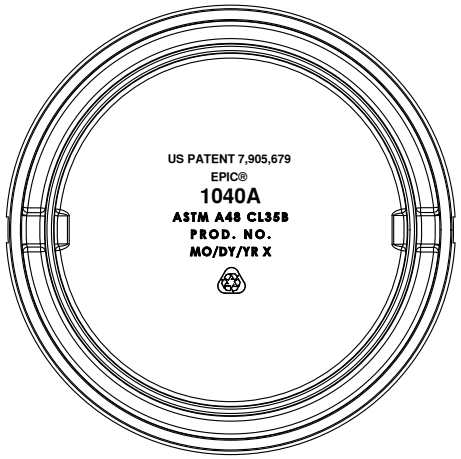
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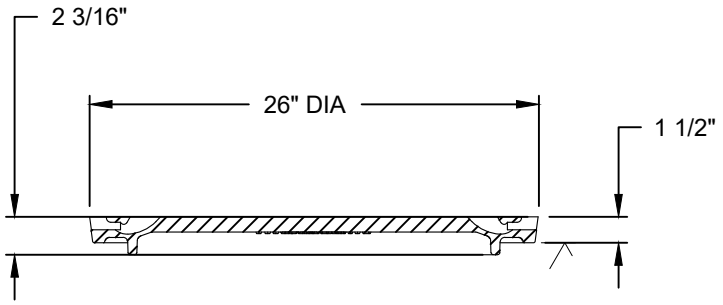
STANDARD CASTING SCHEDULE

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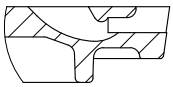




BOTTOM VIEW



SECTION



EPIC® DETAIL

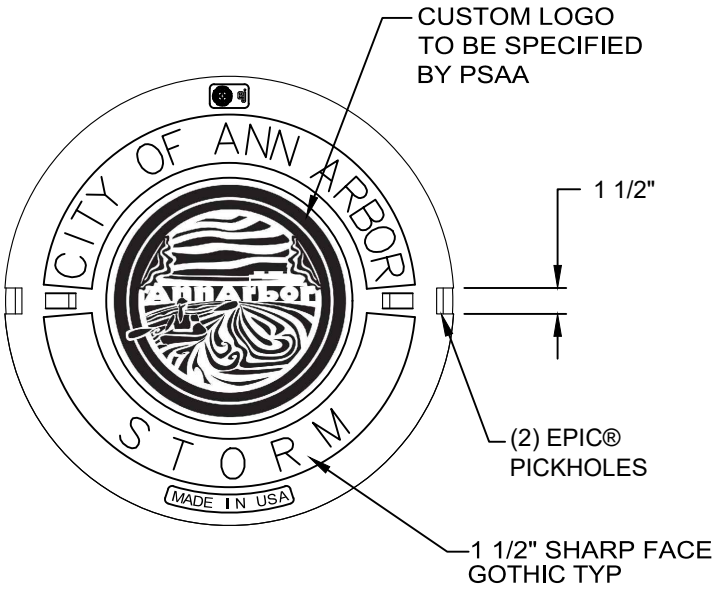
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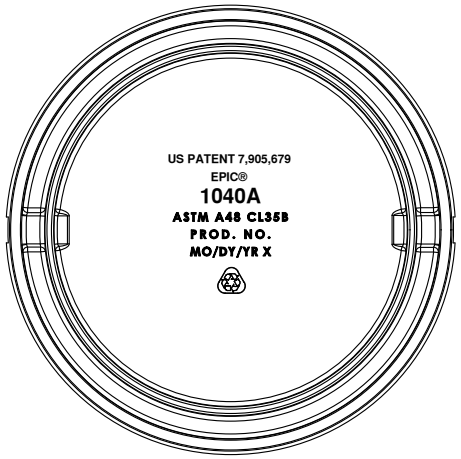
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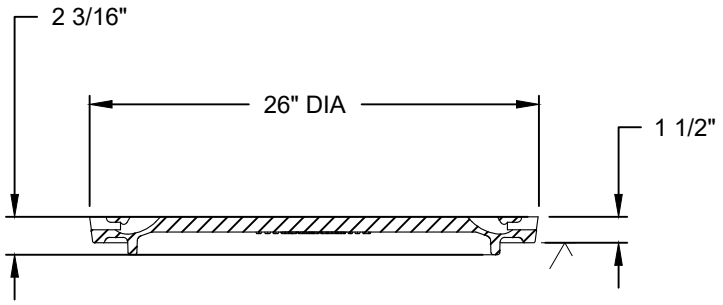
SPECIAL STRUCTURE COVER WATER

DR. ENG	CH. ENG	DRAWING NO.
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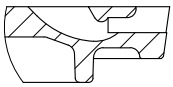




BOTTOM VIEW



SECTION



EPIC® DETAIL

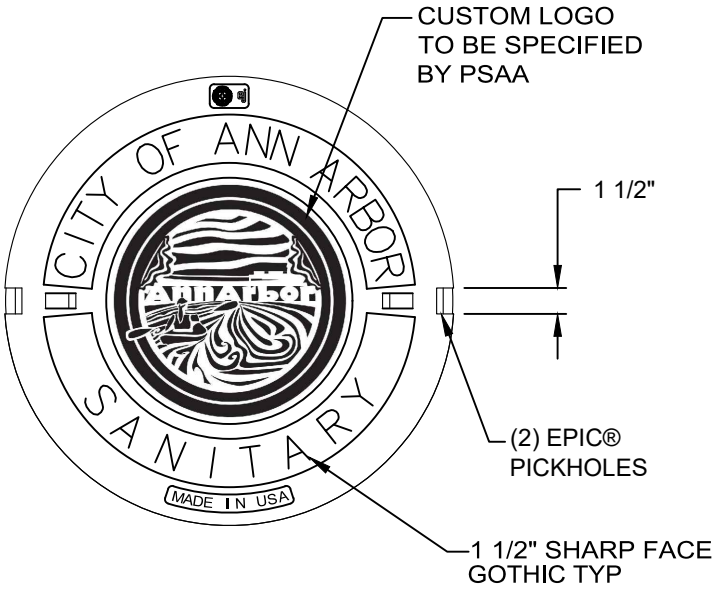
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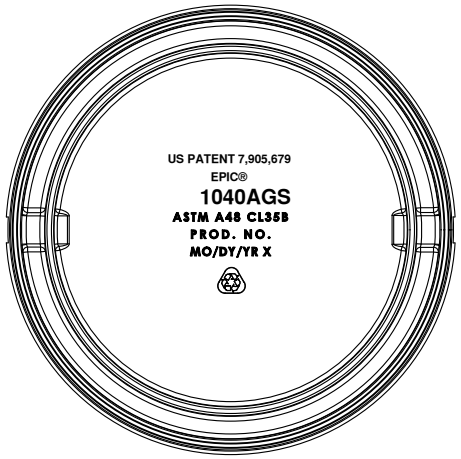
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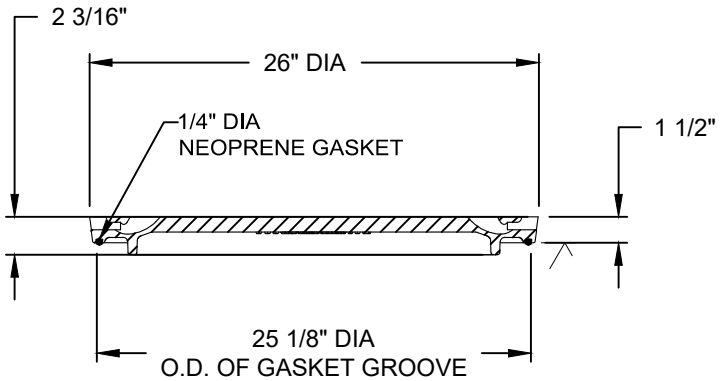
SPECIAL STRUCTURE COVER STORM

DR. ENG	CH. ENG	DRAWING NO.
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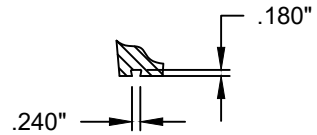




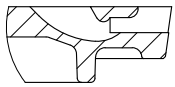
BOTTOM VIEW



SECTION



GROOVE DETAIL



EPIC® DETAIL

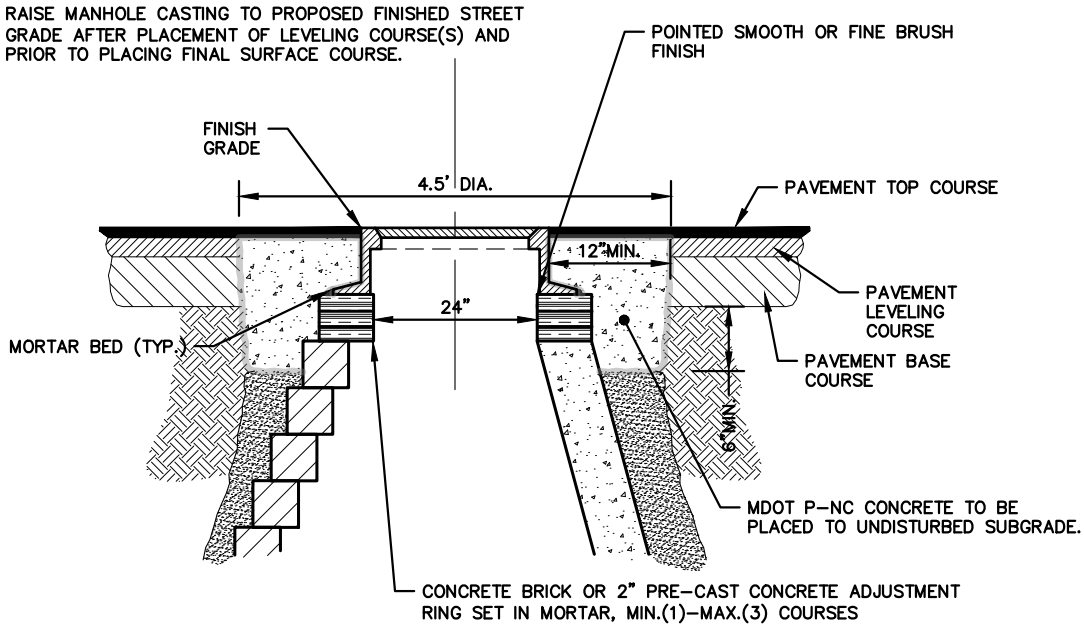
EJ PRODUCT #001040572

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SPECIAL STRUCTURE COVER SANITARY

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-GU-4**



NOTES:

1. IF MANHOLE WILL BE PLACED IN GRAVEL ROAD, CASTING TO BE SET 6" TO 8" BELOW ROADWAY GRADE. ALL CONSTRUCTION METHODS SHALL REMAIN AS SHOWN ABOVE.
2. P-NC CONCRETE MIXTURE SHALL CONTAIN 658 POUNDS PER CUBIC YARD (7 SACKS) OF CEMENT WHEN THE FORECASTED AIR TEMPERATURE IS ABOVE 59°F AND 752 POUNDS PER CUBIC YARD (8 SACKS) OF CONCRETE WHEN THE FORECASTED AIR TEMPERATURE IS 59°F OR LESS.
3. CONSTRUCT EPOXY COATED LANE TIES TO ANCHOR THE CONCRETE TO ADJACENT COMPOSITE PAVEMENT OR CONCRETE SURFACE COURSE, AS NECESSARY.

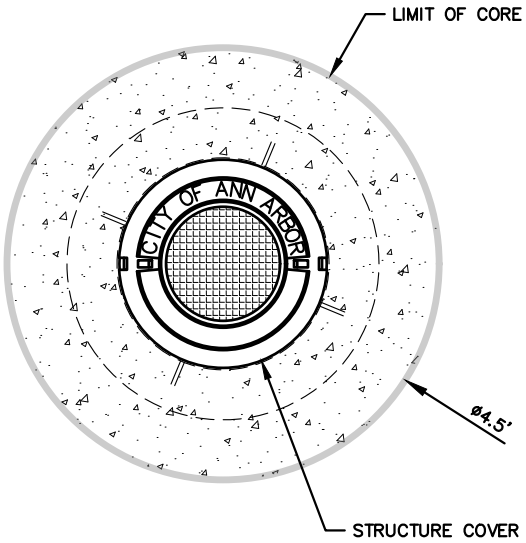
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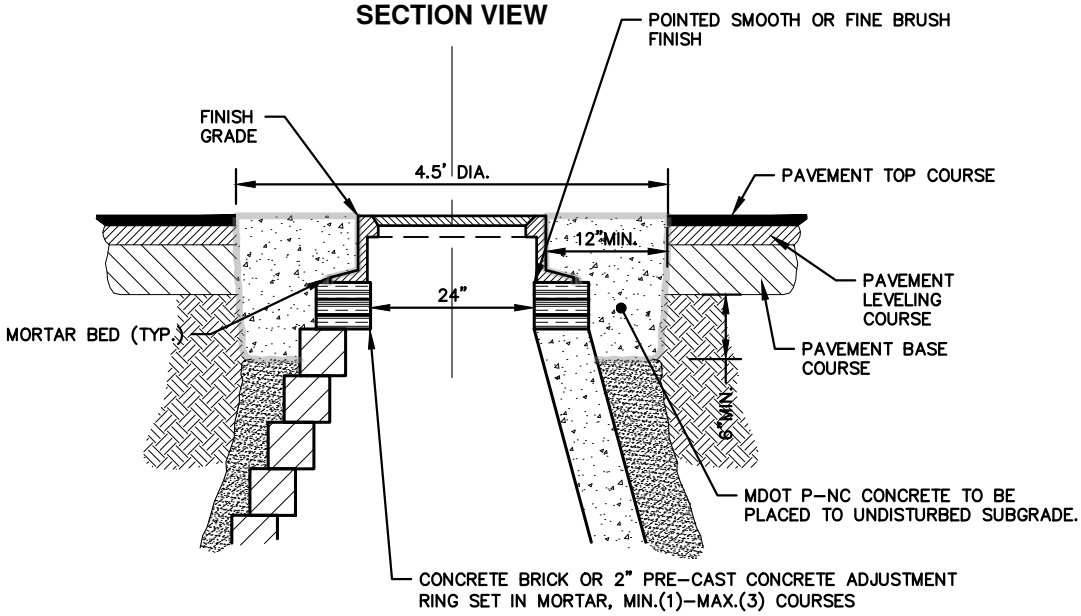
STRUCTURE COVER ADJUST

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-GU-5A**

PLAN VIEW



SECTION VIEW



NOTES:

1. IF MANHOLE WILL BE PLACED IN GRAVEL ROAD, CASTING TO BE SET 6" TO 8" BELOW ROADWAY GRADE. ALL CONSTRUCTION METHODS SHALL REMAIN AS SHOWN ABOVE.
2. P-NC CONCRETE MIXTURE SHALL CONTAIN 658 POUNDS PER CUBIC YARD (7 SACKS) OF CEMENT WHEN THE FORECASTED AIR TEMPERATURE IS ABOVE 59°F AND 752 POUNDS PER CUBIC YARD (8 SACKS) OF CONCRETE WHEN THE FORECASTED AIR TEMPERATURE IS 59°F OR LESS.
3. CONSTRUCT EPOXY COATED LANE TIES TO ANCHOR THE CONCRETE TO ADJACENT COMPOSITE PAVEMENT OR CONCRETE SURFACE COURSE, AS NECESSARY.

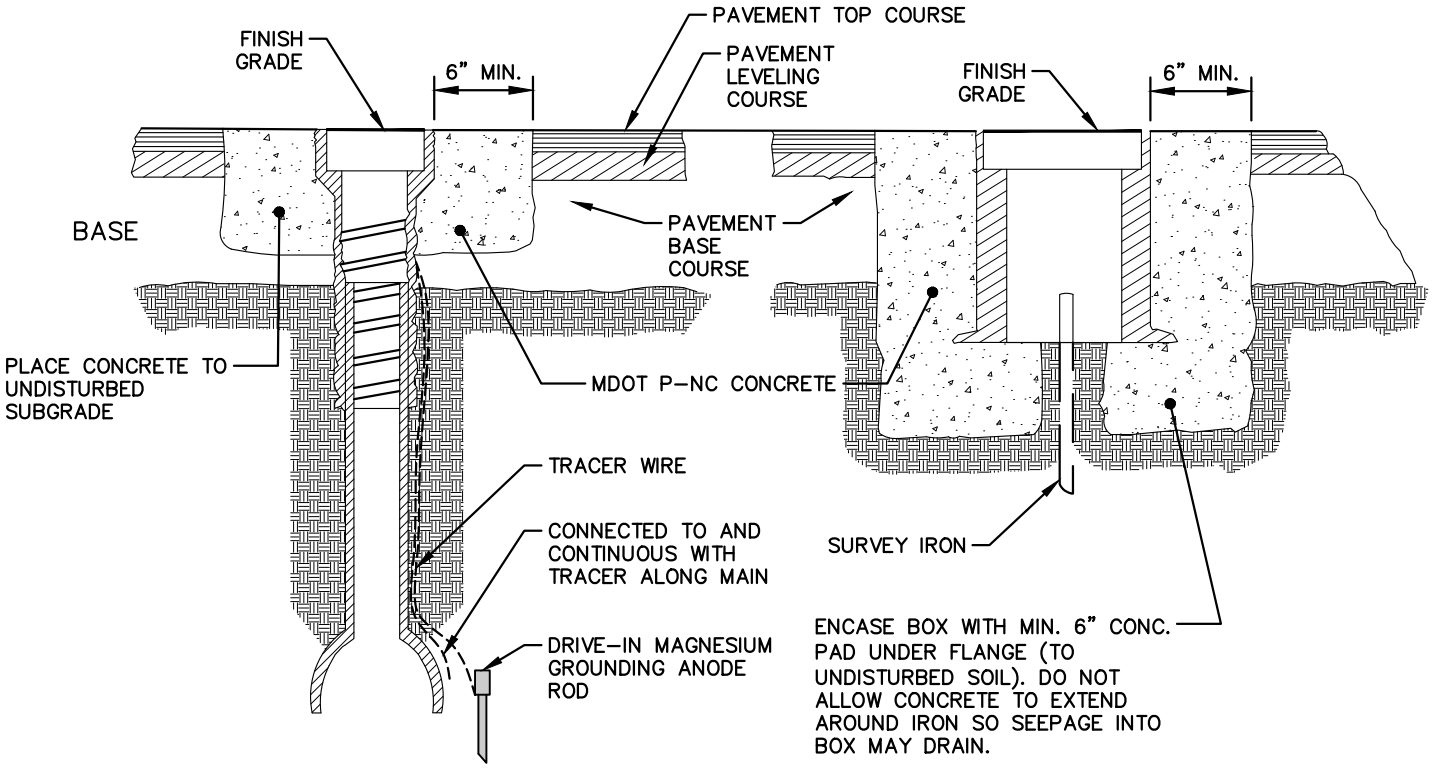
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STRUCTURE COVER ADJUST

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-GU-5B**

WATER OR GAS VALVE BOX ADJUSTMENT **MONUMENT BOX ADJUSTMENT**



NOTES:

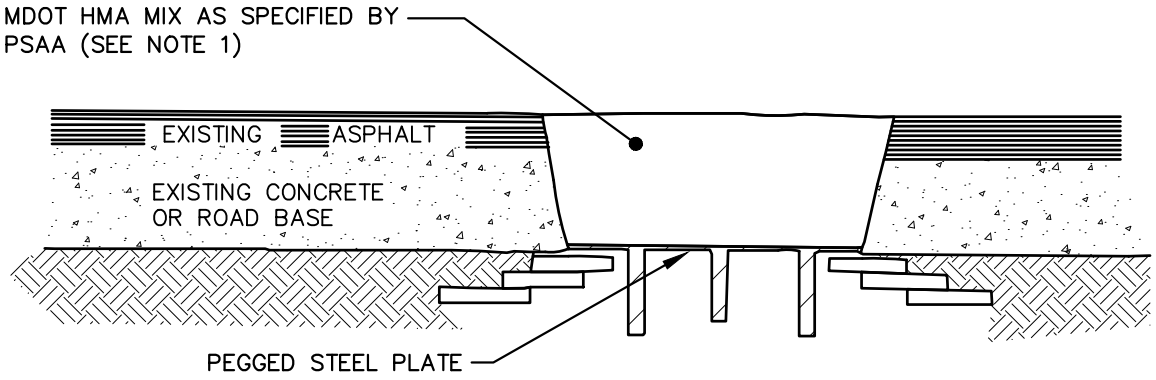
1. GAS VALVE BOXES TO BE ADJUSTED BY THE GAS COMPANY.
2. PLACE CENTER OF [MONUMENT] BOX OVER SURVEY IRON.
3. RAISE CASTINGS TO PROPOSED FINISH GRADE AFTER PLACEMENT OF FINAL SURFACE COURSE.
4. WHERE SERVICE VALVES ARE LOCATED WITHIN A PARKING LOT OR UNDER PAVED AREA, A CITY STANDARD GATE BOX COVER SHALL BE USED OVER THE CURB STOP, REGARDLESS OF THE SERVICE MATERIAL.

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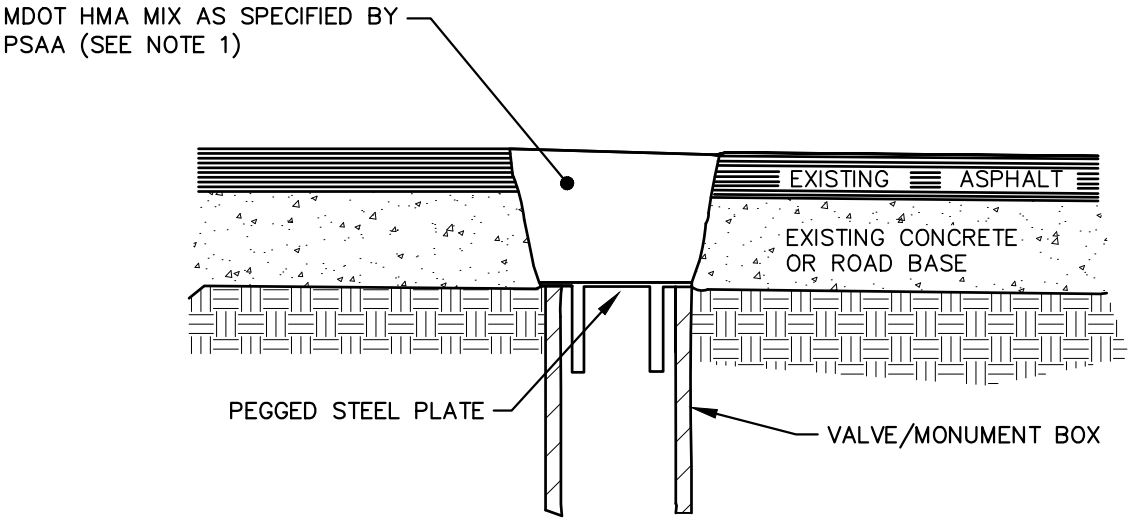
REV. NO.	DATE	DRAWN BY	CHECKED BY
02	12/30/2024	A2D	SSORT
01	8/20/2024	A2D	SSORT

VALVE AND MONUMENT BOX ADJUSTMENT

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-GU-6**



MANHOLE LOWERING DETAIL



VALVE BOX/MONUMENT BOX
LOWERING DETAIL
(SEE NOTE 3)

NOTES:

1. IF TRAFFIC IS TO BE MAINTAINED ON THE ROADWAY BEFORE OR AFTER THE COLD MILLING OPERATION, THE STRUCTURE SHALL BE LOWERED TO THE EXTENT THAT A MINIMUM OF THREE(3) INCHES ASPHALT MATERIAL MDOT HMA MIX AS SPECIFIED BY PSAA. OR ENGINEER APPROVED EQUAL, REMAINS TO SUPPORT TRAFFIC.

2. IF THE ROADWAY BEING MILLED IS CLOSED TO TRAFFIC, THE STRUCTURE SHALL BE LOWERED SUCH THAT THE STEEL PLATE IS A MINIMUM OF FOUR(4) INCHES BELOW THE PROPOSED ROAD GRADE AND THE RESULTING VOID SHALL BE FILLED WITH MDOT HMA MIX AS SPECIFIED BY PSAA OR ENGINEER APPROVED EQUAL.

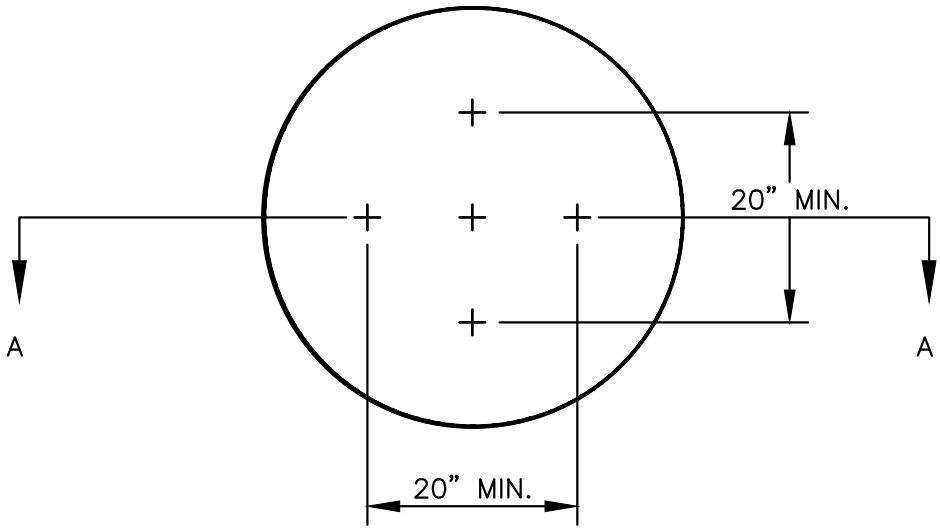
3. WHERE A MONUMENT IS TO BE LOWERED,THE CONTRACTOR SHALL GIVE THE ENGINEER A MINIMUM OF 48 HOURS WRITTEN NOTICE SO THAT THE MONUMENT CAN BE PROPERLY WITNESSED OR PROTECTED. FAILURE TO DO SO SHALL RESULT IN THE ENGINEER.REPLACING SAID MONUMENT AT THE CONTRACTORS EXPENSE.

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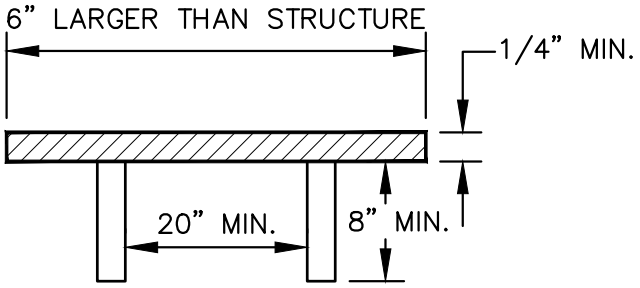
MANHOLE AND VALVE MONUMENT BOX LOWERING

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-GU-7**



NOTE: PLATE MAY BE CIRCULAR, SQUARE OR RECTANGULAR

SECTION A – A



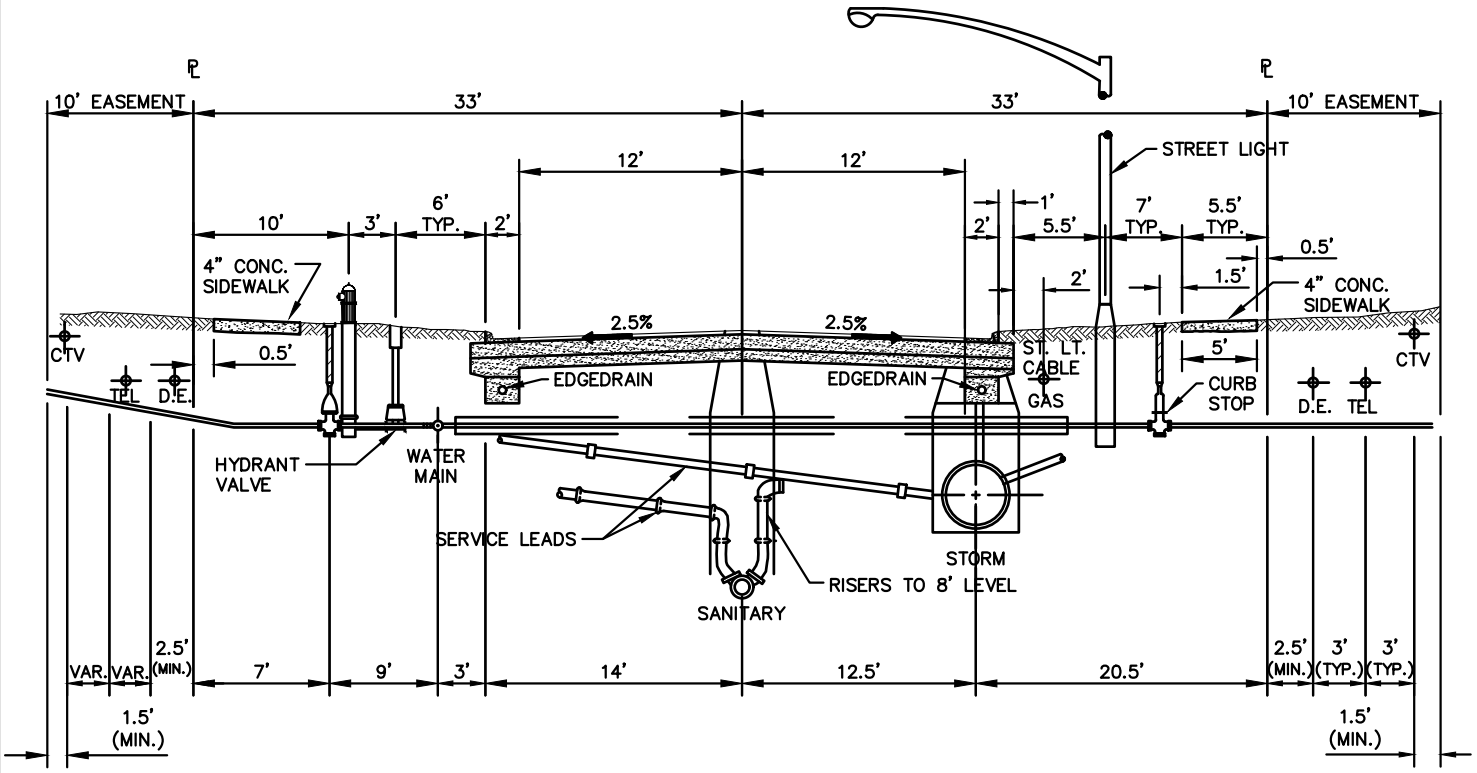
1/4" MIN. THICKNESS AND SUFFICIENT
TO CARRY THE CONSTRUCTION LOAD.

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STRUCTURE PLATE

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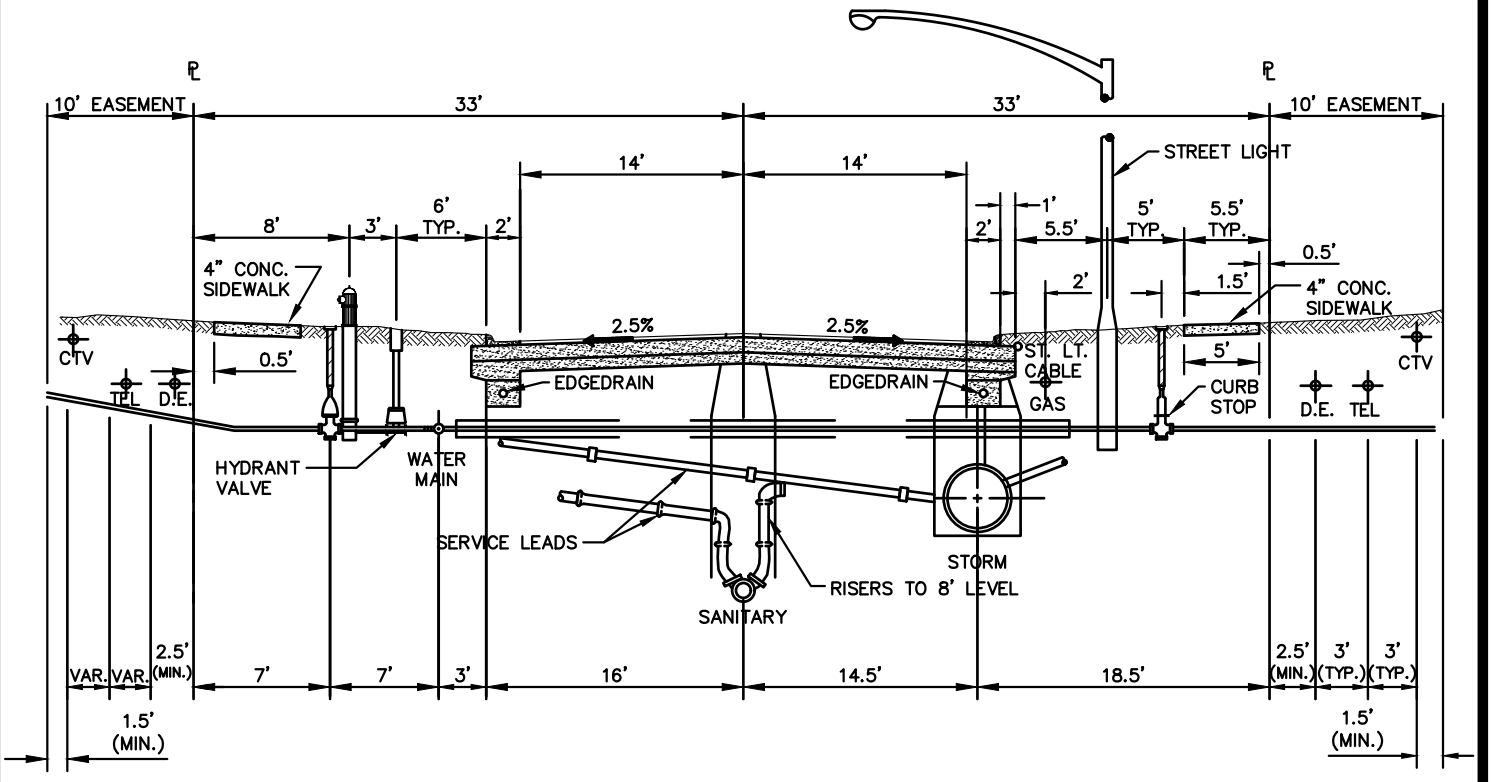
24 FT. RESIDENTIAL STREET
LOOKING NORTH OR EAST

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REV. NO.	DATE	DRAWN BY	CHECKED BY

UTILITY LOCATION PLAN (66' R.O.W. WITH 24' PAVEMENT)

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-GU-9**



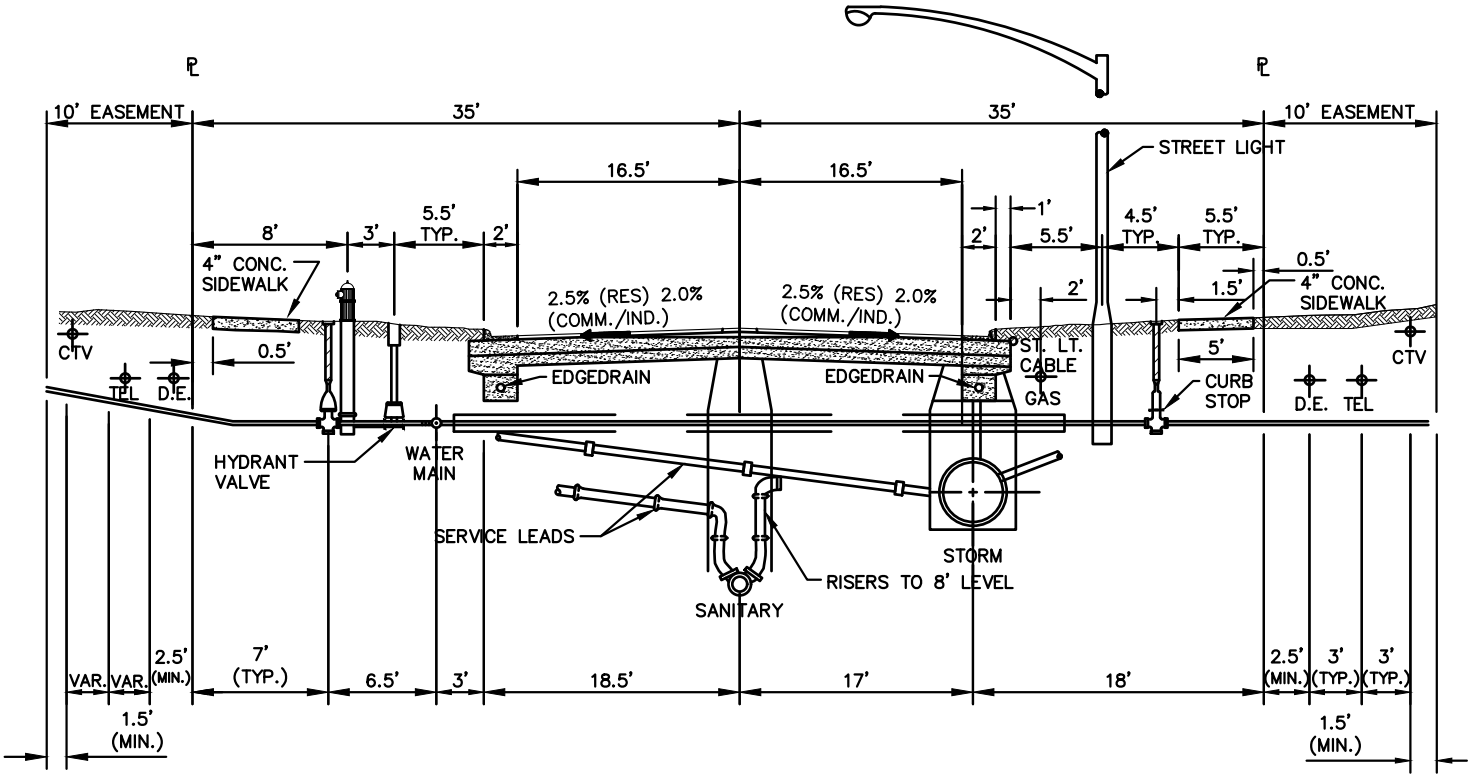
28 FT. RESIDENTIAL STREET
LOOKING NORTH OR EAST

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REV. NO.	DATE	DRAWN BY	CHECKED BY

UTILITY LOCATION PLAN (66' R.O.W. WITH 28' PAVEMENT)

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-GU-10**



28 FT. RESIDENTIAL STREET
LOOKING NORTH OR EAST

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UTILITY LOCATION PLAN (70' R.O.W.)

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-GU-11**

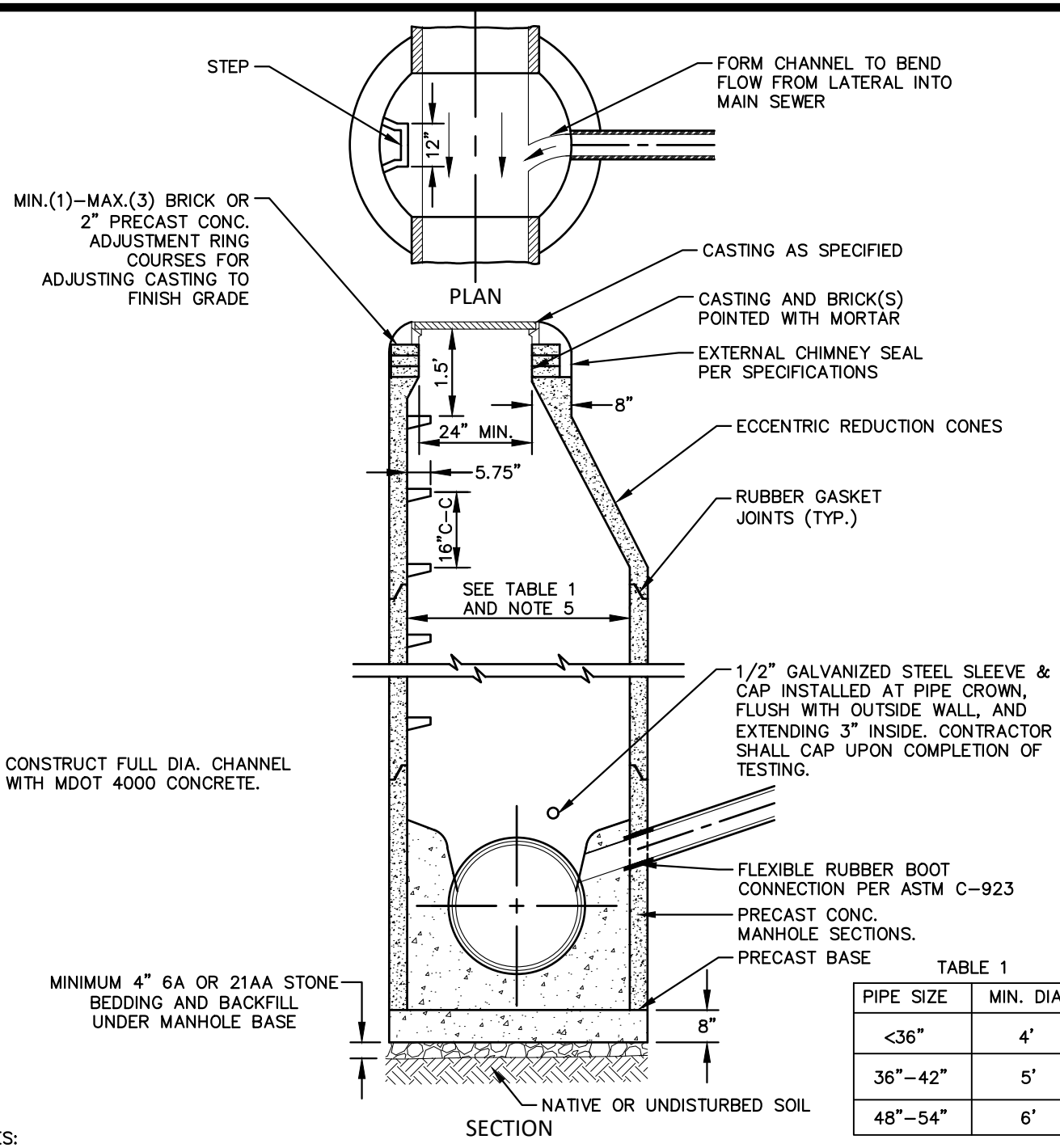


TABLE 1

PIPE SIZE	MIN. DIA.
<36"	4'
36"–42"	5'
48"–54"	6'

NOTES:

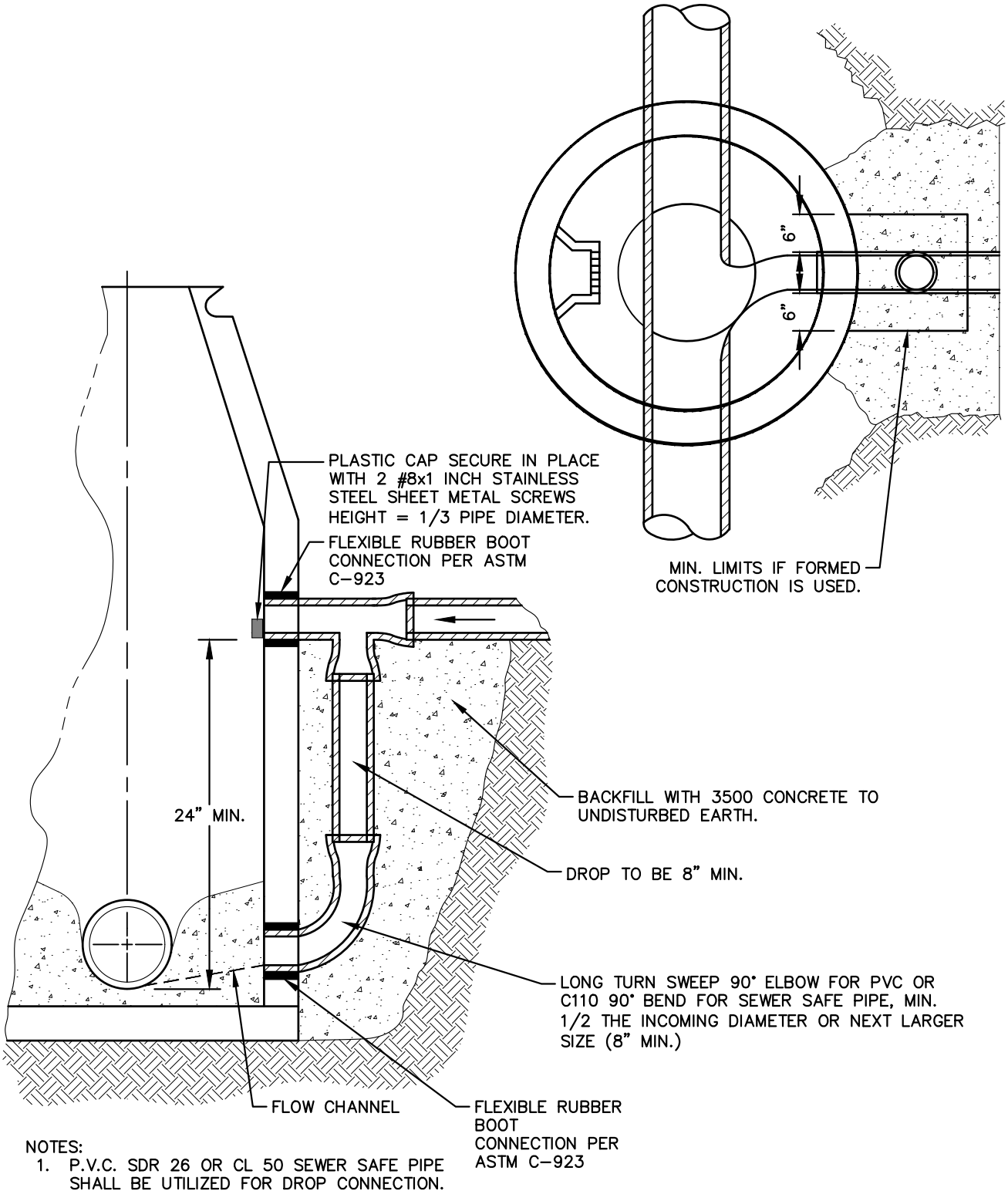
1. ALL SANITARY MANHOLES SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C478 UNLESS APPROVED BY PSAA FOR SHALLOW APPLICATION.
2. ALL MANHOLES MUST HAVE ECCENTRIC CONES.
3. ALL SANITARY SEWER OPENINGS SHALL BE PRECAST WITH RUBBER BOOT CONNECTIONS CONFORMING TO ASTM C923.
4. ALL JOINTS SHALL CONFORM TO ASTM C443.
5. MINIMUM MANHOLE DIAMETER SHOWN IN TABLE 1 SHALL BE INCREASED AS NEEDED BASED ON NUMBER OF PIPES AND ANGLE BETWEEN PIPES WITH 12" MIN. BETWEEN OPENINGS.
6. NO OPENINGS SHALL BE MADE IN PRECAST UNITS WHICH WOULD LEAVE LESS THAN 18 INCHES OF UNDISTURBED CIRCUMFERENTIAL WALL LENGTH, OR WHICH WOULD REMOVE MORE THAN 40% OF THE CIRCUMFERENCE ALONG ANY HORIZONTAL PLANE.

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SANITARY MANHOLE

DR. ENG	CH. ENG	DRAWING NO.
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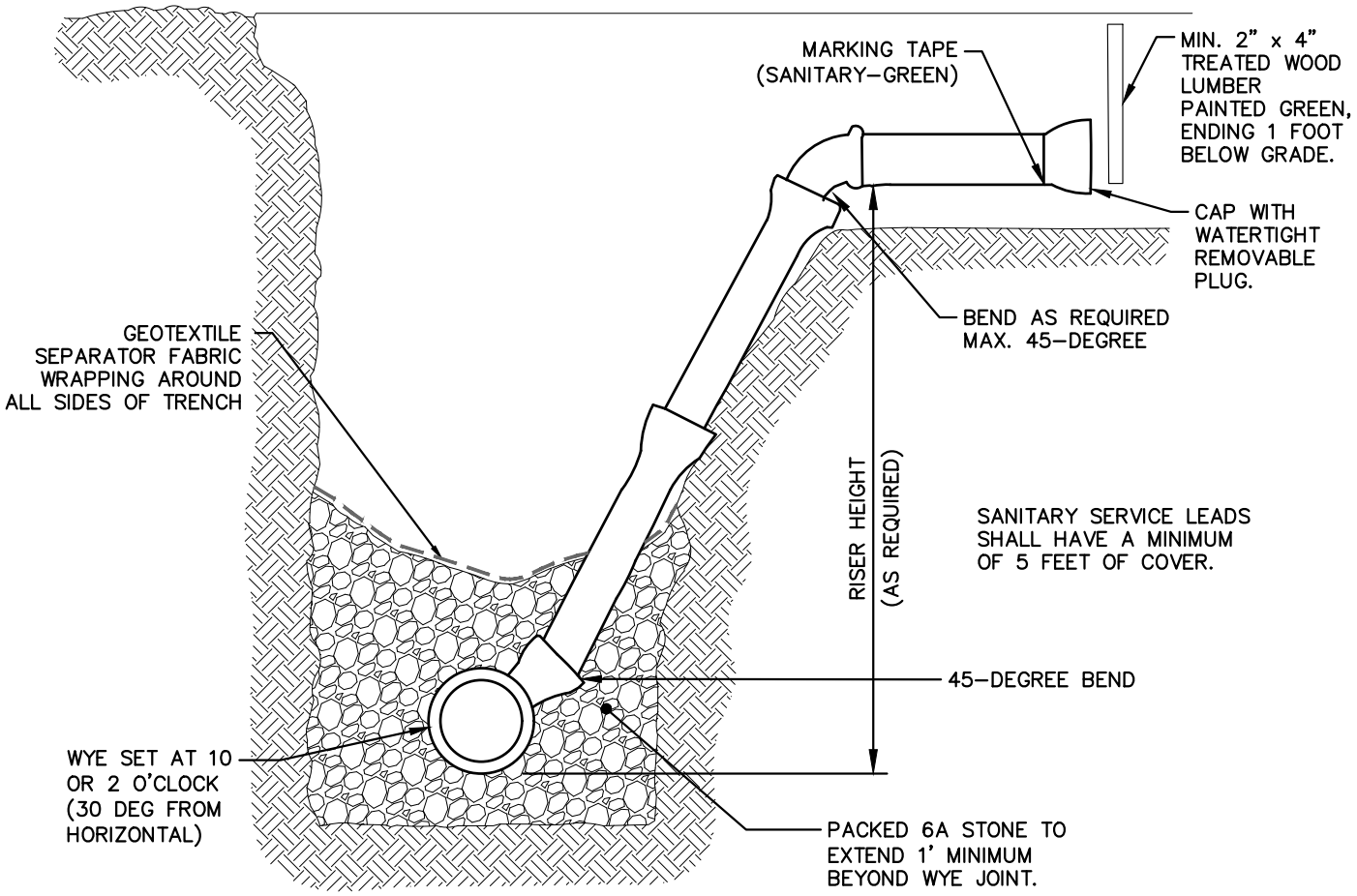
NOTES:
1. P.V.C. SDR 26 OR CL 50 SEWER SAFE PIPE SHALL BE UTILIZED FOR DROP CONNECTION.

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DROP M.H. CONNECTION

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-SN-2**



NOTES:

RISERS AND BUILDING LEADS

A) RISERS SHALL BE INSTALLED WHERE THE SEWER IS MORE THAN 12 FEET BELOW THE ESTABLISHED GRADE OR FUTURE GRADE AND CARRIED TO BETWEEN 9 AND 10 FEET OF THE ESTABLISHED GRADE OR FUTURE GRADE, UNLESS OTHERWISE DETERMINED BY THE PSAA.

B) RISER OPENINGS SHALL BE CLOSED WITH A STOPPER, AS RECOMMENDED BY THE MANUFACTURER, TO MAKE A WATERTIGHT CLOSURE.

C) BUILDING LEADS SHALL CONFORM TO ARTICLE 2 (SANITARY), SECTION I.L (SANITARY SERVICE LEADS) AND DEPTH REQUIREMENTS PER SECTION I.G (DEPTH AND COVER) OF THAT ARTICLE.

D) EACH BUILDING LEAD SHALL BE CLOSED WITH A STOPPER, AS RECOMMENDED BY THE MANUFACTURER, TO MAKE A WATERTIGHT CLOSURE.

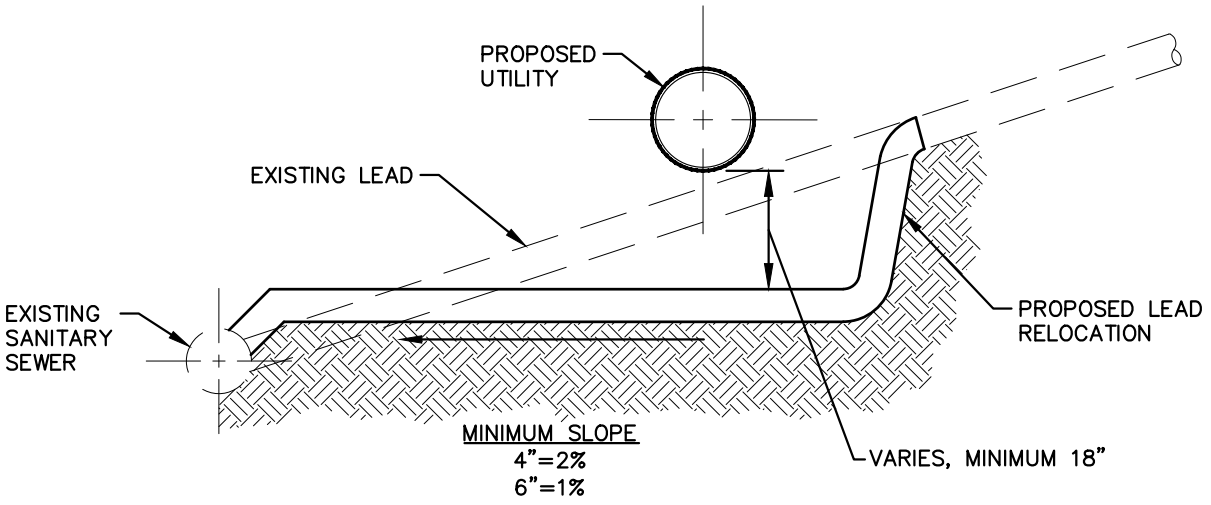
E) UNLESS OTHERWISE DETERMINED BY THE PSAA, PRIOR TO THE BACKFILLING OF A WYE, RISER, OR BUILDING LEAD, A 2–INCH x 2–INCH (MINIMUM CROSS SECTION) WOODEN MARKER SHALL BE PLACED AT A POINT IMMEDIATELY IN FRONT OF THE SERVICE CONNECTION TO 1 FOOT BELOW THE FINISH GROUND SURFACE. DO NOT REST THE MARKER ON ANY PORTION OF THE SERVICE CONNECTION OR STOPPER.

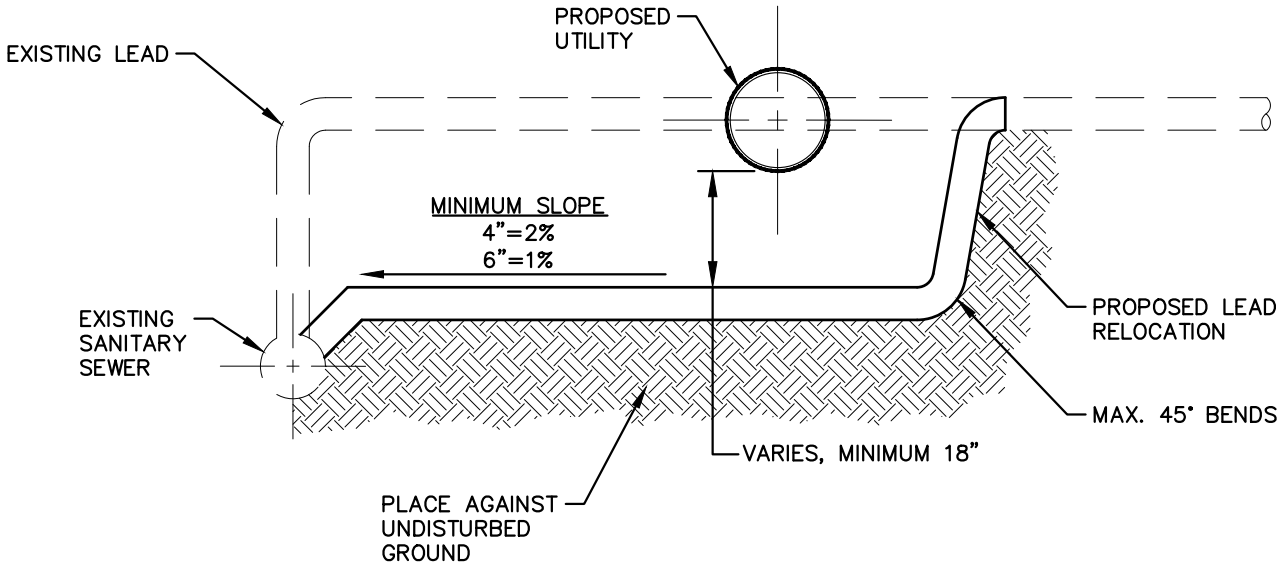
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SANITARY SEWER CONNECTION WITH RISER

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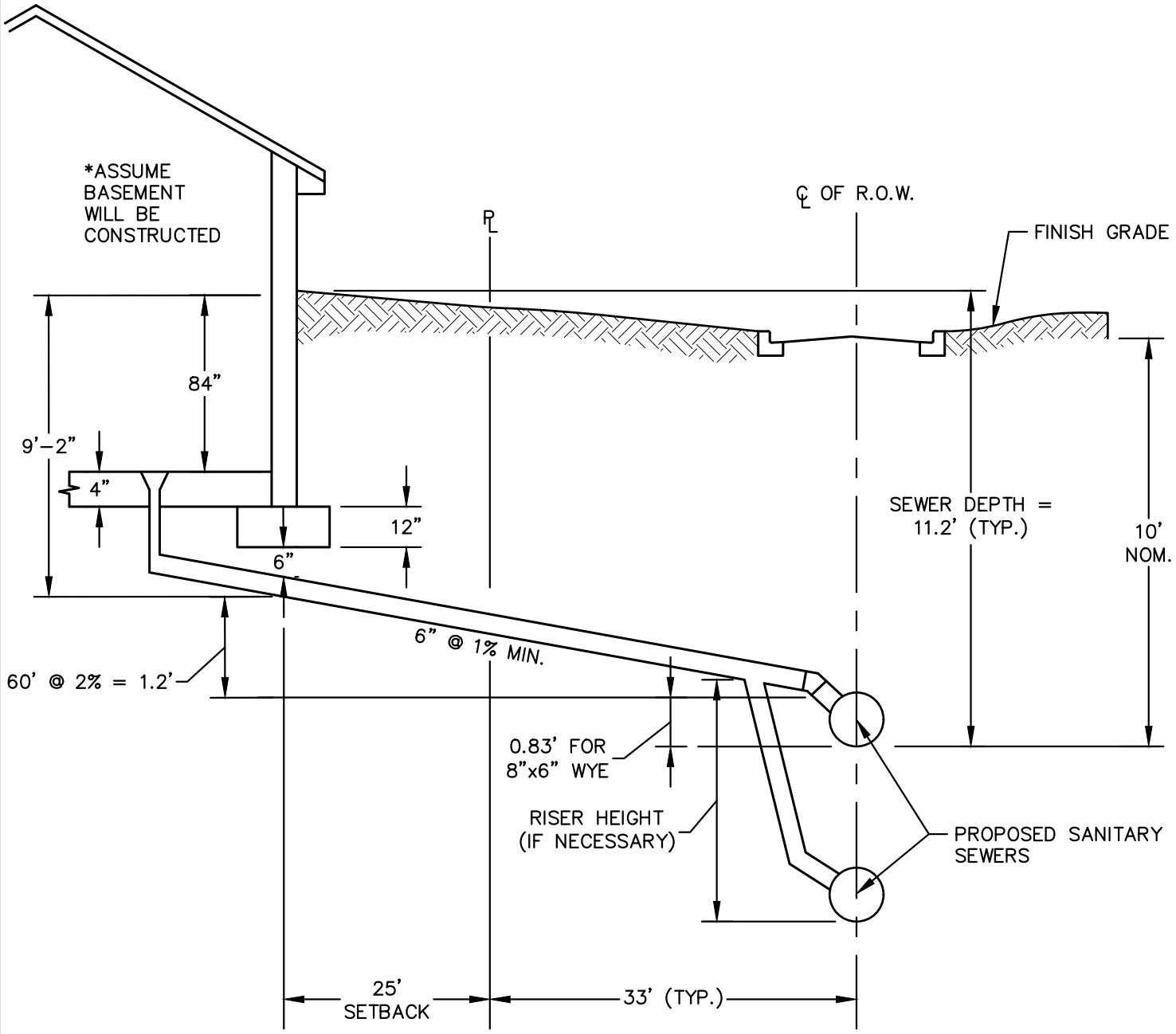


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SANITARY LEAD RELOCATION

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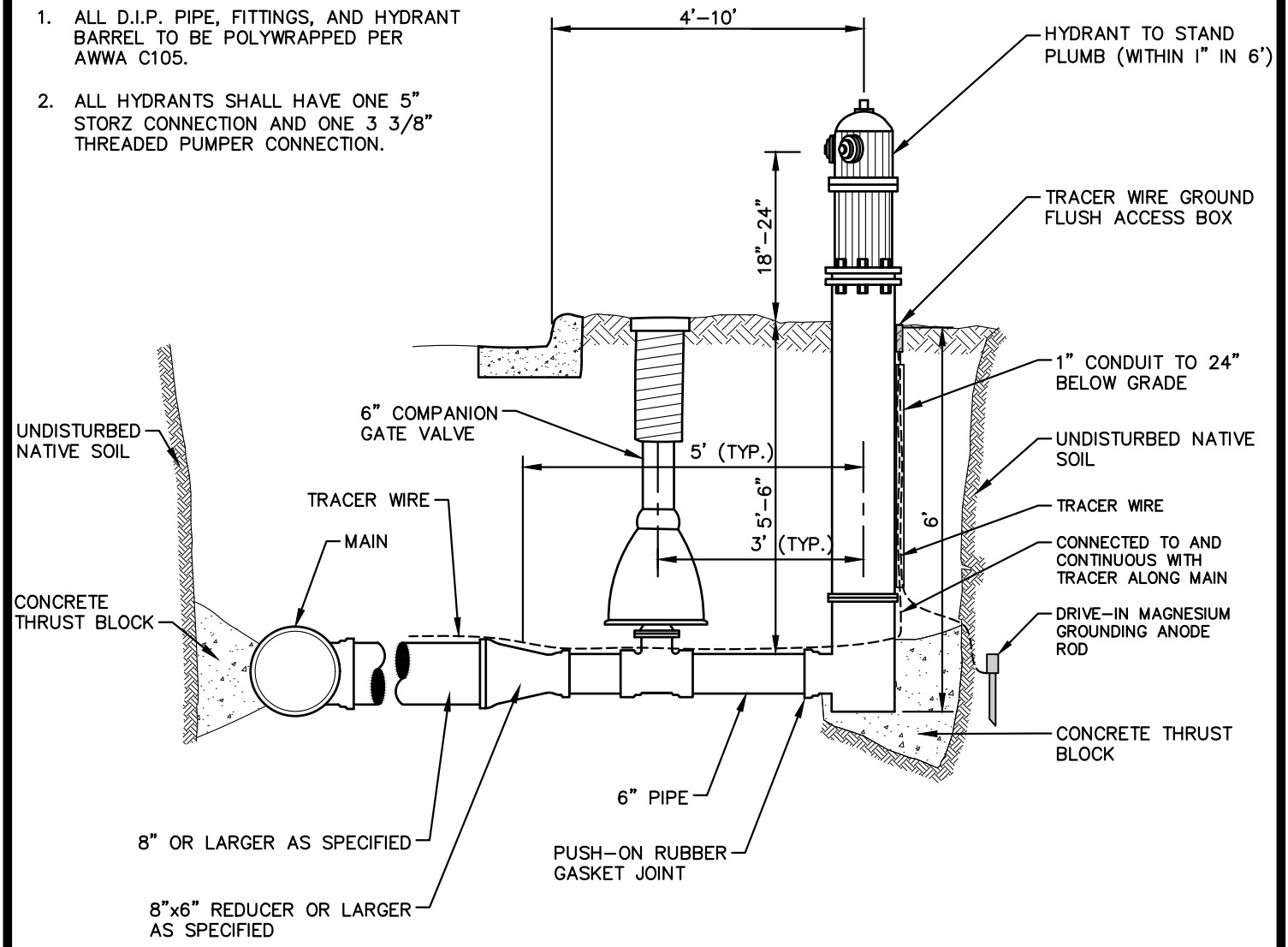
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SANITARY SEWER DEPTH

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-SN-5**

NOTES:

1. ALL D.I.P. PIPE, FITTINGS, AND HYDRANT BARREL TO BE POLYWRAPPED PER AWWA C105.
2. ALL HYDRANTS SHALL HAVE ONE 5" STORZ CONNECTION AND ONE 3 3/8" THREADED PUMPER CONNECTION.



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FIRE HYDRANT ASSEMBLY

DR. ENG	CH. ENG	DRAWING NO.
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MINIMUM STANDARDS

THE MDOT GRADE 3500 OR P-NC CONCRETE AT THE FITTING FACE SHALL EXTEND TO WITHIN 2" OF THE BELL AND SHALL EXTEND FROM THE FITTING FACE A MINIMUM OF 2' TO THE UNDISTURBED SOLID GROUND.

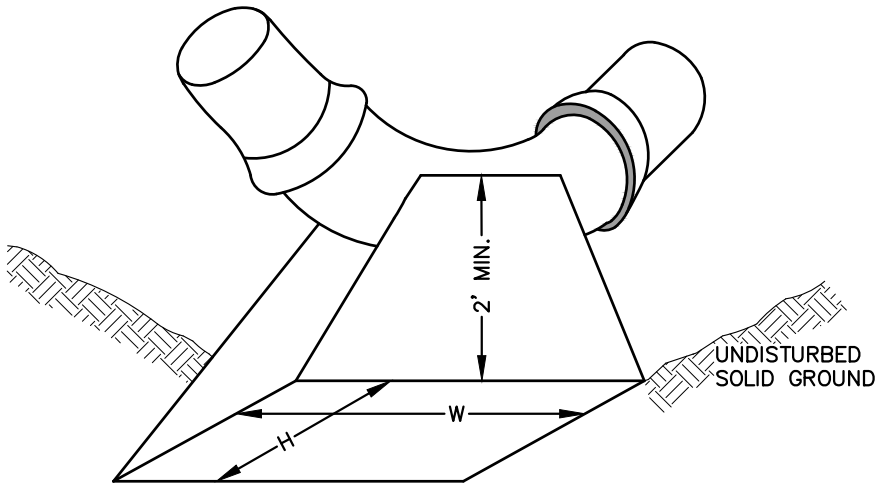
THE DIMENSIONS OF THE THRUST BLOCK AT THE FACE OF THE UNDISTURBED SOLID GROUND SHALL BE AS SHOWN IN THE TABLE BELOW.

IF THERE ISN'T SUFFICIENT SPACE FOR THE INSTALLATION OF THE THRUST BLOCK WITHOUT INTERFERENCE WITH OTHER SERVICES, ANOTHER ARRANGEMENT SATISFACTORY TO THE ENGINEER SHALL BE USED.

FITTINGS I.D.	PLUG TEE CROSS		BENDS								HYDRANT	
			90°		45°		$22\frac{1}{2}°$		$11\frac{1}{4}°$			
INCHES	W	H	W	H	W	H	W	H	W	H	W	H
4	1.0	1.0	1.0	1.0	1.0	1.0						
6	2.0	1.5	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	2.0	1.5
8	2.5	2.0	3.5	2.0	2.0	2.0	2.0	1.0	1.0	1.0	2.5	2.0
12	3.5	3.0	5.5	3.0	3.5	2.5	2.0	2.0	2.0	1.0		
16	6.0	3.5	6.0	4.0	5.0	3.0	3.5	2.5	2.0	2.0		

FOR FITTING SIZES LARGER THAN 16", THRUST BLOCK DIMENSIONS SHALL BE AS SPECIFIED BY ENGINEER.

W = WIDTH IN FEET
H = HEIGHT IN FEET



NOTE:

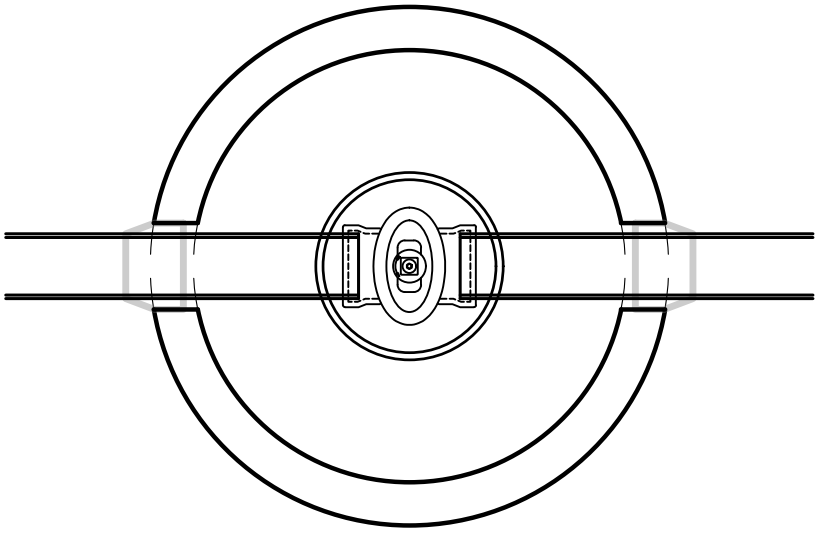
THESE ARE MINIMUM STANDARDS. WHERE SOIL CONDITIONS DICTATE, ADJUSTMENTS IN SIZE SHALL BE MADE AS DIRECTED BY THE PUBLIC SERVICES AREA ADMINISTRATOR.

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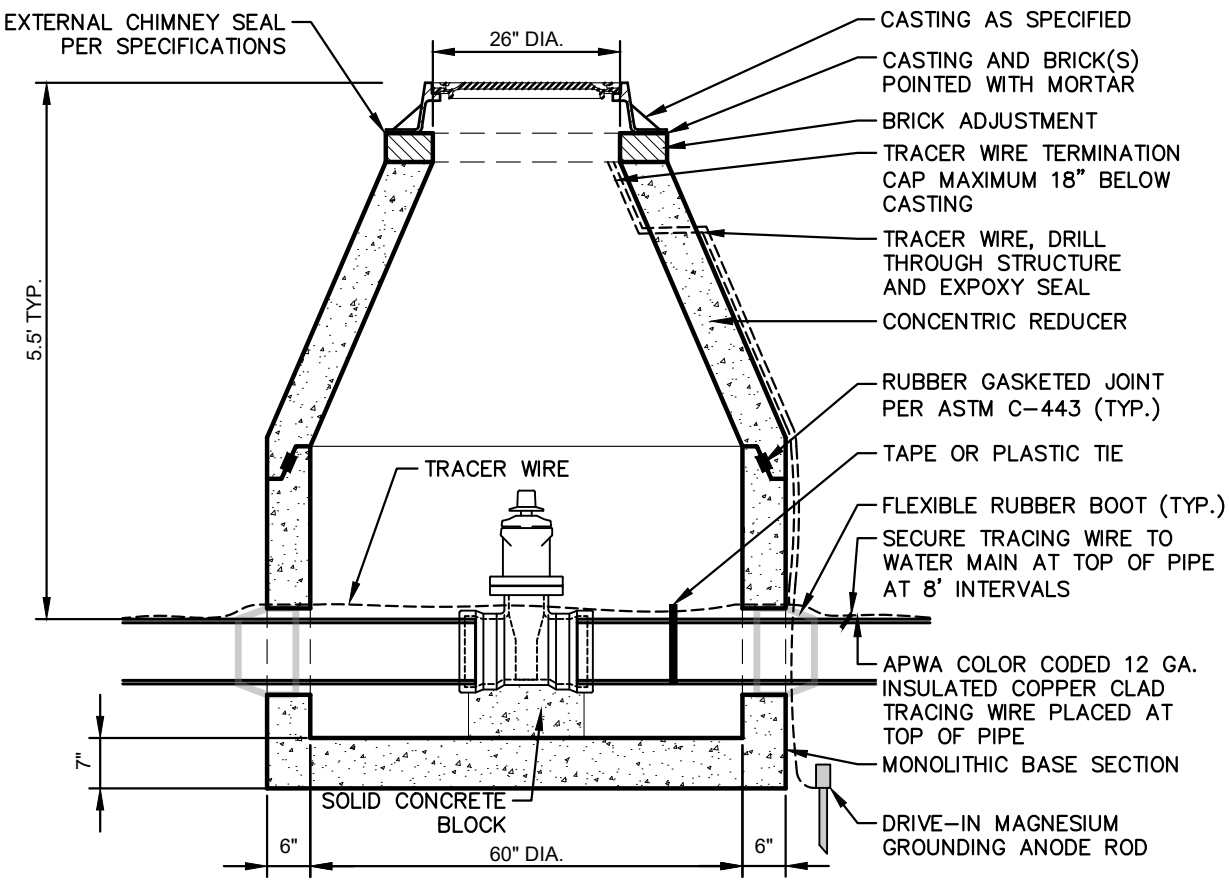
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THRUST BLOCK

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-W-2**



TOP VIEW



TYPICAL MANHOLE SECTION

NOTES:

1. PRECAST MANHOLE PER ASTM C-478.
2. REINFORCING IN WALLS TO BE ONE LAYER OF 2" X 8" W3/W2.9 WELDED WIRE MESH. CIRCUMFERENTIAL REINFORCEMENT = 0.18 SQ. IN./VERT. FT.
3. BASE SLAB TO BE REINFORCED WITH ONE LAYER OF #4 REBAR AT 12" C-C, E.W. AREA/STEEL = .20 SQ. IN./FT E.W.

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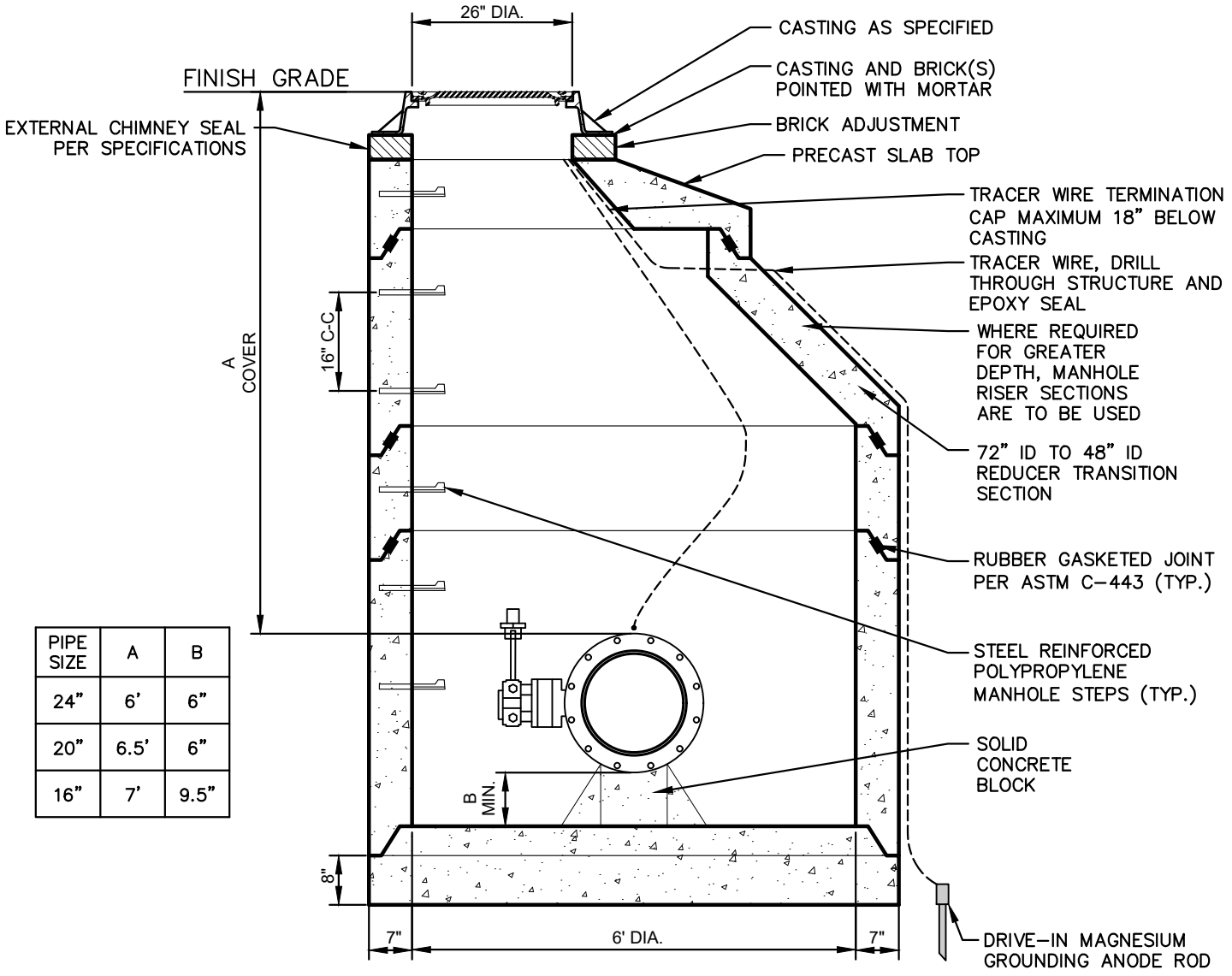
REV. NO.	DATE	DRAWN BY	CHECKED BY
01	09/01/2025	A2D	SSORT
00	10/17/2024	A2D	SSORT

PRECAST GATE WELL (WATERMAINS 16 INCH AND SMALLER)

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-W-3**

NOTES:

1. ALL LIFT HOLES AND JOINTS SHALL BE MORTARED BOTH INSIDE AND OUTSIDE
2. ALL JOINTS SHALL BE MADE WATER TIGHT WITH RUBBER GASKET JOINTS
3. MANHOLE SECTIONS SHALL MEET ASTM C–478
4. CONE TO BE ECCENTRIC TYPE
5. FOR PIPE SIZES LARGE THAN 24", DIAMETER OF MANHOLE AS DIRECTED BY ENGINEER



PIPE SIZE	A	B
24"	6'	6"
20"	6.5'	6"
16"	7'	9.5"

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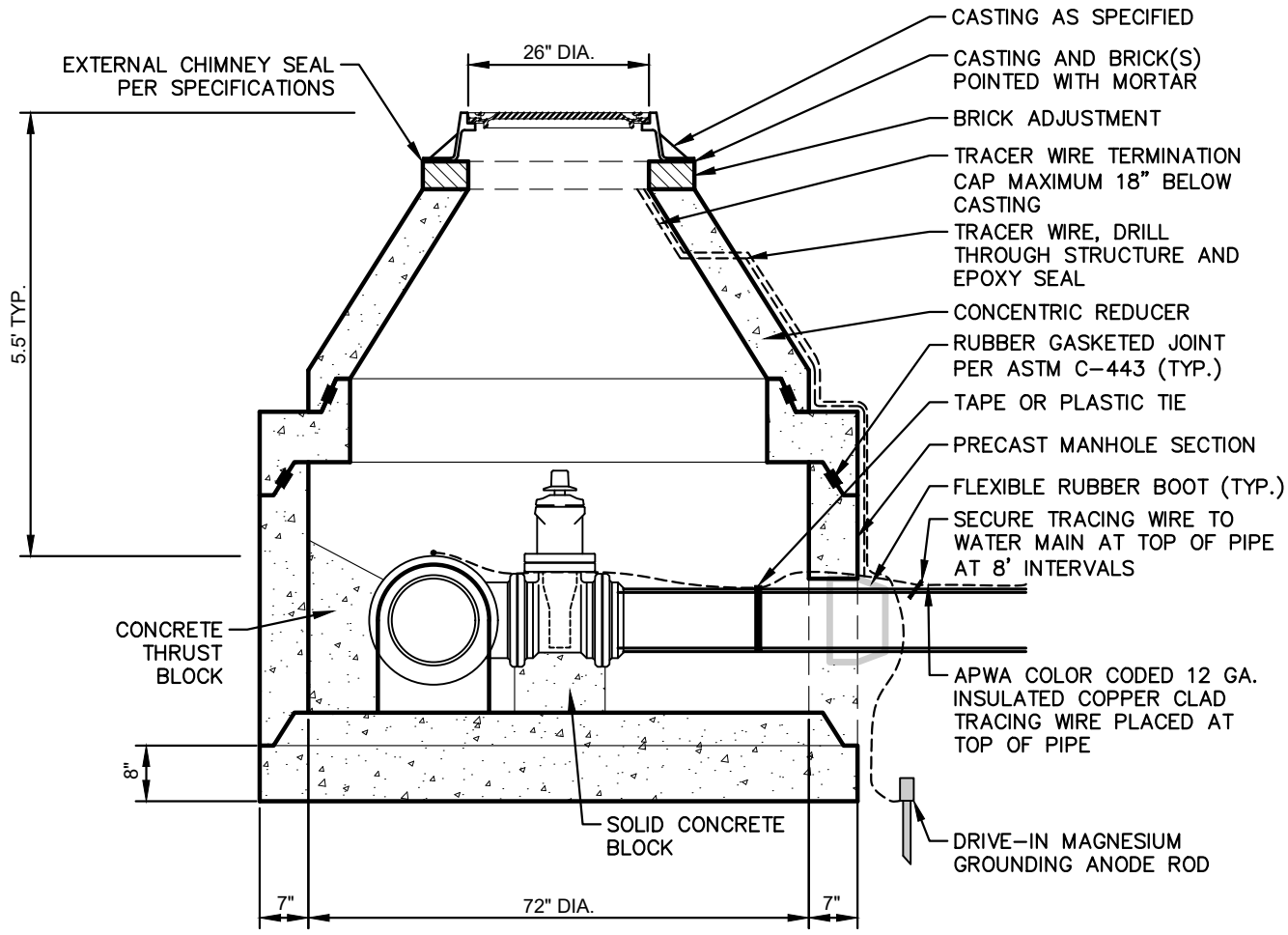
00	10/17/2024	A2D	SSORT
REV. NO.	DATE	DRAWN BY	CHECKED BY

PRECAST GATE WELL (BUTTERFLY VALVES)

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-W-4**

NOTES:

1. ALL LIFT HOLES AND JOINTS SHALL BE MORTARED BOTH INSIDE AND OUTSIDE
2. ALL JOINTS SHALL BE MADE WATER TIGHT WITH RUBBER GASKET JOINTS
3. NO STEPS ARE PERMITTED
4. MANHOLE SECTIONS SHALL MEET ASTM C–478
5. CONE TO BE ECCENTRIC TYPE
6. DETAIL APPLIES TO PIPE DIAMETERS UP TO 16"

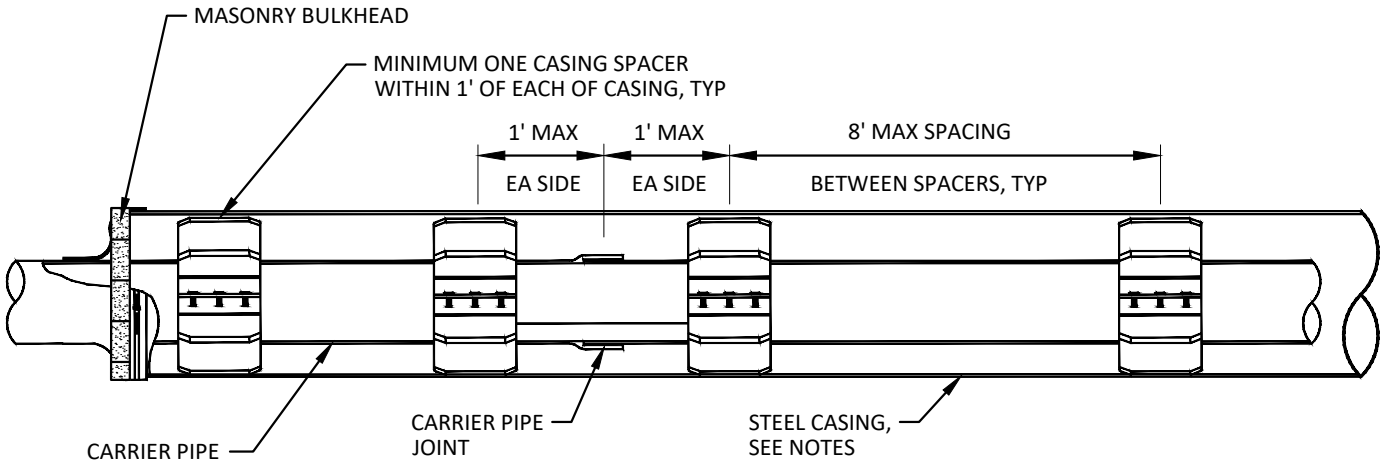


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01	09/01/2025	A2D	SSORT
00	10/17/2024	A2D	SSORT

PRECAST GATE WELL FOR TAPPING SLEEVE AND VALVE

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-W-5**



NOTES:

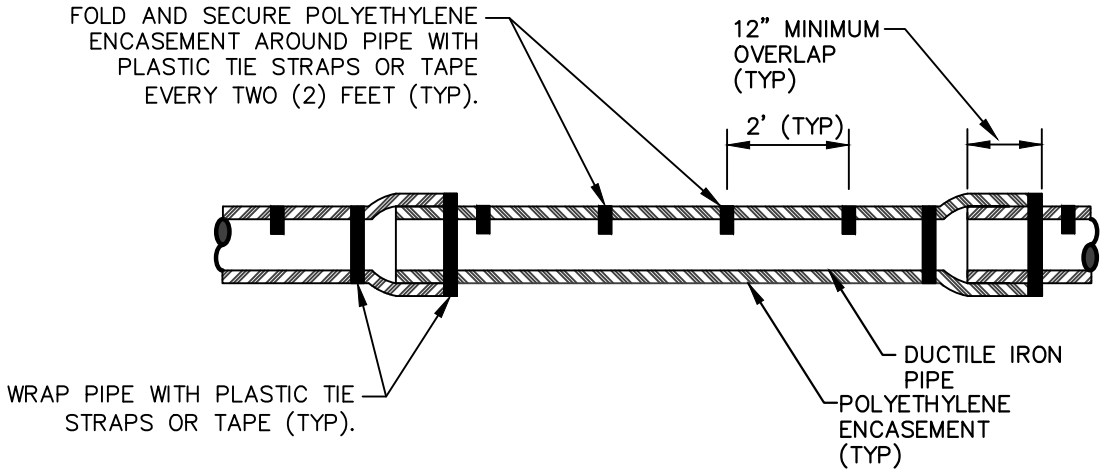
1. THE AREA BETWEEN THE CASING PIPE AND WATER MAIN SHALL BE LEFT OPEN EXCEPT FOR SOLID BRICK MASONRY BULKHEAD AT EACH END, AND MANUFACTURED SPACERS WHEN REQUIRED.
2. EACH JOINT OF CASING PIPE SHALL BE WELDED TOGETHER ALONG ENTIRE CIRCUMFERENCE OF PIPE.
3. MANUFACTURED SPACERS SHALL BE USED.
4. WOOD BLOCK SPACERS ARE NOT ALLOWED.
5. BORING SHALL BE AT 90 DEGREES TO ALL CROSSINGS UNLESS OTHERWISE APPROVED. THE BORING OF THE HOLE AND INSTALLATION OF THE CASING PIPE SHALL BE SIMULTANEOUS. BORE HOLE DIAMETER SHALL ESSENTIALLY BE THE SAME AS THE OUTSIDE DIAMETER OF THE CASING PIPE TO BE INSTALLED.
6. STEEL PIPE CASING SHALL BE SMOOTH STEEL PIPE FABRICATED IN SECTIONS IN ACCORDANCE WITH ASTM A53, TYPE E OR S, GRADE B OR ASTM A139, GRADE B. LENGTHS OF CASING PIPE SHALL BE AS LONG AS PRACTICAL FOR SITE CONDITIONS.
7. JOINTS SHALL CONFORM TO THE REQUIREMENTS OF ASTM. JOINTS BETWEEN SECTIONS SHALL BE COMPLETELY WELDED TO THE PRECEDING SECTIONS. PRIOR TO WELDING JOINTS, THE CONTRACTOR SHALL ENSURE THAT BOTH ENDS OF THE CASING SECTIONS BEING WELDED ARE SQUARE.
8. STEEL PIPE CASING SIZE AND WALL THICKNESS SHALL BE AS SPECIFIED IN ARTICLE I OF THESE STANDARDS. VERIFY CASING SIZES PRIOR TO ORDERING AND SIZING CASING INSULATORS.
9. CASING SPACERS SHALL BE RESTRAINED–TYPE BOLTED SPACERS AND SHALL HAVE A MAXIMUM SPACING AS SHOWN, OR AS RECOMMENDED BY MANUFACTURER, WHICHEVER IS CLOSER.
10. REFER TO ARTICLE 1, XXVI CASING PIPE, FOR PIPE SIZES.

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TYPICAL PIPE CASING DETAIL

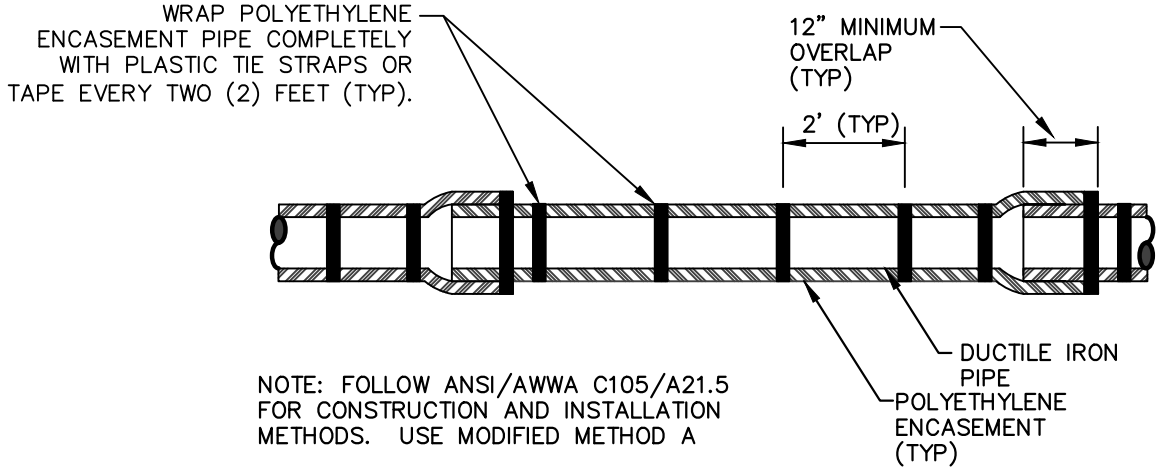
DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-W-6**



NOTE: FOLLOW ANSI/AWWA C105/A21.5 FOR CONSTRUCTION AND INSTALLATION METHODS. USE MODIFIED METHOD A

APPLIES TO: POLYETHYLENE WRAPPED D.I. WATERMAIN
SEE PLANS FOR LOCATIONS

POLYETHYLENE ENCASEMENT (DRY INSTALLATION)



NOTE: FOLLOW ANSI/AWWA C105/A21.5 FOR CONSTRUCTION AND INSTALLATION METHODS. USE MODIFIED METHOD A

APPLIES TO: POLYETHYLENE WRAPPED D.I. WATERMAIN
SEE PLANS FOR LOCATIONS

POLYETHYLENE ENCASEMENT (WET INSTALLATION)

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POLYETHYLENE ENCASEMENT

DR. ENG	CH. ENG	DRAWING NO. SD-W-7
SCALE N.T.S.	DATE 12/8/2023	

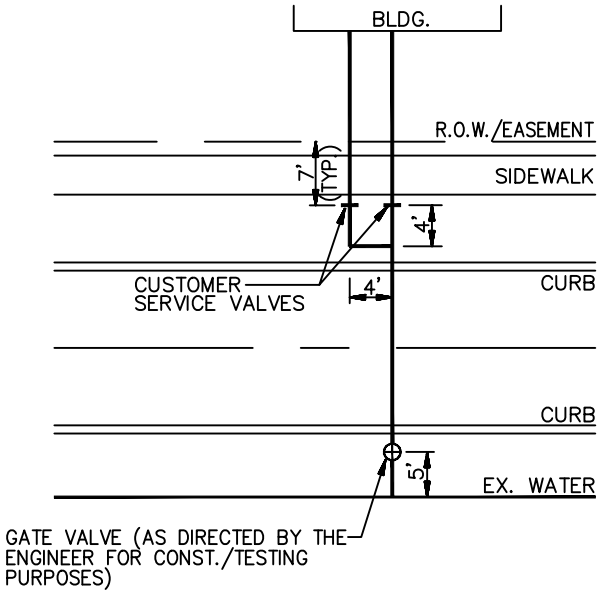
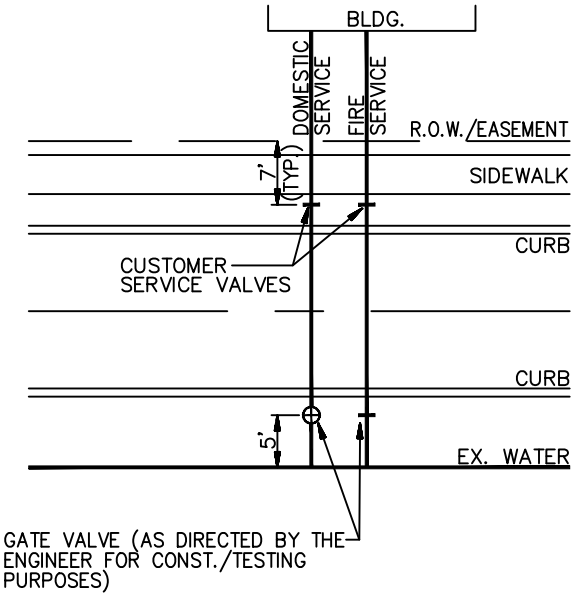
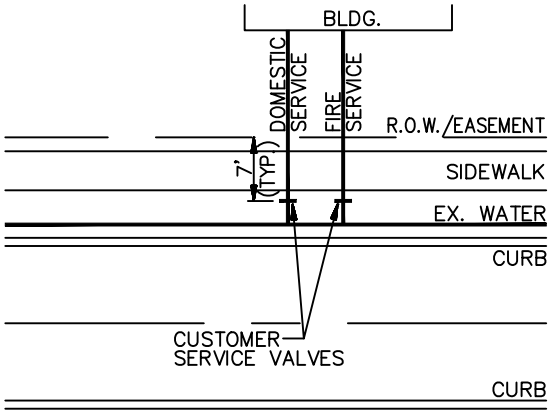


FIGURE 4 CONFIGURATION



SEPARATE SERVICES
LONG SIDE



SEPARATE SERVICES
SHORT SIDE

NOTE:

1. CITY WILL MAINTAIN LEAD UNDER ROAD UP TO AND INCLUDING THE CUSTOMER SERVICE VALVE LOCATION.
2. FOR 13D SPRINKLER SYSTEMS, AS APPROVED BY PLANNING AND DEVELOPMENT SERVICES UNIT, A COMBINATION FIRE AND DOMESTIC LEAD IS PERMITTED.

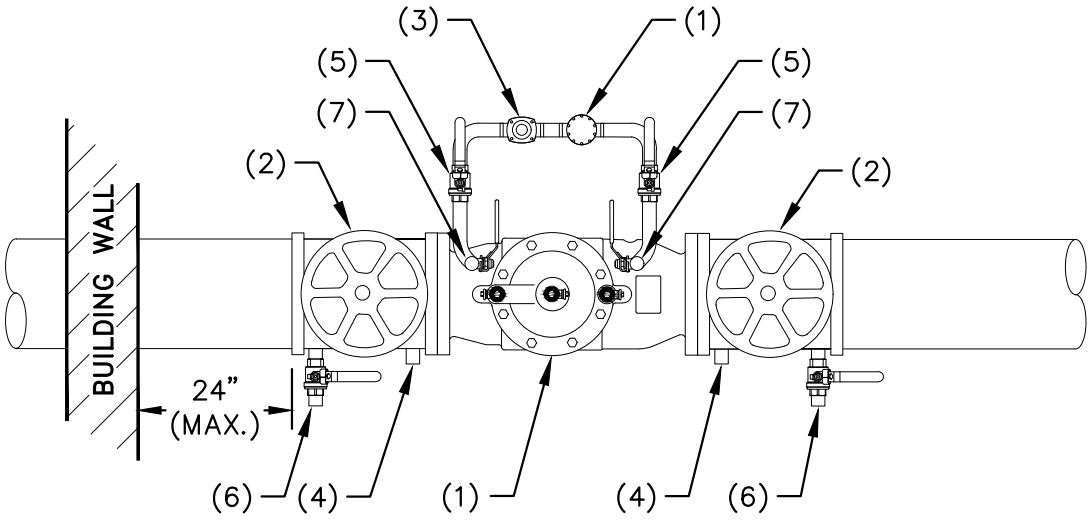
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DOMESTIC AND FIRE SERVICE CONFIGURATIONS

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-W-8**

1. TESTABLE BACK FLOW PREVENTER WITH DETECTOR FLOW METER (RPZ OR DOUBLE CHECK VALVE DEPENDING ON HAZARD LEVEL) – AS DETERMINED BY THE CITY
2. GATE VALVE
3. 3/4" METER
4. 3/4" THREADED PLUG
5. BALL VALVE
6. BALL VALVE WITH 5/8" MALE THREADED HOSE BIBB CONNECTION
7. TEE AND CAP WITH BALL VALVE (FUTURE TESTING PORT)



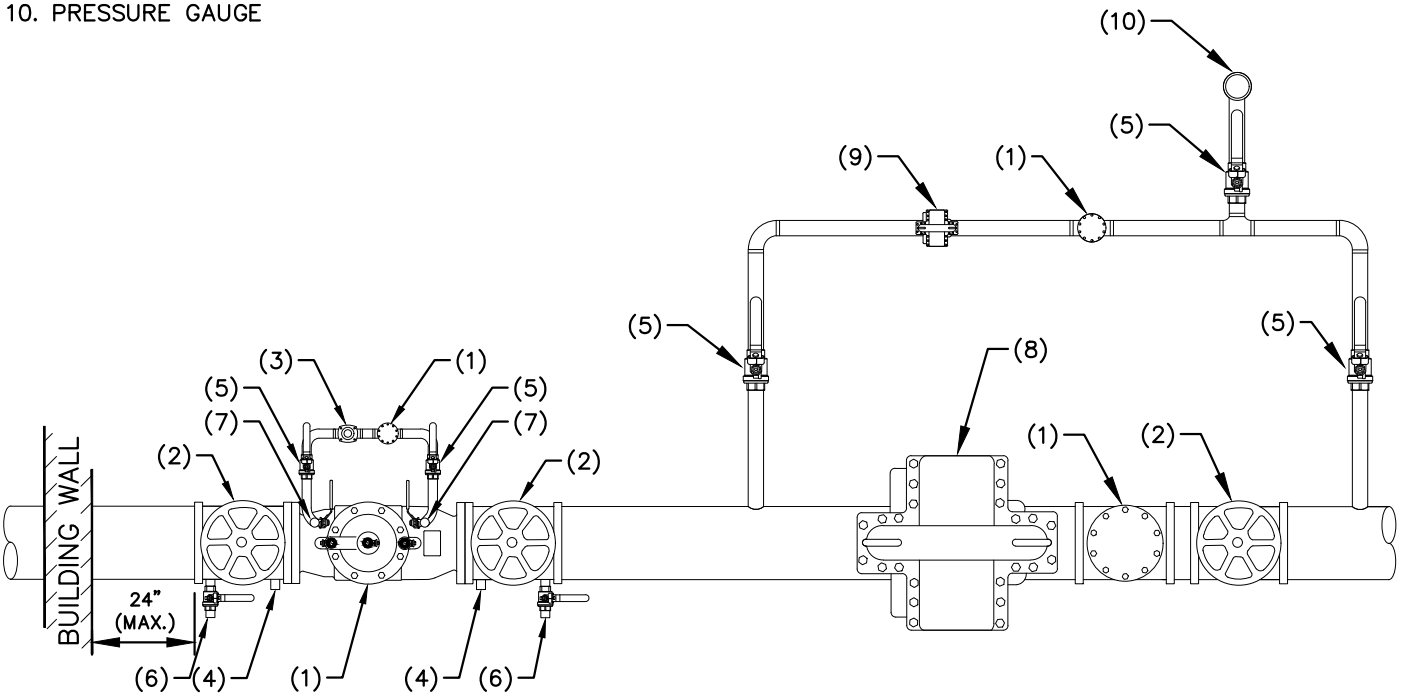
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FIRE SERVICE METERING

DR. ENG	CH. ENG	DRAWING NO. SD-MT-1
SCALE N.T.S.	DATE 12/8/2023	

1. TESTABLE BACK FLOW PREVENTER WITH DETECTOR FLOW METER (RPZ OR DOUBLE CHECK VALVE DEPENDING ON HAZARD LEVEL) – AS DETERMINED BY THE CITY
2. GATE VALVE
3. 3/4" METER
4. 3/4" THREADED PLUG
5. BALL VALVE
6. BALL VALVE WITH 5/8" MALE THREADED HOSE BIBB CONNECTION
7. TEE AND CAP WITH BALL VALVE (FUTURE TESTING PORT)
8. FIRE PUMP
9. JOCKEY PUMP
10. PRESSURE GAUGE



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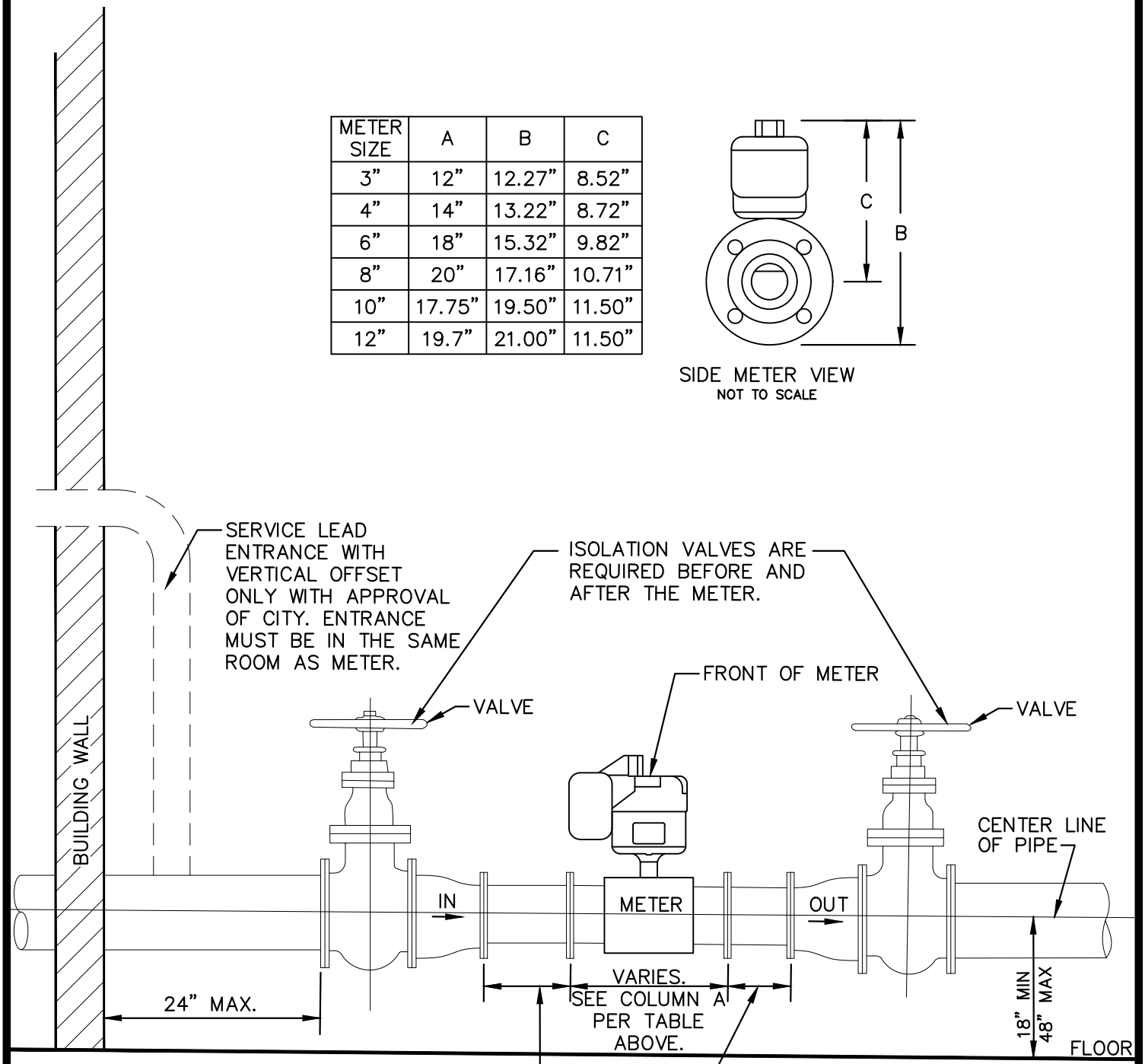
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FIRE SERVICE METERING - FIRE PUMP SYSTEM

DR. ENG	CH. ENG	DRAWING NO. SD-MT-2
SCALE N.T.S.	DATE 12/8/2023	

METER SIZE	A	B	C
3"	12"	12.27"	8.52"
4"	14"	13.22"	8.72"
6"	18"	15.32"	9.82"
8"	20"	17.16"	10.71"
10"	17.75"	19.50"	11.50"
12"	19.7"	21.00"	11.50"

SIDE METER VIEW
NOT TO SCALE



DISTANCE BETWEEN VALVE AND METER SHALL BE MINIMUM 5X THE DIAMETER OF THE PIPE COMING INTO THE METER AND PIPE SIZE SHALL MATCH METER SIZE.

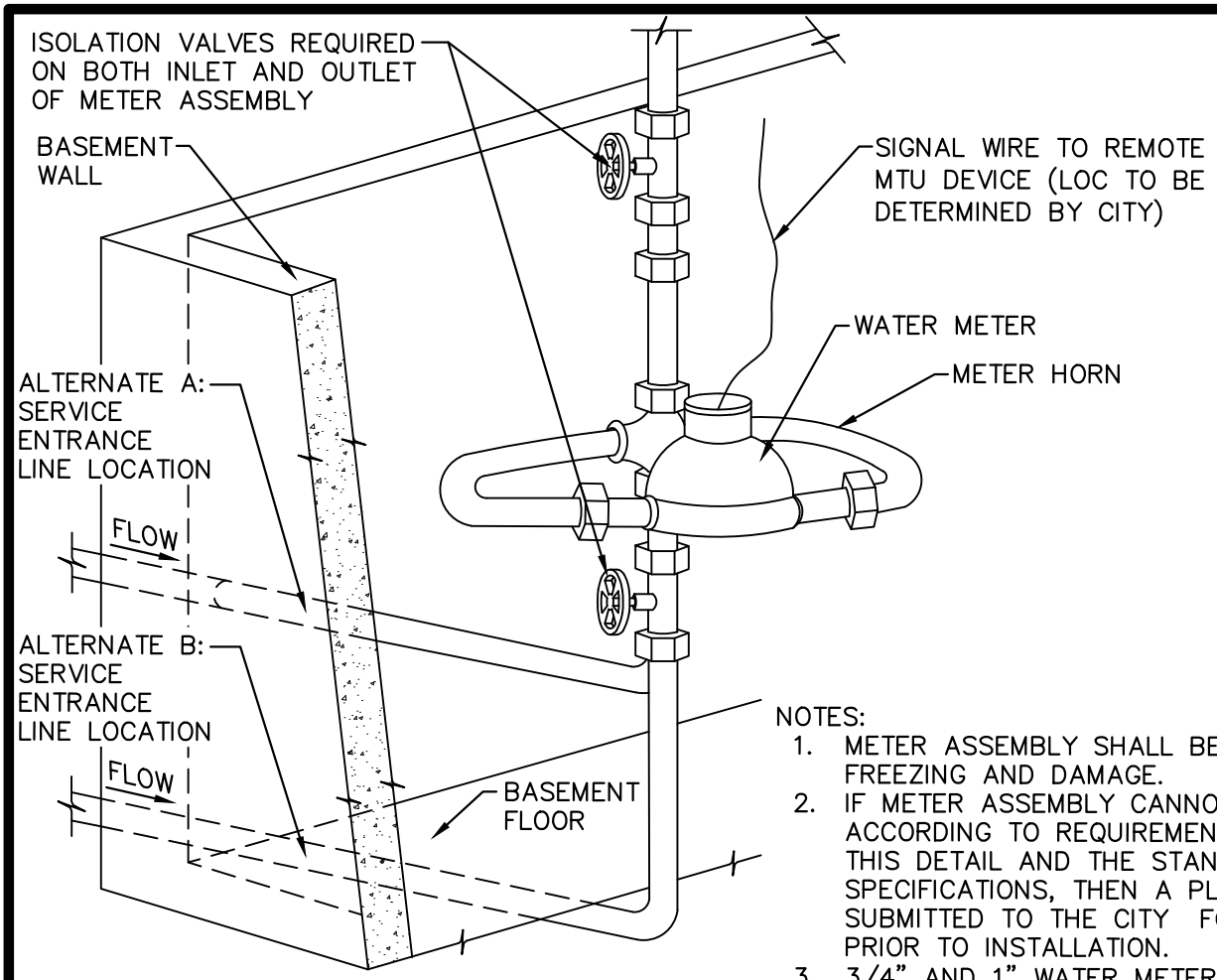
DISTANCE BETWEEN VALVE AND METER SHALL BE MINIMUM 2X THE DIAMETER OF THE PIPE EXITING THE METER AND PIPE SIZE SHALL MATCH METER SIZE.

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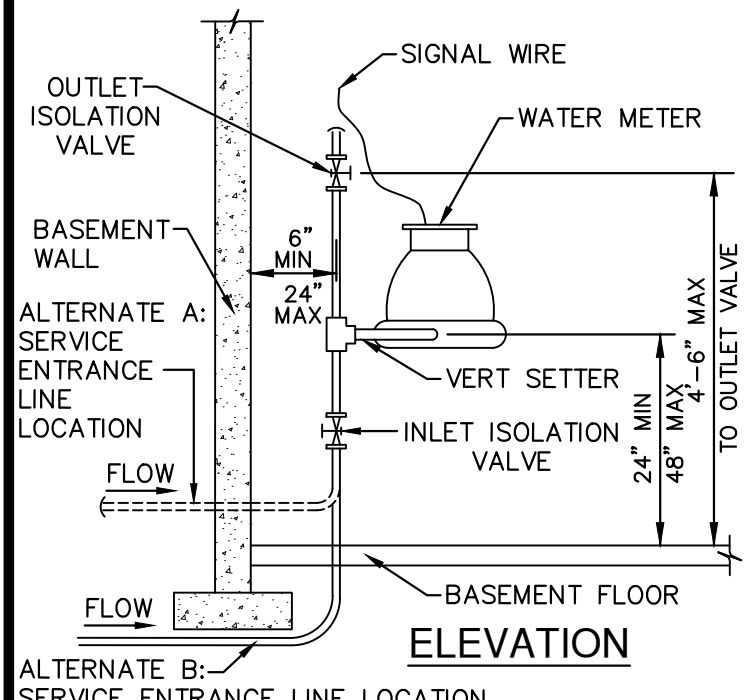
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ELECTROMAGNETIC METER INSTALLATION

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-MT-3**



ISOMETRIC VIEW



ELEVATION

NOTES:

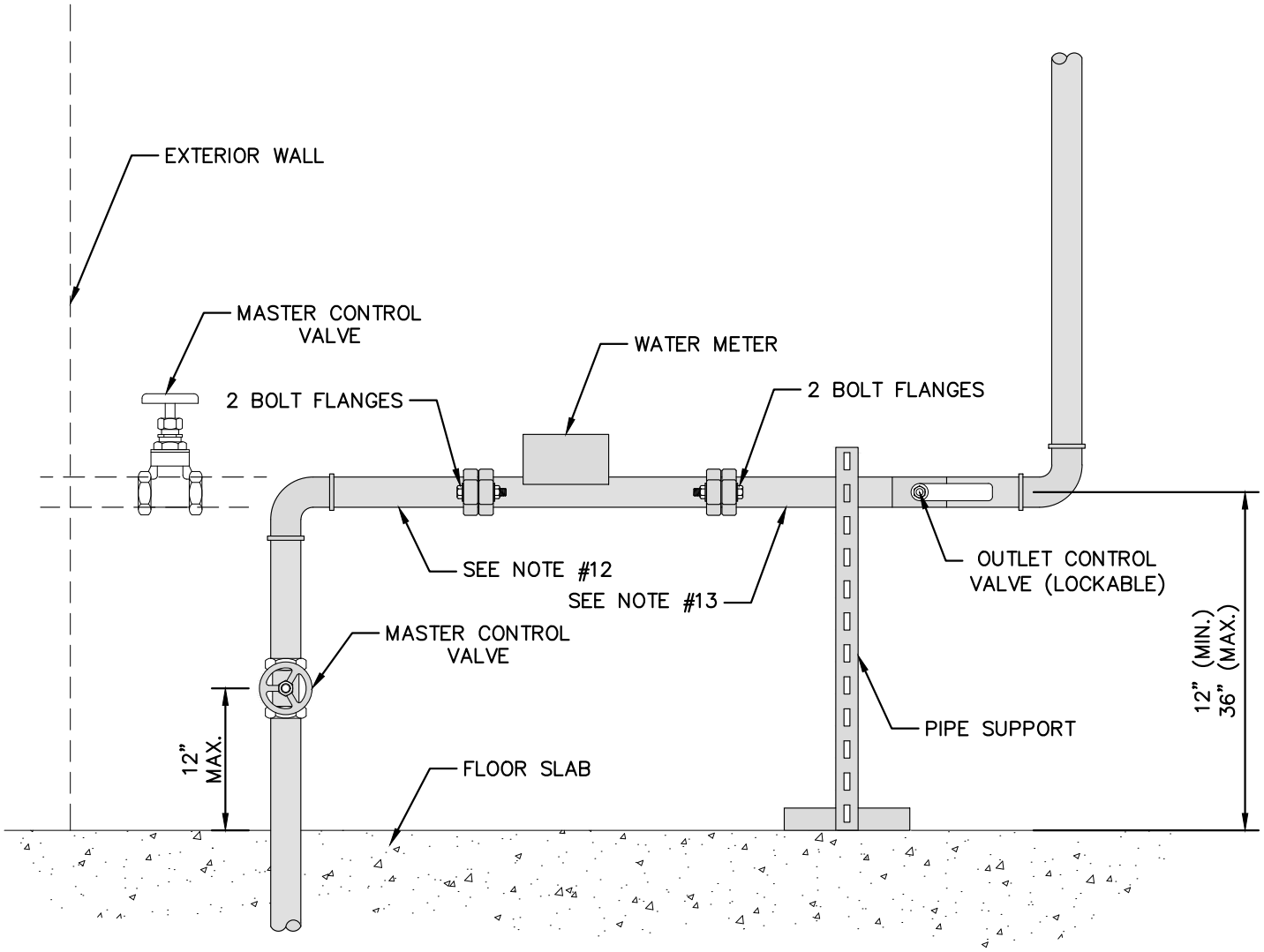
1. METER ASSEMBLY SHALL BE PROTECTED FROM FREEZING AND DAMAGE.
2. IF METER ASSEMBLY CANNOT BE SET ACCORDING TO REQUIREMENTS SET FORTH IN THIS DETAIL AND THE STANDARD SPECIFICATIONS, THEN A PLAN SHALL BE SUBMITTED TO THE CITY FOR APPROVAL PRIOR TO INSTALLATION.
3. 3/4" AND 1" WATER METERS SHALL BE INSTALLED WITH A METER HORN AS SHOWN. METER HORN TO BE PROVIDED BY THE CITY.
4. METER ASSEMBLY AND ISOLATION VALVES MUST BE EASILY ACCESSIBLE BY CITY STAFF AT ALL TIMES FOR MAINTENANCE. METERS CANNOT BE BOXED IN WITHOUT WRITTEN APPROVAL FROM THE CITY.
5. METER TRANSMITTING UNIT (MTU) TO BE MOUNTED WITHIN 15' OF THE WATER METER ASSEMBLY. THE MTU WILL BE MOUNTED BY CITY STAFF.
6. IF THE WATER SERVICE ENTERS THROUGH THE BASEMENT WALL, IT SHALL BE LOCATED AT LEAST 12" MIN. AND 36" MAX. ABOVE THE BASEMENT FLOOR.
7. IF A PRESSURE REDUCING VALVE (PRV) IS REQUIRED BY BUILDING CODE, OR DESIRED BY THE PROPERTY OWNER, IT SHALL BE INSTALLED WITH THE USE OF AN INLINE TANDEM RESETTER.
8. NO BENDS, FITTINGS, CONNECTIONS, OR CHANGES IN PIPE SIZE ARE PERMITTED ON THE SERVICE LINE FROM THE CORPORATION STOP TO THE METER OUTLET EXCEPT AS SHOWN.

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ULTRASONIC METER INSTALLATION
0.75 INCH AND 1 INCH

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-MT-4**



NOTES:

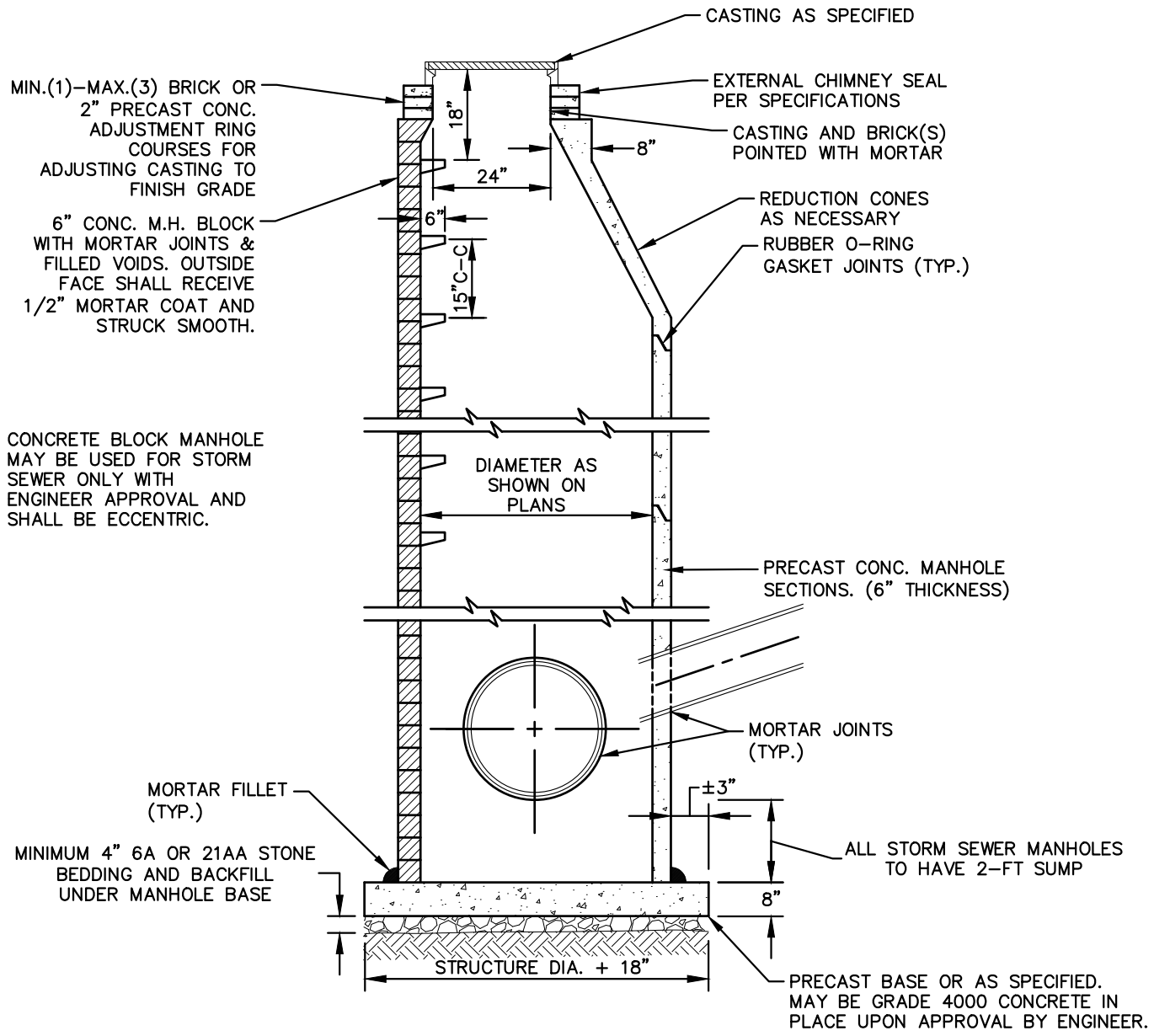
1. PIPING ADJACENT TO THE METER SPACE MUST BE ON A HORIZONTAL PLANE.
2. METER SETTINGS ARE TO BE CONSTRUCTED BY THE CONSUMER.
3. MINIMUM DISTANCE FROM THE CENTERLINE OF PIPING ADJACENT TO METER SPACER IS TO BE 18" FROM ANY ENTRANCE OR OUTSIDE WALL.
4. METER SUPPORT AS REQUIRED (IE. QLINE).
5. A LOCKABLE BALL VALVE SHALL BE INSTALLED AFTER THE FIRE BRANCH AND AFTER ANY BY–PASS BRANCH AT VALVE.
6. METER ASSEMBLY SHALL BE PROTECTED FROM FREEZING AND DAMAGE.
7. IF METER ASSEMBLY CANNOT BE SET ACCORDING TO REQUIREMENTS SET FORTH IN THIS DETAIL AND THE STANDARD SPECIFICATIONS, THEN A PLAN SHALL BE SUBMITTED TO THE CITY FOR APPROVAL PRIOR TO INSTALLATION.
8. METER ASSEMBLY AND ISOLATION VALVES MUST BE EASILY ACCESSIBLE BY CITY STAFF AT ALL TIMES FOR MAINTENANCE. METERS CANNOT BE BOXED IN WITHOUT WRITTEN APPROVAL FROM THE CITY.
9. METER TRANSMITTING UNIT (MTU) TO BE MOUNTED WITHIN 15' OF THE WATER METER ASSEMBLY. THE MTU WILL BE MOUNTED BY CITY STAFF.
10. IF THE WATER SERVICE ENTERS THROUGH THE BASEMENT WALL, IT SHALL BE LOCATED AT LEAST 12" MIN. AND 36" MAX. ABOVE THE BASEMENT FLOOR.
11. NO BENDS, FITTINGS, CONNECTIONS, OR CHANGES IN PIPE SIZE ARE PERMITTED ON THE SERVICE LINE FROM THE CORPORATION STOP TO THE METER OUTLET EXCEPT AS SHOWN.
12. DISTANCE BETWEEN ANY FITTING AND METER SHALL BE MINIMUM 5X THE DIAMETER OF THE PIPE COMING INTO THE METER AND PIPE SIZE SHALL MATCH METER SIZE.
13. DISTANCE BETWEEN ANY FITTING AND METER SHALL BE MINIMUM 2X THE DIAMETER OF THE PIPE EXITING THE METER AND PIPE SIZE SHALL MATCH METER SIZE.

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ULTRASONIC METER INSTALLATION
1.5 INCH AND 2 INCH

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-MT-5**



NOTES:

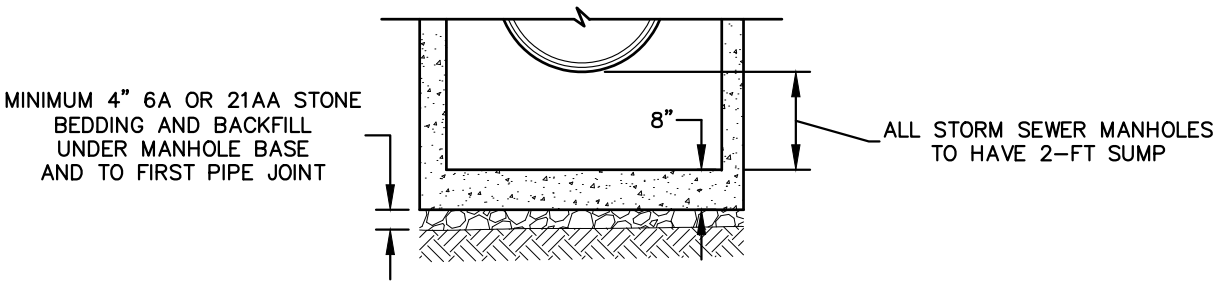
1. ALL STORM MANHOLES MAY BE PRECAST CONCRETE OR MANHOLE BLOCK.
2. ALL MANHOLES MUST HAVE ECCENTRIC CONES.
3. ALL MANHOLE SECTIONS SHALL BE REINFORCED PER ASTM–185.
4. 2' SUMP REQUIRED ON ALL DRAINAGE STRUCTURES.
5. IF A FLAT TOP IS REQUIRED, THEN IT SHALL BE REINFORCED IN BOTH DIRECTIONS TO MEET ASTM C–615.

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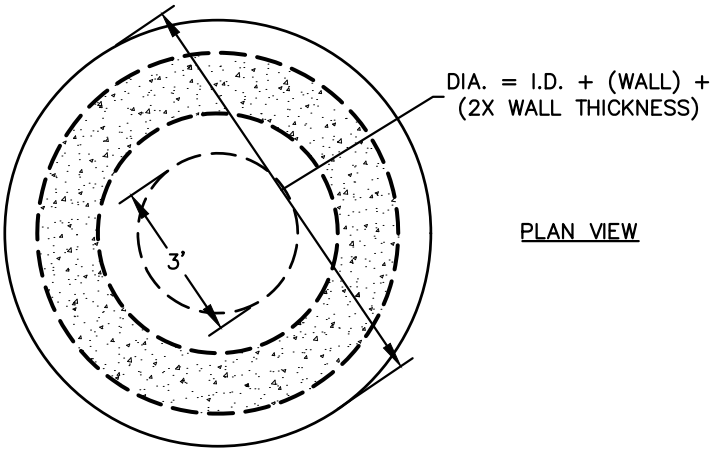
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REV. NO.	DATE	DRAWN BY	CHECKED BY

STANDARD STORM MANHOLE (SEPARATE BASE)

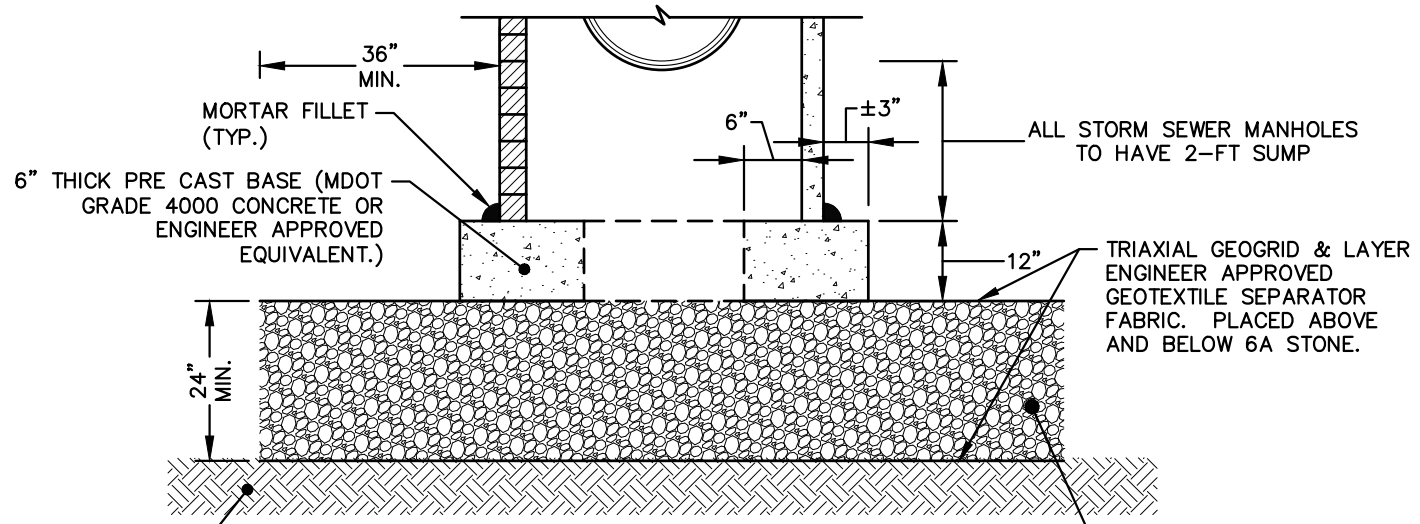
DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-ST-1A**



INTEGRAL BASE OPTION



PLAN VIEW



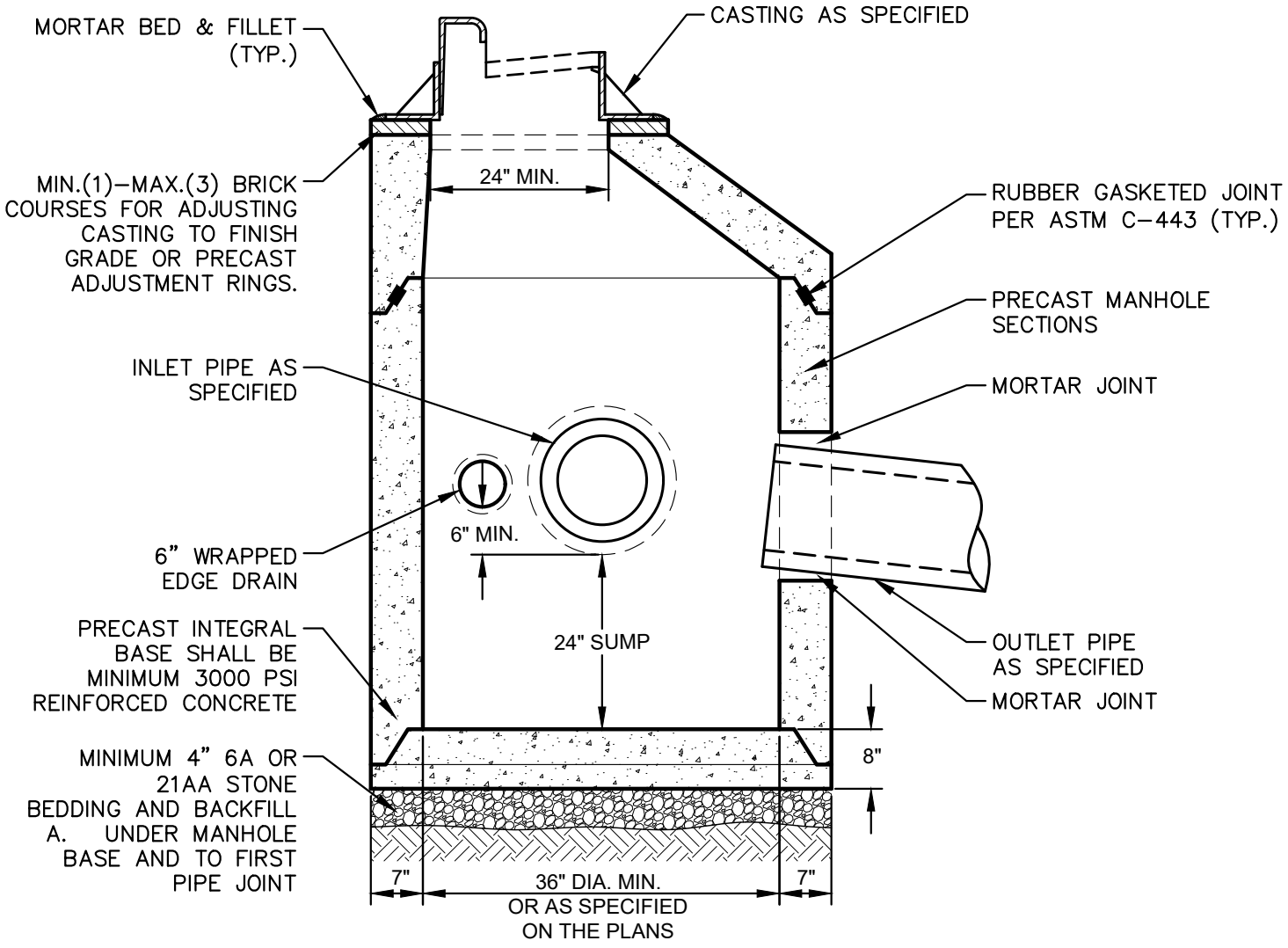
LEACHING BASE OPTION

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00	8/20/12	AG	SSORT

STANDARD STORM MANHOLE
(PRECAST AND LEACHING BASES)

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-ST-1B**



NOTES:

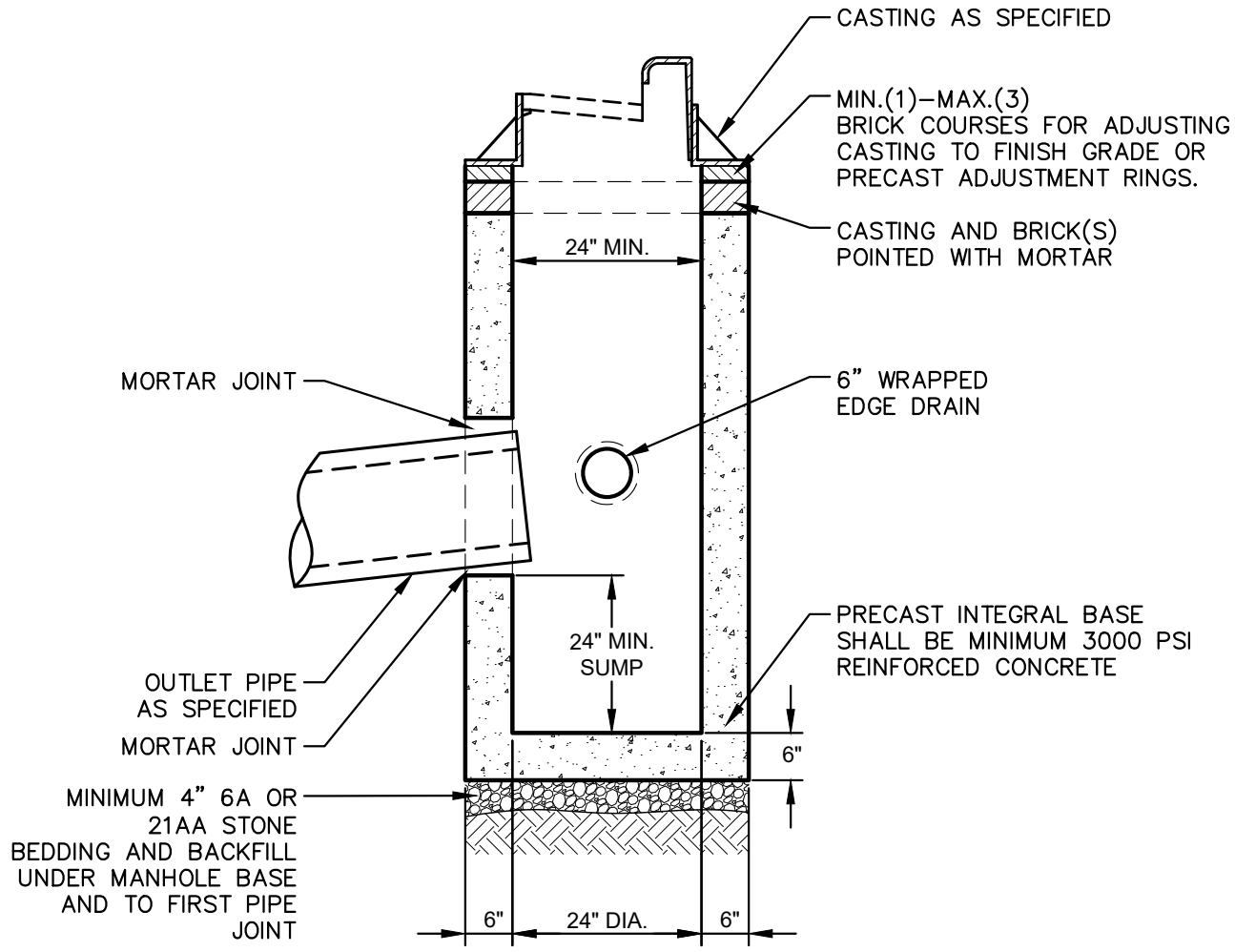
1. FRONT EDGE OF INLET CASTING SHALL BE FLUSH WITH FRONT EDGE OF GUTTER (EDGE–OF–METAL)

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PRECAST JUNCTION INLET

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-ST-2**



NOTES:

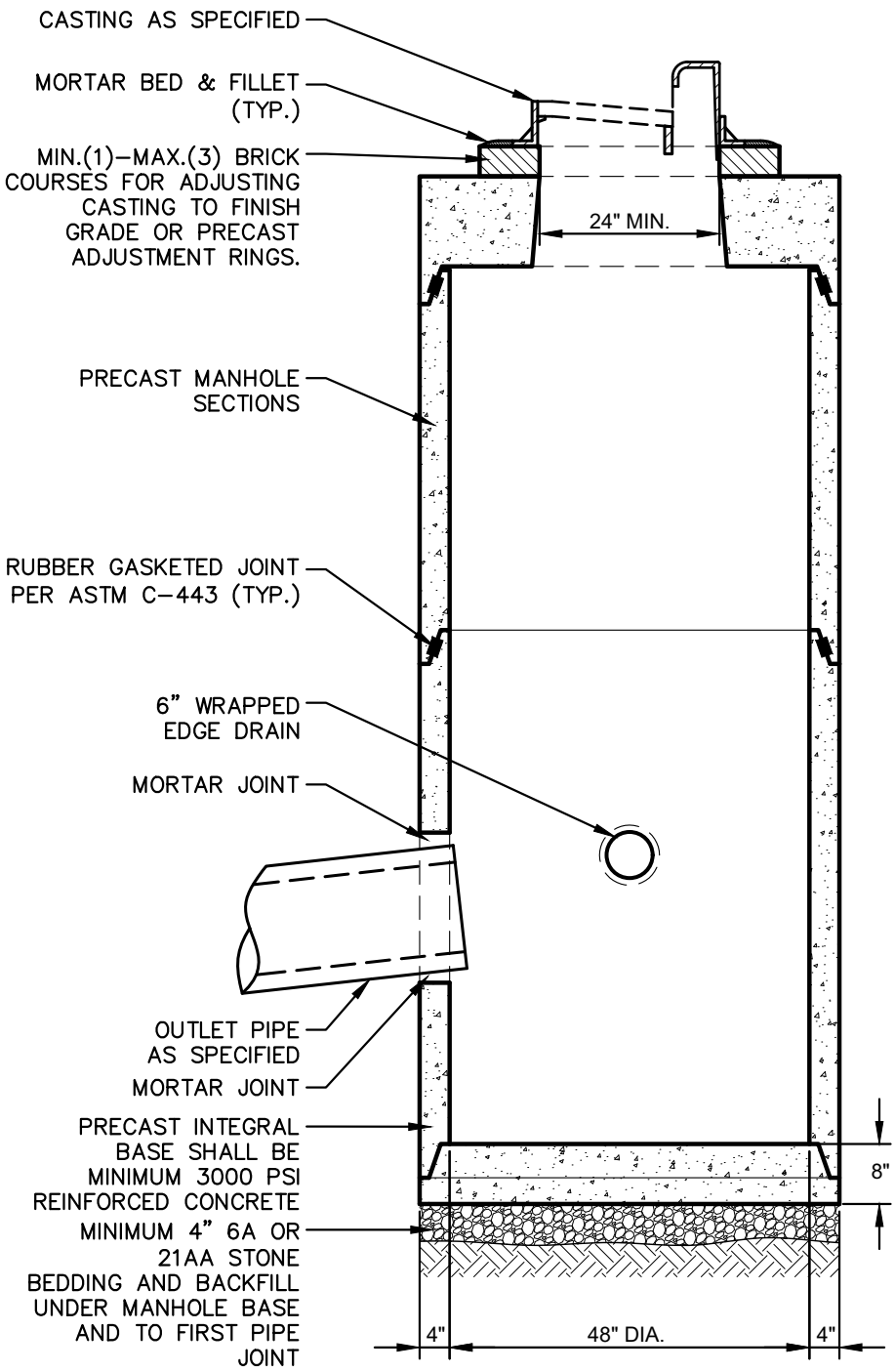
1. MAY BE USED WITH SINGLE OUTLET PIPE AND SINGLE INLET PIPE.
2. FRONT EDGE OF INLET CASTING SHALL BE FLUSH WITH FRONT EDGE OF GUTTER (EDGE–OF–METAL)

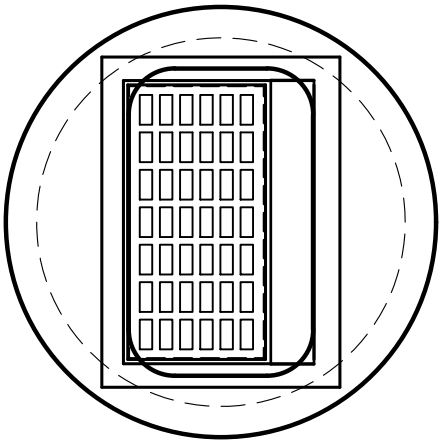
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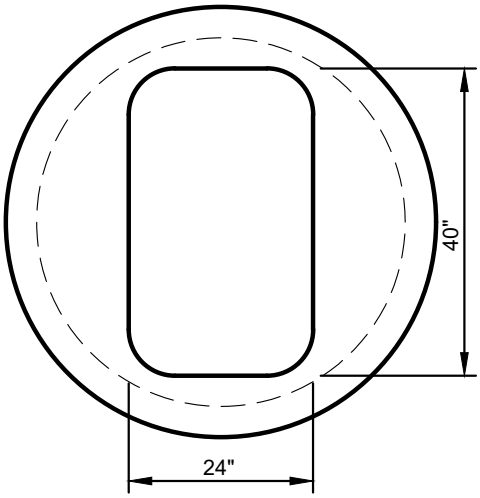
PRECAST SINGLE INLET

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-ST-3**





TOP VIEW



NOTES:

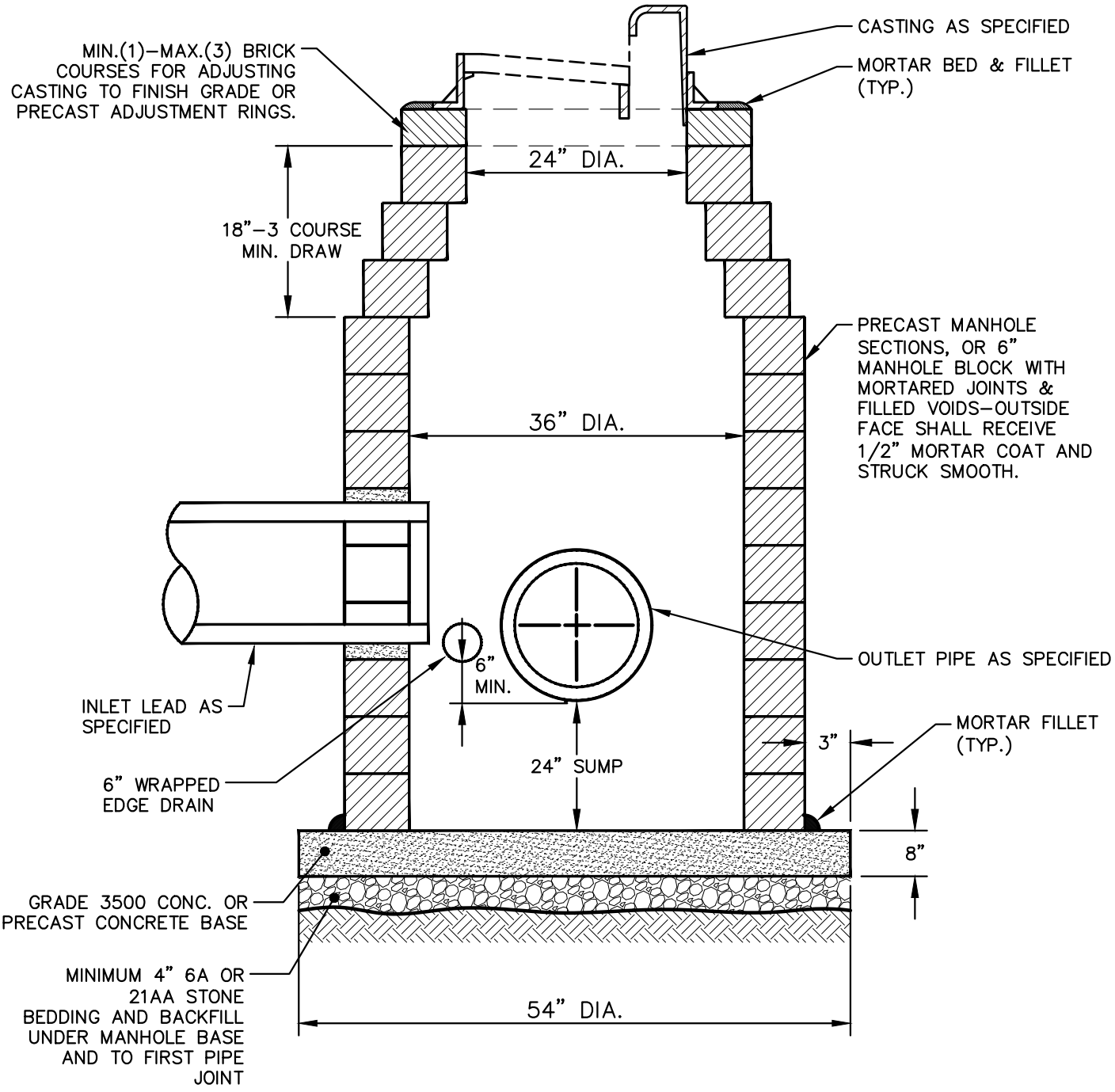
1. FRONT EDGE OF INLET CASTING SHALL BE FLUSH WITH FRONT EDGE OF GUTTER (EDGE–OF–METAL)

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PRECAST HIGH CAPACITY INLET

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-ST-4**



NOTES:

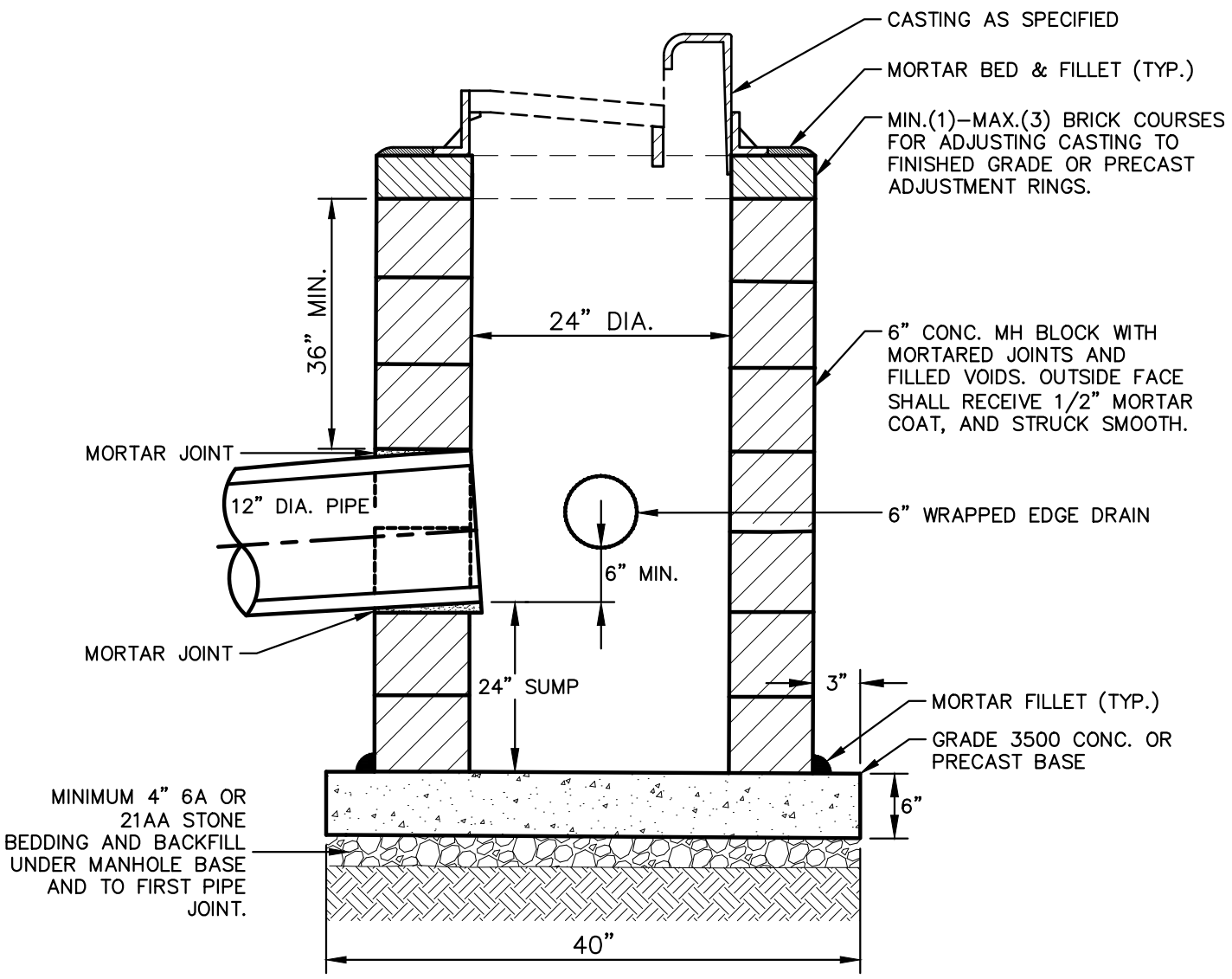
1. MAY BE USED WITH SINGLE OUTLET PIPE AND SINGLE INLET PIPE.
2. FRONT EDGE OF INLET CASTING SHALL BE FLUSH WITH FRONT EDGE OF GUTTER (EDGE–OF–METAL)

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BLOCK JUNCTION INLET

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-ST-5**



NOTES:

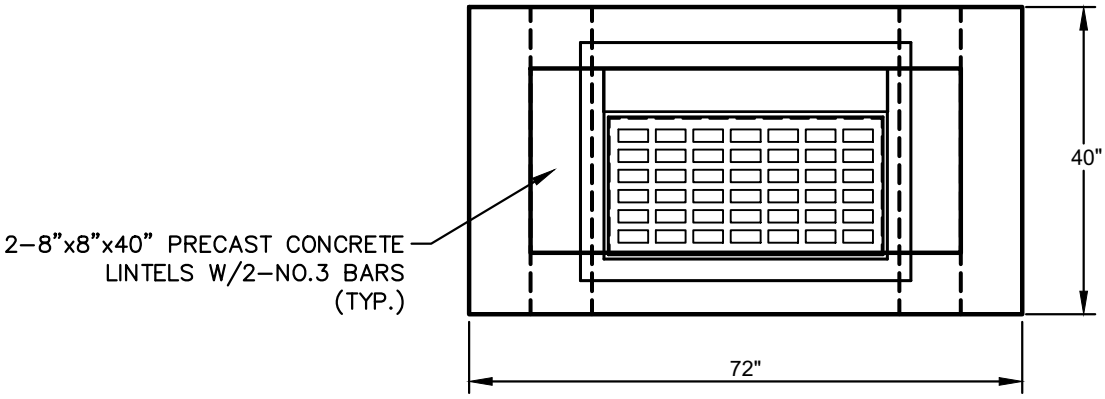
1. MAY BE USED WITH ONLY SINGLE OUTLET PIPE, AND NO INLET PIPE
2. FRONT EDGE OF INLET CASTING SHALL BE FLUSH WITH FRONT EDGE OF GUTTER (EDGE–OF–METAL)

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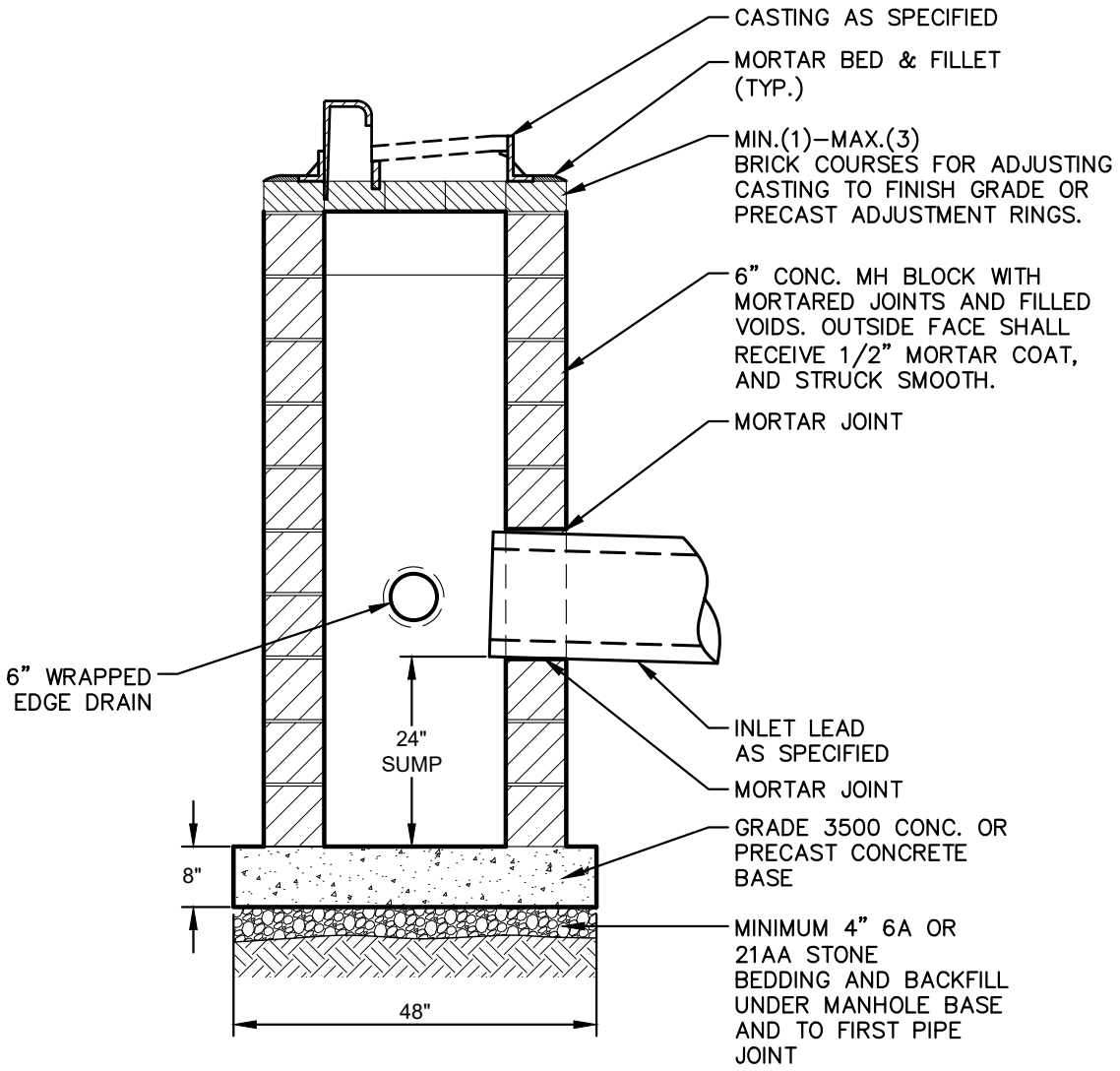
00	12/30/24	A2D	SSORT
REV. NO.	DATE	DRAWN BY	CHECKED BY

BLOCK SINGLE INLET

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-ST-6**



TOP VIEW



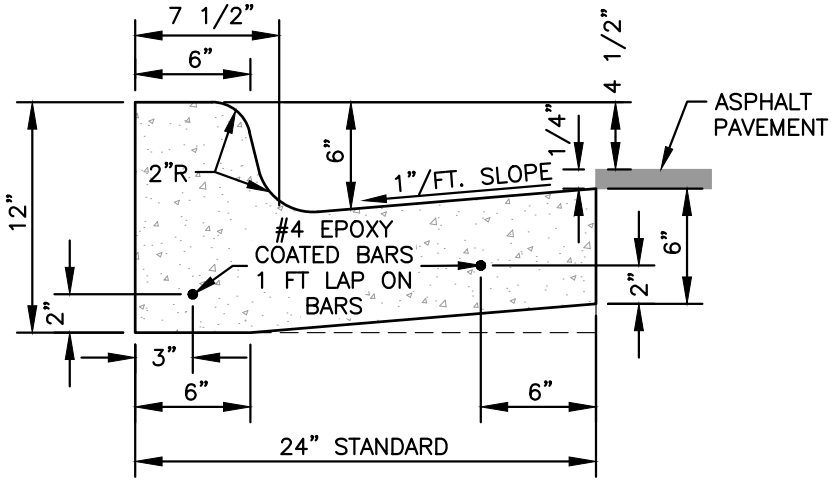
NOTES:
1. MAY BE USED WITH SINGLE OUTLET PIPE AND SINGLE INLET PIPE.
2. FRONT EDGE OF INLET CASTING SHALL BE FLUSH WITH FRONT EDGE OF GUTTER (EDGE–OF–METAL)

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BLOCK HIGH CAPACITY INLET

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-ST-7**



NOTES:

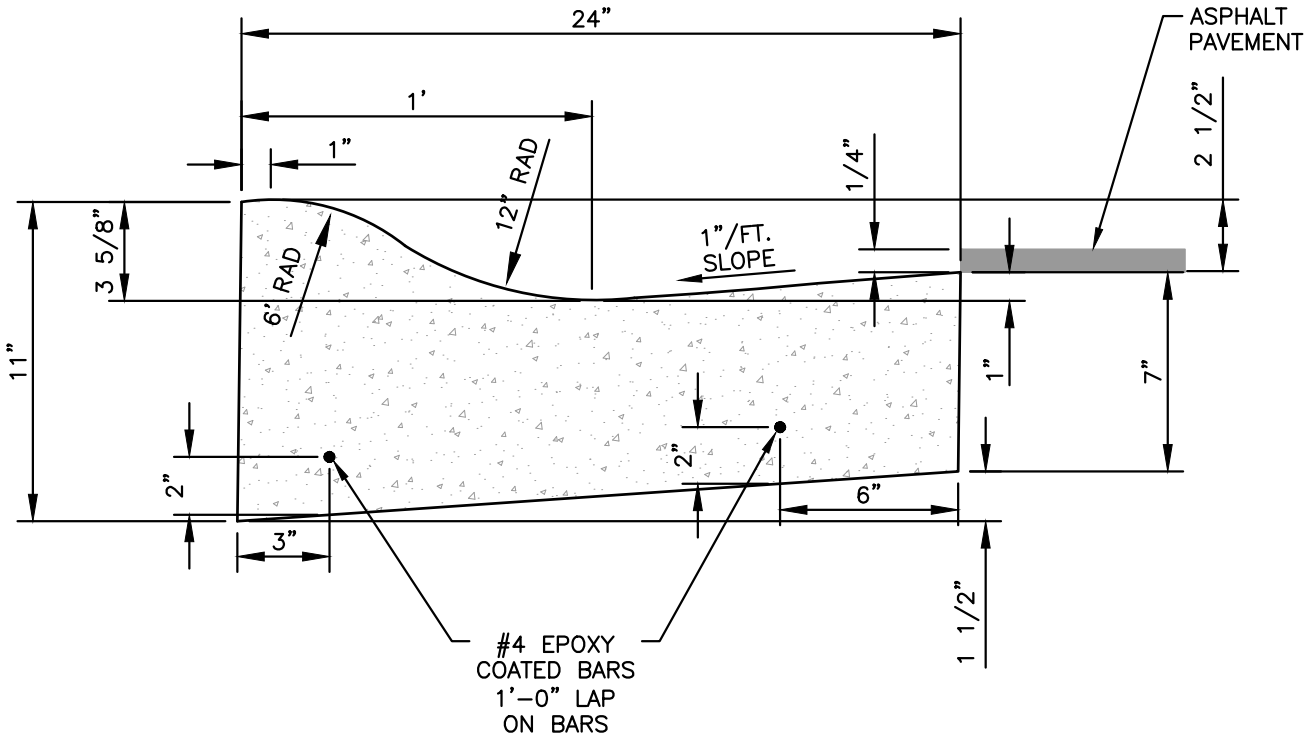
1. BARRIER CURB AND GUTTER ON ASPHALT STREETS SHALL CONFORM TO THIS DETAIL.
2. BARRIER CURB AND GUTTER ON CONCRETE STREETS SHALL CONFORM TO MDOT CURB AND GUTTER DETAIL F3.

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BARRIER CURB AND GUTTER

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-CG-1**



NOTES:

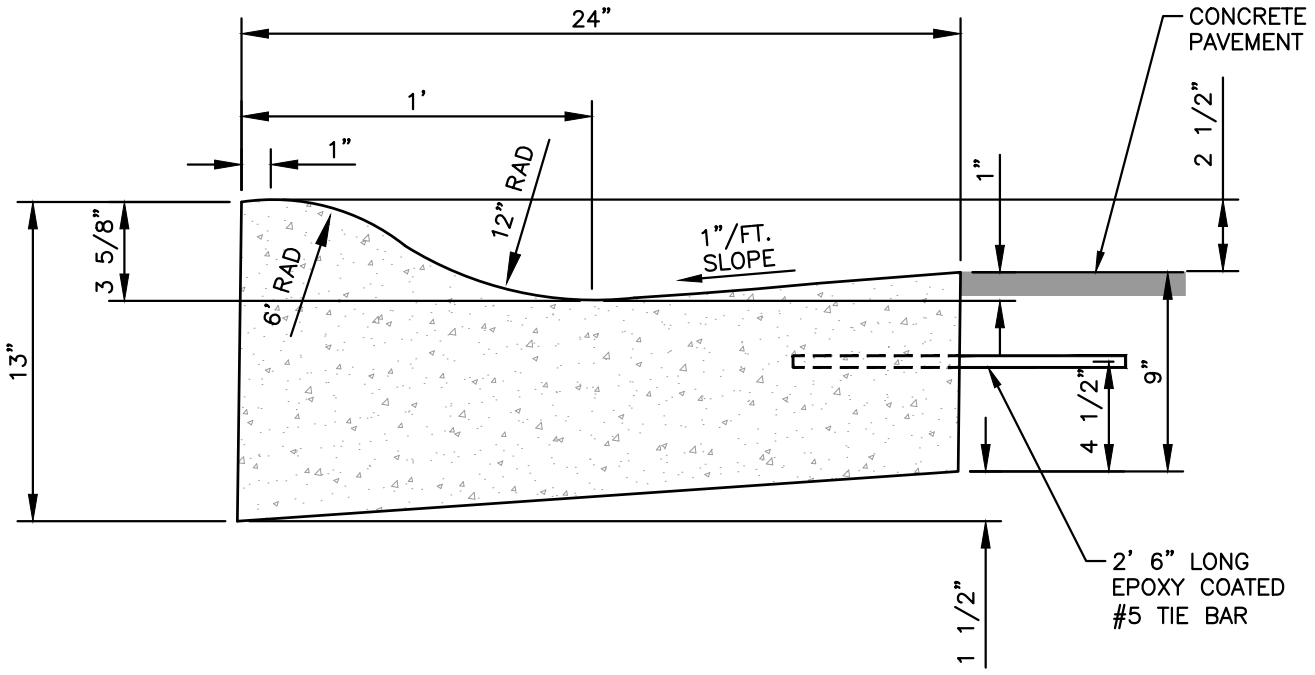
1. FRONT EDGE OF INLET CASTINGS SHALL BE FLUSH WITH FRONT EDGE OF GUTTER (EDGE-OF-METAL).
2. THIS DETAIL SHALL BE USED FOR MOUNTABLE CURB AND GUTTER ON ASPHALT STREETS. SEE SD-CG-3 FOR MOUNTABLE CURB AND GUTTER ON CONCRETE STREETS.

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MOUNTABLE CURB AND GUTTER FOR ASPHALT STREETS

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-CG-2**



NOTES:

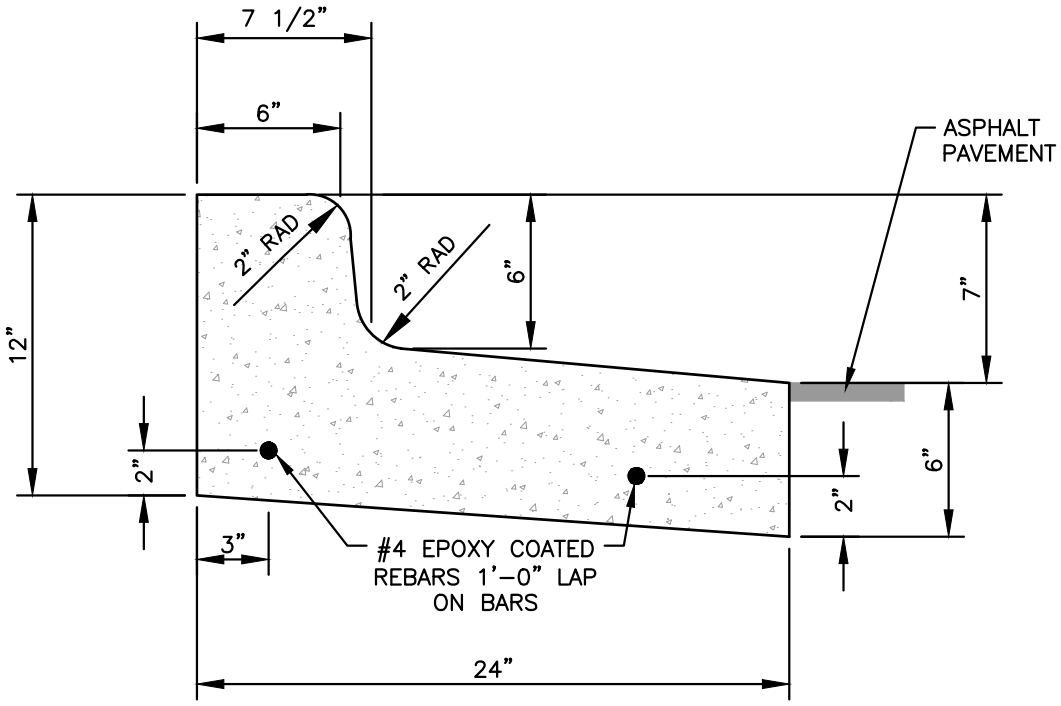
1. FRONT EDGE OF INLET CASTINGS SHALL BE FLUSH WITH FRONT EDGE OF GUTTER (EDGE–OF–METAL).
2. THIS DETAIL SHALL BE USED FOR MOUNTABLE CURB AND GUTTER ON CONCRETE STREETS. SEE SD–CG–2 FOR MOUNTABLE CURB AND GUTTER ON ASPHALT STREETS.

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MOUNTABLE CURB AND GUTTER FOR CONCRETE STREETS

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-CG-3**

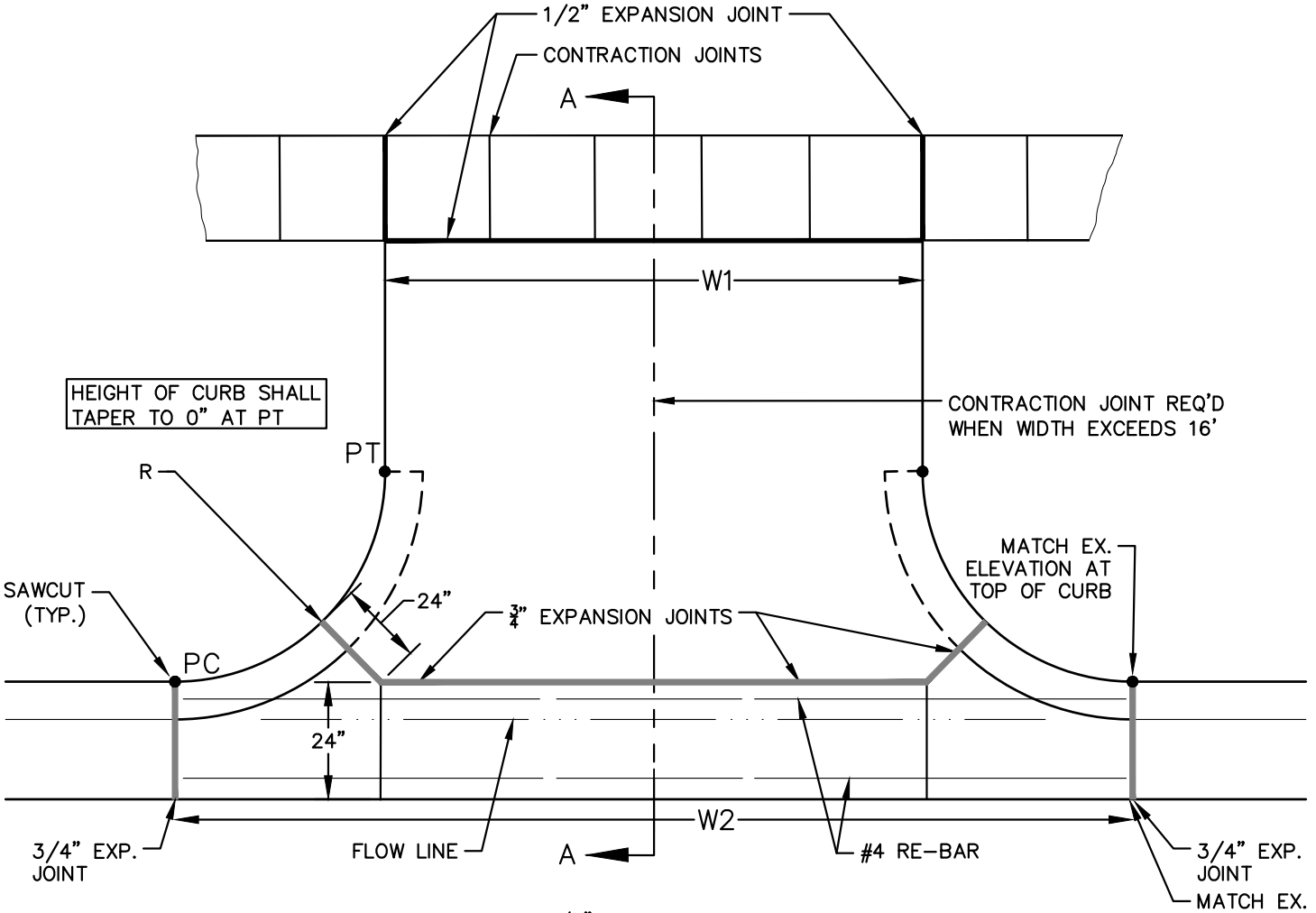


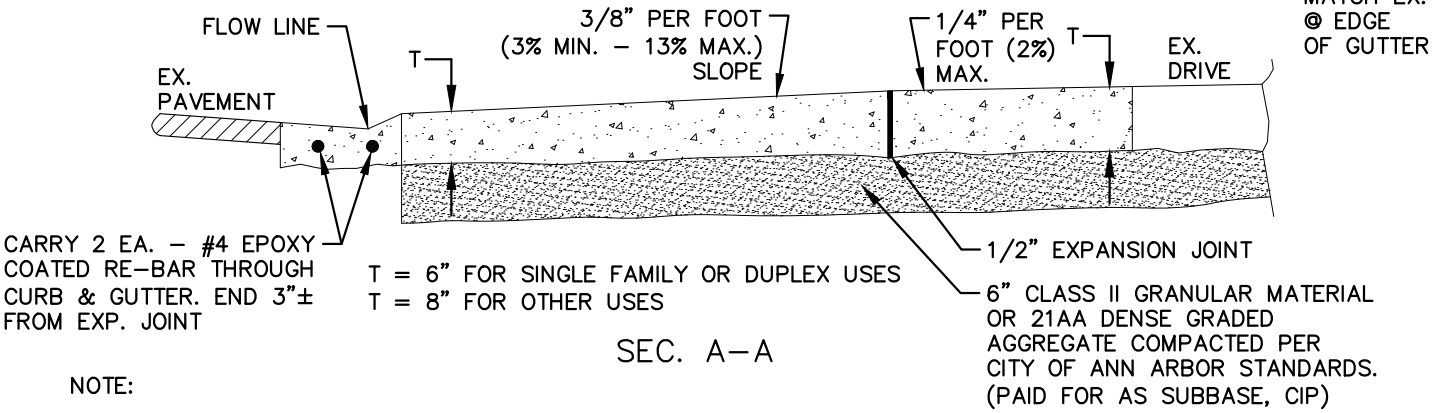
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SPILL-OUT BARRIER CURB AND GUTTER

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	SD-CG-4





SEC. A–A

NOTE:

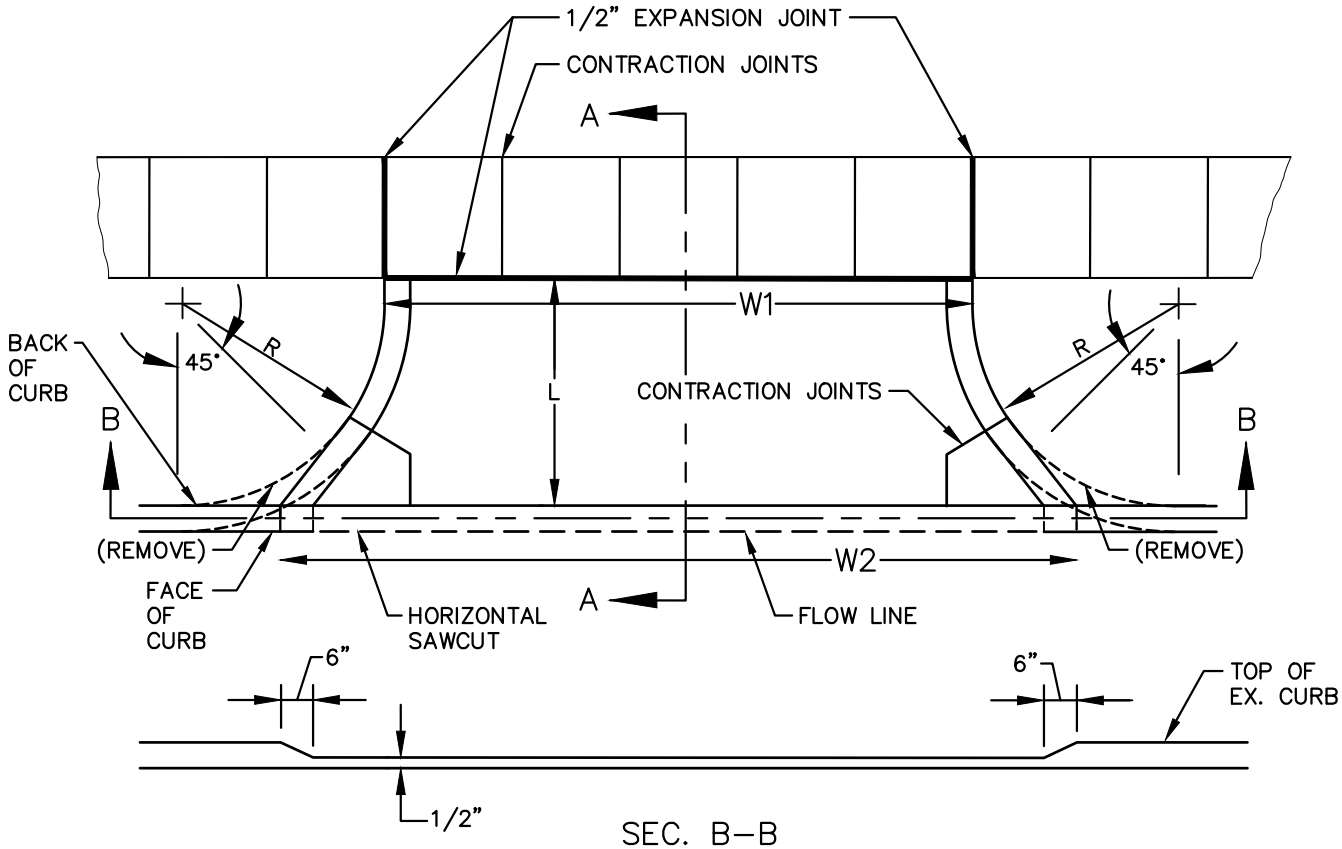
1. MINIMUM REQUIREMENT FOR DRIVE APPROACH TO BE MDOT 3500 CONCRETE.
2. R (RADIUS) AND W1 (OPENING WIDTH) AND W2 (CURB CUT WIDTH) AS REQUIRED PER TABLE A, ARTICLE 6 OF CITY STANDARDS
3. IF GUTTER IS OVERLAID, GUTTER OF THE APPROACH SHALL BE AT SAME ELEVATION AS EXISTING CONCRETE GUTTER AND ASPHALT WEDGE SHALL BE PLACED IN THE APPROACH.

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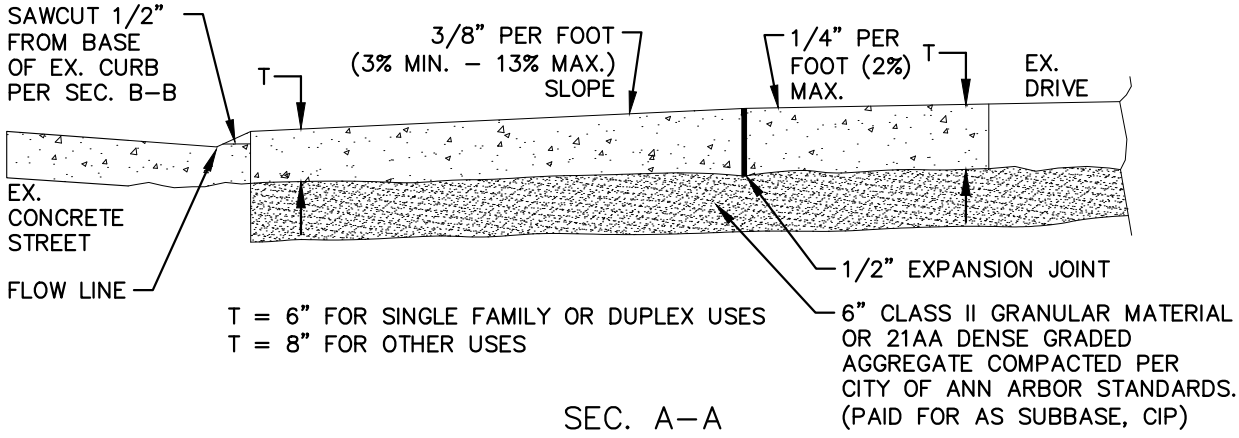
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TYPE M DRIVE APPROACH FOR ASPHALT STREETS WITH BARRIER CURB

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DS-1**



SEC. B–B



SEC. A–A

NOTE:

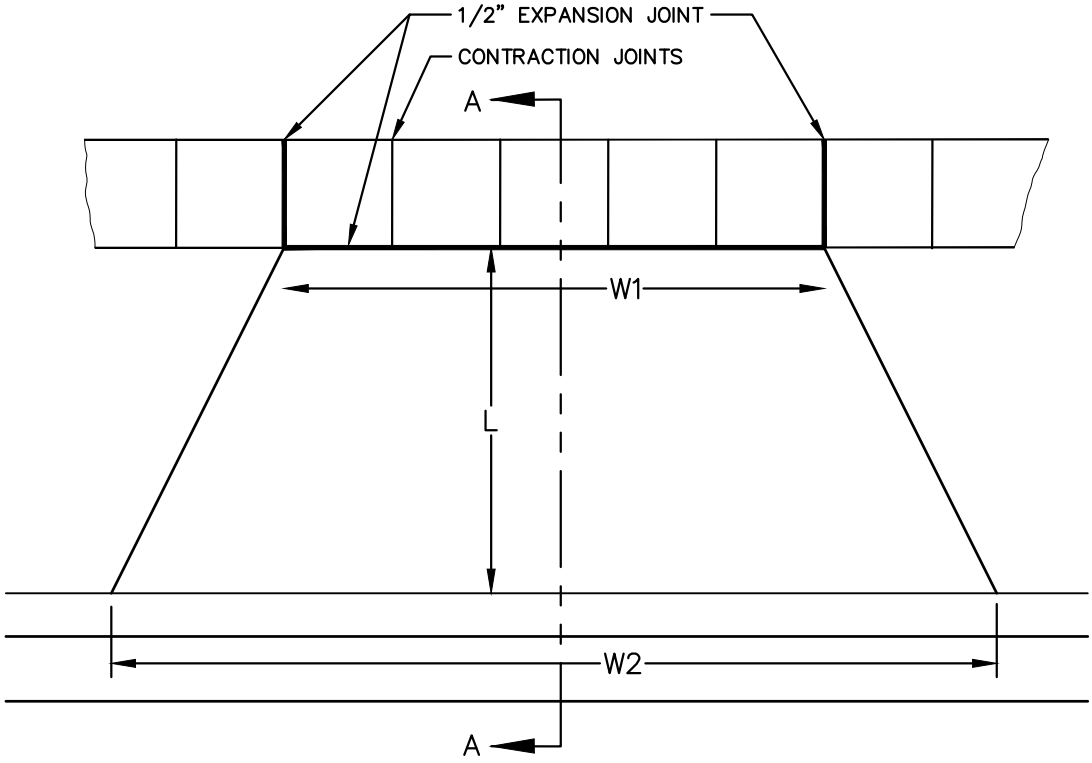
1. MINIMUM REQUIREMENT FOR DRIVE APPROACH TO BE MDOT 3500 CONCRETE.
2. R (RADIUS) AND W1 (OPENING WIDTH) AND W2 (CURB CUT WIDTH) AS REQUIRED PER TABLE A, ARTICLE 6 OF CITY STANDARDS

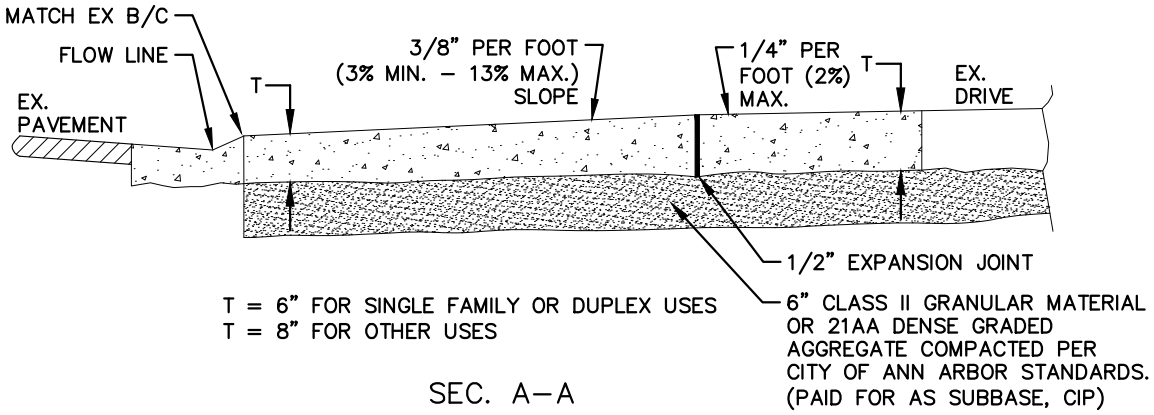
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MODIFIED M DRIVE APPROACH FOR CONCRETE STREETS WITH BARRIER CURB

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DS-2**





SEC. A–A

NOTE:

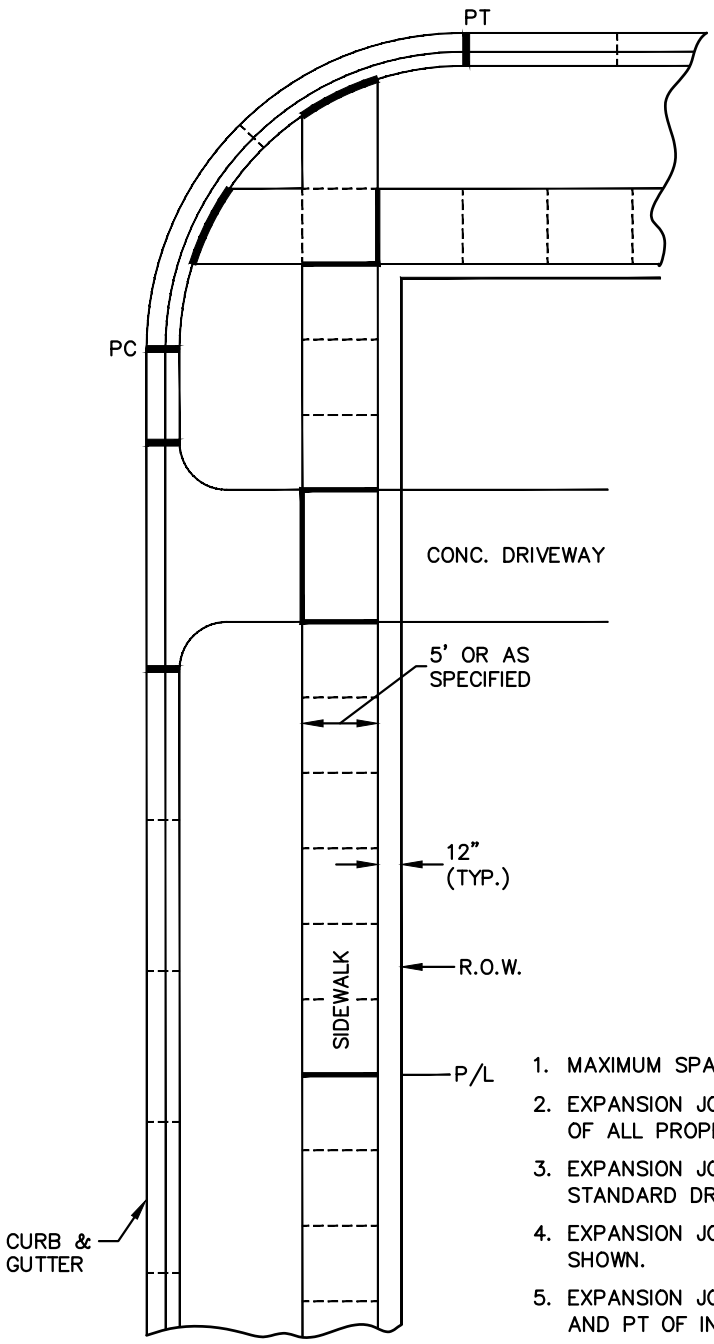
1. MINIMUM REQUIREMENT FOR DRIVE APPROACH TO BE MDOT 3500 CONCRETE.
2. R (RADIUS) AND W1 (OPENING WIDTH) AND W2 (CURB CUT WIDTH) AS REQUIRED PER TABLE A, ARTICLE 6 OF CITY STANDARDS
3. IF GUTTER IS OVERLAID, GUTTER OF THE APPROACH SHALL BE AT SAME ELEVATION AS EXISTING CONCRETE GUTTER AND ASPHALT WEDGE SHALL BE PLACED IN THE APPROACH.

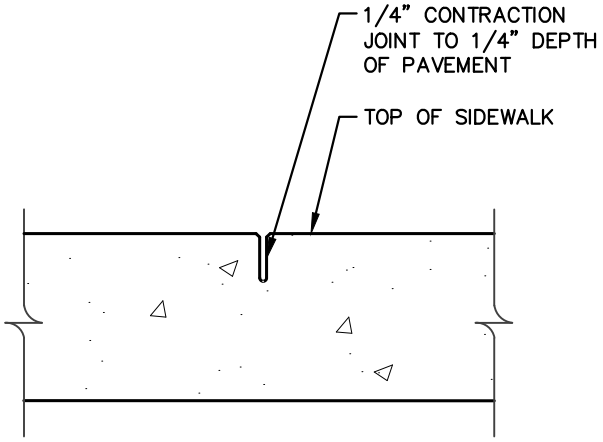
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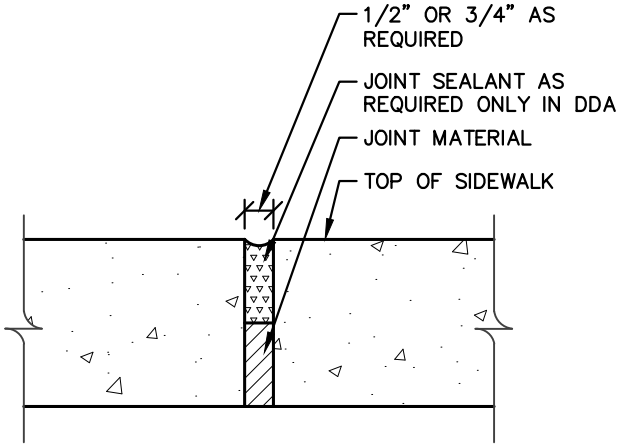
TYPE L DRIVE APPROACH FOR STREETS WITH MOUNTABLE CURB

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DS-3**





CONTRACTION JOINT



EXPANSION JOINT

LEGEND:

CONTRACTION JOINTS -------

1/2" EXPANSION JOINTS ━━━

3/4" EXPANSION JOINTS ━━━

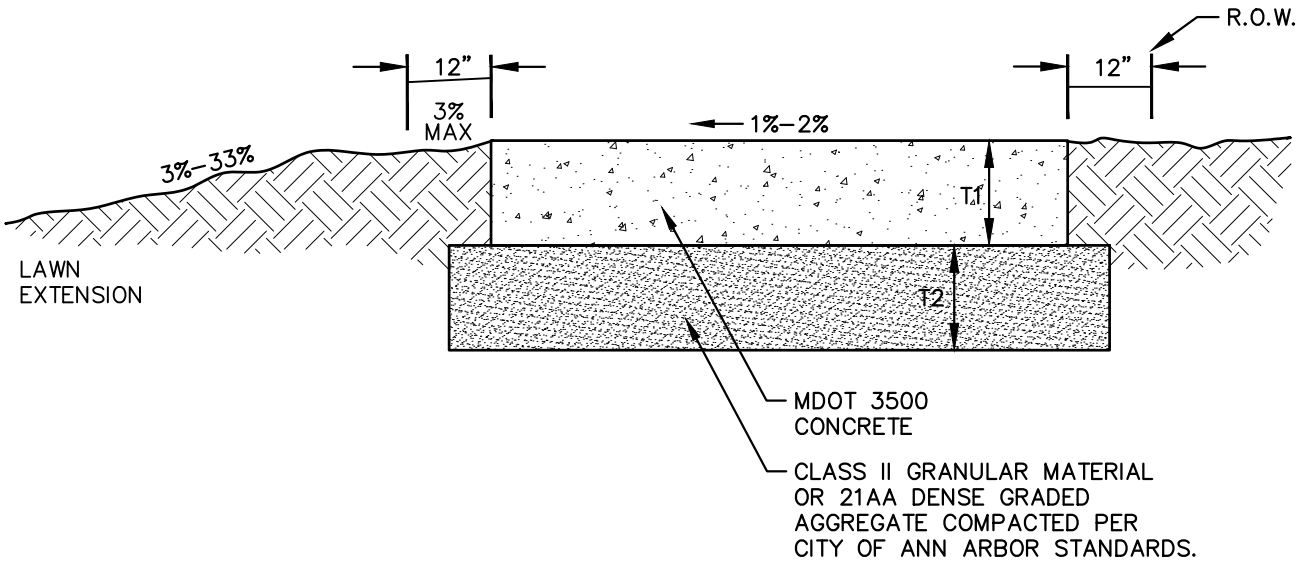
1. MAXIMUM SPACING BETWEEN ALL EXPANSION JOINTS SHALL BE 300'.
2. EXPANSION JOINTS SHALL BE PLACED IN SIDEWALKS AT THE EXTENSION OF ALL PROPERTY LINES.
3. EXPANSION JOINTS SHALL BE PLACED AT DRIVE APPROACH EDGES PER STANDARD DRIVE APPROACH DETAILS SD-DS-1 THROUGH SD-DS-3.
4. EXPANSION JOINTS SHALL BE PLACED AT SIDEWALK INTERSECTIONS AS SHOWN.
5. EXPANSION JOINTS SHALL BE PLACED IN CURB AND GUTTER AT PC AND PT OF INTERSECTION RADII.
6. WHEN SIDEWALK IS AGAINST THE BACK-OF-CURB, AN EXPANSION JOINT SHALL BE PROVIDED ALONG THE CURB.
7. CONTRACTION JOINT SPACING FOR CURB AND CURB SHALL BE 10' STANDARD AND 8' MINIMUM.
8. CONTRACTION JOINTS FOR SIDEWALKS SHALL BE PLACED AT ALL SLAB ENDS (5' TYPICAL, 3' MINIMUM TO 7' MAXIMUM).
9. DESIGN MAY UTILIZE TOOLED OR SAW-CUT CONTRACTION JOINT. PLANS MUST INDICATE SELECTION OF JOINT TYPE. PROJECT MUST HAVE EITHER JOINT TYPE, BUT NOT BOTH.
10. IF THE SIDEWALK IS 8" OR THICKER, THEN THE JOINTS NEED TO BE HAND TOOLED AND SAW-CUT.

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SIDEWALK AND CURB & GUTTER JOINTS

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DS-4**



GENERAL NOTE:

SIDEWALKS IN THE DDA SHALL BE CONSTRUCTED PER DETAILS SD–DDA–1 THROUGH SD–DDA–8.

NOTES:

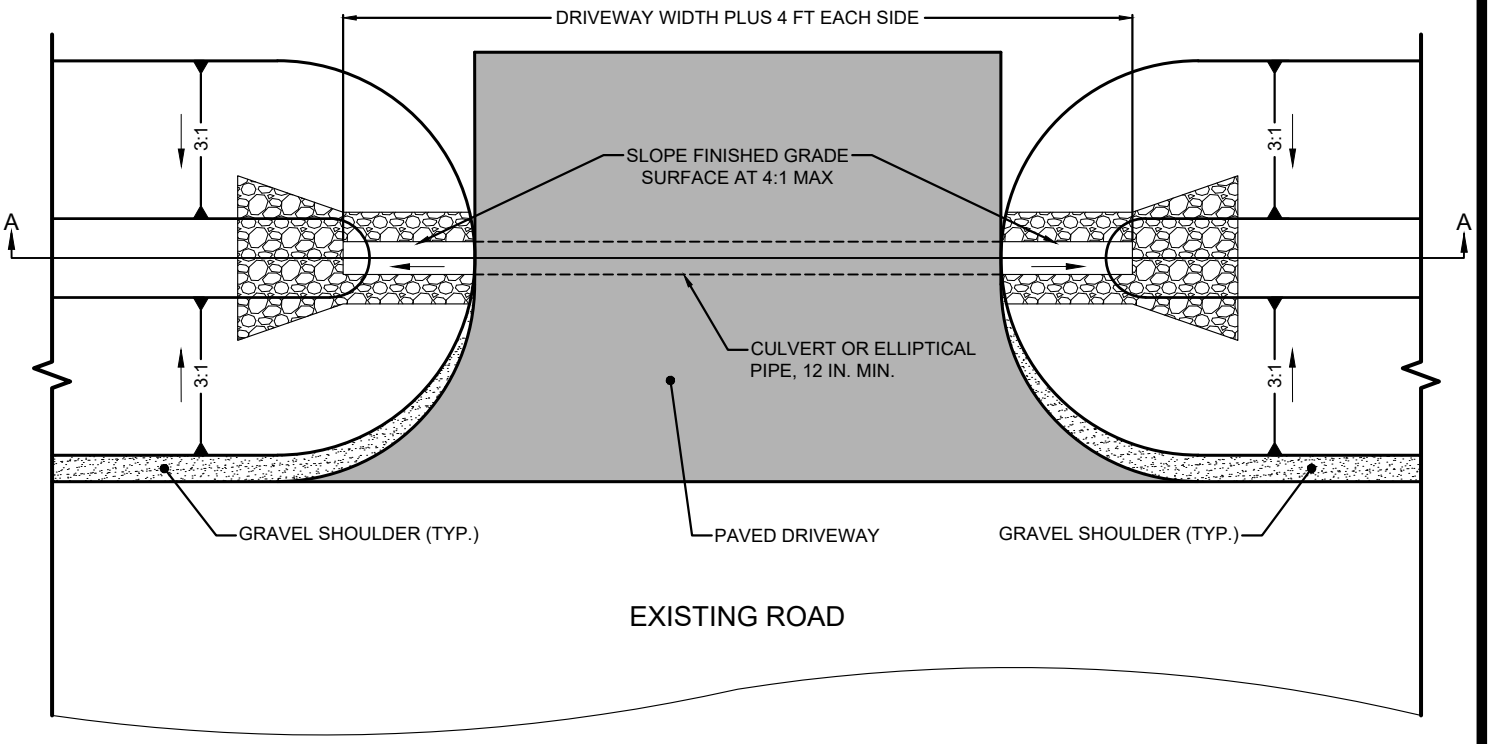
1. STANDARD SIDEWALK WIDTH SHALL BE 5'.
2. STANDARD SLAB LENGTH SHALL BE 5'.
3. MINIMUM SLAB LENGTH SHALL BE 3' AND MAXIMUM 7'.
4. MINIMUM SIDEWALK THICKNESS (T1) SHALL BE 4".
5. SIDEWALK THICKNESS (T1) SHALL BE INCREASED AT DRIVE APPROACHES TO 6" FOR SINGLE OR DUPLEX USES AND TO 8" FOR ALL OTHER USES.
6. MINIMUM BASE THICKNESS (T2) SHALL BE 4".
7. MINIMUM BASE THICKNESS (T2) SHALL BE INCREASED TO 6" AT DRIVE APPROACHES.
8. NATIVE MATERIAL IS ACCEPTABLE FOR SIDEWALK REPLACEMENT IF BASE IS STABLE AND FREE OF ORGANIC OR DELETERIOUS MATERIALS.
9. SIDEWALK RAMPS SHALL BE CONSTRUCTED AT STREET INTERSECTIONS AS DIRECTED AND SHALL COMPLY WITH THE REQUIREMENTS OF MDOT DETAIL R–28 (LATEST VERSION).
10. If SIDEWALKS ARE APPROVED TO MEANDER WITHIN THE RIGHT–OF–WAY TO PROTECT AND SAVE TREES, SLOPES, ETC., CURVES IN THE SIDEWALK SHALL HAVE A MINIMUM 5' RADIUS, WITH A MINIMUM 3' LAWN EXTENSION.
11. EXPANSION AND CONTRACTION JOINTS SHALL BE PROVIDED PER STANDARD DETAIL SD–DS–4.

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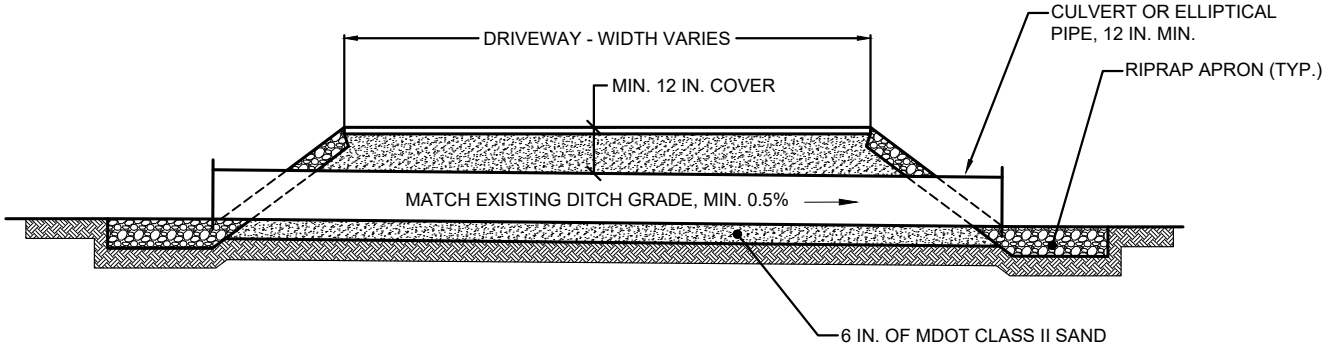
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SIDEWALK CROSS SECTION

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DS-5**



DRIVEWAY PLAN



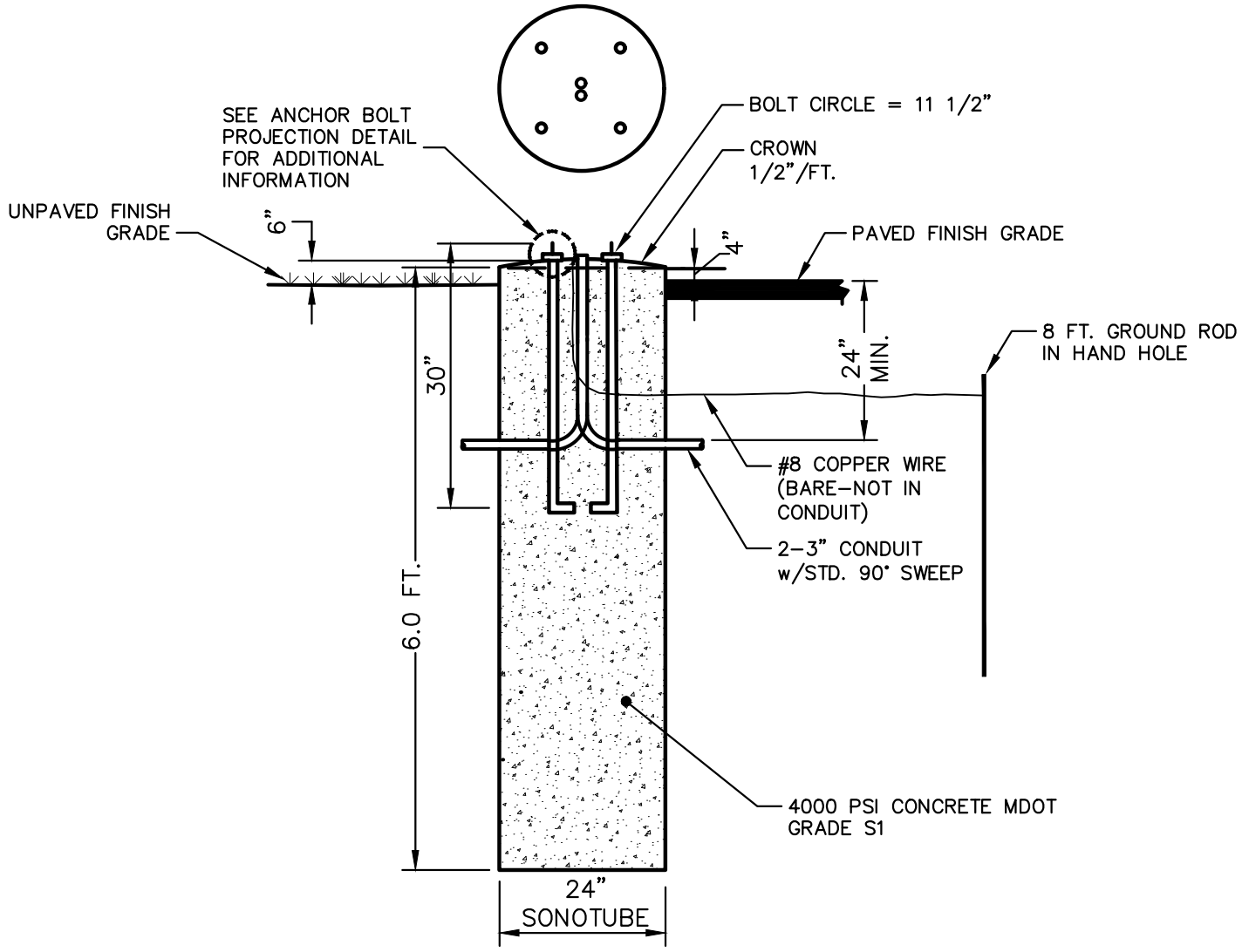
SEC. A-A

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DRIVEWAY CULVERT

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 3/26/2025	**SD-DS-6**



NOTES:

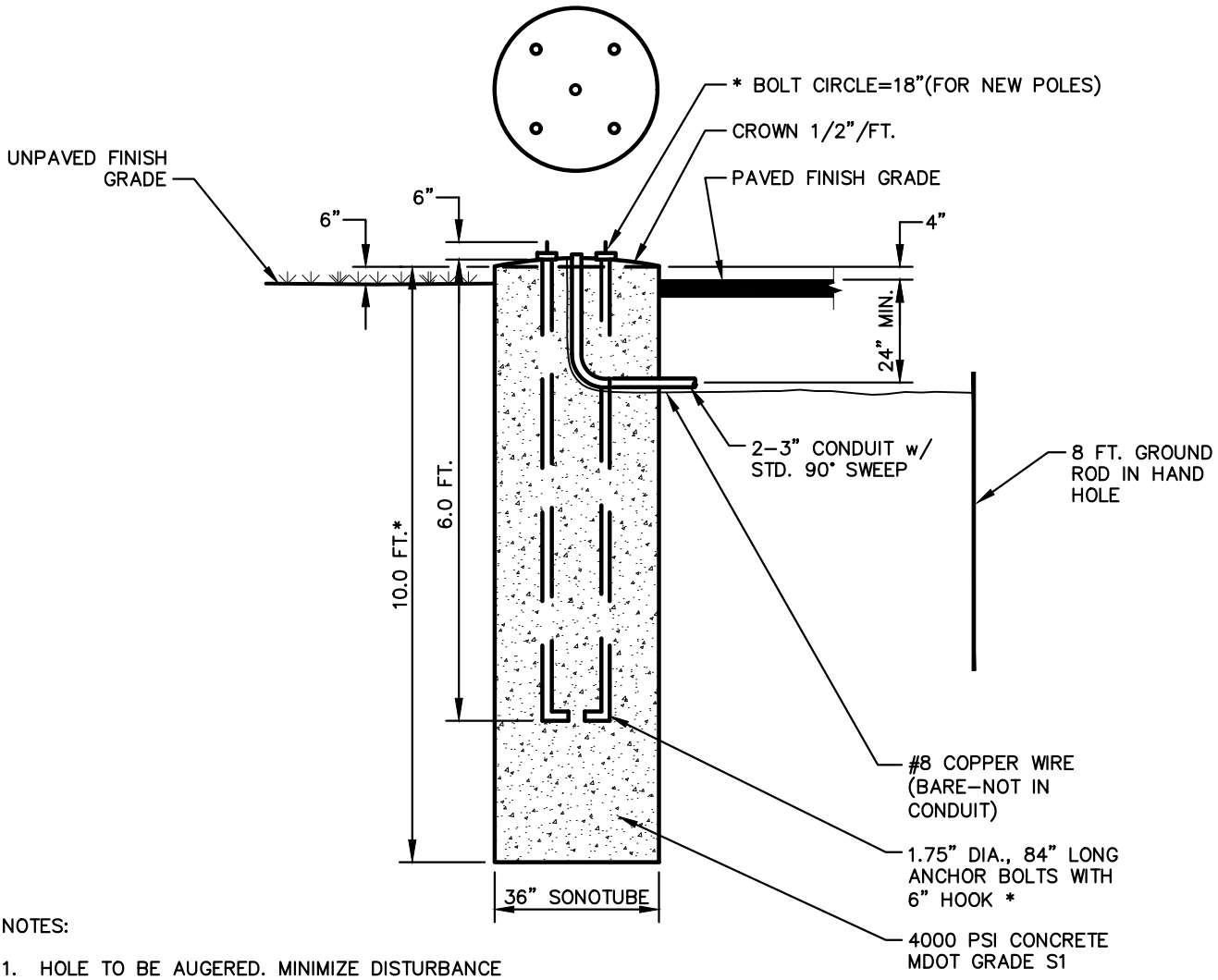
1. HOLE TO BE AUGERED. MINIMIZE DISTURBANCE OF IN–SITU SOILS DURING AUGERING.
2. CONTRACTOR TO PROVIDE PREFABRICATED ANCHOR BOLT BUILD–UP.
3. THE CITY WILL INSPECT THE AUGERED HOLE AND THE ANCHOR BOLT BUILD–UP AND PROVIDE WRITTEN APPROVAL PRIOR TO THE PLACEMENT OF CONCRETE.
4. NO WATER IS TO BE IN HOLE AT TIME OF CONCRETE PLACEMENT.
5. CONCRETE SHALL BE VIBRATED DURING PLACEMENT.
6. CONTRACTOR WILL PROVIDE NECESSARY CONDUIT FOR CONDUCTOR ENTRY.
7. COPPER CLAD GROUND ROD (1 REQUIRED) TO BE 5/8" DIA. x 8'–0".
8. CONDUIT TO EXTEND 1–2" ABOVE BASE. CABLES TO EXTEND 6" OUTSIDE OF HAND HOLE.
9. GROUND CABLE SHALL BE #8 SOFT BARE COPPER WIRE WELDED TO GROUND ROD WITH 24" SLACK ABOVE FOUNDATION TOP. THE NEUTRAL AT THE POLE IS TO BE CONNECTED TO THIS GROUND CABLE.

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REV. NO.	DATE	DRAWN BY	CHECKED BY

STREETLIGHT FOUNDATION

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-SL-1**



NOTES:

1. HOLE TO BE AUGERED. MINIMIZE DISTURBANCE OF IN-SITU SOILS DURING AUGERING.
2. CONTRACTOR TO PROVIDE PREFABRICATED ANCHOR BOLT BUILD-UP.
3. THE CITY WILL INSPECT THE AUGERED HOLE AND THE ANCHOR BOLT BUILD-UP AND PROVIDE WRITTEN APPROVAL PRIOR TO THE PLACEMENT OF CONCRETE.
4. NO WATER IS TO BE IN HOLE AT TIME OF CONCRETE PLACEMENT.
5. CONCRETE SHALL BE VIBRATED DURING PLACEMENT.
6. CONTRACTOR WILL PROVIDE NECESSARY CONDUIT FOR CABLE ENTRY. THE CONDUIT WILL NOT BE PAID FOR SEPARATELY, BUT SHALL BE INCLUDED IN THIS ITEM OF WORK.

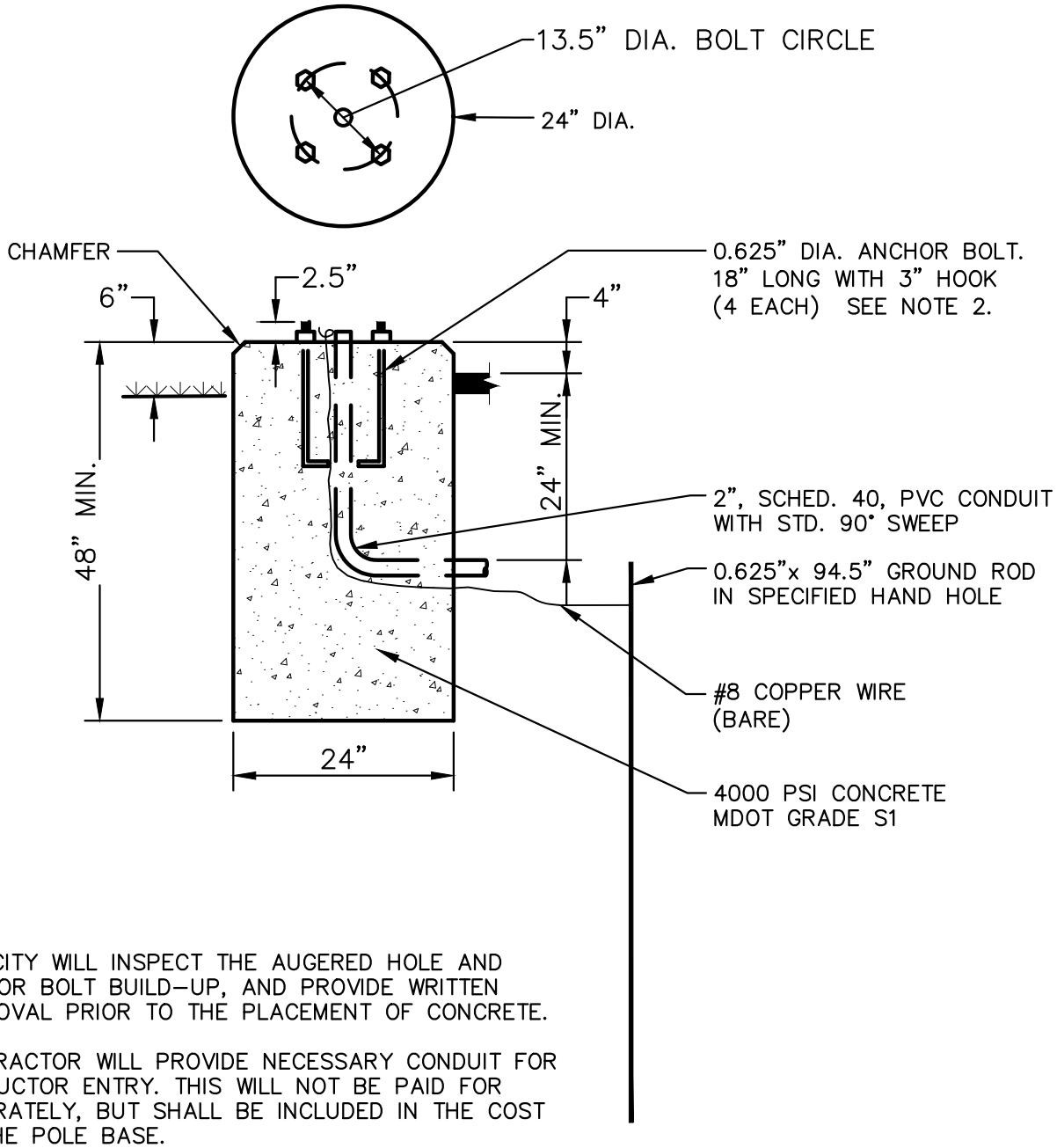
* UNLESS OTHERWISE NOTED ON THE PLANS OR CONTRACT DOCUMENTS

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REV. NO.	DATE	DRAWN BY	CHECKED BY

TRAFFIC SIGNAL POLE FOUNDATION

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-SL-2**



NOTES:

1. THE CITY WILL INSPECT THE AUGERED HOLE AND ANCHOR BOLT BUILD–UP, AND PROVIDE WRITTEN APPROVAL PRIOR TO THE PLACEMENT OF CONCRETE.

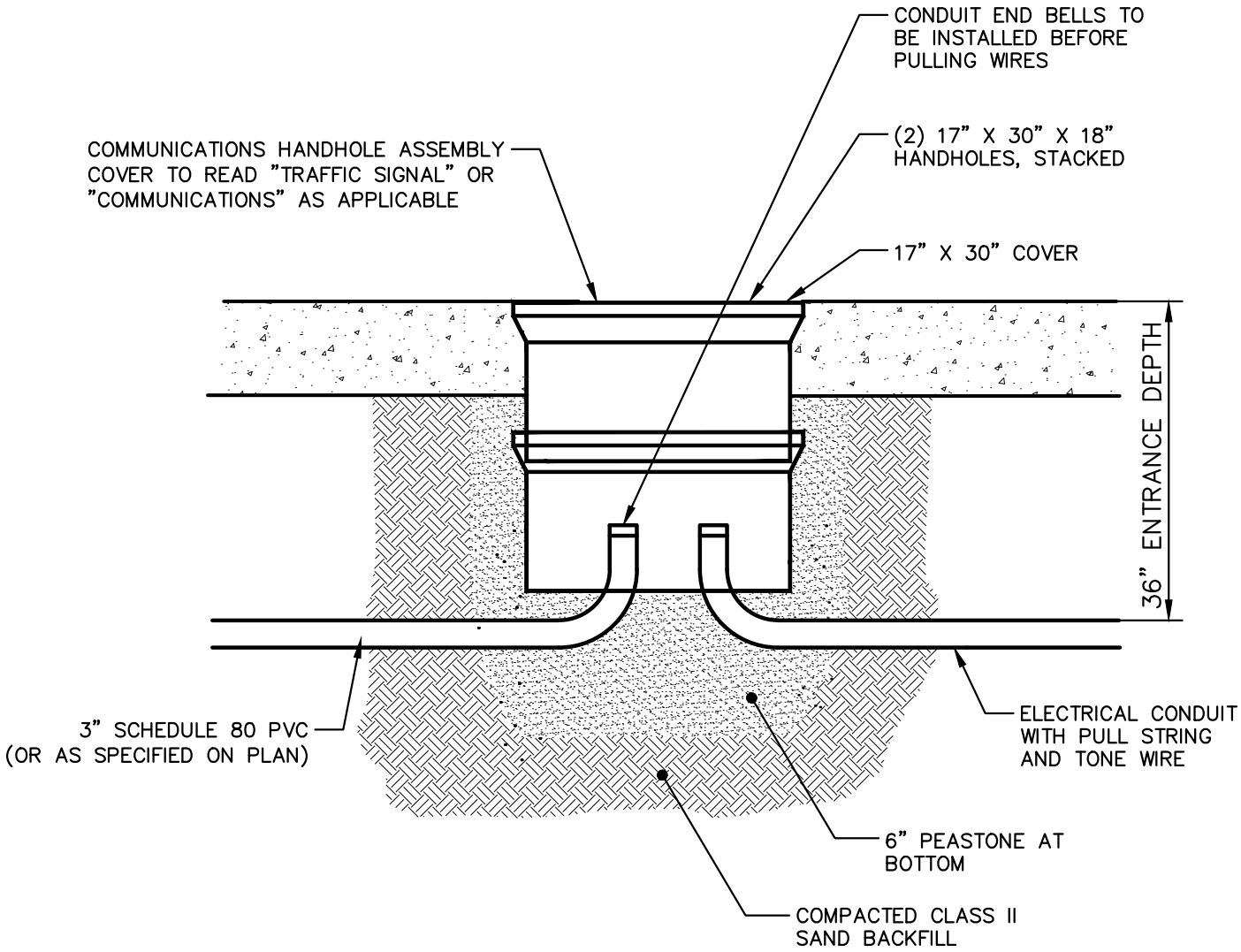
2. CONTRACTOR WILL PROVIDE NECESSARY CONDUIT FOR CONDUCTOR ENTRY. THIS WILL NOT BE PAID FOR SEPARATELY, BUT SHALL BE INCLUDED IN THE COST OF THE POLE BASE.

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PEDESTRIAN SIGNAL POLE FOUNDATION

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-SL-3**



INSTALLATION NOTE:

THE CONDUIT SHALL BE LOWERED TO A MINIMUM ENTRANCE DEPTH OF 36" BELOW TOP OF THE HANDLE OVER A DISTANCE OF 10 FT. ON EACH SIDE OF THE HANDHOLE ASSEMBLY

IF THE CONDUIT HAS TO ENTER THE HANDHOLE AT A DEPTH GREATER THAN 36" DEEP DUE TO CONFLICT, THEN 90 DEGREE SWEEPS SHALL BE PROVIDED."

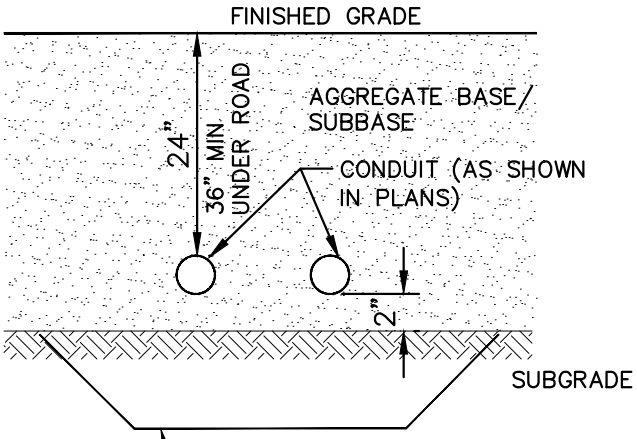
BACKFILL CONDUIT AND HANDHOLE W/CLASS II SAND. IF PLACED IN GREENBELT, PLACE 4" OF TOP SOIL.

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COMMUNICATIONS HANDHOLE ASSEMBLY

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-E-1**



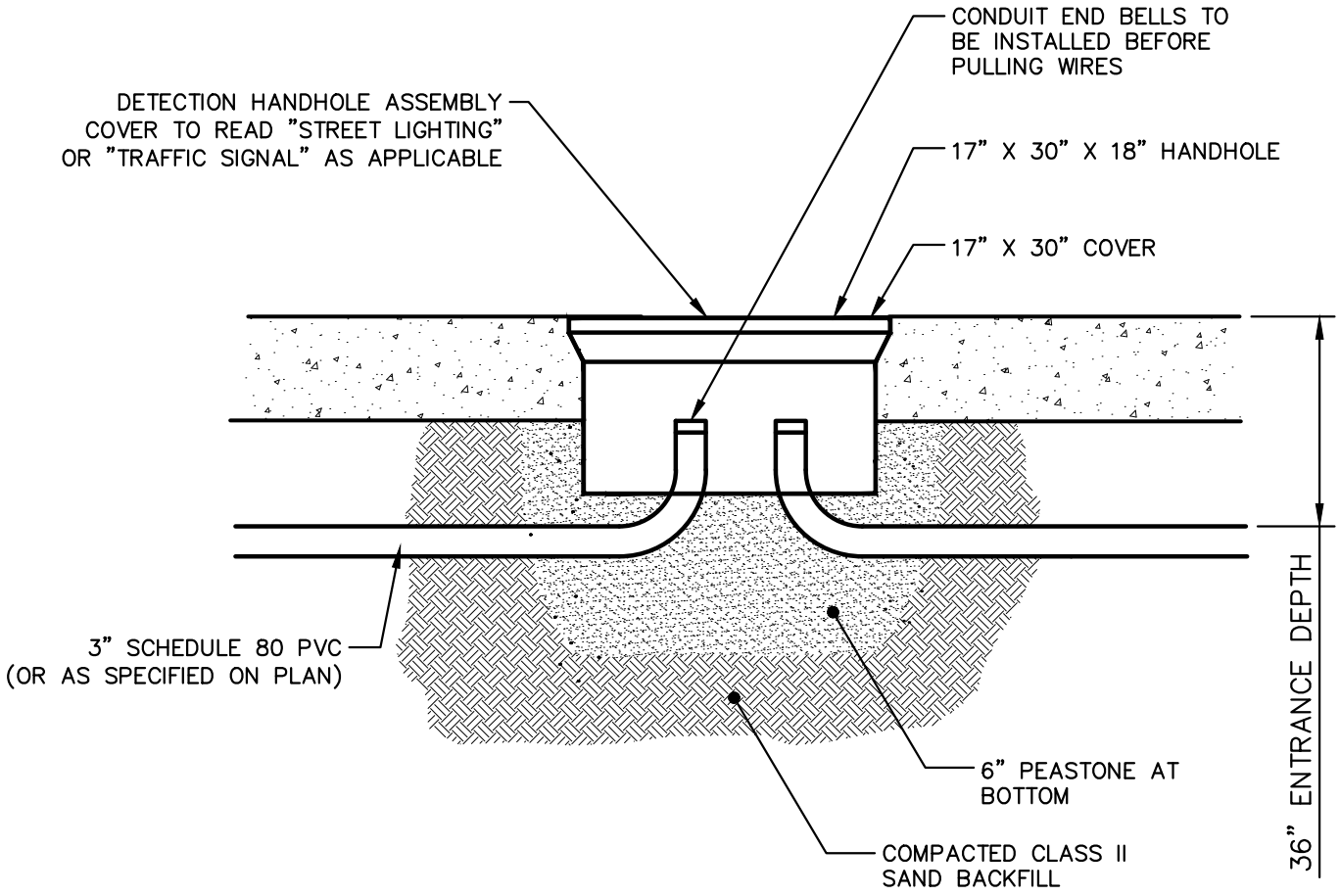
MAY REQUIRE UNDERCUTTING SUBGRADE TO MAINTAIN MINIMUM DEPTH AND 2" BEDDING. BACKFILL WITH MDOT, CL II GRANULAR MATERIAL COMPACTED TO 95% MAXIMUM DENSITY. THIS WORK SHALL BE INCLUDED IN COST OF CONDUIT IF REQUIRED AND WILL NOT BE PAID FOR SEPARATELY.

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CONDUIT PLACEMENT DETAIL

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-E-2**



INSTALLATION NOTE:

THE CONDUIT SHALL BE LOWERED TO A MINIMUM ENTRANCE DEPTH OF 36" BELOW TOP OF THE HANDLE OVER A DISTANCE OF 10 FT. ON EACH SIDE OF THE HANDHOLE ASSEMBLY

IF THE CONDUIT HAS TO ENTER THE HANDHOLE AT A DEPTH GREATER THAN 36" DEEP DUE TO CONFLICT, THEN 90 DEGREE SWEEPS SHALL BE PROVIDED."

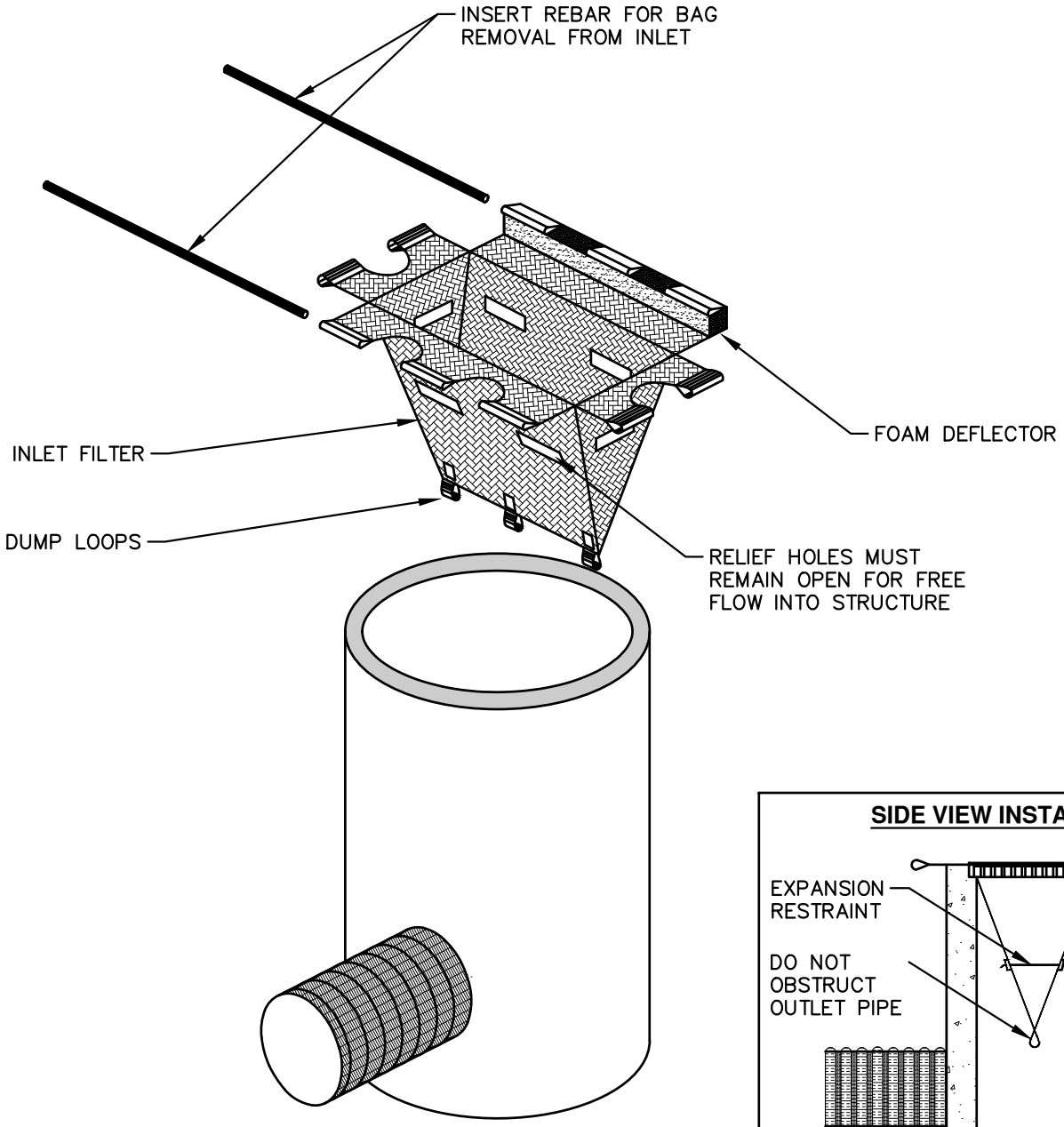
BACKFILL CONDUIT AND HANDHOLE W/CLASS II SAND. IF PLACED IN GREENBELT, PLACE 4" OF TOP SOIL.

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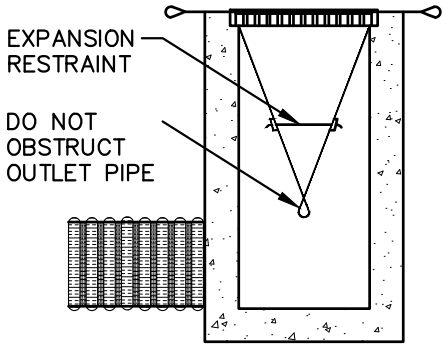
REV. NO.	DATE	DRAWN BY	CHECKED BY

ELECTRICAL HANDHOLE ASSEMBLY

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-E-3**



SIDE VIEW INSTALLED



INSTALLATION DETAIL

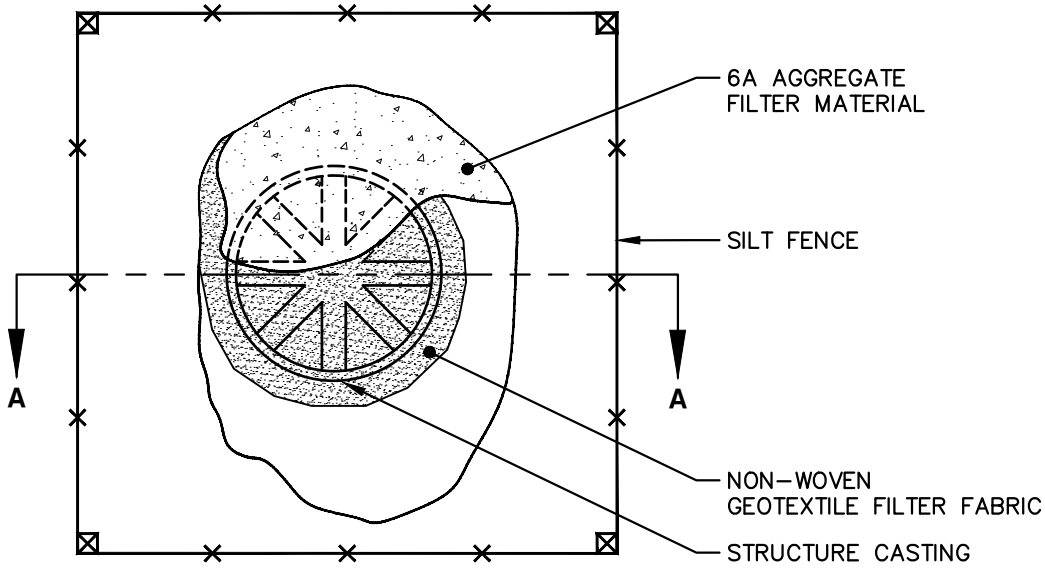
1. SIZE AND SHAPE OF INLET FILTER SHALL MATCH THE STRUCTURE.
2. WHERE CONDITIONS WARRANT, THE FILTER SHALL BE MADE WITH AN OIL–ABSORBENT FILTER WITH A WOVEN PILLOW INSERT.

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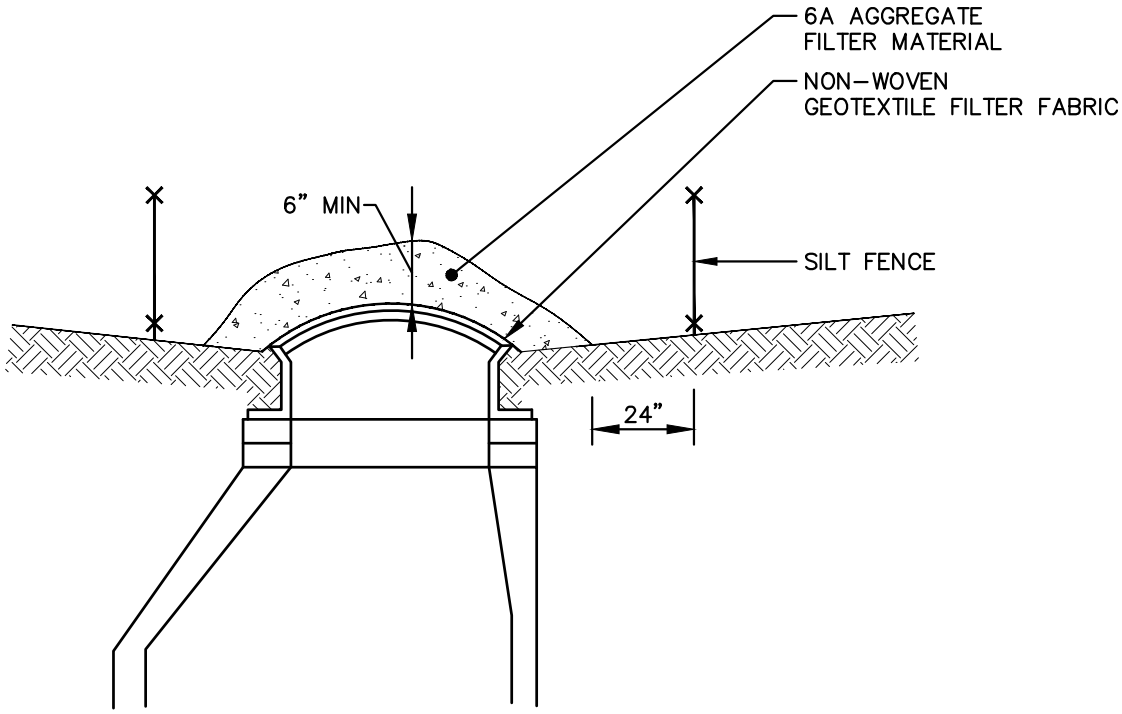
REV. NO.	DATE	DRAWN BY	CHECKED BY

INLET PROTECTION

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-SESC-1**



PLAN VIEW



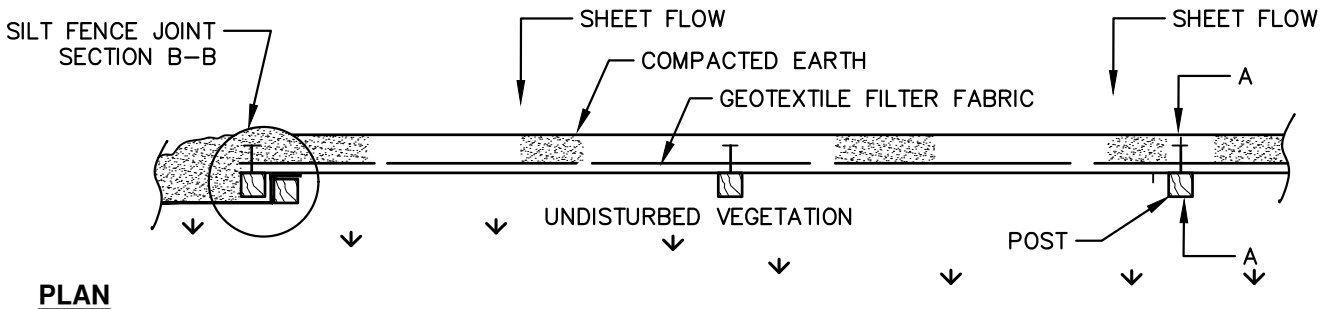
SECTION A-A

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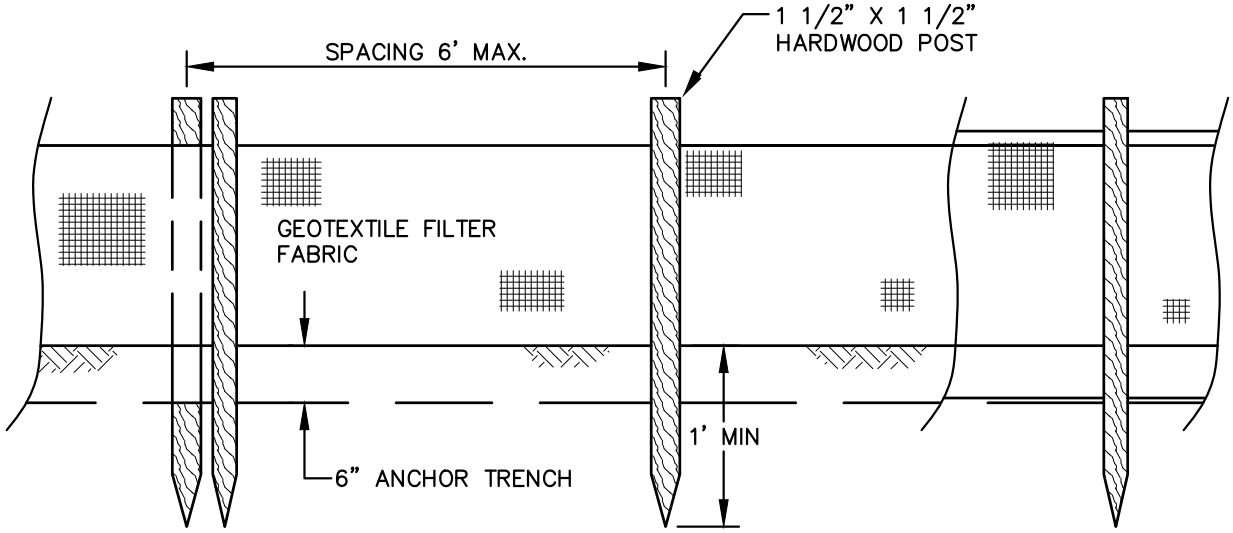
REV. NO.	DATE	DRAWN BY	CHECKED BY

STONE FILTER

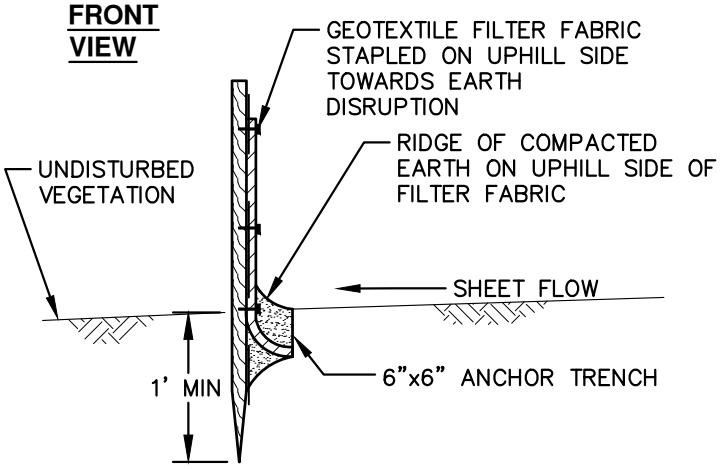
DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-SESC-2**



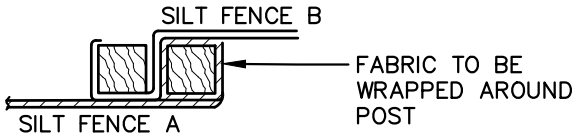
PLAN VIEW

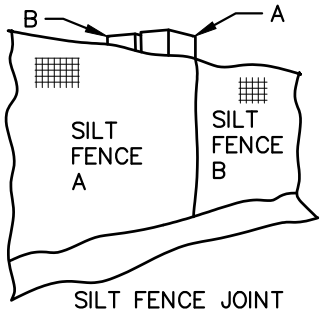


FRONT VIEW



SECTION A-A





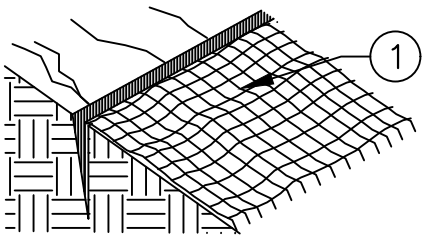
SECTION B-B

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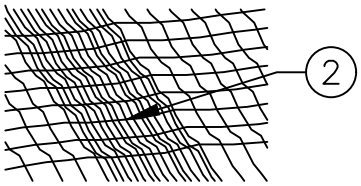
REV. NO.	DATE	DRAWN BY	CHECKED BY

SILT FENCE

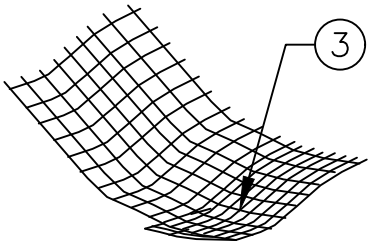
DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-SESC-3**



ANCHOR SLOT
BURY UPHILL END IN
TRENCH 6" DEEP
AND STAKE* 12" O.C.

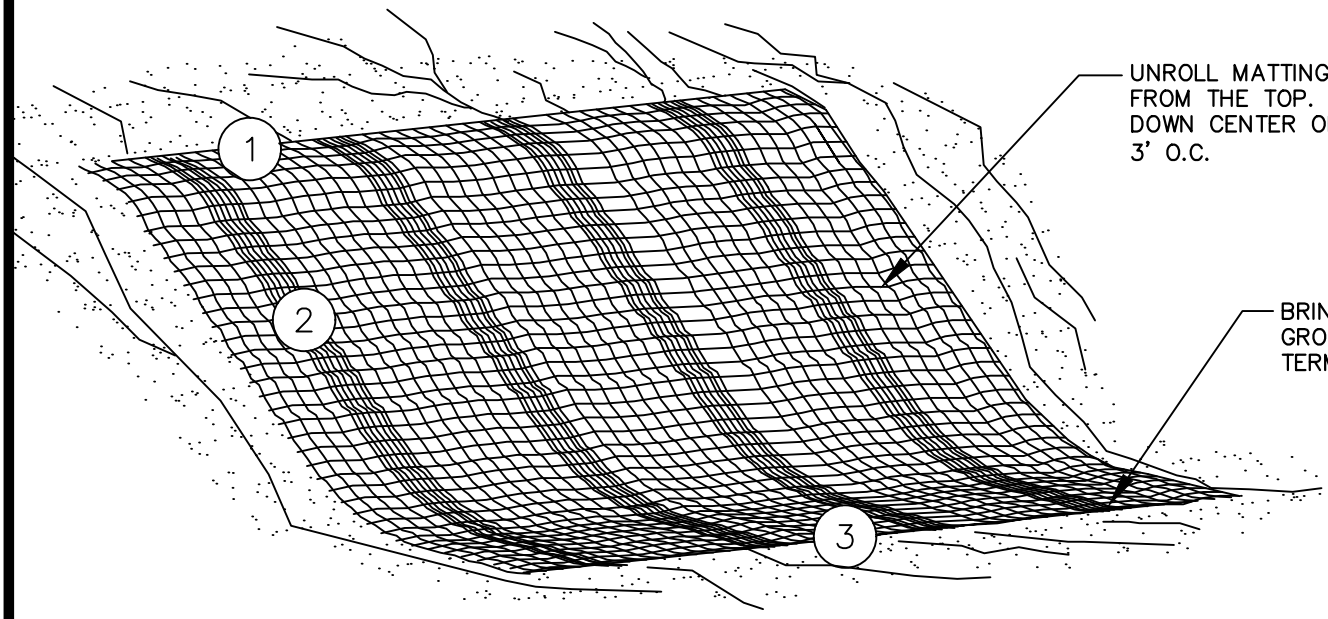


LONGITUDINAL OVERLAP
OVERLAP EDGES 6"
AND STAKE* 12" O.C.



TERMINAL FOLD
TURN END UNDER 6"
AND STAKE* 12" O.C.

*BIODEGRADABLE STAKES ARE TO BE USED
TO ANCHOR MATTING TO THE GROUND.
MINIMUM STAKE LENGTH SHALL BE 6".



NOTE:

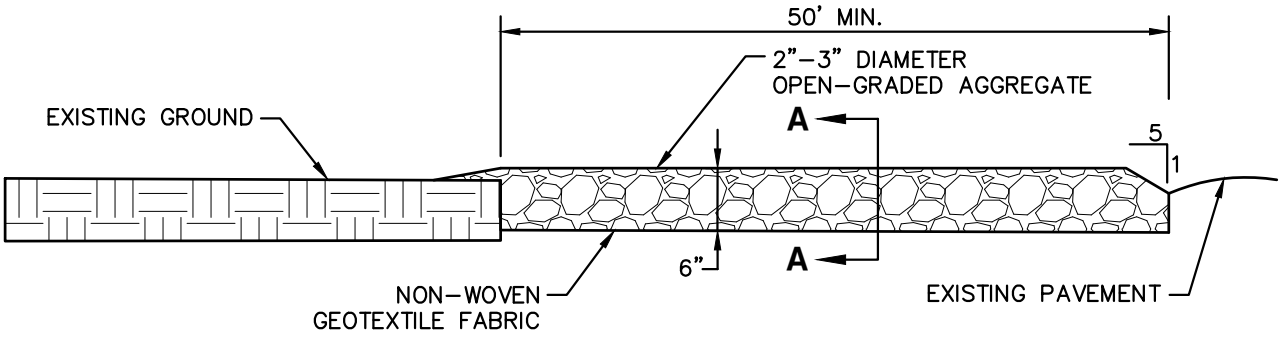
PROVIDE EROSION CONTROL MATTING ON ALL DISTURBED AREAS
TO BE PERMANENTLY RESTORED WITH GRASS AND AS DIRECTED
BY THE ENGINEER. SEE LANDSCAPE PLANS FOR MORE DETAILS.
MATERIAL SHALL BE RAPIDLY BIODEGRADABLE.
USE OF PLASTIC MATERIALS IS SPECIFICALLY PROHIBITED.

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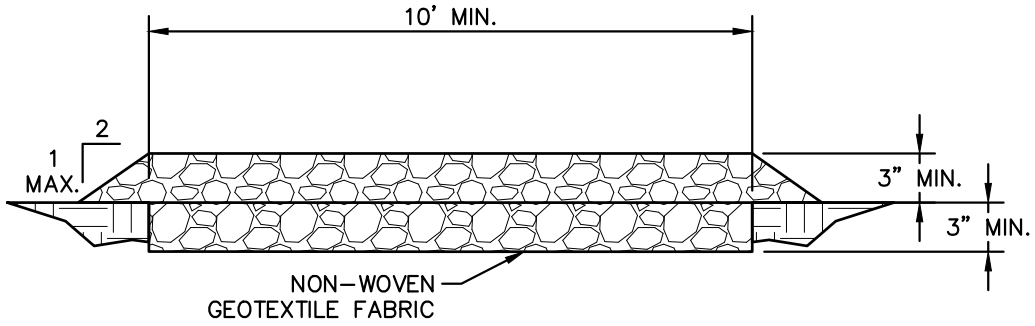
REV. NO.	DATE	DRAWN BY	CHECKED BY

MULCH BLANKET

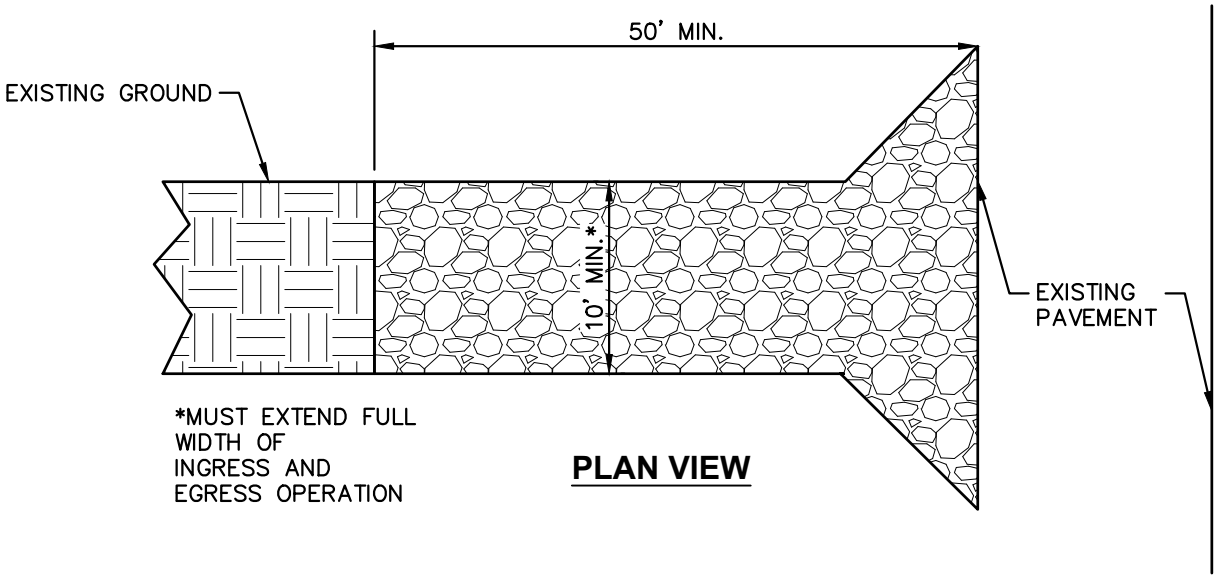
DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-SESC-4**



ELEVATION



SECTION A-A



*MUST EXTEND FULL
WIDTH OF
INGRESS AND
EGRESS OPERATION

PLAN VIEW

NOTE:

ADDITIONAL WIDTH AT CONNECTION TO EXISTING PAVEMENT SHALL BE AS NEEDED TO ACCOMMODATE VEHICLE TURNING.

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REV. NO.	DATE	DRAWN BY	CHECKED BY

MUD MAT

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	SD-SESC-5

NOTIFY THE CITY OF ANN ARBOR SOIL EROSION CONTROL OFFICE 48 HOURS PRIOR TO BEGINNING WORK ON THE PROJECT. PHONE: 734-794-6265.

1. THE CONTRACTOR SHALL IMPLEMENT AND MAINTAIN THE SOIL EROSION CONTROL MEASURES AS SHOWN ON THE PLANS AND AS DIRECTED BY THE ENGINEER AT ALL TIMES DURING CONSTRUCTION. ANY MODIFICATIONS OR ADDITIONS TO THE SOIL EROSION CONTROL MEASURES DUE TO CONSTRUCTION OR CHANGED CONDITIONS SHALL BE AS DIRECTED AND APPROVED BY THE ENGINEER.

2. ALL SOIL EROSION AND SEDIMENTATION CONTROL WORK SHALL CONFORM TO THE PERMIT REQUIREMENTS OF THE CITY OF ANN ARBOR, CHAPTER 55 ANN ARBOR UNIFIED DEVELOPMENT CODE, CITY OF ANN ARBOR STANDARDS DIVISION VII, THE LAWS OF THE STATE OF MICHIGAN, AND THE REQUIREMENTS OF THE CONTRACT DOCUMENTS.

3. DAILY, OR AFTER ANY STORM EVENT, INSPECTIONS OF EROSION CONTROL MEASURES SHALL BE MADE BY THE CONTRACTOR. PERIODIC INSPECTIONS MAY BE MADE BY THE ENGINEER TO DETERMINE THE EFFECTIVENESS OF EROSION AND SEDIMENTATION CONTROL MEASURES. ANY NECESSARY CORRECTIONS SHALL BE MADE WITHOUT DELAY, AND WITHOUT ADDITIONAL COST TO THE CITY OF ANN ARBOR.

4. EROSION AND SEDIMENTATION FROM WORK ON THE SITE SHALL BE CONTAINED ON THE SITE AND NOT BE ALLOWED TO COLLECT ON ANY OFF-SITE AREAS, ROADWAYS OR WATERWAYS.

5. ALL MUD/SOIL TRACKED ONTO ROADWAYS FROM THE SITE DUE TO CONSTRUCTION, SHALL BE PROMPTLY REMOVED BY THE CONTRACTOR. IF SO ORDERED, THE CONTRACTOR SHALL PROVIDE AND OPERATE A VACUUM-TYPE STREET SWEEPER, AT NO ADDITIONAL COST TO THE CITY OF ANN ARBOR.

6. RESTORATION OF ALL DISTURBED AREAS, INCLUDING PLACEMENT OF TOPSOIL, SEED, FERTILIZER AND MULCH AND/OR SOD SHALL BE PERFORMED WITHIN FIVE (5) DAYS OF THE COMPLETION OF FINAL GRADE EXCEPT WHERE TEMPORARY SEEDING OR AN ANCHORED MULCH BLANKET ARE SET FORTH AS TEMPORARY MEASURES PER THE APPROVED SEQUENCE OF SOIL EROSION MEASURES.

7. CONSTRUCTION OPERATIONS SHALL BE SCHEDULED AND PERFORMED SO THAT PREVENTATIVE SOIL EROSION CONTROL MEASURES ARE IN PLACE PRIOR TO EXCAVATION IN CRITICAL AREAS AND TEMPORARY STABILIZATION MEASURES ARE IN PLACE IMMEDIATELY FOLLOWING BACKFILLING OPERATIONS.

8. SPECIAL PRECAUTIONS WILL BE TAKEN IN THE USE OF CONSTRUCTION EQUIPMENT TO PREVENT SITUATIONS THAT PROMOTE EROSION.

9. PROPER DUST CONTROL SHALL BE MAINTAINED DURING CONSTRUCTION BY USE OF WATER TRUCKS AND/OR DUST PALLIATIVE AS REQUIRED.

10. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ALL TEMPORARY SOIL EROSION CONTROL MEASURES AND REMOVAL OF SOME MEASURES UPON AUTHORIZED COMPLETION OF THE PROJECT. FINAL COMPLETION OF PROJECT WILL NOT BE AUTHORIZED UNTIL ALL SITE WORK AND UTILITY CONSTRUCTION IS COMPLETE AND ALL SOILS ARE STABILIZED.

11. THE CONTRACTOR SHALL NOT GRADE INTO ADJACENT PROPERTIES. SILT AND PROTECTIVE FENCE SHALL BE INSTALLED AND MAINTAINED TO PREVENT GRADING, EROSION AND SEDIMENTATION INTO THE ADJACENT PROPERTIES.

12. TREE PROTECTION FENCING MUST REMAIN INTACT UNTIL RESTORATION OF THE SITE IS COMPLETE.

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STANDARD SOIL EROSION AND SEDIMENTATION CONTROL NOTES

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-SESC-6**

SEQUENCE OF EROSION CONTROL MEASURES:

1. THE CONTRACTOR IS TO SUBMIT TO THE ENGINEER, A SEQUENCE OF CONSTRUCTION WITH RESPECT TO THE SOIL EROSION CONTROL MEASURES FOR REVIEW, COMMENT AND APPROVAL. THIS SCHEDULE IS TO INCLUDE INSPECTION AND REPAIR OF ALL TEMPORARY EROSION CONTROL MEASURES DAILY AND WITHIN 24 HOURS OF A STORM EVENT.

SAMPLE SOIL EROSION AND SEDIMENTATION CONTROL INSTALLATION MINIMUM REQUIREMENTS:

1.1. INSTALL SILT FENCE, TREE PROTECTION FENCING, MUD MATS, INLET FILTERS ON EXISTING DRAINAGE FEATURES, AND ALL OTHER TEMPORARY SOIL EROSION CONTROLS, PRIOR TO ANY CLEARING OR EARTH MOVING OPERATION.

1.2. STRIP AND STOCKPILE TOPSOIL. STABILIZE STOCKPILE AS REQUIRED.

1.3. INSTALL WATER MAINS, STORM AND SANITARY SEWERS, AND OTHER ENCLOSED DRAINAGE FEATURES. NEW INLET FILTERS SHALL BE INSTALLED IMMEDIATELY FOLLOWING INSTALLATION OF NEW DRAINAGE INLETS.

1.4. PERFORM MACHINE GRADING OPERATIONS AND CONSTRUCT PAVEMENTS (MAINLINE, SIDEWALKS, DRIVES, ETC.).

1.5. CONTINUALLY MAINTAIN EROSION AND SEDIMENTATION CONTROL MEASURES, AS REQUIRED TO ALLOW DRAINAGE AND SEDIMENT REMOVAL. REMOVE ANY ACCUMULATED SEDIMENT IMMEDIATELY.

1.6. COMPLETE ALL FINE GRADING.

1.7. INSTALL TEMPORARY SEED DURING CONSTRUCTION IN ACCORDANCE WITH ARTICLE 8 OF THE CITY'S PUBLIC WORKS DESIGN AND CONSTRUCTION STANDARDS. DURING MONTHS UNFAVORABLE TO SEEDING, AN ANCHORED MULCH BLANKET SHALL BE INSTALLED PER SD–SESC–4.

1.8. REFER TO LANDSCAPE PLANTING PLANS FOR PERMANENT SITE STABILIZATION.

1.9. CLEAN OUT STORM SEWER SYSTEMS.

1.10. REMEDY ANY NOTED DEFECTS TO THE SATISFACTION OF THE CITY OF ANN ARBOR'S SOIL EROSION AND SEDIMENTATION CONTROL OFFICIAL.

1.11. ALL TEMP. SOIL EROSION CONTROL MEASURES MUST BE REMOVED, WITH ENGINEERS APPROVAL, PRIOR TO FINAL INSPECTION

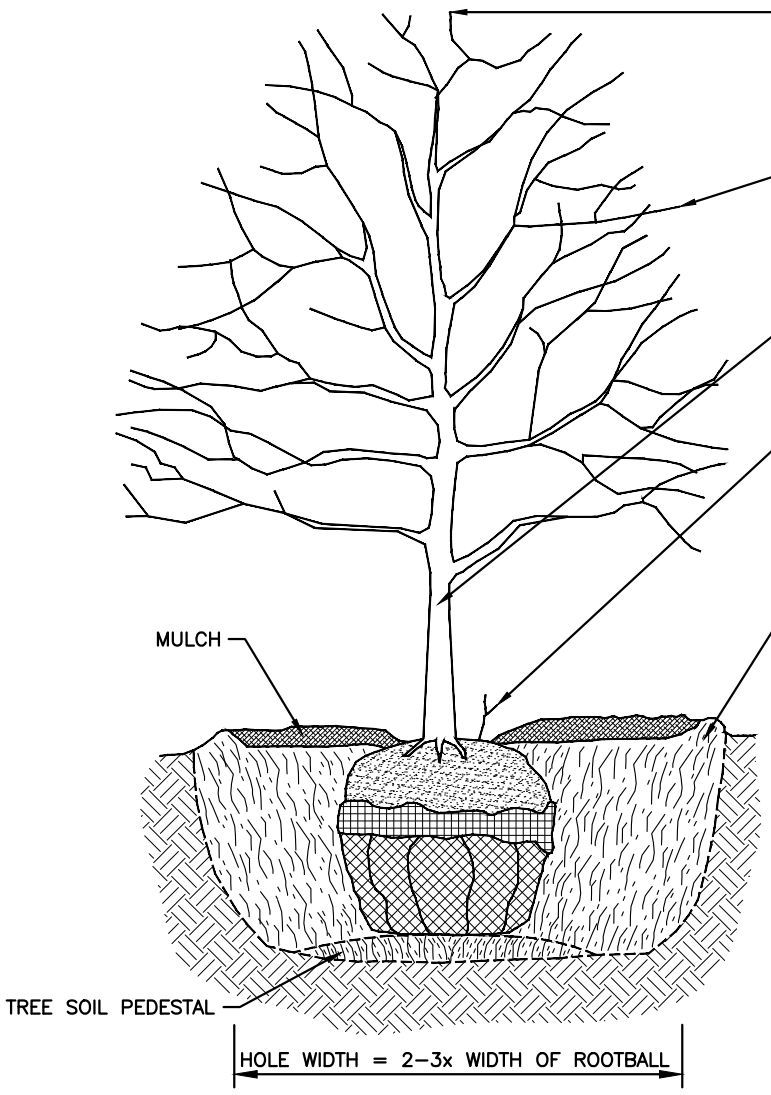
NOTE: THIS SEQUENCE IS FOR INFORMATION ONLY. IT IS INTENDED TO SHOW THE SEQUENCE OF CONSTRUCTION WITH RESPECT TO THE SOIL EROSION AND SEDIMENTATION CONTROL MEASURES. THE CONTRACTOR IS RESPONSIBLE FOR SUBMITTING THEIR OWN DETAILED CONSTRUCTION SEQUENCE AND SCHEDULE TO THE ENGINEER FOR REVIEW, COMMENT, AND APPROVAL. THE APPROVED SEQUENCE OF SOIL EROSION MEASURES MUST BE INCLUDED ON THE APPROVED CONSTRUCTION PLANS.

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SEQUENCE OF SOIL EROSION CONTROL MEASURES

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EXCAVATE HOLE TO TWO TO THREE TIMES THE WIDTH OF ROOTBALL.

BREAK UP (SCARIFY) SIDES OF PLANTING HOLE.

COMPACT SOIL AT BOTTOM OF HOLE TO CREATE A TREE PEDESTAL AS SHOWN.

BEFORE SETTING TREE IN HOLE, EXPOSE THE TRUNK FLARE BY REMOVING BURLAP AROUND TRUNK AND PULLING BACK SOIL.

SET AND CENTER ROOTBALL SO THAT TRUNK FLARE IS LEVEL TO GRADE OR VERY SLIGHTLY HIGHER IN CLAY SOIL.

WITHOUT DISTURBING DEVELOPED ROOTS, FOLD DOWN AND REMOVE ONE–THIRD TO ONE–HALF OF BURLAP TO EXPOSE ROOTBALL.

REMOVE AND DISPOSE OF ALL NON–BIODEGRADABLE MATERIALS, CUTTING AWAY WIRE BASKET TO 10" DEPTH.

BACKFILL HOLE WITH EXCAVATED SOIL, TAMP DOWN SOIL TO REMOVE AIR POCKETS, AND FIRMLY SET TREE. DO NOT AMEND SOIL UNLESS PLANTING IN SEVERELY DISTURBED SOIL.

PLACE DOUBLE–SHREDDED HARDWOOD MULCH 2"–3" DEEP LEAVING A 3" RADIUS CIRCLE OF BARE SOIL AROUND TRUNK OF TREE.

DO NOT STAKE TREE UNLESS PERMITTED PER DETAIL SD–L–2.

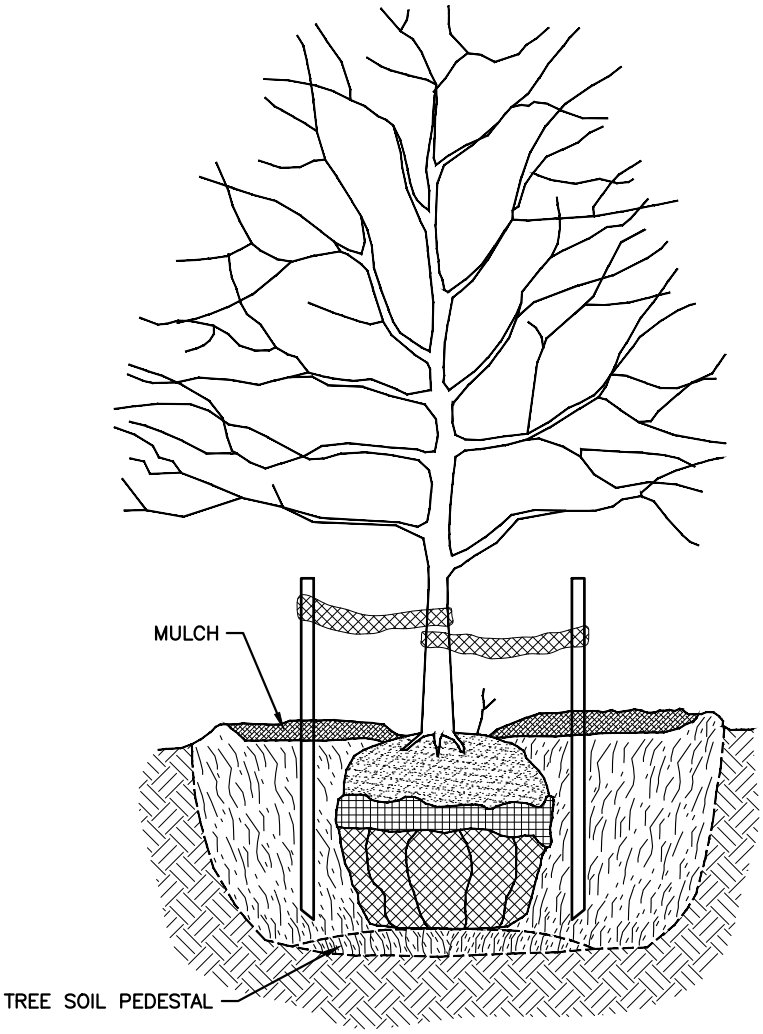
NO UTILITIES SHALL BE PERMITTED IN OR UNDER THE PLANTING HOLE EXCEPT WHERE TREE TUNNELING IS PERMITTED PER SD–L–4.

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REV. NO.	DATE	DRAWN BY	CHECKED BY

TREE PLANTING

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-L-1**



TREE STAKING IS ONLY PERMITTED UNDER ONE OR MORE OF THE FOLLOWING CIRCUMSTANCES:

1) IN HEAVY CLAY SOIL
2) IN WINDY CONDITIONS
3) 3" OR GREATER DIAMETER TREE TRUNK
4) TREE WITH LARGE CROWN

IF STAKING IS NEEDED DUE TO THESE CONDITIONS:

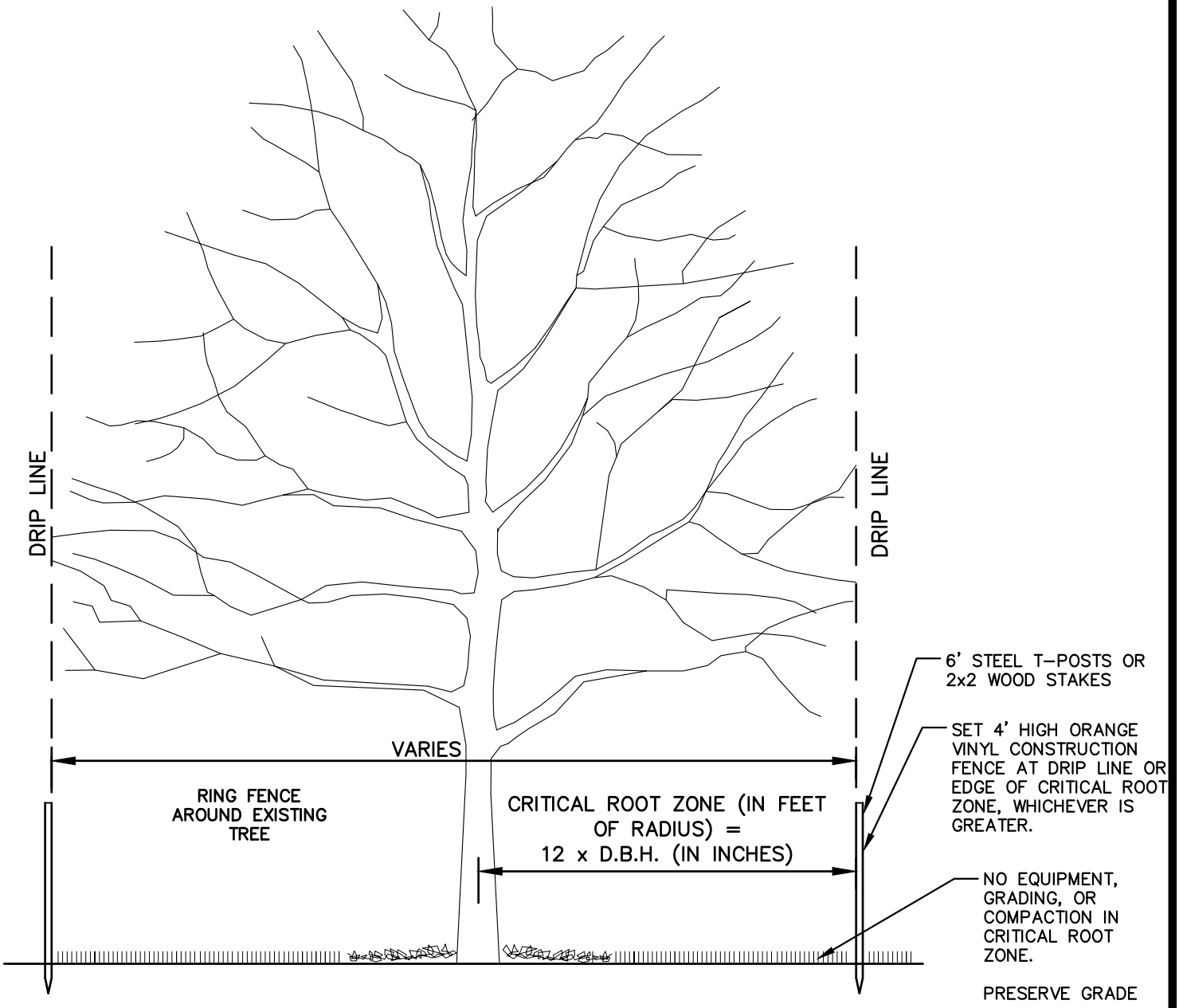
- STAKE WITH 2 x 2 HARDWOOD STAKES, OR APPROVED EQUAL, DRIVEN 6"–8" OUTSIDE OF ROOTBALL.
- LOOSELY STAKE TREE TRUNK TO ALLOW FOR TRUNK FLEXING.
- STAKE TREES JUST BELOW FIRST BRANCH WITH 2"–3" WIDE BELT–LIKE NYLON OR PLASTIC STRAPS (2 PER TREE ON OPPOSITE SIDES OF TREE).
- CONNECT STRAPS FROM TREE TO STAKE HORIZONTALLY.
- DO NOT USE ROPE OR WIRE THROUGH A HOSE.
- REMOVE ALL STAKING MATERIALS AFTER 1 YEAR.

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TREE STAKING

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-L-2**

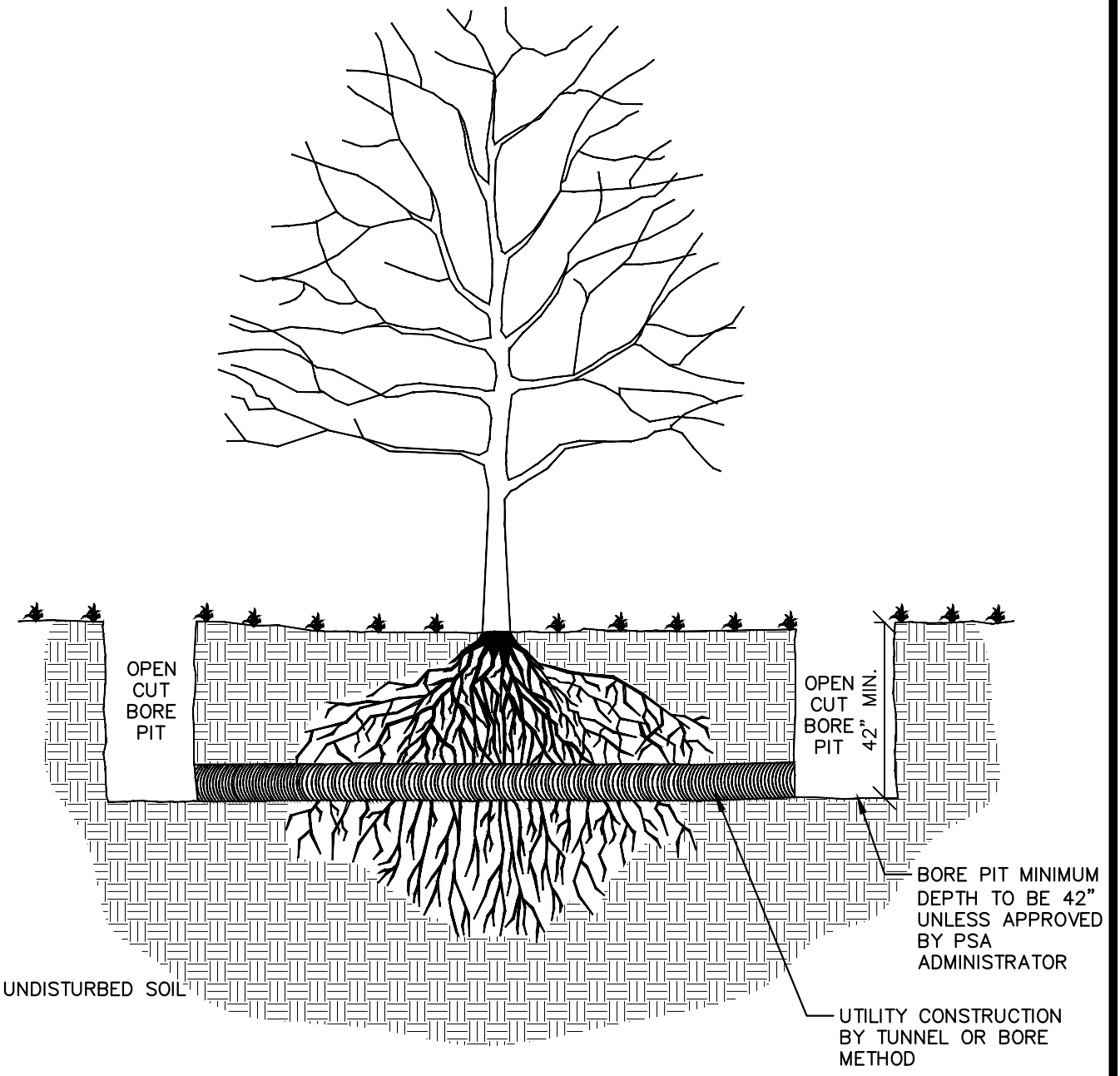


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REV. NO.	DATE	DRAWN BY	CHECKED BY

TREE PROTECTION

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-L-3**



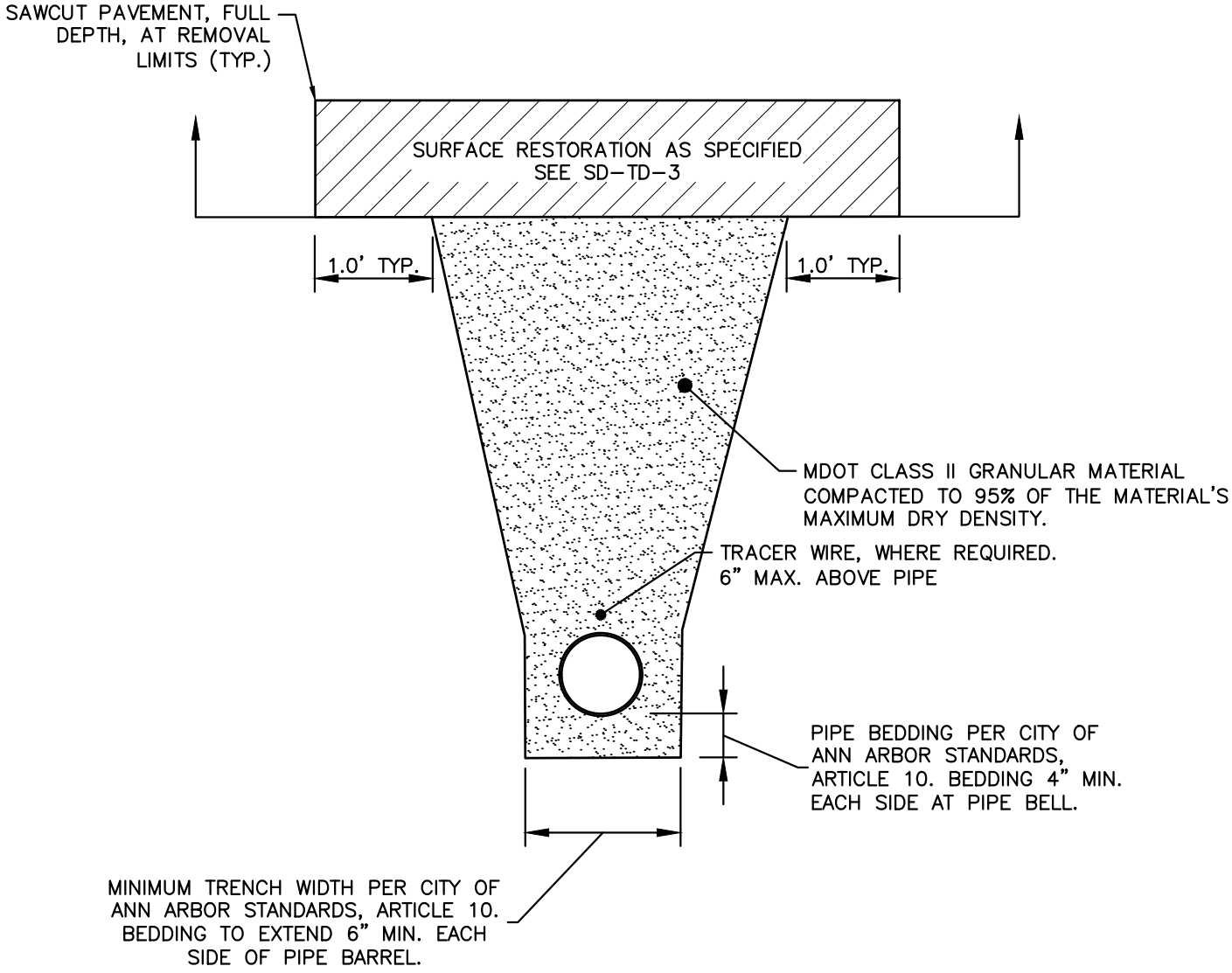
NOTE: IN ALL CASES, THE OPEN CUT BORE PIT SHALL BE LOCATED 1' BEYOND THE CRITICAL ROOT ZONE (SEE SD–L–3)

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REV. NO.	DATE	DRAWN BY	CHECKED BY

TREE TUNNELLING

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-L-4**



NOTES:

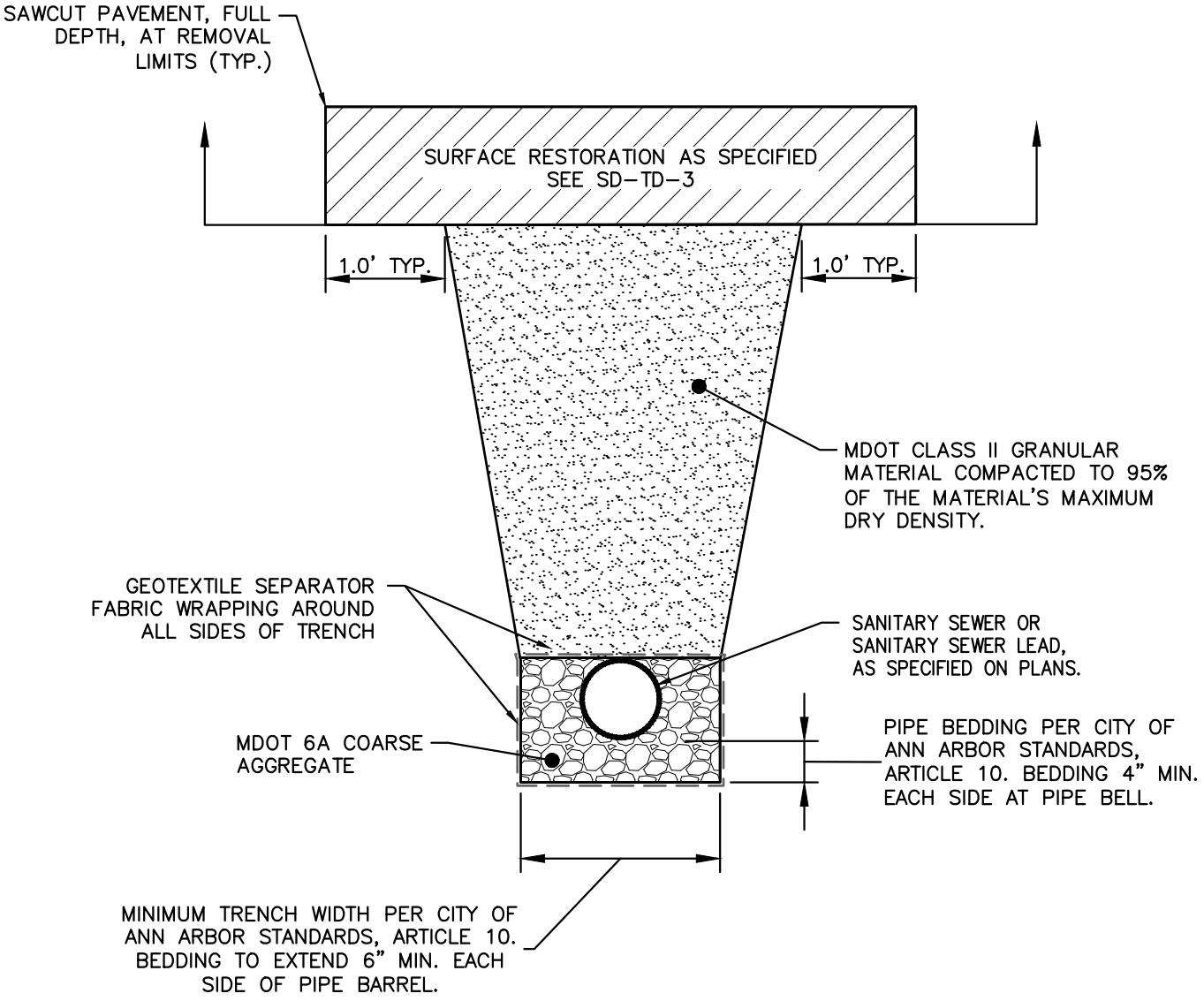
1. ALL TRENCH EXCAVATION, BEDDING, BACKFILLING, AND SURFACE RESTORATION SHALL COMPLY WITH CITY OF ANN ARBOR STANDARDS, ARTICLE 10.
2. TRENCH DETAILS SHOW TYPE OF BACKFILL AND TRENCHING REQUIREMENTS ONLY.
3. ALL TRENCHING TO CONFORM TO ALL APPLICABLE M.I.O.S.H.A. AND CITY STANDARDS.
4. PIPE BEDDING THICKNESS UNDER CONCRETE PIPE 66" OR LARGER SHALL BE INCREASED TO 6".
5. SEE SD-TD-2 FOR SANITARY BEDDING AREA DETAIL. SEE SD-TD-4 FOR EDGE DRAIN BEDDING AND BACKFILL.
6. SURFACE RESTORATION SHALL NOT BE INCLUDED IN THE UNIT PRICE FOR PIPE AND WILL BE PAID FOR SEPARATELY.
7. NOT TO BE USED FOR SANITARY SEWER OR EDGE DRAIN.

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00	10/17/2024	A2D	SSORT

UTILITY TRENCH - TYPE 1

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-TD-1**



NOTES:

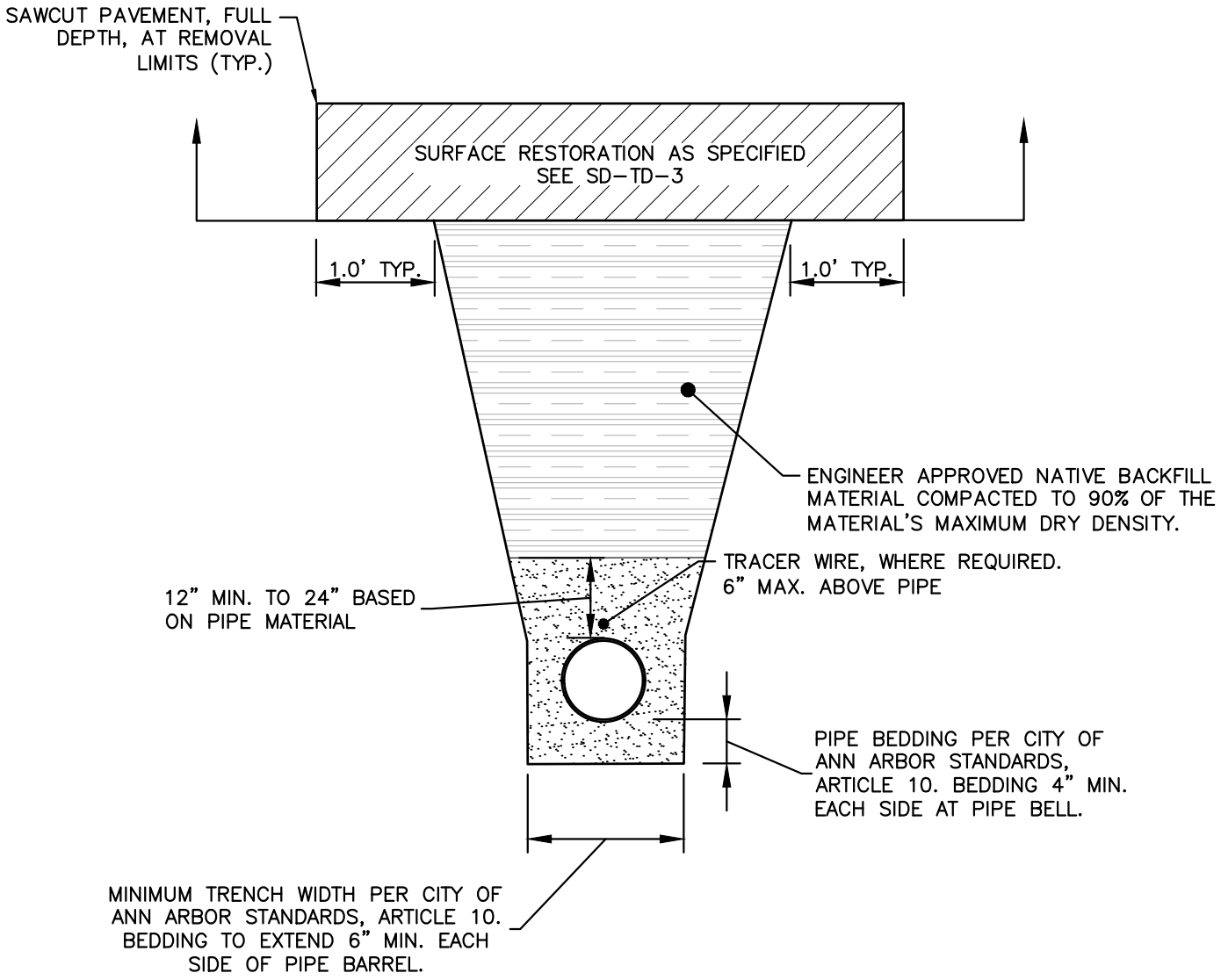
1. ALL TRENCH EXCAVATION, BEDDING, BACKFILLING, AND SURFACE RESTORATION SHALL COMPLY WITH CITY OF ANN ARBOR STANDARDS, ARTICLE 10.
2. TRENCH DETAILS SHOW TYPE OF BACKFILL AND TRENCHING REQUIREMENTS ONLY.
3. ALL TRENCHING TO CONFORM TO ALL APPLICABLE M.I.O.S.H.A. AND CITY STANDARDS.
4. PIPE BEDDING THICKNESS UNDER CONCRETE PIPE 66" OR LARGER SHALL BE INCREASED TO 6".
5. SEE SD-TD-4 FOR EDGE DRAIN BEDDING AND BACKFILL DETAILS.
6. SURFACE RESTORATION SHALL NOT BE INCLUDED IN THE UNIT PRICE FOR PIPE AND WILL BE PAID FOR SEPARATELY.

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REV. NO.	DATE	DRAWN BY	CHECKED BY

UTILITY TRENCH - TYPE 2

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-TD-2**



NOTES:

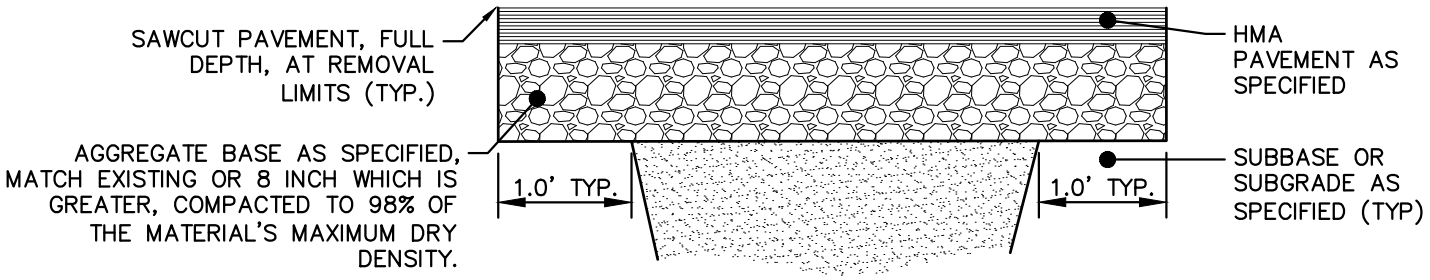
1. ALL TRENCH EXCAVATION, BEDDING, BACKFILLING, AND SURFACE RESTORATION SHALL COMPLY WITH CITY OF ANN ARBOR STANDARDS, ARTICLE 10.
2. TRENCH DETAILS SHOW TYPE OF BACKFILL AND TRENCHING REQUIREMENTS ONLY.
3. ALL TRENCHING TO CONFORM TO ALL APPLICABLE M.I.O.S.H.A. AND CITY STANDARDS.
4. PIPE BEDDING THICKNESS UNDER CONCRETE PIPE 66" OR LARGER SHALL BE INCREASED TO 6".
5. SEE SD-TD-2 FOR SANITARY BEDDING AREA DETAIL. SEE SD-TD-4 FOR EDGE DRAIN BEDDING AND BACKFILL.
6. SURFACE RESTORATION SHALL NOT BE INCLUDED IN THE UNIT PRICE FOR PIPE AND WILL BE PAID FOR SEPARATELY.
7. NOT TO BE USED FOR SANITARY SEWER OR EDGE DRAIN.

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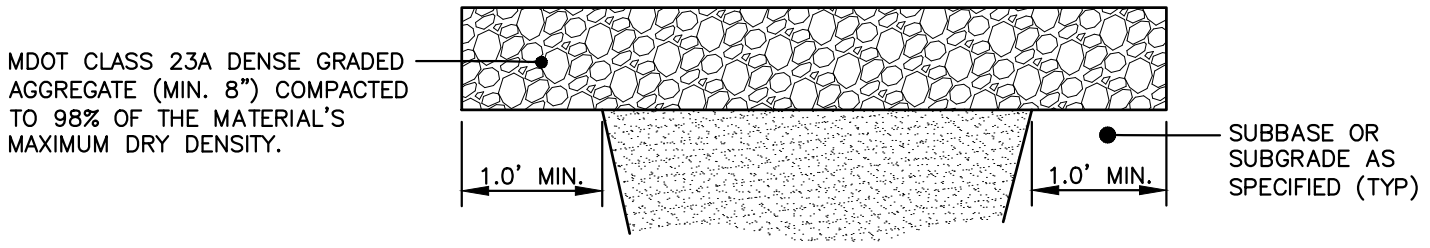
REV. NO.	DATE	DRAWN BY	CHECKED BY
01	09/01/2025	A2D	SSORT
00	10/17/2024	A2D	SSORT

UTILITY TRENCH - TYPE 3

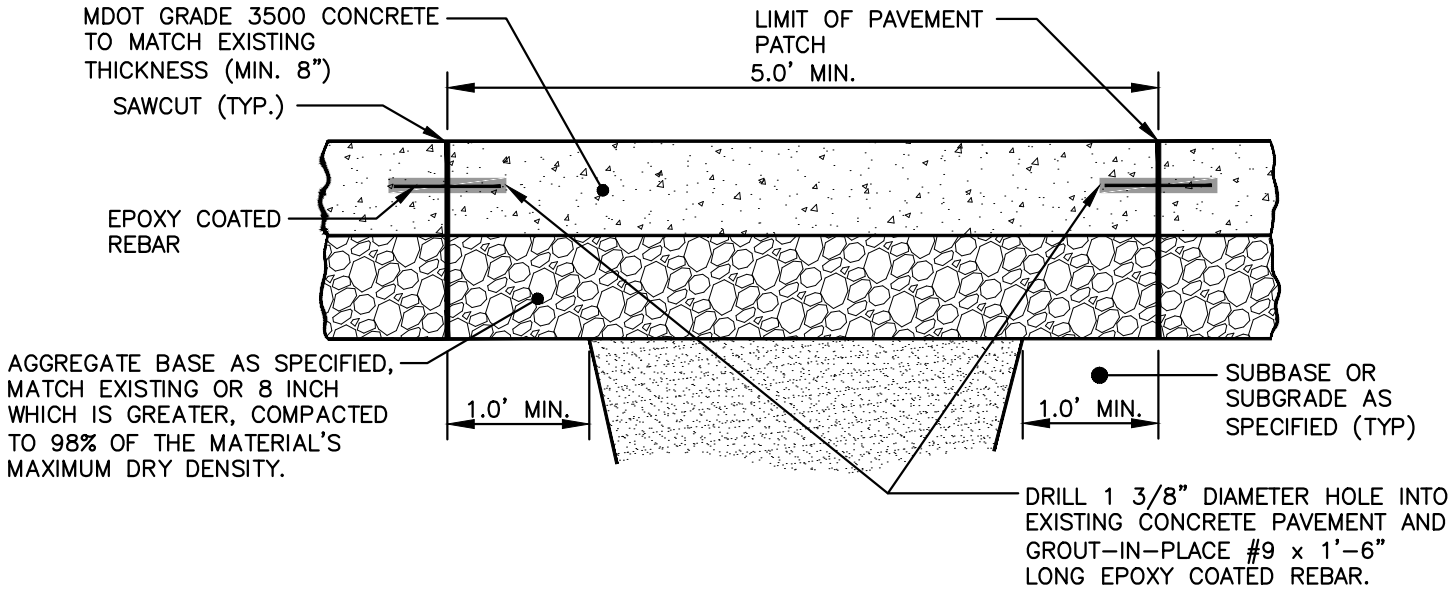
DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-TD-3**



BITUMINOUS PAVEMENT RESTORATION



GRAVEL ROAD / PARKING



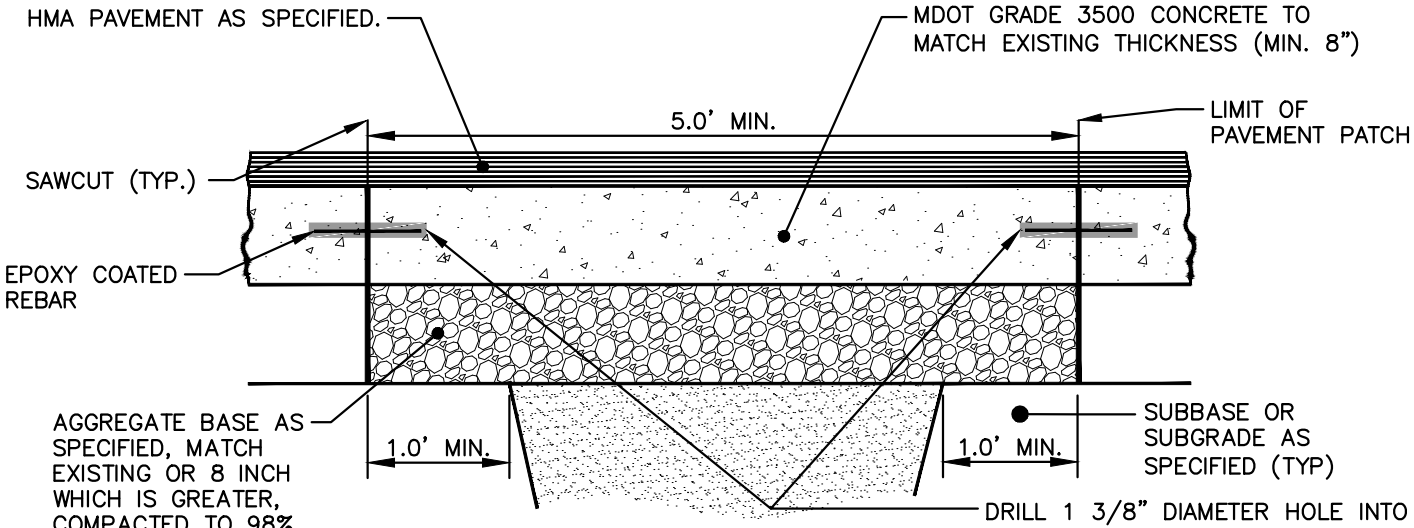
CONCRETE PAVEMENT

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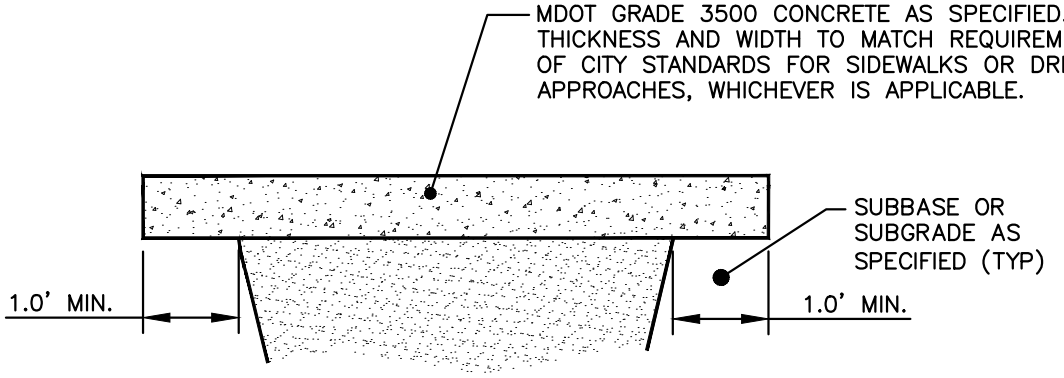
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UTILITY TRENCH SURFACE RESTORATION

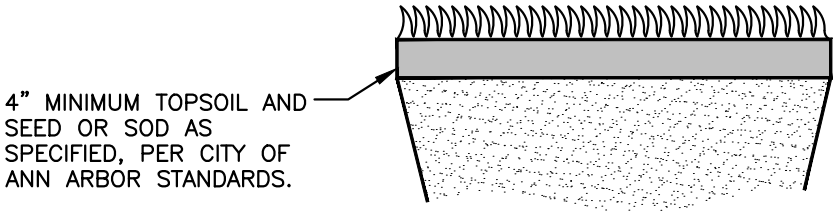
DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-TD-4.1**



CONCRETE PAVEMENT WITH BITUMINOUS OVERLAY



SIDEWALK OR DRIVE APPROACH



TURF

NOTE:

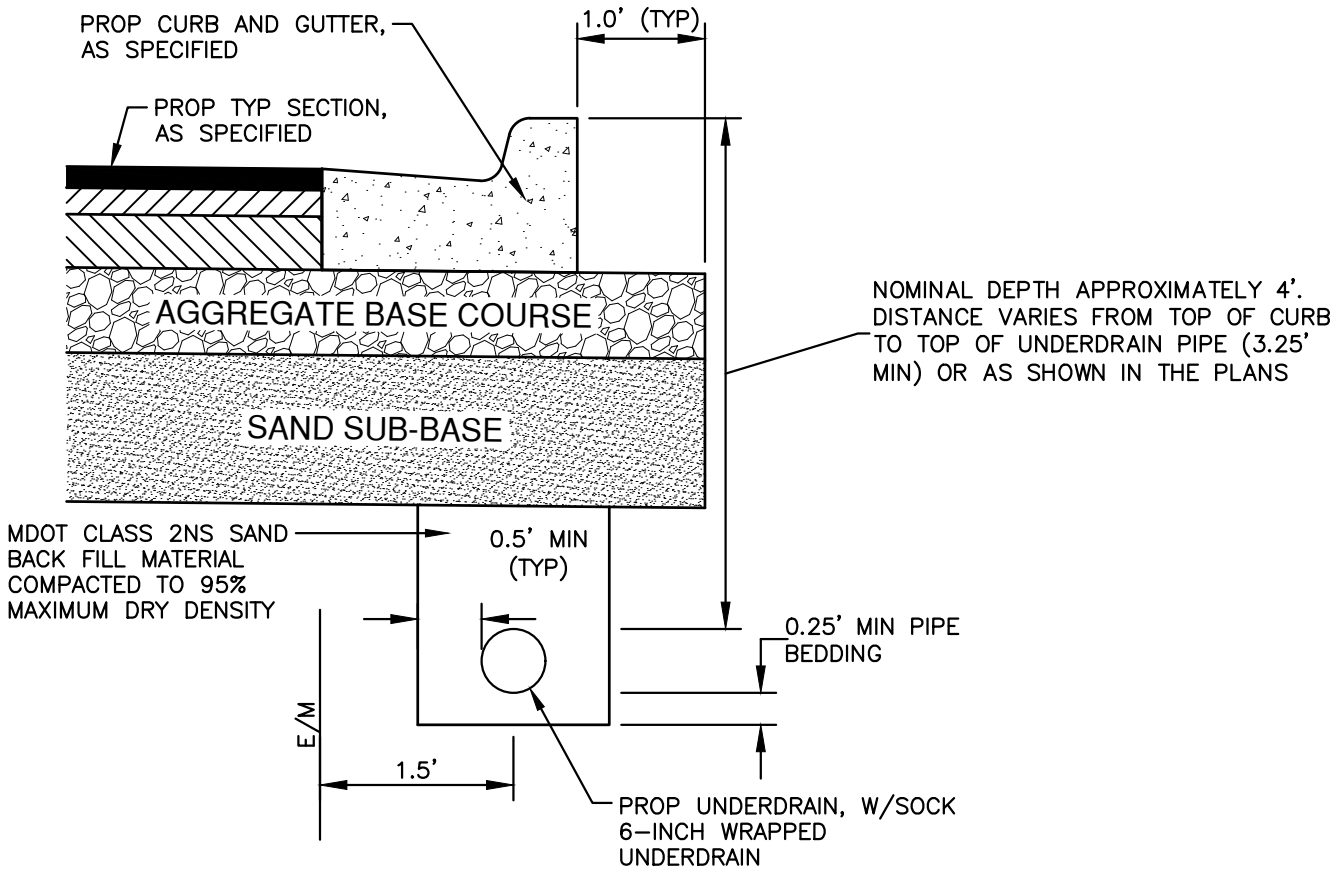
PIPE TO BE BEDDED AND BACKFILLED PER UTILITY TRENCH TYPE-1, TYPE-2, OR TYPE-3.

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UTILITY TRENCH SURFACE RESTORATION

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-TD-4.2**



NOTES:

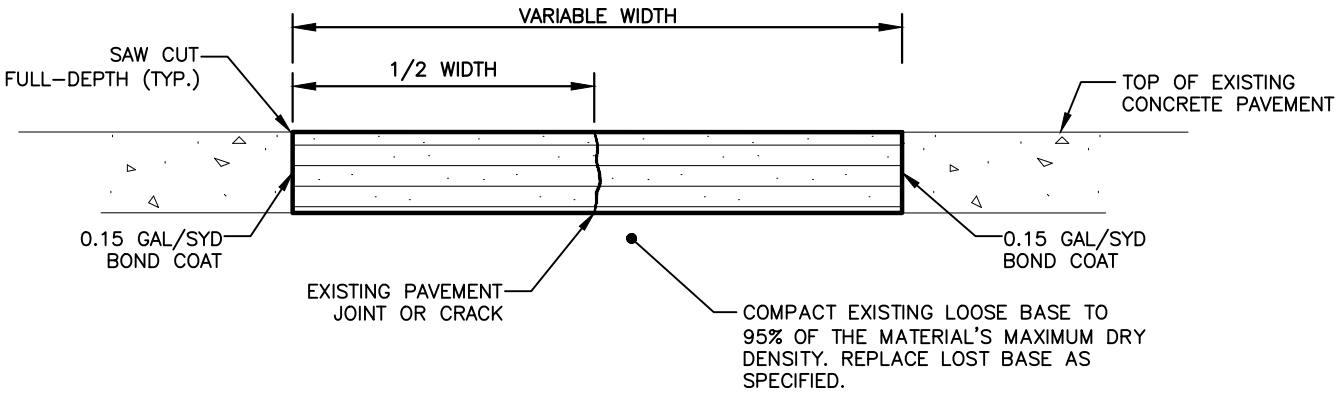
1. IN AREAS WHERE EDGE DRAIN CANNOT BE INSTALLED IN ACCORDANCE WITH THE DETAIL, THE EDGE DRAIN SHALL BE INSTALLED AT THE DEPTH AS INDICATED ON THE PLANS, OR AS DIRECTED BY ENGINEER. IN NO CASE SHALL THE EDGE DRAIN BE INSTALLED AT A GRADE LESS THAN 0.50% OR AT A DEPTH OF LESS THAN 3' BELOW TOP OF PROPOSED PAVEMENT.
2. FOR PAVEMENT BASE AND SUBBASE THICKNESS, SEE TYPICAL PAVEMENT CROSS-SECTION(S)
3. TRENCH DETAILS SHOW TYPE OF BACKFILL AND SURFACE RESTORATION ONLY
4. ALL TRENCHING TO CONFORM TO ALL APPLICABLE M.I.O.S.H.A. STANDARDS
5. EDGE DRAINS SHALL BE CONNECTED TO A DRAINAGE STRUCTURE AND WILL EXTEND A MINIMUM OF 100 FEET UPSLOPE FROM THE STRUCTURE.
6. ADDITIONAL LENGTHS OF EDGE DRAIN MAY BE REQUIRED BY THE ENGINEER BASED ON EXISTING SITE CONDITIONS, INCLUDING CONDITION OF THE SUBGRADE.

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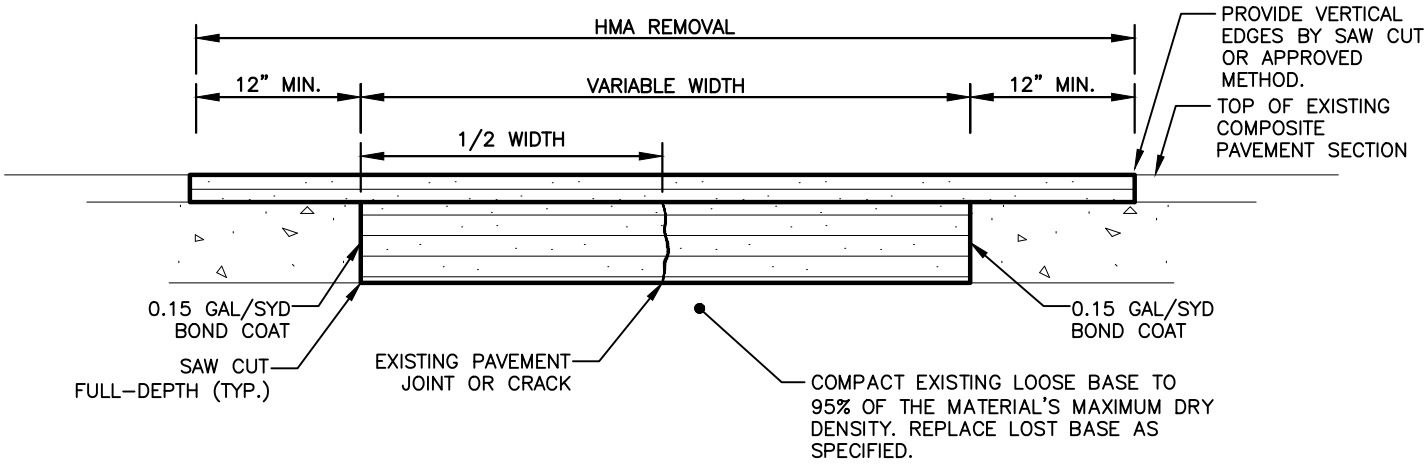
00	10/17/2024	A2D	SSORT
REV. NO.	DATE	DRAWN BY	CHECKED BY

TYPICAL EDGE DRAIN TRENCH

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-TD-5**



DETAIL 'B'
FULL DEPTH HMA REPAIR OF CONCRETE PAVEMENT



DETAIL 'A'
FULL DEPTH HMA REPAIR OF COMPOSITE PAVEMENT SECTION
(CONCRETE PAVEMENT WITH HMA SURFACE)

FOR DETAIL A & B:

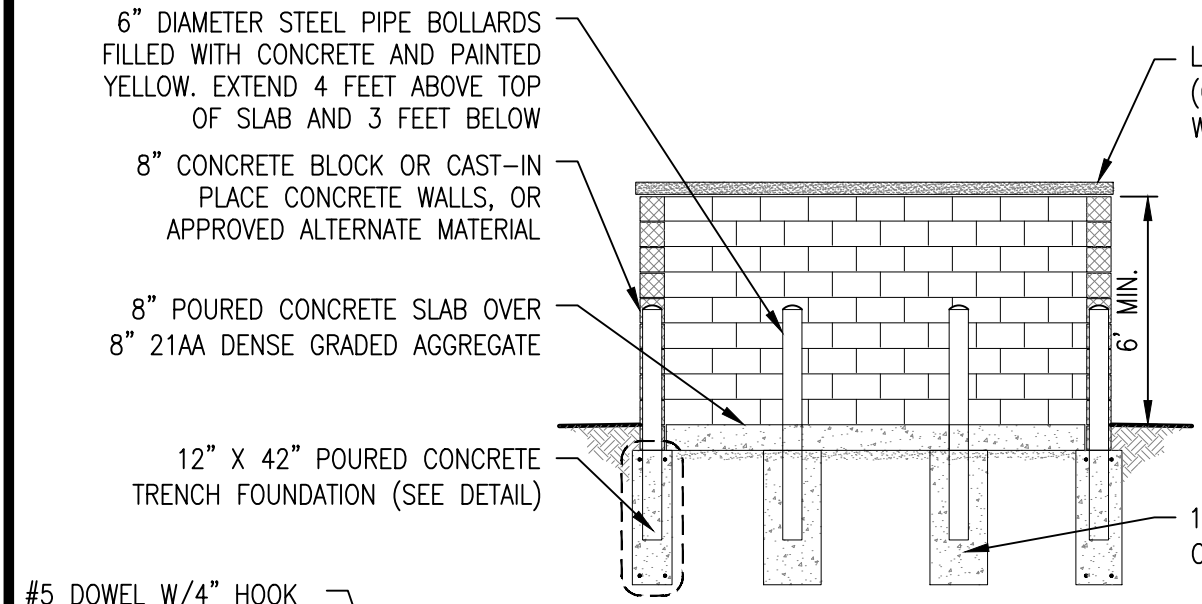
1. REMOVE THE DETERIORATED CONCRETE FULL DEPTH.
2. THE REMOVED MATERIAL SHALL BE REPLACED WITH A HMA TOP COURSE MIXTURE.
3. THE HMA SHALL BE COMPACTED WITH A MACHINE VIBRATOR OR APPROVED ROLLER.
4. BASE LIFTS ARE NOT TO EXCEED 3 INCHES WITH THE TOP COURSE NOT TO EXCEED 2 INCHES.
5. THE FINAL SURFACE SHALL BE FLUSH WITH THE EXISTING PAVEMENT SURFACE.

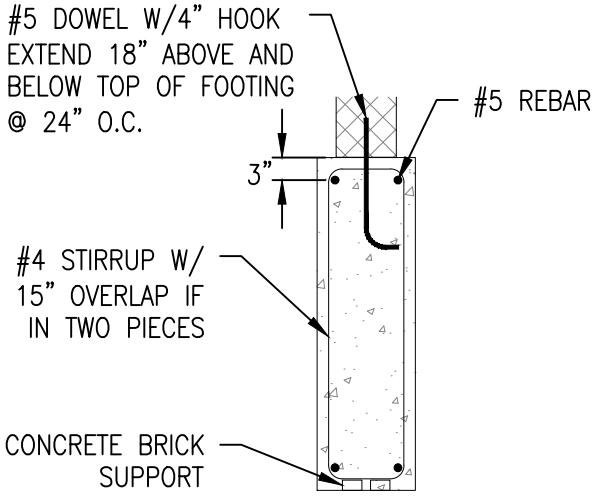
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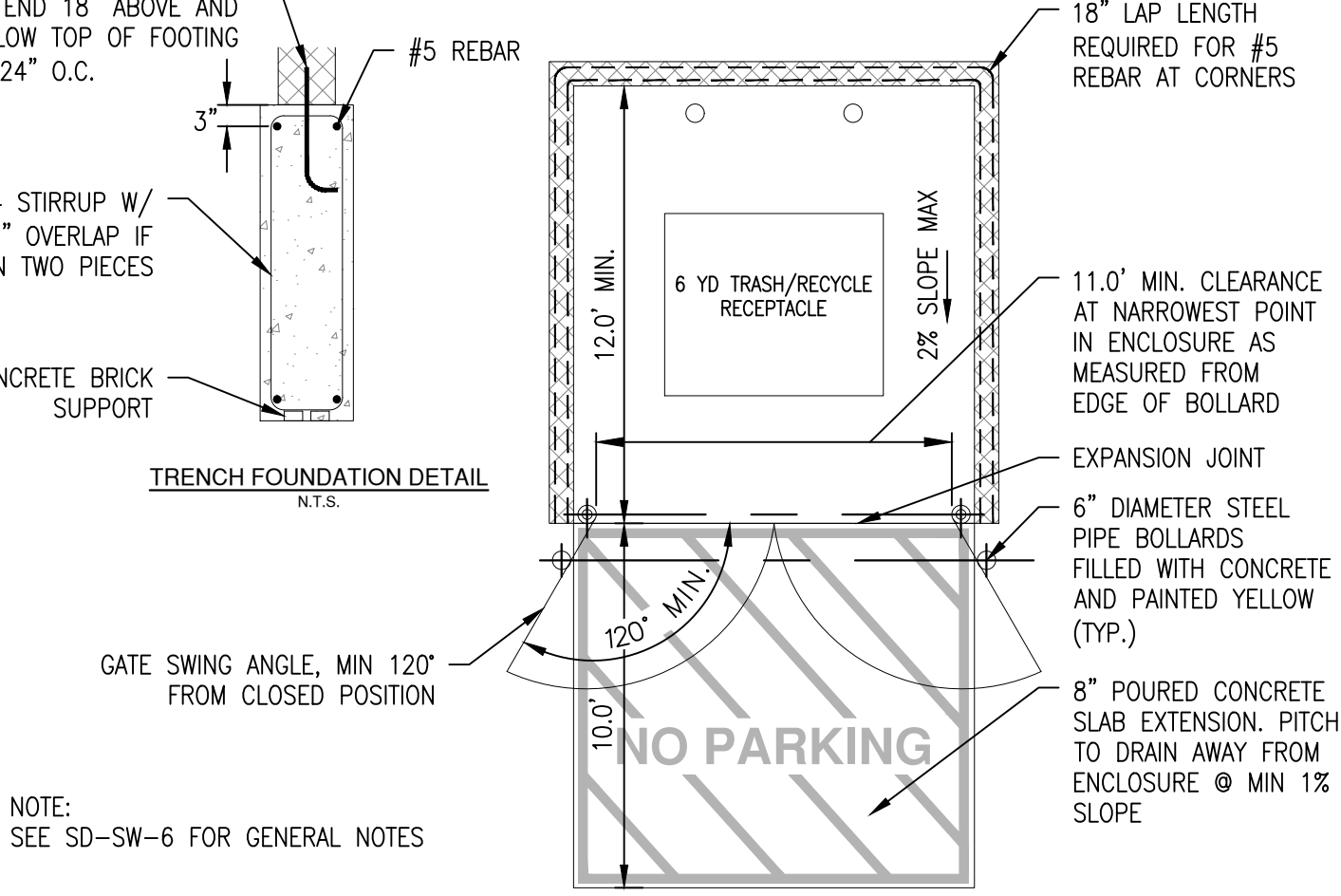
HMA REPAIR OF CONCRETE PAVEMENT

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 09/01/2025	**SD-TD-6**





TRENCH FOUNDATION DETAIL
N.T.S.



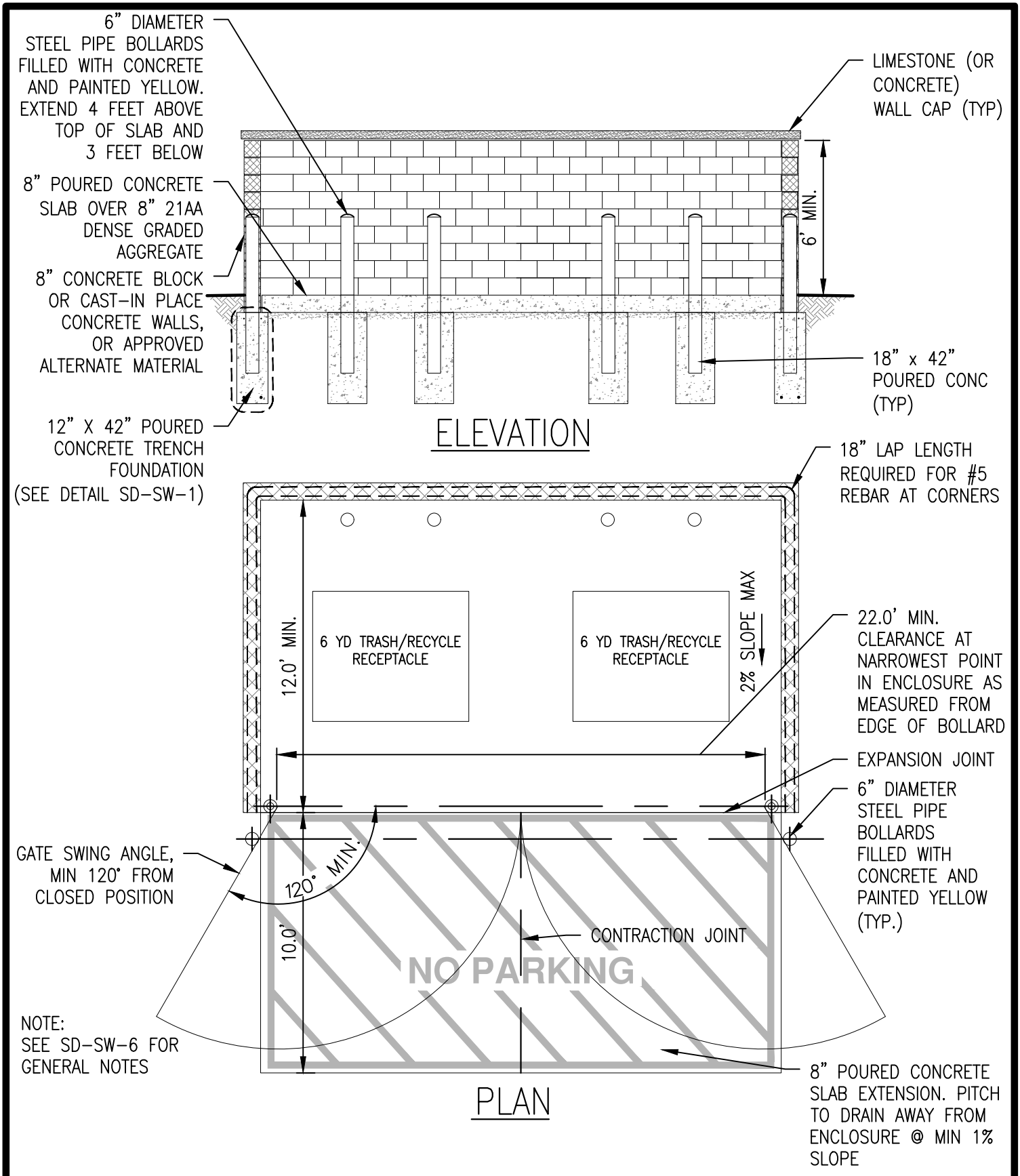
NOTE:
SEE SD-SW-6 FOR GENERAL NOTES

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REV. NO.	DATE	DRAWN BY	CHECKED BY

SINGLE BIN ENCLOSURE

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-SW-1**



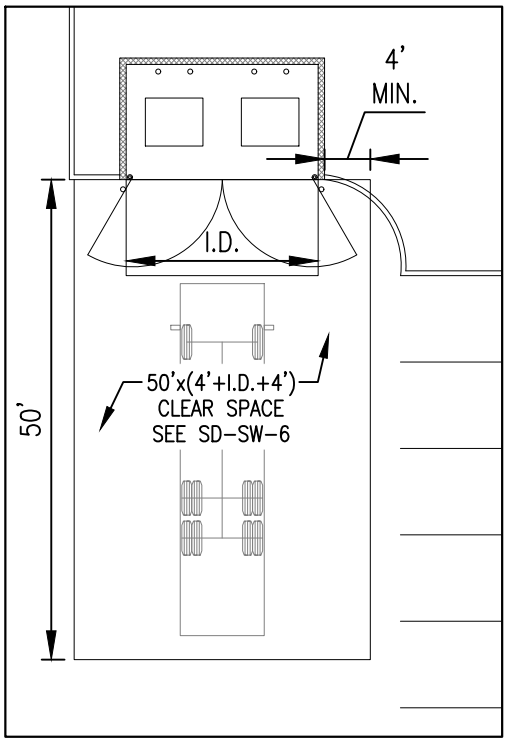
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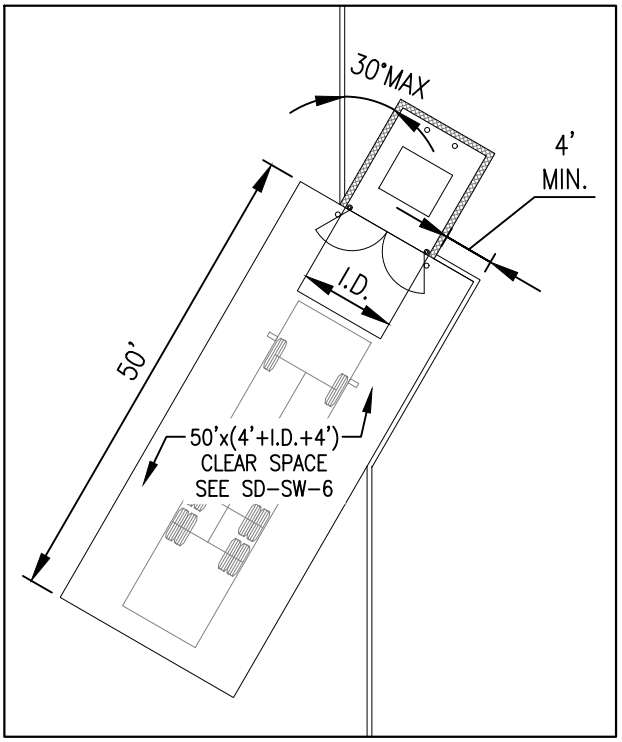
DOUBLE BIN ENCLOSURE

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-SW-2**

ACCEPTABLE

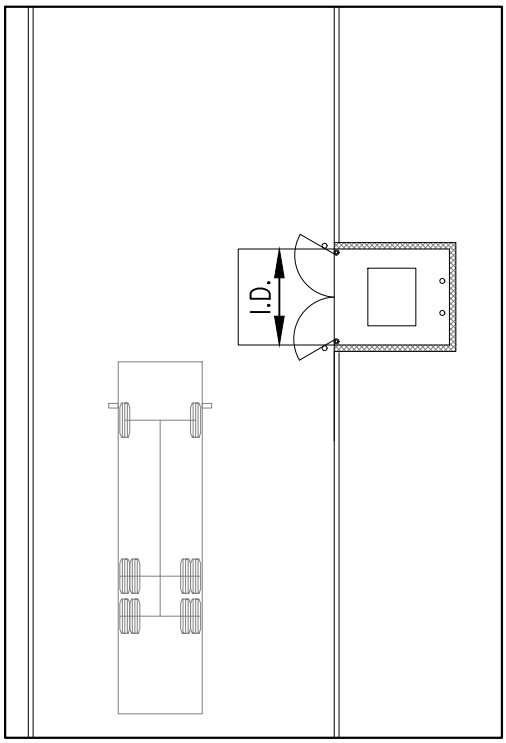


DIRECT ACCESS
(PREFERRED)

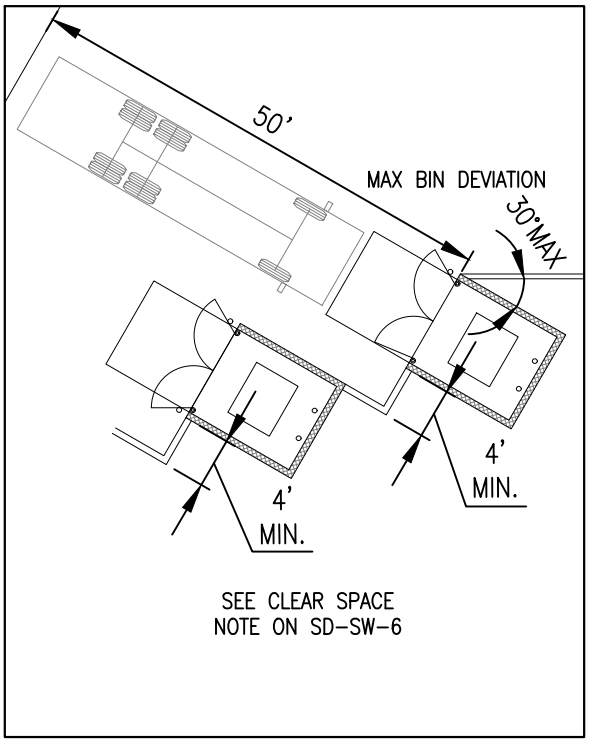


OPTIONAL ANGLED DIRECT ACCESS
(ACCEPTABLE WITH APPROVAL)

UNACCEPTABLE



INDIRECT ACCESS



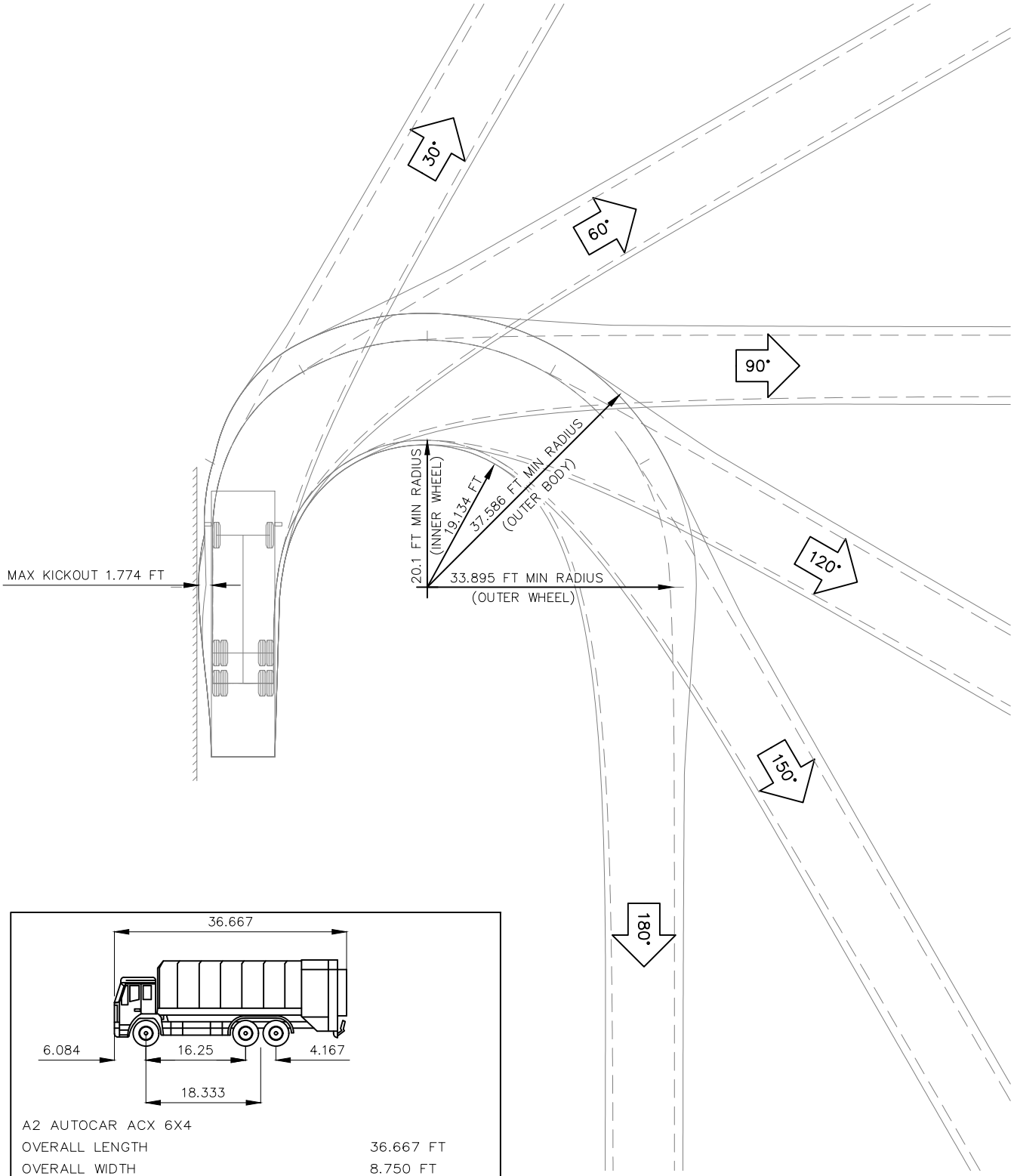
OPTIONAL ANGLED DIRECT ACCESS
(ACCEPTABLE WITH APPROVAL)

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REV. NO.	DATE	DRAWN BY	CHECKED BY

STANDARD BIN ENCLOSURE LAYOUTS

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-SW-3**



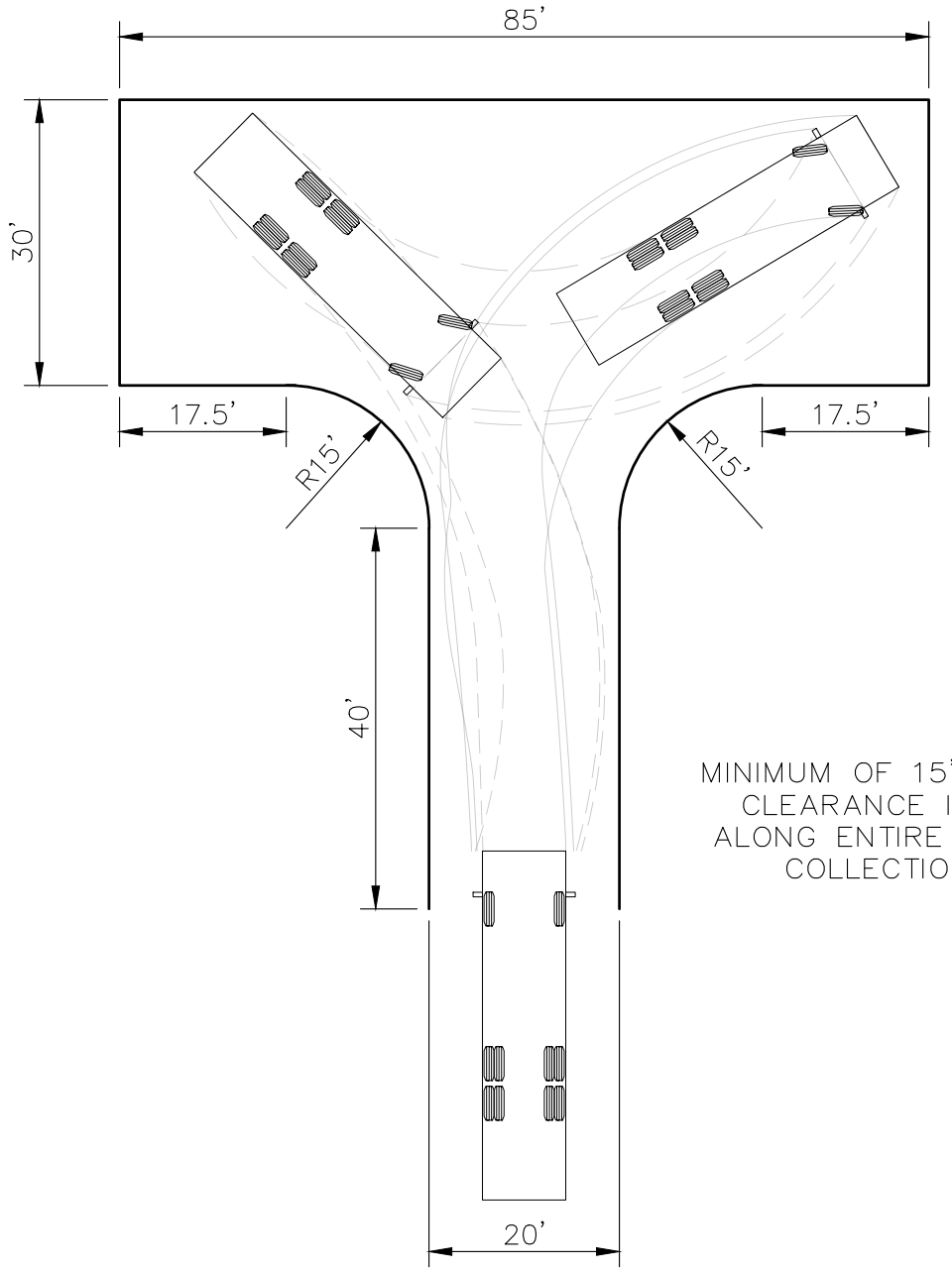
A2 AUTOCAR ACX 6X4	
OVERALL LENGTH	36.667 FT
OVERALL WIDTH	8.750 FT
OVERALL BODY HEIGHT	12.500 FT
MIN BODY GROUND CLEARANCE	0.830 FT
MAX TRACK WIDTH	8.417 FT
LOCK–TO–LOCK TIME	6.00 S
CURB TO CURB TURNING RADIUS	33.895 FT

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REV. NO.	DATE	DRAWN BY	CHECKED BY

SWEPT PATH REQUIREMENTS FOR FRONT LOAD SOLID WASTE VEHICLE

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-SW-4**



MINIMUM OF 15'–0" VERTICAL CLEARANCE IS REQUIRED ALONG ENTIRE SOLID WASTE COLLECTION ROUTE.

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REV. NO.	DATE	DRAWN BY	CHECKED BY

SOLID WASTE VEHICLE TURN-AROUND

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-SW-5**

1. MAINTAIN A CLEAR SPACE DIRECTLY IN FRONT OF THE SOLID WASTE ENCLOSURE. THE CLEAR SPACE SHALL BE A MINIMUM OF FIFTY (50) FEET LONG BY THE WIDTH OF THE INSIDE DIMENSION (I.D.) OF THE ENCLOSURE WALLS PLUS FOUR (4) FEET ON EACH SIDE. A MINIMUM VERTICAL CLEARANCE OF AT LEAST TWENTY–FIVE (25) FEET MUST BE PROVIDED ABOVE THIS AREA.

2. INGRESS AND EGRESS ROUTES MUST BE DEVELOPED BASED ON SOLID WASTE SWEPT PATH REQUIREMENTS PER SD–SW–4. A MINIMUM HORIZONTAL CLEARANCE OF FOUR (4) FEET FROM THE EDGE OF THE SWEPT PATH AND A MINIMUM VERTICAL CLEARANCE OF AT LEAST FIFTEEN (15) FEET MUST BE PROVIDED ALONG THE ENTIRE SOLID WASTE COLLECTION ROUTE.

3. PROVIDE TEN (10) FEET MINIMUM HORIZONTAL CLEARANCE FROM SOLID WASTE ENCLOSURE TO MAJOR ELECTRICAL EQUIPMENT, ABOVE GROUND UTILITY SERVICES, AND EDGE OF OVERHEAD OBSTRUCTIONS SUCH AS TREE BRANCHES, BALCONIES, AND OVERHANGS.

4. IF FORWARD ACCESS TO THE PUBLIC STREET IS NOT AVAILABLE FOR THE SOLID WASTE VEHICLE, THE SITE DEVELOPMENT LAYOUT MUST ACCOMMODATE A TURN–AROUND LOCATION MEETING REQUIREMENTS WITHIN SOLID WASTE REFERENCE SPECIFIC TURN–AROUND DETAIL (SD–SW–5) AND ACCEPTABLE TO THE PSAA.

5. FOR SITES THAT CANNOT ACCOMMODATE A TURN–AROUND, THE FOLLOWING ADDITIONAL REQUIREMENTS MUST BE MET:

   5.1. SOLID WASTE VEHICLES MUST BE ABLE TO SERVICE DUMPSTERS WITHOUT IMPEDING THE PUBLIC STREET OR SIDEWALK.

   5.2. THE COLLECTION LOCATION SHALL BE CLEARLY DELINEATED AND NOT HAVE A SLOPE GREATER THAN 2% IN ANY DIRECTION.

   5.3. BOLLARDS OR ADEQUATE CLEAR SPACE MUST BE PROVIDED BEHIND THE LIFT POINT SO THE DUMPSTERS ARE NOT PUSHED INTO ANY BUILDING OR ACCESS ROUTE.

   5.4. ALL SWEPT–PATH CLEARANCE AND VERTICAL CLEARANCE REQUIREMENTS PREVIOUSLY IDENTIFIED SHALL BE PROVIDED.

   5.5. SOLID WASTE VEHICLE BACK–UP DISTANCES MUST BE LESS THAN 30' ALONG SERVICING ROUTE.

6. GATES ON BIN ENCLOSURES SHALL OPEN A MINIMUM OF 120 DEGREES FROM THE CLOSED POSITION. THE GATES SHALL NOT IMPEDE ON THE REQUIRED BIN ENCLOSURE OPENING WIDTH, SHALL NOT BLOCK ADJACENT PARKING SPOTS, AND NOT BE IMPEDED BY ADJACENT CURBS OR LANDSCAPING.

7. GATES SHALL BE DESIGNED TO BE FREE STANDING WITHOUT CENTER POLE DESIGN. IF CENTER POLE DESIGN IS NECESSARY, 12 INCHES SHALL BE ADDED TO THE MINIMUM INTERIOR WIDTH OF THE ENCLOSURE.

8. GATE DESIGN SHALL INCLUDE A RELIABLE MEANS TO SECURE THE DOOR IN BOTH THE OPEN AND CLOSED POSITIONS.

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SOLID WASTE GENERAL NOTES

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-SW-6A**

9. THE PROPERTY OWNER SHALL BE RESPONSIBLE FOR THE INSTALLATION AND MAINTENANCE OF NO PARKING SIGNS ALONG THE SOLID WASTE INGRESS/EGRESS ROUTE TO ENSURE THE ROUTE REMAINS FREE OF VEHICLES.

10. REFER TO ASSOCIATED STANDARD DETAILS SD-SW-1 AND SD-SW-2 FOR REQUIREMENTS ON SINGLE AND DOUBLE WIDE SOLID WASTE BIN ENCLOSURE LAYOUT AND DESIGN CRITERIA. THE CITY SHALL HAVE THE ABILITY TO MODIFY OR INTERPRET THESE DETAILS AS NECESSARY TO ACCOMMODATE THE CITY OR CITY CONTRACTOR'S NEEDS FOR SOLID WASTE PICK-UP.

11. SOLID WASTE EQUIPMENT ACCESS ROADS AND SERVICE AREA SURFACES SHALL BE DESIGNED AND MAINTAINED TO SUPPORT THE IMPOSED LOADS OF COLLECTION VEHICLES WEIGHING UP TO 79,500 LBS GROSS VEHICLE WEIGHT (GVW) AND SHALL BE PROVIDED WITH AN APPROVED SURFACE SO AS TO PROVIDE ALL WEATHER DRIVING CAPABILITIES. PROPERTY OWNER SHALL BE RESPONSIBLE FOR ALL SNOW AND ICE REMOVAL REQUIRED FOR SAFE ACCESS.

12. FOR SITES THAT CANNOT ACCOMMODATE A STANDARD DUMPSTER ENCLOSURE, THE DUMPSTERS MAY BE ROLLED OUT OF A BUILDING OR ALTERNATE ENCLOSURE BY THE PROPERTY OWNER TO AN APPROVED COLLECTION LOCATION.

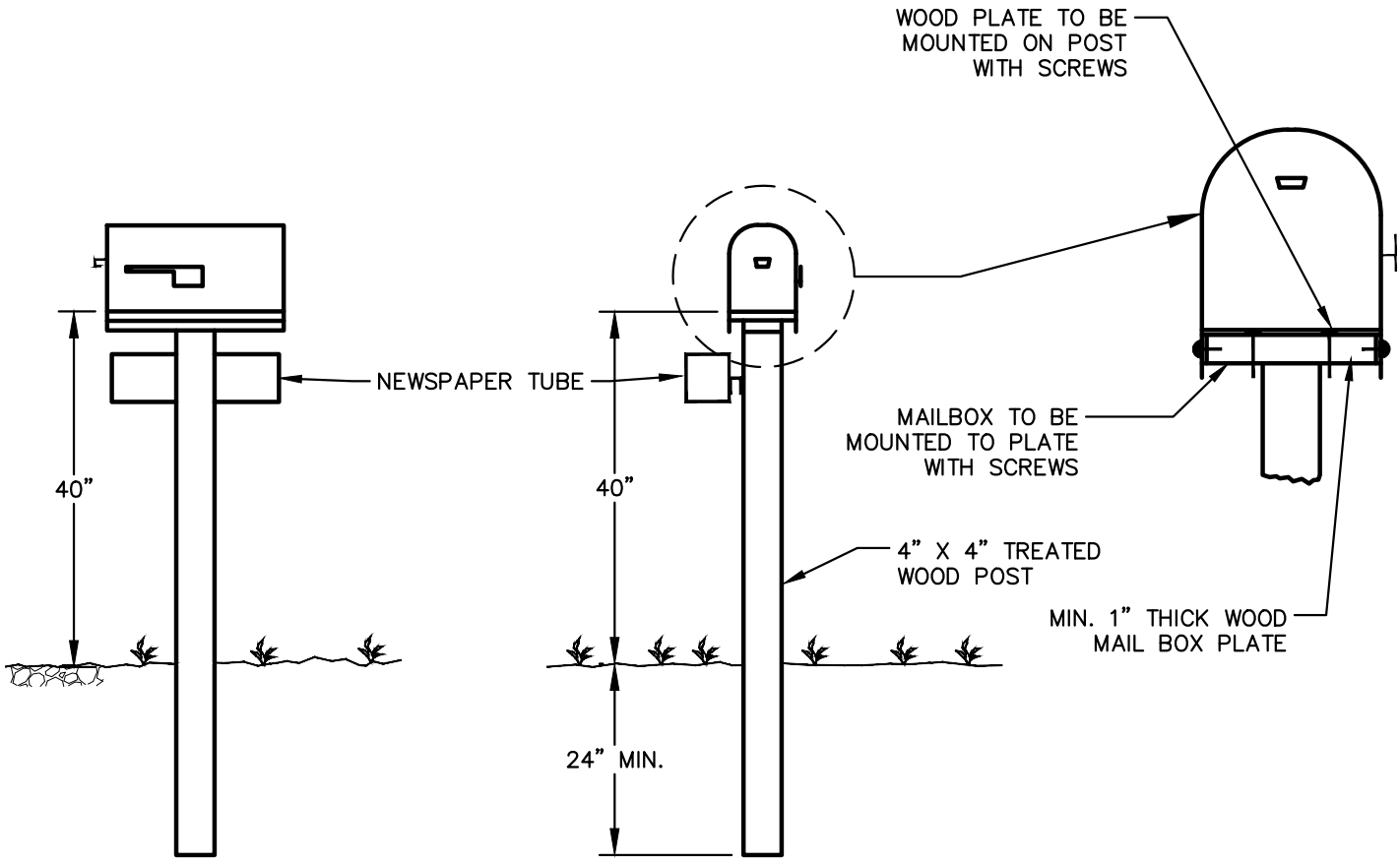
13. SOLID WASTE COLLECTION LOCATIONS MUST BE LOCATED WITHIN THE BOUNDARIES OF THE PROPERTY UNLESS AN APPROPRIATE EASEMENT IS OBTAINED.

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SOLID WASTE GENERAL NOTES

DR. ENG	CH. ENG	DRAWING NO.
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NOTES:

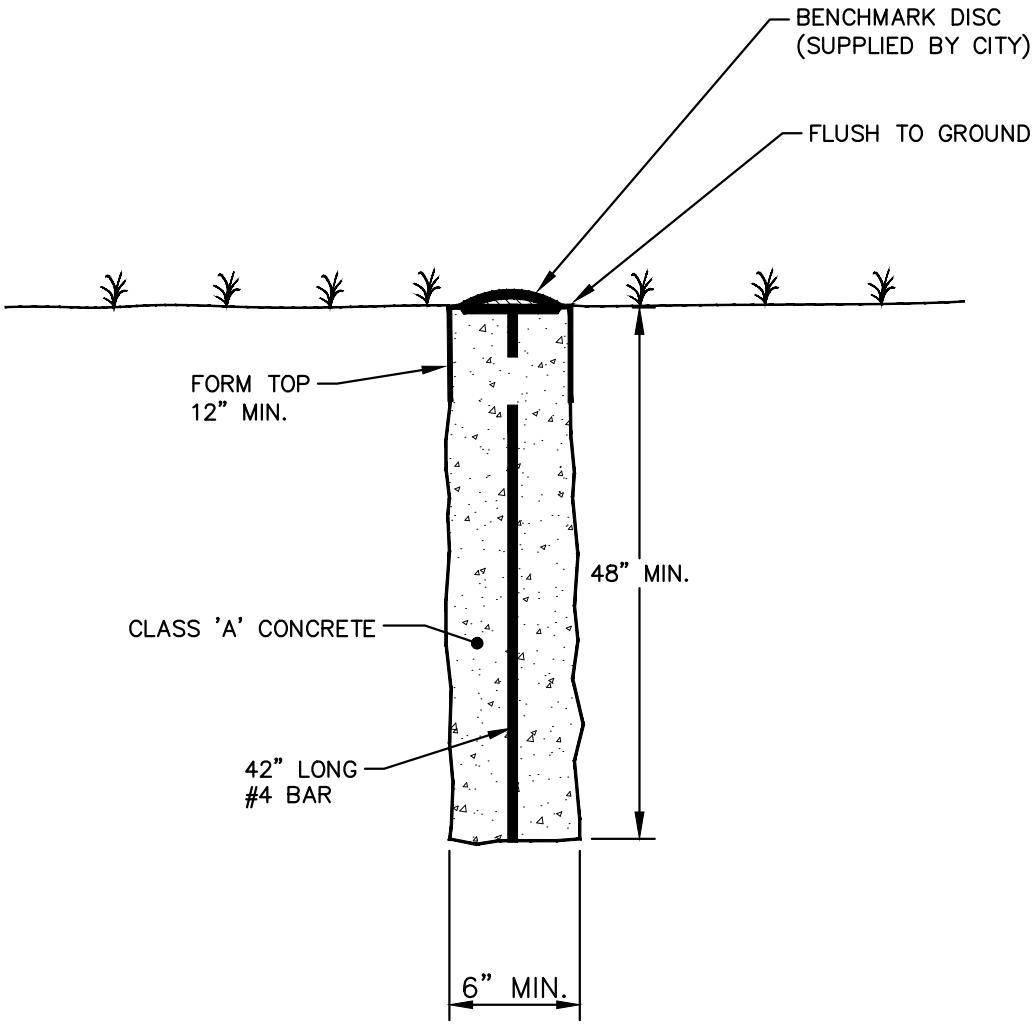
1. ALL WORK TO BE DONE UNDER CURRENT FEDERAL POSTAL SERVICE SPECIFICATIONS.
2. FOR PERMANENT MAILBOX RELOCATION, POST TO BE NEW 4" X 4" POST, OR RESTORE ORIGINAL POST TO AS GOOD OR BETTER THAN ORIGINAL CONDITION.
3. FOR TEMPORARY MAILBOX RELOCATION, THE USE OF EXISTING POST WILL BE PERMITTED.
4. FOR NEWS PAPER TUBE RELOCATION THE USE OF EXISTING POST WILL BE PERMITTED.

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MAILBOX NEWSPAPER TUBE INSTALLATION AND RELOCATION

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SCALE N.T.S.	DATE 12/8/2023	**SD-M-1**



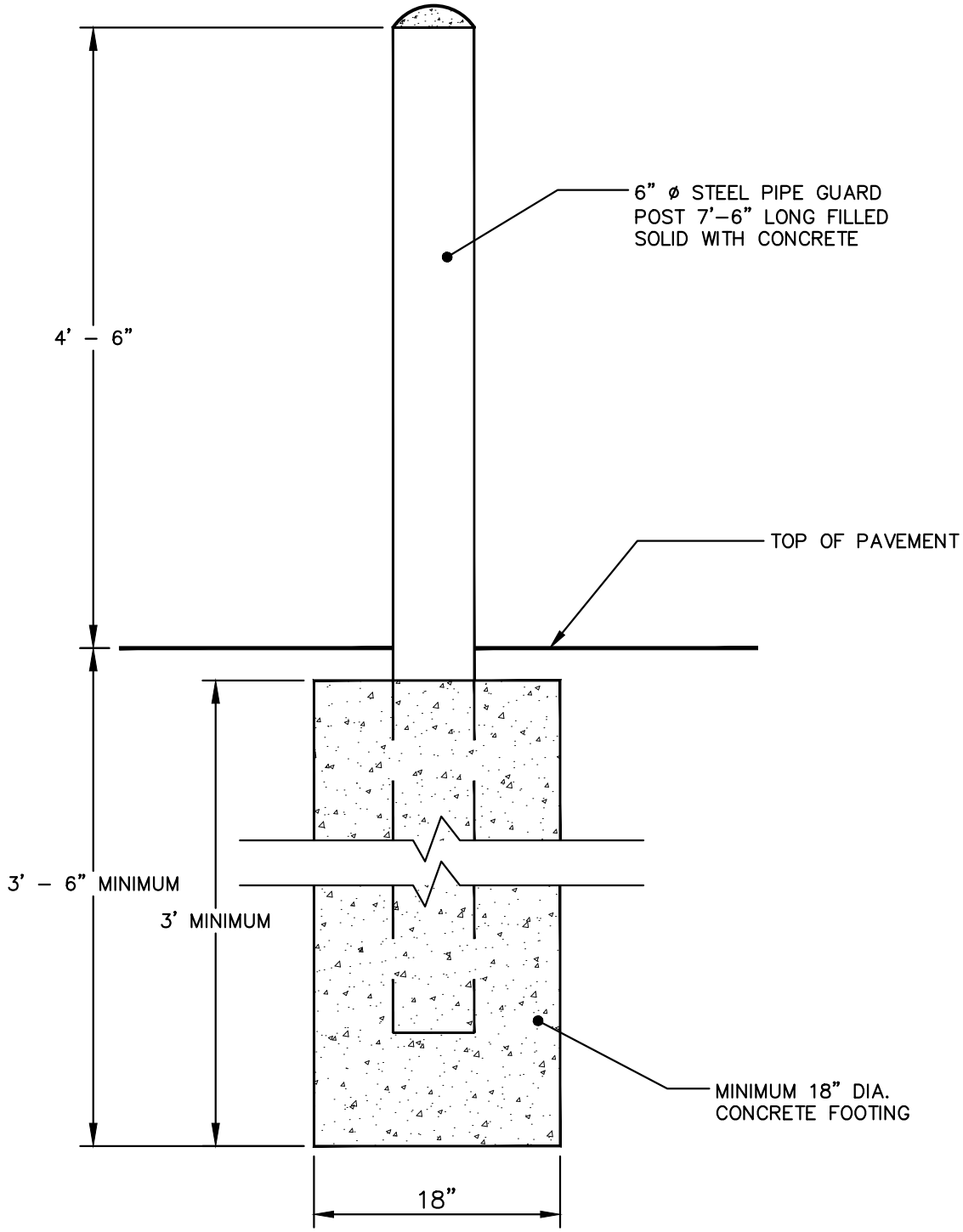
NOTE:
ELEVATION TO BE ESTABLISHED FROM USGS DATUM, AND SHALL BE VERIFIED BY THE CITY OF ANN ARBOR.

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REV. NO.	DATE	DRAWN BY	CHECKED BY

VERTICAL CONTROL MONUMENT

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-M-2**

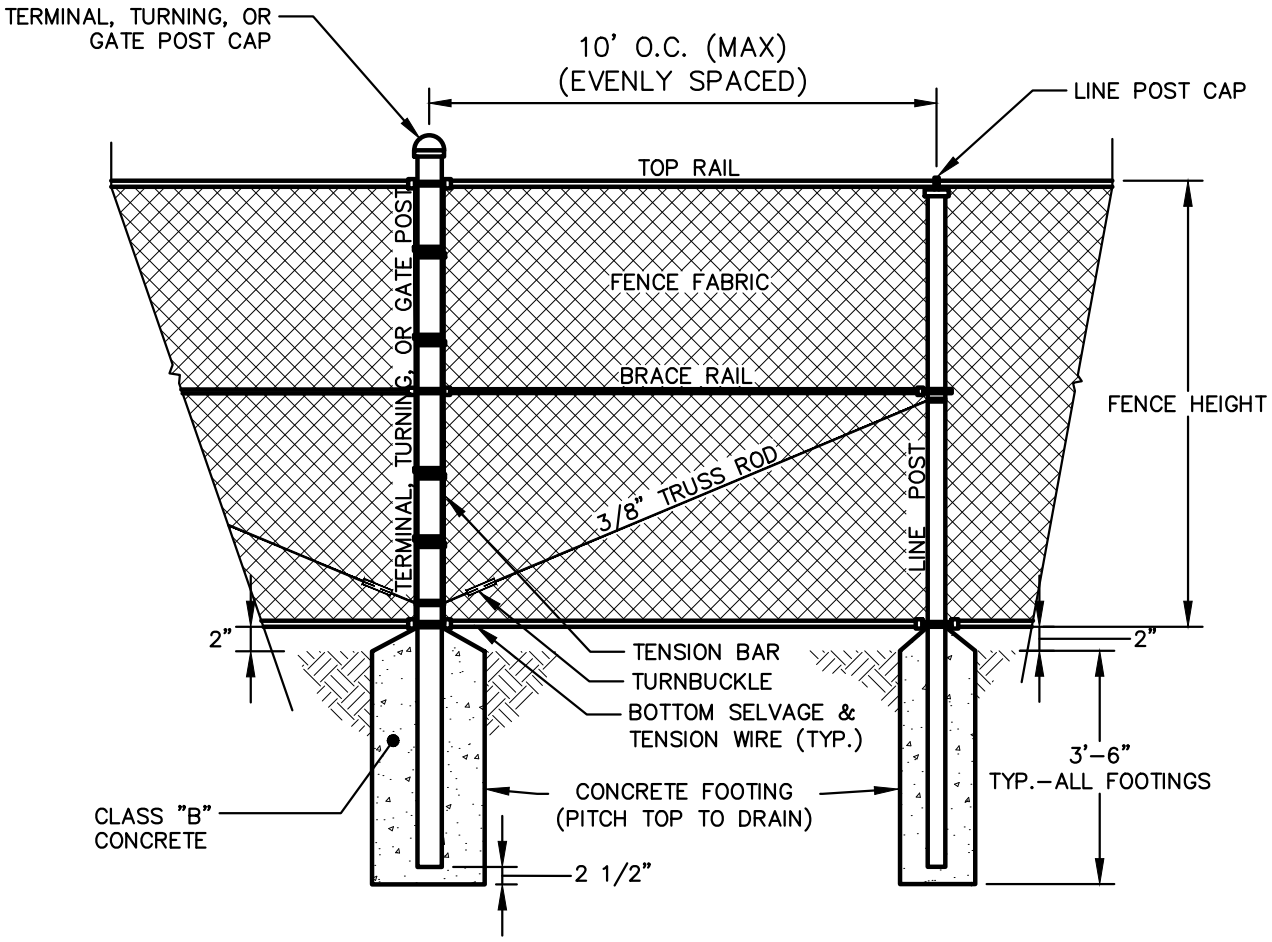


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REV. NO.	DATE	DRAWN BY	CHECKED BY

STEEL PIPE BOLLARD

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-M-3**



FENCE HEIGHT/SIZE REFERENCE CHART

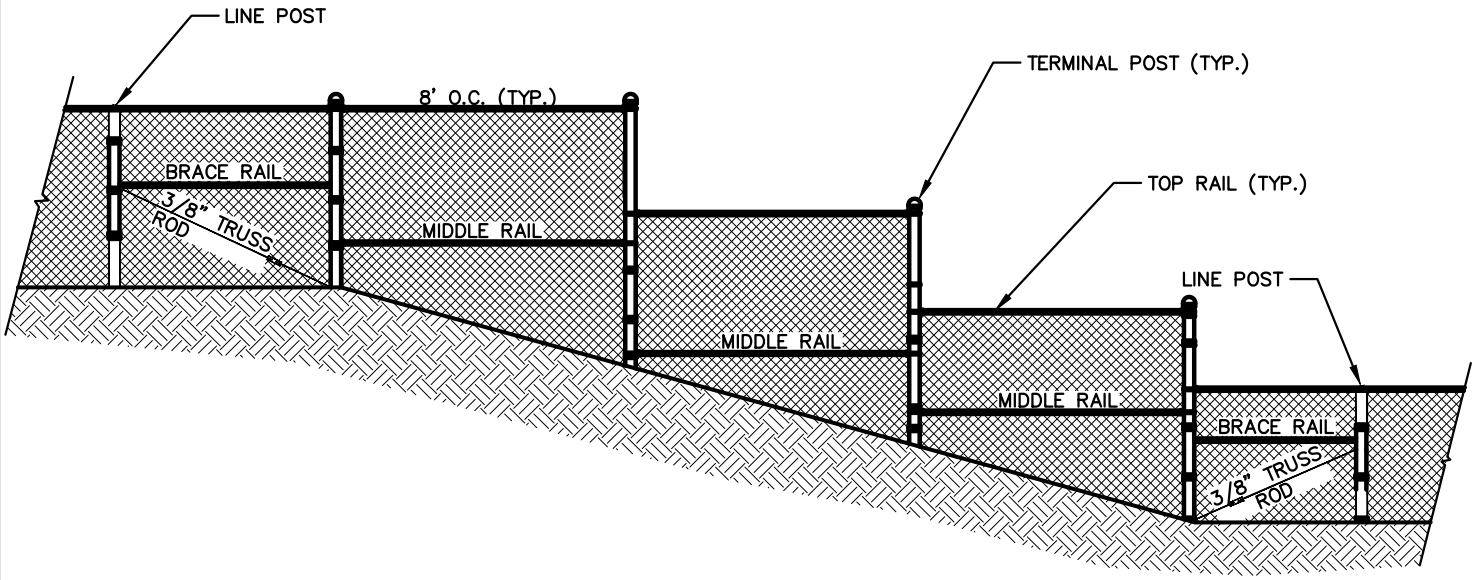
	4' FENCE	6' FENCE	8' FENCE	12' FENCE
NOMINAL PIPE SIZES (WEIGHT)				
TERMINAL, TURNING, OR GATE POST	1 1/2" (2.72#/L.F.)	2 1/2" (5.79#/L.F.)	3 1/2" (9.11#/L.F.)	3 1/2" (9.11#/L.F.)
LINE POST	1 1/4" (2.27#/L.F.)	2" (3.65#/L.F.)	2" (3.65#/L.F.)	2" (3.65#/L.F.)
TOP RAIL	1" (1.68#/L.F.)	1 1/4" (2.27#/L.F.)	1 1/4" (2.27#/L.F.)	1 1/4" (2.27#/L.F.)
MIDDLE RAIL	NONE	NONE	1 1/4" (2.27#/L.F.)	1 1/4" (2.27#/L.F.)
BOTTOM RAIL	NONE	NONE	1 1/4" (2.27#/L.F.)	1 1/4" (2.27#/L.F.)
BRACE RAIL	1" (1.68#/L.F.)	1 1/4" (2.27#/L.F.)	1 1/4" (2.27#/L.F.)	1 1/4" (2.27#/L.F.)
FOOTING DIAMETERS				
TERMINAL, TURNING, OR GATE POST	12"	18"	18"	18"
LINE POST	9"	12"	12"	12"

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REV. NO.	DATE	DRAWN BY	CHECKED BY

CHAIN LINK FENCE

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-M-4**



NOTE:
DIMENSIONS MAY VARY.

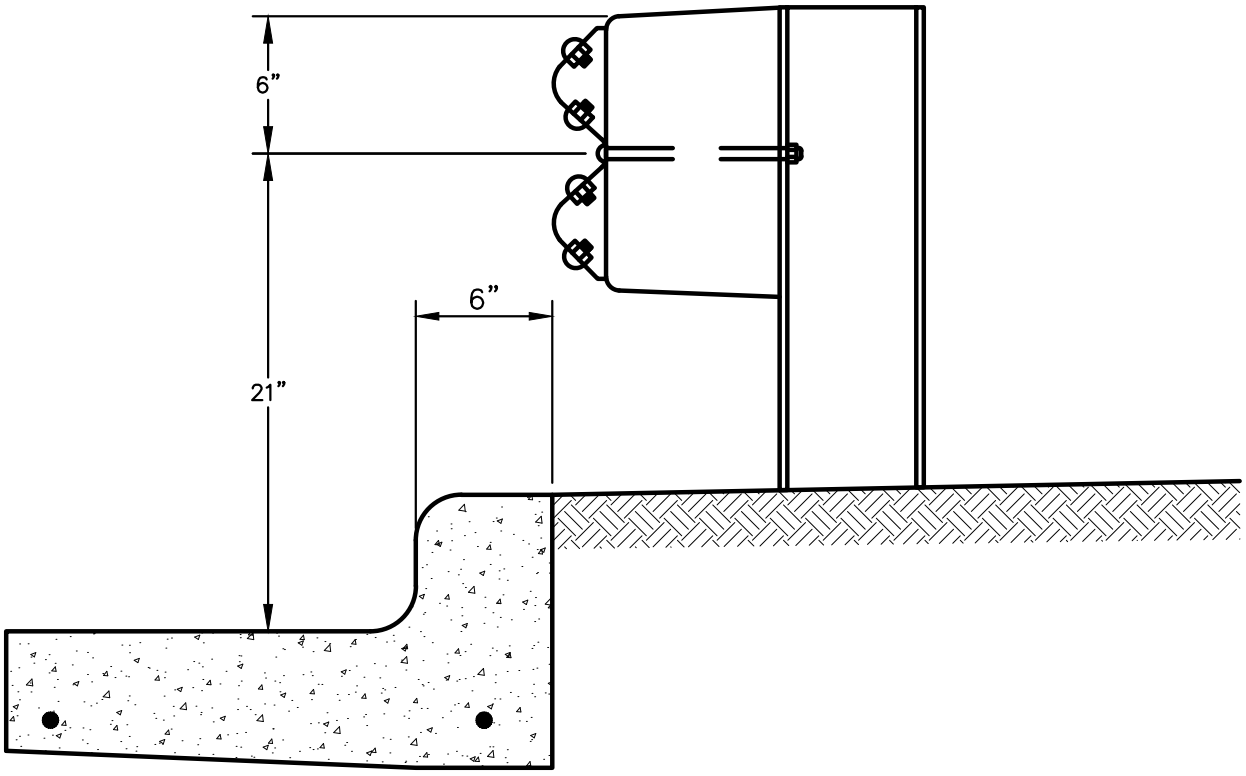
WORK THIS DRAWING WITH THE NOTES AND REFERENCE CHART ON THE CHAIN LINK FENCE DETAIL, SD–M–4

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STEP CHAIN LINK FENCE

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-M-5**



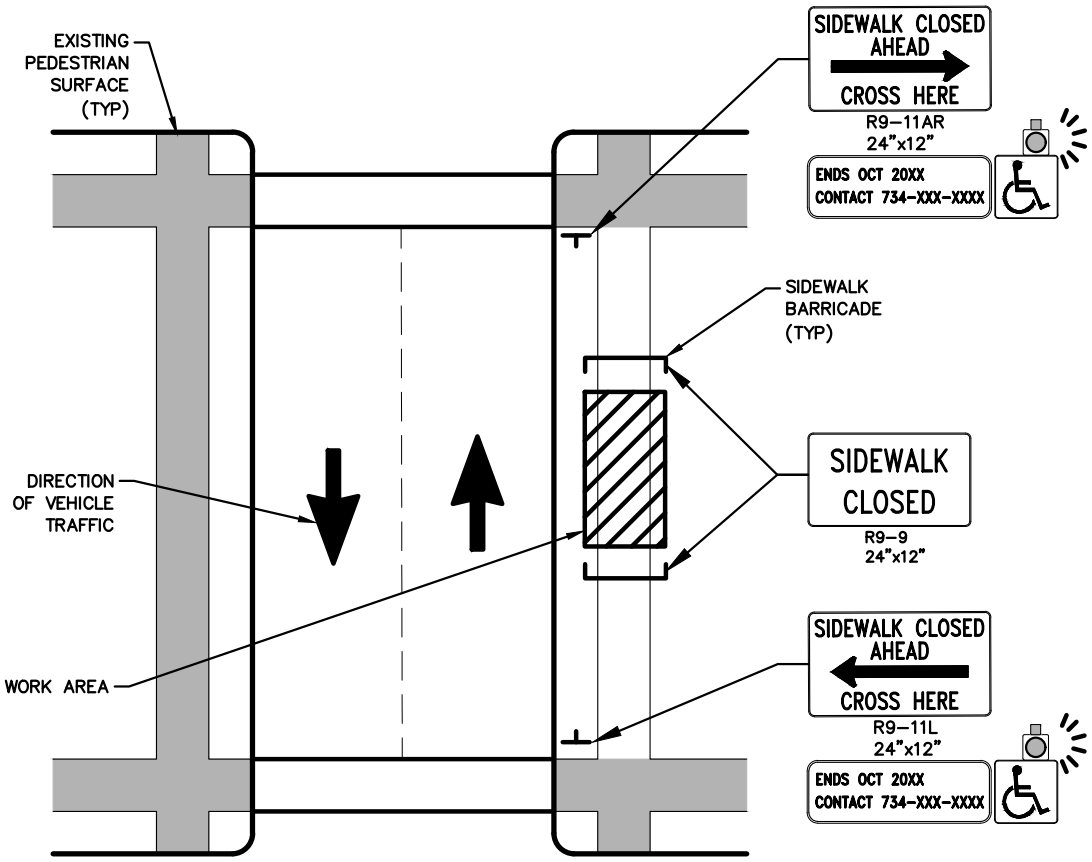
NOTE:
STANDARD GUARDRAIL CONSTRUCTION TO BE IN ACCORDANCE WITH MDOT BEAM GUARDRAIL TYPE B REQUIREMENTS

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REV. NO.	DATE	DRAWN BY	CHECKED BY

URBAN GUARDRAIL LOCATION

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	SD-M-6



WHERE REQUIRED, AN APPROVED AUDIBLE MESSAGE DEVICE OR TACTILE MESSAGE SHOULD BE PROVIDED FOR SIGHT-IMPAIRED PEDESTRIANS. IF MESSAGE DEVICE OR TACTILE MESSAGE IS NOT USED, SIGHT-IMPAIRED PEDESTRIANS ARE TO BE DIRECTED THOUGH TEMPORARY PEDESTRIAN DETOUR BY MEANS OF DETECTABLE DIRECTIONAL TILES AND DETECTABLE WARNING SURFACES.

THE INTERNATIONAL SYMBOL OF ACCESSIBILITY MAY BE DISPLAYED WHEN ANY WALKWAY THROUGH A WORK ZONE HAS BEEN DETERMINED TO BE TPAR COMPLIANT. THE SYMBOL OF ACCESSIBILITY SHALL NOT BE DISPLAYED IF PERSONS WITH DISABILITIES SHOULD NOT USE THE PRIMARY TEMPORARY PEDESTRIAN DETOUR.

TYPICAL SIGN MESSAGE FOR A TEMPORARY PEDESTRIAN DETOUR SHOULD INCLUDE INFORMATION SUCH AS THE DURATION OF THE WALKWAY RESTRICTIONS (BEGINNING AND/OR END DATES) AND A PROJECT CONTACT NUMBER FOR 24/7 QUESTIONS OR REPORTING HAZARDS.

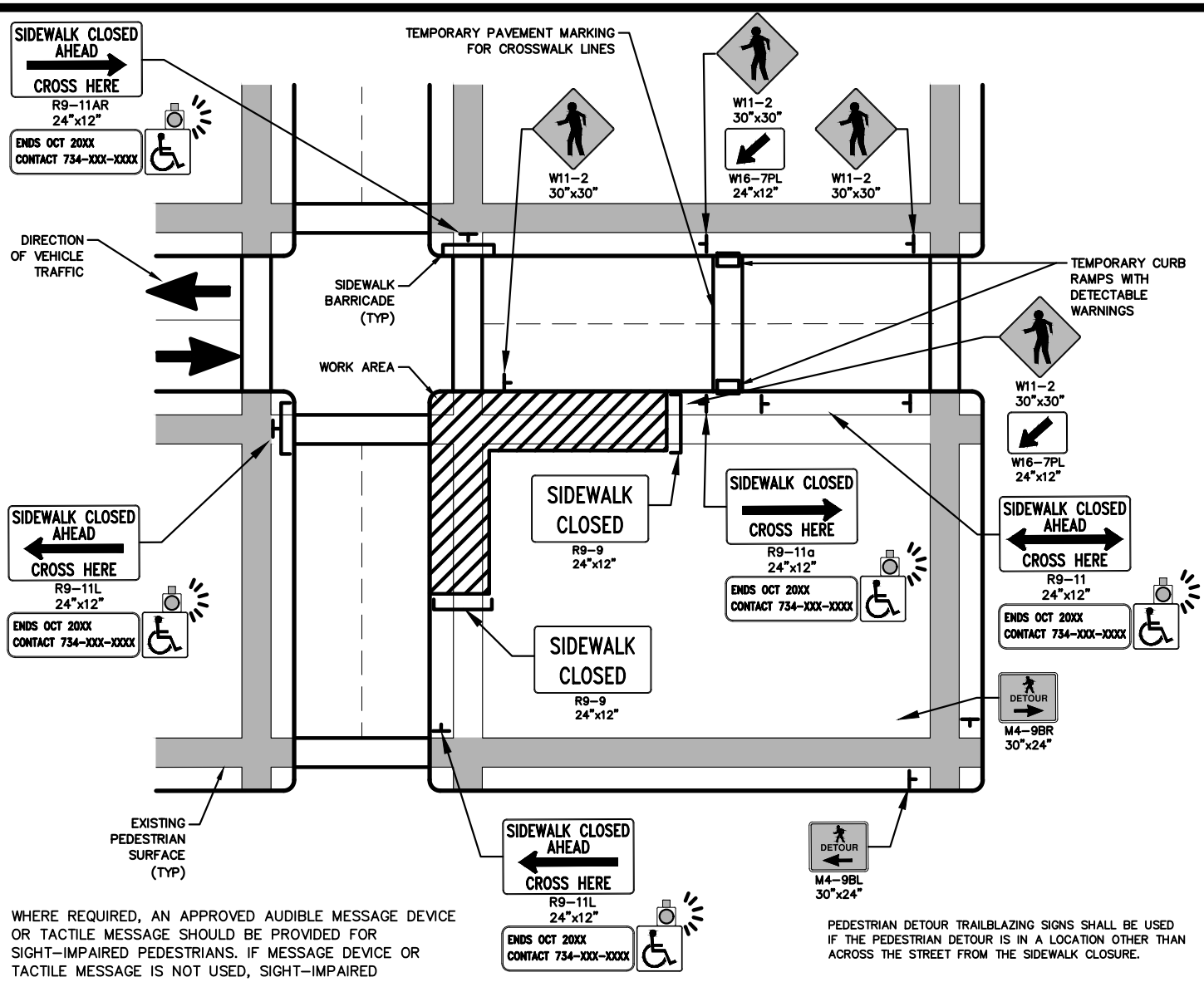
TEMPORARY PEDESTRIAN FACILIITES
PEDESTRIAN DETOUR USING OPPOSITE SIDE OF STREET

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REV. NO.	DATE	DRAWN BY	CHECKED BY

DETOUR 1

DR. DR.	CH. CH.	DRAWING NO.
SCALE N.T.S.	DATE 09/01/2025	**SD-TPR-1**



WHERE REQUIRED, AN APPROVED AUDIBLE MESSAGE DEVICE OR TACTILE MESSAGE SHOULD BE PROVIDED FOR SIGHT–IMPAIRED PEDESTRIANS. IF MESSAGE DEVICE OR TACTILE MESSAGE IS NOT USED, SIGHT–IMPAIRED PEDESTRIANS ARE TO BE DIRECTED THOUGH TEMPORARY PEDESTRIAN DETOUR BY MEANS OF DETECTABLE DIRECTIONAL TILES AND DETECTABLE WARNING SURFACES.

THE INTERNATIONAL SYMBOL OF ACCESSIBILITY MAY BE DISPLAYED WHEN ANY WALKWAY THROUGH A WORK ZONE HAS BEEN DETERMINED TO BE TPAR COMPLIANT. THE SYMBOL OF ACCESSIBILITY SHALL NOT BE DISPLAYED IF PERSONS WITH DISABILITIES SHOULD NOT USE THE PRIMARY TEMPORARY PEDESTRIAN DETOUR.

TYPICAL SIGN MESSAGE FOR A TEMPORARY PEDESTRIAN DETOUR SHOULD INCLUDE INFORMATION SUCH AS THE DURATION OF THE WALKWAY RESTRICTIONS (BEGINNING AND/OR END DATES) AND A PROJECT CONTACT NUMBER FOR 24/7 QUESTIONS OR REPORTING HAZARDS.

PEDESTRIAN DETOUR TRAILBLAZING SIGNS SHALL BE USED IF THE PEDESTRIAN DETOUR IS IN A LOCATION OTHER THAN ACROSS THE STREET FROM THE SIDEWALK CLOSURE.

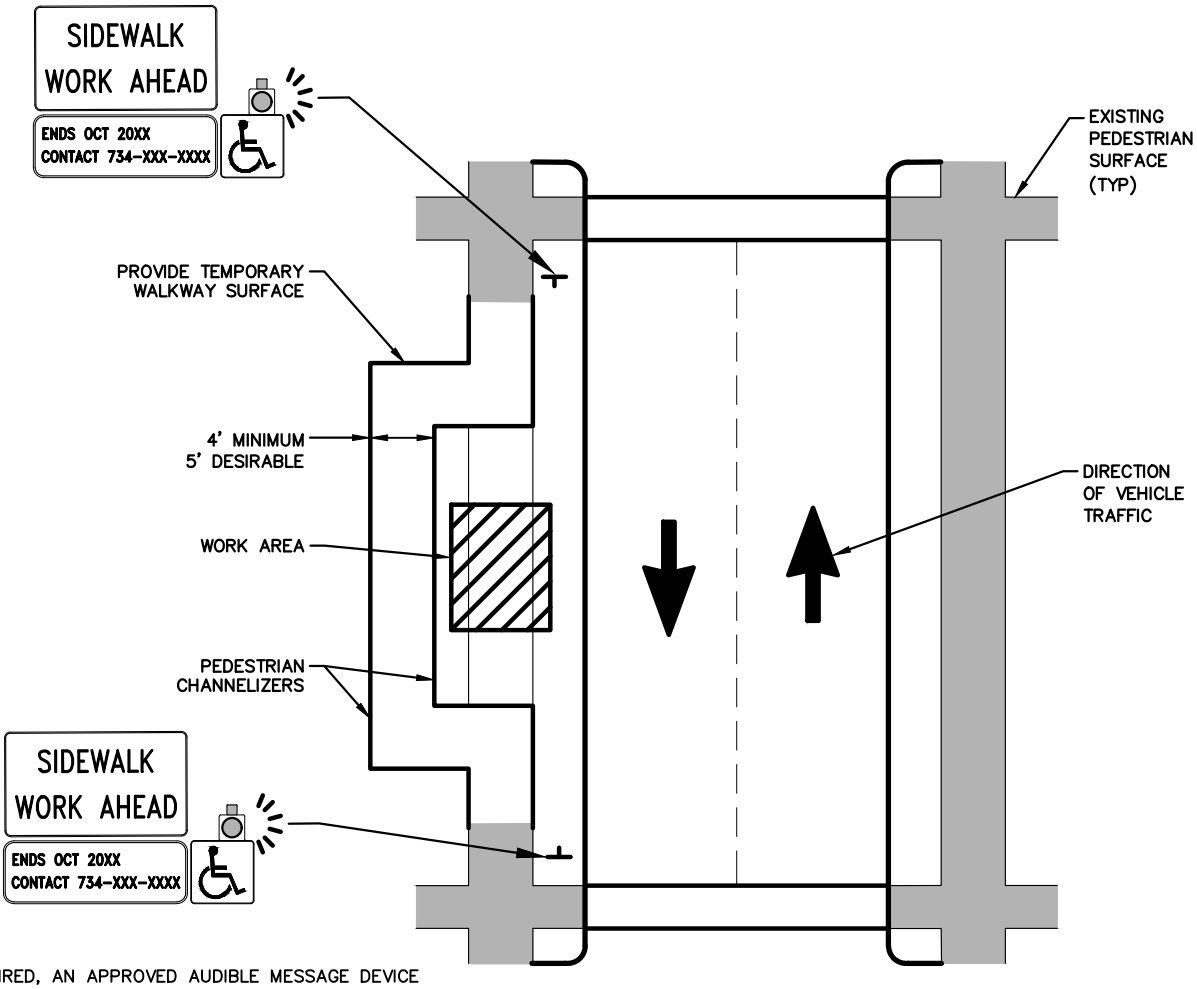
TEMPORARY PEDESTRIAN FACILITIES
OTHER SIDE OF STREET DETOUR OR DETOUR WITH TRAILBLAZING SIGNS
(FOR CORNER SIDEWALK CLOSURE WITH OPTIONAL TEMPORARY CROSSWALK)

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REV. NO.	DATE	DRAWN BY	CHECKED BY

DETOUR 2

DR. DR.	CH. CH.	DRAWING NO.
SCALE N.T.S.	DATE 09/01/2025	**SD-TPR-2**



WHERE REQUIRED, AN APPROVED AUDIBLE MESSAGE DEVICE OR TACTILE MESSAGE SHOULD BE PROVIDED FOR SIGHT–IMPAIRED PEDESTRIANS. IF MESSAGE DEVICE OR TACTILE MESSAGE IS NOT USED, SIGHT–IMPAIRED PEDESTRIANS ARE TO BE DIRECTED THOUGH TEMPORARY PEDESTRIAN DETOUR BY MEANS OF DETECTABLE DIRECTIONAL TILES AND DETECTABLE WARNING SURFACES.

THE INTERNATIONAL SYMBOL OF ACCESSIBILITY MAY BE DISPLAYED WHEN ANY WALKWAY THROUGH A WORK ZONE HAS BEEN DETERMINED TO BE TPAR COMPLIANT. THE SYMBOL OF ACCESSIBILITY SHALL NOT BE DISPLAYED IF PERSONS WITH DISABILITIES SHOULD NOT USE THE PRIMARY TEMPORARY PEDESTRIAN DETOUR.

TYPICAL SIGN MESSAGE FOR A TEMPORARY PEDESTRIAN DETOUR SHOULD INCLUDE INFORMATION SUCH AS THE DURATION OF THE WALKWAY RESTRICTIONS (BEGINNING AND/OR END DATES) AND A PROJECT CONTACT NUMBER FOR 24/7 QUESTIONS OR REPORTING HAZARDS.

TEMPORARY PEDESTRIAN FACILITIES
BYPASS ON ADJACENT AVAILABLE RIGHT-OF-WAY
BYPASS TYPE A

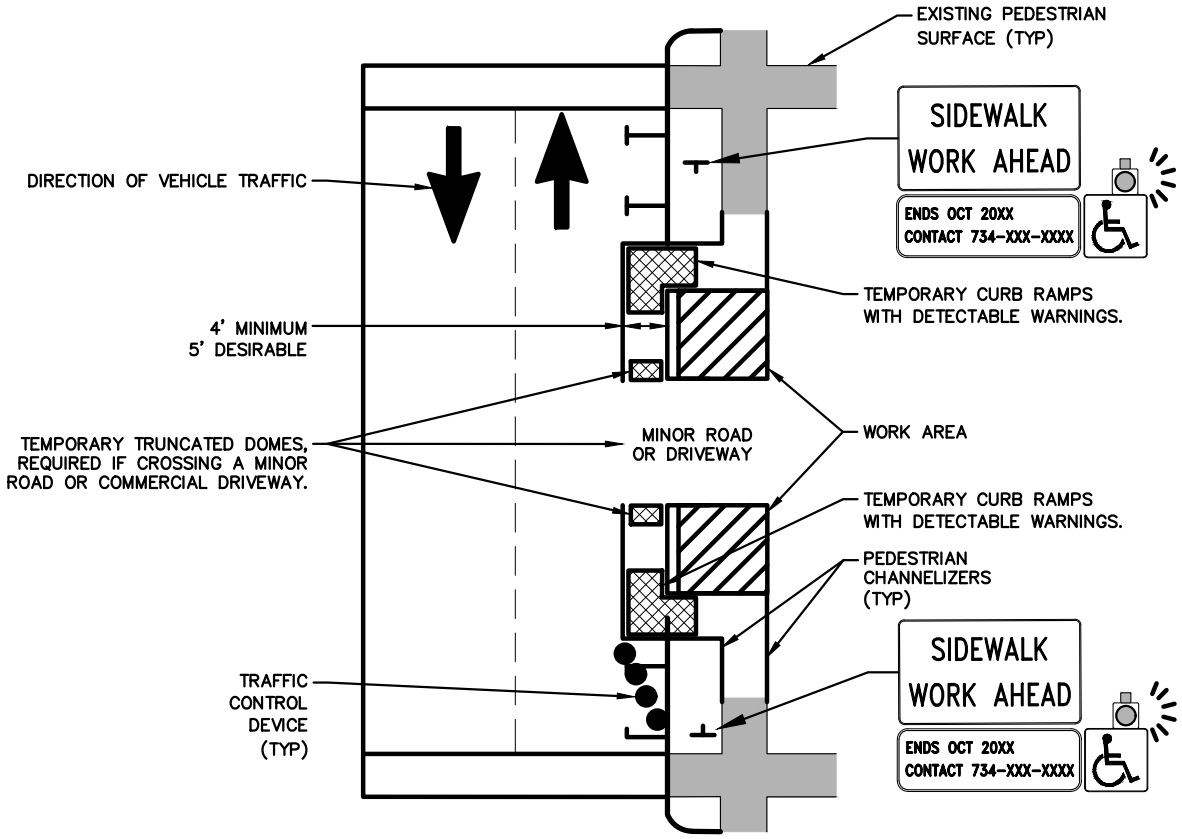
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BYPASS A

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SCALE N.T.S.	DATE 09/01/2025	**SD-TPR-3**

NOTE: MAY ONLY BE USED ON ROADWAY WITH POSTED SPEED OF 45 MPH OR LESS.



WHERE REQUIRED, AN APPROVED AUDIBLE MESSAGE DEVICE OR TACTILE MESSAGE SHOULD BE PROVIDED FOR SIGHT–IMPAIRED PEDESTRIANS. IF MESSAGE DEVICE OR TACTILE MESSAGE IS NOT USED, SIGHT–IMPAIRED PEDESTRIANS ARE TO BE DIRECTED THOUGH TEMPORARY PEDESTRIAN DETOUR BY MEANS OF DETECTABLE DIRECTIONAL TILES AND DETECTABLE WARNING SURFACES.

THE INTERNATIONAL SYMBOL OF ACCESSIBILITY MAY BE DISPLAYED WHEN ANY WALKWAY THROUGH A WORK ZONE HAS BEEN DETERMINED TO BE TPAR COMPLIANT. THE SYMBOL OF ACCESSIBILITY SHALL NOT BE DISPLAYED IF PERSONS WITH DISABILITIES SHOULD NOT USE THE PRIMARY TEMPORARY PEDESTRIAN DETOUR.

TYPICAL SIGN MESSAGE FOR A TEMPORARY PEDESTRIAN DETOUR SHOULD INCLUDE INFORMATION SUCH AS THE DURATION OF THE WALKWAY RESTRICTIONS (BEGINNING AND/OR END DATES) AND A PROJECT CONTACT NUMBER FOR 24/7 QUESTIONS OR REPORTING HAZARDS.

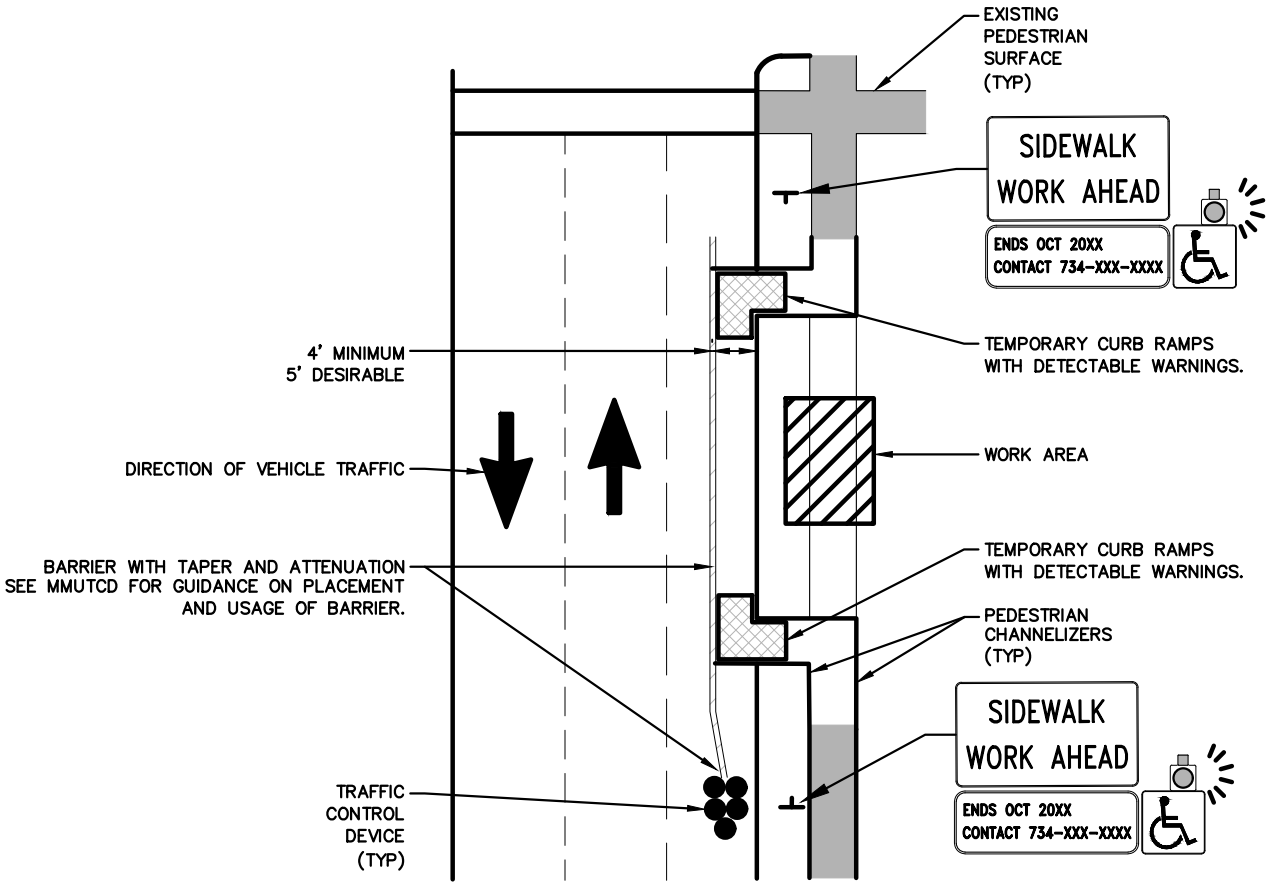
TEMPORARY PEDESTRIAN FACILITIES
SIDEWALK BYPASS USING PARKING OR SHOULDER ON LOW SPEED ROADWAY
BYPASS TYPE B

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BYPASS B

DR. DR.	CH. CH.	DRAWING NO. **SD-TPR-4**
SCALE N.T.S.	DATE 09/01/2025	



WHERE REQUIRED, AN APPROVED AUDIBLE MESSAGE DEVICE OR TACTILE MESSAGE SHOULD BE PROVIDED FOR SIGHT-IMPAIRED PEDESTRIANS. IF MESSAGE DEVICE OR TACTILE MESSAGE IS NOT USED, SIGHT-IMPAIRED PEDESTRIANS ARE TO BE DIRECTED THOUGH TEMPORARY PEDESTRIAN DETOUR BY MEANS OF DETECTABLE DIRECTIONAL TILES AND DETECTABLE WARNING SURFACES.

THE INTERNATIONAL SYMBOL OF ACCESSIBILITY MAY BE DISPLAYED WHEN ANY WALKWAY THROUGH A WORK ZONE HAS BEEN DETERMINED TO BE TPAR COMPLIANT. THE SYMBOL OF ACCESSIBILITY SHALL NOT BE DISPLAYED IF PERSONS WITH DISABILITIES SHOULD NOT USE THE PRIMARY TEMPORARY PEDESTRIAN DETOUR.

TYPICAL SIGN MESSAGE FOR A TEMPORARY PEDESTRIAN DETOUR SHOULD INCLUDE INFORMATION SUCH AS THE DURATION OF THE WALKWAY RESTRICTIONS (BEGINNING AND/OR END DATES) AND A PROJECT CONTACT NUMBER FOR 24/7 QUESTIONS OR REPORTING HAZARDS.

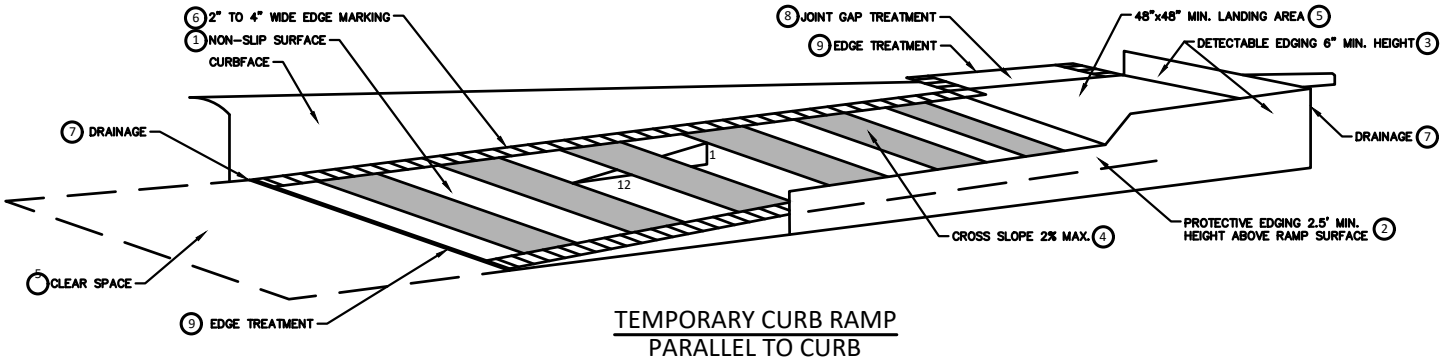
TEMPORARY PEDESTRIAN FACILITIES
SIDEWALK BYPASS USING SHOULDER OR PARKING LANE ON HIGH SPEED ROADWAY
BYPASS TYPE C

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BYPASS C

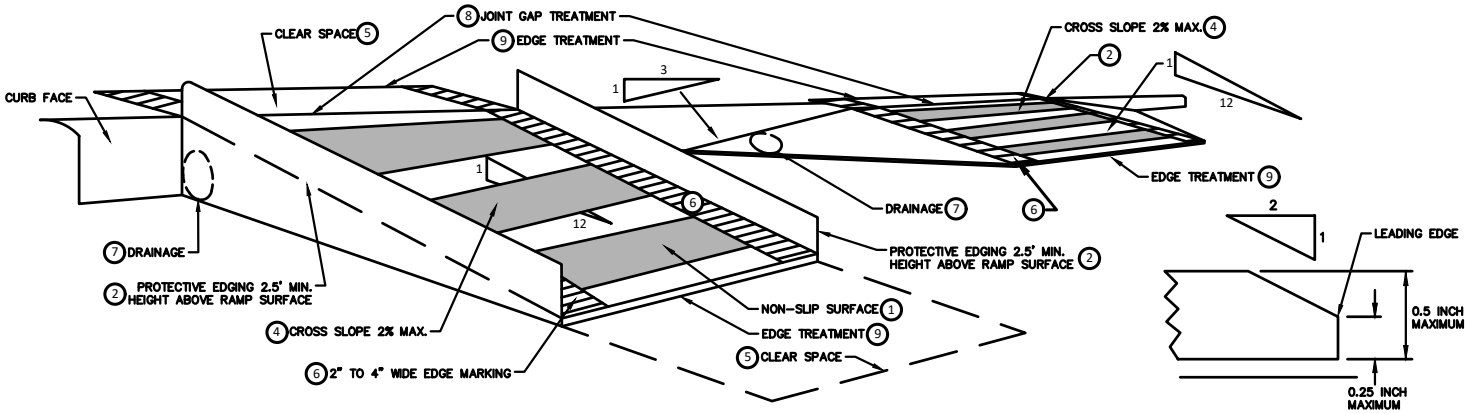
DR. DR.	CH. CH.	DRAWING NO.
SCALE N.T.S.	DATE 09/01/2025	**SD-TPR-5**



TEMPORARY CURB RAMP
PARALLEL TO CURB

SHOWN WITH PROTECTIVE EDGE

SHOWN WITH SIDE APRON



9 EDGE TREATMENT

TEMPORARY CURB RAMP
PERPENDICULAR TO CURB

SPECIFIC NOTES

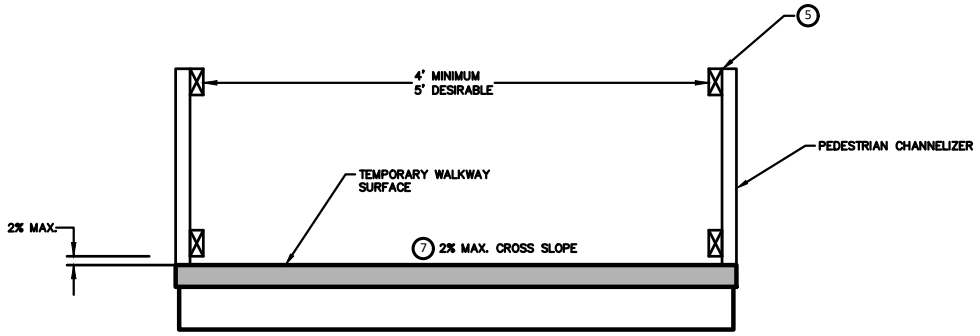
1. CURB RAMPS SHALL BE 48" MIN. WIDTH WITH A FIRM, STABLE AND SLIP RESISTANT SURFACE.
2. PROTECTIVE EDGING WITH A 2.5" MIN. HEIGHT ABOVE THE RAMP SHALL BE PLACED WHEN A CURB RAMP OR LANDING PLATFORM HAS A VERTICAL DROP OF 6" OR GREATER OR HAS A SIDE APRON SLOPE STEEPER THAN 1:3. PROTECTIVE EDGING SHOULD BE CONSIDERED WHEN CURB RAMPS OR LANDING PLATFORMS HAVE A VERTICAL DROP OF 3" OR MORE.
3. DETECTABLE EDGING ANYTIME A HANDRAIL IS REQUIRED, AND ANYTIME THE PATH CHANGES DIRECTION. THIS INCLUDES A TURN ONTO THE RAMP FROM THE PATH. DETECTABLE EDGING MUST BEGIN A MAXIMUM OF 2.5" ABOVE THE RAMP SURFACE, AND EXTEND AT LEAST 6" ABOVE THE RAMP SURFACE. CONTRASTING COLOR SHALL BE PLACED ON ALL CURB RAMP LANDINGS WHERE THE WALKWAY CHANGES DIRECTION (TURNS).
4. CURB RAMPS AND LANDINGS SHALL HAVE A 2% MAX. CROSS SLOPE.
5. CLEAR SPACE OF 48" x 48" MIN. SHALL BE PROVIDED ABOVE AND BELOW THE CURB RAMP.
6. THE CURB RAMP WALKWAY EDGE SHALL BE MARKED WITH A CONTRASTING COLOR, 2" TO 4" WIDE MARKING. THE MARKING IS OPTIONAL WHERE COLOR CONTRASTING EDGING IS USED.
7. WATER FLOW IN THE GUTTER SYSTEM SHALL NOT BE IMPEDED.
8. LATERAL JOINTS OR GAPS BETWEEN SURFACES SHALL BE LESS THAN 1/2" WIDTH.
9. CHANGES BETWEEN SURFACE HEIGHTS SHALL NOT EXCEED 1/2". LATERAL EDGES SHOULD BE VERTICAL UP TO 1/4" HIGH, AND BEVELED AT 1:2 BETWEEN 1/4" AND 1/2" HEIGHT.

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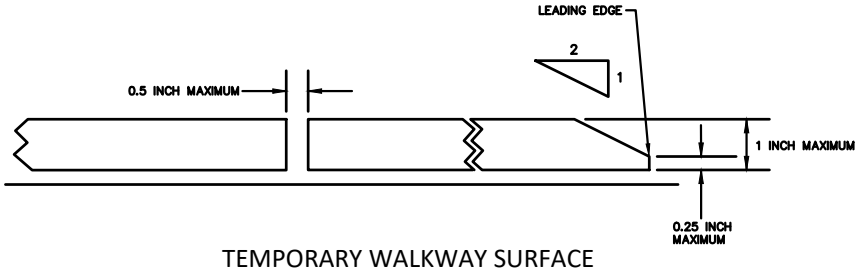
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TEMPORARY RAMPS

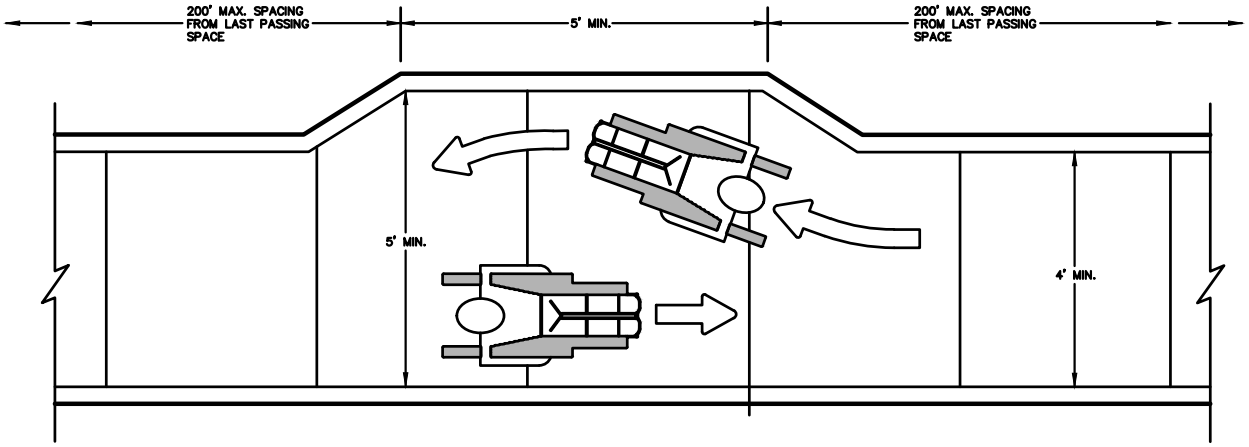
DR. DR.	CH. CH.	DRAWING NO.
SCALE N.T.S.	DATE 09/01/2025	**SD-TPR-6**



TEMPORARY PEDESTRIAN ACCESS



TEMPORARY WALKWAY SURFACE



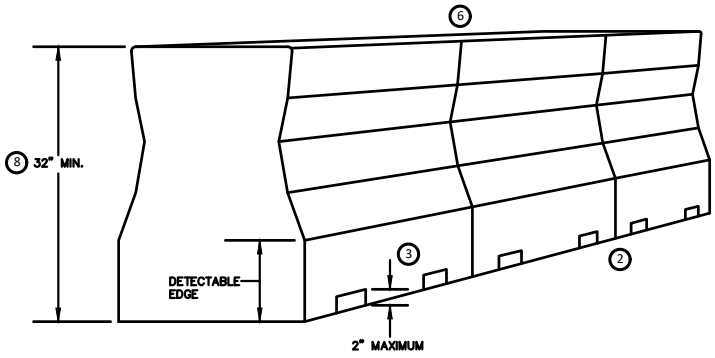
NARROW TEMPORARY PEDESTRIAN ACCESS ROUTE PASSING DETAIL

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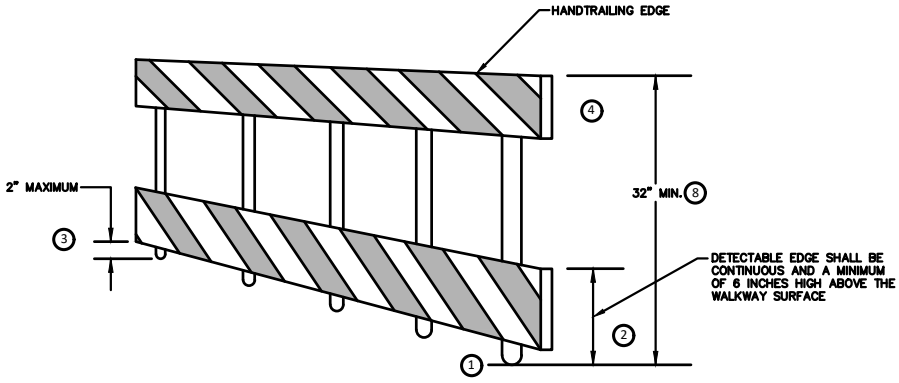
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WALKWAY DEVICES 1

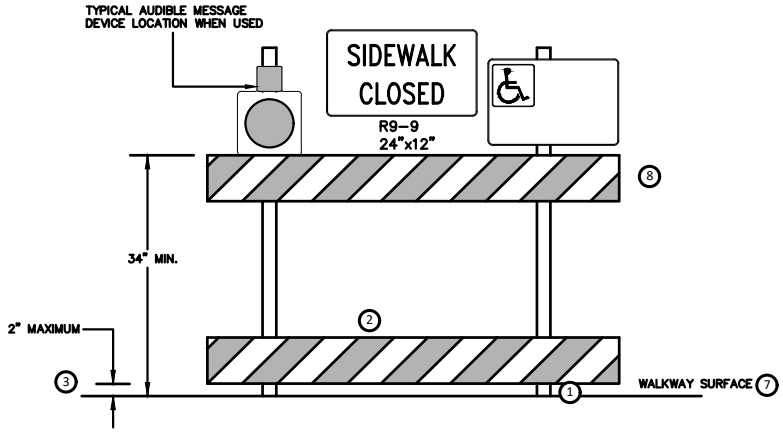
DR. DR.	CH. CH.	DRAWING NO.
SCALE N.T.S.	DATE 09/01/2025	**SD-TPR-7**



PEDESTRIAN CHANNELIZER USING A BARRIER
(MINIMUM REQUIREMENTS)



PEDESTRIAN CHANNELIZER
(MINIMUM REQUIREMENTS)



SIDEWALK BARRICADE

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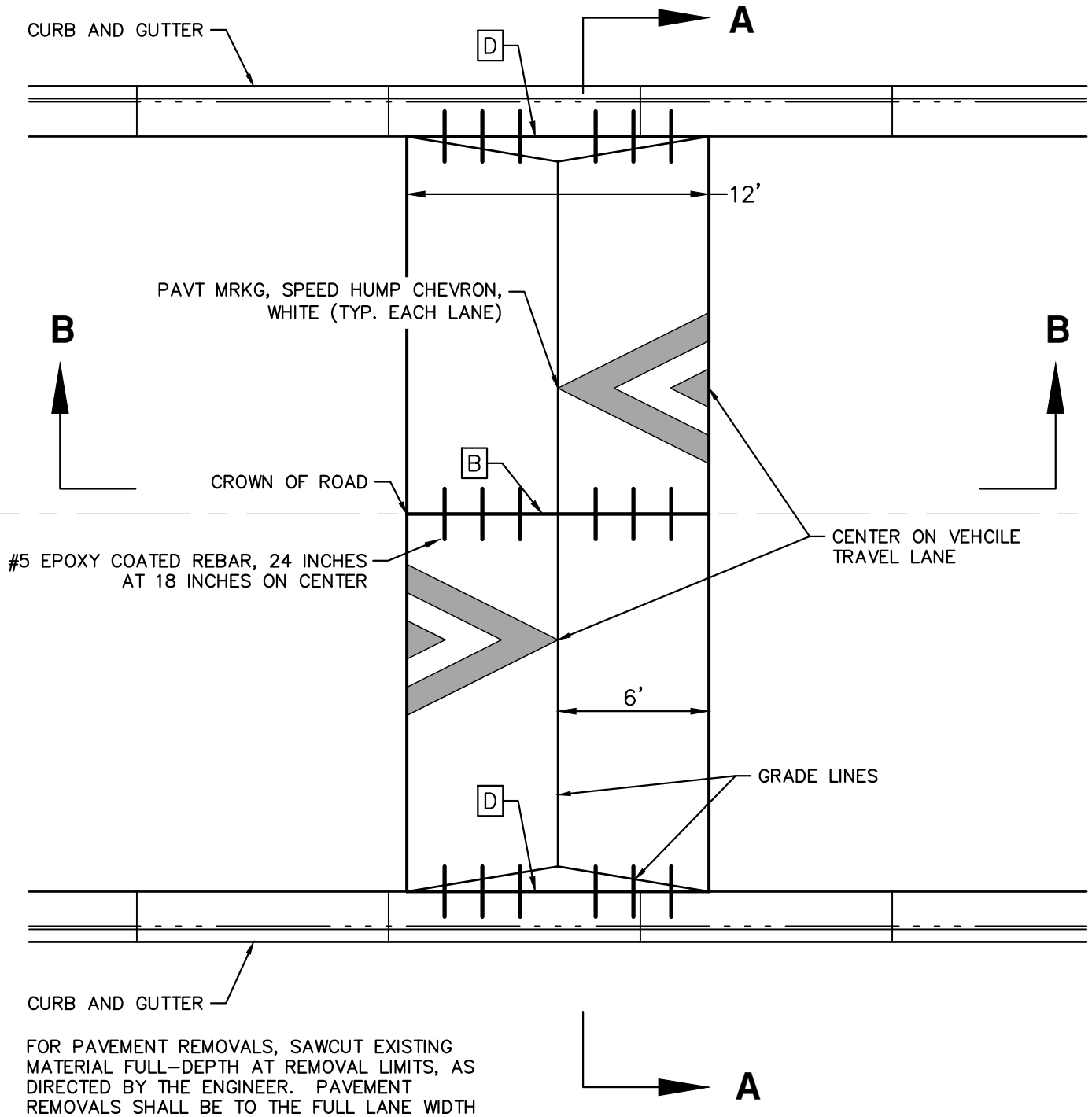
WALKWAY DEVICES 2

DR. DR.	CH. CH.	DRAWING NO. SD-TPR-8
SCALE N.T.S.	DATE 09/01/2025	

CONCRETE JOINT LEGEND:

B – LONGITUDINAL BULKHEAD JOINT, SEALED ACCORDING TO MDOT STANDARD PLAN R–41 SERIES, SYMBOL (B)

D – LONGITUDINAL LANE TIE JOINT WITH TIE BARS, SEALED ACCORDING TO MDOT STANDARD PLAN R–41 SERIES, SYMBOL (D)



FOR PAVEMENT REMOVALS, SAWCUT EXISTING MATERIAL FULL–DEPTH AT REMOVAL LIMITS, AS DIRECTED BY THE ENGINEER. PAVEMENT REMOVALS SHALL BE TO THE FULL LANE WIDTH AND TO AN EXISTING CONCRETE JOINT.

PLAN VIEW

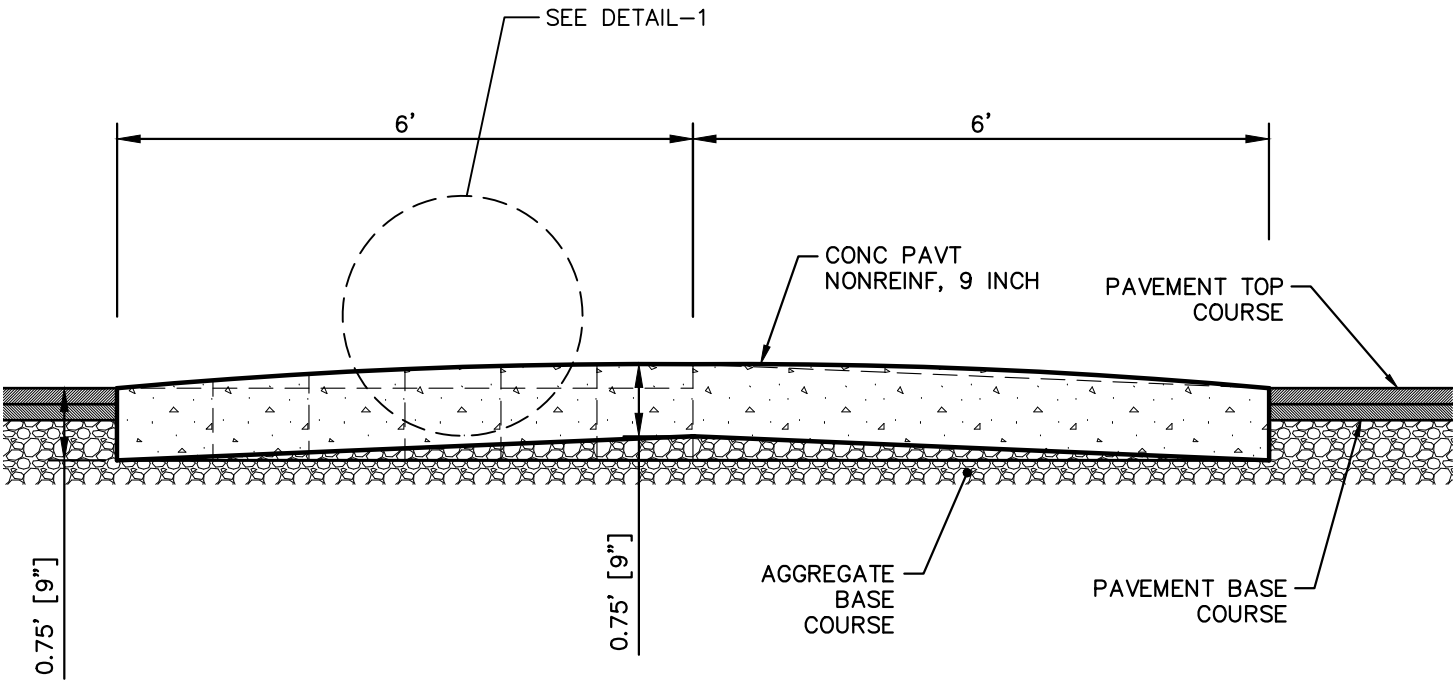
NOT TO SCALE

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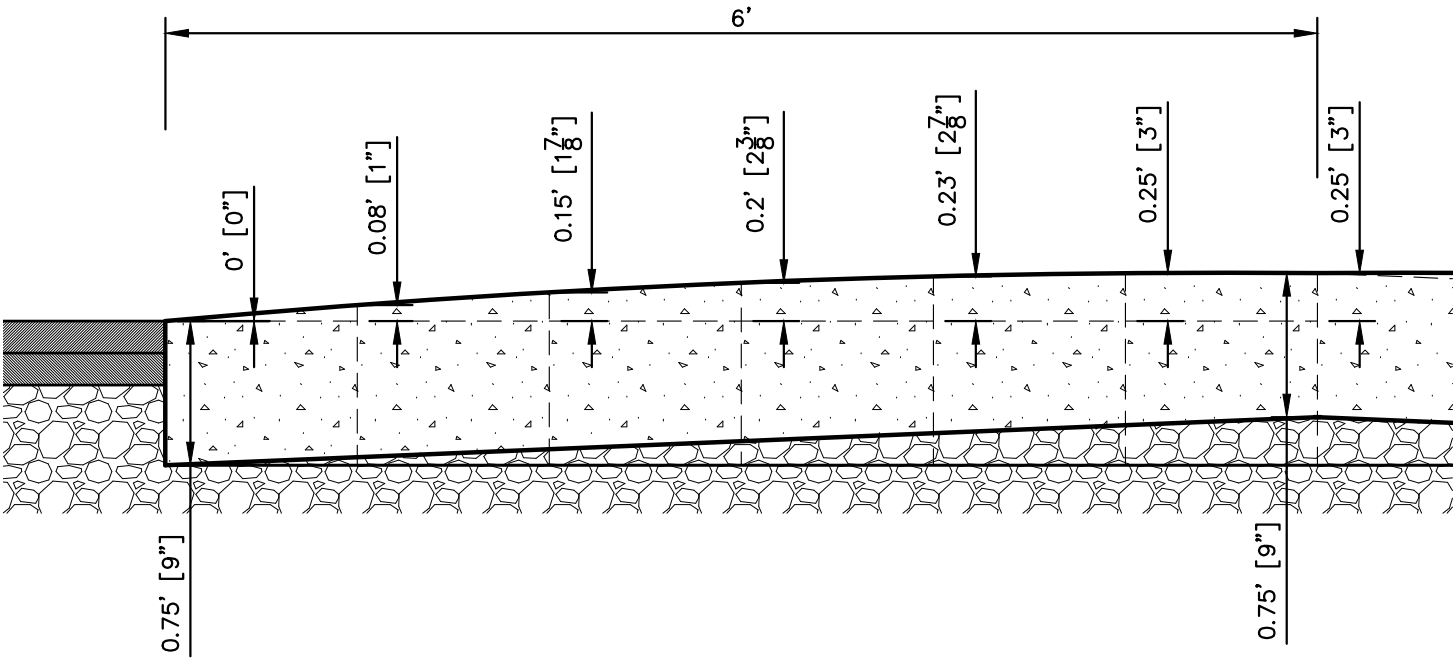
SPEED HUMP

DR. DR.	CH. CH.	DRAWING NO.
SCALE N.T.S.	DATE 09/01/2025	**SD-VT-1**



SECTION B-B

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DETAIL - 1

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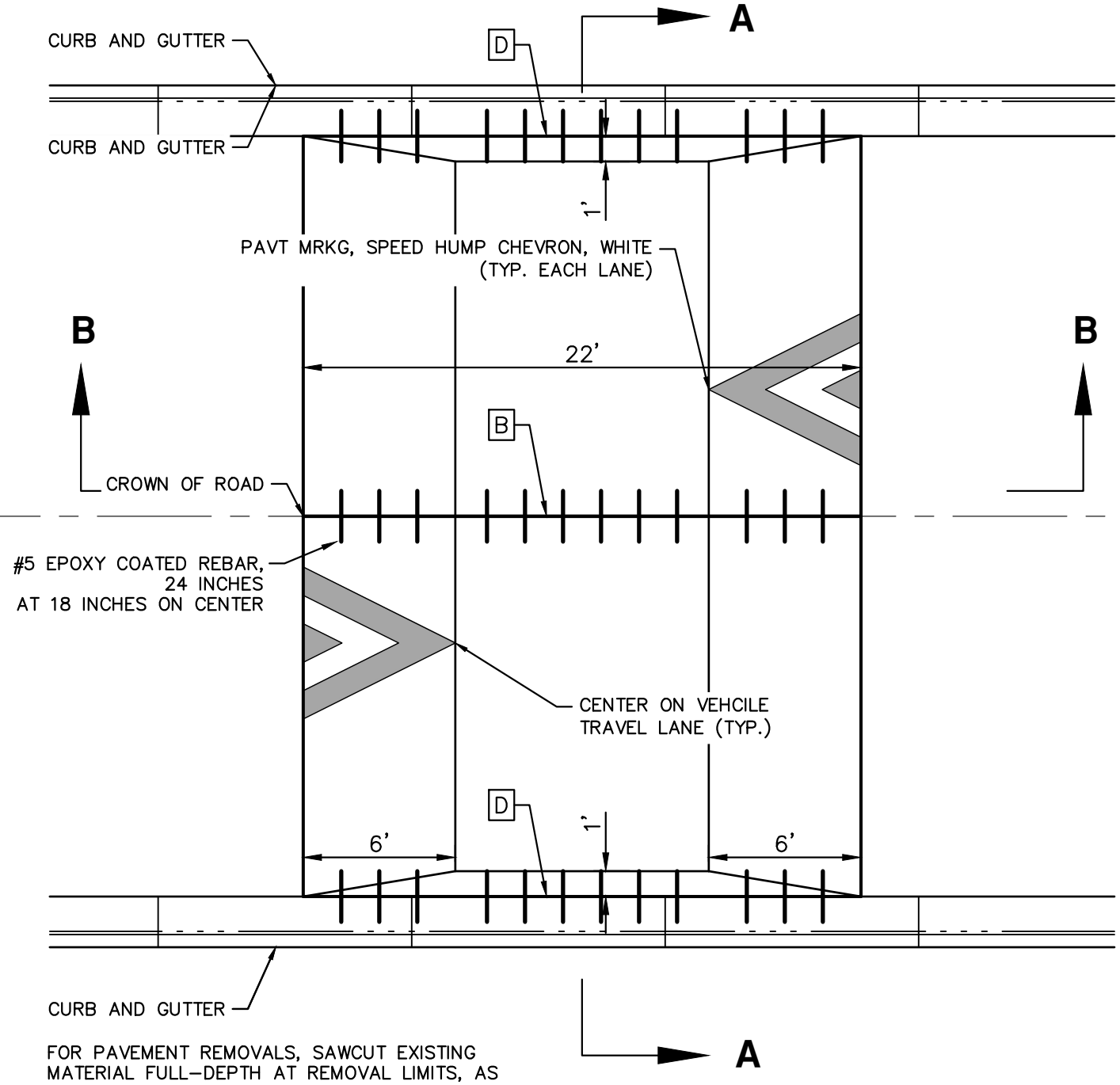
SPEED HUMP SECTION B-B & DETAIL 1

DR. DR.	CH. CH.	DRAWING NO. SD-VT-2
SCALE N.T.S.	DATE 09/01/2025	

CONCRETE JOINT LEGEND:

B – LONGITUDINAL BULKHEAD JOINT, SEALED ACCORDING TO MDOT STANDARD PLAN R-41 SERIES, SYMBOL (B)

D – LONGITUDINAL LANE TIE JOINT WITH TIE BARS, SEALED ACCORDING TO MDOT STANDARD PLAN R-41 SERIES, SYMBOL (D)



FOR PAVEMENT REMOVALS, SAWCUT EXISTING MATERIAL FULL-DEPTH AT REMOVAL LIMITS, AS DIRECTED BY THE ENGINEER. PAVEMENT REMOVALS SHALL BE TO THE FULL LANE WIDTH AND TO AN EXISTING CONCRETE JOINT.

PLAN VIEW

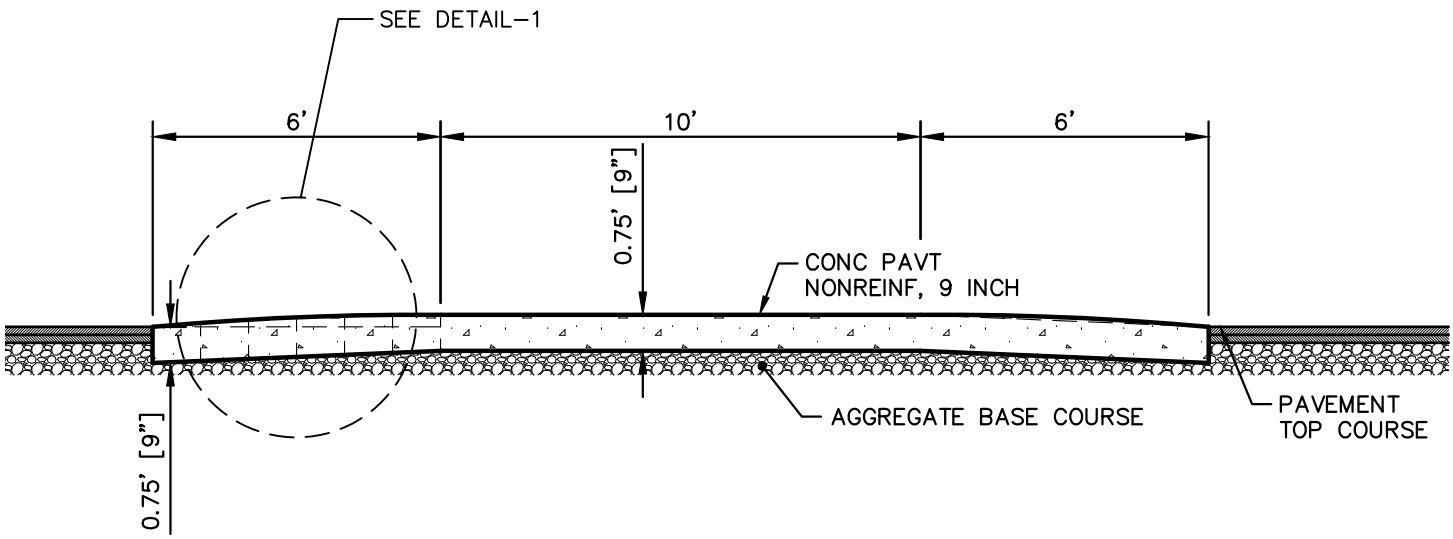
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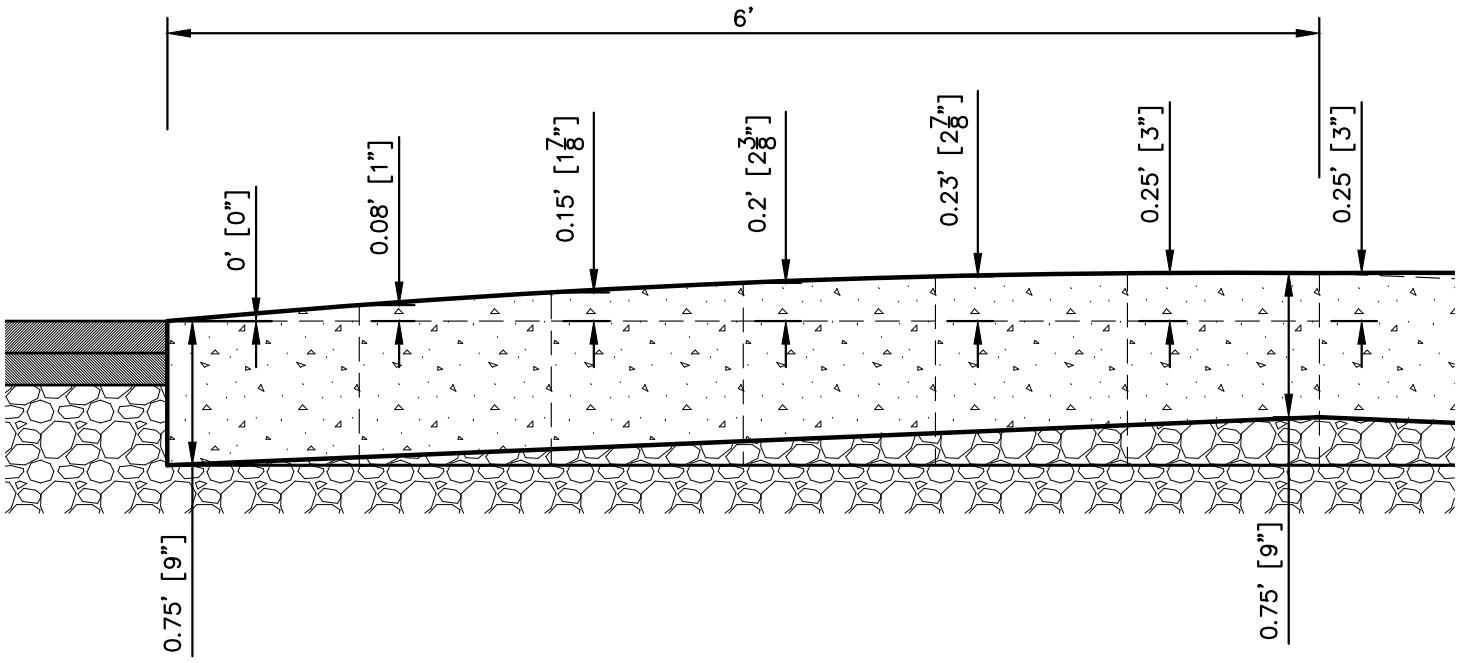
SPEED TABLE

DR. DR.	CH. CH.	DRAWING NO.
SCALE N.T.S.	DATE 09/01/2025	**SD-VT-3**



SECTION B-B

NOT TO SCALE



DETAIL - 1

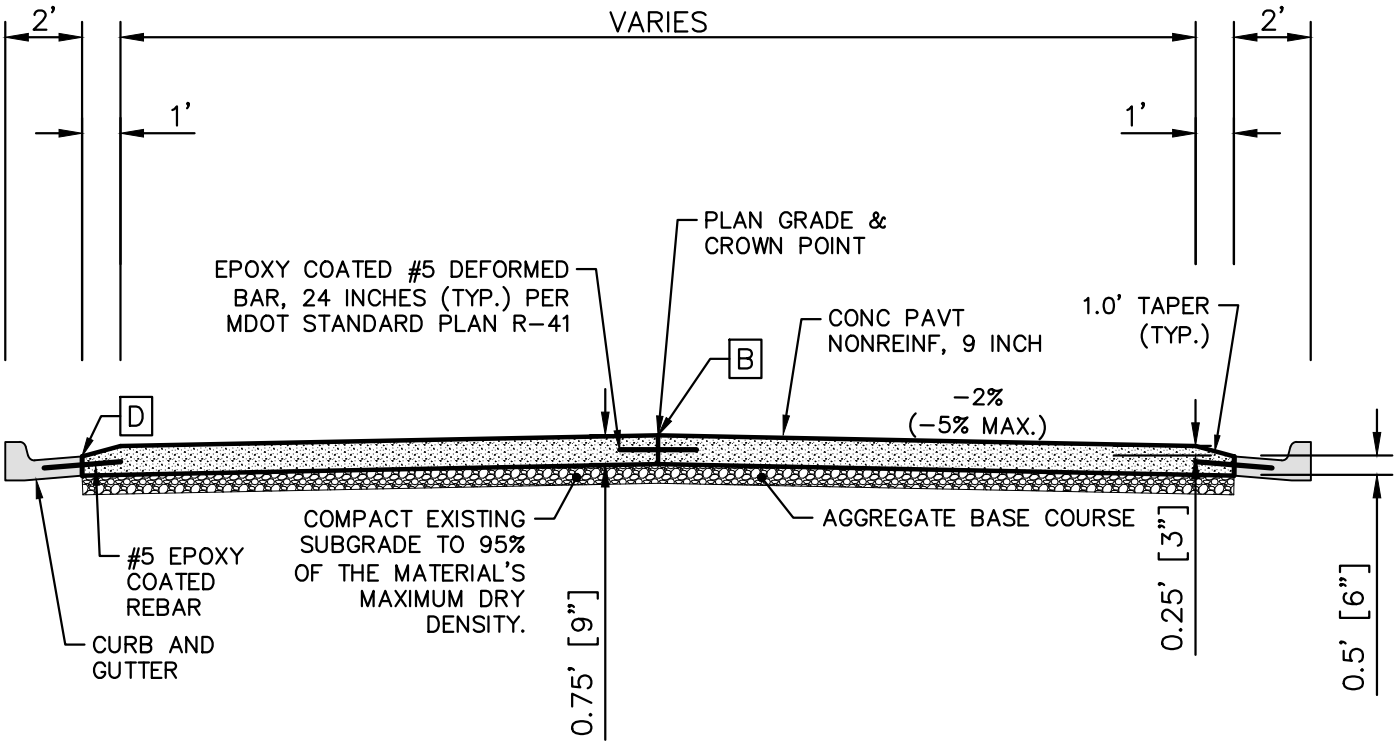
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SPEED TABLE SECTION B-B & DETAIL 1

DR. DR.	CH. CH.	DRAWING NO.
SCALE N.T.S.	DATE 09/01/2025	SD-VT-4



SECTION A-A

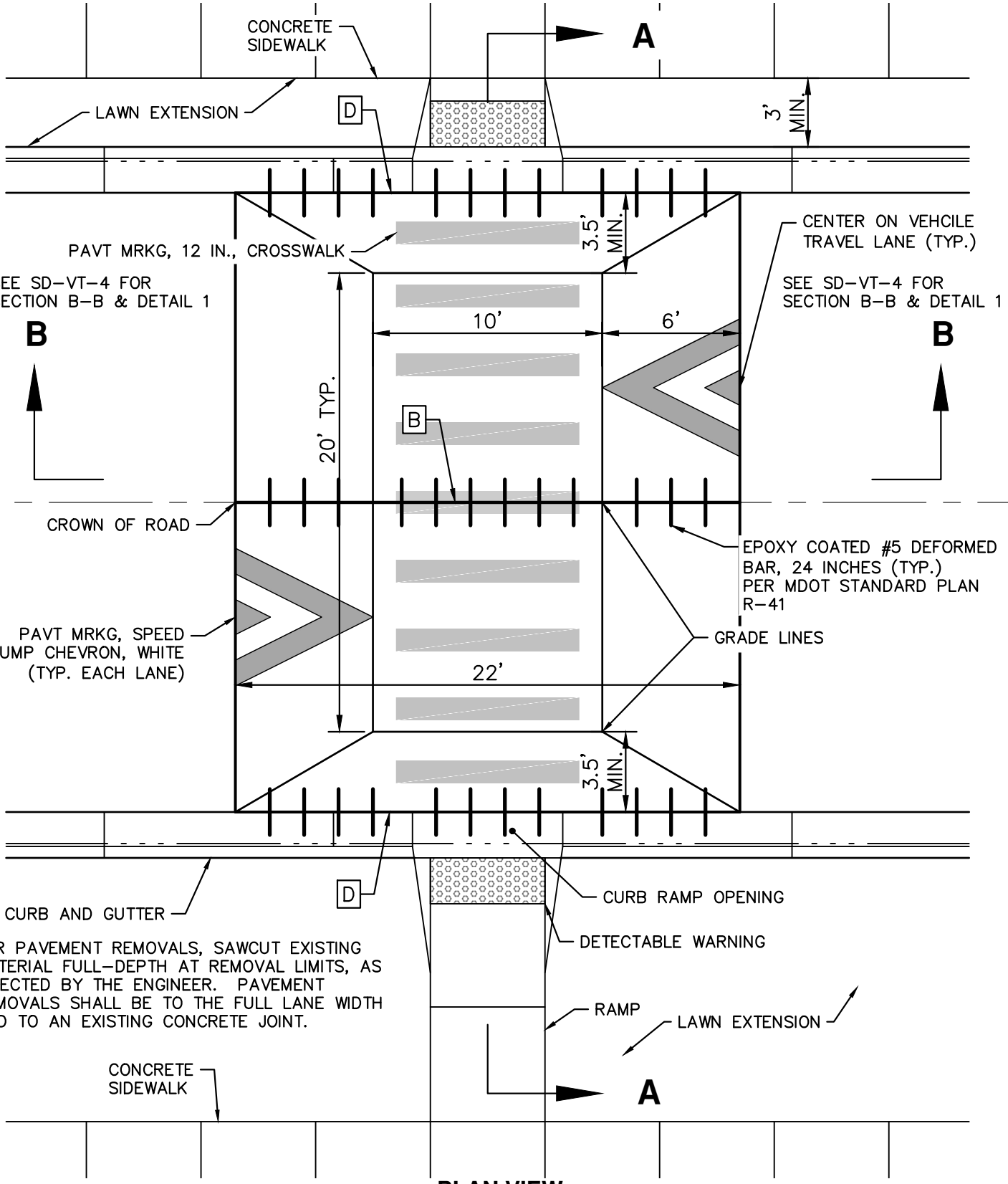
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SPEED HUMP & SPEED TABLE SECTION A-A

DR. DR.	CH. CH.	DRAWING NO.
SCALE N.T.S.	DATE 09/01/2025	**SD-VT-5**



FOR PAVEMENT REMOVALS, SAWCUT EXISTING MATERIAL FULL-DEPTH AT REMOVAL LIMITS, AS DIRECTED BY THE ENGINEER. PAVEMENT REMOVALS SHALL BE TO THE FULL LANE WIDTH AND TO AN EXISTING CONCRETE JOINT.

PLAN VIEW

NOT TO SCALE

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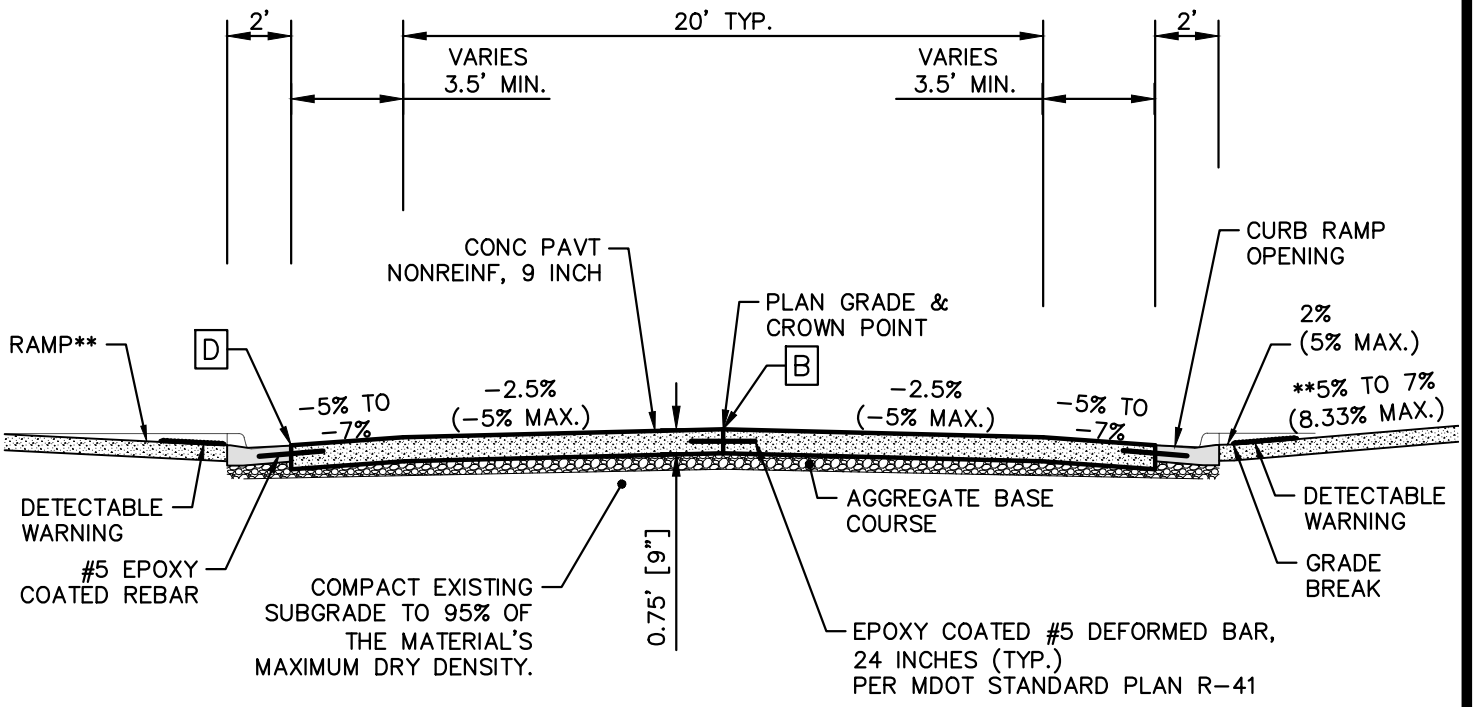
RAISED CROSSWALK

DR. DR.	CH. CH.	DRAWING NO.
SCALE N.T.S.	DATE 09/01/2025	**SD-VT-6**

CONCRETE JOINT LEGEND:

B – LONGITUDINAL BULKHEAD JOINT, SEALED ACCORDING TO MDOT STANDARD PLAN R–41 SERIES, SYMBOL (B)

D – LONGITUDINAL LANE TIE JOINT WITH TIE BARS, SEALED ACCORDING TO MDOT STANDARD PLAN R–41 SERIES, SYMBOL (D)



SECTION A-A

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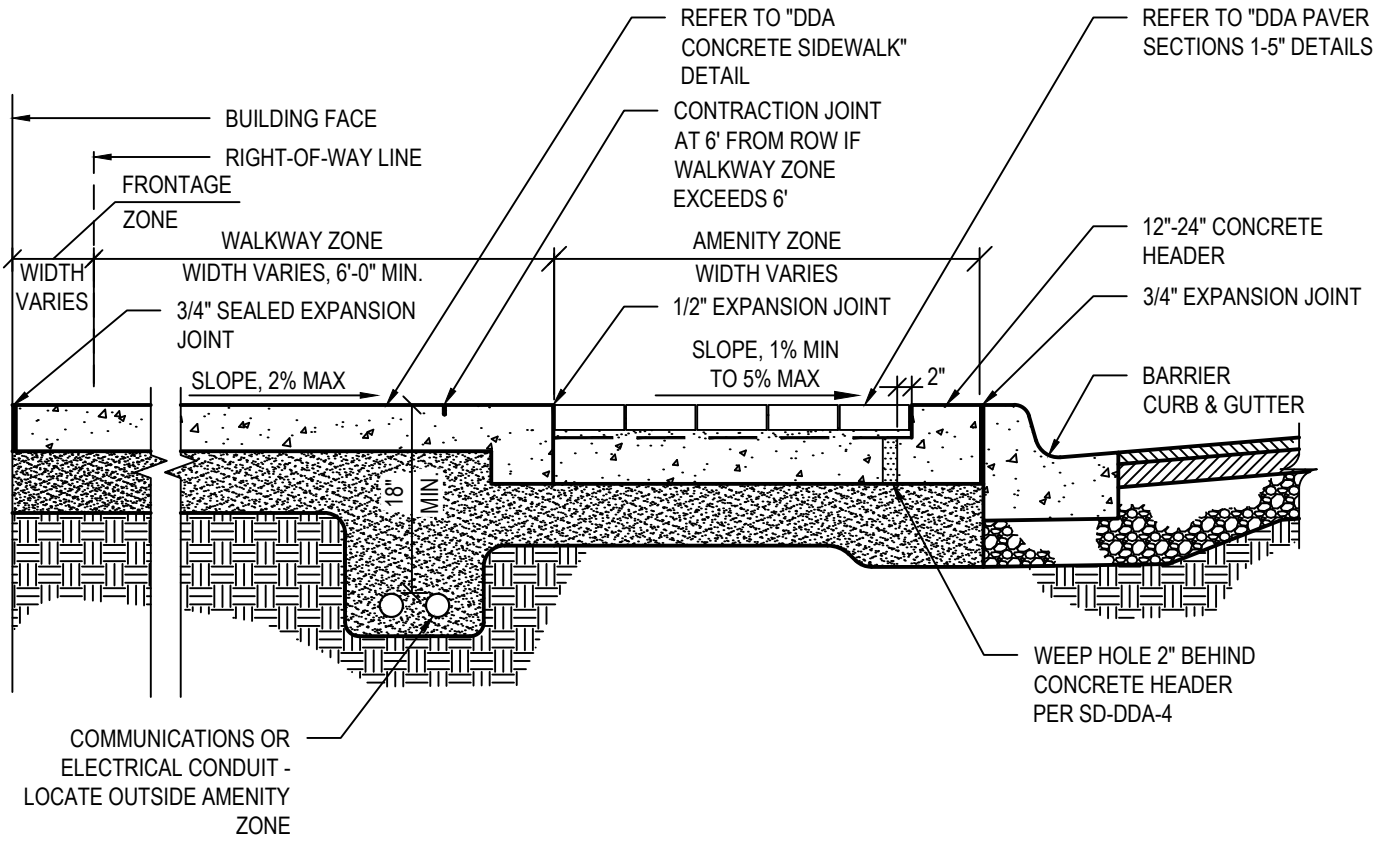
REV. NO.	DATE	DRAWN BY	CHECKED BY

RAISED CROSSWALK SECTION A-A

DR. DR.	CH. CH.	DRAWING NO.
SCALE N.T.S.	DATE 09/01/2025	SD-VT-7

NOTES:

1. REFER TO SITE PLAN FOR PROJECT SPECIFIC TYPES & LIMITS OF SURFACE MATERIALS.

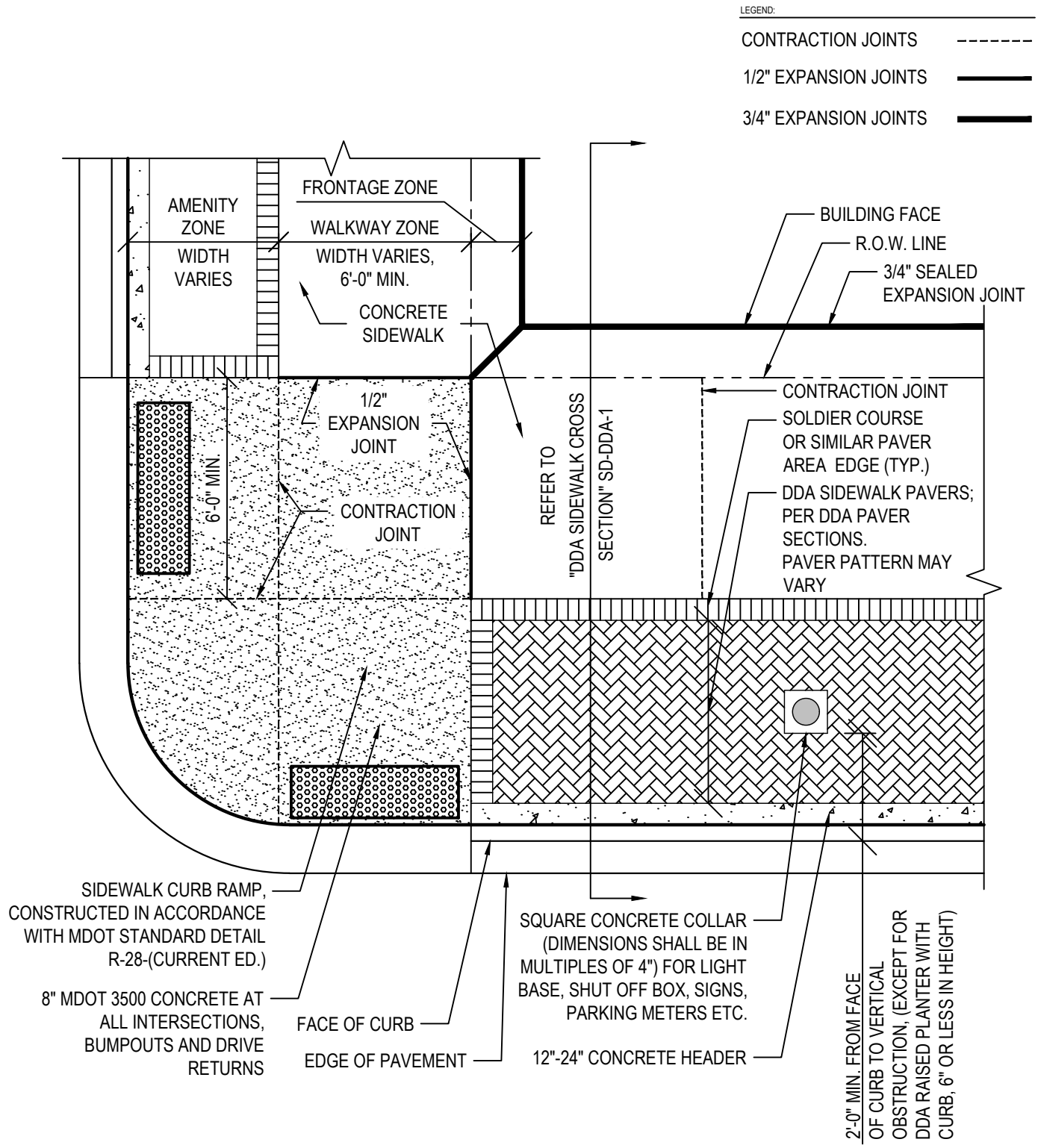


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DDA SIDEWALK CROSS SECTION

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-1**



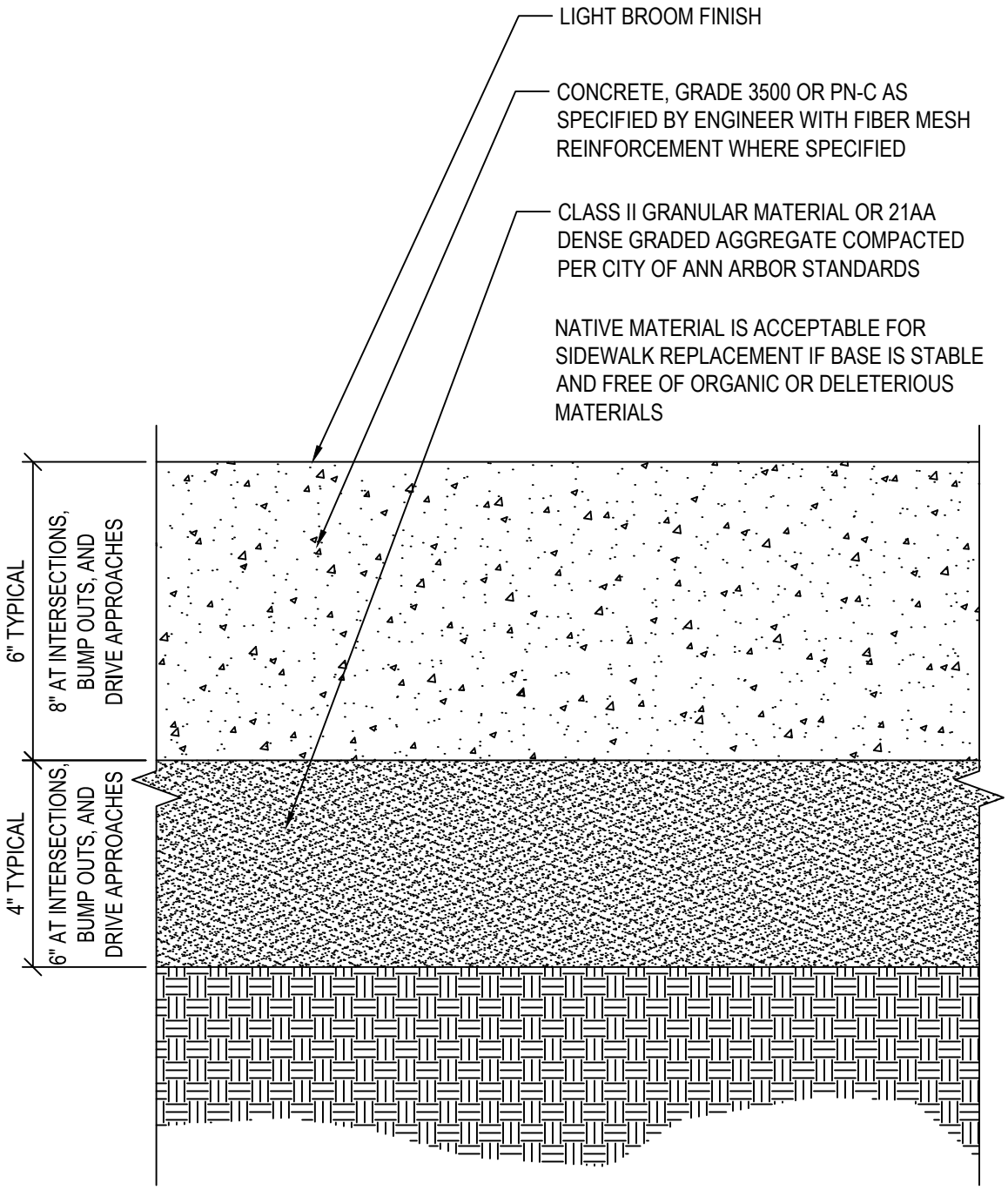
NOTES: ALL EXPANSION JOINTS SHALL BE SEALED IN THE DDA AREA.

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DDA SIDEWALK AND AMENITY ZONE PLAN VIEW

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-2**

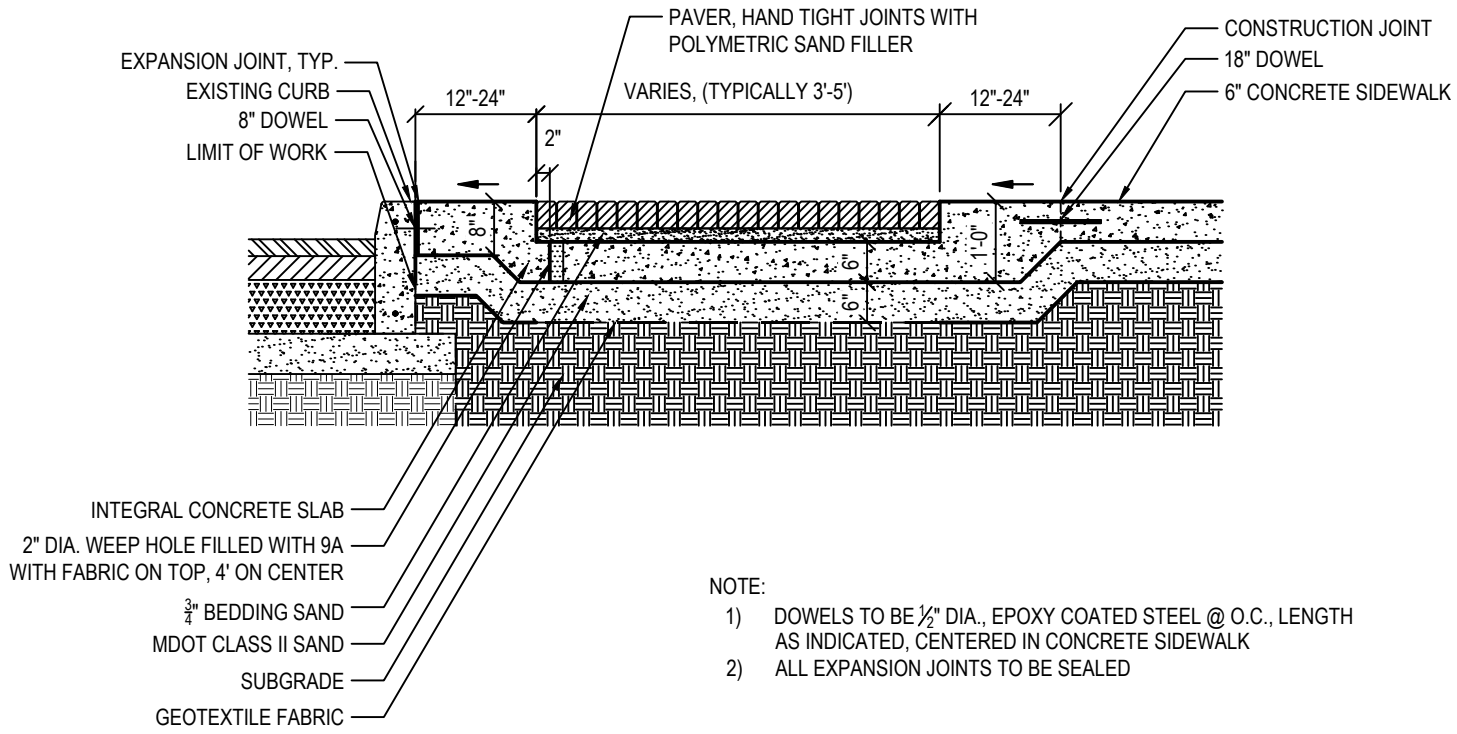


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DDA CONCRETE SIDEWALK

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-3**



NOTE:

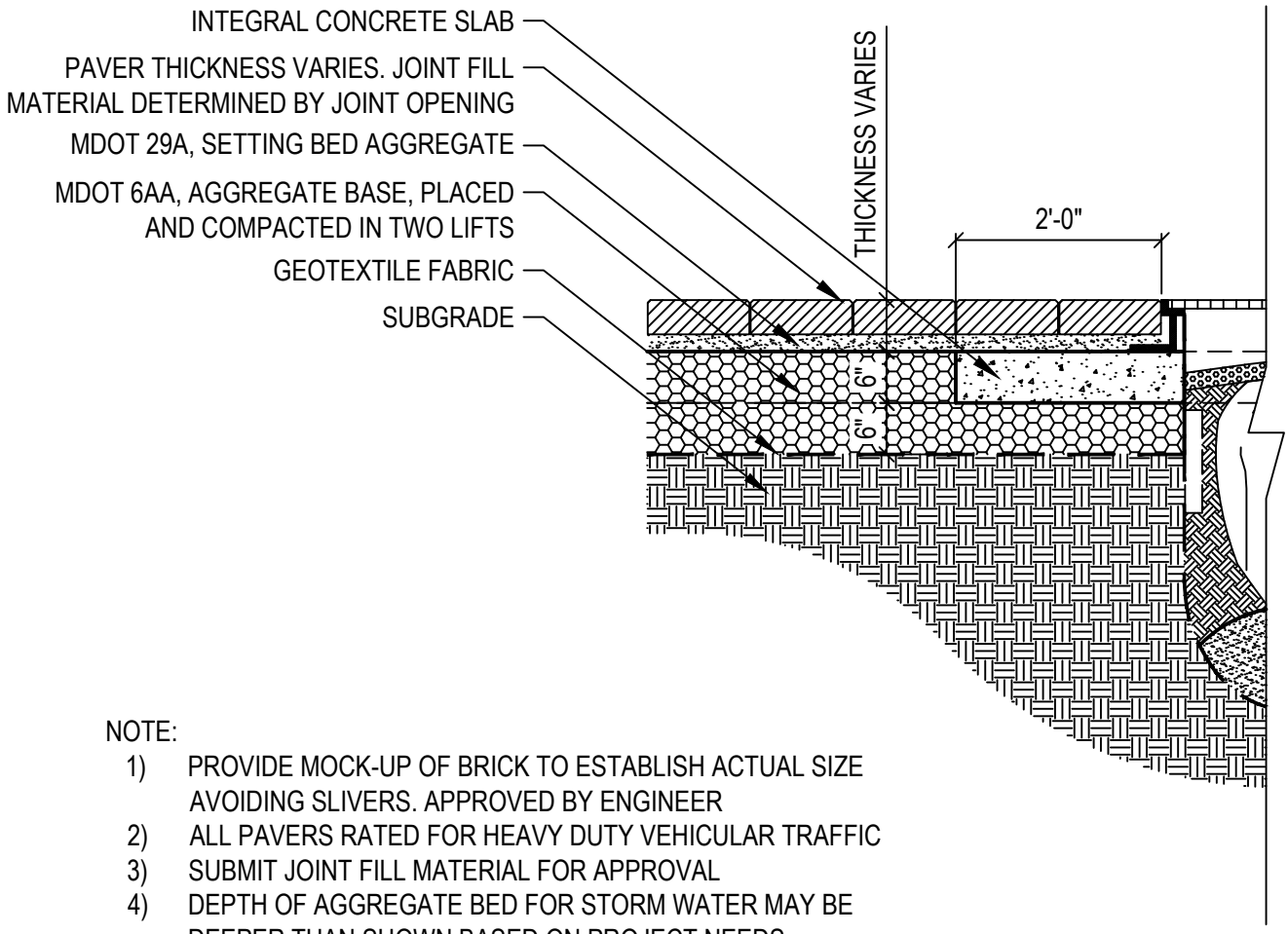
1) DOWELS TO BE ½" DIA., EPOXY COATED STEEL @ O.C., LENGTH AS INDICATED, CENTERED IN CONCRETE SIDEWALK
2) ALL EXPANSION JOINTS TO BE SEALED

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PAVER SECTION 1 - PAVERS ABOVE INTEGRAL CONCRETE SLAB

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-4**



NOTE:

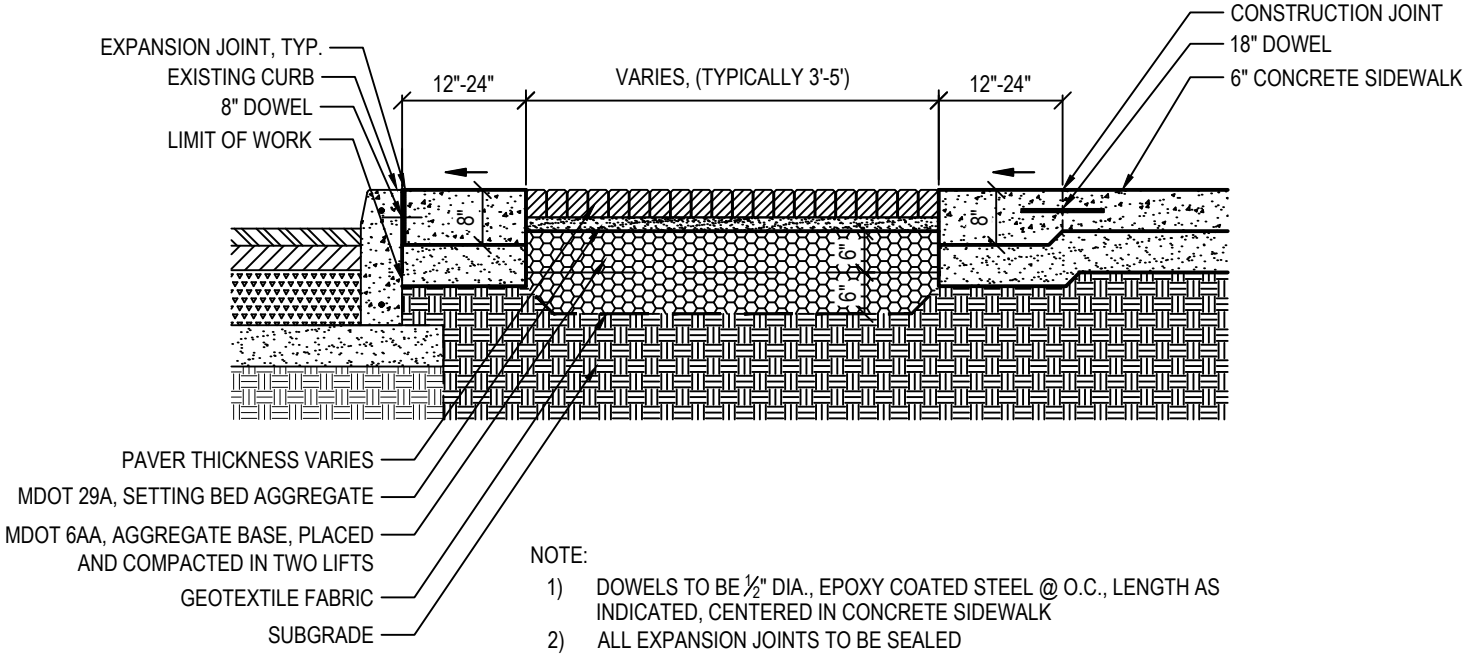
1) PROVIDE MOCK-UP OF BRICK TO ESTABLISH ACTUAL SIZE AVOIDING SLIVERS. APPROVED BY ENGINEER
2) ALL PAVERS RATED FOR HEAVY DUTY VEHICULAR TRAFFIC
3) SUBMIT JOINT FILL MATERIAL FOR APPROVAL
4) DEPTH OF AGGREGATE BED FOR STORM WATER MAY BE DEEPER THAN SHOWN BASED ON PROJECT NEEDS

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DDA PAVER SECTION 2 - POROUS PAVERS AT PLANTER AND TREE GRATE

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-5**



NOTE:

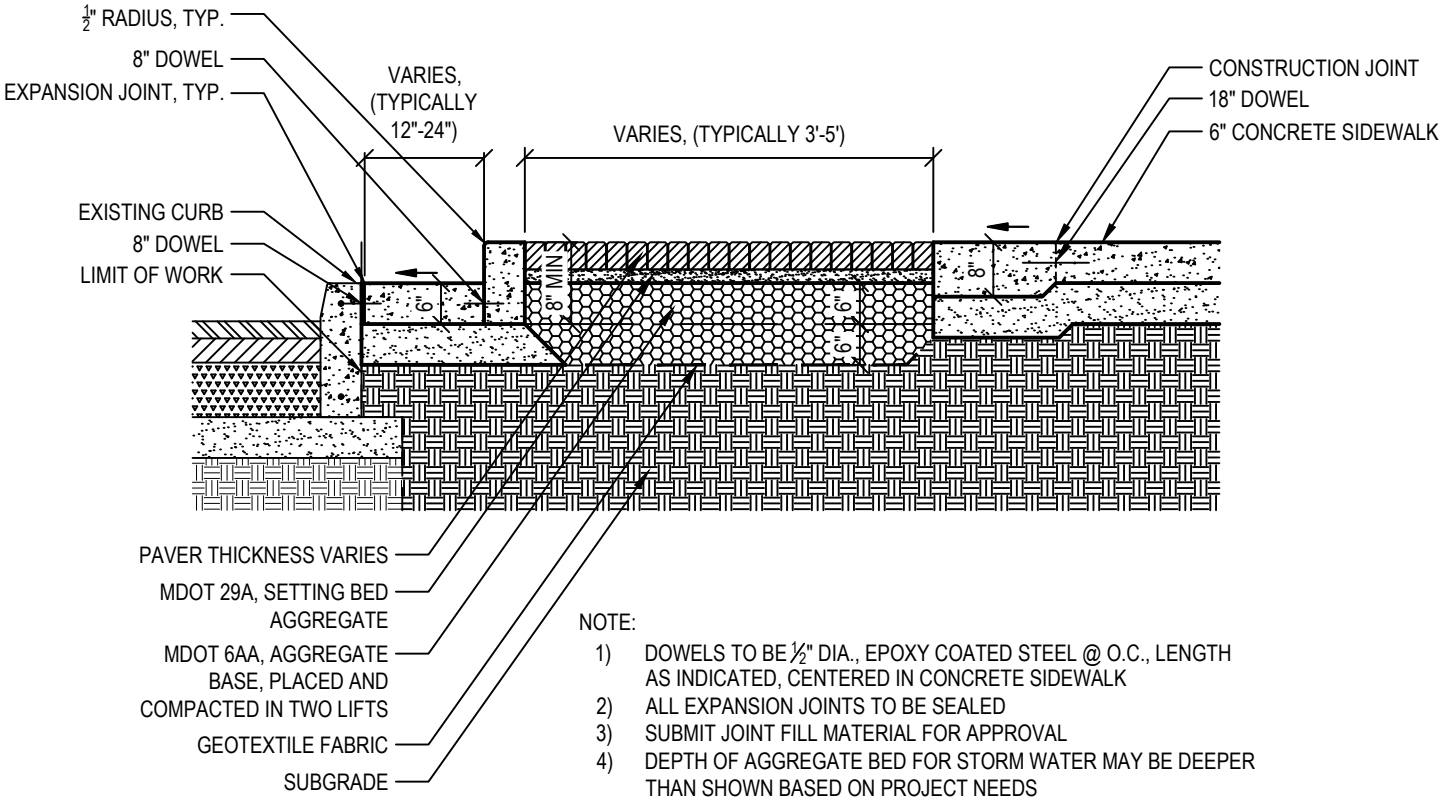
1) DOWELS TO BE ½" DIA., EPOXY COATED STEEL @ O.C., LENGTH AS INDICATED, CENTERED IN CONCRETE SIDEWALK
2) ALL EXPANSION JOINTS TO BE SEALED
3) SUBMIT JOINT FILL MATERIAL FOR APPROVAL
4) DEPTH OF AGGREGATE BED FOR STORM WATER MAY BE DEEPER THAN SHOWN BASED ON PROJECT NEEDS

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DDA PAVER SECTION 3 - POROUS PAVERS ADJ. TO CONCRETE SIDEWALK

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-6**



NOTE:

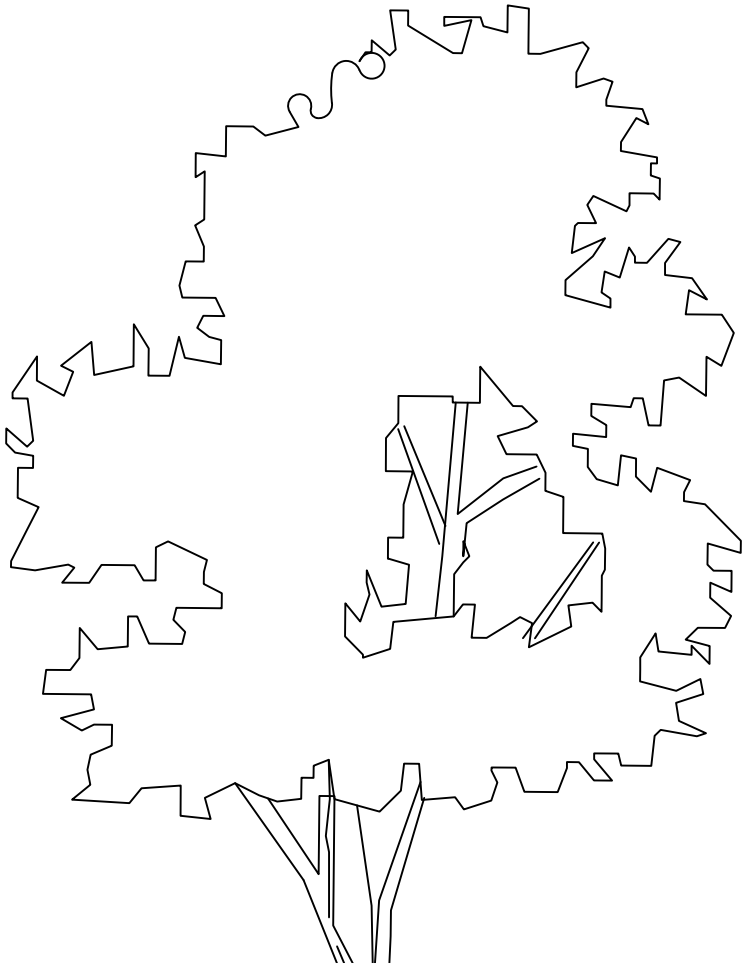
1) DOWELS TO BE ½" DIA., EPOXY COATED STEEL @ O.C., LENGTH AS INDICATED, CENTERED IN CONCRETE SIDEWALK
2) ALL EXPANSION JOINTS TO BE SEALED
3) SUBMIT JOINT FILL MATERIAL FOR APPROVAL
4) DEPTH OF AGGREGATE BED FOR STORM WATER MAY BE DEEPER THAN SHOWN BASED ON PROJECT NEEDS

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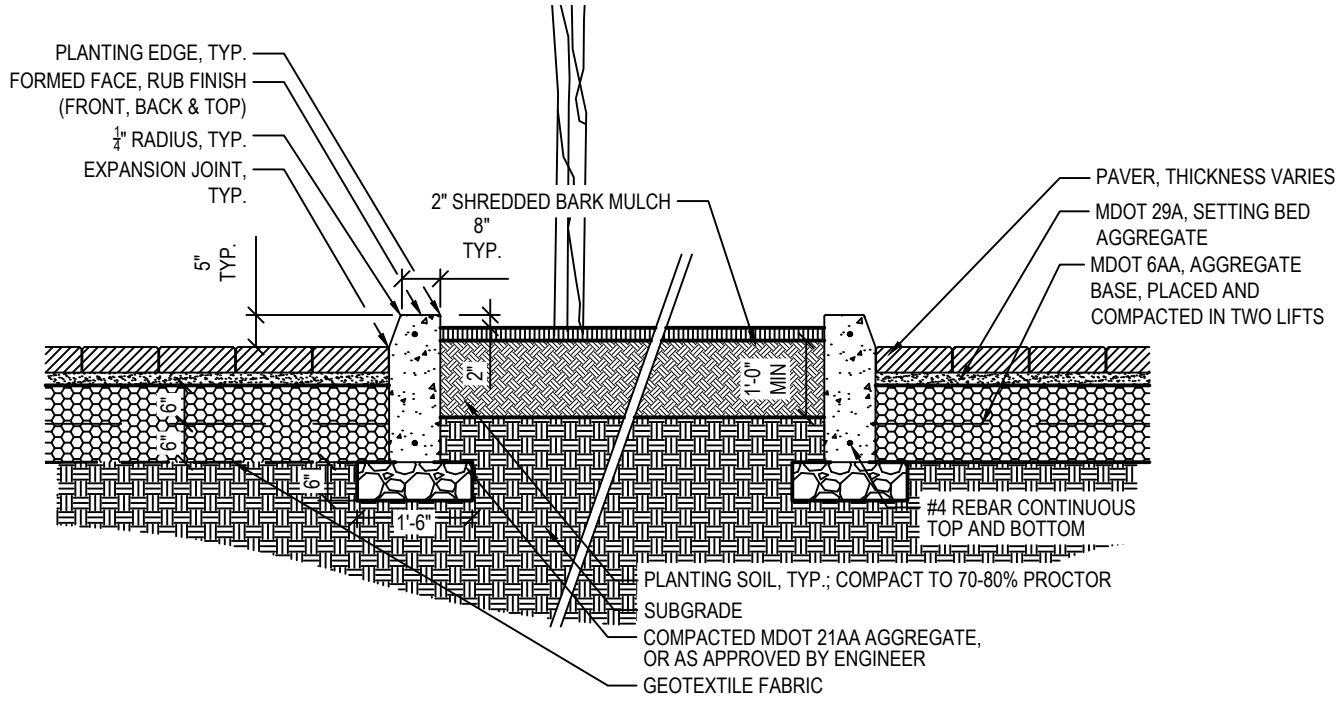
REV. NO.	DATE	DRAWN BY	CHECKED BY

DDA PAVER SECTION 4 - POROUS PAVERS ADJ. TO CONCRETE CURB

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-7**



NOTE:
REFER TO GRADING PLANS FOR PROPOSED WALK AND TOP OF PROPOSED CURBS.

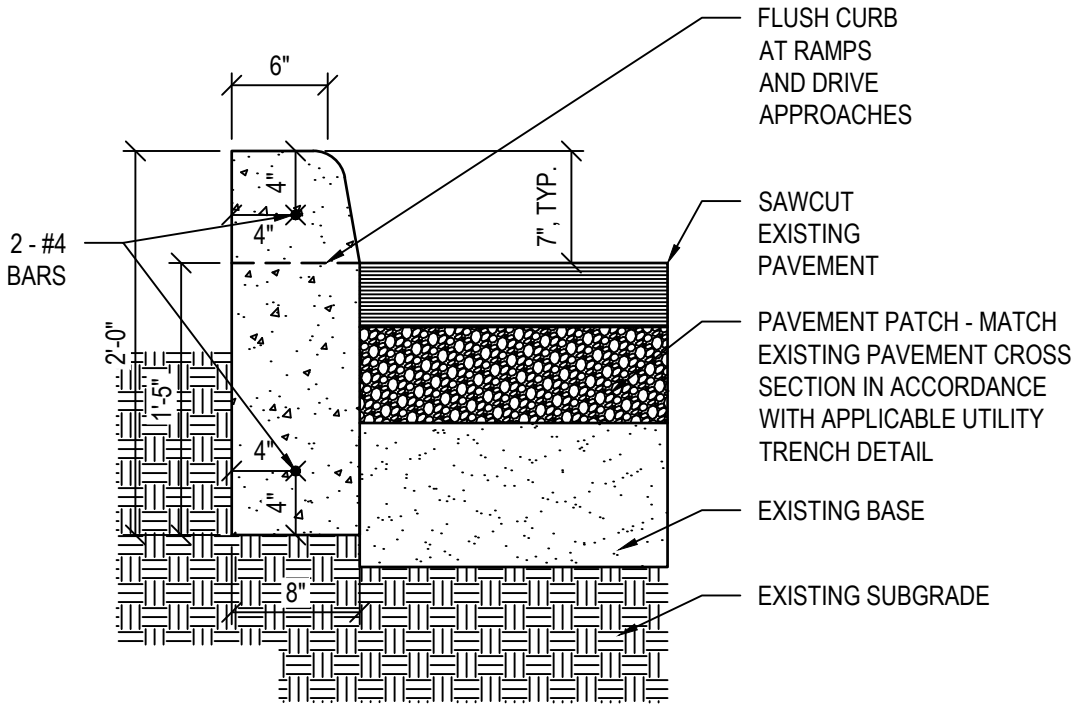


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DDA PAVER SECTION 5 - POROUS PAVERS AT PLANTER

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-8**



NOTE:
TO BE USED FOR REPLACEMENT OF EXISTING SLATE OR CONCRETE CURB WITH NO EXISTING GUTTER PAN

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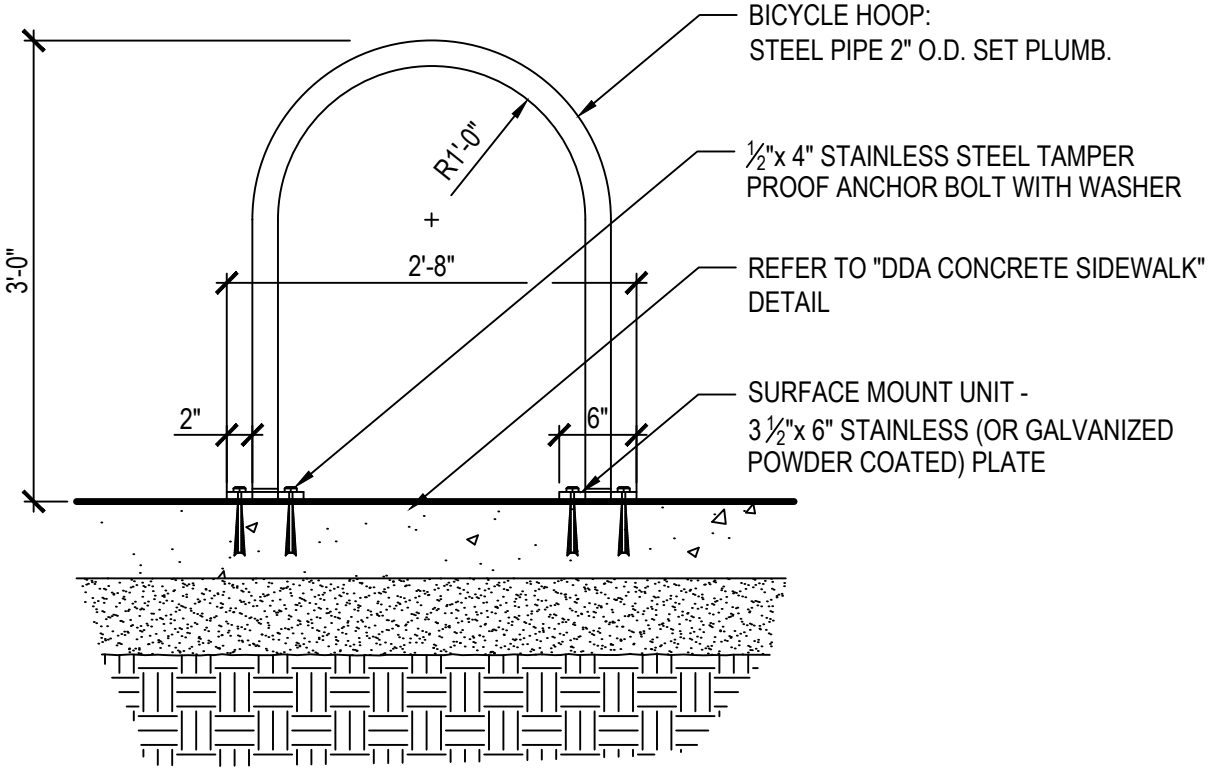
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DDA CONCRETE CURB

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-9**

BICYCLE HOOP NOTES:

1. TO BE USED ONLY FOR DDA CONCRETE SIDEWALK SURFACES
2. LOCATE AND GROUP BICYCLE HOOPS IN THE AMENITY ZONE
3. BIKE HOOPS TO BE MINIMUM OF 2'-10" FROM FACE OF CURB WHEN PERPENDICULAR TO CURB, AND 2'-0" WHEN PARALLEL
4. REFER TO ANN ARBOR DOWNTOWN STREET DESIGN MANUAL FOR ADDITIONAL LAYOUT GUIDELINES
5. POWDER-COATED GALVANIZED STEEL, BLACK



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DDA BIKE HOOP SURFACE MOUNTED

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-10**

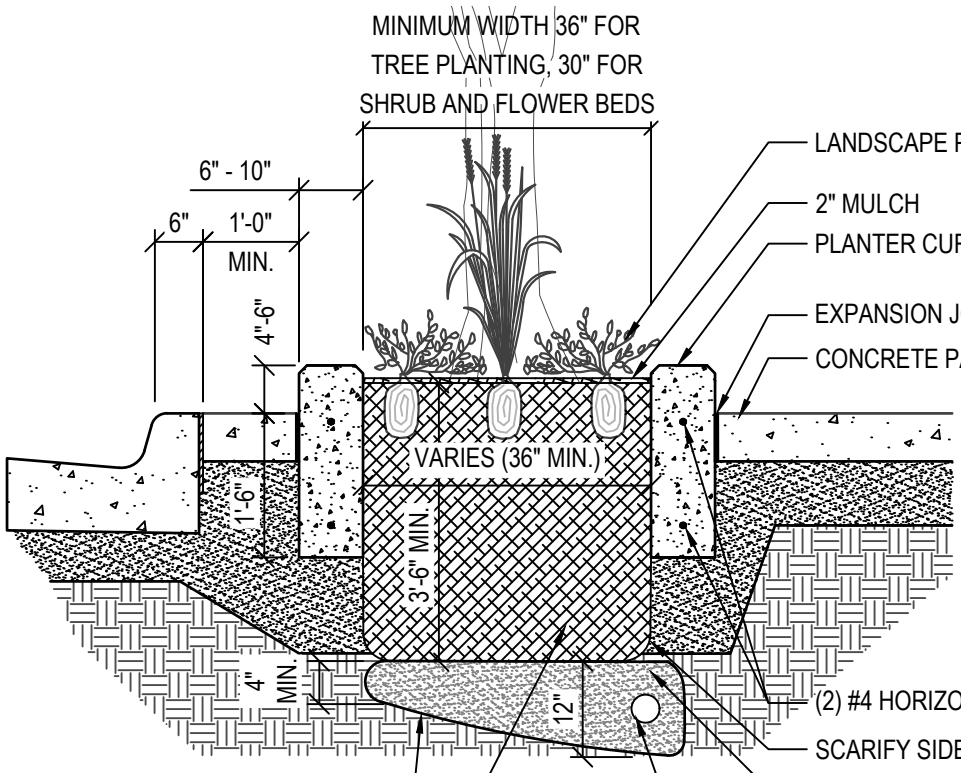
NOTES:

1. CONTRACTOR TO EXCAVATE ENTIRE PLANTING AREA. EXISTING SOIL MATERIAL TO BE DISPOSED OF OFF-SITE AT NO ADDITIONAL COST TO OWNER

2. RAISED PLANTER MAY INTEGRATE A PLANTER BOX WALL PER ANN ARBOR DOWNTOWN STREET DESIGN MANUAL, ON SIDEWALK SIDE. IN SUCH CASES, WALL WIDTH SHALL BE 12"-16" AND WALL HEIGHT SHALL BE 15"-22".

3. LENGTH OF PLANTER WITH CURB MAY VARY; MUST MEET SOIL VOLUME REQUIREMENTS IN ANN ARBOR DOWNTOWN STREET DESIGN MANUAL FOR TREE PLANTING.

4. NO UTILITIES SHALL BE PERMITTED IN THE RAISED PLANTER AMENITY ZONE. SEE DDA SIDEWALK CROSS SECTION FOR COMMUNICATIONS OR ELECTRICAL CONDUIT ALLOWABLE LOCATION.



6" DIA. PERFORATED HDPE UNDERDRAIN:

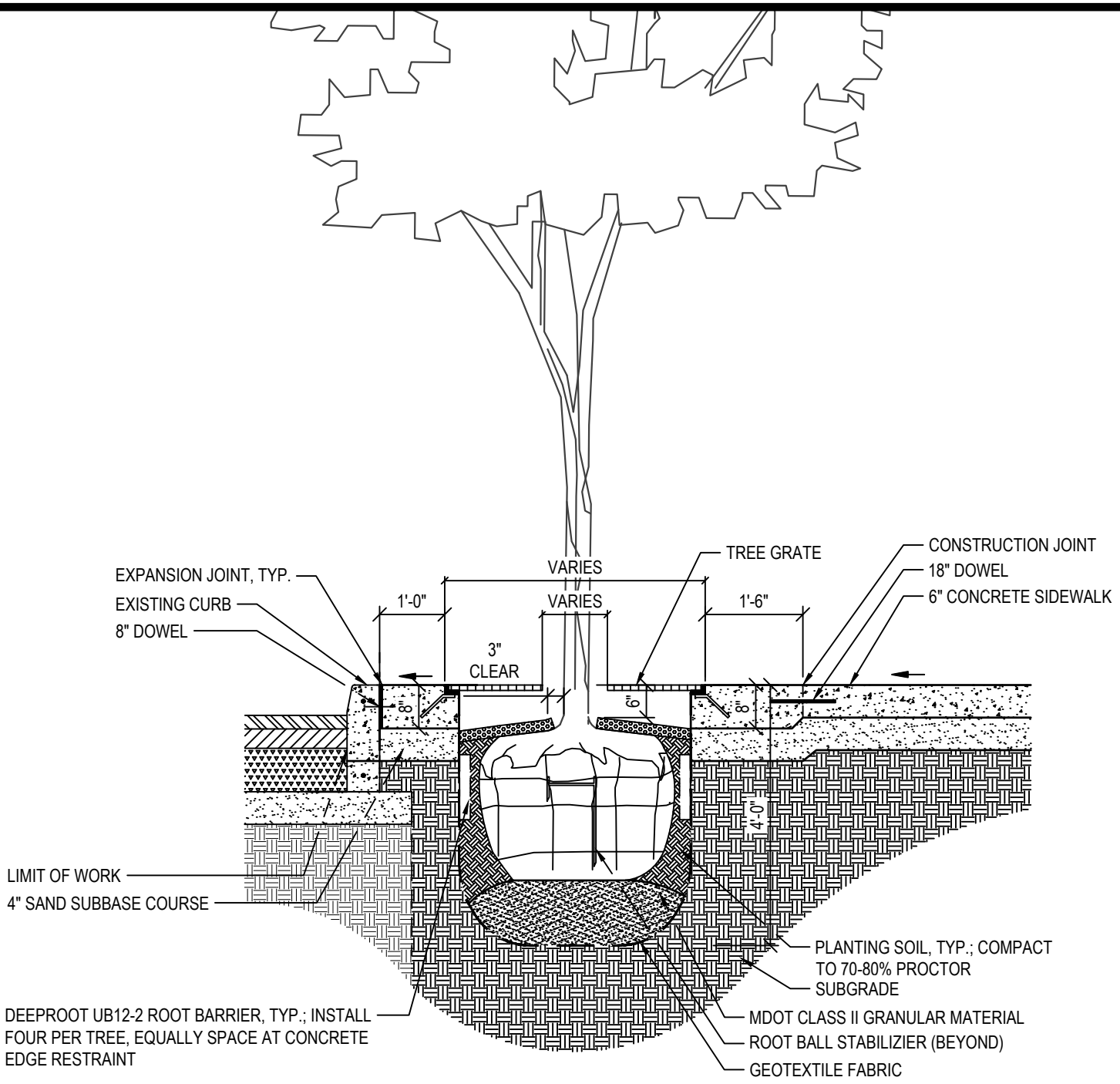
1) SLOPE AT MIN. OF 0.5% TOWARDS OUTFALL
2) INCREASE DEPTH OF UNDERDRAIN AGGREGATE AS NEEDED TO ACCOMMODATE PIPE SLOPE
3) CONNECT UNDERDRAIN TO INLET OR INLET JUNCTION CHAMBER
4) FINAL LOCATION AS DIRECTED BY ENGINEER
5) IN NO CASE SHALL UNDERDRAIN BE INSTALLED AT A DEPTH OF LESS THAN 3.25' BELOW TOP OF PAVEMENT

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DDA RAISED PLANTER WITH CURB

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-11**



NOTE:

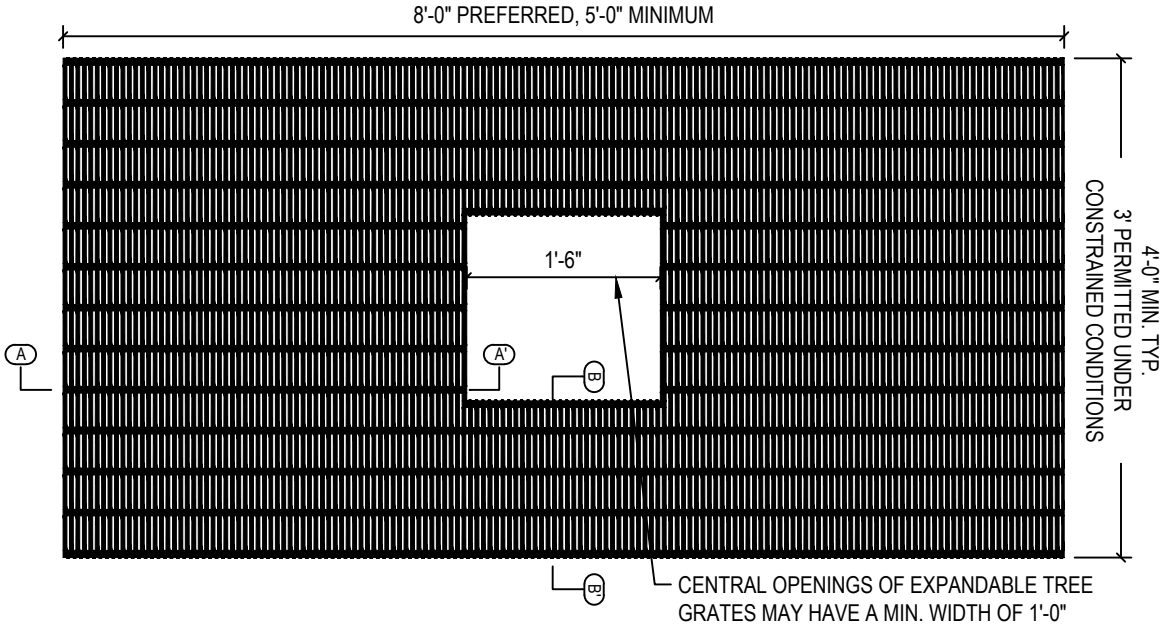
1. CONTRACTOR TO EXCAVATE ENTIRE PLANTING AREA. EXISTING SOIL MATERIAL TO BE DISPOSED OF OFF-SITE AT NO ADDITIONAL COST TO OWNER
2. DO NOT PRUNE TERMINAL LEADER OR BRANCH TIPS. PRUNE AWAY DEAD AND BROKEN BRANCHES ONLY
3. REMOVE TOP ⅓ TO ½ BURLAP, TWINE, ROPE, OVAL WIRE BASKET. EXPOSE THE TRUCK FLARE BY PULLING BACK SOIL AND FOLDING BACK BURLAP
4. REMOVE TEMPORARY WATER BAGS FOLLOWING END OF WARRANTY PERIOD AND DURING WINTER
5. DOWELS TO BE ½" DIA., EPOXY COATED STEEL @ O.C., LENGTH AS INDICATED, CENTERED IN CONCRETE SIDEWALK
6. PLANTING SOIL TO EXTEND TO THE LIMITS OF THE TREE GRATE, FULL DEPTH
7. ALL EXPANSION JOINTS TO BE SEALED
8. 2" OF MULCH ON TOP OF ROOT BALL. AVOID PLACING MULCH AGAINST TREE TRUNK

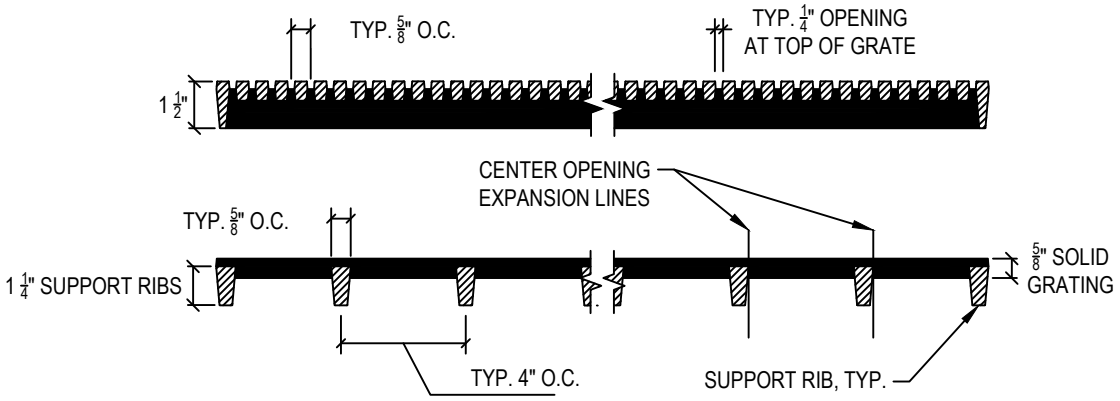
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DDA TREE PIT WITH GRATE

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SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-12**





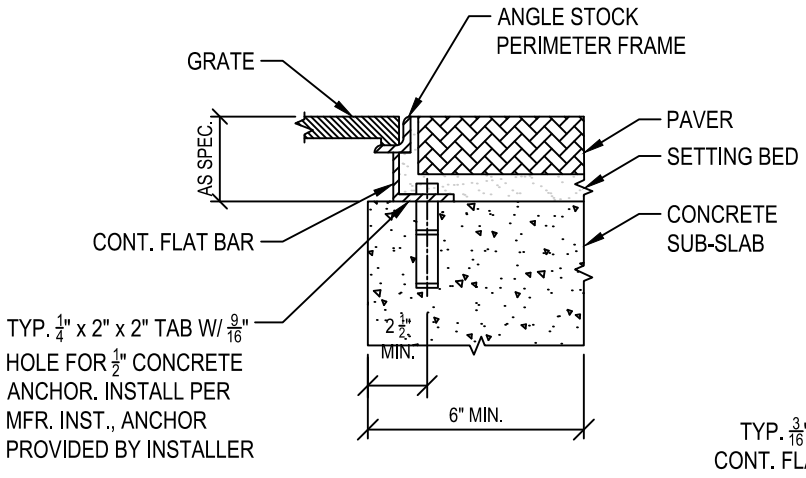
NOTES:
1. GRATE TO MEET ADA REQUIREMENTS
2. GRADE TO BE RATED FOR LIGHT VEHICULAR TRAFFIC
3. OVERALL DIMENSIONS FOR GRATE OPENING TO BE 30 SQUARE FEET, MINIMUM

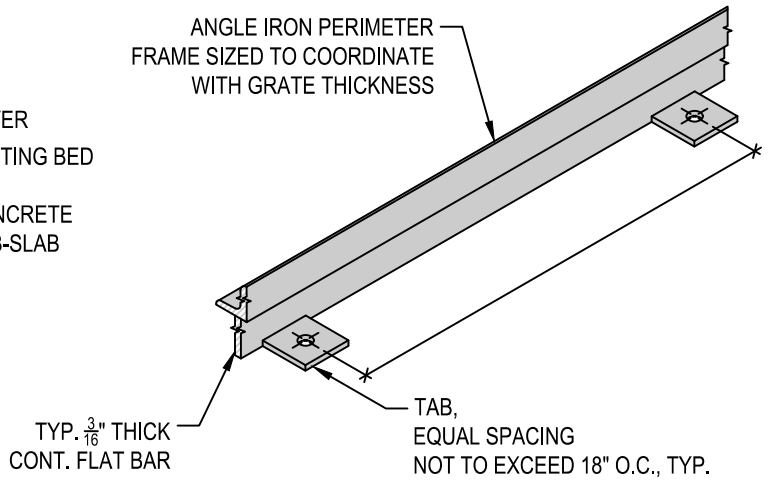
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DDA TREE GRATE DETAIL

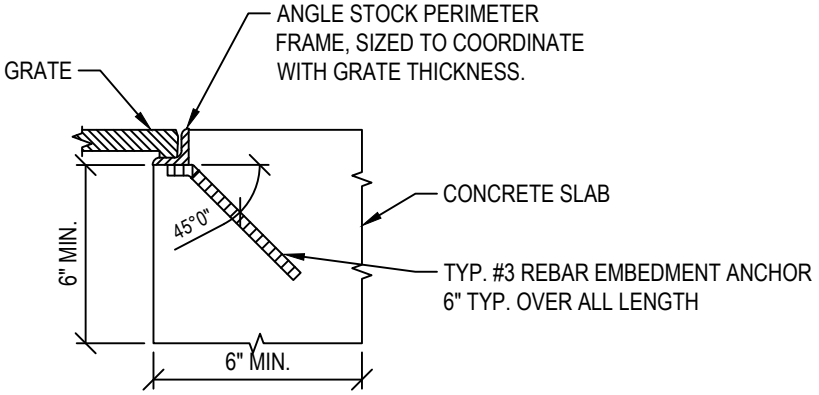
DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-13**



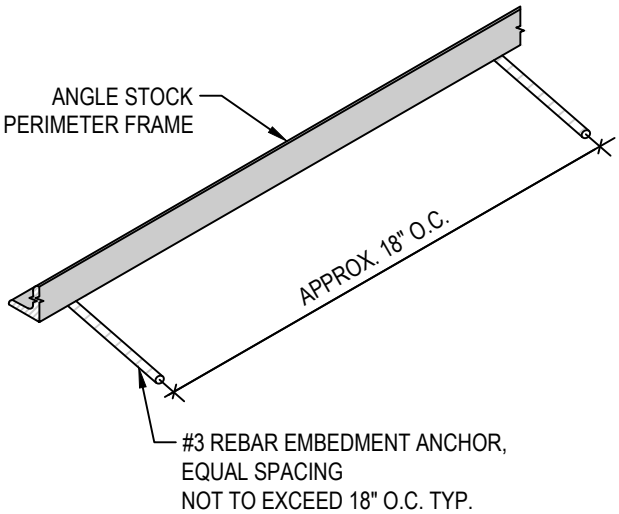


1 TREE GRATE AT PAVERS

SCALE: NTS



NOTE: USE "S" STANDARD INSTALLATION TYPE WHERE ADJACENT TO PAVERS



2 TREE GRATE AT CONCRETE PAVEMENT

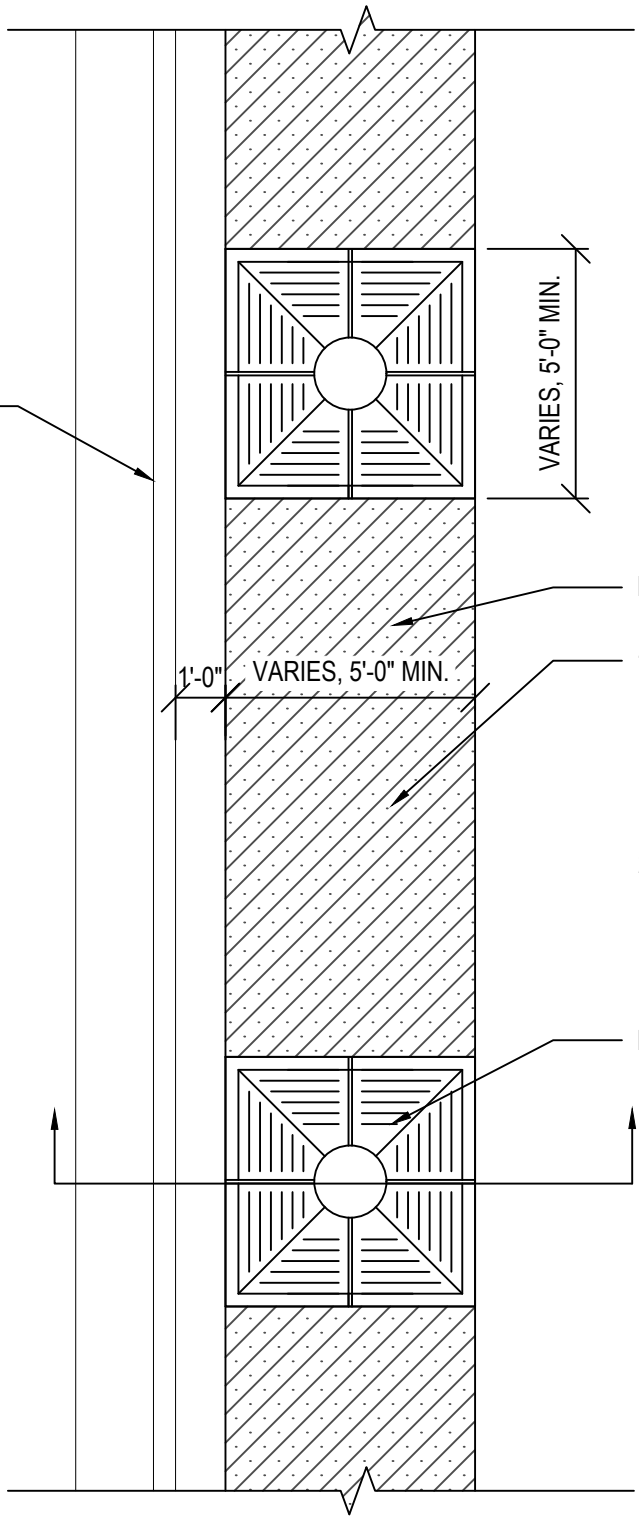
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DDA TREE GRATE FRAME INSTALLATION

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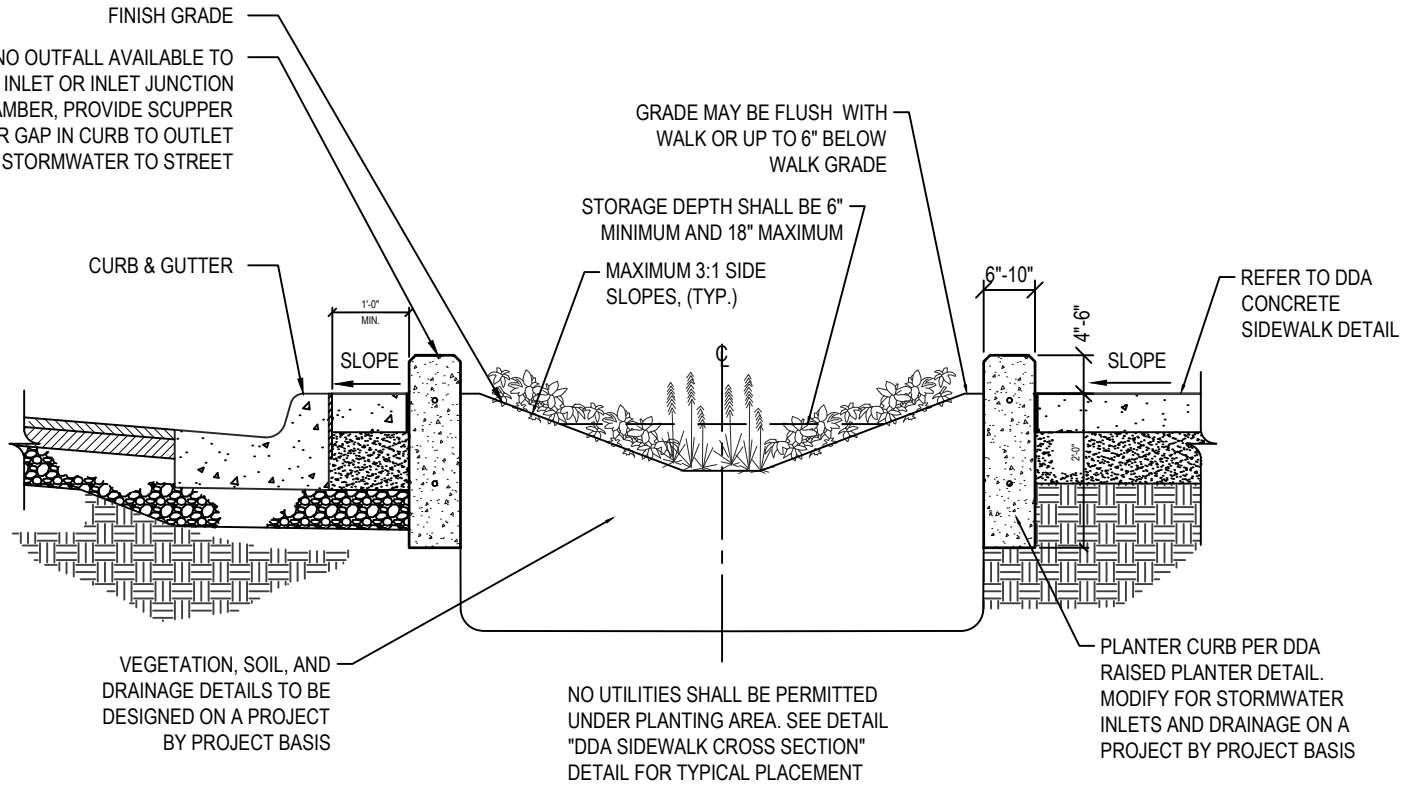


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DDA PLANTING ZONE BETWEEN TREE PITS

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-15**

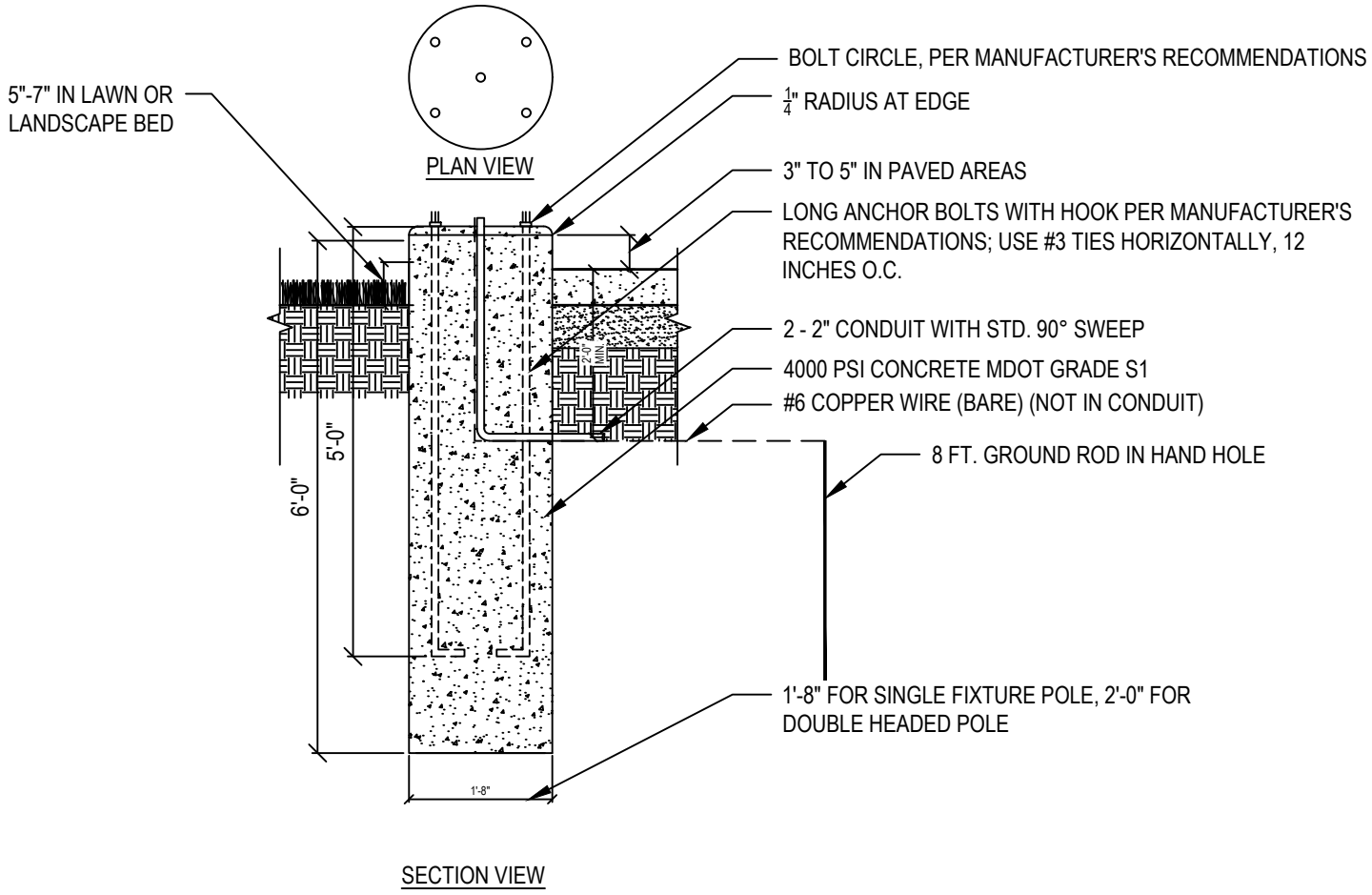


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DDA VEGETATED SWALE AND RAIN GARDEN

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-16**



NOTES:

1. HOLE TO BE AUGERED. MINIMIZE DISTURBANCE OF IN-SITU SOILS DURING AUGERING
2. CONTRACTOR TO PROVIDE PREFABRICATED ANCHOR BOLT BUILD-UP
3. THE CITY WILL INSPECT THE AUGERED HOLE AND THE ANCHOR BOLT BUILD-UP AND PROVIDE WRITTEN APPROVAL PRIOR TO THE PLACEMENT OF CONCRETE
4. NO WATER IS TO BE IN HOLE AT TIME OF CONCRETE PLACEMENT
5. CONCRETE SHALL BE VIBRATED DURING PLACEMENT
6. EXCESSIVE HOLE SIZE CREATED DURING AUGERING OF FOUNDATION SHALL BE FLO-FILLED TO 3' FROM FINISH GRADE
7. CONTRACTOR WILL PROVIDE NECESSARY CONDUIT FOR ENTRY. PAID FOR AT THE CONTRACT UNIT PRICE FOR 2" CONDUIT
8. COPPER CLAD GROUND ROD (1 REQUIRED) TO BE 5/8" DIA. x 8'-0"
9. CONDUIT TO EXTEND 1-2" ABOVE BASE. CABLES TO EXTEND 6" OUTSIDE OF HANDHOLE
10. SHIMS TO BE 1/2" MIN. PER D.E. SPEC
11. GROUND CABLE SHALL BE #6 SOFT BARE COPPER WIRE WELDED TO GROUND ROD WITH 24" SLACK ABOVE FOUNDATION TOP; THE NEUTRAL AT THE POLE IS TO BE CONNECTED TO THIS GROUND CABLE

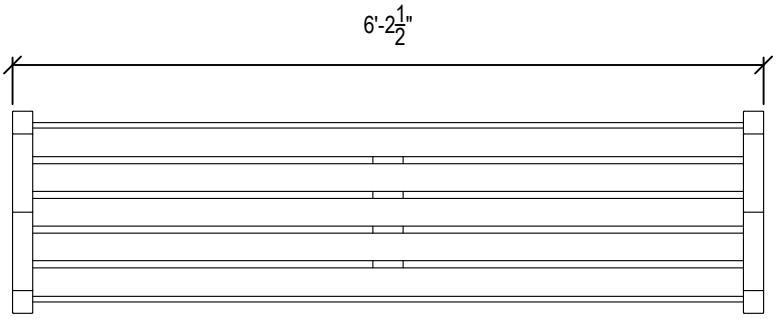
*UNLESS OTHERWISE NOTED ON THE PLANS OR CONTRACT DOCUMENT

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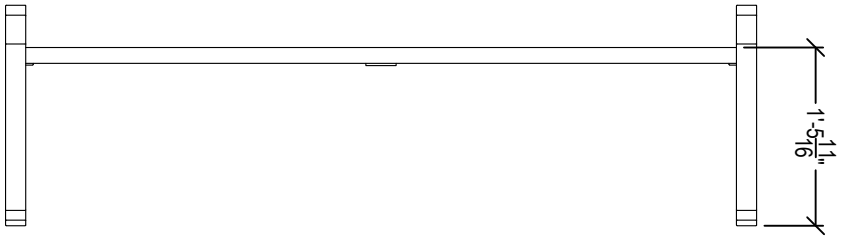
DDA LIGHT POLE FOUNDATION

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-17**



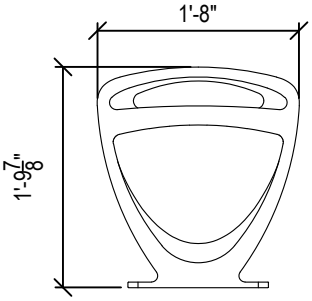
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SCALE: N.T.S



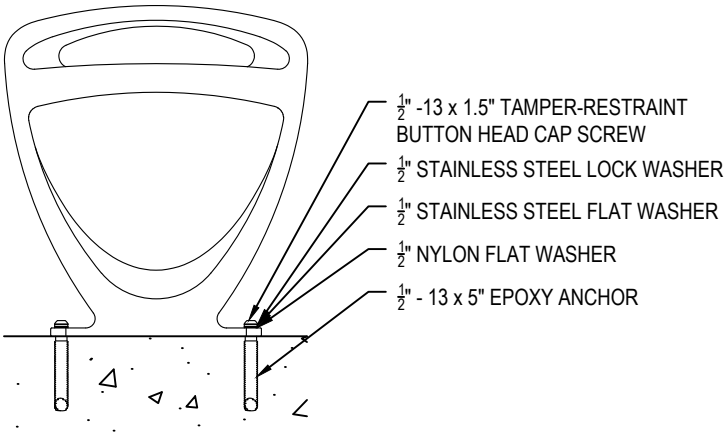
2 ELEVATION

SCALE: N.T.S



3 SECTION

SCALE: N.T.S



4 URBAN BENCH INSTALLATION DETAIL

SCALE: N.T.S

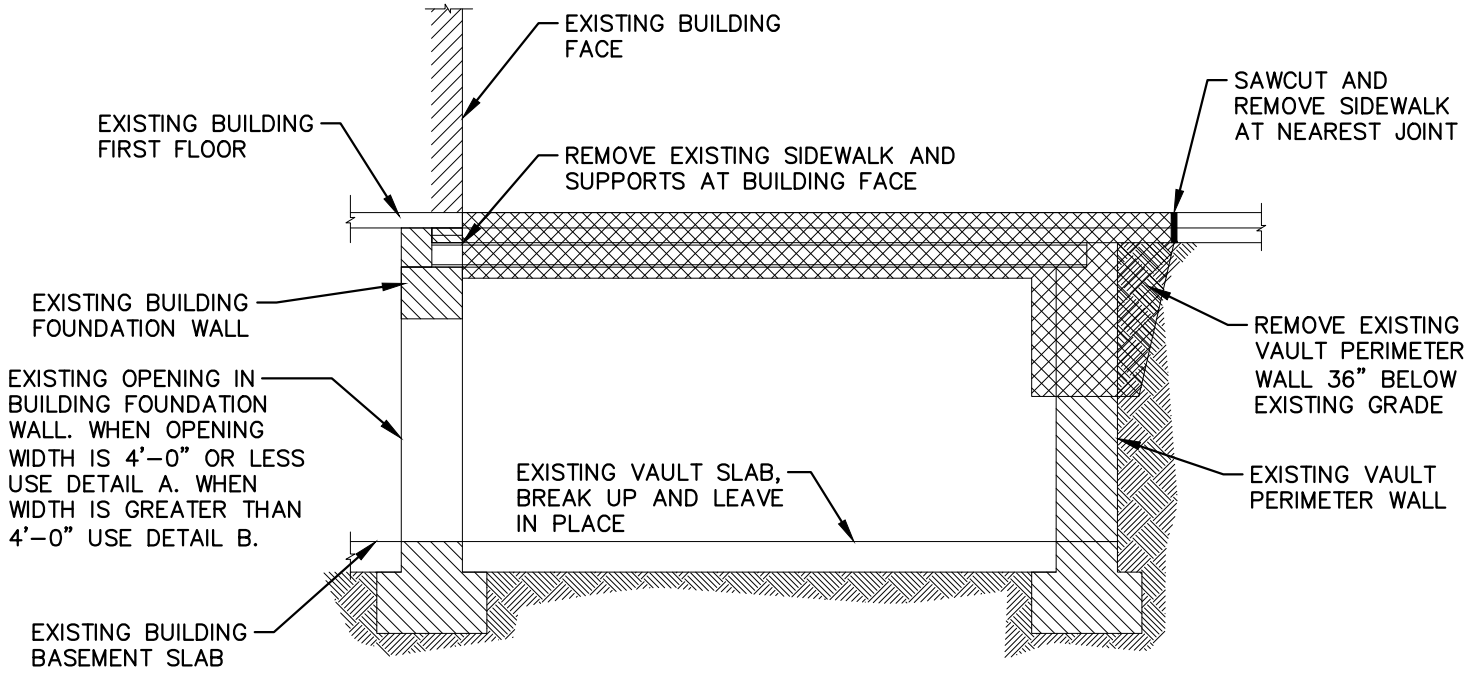
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DDA BENCH DETAIL

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 12/8/2023	**SD-DDA-18**

DDA VAULT ABANDONMENT



NOTES:

1. PROPERTY OWNER IS RESPONSIBLE FOR ALL WORK.
2. THE CONTRACTOR MUST OBTAIN ALL REQUIRED PERMITS, INCLUDING BUT NOT LIMITED TO: BUILDING, RIGHT-OF-WAY, LANE CLOSURE, METER BAGS AND MDOT PERMITS.
3. THESE ARE TYPICAL DETAILS FOR INFORMATION AND REFERENCE. A REGISTERED STRUCTURAL ENGINEER MUST CERTIFY PLANS FOR WORK ASSOCIATED WITH THE BUILDING STRUCTURE.

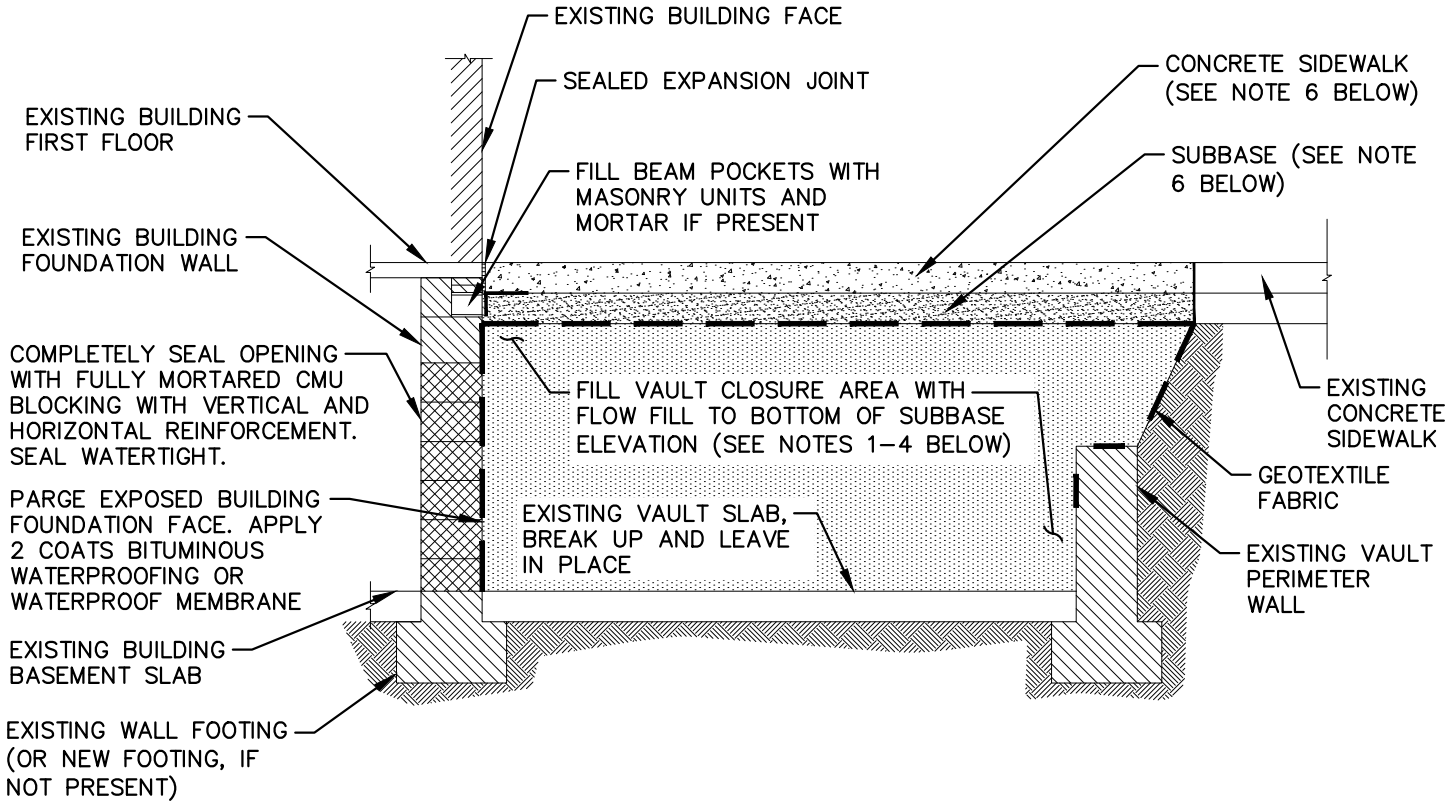
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VAULT PREPARATION

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 09/01/2025	**SD-DDA-19**

DDA VAULT ABANDONMENT



NOTES:

1. FLOW FILL SHALL PLACED IN LIFTS OF ONE THIRD ($\frac{1}{3}$) THE TOTAL HEIGHT AND ALLOW SUFFICIENT TIME FOR EACH LIFT TO SET BEFORE POURING SUBSEQUENT LIFTS.
2. PROTECT ANY EXISTING UTILITY PIPES WITHIN VAULT CLOSURE AREA.
3. ANY METERING OR OTHER UTILITY APPARATUSES ARE TO BE RELOCATED WITHIN BUILDING AS REQUIRED BY APPLICABLE UTILITIES.
4. PROPERLY ABANDON ANY FLOOR DRAINS LOCATED WITHIN VAULT CLOSURE AREA.
5. CONSTRUCT CONCRETE SIDEWALK AND SUBBASE PER CITY OF ANN ARBOR STANDARD DETAILS.

DETAIL A
VAULT OPENING WIDTH 4'-0" OR LESS - CMU BLOCKING

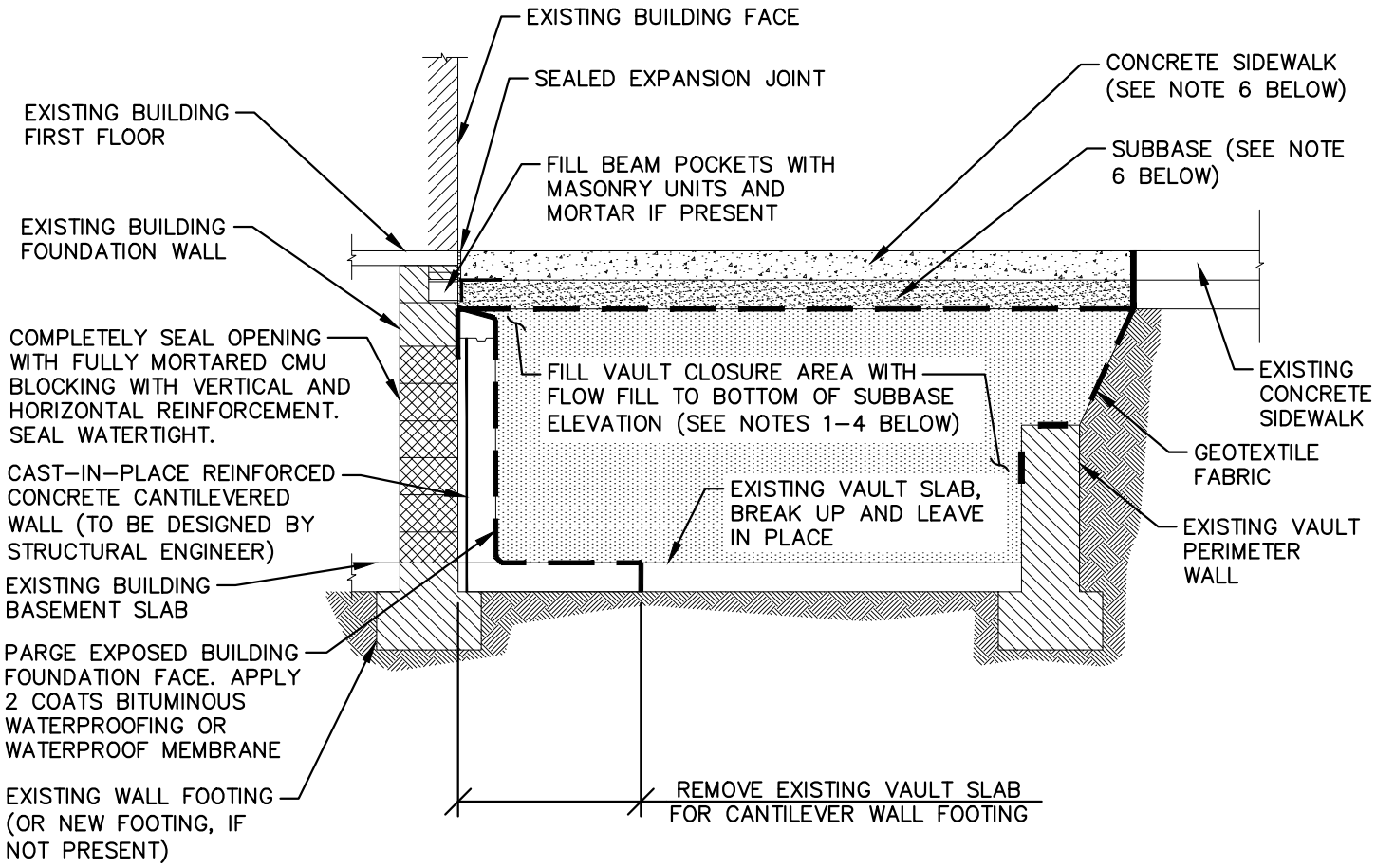
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VAULT OPENING 4 OR LESS

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 09/01/2025	**SD-DDA-20**

DDA VAULT ABANDONMENT



NOTES:

1. FLOW FILL SHALL PLACED IN LIFTS OF ONE THIRD ($\frac{1}{3}$) THE TOTAL HEIGHT AND ALLOW SUFFICIENT TIME FOR EACH LIFT TO SET BEFORE POURING SUBSEQUENT LIFTS.
2. PROTECT ANY EXISTING UTILITY PIPES WITHIN VAULT CLOSURE AREA.
3. ANY METERING OR OTHER UTILITY APPARATUSES ARE TO BE RELOCATED WITHIN BUILDING AS REQUIRED BY APPLICABLE UTILITIES.
4. PROPERLY ABANDON ANY FLOOR DRAINS LOCATED WITHIN VAULT CLOSURE AREA.
5. CONSTRUCT CONCRETE SIDEWALK AND SUBBASE PER CITY OF ANN ARBOR STANDARD DETAILS.

DETAIL B
VAULT OPENING WIDTH GREATER THAN 4'-0" - CANTILEVER WALL SUPPORT

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VAULT OPENING GREATER THAN 4

DR. ENG	CH. ENG	DRAWING NO.
SCALE N.T.S.	DATE 09/01/2025	**SD-DDA-21**

Appendix A:
CITY OF ANN ARBOR MATERIAL REQUIREMENTS

- This reference sheet provides a list of some commonly used materials. This is not a comprehensive list of all material types that may be used for Public Improvements and other improvements in the public right-of-way. Each type of material listed includes requirements that must be followed such as applicable standards, manufacturer or model, and other details. Materials provided on the list are deemed acceptable; materials not listed are subject to approval by the PSAA. Additional materials information is provided within the Articles of the City of Ann Arbor Standard Specifications.

- The City of Ann Arbor recognizes its responsibility to minimize negative impacts on human health and the environment while supporting a vibrant community and economy. The City further recognizes that the products and services the City buys have inherent environmental and economic impacts and that the City should make procurement decisions that embody, promote, and encourage the City's commitment to the environment. The City encourages potential vendors to bring forward emerging and progressive products and services that align with the City's environmental principles as well as these Standards.

Material Type	Applicable Standards	Allowable Materials (Manufacturer/Model) and Additional Requirements
AGGREGATES/BACKFILL MATERIAL		
2NS	MDOT 2NS	Required Bedding & Backfill for Road Underdrain/Edgedrain
6A Crushed Limestone	MDOT 6A	Required Bedding & Initial Backfill for PVC Sewer Pipe
21AA	MDOT 21AA	
City of Ann Arbor Class II Sand	MDOT Class II	
Aggregates		Each gradation for drainage system (3 different material certifications)
DRIVES, SIDEWALKS AND BIKE FACILITIES		
Detectable Warning	See Article 10, Section III.H.3.f)	ADA Solutions Cast in Place Paver - Composite Armor-Tile Cast in Place Composite
Bike Lane Separator and Delineators		Qwick Kurb Slender Bender Qwick Kurb Lane Separator City Post Surface Mount Delineator (28 in. height; black post with white sheeting where white edgeline would be used; or yellow post with yellow sheeting in areas where yellow edgeline would be used)
SANITARY *Also see 'Utilities- General' for materials that apply to multiple utility areas*		
Chimney Seal Wrap		WrapidSeal™ Manhole Encapsulation System
Concrete Pipe	Reinforced ASTM Designation C-76 Class IV or Class V depending on depth	Allowed for 18" diameter or greater pipe, subject to approval of PSAA
Flexible Pipe Coupling and Stainless Steel Shear Ring	ASTM C1173 for flexible transition couplings for underground piping system CSA B602 for stainless steel shear ring	Fernco StrongBack
Ductile Iron Sewer Pipe	Pressure Class (PC) 350 for 12-inch and smaller, PC 250 for 14-20-inch, and PC 200 for 24-inch conforming to ASTM A746	American Pipe with Protecto 401 Lining US Pipe with Protecto 401 Lining McWane with Protecto 401 Lining
Ductile Iron Sewer Pipe Joints	ANSI/AWWA C111/A21.11	
Polyvinyl Chloride (PVC) Pipe	ASTM Designation D3034, minimum SDR 26 (4-15 inch diameter), or ASTM Designation F679, PS115 (18-48 inch diameter)	Integral wall bell and spigot required
Precast Concrete Sanitary Manholes	ASTM C478 with precast rubber boot connections for openings conforming to ASTM C923 and joints conforming to ASTM C443	
PVC Joints	Elastomeric gasketed push-on joints conforming to ASTM D3212	
Vitrified Clay Pipe	ASTM C700, Extra Strength	Pipe to be the bell and spigot type and glazed
Vitrified Clay Pipe Joints	Premium compression joints conforming to ASTM C-425	
STORMWATER *Also see 'Utilities- General' for materials that apply to multiple utility areas*		
Concrete Masonry Units/Block for Structures	ASTM C139	
Concrete Pipe	Reinforced ASTM Designation C-76 Class IV or Cl V depending on depth Reinforced Elliptical - ASTM Designation C-507	Allowed for 18" diameter or greater pipe
Corrugated Exterior, Smooth Interior, Polyethylene Pipe (PE)	AASHTO M294 or ASTM F2306	ADS N-12
Corrugated Metal Pipe	AASHTO M36, Type I or Type II	For single family residential driveways only, with PSAA approval
Corrugated Metal Pipe Joints	Coupling bands conforming to AASHTO M36	
Curb Drain	AWWA C906 and ASTM D3350	HDPE, DR17 with green stripe
Edgedrain/Underdrain	Except PVC plastic, shall conform with ASTM D3033; Geotextile wrapping	ADS 6-inch underdrain - 06430100MI Pipe: AASHTO M252 Filter Sock: ASTM D6707

Material Type	Applicable Standards	Allowable Materials (Manufacturer/Model) and Additional Requirements
HDPE Pipe	AASHTO M-294 or ASTM F-892	Hancor Titeline ADS N-12
HDPE Pipe Joints (Gaskets)	ASTM D-3212	
PE Pipe Joints	Water-tight joints meeting ASTM D3212; Gaskets meeting ASTM F477	
Precast Concrete Storm Manholes	ASTM C478 with precast rubber boot connections for openings conforming to ASTM C923 and joints conforming to ASTM C443	
STREETLIGHTS		
All Streetlight Materials and Equipment	Shall fully comply with the latest IEEE, NEMA and ANSI Standards, for that class of equipment	
Cables (direct bury)		Copper, #6 AWG or larger
Cables (underground)		600V, XLPE, U.L. listed USE.
Cable Connectors	UL 486A (Wire Connections and Soldering Lugs for Use with Copper Connectors) and UL 486B (Standard for Safety Wire Connectors for Use with Aluminum Conductors)	Connector Cable Tap Alum #8-1/0 for aluminum terminal blocks Cover Plastisol F/Utilco SLC4-0 for covers Connectors at lighting standards shall be multiple aluminum with four positions for #2 AWG copper and a fifth position for #12 AWG or larger fixture wire
Conduit for Service Pole Risers (first 10 feet above ground)	Article 346 of National Electric Code (NEC)	Rigid galvanized steel Hot-dip galvanized inside and out; zinc coating throughout Threaded connections
Conduit for Service Pole Risers (more than 10 feet above ground)	Article 347 of NEC	Schedule 80 PVC or HDPE SDR11
Disconnect Cabinets (non-DDA areas)		Trinetics MY-RO Spec 6442 per details on Plan
Fuse Holder Kit		BUSS HEB-AA for fuse holder and boots kit BUSFNM-5 for 5A fuse
Handholes in concrete or soil		Type-Below Ground Enclosure Material-Polymer Concrete Wall Type-Straight Load Rating-Tier 22 for handhole and lid/cover Open Bottom Size shall be 17" x 30" x 18" Including 8-foot ground rod, 5/8 inch diameter
Luminaires	IES RP-8	Match adjacent lighting, subject to approval by PSAA Color temperature shall be no greater than 2700K Must be LED Streetlight Luminaire - Detroit Series Small Area Light - Lumecon LDS-SAL-60-GR-T2-1-27-TM-7P-2FT - 60W, 8,400 lumens, Gray, Type II Distribution, 120/277v, 2700K, Tenon Mount, 7-Pin Receptacle, 40kV Extreme Rated Surge Suppressor ** 2ft wire coming out of fixture Decorative Post Top Streetlight - Globe Style - 35 West Globe Luminaires - Lumecon L35W-1-1-WW-B-D-7P - 54W, Type V Distribution, 2700K, 120-277v, Acrylic Prismatic Globe with Black Cast Aluminum Cage, Diffused Cutoff Litelid, 7-Pin Photocell Receptacle, 40kV Extreme Rated Surge Suppressor **Used in DDA, also see Downtown Street Design Manual (Appendix D) Decorative Post Top Streetlight – Acorn Style - Lumecon - LROF-3-1-WW-A-CL-8-X-2-S-B-X-X-L - Ring of Fire - Type 3, 58W, 4574 Lumens 2700K, Spike Finial 8"Fitter for 4"OD Pole, Part number 27-00145, Perforated Lit-Lid, 20KA Surge
Poles (DDA District)		Decorative 11'2" Center City District Steel Post - Spring City Electrical - Hancock with Steel Shaft Assembly - 3 ½" SCC 40 Steel Pipe (4"O.D.) Tenon 4" Dia x 5" High, Decorative Cast Ductile Iron 2-Piece Wrap Around Base Included. Finish: HD Galvanized then Powder Coat Gloss Black – (TMP-12BC4)

Material Type	Applicable Standards	Allowable Materials (Manufacturer/Model) and Additional Requirements
Poles (non-DDA areas)		30' Straight Composite Round Pole with 6' arm - Shakespeare/Valmont - AS30-10S1DB01/OPAR6-BK-H - 30' Smooth Finish, Anchor Base w/Handhole 4"x12", Drilled for 6' Aluminum Mast Arm and Base Cover, Black Powder Coated 1pc Black Base Cover, 1" Diameter Anchor Bolts 15' Straight Aluminum Round Pole - Hapco - H-A3S15-SRO-T304-BA, Straight Aluminum Round Pole with Alren 13 Base, 15' Height x 4" diameter, Black Powder Coat Finish, 2 7/8 Tenon 25' Steel Streetlight Pole with Luminaire (Stadium) - Spring City Electrical - LP-29769 - Columbia 80w LED Luminaire, Columbia Arm, Type III, 300k Type III, 300k with Columbia Crossarm, Base and Shaft - ALMCLU-LED080/EVX/X2-30-CR3-GR14-LACLB-FED-CU Luminaire - AARCLA-1s-51-53-TN2.38/7.00-CU Cross Arm Bracket - DWBNRT-20-CU Ductile Iron Base - SSH6-G11-7.50/20.50-TN3.50/8.00-GV/CU Pole Shaft
TRAFFIC SIGNALS		
Rectangular Rapid Flashing Beacon (RRFB)	MDOT Specifications, Sections 918 (Electrical and Lighting Materials) and 921 (Permanent Traffic Signal Materials)	Carrmanah Model # SC315-G Solar
UTILITIES - GENERAL *These materials are common amongst multiple utility areas.*		
Cast Iron Manhole Frames and Covers	ASTM A 48, Class No. 35B per Casting Schedule (SD-GU-1 through -4)	
Concrete Brick for Adjustments and Structures	ASTM C-55, Grade N-1	
Concrete Pipe Joints	Elastomeric gasketed push-on joint conforming to ASTM C443	For concrete pipe over 36" diameter, inside joints to be cement mortar pointed to their full depth and outside joints to be provided with a cement mortar collar.
Couplings Dissimilar Material	ASTM C1173 for flexible transition couplings for underground piping systems	
Manhole Adjustment Rings	ASTM C-478 for concrete ASTM D4976 for HDPE	
Manhole Liner		OBIC Armor System including OBIC 1000 flexible polyurea and OBIC 1306 closed-cell foam core
Manhole Steps	ASTM D-4101	MA Industries PS1-PF
Precast Manholes	ASTM C-478	
Spacers		HDPE
Steel Casing Pipe	Midway Structural Pipe and Supply ASTM A-139, Grade B, 35,000 PSI Minimum Yield Strength	Diameter of Pipe --> Wall thickness (minimum) Under 14" --> 0.250" 14", 16", 18" --> 0.312" 18" --> 0.375" 20", 22" --> 0.375" 24", 26", 28", 30" --> 0.500" 32", 34" --> 0.563" 36", 38", 40", 42" 48" --> 0.625" Non-spiral, minimum yield strength 35,000psi, leakproof joints, continuous welds; ASTMA53; Type E or S; Grade B
WATER *Also see 'Utilities- General' for materials that apply to multiple utility areas*		
All Water Materials	NSF/ANSI Standard 61	
Boxes - Valve		EJ 8560 Series Tyler Union 6860, 32U (Heavy Duty) Size D, screw type 3-piece, 5 1/4 inch shaft and a #6 base for a valve 8" or less and #8 base for 10" and 12" valves
Boxes - Curb		Tyler Union 6500 Bibby Ste. Croix B-2000 Buffalo type, Size 95E, screw type, 2-piece, 2 ½ inch shaft, extendable from 4 ½ feet to 6 ½ feet

Material Type	Applicable Standards	Allowable Materials (Manufacturer/Model) and Additional Requirements
Butterfly Valves	AWWA C504, require special approval	Henry Pratt AWWA"Groundhog" Mueller "Lineseal III" DeZURIK AWWA Butterfly Valve, BAW, MJ, CI, NBRN-NRB, 150B, CI, Nut Where approved shall have an operator for buried service with 2 inch square opening nut, operating right, push-on by push-on only with restrained gaskets.
Ductile Iron Pipe (DIP)	ANSI/AWWA C151/A21.51 with cement mortar lining with: 1) seal coat per ANSI/AWWA C104/A21.4 and 2) outside coating per ANSI/AWWA C151/A21.51 and 3) polyethylene wrap meeting the requirements of ANSI/AWWA C105/A21.5 and 4) non-restrained push-on rubber gasket joints per ANSI/AWWA C111/A21.11 (unless otherwise req.) The pipe markings should indicate class of pipe and that is double cement lined.	Pressure Class (PC) 350 for 12-inch and smaller, PC 250 for 14-20-inch, and PC 200 for 24-inch. Exception: Ductile iron pipe crossing under a railroad, river, or interstate highway shall be Special Thickness Class 56. Pipe manufacturer required to be a DIPRA member company.
DIP Fittings (General)	ANSI/AWWA C110/A21.10 or C153/A21.53 with: 1) cement mortar lining with seal coat per ANSI/AWWA C104/A21.4 and 2) outside coating per ANSI/AWWA C151/A21.51 and 3) polyethylene wrap meeting the requirements of ANSI/AWWA C105/A21.5 and 4) restrained push-on rubber gasket joints per ANSI/AWWA C111/A21.11 (unless otherwise required)	
Fire Hydrants	ANSI/AWWA C502	EJIW WaterMaster 5BR250 - product number 55931D One 3 ⅜ inch threaded Ann Arbor standard pumper connection with 7 ½ threads per inch and 4.05-inch outside diameter and one 5-inch Storz pumper connection, breakable traffic flange, and mechanical joint assembly with high strength, low alloy steel, ceramic-filled fluorocarbon resin coated bolts are required. 1 ⅜ inch pentagon operating nut and cap nuts shall be utilized (1 ⅜ inch point-to-flat at top and 1 $\frac{7}{16}$ inch point-to-flat at base) and shall open left
Fire Hydrant Extensions		Fire hydrant extensions shall be as furnished by manufacturer
Joints for Directionally Drilled Installations		US Pipe - HDSS McWane - TR Flex American Pipe - Flex Ring
Mechanical Joints for Hydrants & Solid Sleeves		EBAA Mega Lug Series 1100 Joint Restraint System Ford Meter Box Company, Uni-Flange Retainer (UFR1400-D-x style) Bolts to be high strength, low alloy steel, ceramic-filled fluorocarbon resin coated
Polyethylene Pipe Fittings	AWWA C906 and approved for use with potable water under ANSI/NSF Standard 14	Restraining collars, reducers and ductile iron to PE transition adaptor shall be DIOD sized
Polyethylene Pressure Pipe	AWWA C906 and approved for use with potable water under ANSI/NSF Standard 14	SDR 11; PE-4710 All pipe shall have be DIOD (Ductile Iron Outside diameter) sized
Polyethylene Wrap for DIP	ANSI/AWWA C105/A21.5, Polyethylene Encasement for Ductile Iron Pipe Systems	V-Bio® Enhanced Polyethylene Encasement for Ductile Iron Pipe
Push-On Restrained Rubber Gasket Joint Systems	ANSI/AWWA C111/A21.11and approved for use with potable water under ANSI/NSF Standard 14	American Pipe "Fast Grip" Gasket System US Pipe "Field Lok 350" Gasket System McWane "Sure Stop" Gasket System TYTON "Barracuda" Gasket System

Material Type	Applicable Standards	Allowable Materials (Manufacturer/Model) and Additional Requirements
Resilient Wedge Gate Valves	AWWA C509 or C515	American Flow Control Series 2500 Single Resilient Wedge w/ push-on ends Clow Model 2638 (4" through 16") Resilient Wedge Valve, F-6112 EJIW FlowMaster Resilient Wedge Valve, Tyton x Tyton Mueller Series (4"-12") A-2361-61 Resilient Wedge Valve SL. x SL for Field Lok Gaskets. US Pipe A-USP1-61 Resilient Wedge Valve SLxSL for Field Lok Gaskets Operator for buried service with 2-inch square opening nut, operating right, push-on by push-on only with restrained gaskets
Solid Sleeves		Shall be long sleeves
Solid Sleeves for Oversized Existing Main		Tyler Dual Sleeve 5-146L Smith-Blair 441 Coupling Sleeves
Tapping Sleeves	ANSI/AWWA C223 for stainless steel ANSI/AWWA C111/A21.11 high-strength low-alloy steel	Ford FTSS Smith Blair 665 Mueller H-615 Kennedy 920ss Bolts to be Grade 304 stainless steel or high strength, low alloy steel, ceramic-filled fluorocarbon resin coated
Tracer Wire		For open trench: #12 AWG Solid Copper Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness For directional drilling: #12 AWG Solid Copper Clad Steel, Extra High Strength with minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness

Appendix B Sanitary Design Dry Weather Flow Rates	
TYPE OF FACILITY OR USE	DESIGN DRY WEATHER FLOW RATE
Single Family Residence	300 gpd
Two Family Residence (Duplex)	600 gpd
Apartments, condos, mobile homes, trailers, coops, etc. up to 600 sq. ft. of gross floor area	175 gpd/unit
Apartments, condos, mobile homes, trailers, co-ops., etc. between 601-1200 sq. ft. of gross floor area	250 gpd/unit
Apartments, condos, mobile homes, trailers, co-ops., etc. greater than 1200 sq. ft. of gross floor area.	300 gpd/unit
Motel or hotel unit less than 400 sq. ft	75 gpd/unit
Motel or hotel unit greater than 400 sq. ft.	150 gpd/unit
Hospital and Nursing Homes	150 gpd/bed
University housing, rooming house, or apartment unit housing more than 4 people	75 gpd/capita
Cafeteria (integral to an office, industrial building, or school)	2.50 gpd/capita
Non-Medical Office space	0.06 gpd/sq.ft. of gross floor area
Medical Office Space (doctor, dentist, urgent care, etc.)	0.10 gpd/sq.ft. of gross floor area
General Industrial Space	0.04 gpd/sq.ft. of gross floor area
Auditorium/Theater	5 gpd/seat
Bowling alley (plus food service areas per Restaurant standard)	100 gpd/alley
Parking Structure (exc. spaces on uncovered top decks)	27 gpd/parking space to maximum of 3,375 gpd
Church	1.50 gpd/seat
Fast Food Restaurants and Coffee Shops	20 gpd/seat
Restaurant (Other Than Fast Food)	30 gpd/seat
Stores with Food Processing but no seating (delis, butcher shop areas, etc.)	0.15 gpd/sq.ft. of gross floor area
Stores with Non-Food Process Water (barbershop, beauty salon, etc.)	0.10 gpd/sq.ft. of gross floor area
Retail Store (no process water discharge)	0.03 gpd/sq.ft. of gross floor area
Catering Hall	7.50 gpd/capita based on maximum occupancy
Grocery Store (Note: Deli and butcher shop areas to be calculated using Stores with Food Processing design rate)	0.05 gpd /sq.ft. of gross floor area
Bar, Tavern, Nightclub with no food preparation	15 gpd/capita based on maximum occupancy
Bar, Tavern, Nightclub with food preparation	30 gpd/seat
Swimming Pool (Note: Filter Backwash to be calculated using Swimming Pool Filter Backwash design rate)	20 gpd/capita based on maximum occupancy
Swimming Pool Filter Backwash based on manufacturer's spec.	To Be Determined by Public Services Area Admin.
Gas Stations	300 gpd/double hose pump
Warehouse and Storage Facilities: Manned Areas	0.06 gpd/sq.ft. of gross floor area
Laundry	425 gpd/laundry machine
Nursery and elementary schools	10 gpd/student
Middle and high schools	20 gpd/student
Spa, Country Club	0.30 gpd/sq.ft. of gross floor area
Industrial or Manufacturing Facility, Large Research Facility, or other uses not specified	To Be Determined by Public Services Area Admin.
Others (car wash, etc)	To Be Determined by Public Services Area Admin.

Appendix C: Pay Item Numbers

ITEM NUMBER	LEGEND	UNIT
	General	
01000.00	General Conditions, Max. $_____	LS
01001.00	Project Supervision, Max. $_____	LS
01002.00	Project Clean-Up and Restoration	LS
01003.00	Digital Audio Visual Coverage	LS
01020.00	Erosion Control, Check Dam	Ft
01021.00	Erosion Control, Inlet Protection, Fabric Drop	Ea
01022.00	Erosion Control, Silt Fence	Ft
01023.00	Erosion Control, Mud Mat	Syd
01030.00	Tree Protection Fence	Ft
01040.00	Minor Traffic Control, Max. $_____	LS
01041.00	Traffic Regulator Control	LS
01042.00	Traffic Regulator Control, Modified	Hr
01050.00	Sign, Type B, Temp, Prismatic, Furn & Oper	Sft
01051.00	Sign, Type B, Temp, Prismatic, Special, Furn & Oper	Sft
01052.00	Temporary "No Parking" Sign	Ea
01060.00	Lighted Arrow, Type A, Furn & Oper	Ea
01061.00	Lighted Arrow, Type B, Furn & Oper	Ea
01062.00	Lighted Arrow, Type C, Furn & Oper	Ea
01070.00	Sign, Portable, Changeable Message, Furn & Oper	Ea
01080.00	Plastic Drum, High Intensity, Lighted, Furn & Oper	Ea
01081.00	Channelizer Cone, High Intensity, 42 In., Furn & Oper	Ea
01090.00	Barricade, Type II, High Intensity, Double Sided, Lighted, Furn & Oper	Ea
01091.00	Barricade, Type III, High Intensity, Lighted, Furn & Oper	Ea
01092.00	Barricade, Type III, High Intensity, Double Sided, Lighted, Furn & Oper	Ea
01100.00	Pedestrian Type II Barricade, Temp, Furn & Oper	Ea
01101.00	Pedestrian Channelizer Device, Furn & Oper	Ea
01102.00	Temporary Pedestrian Ramp, Furn & Oper	Ea
01103.00	Temporary Pedestrian Mat, Furn & Oper	Ft
01110.00	Pavt Mrkg, Longit, Remove	Ft
01111.00	Pavt Mrkg, Symbol Or Legend, Remove	Ea
01112.00	Pavt Mrkg Cover, Type R, Black	Ft
01113.00	Pavt Mrkg, Type NR, Paint, 6 In., Crosswalk	Ft
01114.00	Pavt Mrkg, Type NR, Paint, 24 In., Stop Bar	Ft
01115.00	Pavt Mrkg, Type NR, Paint, Lt Turn Arrow	Ea
01116.00	Pavt Mrkg, Type NR, Paint, Rt Turn Arrow	Ea
01117.00	Pavt Mrkg, Type NR, Paint, Thru Arrow	Ea
01118.00	Pavt Mrkg, Wet Reflective, Type NR, Paint, 4 In., White, Temp	Ft
01119.00	Pavt Mrkg, Wet Reflective, Type NR, Paint, 4 In., Yellow, Temp	Ft
01120.00	Pavt Mrkg, Wet Reflective, Type R, Tape, 4 In., White, Temp	Ft

ITEM NUMBER	LEGEND	UNIT
01121.00	Pavt Mrkg, Wet Reflective, Type R, Tape, 4 In., Yellow, Temp	Ft
01122.00	Pavt Mrkg, Wet Reflective, Type R, Tape, 6 In., Crosswalk	Ft
01123.00	Pavt Mrkg, Wet Reflective, Type R, Tape, Lt Turn Arrow	Ea
01124.00	Pavt Mrkg, Wet Reflective, Type R, Tape, Rt Turn Arrow	Ea
01125.00	Pavt Mrkg, Wet Reflective, Type R, Tape, Thru Arrow	Ea
01126.00	Pavt Mrkg, Wet Reflective, Type R, Tape, 24 In., Stop Bar	Ft
01127.00	Pavt Mrkg, Wet Reflective, Type R, Tape, 6 In., White, Temp	Ft
01128.00	Pavt Mrkg, Wet Reflective, Type R, Tape, 6 In., Yellow, Temp	Ft
01129.00	Pavt Mrkg, Wet Reflective, Type NR, Paint, 6 In., White, Temp	Ft
01130.00	Pavt Mrkg, Wet Reflective, Type NR, Paint, 6 In., Yellow, Temp	Ft
01131.00	Pavt Mrkg, Wet Reflective, Type R, Tape, 12 In., White, Temp	Ft
01132.00	Pavt Mrkg, Wet Reflective, Type R, Tape, 12 In., Yellow, Temp	Ft
01133.00	Pavt Mrkg, Wet Reflective, Type NR, Paint, 12 In., White, Temp	Ft
01134.00	Pavt Mrkg, Wet Reflective, Type NR, Paint, 12 In., Yellow, Temp	Ft
01135.00	Pavt Mrkg, Type NR, Paint, Only	Ea
01136.00	Pavt Mrkg, Type NR, Paint, Rt and Lt Turn Arrow Sym	Ea
01137.00	Pavt Mrkg, Type NR, Paint, Rt, Thru and Lt Turn Arrow	Ea
01138.00	Pavt Mrkg, Type NR, Paint, Thru and Lt Turn Arrow Sym	Ea
01139.00	Pavt Mrkg, Type NR, Paint, Thru and Rt Turn Arrow Sym	Ea
01140.00	Pavt Mrkg, Type NR, Paint, Sharrow Sym	Ea
01141.00	Pavt Mrkg, Type NR, Paint, 12 In., Cross Hatching, White	Ft
01142.00	Pavt Mrkg, Type NR, Paint, 12 In., Cross Hatching, Yellow	Ft
01143.00	Pavt Mrkg, Wet Reflective, Type R, Tape, Only	Ea
01144.00	Pavt Mrkg, Wet Reflective, Type R, Tape, Rt and Lt Turn Arrow Sym	Ea
01145.00	Pavt Mrkg, Wet Reflective, Type R, Tape, Rt, Thru and Lt Turn Arrow	Ea
01146.00	Pavt Mrkg, Wet Reflective, Type R, Tape, Thru and Lt Turn Arrow Sym	Ea
01147.00	Pavt Mrkg, Wet Reflective, Type R, Tape, Thru and Rt Turn Arrow Sym	Ea
01148.00	Pavt Mrkg, Wet Reflective, Type R, Tape, Sharrow Sym	Ea
01149.00	Pavt Mrkg, Wet Reflective, Type R, Tape, 12 In., Cross Hatching, White	Ft
01150.00	Pavt Mrkg, Wet Reflective, Type R, Tape, 12 In., Cross Hatching, Yellow	Ft
	Removals	
02000.01	Tree, Rem, 6 In. - 12 In.	Ea
02000.02	Tree, Rem, 13 In. - 19 In.	Ea
02000.03	Tree, Rem, 20 In. - 29 In.	Ea
02000.04	Tree, Rem, 30 In. - 39 In.	Ea
02000.05	Tree, Rem, 40 In. and larger	Ea
02010.00	Stump, Rem	Ea
02020.00	HMA, Any Thickness, Rem	Syd
02021.00	HMA Surface, Rem	Syd
02022.00	HMA Patch, Rem	Syd
02023.00	Cold-Milling HMA Surface	Syd

ITEM NUMBER	LEGEND	UNIT
02023.01	Cold-Milling HMA Surface, Plunge Cut	Syd
02024.00	Cold-Milling HMA Surface, Modified	Ton
02025.00	Concrete Pavt, Any Thickness, Rem	Syd
02030.00	Curb, Gutter, and Curb and Gutter, Any Type, Rem	Ft
02040.00	Sidewalk, Sidewalk Ramp, and Driveway Approach, Any Thickness, Rem	Sft
02050.00	Sign, Rem, Salv	Ea
	Earthwork	
03000.00	Machine Grading, _____, Modified	Sta
03001.00	Machine Grading, _____	Syd
03010.00	Hand Dig, Sidewalk	Syd
03011.00	Hand Dig, Utility	Syd
03020.00	Subgrade Undercutting, Type I	Cyd
03021.00	Subgrade Undercutting, Type II	Cyd
03022.00	Subgrade Undercutting, Type III	Cyd
03030.01	Exploratory Excavation, SD-TD-1, (0-10' Deep)	Ea
03030.02	Exploratory Excavation, SD-TD-1, Additional Depth	Ft
03030.03	Exploratory Excavation, SD-TD-2, (0-10' Deep)	Ea
03030.04	Exploratory Excavation, SD-TD-2, Additonal Depth	Ft
03040.00	Earth Excavation	Cyd
03050.00	Embankment	Cyd
03060.00	Non-Hazardous Contaminated Material Handling and Disposal	Cyd
03070.00	Dewatering	LS
	Sanitary Sewer	
04000.01	8 In., SDR 26 PVC Sanitary Sewer, SD-TD-2	Ft
04000.02	10 In., SDR 26 PVC Sanitary Sewer, SD-TD-2	Ft
04000.03	12 In., SDR 26 PVC Sanitary Sewer, SD-TD-2	Ft
04000.04	15 In., SDR 26 PVC Sanitary Sewer, SD-TD-2	Ft
04000.05	18 In., SDR 26 PVC Sanitary Sewer, SD-TD-2	Ft
04000.06	21 In., SDR 26 PVC Sanitary Sewer, SD-TD-2	Ft
04000.07	24 In., SDR 26 PVC Sanitary Sewer, SD-TD-2	Ft
04000.08	30 In., SDR 26 PVC Sanitary Sewer, SD-TD-2	Ft
04000.09	36 In., SDR 26 PVC Sanitary Sewer, SD-TD-2	Ft
04001.01	8 In., ES VCP Sanitary Sewer, SD-TD-2	Ft
04001.02	10 In., ES VCP Sanitary Sewer, SD-TD-2	Ft
04001.03	12 In., ES VCP Sanitary Sewer, SD-TD-2	Ft
04001.04	15 In., ES VCP Sanitary Sewer, SD-TD-2	Ft
04001.05	18 In., ES VCP Sanitary Sewer, SD-TD-2	Ft
04001.06	21 In., ES VCP Sanitary Sewer, SD-TD-2	Ft
04001.07	24 In., ES VCP Sanitary Sewer, SD-TD-2	Ft
04001.08	30 In., ES VCP Sanitary Sewer, SD-TD-2	Ft

ITEM NUMBER	LEGEND	UNIT
04001.09	36 In., ES VCP Sanitary Sewer, SD-TD-2	Ft
04002.01	8 In., CL IV RCP Sanitary Sewer, SD-TD-1	Ft
04002.02	10 In., CL IV RCP Sanitary Sewer, SD-TD-1	Ft
04002.03	12 In., CL IV RCP Sanitary Sewer, SD-TD-1	Ft
04002.04	15 In., CL IV RCP Sanitary Sewer, SD-TD-1	Ft
04002.05	18 In., CL IV RCP Sanitary Sewer, SD-TD-1	Ft
04002.06	21 In., CL IV RCP Sanitary Sewer, SD-TD-1	Ft
04002.07	24 In., CL IV RCP Sanitary Sewer, SD-TD-1	Ft
04002.08	30 In., CL IV RCP Sanitary Sewer, SD-TD-1	Ft
04002.09	36 In., CL IV RCP Sanitary Sewer, SD-TD-1	Ft
04003.01	8 In., PC 350 DIP Gravity, SD-TD-1	Ft
04003.02	12 In., PC 350 DIP Gravity, SD-TD-1	Ft
04004.01	16 In., PC 250 DIP Gravity, SD-TD-1	Ft
04004.02	18 In., PC 250 DIP Gravity, SD-TD-1	Ft
04005.01	24 In., PC 200 DIP Gravity, SD-TD-1	Ft
04010.01	6 In., SDR 26 PVC Sanitary Sewer Wye	Ea
04010.02	8 In., SDR 26 PVC Sanitary Sewer Wye	Ea
04011.01	6 In., CL IV RCP Sanitary Sewer Wye	Ea
04011.02	8 In., CL IV RCP Sanitary Sewer Wye	Ea
04012.01	6 In., CL V RCP Sanitary Sewer Wye	Ea
04012.02	8 In., CL V RCP Sanitary Sewer Wye	Ea
04013.01	6 In., ES VCP Sanitary Sewer Wye	Ea
04013.02	8 In., ES VCP Sanitary Sewer Wye	Ea
04014.01	6 In., SDR 26 PVC Sanitary Service Lead, SD-TD-2	Ft
04014.02	8 In., SDR 26 PVC Sanitary Service Lead, SD-TD-2	Ft
04020.00	Pipe Undercut & Backfill, Sanitary	Cyd
04030.01	Sanitary Manhole, 48 In. Dia. (0-8' Deep)	Ea
04030.02	Sanitary Manhole, 48 In. Dia., Additional Depth	Ft
04030.03	Sanitary Manhole, 60 In. Dia. (0-8' Deep)	Ea
04030.04	Sanitary Manhole, 60 In. Dia. , Additional Depth	Ft
04030.05	Sanitary Manhole, 72 In. Dia. (0-8' Deep)	Ea
04030.06	Sanitary Manhole, 72 In. Dia. , Additional Depth	Ft
04040.01	Sanitary Manhole Drop Connection, 4 In.	Ft
04040.02	Sanitary Manhole Drop Connection, 6 In.	Ft
04040.03	Sanitary Manhole Drop Connection, 8 In.	Ft
04040.04	Sanitary Manhole Drop Connection, 10 In.	Ft
04040.05	Sanitary Manhole Drop Connection, 12 In.	Ft
04050.01	Sanitary Manhole Over Existing ("Doghouse"), 48 In. Dia.	Ea
04050.02	Sanitary Manhole Over Existing ("Doghouse"), 60 In. Dia.	Ea
04050.03	Sanitary Manhole Over Existing ("Doghouse"), 72 In. Dia.	Ea
04060.00	Sanitary Structure Cover	Ea

ITEM NUMBER	LEGEND	UNIT
04061.00	Sanitary Structure Cover, Adjust	Ea
04070.01	Sanitary Sewer Pipe, 8 In. Dia., Abandon	Ft
04070.02	Sanitary Sewer Pipe, 10 In. Dia., Abandon	Ft
04070.03	Sanitary Sewer Pipe, 12 In. Dia., Abandon	Ft
04070.04	Sanitary Sewer Pipe, 15 In. Dia., Abandon	Ft
04070.05	Sanitary Sewer Pipe, 18 In. Dia., Abandon	Ft
04070.06	Sanitary Sewer Pipe, 21 In. Dia., Abandon	Ft
04070.07	Sanitary Sewer Pipe, 24 In. Dia., Abandon	Ft
04070.08	Sanitary Sewer Pipe, 30 In. Dia., Abandon	Ft
04070.09	Sanitary Sewer Pipe, 36 In. Dia., Abandon	Ft
04080.01	Sanitary Sewer Pipe, 8 In. Dia., Rem	Ft
04080.02	Sanitary Sewer Pipe, 10 In. Dia., Rem	Ft
04080.03	Sanitary Sewer Pipe, 12 In. Dia., Rem	Ft
04080.04	Sanitary Sewer Pipe, 15 In. Dia., Rem	Ft
04080.05	Sanitary Sewer Pipe, 18 In. Dia., Rem	Ft
04080.06	Sanitary Sewer Pipe, 21 In. Dia., Rem	Ft
04080.07	Sanitary Sewer Pipe, 24 In. Dia., Rem	Ft
04080.08	Sanitary Sewer Pipe, 30 In. Dia., Rem	Ft
04080.09	Sanitary Sewer Pipe, 36 In. Dia., Rem	Ft
04090.00	Sanitary Sewer Structure, Abandon	Ea
04100.00	Sanitary Sewer Structure, Rem	Ea
04110.01	Sanitary Sewer Tap, 8 In. Dia.	Ea
04110.02	Sanitary Sewer Tap, 10 In. Dia.	Ea
04110.03	Santiary Sewer Tap, 12 In. Dia.	Ea
04110.04	Sanitary Sewer Tap, 15 In. Dia.	Ea
04110.05	Sanitary Sewer Tap, 18 In. Dia.	Ea
	Sewer and Manhole Rehab	
05000.01	Clean Sanitary Sewer, ___In. Dia.	Ft
05010.01	Televise Sanitary Sewer, ___In. Dia.	Ft
05020.00	Level 2 MACP Inspect Manhole	Ea
05030.01	CIPP Liner, ___In. Dia., Sanitary Sewer	Ft
05040.01	PreLiner ___ In. Dia., Sanitary Sewer	Ft
05050.00	Internal Chimney Seal	Ea
05051.00	External Chimney Seal	Ea
05060.00	Chemical Grouting	Gal
05070.00	Cementitious Manhole Liner	Ft
05080.00	Epoxy Manhole	LFt
05090.00	Reconstruction Flow Channel	Ea
	Storm and Drainage	
06000.01	12 In., CL IV RCP Storm Sewer, SD-TD-1	Ft

ITEM NUMBER	LEGEND	UNIT
06000.02	15 In., CL IV RCP Storm Sewer, SD-TD-1	Ft
06000.03	18 In., CL IV RCP Storm Sewer, SD-TD-1	Ft
06000.04	21 In., CL IV RCP Storm Sewer, SD-TD-1	Ft
06000.05	24 In., CL IV RCP Storm Sewer, SD-TD-1	Ft
06000.06	30 In., CL IV RCP Storm Sewer, SD-TD-1	Ft
06000.07	36 In., CL IV RCP Storm Sewer, SD-TD-1	Ft
06000.08	42 In., CL IV RCP Storm Sewer, SD-TD-1	Ft
06000.09	48 In., CL IV RCP Storm Sewer, SD-TD-1	Ft
06001.01	12 In., CL V RCP Storm Sewer, SD-TD-1	Ft
06001.02	15 In., CL V RCP Storm Sewer, SD-TD-1	Ft
06001.03	18 In., CL V RCP Storm Sewer, SD-TD-1	Ft
06001.04	21 In., CL V RCP Storm Sewer, SD-TD-1	Ft
06001.05	24 In., CL V RCP Storm Sewer, SD-TD-1	Ft
06002.01	6 In., CMP Storm Sewer, SD-TD-2	Ft
06002.02	8 In., CMP Storm Sewer, SD-TD-2	Ft
06002.03	10 In., CMP Storm Sewer, SD-TD-2	Ft
06002.04	12 In., CMP Storm Sewer, SD-TD-2	Ft
06002.05	15 In., CMP Storm Sewer, SD-TD-2	Ft
06002.06	18 In., CMP Storm Sewer, SD-TD-2	Ft
06002.07	21 In., CMP Storm Sewer, SD-TD-2	Ft
06002.08	24 In., CMP Storm Sewer, SD-TD-2	Ft
06003.01	6 In., PE Storm Sewer, SD-TD-2	Ft
06003.02	8 In., PE Storm Sewer, SD-TD-2	Ft
06003.03	10 In., PE Storm Sewer, SD-TD-2	Ft
06003.04	12 In., PE Storm Sewer, SD-TD-2	Ft
06003.05	15 In., PE Storm Sewer, SD-TD-2	Ft
06003.06	18 In., PE Storm Sewer, SD-TD-2	Ft
06003.07	21 In., PE Storm Sewer, SD-TD-2	Ft
06003.08	24 In., PE Storm Sewer, SD-TD-2	Ft
06010.01	12 In., CMP End Section	Ea
06010.02	15 In., CMP End Section	Ea
06010.03	18 In., CMP End Section	Ea
06010.04	24 In., CMP End Section	Ea
06010.05	30 In., CMP End Section	Ea
06010.06	36 In., CMP End Section	Ea
06011.01	12 In., PE End Section	Ea
06011.02	15 In., PE End Section	Ea
06011.03	18 In., PE End Section	Ea
06011.04	24 In., PE End Section	Ea
06011.05	30 In., PE End Section	Ea
06011.06	36 In., PE End Section	Ea

ITEM NUMBER	LEGEND	UNIT
06012.01	12 In., CL IV RCP End Section	Ea
06012.02	15 In., CL IV RCP End Section	Ea
06012.03	18 In., CL IV RCP End Section	Ea
06012.04	24 In., CL IV RCP End Section	Ea
06012.05	30 In., CL IV RCP End Section	Ea
06012.06	36 In., CL IV RCP End Section	Ea
06012.07	12 In., CL V RCP End Section	Ea
06012.08	15 In., CL V RCP End Section	Ea
06012.09	18 In., CL V RCP End Section	Ea
06012.10	24 In., CL V RCP End Section	Ea
06012.11	30 In., CL V RCP End Section	Ea
06012.12	36 In., CL V RCP End Section	Ea
06020.00	Pipe Undercut & Backfill, Storm	Cyd
06030.01	Storm Sewer Tap, 6 In. Dia.	Ea
06030.02	Storm Sewer Tap, 8 In. Dia.	Ea
06030.03	Storm Sewer Tap, 10 In. Dia.	Ea
06030.04	Storm Sewer Tap, 12 In. Dia.	Ea
06030.05	Storm Sewer Tap, 15 In. Dia.	Ea
06030.06	Storm Sewer Tap, 18 In. Dia.	Ea
06030.07	Storm Sewer Tap, 21 In. Dia.	Ea
06030.08	Storm Sewer Tap, 24 In. Dia.	Ea
06040.00	Riprap, Grouted	Syd
06041.00	Riprap, Plain	Syd
06042.00	Riprap, Heavy	Syd
06043.00	Gabions, Stone Fill	Cyd
06050.01	Storm Manhole, 48 In. Dia. (0-8' deep)	Ea
06050.02	Storm Manhole, 48 In. Dia. , Additional Depth	Ft
06050.03	Storm Manhole, 60 In. Dia. (0-8' deep)	Ea
06050.04	Storm Manhole, 60 In. Dia., Additional Depth	Ft
06050.05	Storm Manhole, 72 In. Dia. (0-8' deep)	Ea
06050.06	Storm Manhole, 72 In. Dia. , Additional Depth	Ft
06050.07	Storm Manhole, 84 In. Dia. (0-8' deep)	Ea
06050.08	Storm Manhole, 84 In. Dia. , Additional Depth	Ft
06050.09	Storm Manhole, 96 In. Dia. (0-8' deep)	Ea
06050.10	Storm Manhole, 96 In. Dia., Additional Depth	Ft
06060.01	Storm Inlet-Junction, 36 In. Dia., (0-8' deep)	Ea
06060.02	Storm Inlet-Junction, 36 In. Dia., Additional Depth	Ft
06060.03	Storm Inlet-Junction, 48 In. Dia., (0-8' deep)	Ea
06060.04	Storm Inlet-Junction, 48 In. Dia., Additional Depth	Ft
06060.05	Storm Inlet- Junction, 60 In. Dia., (0-8' deep)	Ea
06060.06	Storm Inlet-Junction, 60 In. Dia., Additional Depth	Ft

ITEM NUMBER	LEGEND	UNIT
06060.07	Storm Inlet-Junction, 72 In. Dia., (0-8' deep)	Ea
06060.08	Storm Inlet-Junction, 72 In. Dia., Additional Depth	Ft
06070.01	Storm Single Inlet, 24 In. Dia., (0-8' deep)	Ea
06070.02	Storm Single Inlet, 24 In. Dia., Additional Depth	Ft
06080.01	Storm High Capacity Inlet, 48 In. Dia., (0-8' deep)	Ea
06080.02	Storm High Capacity Inlet, 48 In. Dia., Additional Depth	Ft
06090.01	Storm Manhole with Weir, 72 In. Dia. (0-8' deep)	Ea
06090.02	Storm Manhole with Weir, 72 In. Dia., Additional Depth	Ft
06090.03	Storm Manhole with Weir, 84 In.Dia. (0-8 In. deep)	Ea
06090.04	Storm Manhole with Weir, 84 In. Dia., Additional Depth	Ft
06090.05	Storm Manhole with Weir, 96 In. Dia. (0-8 feet)	Ea
06090.06	Storm Manhole with Weir, 96 In. Dia., Additional Depth	Ft
06100.01	Storm Manhole Over Existing ("Doghouse"), 48 In. Dia.	Ea
06100.02	Storm Manhole Over Existing ("Doghouse"), 60 In. Dia.	Ea
06100.03	Storm Manhole Over Existing ("Doghouse"), 72 In. Dia.	Ea
06110.01	Storm Sewer Pipe, 8 In. Dia., Abandon	Ft
06110.02	Storm Sewer Pipe, 10 In. Dia., Abandon	Ft
06110.03	Storm Sewer Pipe, 12 In. Dia., Abandon	Ft
06110.04	Storm Sewer Pipe, 15 In. Dia., Abandon	Ft
06110.05	Storm Sewer Pipe, 18 In. Dia., Abandon	Ft
06110.06	Storm Sewer Pipe, 21 In. Dia., Abandon	Ft
06110.07	Storm Sewer Pipe, 24 In. Dia., Abandon	Ft
06110.08	Storm Sewer Pipe, 30 In. Dia., Abandon	Ft
06110.09	Storm Sewer Pipe, 36 In. Dia., Abandon	Ft
06110.10	Storm Sewer Pipe, 42 In. Dia., Abandon	Ft
06110.11	Storm Sewer Pipe, 48 In. Dia., Abandon	Ft
06110.12	Storm Sewer Pipe, 54 In. Dia., Abandon	Ft
06110.13	Storm Sewer Pipe, 60 In. Dia., Abandon	Ft
06110.14	Storm Sewer Pipe, 72 In. Dia., Abandon	Ft
06110.15	Storm Sewer Pipe, 84 In. Dia., Abandon	Ft
06110.16	Storm Sewer Pipe, 96 In. Dia., Abandon	Ft
06120.01	Storm Sewer Pipe, 8 In. Dia., Rem	Ft
06120.02	Storm Sewer Pipe, 10 In. Dia., Rem	Ft
06120.03	Storm Sewer Pipe, 12 In. Dia., Rem	Ft
06120.04	Storm Sewer Pipe, 15 In. Dia., Rem	Ft
06120.05	Storm Sewer Pipe, 18 In. Dia., Rem	Ft
06120.06	Storm Sewer Pipe, 21 In. Dia., Rem	Ft
06120.07	Storm Sewer Pipe, 24 In. Dia., Rem	Ft
06120.08	Storm Sewer Pipe, 30 In. Dia., Rem	Ft
06120.09	Storm Sewer Pipe, 36 In. Dia., Rem	Ft
06120.10	Storm Sewer Pipe, 42 In. Dia., Rem	Ft

ITEM NUMBER	LEGEND	UNIT
06120.11	Storm Sewer Pipe, 48 In. Dia., Rem	Ft
06120.12	Storm Sewer Pipe, 54 In. Dia., Rem	Ft
06120.13	Storm Sewer Pipe, 60 In. Dia., Rem	Ft
06120.14	Storm Sewer Pipe, 72 In. Dia., Rem	Ft
06120.15	Storm Sewer Pipe, 84 In. Dia., Rem	Ft
06120.16	Storm Sewer Pipe, 96 In. Dia., Rem	Ft
06130.00	Storm Sewer Structure, Abandon	Ea
06140.00	Storm Sewer Structure, Rem	Ea
06150.00	Storm Sewer Drop Structure, Rem	Ea
06160.01	Storm Structure Cover	Ea
06160.02	Storm Structure Cover, Adjust	Ea
06160.03	Storm Structure Adjust, Additional Depth	Ft
06170.00	Storm Structure, Reconstruct	Ft
06180.01	Underdrain, Subgrade, 4 In.	Ft
06180.02	Underdrain, Subgrade, 6 In.	Ft
06181.01	Underdrain, Subbase, 4 In.	Ft
06181.02	Underdrain, Subbase, 6 In.	Ft
06182.01	Underdrain, Edge, 4 In.	Ft
06182.02	Underdrain, Edge, 6 In.	Ft
06183.01	Underdrain, Outlet, 4 In.	Ft
06183.02	Underdrain, Outlet, 6 In.	Ft
06184.01	Underdrain, Outlet Ending, 4 In.	Ea
06184.02	Underdrain, Outlet Ending, 6 In.	Ea
06190.01	Curb Drain, HDPE DR 17, HDD, 6 inch	Ft
06191.01	Curb Drain, HDPE DR 17, SD-TD-2, 6 inch	Ft
06200.01	Curb Drain, Tap	Ea
06210.01	Curb Drain, Cleanout	Ea
	Water Mains	
07000.01	4 In., PC 350 DIP w/polywrap, SD-TD-1	Ft
07000.02	6 In., PC 350 DIP w/polywrap, SD-TD-1	Ft
07000.03	8 In., PC 350 DIP w/polywrap, SD-TD-1	Ft
07000.04	10 In., PC 350 DIP w/polywrap, SD-TD-1	Ft
07000.05	12 In., PC 350 DIP w/polywrap, SD-TD-1	Ft
07001.01	16 In., PC 250 DIP w/polywrap, SD-TD-1	Ft
07001.02	20 In., PC 250 DIP w/polywrap, SD-TD-1	Ft
07002.01	24 In., PC 200 DIP w/polywrap, SD-TD-1	Ft
07003.01	6 In., Class 56 DIP w/polywrap, SD-TD-1	Ft
07003.02	8 In., Class 56 DIP w/polywrap, SD-TD-1	Ft
07003.03	10 In., Class 56 DIP w/polywrap, SD-TD-1	Ft
07003.04	12 In., Class 56 DIP w/polywrap, SD-TD-1	Ft
07003.05	16 In., Class 56 DIP w/polywrap, SD-TD-1	Ft

ITEM NUMBER	LEGEND	UNIT
07003.06	20 In., Class 56 DIP w/polywrap, SD-TD-1	Ft
07003.07	24 In., Class 56 DIP w/polywrap, SD-TD-1	Ft
07004.01	8 In., HDPE Water Main, Directional Drill	Ft
07004.02	10 In., HDPE Water Main, Directional Drill	Ft
07004.03	12 In., HDPE Water Main, Directional Drill	Ft
07004.04	14 In., HDPE Water Main, Directional Drill	Ft
07004.05	16 In., HDPE Water Main, Directional Drill	Ft
07004.06	18 In., HDPE Water Main, Directional Drill	Ft
07004.07	20 In., HDPE Water Main, Directional Drill	Ft
07004.08	24 In., HDPE Water Main, Directional Drill	Ft
07010.01	6 In. 90° DIP Bend	Ea
07010.02	6 In. 45° DIP Bend	Ea
07010.03	6 In. 22.5° DIP Bend	Ea
07010.04	6 In. 11.25° DIP Bend	Ea
07011.01	8 In. 90° DIP Bend	Ea
07011.02	8 In. 45° DIP Bend	Ea
07011.03	8 In. 22.5° DIP Bend	Ea
07011.04	8 In. 11.25° DIP Bend	Ea
07012.01	10 In. 90° DIP Bend	Ea
07012.02	10 In. 45° DIP Bend	Ea
07012.03	10 In. 22.5° DIP Bend	Ea
07012.04	10 In. 11.25° DIP Bend	Ea
07013.01	12 In. 90° DIP Bend	Ea
07013.02	12 In. 45° DIP Bend	Ea
07013.03	12 In. 22.5° DIP Bend	Ea
07013.04	12 In. 11.25° DIP Bend	Ea
07014.01	16 In. 90° DIP Bend	Ea
07014.02	16 In. 45° DIP Bend	Ea
07014.03	16 In. 22.5° DIP Bend	Ea
07014.04	16 In. 11.25° DIP Bend	Ea
07015.01	24 In. 90° DIP Bend	Ea
07015.02	24 In. 45° DIP Bend	Ea
07015.03	24 In. 22.5° DIP Bend	Ea
07015.04	24 In. 11.25° DIP Bend	Ea
07020.01	6 In. X 4 In. DIP Reducer	Ea
07020.02	8 In. X 4 In. DIP Reducer	Ea
07020.03	8 In. X 6 In. DIP Reducer	Ea
07020.04	10 In. X 4 In. DIP Reducer	Ea
07020.05	10 In. X 6 In. DIP Reducer	Ea
07020.06	10 In. X 8 In. DIP Reducer	Ea
07020.07	12 In. X 4 In. DIP Reducer	Ea

ITEM NUMBER	LEGEND	UNIT
07020.08	12 In. X 6 In. DIP Reducer	Ea
07020.09	12 In. X 8 In. DIP Reducer	Ea
07020.10	12 In. X 10 In. DIP Reducer	Ea
07020.11	16 In. X 6 In. DIP Reducer	Ea
07020.12	16 In. X 8 In. DIP Reducer	Ea
07020.13	16 In. X 10 In. DIP Reducer	Ea
07020.14	16 In. X 12 In. DIP Reducer	Ea
07020.15	18 In. X 8 In. DIP Reducer	Ea
07020.16	18 In. X 10 In. DIP Reducer	Ea
07020.17	18 In. X 12 In. DIP Reducer	Ea
07020.18	18 In. X 16 In. DIP Reducer	Ea
07020.19	20 In. X 8 In. DIP Reducer	Ea
07020.20	20 In. X 10 In. DIP Reducer	Ea
07020.21	20 In. X 12 In. DIP Reducer	Ea
07020.22	20 In. X 16 In. DIP Reducer	Ea
07020.23	20 In. X 18 In. DIP Reducer	Ea
07020.24	24 In. X 8 In. DIP Reducer	Ea
07020.25	24 In. X 10 In. DIP Reducer	Ea
07020.26	24 In. X 12 In. DIP Reducer	Ea
07020.27	24 In. X 16 In. DIP Reducer	Ea
07020.28	24 In. X 18 In. DIP Reducer	Ea
07020.29	24 In. X 20 In. DIP Reducer	Ea
07030.01	4 In. X 4 In. X 4 In. DIP Tee	Ea
07030.02	6 In. X 6 In. X 4 In. DIP Tee	Ea
07030.03	6 In. X 6 In. X 6 In. DIP Tee	Ea
07030.04	8 In. X 8 In. X 4 In. DIP Tee	Ea
07030.05	8 In. X 8 In. X 6 In. DIP Tee	Ea
07030.06	8 In. X 8 In. X 8 In. DIP Tee	Ea
07030.07	10 In. X 10 In. X 4 In. DIP Tee	Ea
07030.08	10 In. X 10 In. X 6 In. DIP Tee	Ea
07030.09	10 In. X 10 In. X 8 In. DIP Tee	Ea
07030.10	10 In. X 10 In. X 10 In. DIP Tee	Ea
07030.11	12 In. X 12 In. X 4 In. DIP Tee	Ea
07030.12	12 In. X 12 In. X 6 In. DIP Tee	Ea
07030.13	12 In. X 12 In. X 8 In. DIP Tee	Ea
07030.14	12 In. X 12 In. X 10 In. DIP Tee	Ea
07030.15	12 In. X 12 In. X 12 In. DIP Tee	Ea
07030.16	16 In. X 16 In. X 6 In. DIP Tee	Ea
07030.17	16 In. X 16 In. X 8 In. DIP Tee	Ea
07030.18	16 In. X 16 In. X 12 In. DIP Tee	Ea
07030.19	16 In. X 16 In. X 14 In. DIP Tee	Ea

ITEM NUMBER	LEGEND	UNIT
07030.20	16 In. X 16 In. X 16 In. DIP Tee	Ea
07030.21	18 In. X 18 In. X 6 In. DIP Tee	Ea
07030.22	18 In. X 18 In. X 8 In. DIP Tee	Ea
07030.23	18 In. X 18 In. X 12 In. DIP Tee	Ea
07030.24	18 In. X 18 In. X 14 In. DIP Tee	Ea
07030.25	18 In. X 18 In. X 16 In. DIP Tee	Ea
07030.26	18 In. X 18 In. X 18 In. DIP Tee	Ea
07030.27	20 In. X 20 In. X 6 In. DIP Tee	Ea
07030.28	20 In. X 20 In. X 8 In. DIP Tee	Ea
07030.29	20 In. X 20 In. X 12 In. DIP Tee	Ea
07030.30	20 In. X 20 In. X 14 In. DIP Tee	Ea
07030.31	20 In. X 20 In. X 16 In. DIP Tee	Ea
07030.32	20 In. X 20 In. X 18 In. DIP Tee	Ea
07030.33	20 In. X 20 In. X 20 In. DIP Tee	Ea
07030.34	24 In. X 24 In. X 6 In. DIP Tee	Ea
07030.35	24 In. X 24 In. X 8 In. DIP Tee	Ea
07030.36	24 In. X 24 In. X 12 In. DIP Tee	Ea
07030.37	24 In. X 24 In. X 14 In. DIP Tee	Ea
07030.38	24 In. X 24 In. X 16 In. DIP Tee	Ea
07030.39	24 In. X 24 In. X 18 In. DIP Tee	Ea
07030.40	24 In. X 24 In. X 20 In. DIP Tee	Ea
07030.41	24 In. X 24 In. X 24 In. DIP Tee	Ea
07040.01	6 In. X 6 In. DIP Cross	Ea
07040.02	8 In. X 8 In. DIP Cross	Ea
07040.03	10 In. X 8 In. DIP Cross	Ea
07040.04	12 In. X 8 In. DIP Cross	Ea
07040.05	16 In. X 8 In. DIP Cross	Ea
07040.06	10 In. X 10 In. DIP Cross	Ea
07040.07	12 In. X 10 In. DIP Cross	Ea
07040.08	16 In. X 10 In. DIP Cross	Ea
07040.09	12 In. X 12 In. DIP Cross	Ea
07040.10	16 In. X 12 In. DIP Cross	Ea
07040.11	16 In. X 16 In. DIP Cross	Ea
07050.01	Gate Valve in Box, 6 In.	Ea
07050.02	Gate Valve in Box, 8 In.	Ea
07050.03	Gate Valve in Box, 10 In.	Ea
07050.04	Gate Valve in Box, 12 In.	Ea
07050.05	Gate Valve in Box, 16 In.	Ea
07050.06	Gate Valve in Box, 18 In.	Ea
07050.07	Gate Valve in Box, 20 In.	Ea
07050.08	Gate Valve in Box, 24 In.	Ea

ITEM NUMBER	LEGEND	UNIT
07060.01	Gate Valve in Well, 6 In.	Ea
07060.02	Gate Valve in Well, 8 In.	Ea
07060.03	Gate Valve in Well, 10 In.	Ea
07060.04	Gate Valve in Well, 12 In.	Ea
07060.05	Gate Valve in Well, 16 In.	Ea
07060.06	Gate Valve in Well, 18 In.	Ea
07060.07	Gate Valve in Well, 20 In.	Ea
07060.08	Gate Valve in Well, 24 In.	Ea
07070.01	Tapping Sleeve & Valve in Box, 6 In.	Ea
07070.02	Tapping Sleeve & Valve in Box, 8 In.	Ea
07070.03	Tapping Sleeve & Valve in Box, 10 In.	Ea
07070.04	Tapping Sleeve & Valve in Box, 12 In.	Ea
07070.05	Tapping Sleeve & Valve in Box, 16 In.	Ea
07071.01	Tapping Sleeve & Valve in Well, 6 In.	Ea
07071.02	Tapping Sleeve & Valve in Well, 8 In.	Ea
07071.03	Tapping Sleeve & Valve in Well, 10 In.	Ea
07071.04	Tapping Sleeve & Valve in Well, 12 In.	Ea
07071.05	Tapping Sleeve & Valve in Well, 16 In.	Ea
07080.00	Excavate & Backfill For Water Service Tap and Lead	Ft
07090.00	Water Structure Cover	Ea
07091.00	Water Structure Cover, Adjust	Ea
07100.00	Fire Hydrant Assembly, Complete	Ea
07101.00	Fire Hydrant, Extension	Ft
07102.00	Fire Hydrant Assembly, Rem	Ea
07110.01	Sacrificial Anode, 17-pound	Ea
07110.02	Sacrificial Anode, 32-pound	Ea
07120.00	Gate Box, Adjust	Ea
07121.00	Curb Box, Adjust	Ea
07122.00	Gate Box Cover	Ea
07130.01	Temporary Water Main Line Stop, 8 In. or less	Ea
07130.02	Temporary Water Main Line Stop, 10 In.	Ea
07130.03	Temporary Water Main Line Stop, 12 In.	Ea
07130.04	Temporary Water Main Line Stop, 16 In.	Ea
07130.05	Temporary Water Main Line Stop, 18 In.	Ea
07130.06	Temporary Water Main Line Stop, 20 In.	Ea
07130.07	Temporary Water Main Line Stop, 24 In.	Ea
07131.00	Temporary Water Main Line Stop, Additional Rental Day	Ea
07140.01	Water Main Pipe, 4 In. Dia., Abandon	Ft
07140.02	Water Main Pipe, 6 In. Dia., Abandon	Ft
07140.03	Water Main Pipe, 8 In. Dia., Abandon	Ft
07140.04	Water Main Pipe, 10 In. Dia., Abandon	Ft

ITEM NUMBER	LEGEND	UNIT
07140.05	Water Main Pipe, 12 In. Dia., Abandon	Ft
07140.06	Water Main Pipe, 14 In. Dia., Abandon	Ft
07140.07	Water Main Pipe, 16 In. Dia., Abandon	Ft
07140.08	Water Main Pipe, 18 In. Dia., Abandon	Ft
07140.09	Water Main Pipe, 20 In. Dia., Abandon	Ft
07140.10	Water Main Pipe, 24 In. Dia., Abandon	Ft
07140.11	Water Main Pipe, 30 In. Dia., Abandon	Ft
07140.12	Water Main Pipe, 36 In. Dia., Abandon	Ft
07140.13	Water Main Pipe, 42 In. Dia., Abandon	Ft
07141.00	Water Main Pipe, Abandon, Modified	LS
07150.01	Water Main Pipe, 4 In. Dia., Rem	Ft
07150.02	Water Main Pipe, 6 In. Dia., Rem	Ft
07150.03	Water Main Pipe, 8 In. Dia., Rem	Ft
07150.04	Water Main Pipe, 10 In. Dia., Rem	Ft
07150.05	Water Main Pipe, 12 In. Dia., Rem	Ft
07150.06	Water Main Pipe, 14 In. Dia., Rem	Ft
07150.07	Water Main Pipe, 16 In. Dia., Rem	Ft
07150.08	Water Main Pipe, 18 In. Dia., Rem	Ft
07150.09	Water Main Pipe, 20 In. Dia., Rem	Ft
07150.10	Water Main Pipe, 24 In. Dia., Rem	Ft
07150.11	Water Main Pipe, 30 In. Dia., Rem	Ft
07150.12	Water Main Pipe, 36 In. Dia., Rem	Ft
07150.13	Water Main Pipe, 42 In. Dia., Rem	Ft
07160.01	Gate Valve in Box, 4 In. Dia., Abandon	Ea
07160.02	Gate Valve in Box, 6 In. Dia., Abandon	Ea
07160.03	Gate Valve in Box, 8 In. Dia., Abandon	Ea
07160.04	Gate Valve in Box, 10 In. Dia., Abandon	Ea
07160.05	Gate Valve in Box, 12 In. Dia., Abandon	Ea
07160.06	Gate Valve in Box, 16 In. Dia., Abandon	Ea
07160.07	Gate Valve in Box, 24 In. Dia., Abandon	Ea
07160.08	Gate Valve in Box, 30 In. Dia., Abandon	Ea
07160.09	Gate Valve in Box, 36 In. Dia., Abandon	Ea
07160.10	Gate Valve in Box, 42 In. Dia., Abandon	Ea
07160.11	Gate Valve in Box, 48 In. Dia., Abandon	Ea
07170.01	Gate Valve in Box, 4 In. Dia., Rem	Ea
07170.02	Gate Valve in Box, 6 In. Dia., Rem	Ea
07170.03	Gate Valve in Box, 8 In. Dia., Rem	Ea
07170.04	Gate Valve in Box, 10 In. Dia., Rem	Ea
07170.05	Gate Valve in Box, 12 In. Dia., Rem	Ea
07170.06	Gate Valve in Box, 16 In. Dia., Rem	Ea
07170.07	Gate Valve in Box, 24 In. Dia., Rem	Ea

ITEM NUMBER	LEGEND	UNIT
07170.08	Gate Valve in Box, 30 In. Dia., Rem	Ea
07170.09	Gate Valve in Box, 36 In. Dia., Rem	Ea
07170.10	Gate Valve in Box, 42 In. Dia., Rem	Ea
07170.11	Gate Valve in Box, 48 In. Dia., Rem	Ea
07180.01	Gate Valve in Well, 4 In. Dia., Abandon	Ea
07180.02	Gate Valve in Well, 6 In. Dia., Abandon	Ea
07180.03	Gate Valve in Well, 8 In. Dia., Abandon	Ea
07180.04	Gate Valve in Well, 10 In. Dia., Abandon	Ea
07180.05	Gate Valve in Well, 12 In. Dia., Abandon	Ea
07180.06	Gate Valve in Well, 16 In. Dia., Abandon	Ea
07180.07	Gate Valve in Well, 24 In. Dia., Abandon	Ea
07180.08	Gate Valve in Well, 30 In. Dia., Abandon	Ea
07180.09	Gate Valve in Well, 36 In. Dia., Abandon	Ea
07180.10	Gate Valve in Well, 42 In. Dia., Abandon	Ea
07180.11	Gate Valve in Well, 48 In. Dia., Abandon	Ea
07190.01	Gate Valve in Well, 4 In. Dia., Rem	Ea
07190.02	Gate Valve in Well, 6 In. Dia., Rem	Ea
07190.03	Gate Valve in Well, 8 In. Dia., Rem	Ea
07190.04	Gate Valve in Well, 10 In. Dia., Rem	Ea
07190.05	Gate Valve in Well, 12 In. Dia., Rem	Ea
07190.06	Gate Valve in Well, 16 In. Dia., Rem	Ea
07190.07	Gate Valve in Well, 24 In. Dia., Rem	Ea
07190.08	Gate Valve in Well, 30 In. Dia., Rem	Ea
07190.09	Gate Valve in Well, 36 In. Dia., Rem	Ea
07190.10	Gate Valve in Well, 42 In. Dia., Rem	Ea
07190.11	Gate Valve in Well, 48 In. Dia., Rem	Ea
	Streets, Driveways, & Sidewalks	
08000.00	Subbase, CIP	Cyd
08010.00	Aggregate Base Course, 21AA, CIP	Cyd
08010.01	Aggregate Base, 4 In., 21AA, CIP	Syd
08010.02	Aggregate Base, 6 In., 21AA, CIP	Syd
08010.03	Aggregate Base, 8 In., 21AA, CIP	Syd
08010.04	Aggregate Base, 10 In., 21AA, CIP	Syd
08010.05	Aggregate Base, 12 In., 21AA, CIP	Syd
08020.00	Aggregate Surface Course, 23A, CIP	Cyd
08020.01	Aggregate Surface Course, 8 In., 23A, CIP	Syd
08030.00	HMA Base Crushing and Shaping	Syd
08040.01	Aggregate Shoulder, Cl I, 22A	Ton
08040.02	Aggregate Shoulder, Cl I, 21AA	Ton
08041.01	Aggregate Shoulder, Cl II, 23A	Ton
08050.00	Geotextile Separator Fabric	Syd

ITEM NUMBER	LEGEND	UNIT
08051.00	Geotextile Stabilization Fabric	Syd
08060.00	Hand Patching	Ton
08070.01	HMA, 2C	Ton
08070.02	HMA, 3C	Ton
08070.03	HMA, 4C	Ton
08070.04	HMA, 13A	Ton
08070.05	HMA, 36A	Ton
08070.06	HMA, 2EL	Ton
08070.07	HMA, 2EML	Ton
08070.08	HMA, 2EMH	Ton
08070.09	HMA, 2EH	Ton
08070.10	HMA, 3EL	Ton
08070.11	HMA, 3EML	Ton
08070.12	HMA, 3EMH	Ton
08070.13	HMA, 3EH	Ton
08070.14	HMA, 4EL	Ton
08070.15	HMA, 4EML	Ton
08070.16	HMA, 4EMH	Ton
08070.17	HMA, 4EH	Ton
08070.18	HMA, 5EL	Ton
08070.19	HMA, 5EML	Ton
08070.20	HMA, 5EMH	Ton
08070.21	HMA, 5EH	Ton
08070.22	HMA, High Stress	Ton
08071.00	HMA Approach	Ton
08080.01	Conc Pavt, Non-Reinf, 6 In.	Syd
08080.02	Conc Pavt, Non-Reinf, 7 In.	Syd
08080.03	Conc Pavt, Non-Reinf, 8 In.	Syd
08080.04	Conc Pavt, Non-Reinf, 9 In.	Syd
08080.05	Conc Pavt, Non-Reinf, 10 In.	Syd
08080.06	Conc Pavt, Non-Reinf, 11 In.	Syd
08080.07	Conc Pavt, Non-Reinf, 12 In.	Syd
08090.01	Joint, Contraction, Cp	Ft
08090.02	Joint, Contraction, C3p	Ft
08090.03	Joint, Contraction, C	Ft
08090.04	Joint, Contraction, C2	Ft
08090.05	Joint, Contraction, C3	Ft
08090.06	Joint, Contraction, C4	Ft
08091.01	Joint, Expansion, E2	Ft
08091.02	Joint, Expansion, E3	Ft
08091.03	Joint, Expansion, E4	Ft

ITEM NUMBER	LEGEND	UNIT
08092.01	Joint, Plane-of-Weakness, W	Ft
08100.01	Conc Pavt With Integral Curb, Non-Reinf, 6 In.	Syd
08100.02	Conc Pavt With Integral Curb, Non-Reinf, 7 In.	Syd
08100.03	Conc Pavt With Integral Curb, Non-Reinf, 8 In.	Syd
08100.04	Conc Pavt With Integral Curb, Non-Reinf, 9 In.	Syd
08100.05	Conc Pavt With Integral Curb, Non-Reinf, 10 In.	Syd
08100.06	Conc Pavt With Integral Curb, Non-Reinf, 11 In.	Syd
08100.07	Conc Pavt With Integral Curb, Non-Reinf, 12 In.	Syd
08101.00	Conc Pavt Repair (MDOT Detail 8)	Ft
08110.00	Conc, Curb or Curb & Gutter, All Types	Ft
08120.01	Conc, Driveway Opening, Type M	Ft
08120.02	Conc, Driveway Opening, Type M Modified	Ft
08120.03	Conc, Driveway Opening, Type M, High Early	Ft
08121.01	Conc, Driveway Opening, Type L	Ft
08121.02	Conc, Driveway Opening, Type L, High Early	Ft
08130.01	Conc, Sidewalk, 4 In.	Sft
08131.01	Conc, Sidewalk, Drive Approach, or Ramp, 6 In.	Sft
08131.02	Conc, Sidewalk, Drive Approach, or Ramp, 8 In.	Sft
08132.01	Conc, Sidewalk, Drive Approach, or Ramp, 6 In., High Early	Sft
08132.02	Conc, Sidewalk, Drive Approach, or Ramp, 8 In., High Early	Sft
08133.00	Conc, Speed Hump	Syd
08134.00	Conc, Speed Cushions	Syd
08135.00	Conc, Speed Table	Syd
08136.00	Conc, Raised Crosswalk	Syd
08137.00	Conc, Raised Intersection	Syd
08140.00	Brick Pavers, Sidewalk, Rem and Reinstall	Sft
08150.00	Detectable Warning Surface	Ft
08160.00	Micro-Surfacing	Syd
08170.00	Chip Seal	Syd
08180.01	Pavt Mrkg, Ovly Cold Plastic, Bike, Large Sym	Ea
08180.02	Pavt Mrkg, Ovly Cold Plastic, Bike, Small Sym	Ea
08180.03	Pavt Mrkg, Ovly Cold Plastic, Bike Thru Arrow Sym	Ea
08180.04	Pavt Mrkg, Ovly Cold Plastic, Sharrow Sym	Ea
08190.01	Pavt Mrkg, Polymer Cement Surface, Bike, Large Sym	Ea
08190.02	Pavt Mrkg, Polymer Cement Surface, Bike, Small Sym	Ea
08190.03	Pavt Mrkg, Polymer Cement Surface, Bike Thru Arrow Sym	Ea
08190.04	Pavt Mrkg, Polymer Cement Surface, Bike Lt Turn Arrow Sym	Ea
08190.05	Pavt Mrkg, Polymer Cement Surface, Bike Rt Turn Arrow Sym	Ea
08190.06	Pavt Mrkg, Polymer Cement Surface, Bike Lane Green	Sft
08190.07	Pavt Mrkg, Polymer Cement Surface, Tan	Sft
08200.01	Pavt Mrkg, Polyurea, Bike, Large Sym	Ea

ITEM NUMBER	LEGEND	UNIT
08200.02	Pavt Mrkg, Polyurea, Bike, Small Sym	Ea
08200.03	Pavt Mrkg, Polyurea, Bike Thru Arrow Sym	Ea
08200.04	Pavt Mrkg, Polyurea, Sharrow Sym	Ea
08200.05	Pavt Mrkg, Polyurea, 12 In., Cross Hatching, White	Ft
08200.06	Pavt Mrkg, Polyurea, 12 In., Cross Hatching, Yellow	Ft
08200.07	Pavt Mrkg, Polyurea, 12 In., Crosswalk	Ft
08200.08	Pavt Mrkg, Polyurea, 12 In., White	Ft
08200.09	Pavt Mrkg, Polyurea, 24 In., Stop Bar	Ft
08200.10	Pavt Mrkg, Polyurea, 24 In., Crosswalk	Ft
08200.11	Pavt Mrkg, Polyurea, 4 In., White	Ft
08200.12	Pavt Mrkg, Polyurea, 4 In., Yellow	Ft
08200.13	Pavt Mrkg, Polyurea, 6 In., White	Ft
08200.14	Pavt Mrkg, Polyurea, 6 In., Yellow	Ft
08200.15	Pavt Mrkg, Polyurea, Lt Turn Arrow Sym	Ea
08200.16	Pavt Mrkg, Polyurea, Rt and Lt Turn Arrow Sym	Ea
08200.17	Pavt Mrkg, Polyurea, Rt Turn Arrow Sym	Ea
08200.18	Pavt Mrkg, Polyurea, Thru Arrow Sym	Ea
08200.19	Pavt Mrkg, Polyurea, Thru and Lt Turn Arrow Sym	Ea
08200.20	Pavt Mrkg, Polyurea, Thru and Rt Turn Arrow Sym	Ea
08200.21	Pavt Mrkg, Polyurea, Lt Roundabout Arrow Sym	Ea
08200.22	Pavt Mrkg, Polyurea, Thru and Lt Roundabout Arrow Sym	Ea
08200.23	Pavt Mrkg, Polyurea, Merge	Ea
08200.24	Pavt Mrkg, Polyurea, Merge Arrow Sym	Ea
08200.25	Pavt Mrkg, Polyurea, Only	Ea
08200.26	Pavt Mrkg, Polyurea, Railroad Sym	Ea
08200.27	Pavt Mrkg, Polyurea, School	Ea
08200.28	Pavt Mrkg, Polyurea, Stop	Ea
08200.29	Pavt Mrkg, Polyurea, Yield	Ea
08200.30	Pavt Mrkg, Polyurea, Yield Triangle Sym	Ea
08200.31	Pavt Mrkg, Polyurea, Speed Hump Chevron, White	Ea
08200.32	Pavt Mrkg, Polyurea, Accessible Sym	Ea
08210.01	Pavt Mrkg, Sprayable Thermopl, 4 In., White	Ft
08210.02	Pavt Mrkg, Sprayable Thermopl, 4 In., Yellow	Ft
08210.03	Pavt Mrkg, Sprayable Thermopl, 6 In., Dotted Thru Guide Line, White	Ft
08210.04	Pavt Mrkg, Sprayable Thermopl, 6 In., White	Ft
08210.05	Pavt Mrkg, Sprayable Thermopl, 6 In., Yellow	Ft
08220.01	Pavt Mrkg, Thermopl, 12 In., Cross Hatching, White	Ft
08220.02	Pavt Mrkg, Thermopl, 12 In., Cross Hatching, Yellow	Ft
08220.03	Pavt Mrkg, Thermopl, 12 In., Crosswalk	Ft
08220.04	Pavt Mrkg, Thermopl, 12 In., White	Ft
08220.05	Pavt Mrkg, Thermopl, 24 In., Crosswalk	Ft

ITEM NUMBER	LEGEND	UNIT
08220.06	Pavt Mrkg, Thermopl, 24 In., Stop Bar	Ft
08220.07	Pavt Mrkg, Thermopl, 4 In., For On-Street Parking, White	Ft
08220.08	Pavt Mrkg, Thermopl, 6 In., Dotted Thru Guide Line, White	Ft
08220.09	Pavt Mrkg, Thermopl, Lt Turn Arrow Sym	Ea
08220.10	Pavt Mrkg, Thermopl, Rt and Lt Turn Arrow Sym	Ea
08220.11	Pavt Mrkg, Thermopl, Rt Turn Arrow Sym	Ea
08220.12	Pavt Mrkg, Thermopl, Thru Arrow Sym	Ea
08220.13	Pavt Mrkg, Thermopl, Thru and Lt Turn Arrow Sym	Ea
08220.14	Pavt Mrkg, Thermopl, Thru and Rt Turn Arrow Sym	Ea
08220.15	Pavt Mrkg, Thermopl, Lt Roundabout Arrow Sym	Ea
08220.16	Pavt Mrkg, Thermopl, Thru and Lt Roundabout Arrow Sym	Ea
08220.17	Pavt Mrkg, Thermopl, Merge	Ea
08220.18	Pavt Mrkg, Thermopl, Merge Arrow Sym	Ea
08220.19	Pavt Mrkg, Thermopl, Only	Ea
08220.20	Pavt Mrkg, Thermopl, Railroad Sym	Ea
08220.21	Pavt Mrkg, Thermopl, School	Ea
08220.22	Pavt Mrkg, Thermopl, Stop	Ea
08220.23	Pavt Mrkg, Thermopl, Yield	Ea
08220.24	Pavt Mrkg, Thermopl, Yield Triangle Sym	Ea
08220.25	Pavt Mrkg, Thermopl, Speed Hump Chevron, White	Ea
08230.00	Pavt Mrkg, Preformed Thermopl, Accessible Sym	Ea
08240.01	Pavt Mrkg, Waterborne, 4 In., White	Ft
08240.02	Pavt Mrkg, Waterborne, 4 In., Yellow	Ft
08240.03	Pavt Mrkg, Waterborne, 6 In., White	Ft
08240.04	Pavt Mrkg, Waterborne, For On-Street Parking, 4 In., White	Ft
08251.00	Recessing Pavt Mrkg, Longit	Ft
08252.00	Recessing Pavt Mrkg, Transv	Sft
08261.00	Rem Curing Compound, Longit	Ft
08262.00	Rem Curing Compound, Transv	Ft
08263.00	Rem Curing Compound, for Spec Mrkg	Sft
08264.00	Rem Spec Mrkg	Sft
08265.00	Rem Pavt Mrkg, Longit	Ft
08266.00	Rem Pavt Mrkg, Transverse	Ft
08300.00	Monument Box, Adjust	Ea
	Lighting and Electrical	
09000.01	Conductors, No. 4AWG	Ft
09000.02	Conductors, No. 6AWG	Ft
09000.03	Conductors, No. 8AWG	Ft
09000.04	Conductors, No. 10AWG	Ft
09000.05	Conductors, No. 12AWG	Ft
09010.01	Conduit, Schedule 80 PVC, 2 In.	Ft

ITEM NUMBER	LEGEND	UNIT
09010.02	Conduit, Schedule 80 PVC, 3 In.	Ft
09010.03	Conduit, Schedule 80 PVC, 4 In.	Ft
09011.01	Conduit, Schedule 80 PVC, 2 In., Qty 2	Ft
09011.02	Conduit, Schedule 80 PVC, 3 In., Qty 2	Ft
09011.03	Conduit, Schedule 80 PVC, 4 In., Qty 2	Ft
09012.01	Conduit, Schedule 80 PVC, 2 In., Directional Drill	Ft
09012.02	Conduit, Schedule 80 PVC, 3 In., Directional Drill	Ft
09012.03	Conduit, Schedule 80 PVC, 4 In., Directional Drill	Ft
09013.01	Conduit, Schedule 80 HDPE, 2 In., Directional Drill	Ft
09013.02	Conduit, Schedule 80 HDPE, 3 In., Directional Drill	Ft
09013.03	Conduit, Schedule 80 HDPE, 4 In., Directional Drill	Ft
09020.00	Handhole, Rem	Ea
09030.01	Handhole Assembly, 17 In. X 30 In. x 18 In.	Ea
09030.02	Handhole Assembly, 13 In. X 24 In. x 18 In.	Ea
09030.03	Handhole Assembly, 24 In. X 36 In. x 18 In.	Ea
09040.01	Cabinet, Type Small	Ea
09040.02	Cabinet, Type Large	Ea
09050.00	Foundation, Light Pole	Ea
09060.00	Foundation, Light Pole, Rem	Ea
09070.00	Foundation, Streetlight Cabinet	Ea
09080.00	Foundation, Streetlight Cabinet, Rem	Ea
09090.01	Light Pole, DDA	Ea
09090.02	Light Pole, DDA, City Furnish	Ea
09091.01	Light Pole, Stadium	Ea
09091.02	Light Pole, Stadium, City Furnish	Ea
09092.01	Light Pole, 15' Standard	Ea
09092.02	Light Pole, 15' Standard, City Furnish	Ea
09093.01	Light Pole, 30' Standard	Ea
09093.02	Light Pole, 30' Standard, City Furnish	Ea
09101.00	Light Pole, Rem	Ea
09102.00	Light Pole, Rem and Salvage	Ea
09103.00	Light Pole, Reinstall	Ea
09110.01	Light Fixture, Standard	Ea
09110.02	Light Fixture, Standard, City Furnish	Ea
09111.01	Light Fixture, Decorative Acorn	Ea
09111.02	Light Fixture, Decorative Acorn, City Furnish	Ea
09112.01	Light Fixture, Decorative Globe	Ea
09112.02	Light Fixture, Decorative Globe, City Furnish	Ea
09121.00	Light Fixture, Rem	Ea
09122.00	Light Fixture, Rem and Salvage	Ea
09123.00	Light Fixture, Reinstall	Ea

ITEM NUMBER	LEGEND	UNIT
09130.00	Streetlight Disconnect Box,Complete	Ea
09140.00	Photoelectric Control	Ea
	Landscaping	
10000.01	Tree, Medium, B&B	Ea
10000.02	Tree, Large, B&B	Ea
10010.01	Plant, Plug	Ea
10010.02	Plant, Live Stake	Ea
10010.03	Plant, Gal	Ea
10020.01	Fence, Chain Link, 48 In.	Ft
10020.02	Fence, Chain Link, 60 In.	Ft
10020.03	Fence, Chain Link, 72 In.	Ft
10030.00	Fence, Rem	Ft
10031.00	Fence, Salvage and Re-Erect	Ft
10040.00	Landscape Maintenance and Warranty, 1 Year	LS
10041.00	Landscape Maintenance and Warranty, 2nd Year	LS
10050.00	Underground Sprinkling System, Restore	Dlr
10051.00	Irrigation System, Protection and Preserving	LS
10060.00	Turf Restoration	Syd
10070.00	Hydroseeding	Syd
10080.00	Sodding	Syd
10090.00	Mulch Blanket	Syd
10091.00	Mulch Blanket, High Velocity	Syd

ANN ARBOR DOWNTOWN

STREET DESIGN MANUAL













DECEMBER 2023

ACKNOWLEDGMENTS

The project team thanks the Advisory Committee Members for their involvement, insights, and engagement in developing the Ann Arbor Downtown Street Design Manual

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1.1 INTRODUCTION

THE PURPOSE OF THE DOWNTOWN STREET DESIGN MANUAL

Downtown streets, which include the public right-of-way, sidewalks, and roadways, serve the needs of residents and businesses of downtown as well as the broader community. The Downtown Street Design Manual is intended to provide the public and private sectors with design standards and best practices for building and managing downtown streets. It addresses the key roles of the street and the public right-of-way in supporting multiple modes of transportation, economic vitality, environmental health, and community character.

What are "Streets"

Streets, for purposes of this manual, are defined as the entire public right-of-way between buildings, not just the roadway. Streets includes the roadway and travel lanes, parking lanes, the amenity zone (between the curb and sidewalk) sidewalks, and public alleys.

The street is divided into a number of different zones, which are described in section **1.2 Key Terms & Organization.**

WHY HAVE A DOWNTOWN STREET DESIGN MANUAL?

Ann Arbor's downtown streets each have their own personality and needs. The 67 blocks of the Downtown Development Authority (DDA) District host a variety of uses including shops, offices, and residences. There are over 100 sidewalk cafes and other areas for public seating or gathering. Downtown streets are the location for many of the events for which Ann Arbor is known.

The streets serve many demands from different users. Infrastructure once built only to serve auto traffic is now changing to meet use and demand. Pedestrian volumes are heavy in many parts of downtown and bicycles use is increasing. On-street parking and loading is a prominent demand on the streets. Many bus routes converge on the transit center and transit ridership continues to grow.

The Downtown Street Design Manual recognizes the role that downtown streets play in transportation function and supporting land uses. The manual is intended to assist in developing designs that support and enhance these functions and deliver an overall system that provides for all modes of travel and uniquely responds to the local street context.

WHAT IS THE DOWNTOWN STREET DESIGN MANUAL?

The Downtown Street Design Manual is a unified set of best management practices to govern how downtown streets are designed, built, and maintained for all people. The manual seeks to balance the needs of all street users and ensure that the multiple goals for the street space are met in coordination with one another in order to create streets that are safe, equitable, affordable, inclusive, resilient, vibrant, implementable, maintainable, and that connect the community.

The manual places special importance on improving the pedestrian experience, recognizing that everyone is a pedestrian at some point in their downtown trip. Whether traveling to downtown by foot, bike, bus, or car, the pedestrian experience is critical to the success and vibrancy of downtown.

The Downtown Street Design Manual consists of the following chapters:

- **Chapter 1 - Introduction:** A set of overall planning goals and targets derived from established and adopted metrics identified in other city planning efforts. These goals and targets are utilized in the design development process as metrics to weigh street design decisions and as metrics to track over time.
- **Chapter 2 - Street Framework:** Presents the street typology framework specific to Ann Arbor's downtown streets. The typology reflects the existing and desired uses and activities along the street overlaid with the emphasized function of street corridors. The intent of the typology system is to design street segments to support the unique conditions and land use contexts along that street segment while still supporting the overall transportation function the corridor serves in the network.
- **Chapter 3 - User Guide:** Describes a predictable and consistent process for street design and development to ensure that key agencies and partners are involved early and throughout the design process.
- **Chapter 4 - Design Elements:** Guidance on downtown street design and appropriate treatments to serve a menu of transportation needs and create a quality street environment for accessing commerce and community life. The elements include maintenance considerations to enable them to perform well over the long-term and through all seasons of the year.

The Downtown Street Design Manual is intended to augment, supplement and tailor existing guidelines and standards for streets and sidewalks within the DDA District. It provides best practice recommendations and decision tools to assist the public and private sector in making informed street design decisions that supports a vibrant downtown context and the needs of multi-modal transportation systems.



WHO SHOULD USE THE DOWNTOWN STREET DESIGN MANUAL?

The manual is laid out in an easy to understand format to enable predictable, consistent and collaborative design implementation by:

- Private developers or utilities with projects that impact the public right-of-way;
- Utility Companies;
- City staff, DDA staff and consultants as they work on street construction, improvement, or maintenance projects.



HOW DOES THE DOWNTOWN STREET DESIGN MANUAL FIT WITH OTHER PLANS AND STANDARDS?

City Plans

The Downtown Street Design Manual builds on and compliments the goals, objectives, and intent of many existing plans developed and adopted by the City of Ann Arbor. These include:

- The City Comprehensive Plan Elements
  - » Downtown Plan (2009)
  - » City Transportation Comprehensive Plan (2020)
  - » Treeline Master Plan (2019)
  - » Sustainability Framework (2013)
- Downtown Development Authority Renewal Plan (2003)
- Downtown Design Guidelines (2011)
- Urban & Community Forest Management Plan (2014)
- TheRide's 2045 Long-Range Plan (2022)
- Solid Waste Resources Management Plan (2019)

City Policies

The Downtown Street Design Manual advances other policies, resolutions, and initiatives underway. Notable policies include:

- **Green Streets Policy (2014):** Stormwater Management Guidelines for public street construction and reconstruction outlining the use of green infrastructure to infiltrate stormwater runoff.
- **Vision Zero Commitment:** The design of the City's transportation network strives to achieve the goal of zero fatalities and severe injuries from traffic incidents by 2025.
- **A2Zero Carbon Neutrality / Climate Action Plan (2019):** A plan for achieving the goal of carbon neutrality by 2030 for the Ann Arbor community.

- **Affordable Housing Initiatives:** The Housing Affordability and Economic Equity Analysis for Washtenaw County (2015) was adopted by the City Council and set a goal of adding 140 new affordable units each year. To achieve this goal, residents voted to support a City Charter amendment establishing an Affordable Housing Millage.

Design Standards

The Downtown Street Design Manual utilizes national best practices, design guidance, and local standards and regulations to ensure that street projects improve the safety, comfort, and access and all users of downtown streets. Throughout this document, design direction or recommendations may refer to any of the following documents for further detail and clarity for how they are to be implemented in accordance with best practice.

- **Local Standards + Guidelines**
  - **Standard Specifications (PSSS / "The Orange Book"):** Includes: General Specifications; Design, Material, Utility, Street, Streetlight, Soil Erosion, and Landscaping Standards; Pay Items; Standard Details.
  - **Crosswalk Design Guidelines:** This document provides standards for the design of controlled (e.g. stop signs or signalized intersections) and uncontrolled crossing (e.g. mid-block crossings) for streets in Ann Arbor. These guidelines describe the desired use of crossing elements based on roadway characteristics and pedestrian volumes.
- **State Standards + Guidelines**
  - **Michigan Manual on Uniform Traffic Control Devices (MMUTCD) (2013):** Specifies the design, installation, and use standards for traffic signs, road surface markings, and signals.
  - **MDOT – Bicycle and Pedestrian Resources for Transportation Professionals (2016):** A resource with the latest research, resources, and guidance on pedestrian and bicycle planning, safety, and design.
  - **MDOT – Best Design Practices for Walking and Bicycling in Michigan:** A toolbox of non-motorized improvements that have been shown to reduce crashes involving pedestrians and bicyclists.
- **National Guidelines + Design Resources**
  - **NACTO – Urban Bikeway Design Guide (2012):** Guidelines for bicycle infrastructure including lanes, cycle tracks, intersection treatments, signals, signage, bicycle boulevards.
  - **AASHTO – Guide for the Development of Bicycle Facilities (2012, new edition expected 2021):** Information on accommodating bicycle travel and operations in most riding environments.
  - **NACTO – Urban Street Design Guide (2013):** Principles and practices of designing safe, multi-modal streets.
  - **NACTO – Transit Street Design Guide (2014):** Guidance for the development of transit facilities on city streets.
  - **FHWA – Separated Bike Lane Planning & Design Guide (2015):** Planning considerations for separated bike lanes, including a menu of design options covering typical one and two-way scenarios.
  - **FWHA – Small Town and Rural Multimodal Networks (2016):** A resource for applying national design guidelines in a rural setting and highlights small town and rural case studies.
  - **NACTO – Designing for All Ages and Abilities (2017):** Facility selection guide for a wide variety of urban street types to allow planners to determine how to best combine traffic calming tools to reduce fatalities and increase cycling rates and comfort.
  - **FHWA – Bikeway Selection Guide (2019):** A resource to help transportation planners make informed trade-off decisions relating to selection of bikeway types, focusing on safety.
  - **NACTO – Urban Street Stormwater Guide (2017):** National best practices for sustainable stormwater management in the public right-of-way.



1.2
KEY TERMS & ORGANIZATIONS

STREET CHARACTERISTICS

The Ann Arbor Downtown Street Design Manual uses a number of terms throughout the document for describing the street environment and its qualities and functions.

- **STREET**: Street are the entire public right-of-way outside of private property lines. Typically, this is from building face to building in the downtown where buildings are constructed up to their front property line.
- **SIDEWALK**: Sidewalks are paved areas of the street, typically 5 feet or more in width and located within the Walkway Zone.
- **RIGHT-OF-WAY**: Publicly owned property where streets are located.
- **STREET TYPOLOGY**: Each street is assigned a typology based on its Frontage Context and Functional Emphasis. See Section 2.1- Street Framework for more information.
- **FRONTAGE CONTEXT**: Refers the mix of land uses (e.g. retail, commercial, residential, office) and level of intensity of land use along a street. See Section 2.3- Frontage Context for full descriptions.
- **FUNCTIONAL EMPHASIS**: Refers to the transportation and street use mode (pedestrian, vehicle, bicycle, etc.) that is emphasized along a particular street. See Section 2.4.- Functional Emphasis for full descriptions.
- **DESIGN ELEMENT**: A design element is a specific built feature or other device that is located in the street. The applicability of design elements to downtown streets relate to the street's typology.

- **STREET ZONES**: A street is comprised of a number of zones that affect the uses and functions of the street. *Refer to Section 2.1 - Street Framework for additional information*. Street zones include the following:

A **Roadway Zone**: The central portion of the street typically dedicated to travel lanes for vehicle, transit, and bicycle movement.

B **Curbside Zone**: Area adjacent to the curb and commonly used for on-street parking and loading.

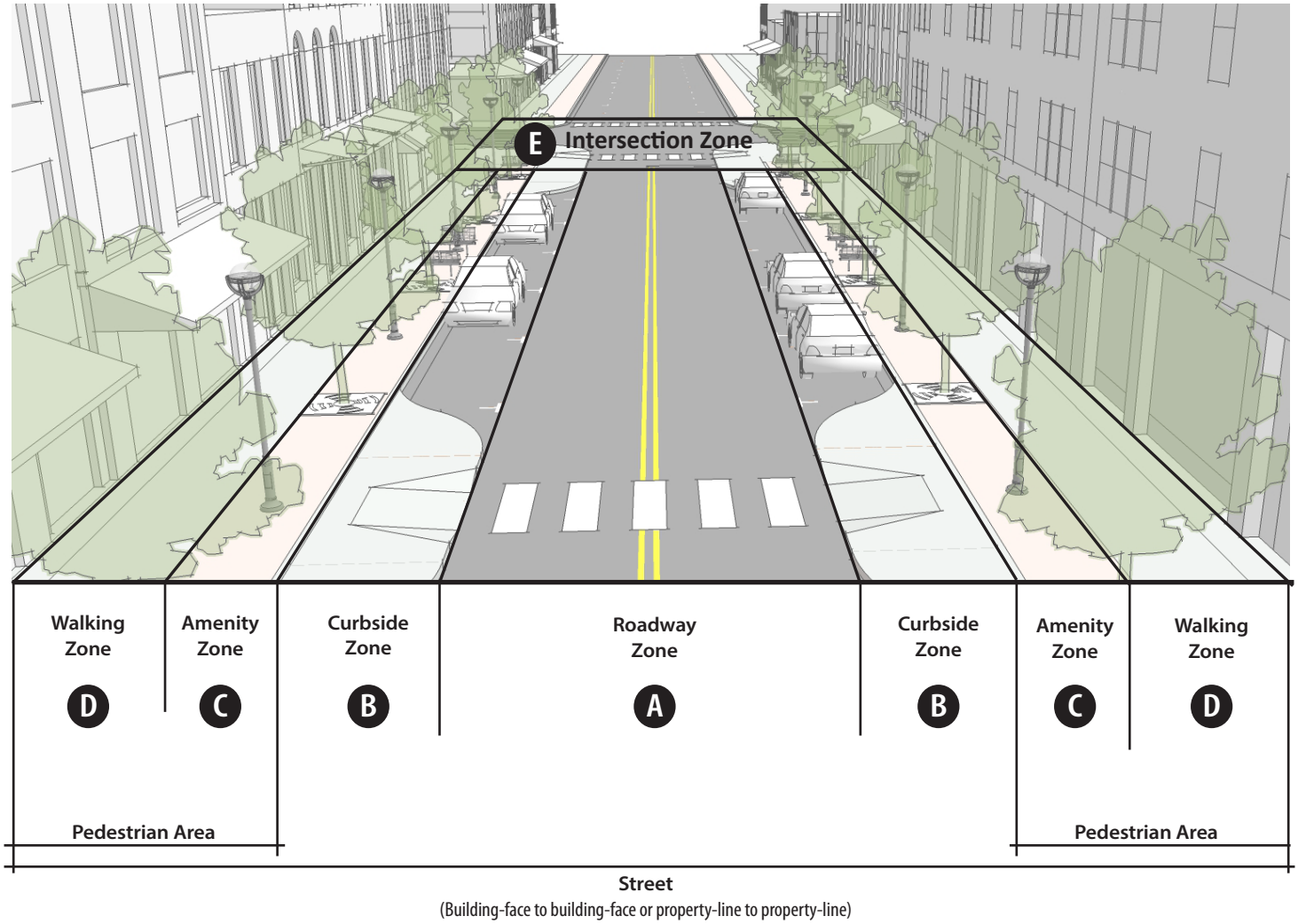
- **Pedestrian Area**: This is the area between the curb and the outside edge of the public right-of-way and private property line. The Pedestrian Area encompasses the Amenity Zone, Walkway Zone, and Frontage Zone.

C **Amenity Zone**: Area between the sidewalk and the curb. Commonly the location for street trees, light poles, road signs, and other street furnishings.

D **Walkway Zone**: A clear, consistent, paved area dedicated to pedestrian movement.

E **Intersection Zone:** The intersection zone occurs where two street meet.

Figure 1.2.1 - Street Zones



ORGANIZATIONS

A number of public organizations and other entities have a role or interaction in the design and management of Downtown Streets and are referenced throughout the Downtown Street Design Manual.

- **City of Ann Arbor (the City)**: The City of Ann Arbor is the public municipality that owns the right-of-way in Downtown. A number of City Units are referenced in this document that have a relationship to the street:
  - **Engineering Services**: Responsible for designing and constructing utility, roadway, and sidewalk projects; coordinating and inspecting utility and roadway work with development projects, and managing traffic flow throughout the city. Includes:
    - Transportation & Non-Motorized Planning
  - **Public Works**: Combination of field-oriented maintenance and operations. Relevant responsibilities include: Water Utility, Forestry (street trees), Solid Waste (trash, recycling, and compost), and Street Maintenance. Includes:
    - Urban Forestry & Natural Resources
    - Solid Waste & Recycling Coordination
  - **Planning & Development Services**: Responsible for construction and building permits, code enforcement, planning, zoning, and site plan review.
  - **Systems Planning**: Multi-disciplinary department responsible for asset management and planning related to built and natural infrastructure. Includes:
    - Stormwater & Floodplain Coordination
    - Water Quality Management
  - **Office of Sustainability & Innovations:** This office works with all Ann Arborites to ensure Ann Arbor is the most sustainable and equitable City in America. The OSI is guided by the Ann Arbor Carbon Neutrality Plan: A2ZERO.
  - **Community Standards**: Group within the Police Department responsible for enforcing city codes and ordinances.
  - **Customer Services:** Entity within the City responsible for issuing and managing many permits relevant to street use (e.g. sidewalk occupancy, street closures, special event permits, etc).
  - **Street Design Team**: Cross-agency working group established through the Downtown Street Design Manual to oversee and coordinate significant street investments and infrastructure projects.
  - **Communications Office:** Coordinates outreach and engagement efforts, notices related to construction.
- **Ann Arbor Downtown Development Authority (DDA)**: Coordinates and implements public improvements and infrastructure projects to increase the economic vitality and attractiveness of downtown.
- **Ann Arbor Area Transportation Authority (AAATA or "The Ride")**: Operates transit bus service in Ann Arbor and surrounding municipalities.
- **Michigan Department of Transportation (MDOT)**: State transportation department with jurisdiction over certain streets in Downtown (Huron and North Main). Coordination with MDOT is also required for railroad crossings and safety.
- **Michigan Department of Environment, Great Lakes, and Energy (EGLE):** Reviews and issues permits for projects within the floodplain.
- **WATCO Companies:** The owner of the north-south rail line through Ann Arbor, which is operated by Ann Arbor Rail. Coordination with WATCO is required for rail crossings.
- **DTE Energy:** Provides electrical and gas service to Ann Arbor. DTE operates, at the City's expense, many of the street lights in Ann Arbor.
- **University of Michigan (UofM)**: Major research institution and significant property owner downtown.
- **Boards & Commissions**: A number of local boards and commissions have a bearing on downtown streets:

- » **Historic District Commission**: Reviews and advises projects in historic districts and properties.
- » **Design Review Board**: Advises private development projects on meeting the spirit and intent of the Ann Arbor Downtown Design Guidelines.
- » **Planning Commission**: Advises and makes recommendations to City Council regarding continuance of the city's Comprehensive Plan, zoning, ordinances, and other applicable codes.
- » **Transportation Commission:** The commission serves as an advisory body to the City Council and the City Administrator on transportation policy with a focus on accessibility, mobility, equity, and safety for all.
- » **Downtown Development Authority:** The DDA Board sets values for DDA projects and approves construction contracts.

- **Downtown Merchant and Business Area Associations:** Numerous associations representing different districts in Ann Arbor, including:
  - » Main Street Area Association
  - » Kerrytown District Association
  - » State Street Association
  - » South University Association





1.3
VISION & VALUES

The Downtown Street Design Manual is derived from a multitude of plans, standards, guidance and policy adopted or supported by the City of Ann Arbor and the Downtown Development Authority (DDA). The City Comprehensive Plan is the foundational planning document for Ann Arbor and includes not only the Downtown Plan, but also the City's Sustainability Framework, Transportation Plan, Non-Motorized Transportation Plan, Parks and Recreation Open Space Plan, and overall Land Use vision.

VISION

The Downtown Street Design Manual envisions a future network of streets that:

- Improve downtown resiliency — environmentally, economically, and socially
- Support and strengthen the uses and activities unique to the diverse blocks and areas of downtown
- Safely & equitably accommodate all modes of travel through and around the downtown

VALUES

Values frame what is important to a community and provide direction to guide the design, implementation, and evaluation of public projects. The DDA has adopted seven core values that are to be used to inform the decision-making process for DDA infrastructure projects.

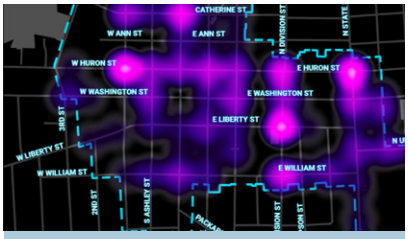
Linking Values to Projects

The process of linking values to projects starts with aligning values with the community at large "**community alignment**". For each project, the seven values can be linked to established plans and policies – such as Vision Zero, Green Streets, A2Zero, and the city's climate action plan – in order to demonstrate how they relate to the broader community. "**Desired outcomes**," which are measurable changes, can be identified and associated with each value. Finally, specific design elements and policies that will lead to the desired outcomes can be incorporated into specific "**project opportunities**" and pursued for implementation.



Community Alignment

Define what's important
Align with other efforts



Desired Outcomes

Identify tangible improvements
Establish a method for measurement



Project Opportunities

Evaluate + prioritize based on potential outcomes
Measure and track outcomes



Value 1: Safe, Comfortable Downtown Streets

Streets must balance and accommodate a variety of modes of travel while prioritizing safety to eliminate death and serious injury from traffic crashes.



Value 2: Equitable, Just Access for All People

Streets must serve the entire community regardless of ability, age, and mode of transportation. They must provide equitable connections to destinations, places of employment, housing, and basic needs.



Value 3: Affordable and Inclusive Community

To create an inclusive community, Streets must provide affordable transportation options to residents.



Value 4: Resilient and Energy Responsible Downtown

Streets must be designed to support improvements in air and water quality, efforts to become carbon neutral, and responsible energy use.



Value 5: Vibrant and Thriving Local Economy

Critical to the success and vitality of the local economy is having streets that support people's access to business, provide space for commerce, and promote a comfortable and attractive environment where people and businesses want to be.



Value 6: Responsible Design and Implementation

Streets projects and maintenance must use public funds wisely to achieve maximum impact at a responsible price.



Value 7: Connected Community with Streets as Civic Spaces

The design of downtown streets needs to be flexible to allow for use as community space and reflect the local character, in order to help connect the community.



Value 1: Safe, Comfortable Downtown Streets

Streets accommodate a variety of modes of travel - people traveling on foot, bicycle and in mass transit or private vehicles. However, not every street can accommodate all modes to the same degree; every street needs to balance the needs and safety for every mode. For instance, dense commercial main streets may emphasize pedestrians over automobile. Less commercial streets may be ideal for bicycle travel. Streets with concentrations of bus stops may cater to transit riders, while other streets may facilitate necessary auto movements and services.

Regardless of the balance of transit modes, all streets need to prioritize the safety of people traveling by each mode to achieve the goal of Vision Zero: the elimination of death and serious injury from traffic crashes. To achieve Vision Zero, street design needs to incorporate physical design strategies that prevent traffic crashes, such as small turning radii to slow traffic at crossings, physical separations for bicycle lanes, and leading pedestrian and bicycle signals.

Community Alignment

- Vision Zero by 2025 policy: No Serious injuries or deaths
- Safe crossing guidelines and mid-block crossing policies
- Pedestrian visibility and crosswalk lighting

Desired Outcomes

- Eliminate fatalities and serious injuries caused by traffic crashes by 2025.
- Reduce crashes, especially for vulnerable users.
- Reduce speeds and speeding to a max of 25 MPH.
- Improve pedestrian and cyclist comfort and reduce level of traffic stress.
- Increase accessibility for all users.

Project Opportunities

- Redesign roadways to manage speeds and follow complete streets guidelines.
- Develop and redevelop bicycle infrastructure to fill in gaps, reduce traffic stress, increase safety and comfort.
- Prioritize improvements for vulnerable users.
- Improve comfort of non-motorized travel through shade, wide sidewalks, landscaping, and places to rest.
- Design for public health: improve air quality, promote active lifestyles, reduce injuries, provide access to necessities.
- Support public transit: improve reliability and trip times.



Value 2: Equitable, Just Access for All People

As streets are public space, they must serve the entire community regardless of ability, age, and mode of transportation. At the most essential level, downtown streets must be safe, comfortable, and welcoming to the most vulnerable — pedestrians, bicyclists, children, elderly, and those with disabilities. Many people may rely on transit, or may have mobility needs that necessitate accessible routes. Moreover, everyone who accesses the downtown is a pedestrian at some point during their trip, and improving the quality of the environment benefits everyone.

From a broader accessibility standpoint, the streets must be equitably accessible. To accomplish this, we must recognize that historically, decision-makers have not treated all modes and people equitably. Downtown should safely and comfortably serve all modes of travel. In addition, regardless of which direction you are coming from or mode of travel, downtown should be safely and comfortably accessed.

Community Alignment

- A2Zero Plan: identifies equity impacts from transportation
- City Transportation Comprehensive Plan: focuses on equity and safety for all users

Desired Outcomes

- Transportation infrastructure that's designed to protect the most vulnerable.
- Provide safe and efficient access to jobs, services, shops, school, and social spaces.
- Increase active transportation mode share and promote healthy lifestyle options for all people.
- Reduce emissions for streets & neighborhoods heavily impacted by the transportation system.
- Understand and integrate regional transportation needs & opportunities.

Project Opportunities

- Construct bicycle infrastructure that welcomes all ages, abilities, and comfort levels of biking near vehicles.
- Improve connections to areas of greater need and those that have not been historically prioritized, such as affordable housing.
- Engage those who have been historically excluded and have greater need in the design process and incorporate their specific needs.
- Incorporate universal design strategies into projects beyond minimum ADA regulations.





Value 3: Affordable and Inclusive Community

Ann Arbor strives to be a welcoming and inclusive community for all people. Affordability is a central aspect of living in the city that impacts the inclusivity of the community. Two issues within the downtown directly affect affordability: housing costs and transportation expenses.

Public infrastructure projects can help improve affordability by supporting greater density (more housing stock) and supporting affordable housing projects specifically. DDA plans, capital improvements, and other initiatives can support the creation of affordable housing in the downtown with access to a diverse range of employment and services. Additionally, street projects that improve mobility options and choices for people can lower their transportation costs – especially for people without reliable access to personal vehicles that are reliant on walking, biking, and riding public transit. Creating a safer environment for all modes of travel can support a more affordable and inclusive community.

Community Alignment

- Affordable Housing Initiatives: policies & actions increasing units in Ann Arbor
- Housing Commission Programs: Public Housing, Project Based Vouchers, Section 8

Desired Outcomes

- Use infrastructure to reduce, offset, and/or act as a match to housing commission projects.
- Position housing projects to be competitive for LIHTC funding and other opportunities.

Project Opportunities

- Upsize water mains to support affordable projects.
- Create a bank of sanitary sewer improvements to offset Housing Commission development costs.
- Manage building-side stormwater within the roadway.
- Provide safe public transit and non-motorized connections to those without access to vehicles.
- Support lower cost transportation initiatives (ebikes, rideshare, etc).



Value 4: Resilient and Energy Responsible Downtown

The City of Ann Arbor values the health and quality of its local environment and acknowledges its relationship to global sustainability and climate change. Ann Arbor has adopted a number of sustainable policy positions in order to improve air and water quality, become carbon neutral, and use energy responsibly.

The design and operation of public streets is a significant opportunity to help the city advance sustainability goals and meet adopted policies. Mobility projects can improve the comfort and attractiveness of non-motorized travel and reduce vehicle miles traveled, all while supporting more active lifestyles. Streetscape projects can use more energy-efficient lighting while improving visibility and reducing light pollution. Incorporating green infrastructure in street projects reduces runoff and pollution entering the Huron River, better protecting water quality.

Community Alignment

- A2 Zero Carbon Neutrality Plan: achieve by 2030
- Sustainability Framework: goals for a sustainable future
- LED Streetlight Program & Dark Skies Initiative
- Green Streets Policy

Desired Outcomes

- Reduce Vehicles Miles Traveled by 50% by 2030
- Mode shift towards non-single occupancy vehicles
- Infiltrate and/or retain stormwater in excess of required targets
- Reduce urban heat island
- Increase access to mobility hubs

Project Opportunities

- Support modes
- Specify environmentally responsible products, materials, and systems



Value 5: Vibrant and Thriving Local Economy

Downtown's are a place of interaction, commerce, and exchange, where people and ideas come together in supporting the city's economy and vitality. Critical to the success and vitality of the local economy is having streets that support people's access to business, provide space for commerce, and promote a comfortable and attractive environment where people and businesses want to be.

Street can support economic vitality by providing easy wayfinding and navigation for residents, visitors, and workers alike. They can establish a comfortable pedestrian environment, becoming a destination where people want to visit, shop, and dine. And streets support important business-supportive functions, like outdoor retailing/dining and commercial loading/delivery.

Community Alignment

- Economic Vitality (Sustainability Framework): Support a resilient local economy, diverse jobs across all sectors, create opportunity

Desired Outcomes

- Strengthen local business growth and ownership
- Design for flexibility in the streets
- Improve attractiveness
- Ensure all people feel welcome
- Increase diversity and supply of employment opportunities
- Support lower income employees

Project Opportunities

- Provide flexible curb-side lanes and uses
- Provide more sidewalk space for active commercial uses
- Create a comfortable, welcoming streetscape environment
- Increase access to businesses for all modes of travel
- Leverage unique assets / qualities to build a sense of place



Value 6: Responsible Design and Implementation

Public infrastructure and capital projects, like street and mobility projects, are an important use of public funds. But with this comes the responsibility to use public dollars wisely and where they can benefit the community in an equitable and cost-effective manner.

For street projects, responsible design and implementation means making use of best practices to protect public health and safety, to fully consider the long-term maintenance and operational costs of projects and seek to minimize those, to prioritize treatments that are durable with lower long-term costs. Responsible implementation also requires aligning improvements with other project opportunities, such that costs and impacts can be shared and minimized wherever possible.

Community Alignment

- Responsible resource use (Sustainability Framework)

Desired Outcomes

- Deliver improvements that are maintainable
- Coordinate construction with other projects and improvements

Project Opportunities

- Integrate equitable engagement strategies into design process
- Continue to build + implement education and communication strategies
- Build knowledge within local leadership
- Support workforce health and development through street and sustainability projects



Value 7: Connected Community with Streets as Civic Spaces

Streets serve communities in ways beyond transportation; they facilitate connections between people. They are places for people to meet, eat, recreate, and host events. The design of downtown streets needs to be flexible to allow for use as community space and reflect the aesthetics of the local character.

Community Alignment

- Active Living & Learning (Sustainability Framework): improve quality of life through diverse cultural, recreational and educational opportunities for all members of our community

Desired Outcomes

- Deliver improvements that respect neighborhood context and foster more connections between people
- Deliver improvements that encourage social interactions between people and the community around them
- Prioritize improvements that provide flexibility for civic uses and events, where appropriate
- Reflect local character through creative ideas, art, and collaborations

Project Opportunities

- Integrate local artists into the design / planning process
- Design streets for flexibility and easy adaptation
- Engage residents, business owners, and other street users to meet localized needs



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2.0 STREET FRAMEWORK

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2.1
STREET FRAMEWORK

STREET DESIGN APPROACH

Traditional Street Design Approach

Traditionally, streets have been designed with a "centerline out" (Figure 2.1.1) approach and with a hierarchy of streets from interstates and highways down to arterials, collectors, and local roads. The functional needs of the roadway, primarily access and mobility, are considered and determined first. Then the land use context and activities "behind the curb" are considered, but only after determining road priorities. This is typically a highway engineering approach, rather than a street design approach.

Context-based Street Design Approach

Downtown streets do not conform to the strict dichotomy of mobility versus access. While autos continue to be an important mode of travel, access and mobility by other modes are equally important and essential. Downtown streets must provide inviting environments for efficient movements of pedestrians, bicycles, and transit riders. Unlike the traditional methodology, context-based street design works from the built environment inward to the centerline of the street.

The land use and urban design context of the street is as critical as its transportation function. The primary objective of transportation is to achieve larger public objectives, not simply to move people around without any specific purpose. As a result, a more holistic approach for street design is to take a "building in" approach (Figure 2.1.2).

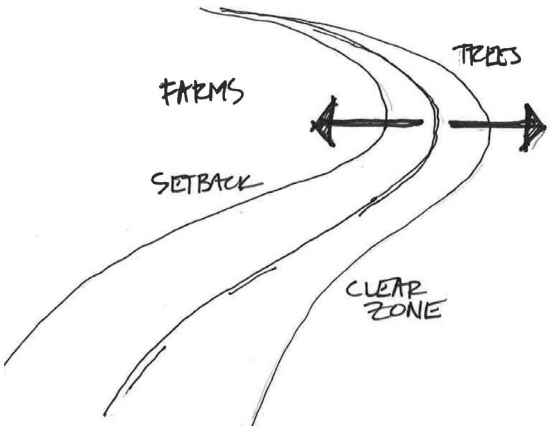


Figure 2.1.1 - Centerline Out

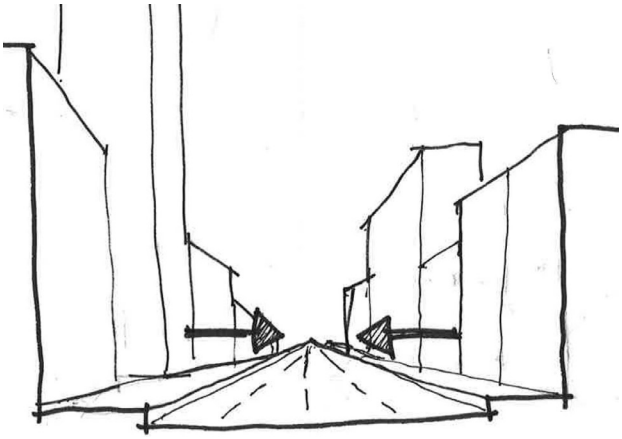


Figure 2.1.2 - Building In

Context-based street design examines the land use activity and urban design character along with the primary transportation function. It is a method for working from the built environment to the center of the street so that transportation is supporting and enabling the envisioned land uses both for local blocks as well as serving larger area mobility needs.

A context-based approach will benefit downtown Ann Arbor by:

1. Ensuring that the needs of all users of the street and adjacent properties are comprehensively considered in street design and management decisions.
2. Ensuring that single interests or modes of use do not dominate the street to the determent of others interests.

All-Ages & Abilities Street Design

An accessible bicycle network is one where people of all ages and abilities feel safe and comfortable when riding a bike. While conventional bike lanes have been instrumental in advancing adoption of dedicated bicycle facilities in communities across the country, they often fail to provide a suitable facility for more cautious and/or less confident bike riders. As such, communities are placing increased emphasis on building "low stress" bike facilities that make critical connections using facilities that are welcoming are comfortable for a broader range of users.

Table 2.1.1 - All Ages & Abilities Bikeways (NACTO – Designing for All Ages and Abilities, 2017)

Contextual Guidance for Selecting All Ages & Abilities Bikeways				
Roadway Context				All Ages & Abilities Bicycle Facility
Target Motor Vehicle Speed*	Target Max. Motor Vehicle Volume (ADT)	Motor Vehicle Lanes	Key Operational Considerations	
Any		*Any*	*Any of the following:* high curbside activity, frequent buses, motor vehicle congestion, or turning conflicts‡	**Protected Bicycle Lane**
< 10 mph	Less relevant	No centerline, or single lane one-way	Pedestrians share the roadway	**Shared Street**
≤ 20 mph	≤ 1,000 – 2,000		< 50 motor vehicles per hour in the peak direction at peak hour	**Bicycle Boulevard**
≤ 25 mph	≤ 500 – 1,500			
	≤ 1,500 – 3,000	Single lane each direction, or single lane one-way	Low curbside activity, or low congestion pressure	**Conventional or Buffered Bicycle Lane, or Protected Bicycle Lane**
	≤ 3,000 – 6,000			**Buffered or Protected Bicycle Lane**
	Greater than 6,000			**Protected Bicycle Lane**
	Any	Multiple lanes per direction		
Greater than 26 mph†	≤ 6,000	Single lane each direction	Low curbside activity, or low congestion pressure	**Protected Bicycle Lane, or Reduce Speed**
		Multiple lanes per direction		**Protected Bicycle Lane, or Reduce to Single Lane & Reduce Speed**
	Greater than 6,000	*Any*	*Any*	**Protected Bicycle Lane, or Bicycle Path**
High-speed limited access roadways, natural corridors, or geographic edge conditions with limited conflicts		*Any*	High pedestrian volume	**Bike Path with Separate Walkway or Protected Bicycle Lane**
			Low pedestrian volume	**Shared-Use Path or Protected Bicycle Lane**

As facilities are designed for a broader range of users, they become accessible to more people and encourage greater adoption of non-motorized means of travel. This can help realize a greater range of benefits - through positive public health outcomes, reduced transportation costs, improved safety for all roadway users, and equitable access to transportation choices.

The 2017 NACTO design guide "Designing for All Ages & Abilities" provides guidance on the types of bicycle facilities that should be considered based on roadway conditions and achieving an all ages and abilities goal. Table 2.1.1. provides a decision-making tool that considers the speed of the roadway, traffic volumes, numbers of vehicle lanes, and other critical considerations. These considerations inform a minimum level of facility that should be used to serve all ages and abilities.



STREET TYPOLOGY

A street typology is a context-based approach for systematically assigning individual streets to a particular "street type" in a way that respects adjacent land areas and functions as part of a broader transportation network.

The typology presented here is unique to Ann Arbor. It began with a comprehensive evaluation of the street land use context along each block in the downtown area as well as the multi-modal needs of the broader transportation network. This evaluation described two factors for defining street types: street Frontage Context and transportation Functional Emphasis.

- **Frontage Context** includes consideration of ground floor activities, urban design and street wall conditions, unique characteristics of place and history, and general aesthetics and atmosphere of the human experience. The Frontage Contexts assigned to blocks of downtown are *forward leading*. They may not reflect what currently is, but rather provide a context to support and enable a desired future condition.
- **Functional Emphasis** includes the unique role a multi-block corridor plays in the overall transportation networks. It establishes a prioritization of modes that is not uniform for every street, but rather uniquely identified by corridor to provide for comfortable mobility and efficient access of all modes.

When combined (Figure 2.1.3), the overlay of Frontage Context with transportation Functional Emphasis results in 12 different street types specific to downtown Ann Arbor. These street types guide holistic street design by identifying key considerations like lane configurations, modal priorities, traffic operations, and maintenance considerations. Street types also address placemaking and land development concerns such as street character, connections, materials and furnishings and environment.

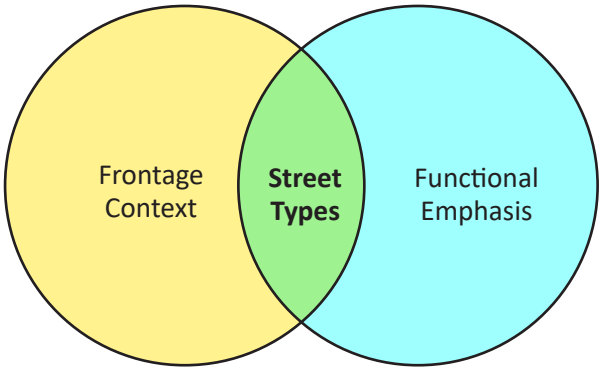


Figure 2.1.3 - Street Types

Street Frontage Context

Street Frontage Contexts are aspirational. While in many instances, downtown blocks have already achieved the desired land use context, there are some areas where downtown continues to evolve. This manual designates street with the envisioned rather than existing street Frontage Context in order to encourage street design that supports this continued evolution.

Street Frontage Context and associated activity varies widely in downtown from blank walls of parking ramps to lively commercial destinations to quaint residential dwellings. This rich tapestry of frontage uses was simplified down to five primary types of street frontages:

- Destination Commercial
- Commercial
- Mixed
- Civic & University
- Near Neighborhood

Functional Emphasis

Streets and public rights-of-way are typically 66 feet wide (Main Street is a notable exception) in Ann Arbor's downtown, requiring trade-offs in how streets are designed. Not all streets can serve all modes equally and still provide an efficient, reliable and easy-to-navigate system. While Frontage Contexts may vary from block to block, the transportation Functional Emphasis of a street generally remains consistent along long segments of a corridor to make a logical system for multi-modal circulation and travel.

The Functional Emphasis facilitates predictable and consistent street design by identifying when and where certain transportation modes or activities are emphasized over others. The Functional Emphases addresses the four primary modes of transportation – walking, bicycling, transit, and auto or truck travel. The five major Functional Emphasis types are:

- Pedestrians & access
- Bicycle
- Transit
- Vehicle
- Balanced street

In addition to the five Functional Emphasis street types, two other street types are included that provide secondary linkages and access and service not along the primary road corridors:

- Alleys
- Pedestrian connectors

Transportation is multi-dimensional. Although streets may emphasize and enhance one or more particular modes, each and every street in a downtown such as Ann Arbor must accommodate all modes comfortably. The transportation types address not only travel through downtown by common modes such as walking, bicycling, driving and transit, but also address the transportation function of getting to downtown destinations.

In some instances, the desired street frontage requires a consistent approach to transportation function. This is the case for Destination Commercial areas that must be supported by a transportation function that emphasizes business access by foot and vehicle. However in most cases, the street Frontage Zone may have different transportation emphasis in different areas. Similarly, a transportation type – such as bicycle emphasis – may traverse a variety of different street Frontage Contexts. In these cases, street design may be subtly (or significantly) modified over the length.



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FUNCTIONAL EMPHASIS

Pedestrian & Access

The pedestrian and parking emphasis is reserved for areas with high concentrations of pedestrian activity. In these segments, the priority is placed on ensuring adequate space in the right-of-way for both through pedestrian travel as well as gathered pedestrians window shopping, sitting or waiting.

Transit

Transit emphasis corridors prioritize the efficient and reliable travel of transit vehicles (i.e. transit operations).

Bicycle

Bicycle emphasis corridors are those few streets where bicycles are afforded a generous space in the public right-of-way to provide for dedicated and comfortable bicycle travel.

Balanced

Balanced streets do not default to any particular modal emphasis, but instead balance the needs of many different travel demands on the corridor.

Public Alley

The primary purpose of alleys is to provide access to properties for services including loading and deliveries and waste removal.

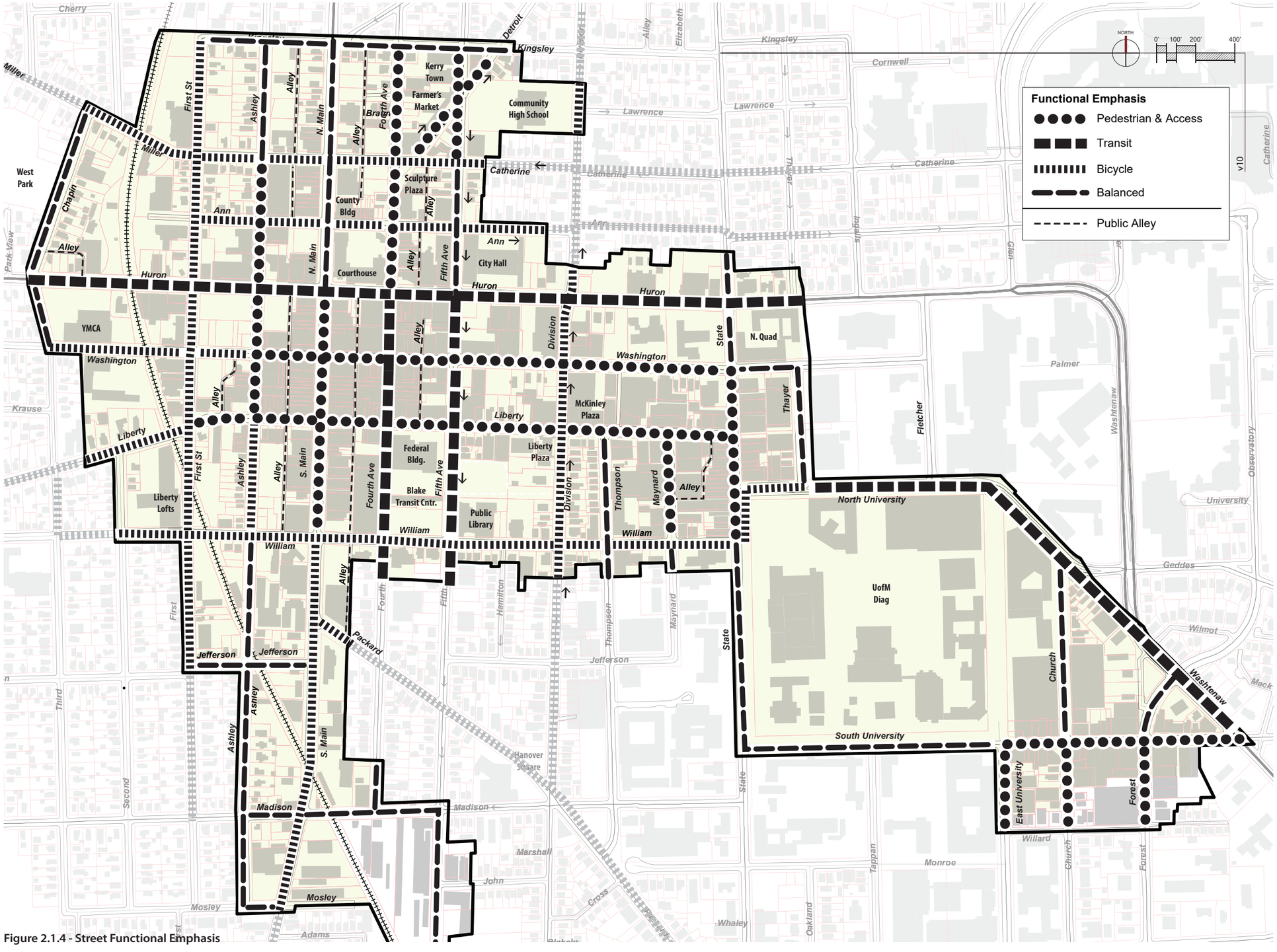


Figure 2.1.4 - Street Functional Emphasis

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FRONTAGE CONTEXT

Destination Commercial

Streets with a concentration of the highest attraction destinations that create an active commercial ground floor use, including dining, shopping, theaters, and major civic spaces. Pedestrians are the priority users as they move between destinations as well as sit, socialize, or stroll.

Commercial

Commercial blocks are only slightly less intense than “Destination Commercial,” they are characterized by a rich mix of high-activity uses such as retail, dining, major office, and multi-family residential. Pedestrians are the highest priority user in order to support commercially oriented land uses.

Mixed

Mixed frontages have a diversity of uses that range from low scale, single use buildings to higher intensity uses. These blocks may also have some or all of their frontages occupied by less active uses such as parking ramps, public services, or the occasional blank wall.

Civic / University

Civic & University Frontage Context blocks are blocks that are anchored by major civic uses. These are well-known public destinations and icons such as city hall, court buildings, or the public library.

Near Neighborhood

Near Neighborhood blocks are predominantly residential but often include low-intensity commercial or service uses.

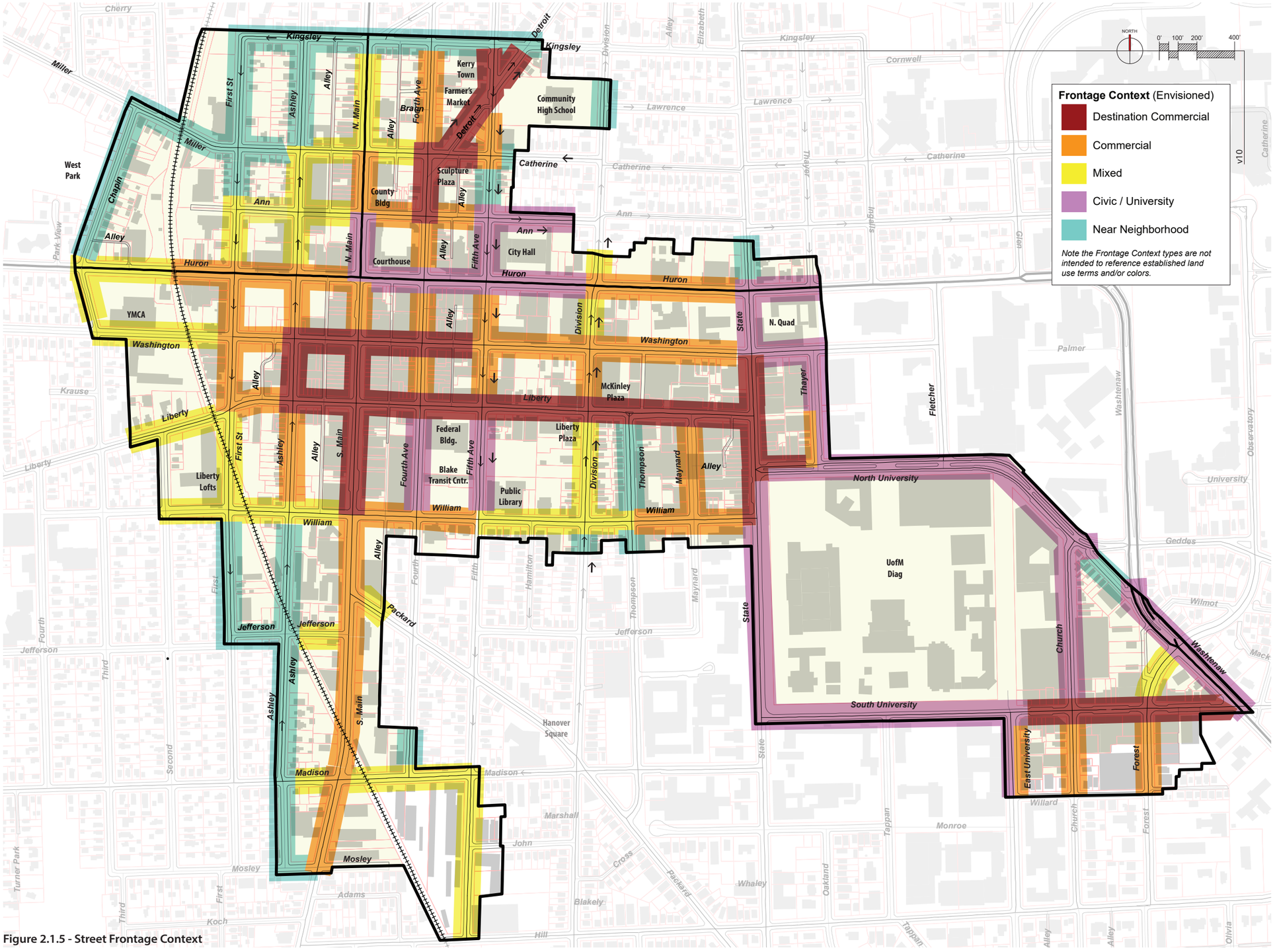


Figure 2.1.5 - Street Frontage Context

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STREET TYPOLOGY MAP

The **Street Typology Map** shows each street's assigned Frontage Context (background colors) and Functional Emphasis (black dashed lines) across the downtown area.

Detailed descriptions of the Frontage Context types are provided in section 2.2, and detailed descriptions of the Functional Emphasis types are provided in section 2.3.

Note that the Frontage Contexts are informed by existing and envisioned land uses but are not intended to depict actual land use patterns, existing or in the future.

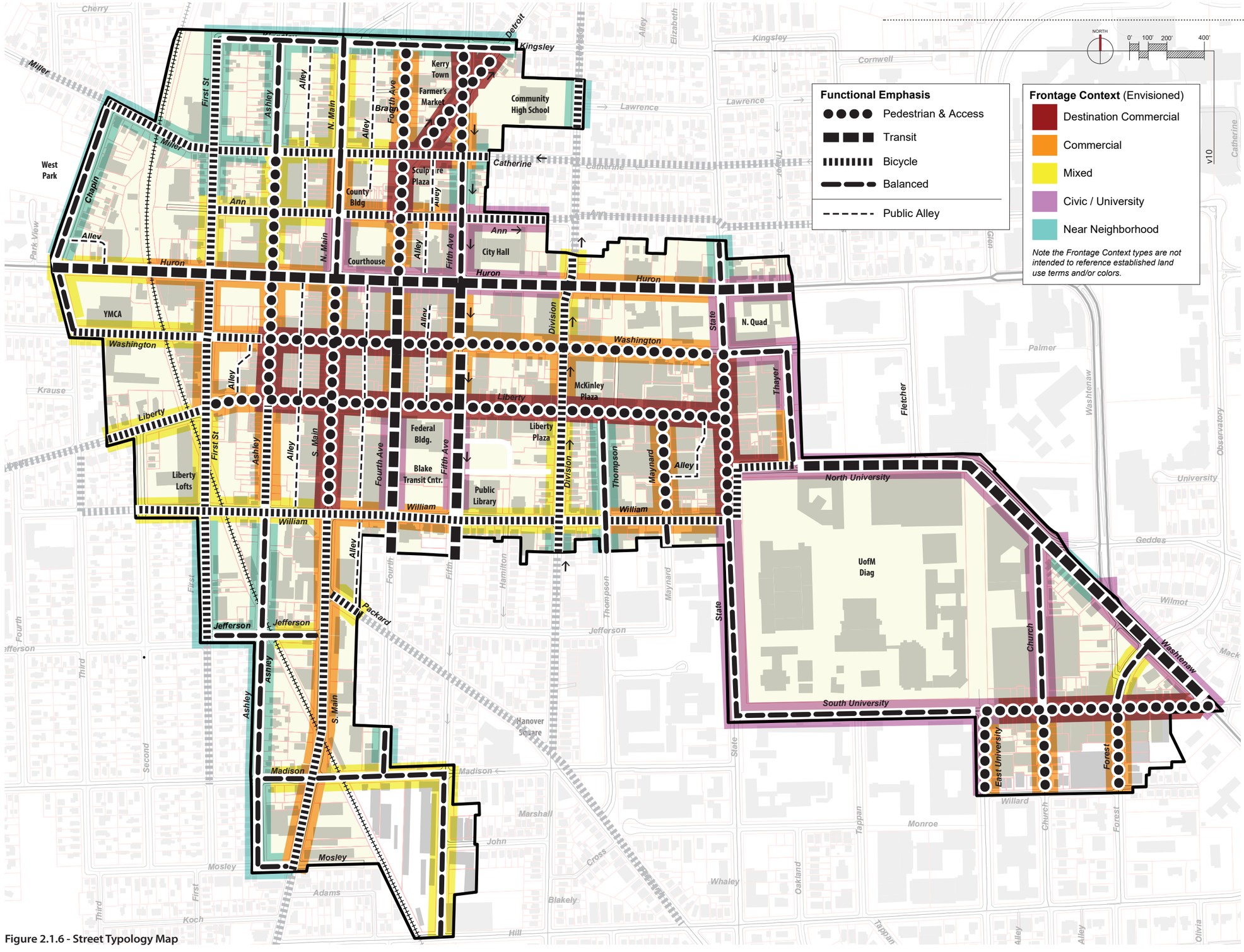


Figure 2.1.6 - Street Typology Map

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SPECIAL DISTRICTS

Ann Arbor's Downtown is not a uniform urban landscape, but is instead comprised of many different districts, each with their own character and unique features, in addition to a number of Historic Districts.

Character Districts

Nine Character Districts are recognized in downtown as part of the City of Ann Arbor Downtown Design Guidelines (2011). The chart inset on the map at the right lists the nine Character Districts. While the Character Districts were established primarily to guide development and building architecture, through project review by the Design Review Board, the physical design of the street can reinforce the unique character of each district through certain design elements. For example, using a particular street light exclusively within a given district can help emphasize that district's identity.

Many design elements, described in Chapter 4, have an opportunity to reinforce district character and a special note will be made under the element's design guidelines. These elements include, but are not limited to: street furnishings (benches and waste receptacles), street lighting, roadway paving materials, Sidewalk and Amenity Zone materials, landscape planters, street trees, bicycle parking, public art, and wayfinding.

The Street Design Team and Design Review Board may be consulted for guidance concerning the design of certain elements within established character districts.

Historic Districts

In addition, the map at the right identifies areas that are part of local Historic Districts. If historic features are identified that exist within the street right-of-way and might be impacted by street projects, the Historic District commission may be consulted to provide additional guidance.

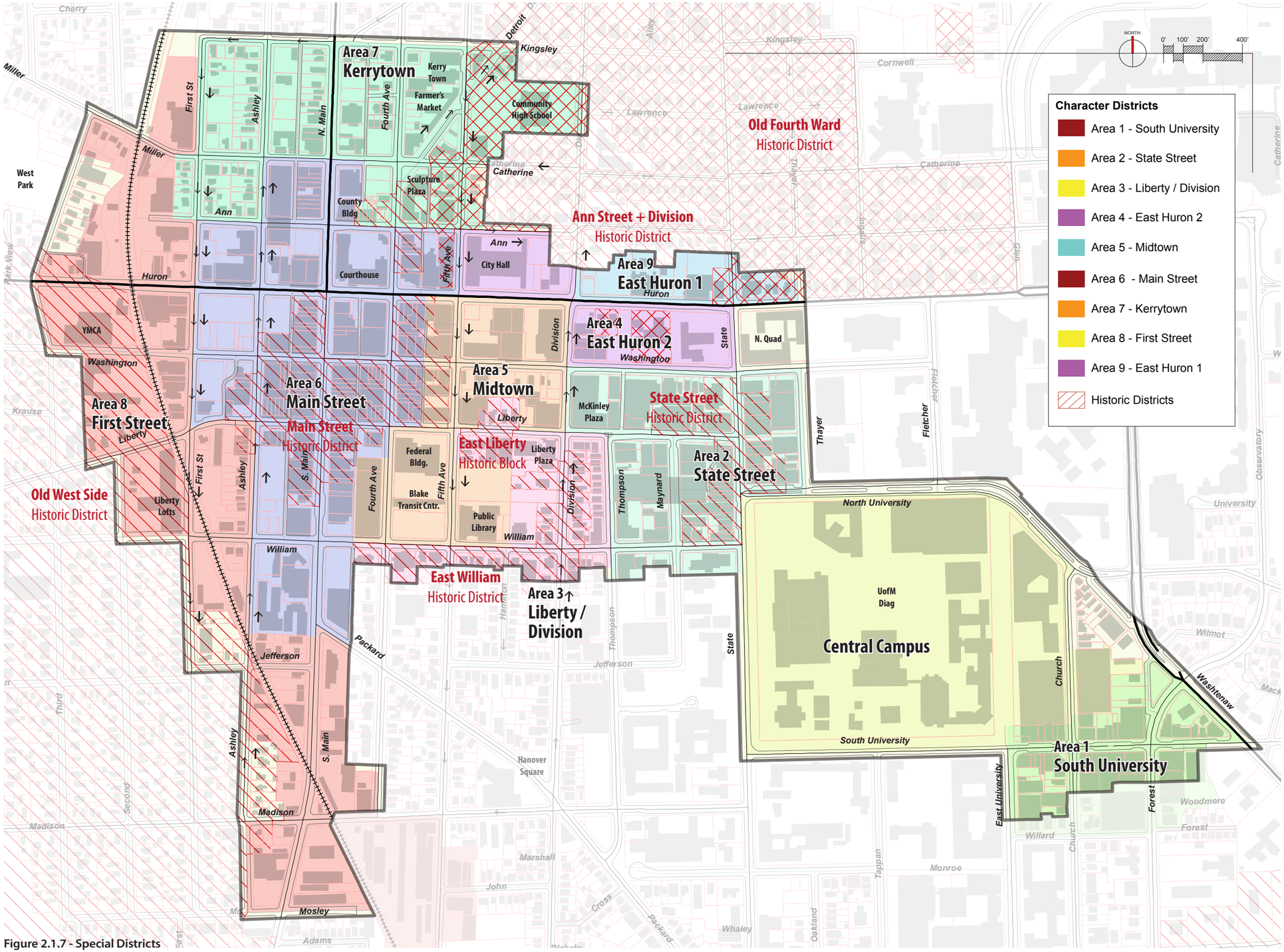


Figure 2.1.7 - Special Districts



2.2
DESIGN ELEMENT PRIORITIZATION

The Design Element Priority (Table 2.2.1) lists street design elements across five categories. For each combination of street Frontage Context and Functional Emphasis, the table identifies what elements are important to incorporate into the street design and to prioritize above other elements.

The Design Element Priority table provide a decision making tool for evaluating trade-offs between what elements to include or exclude from a particular street design.

For example, on bicycle emphasis streets, buffered bicycle lanes are recommended whereas on-street parking is listed as an opportunity. Hence, bicycle facilities need to be accommodated first before on-street parking, provided there is any remaining space for parking.

The priorities, from highest to lowest, are defined as follows:

- **Required**: These design elements should be incorporated into this street design and must meet the design requirements listed within the design guidelines section for that element.
- **Recommended**: These design elements are critically important to the design of this street type. Street design must include these elements unless technical feasibility issues or other significant constraints exist. Not meeting recommended design elements requires approval of the Street Design Team.
- **Opportunity**: These design elements may be appropriate to the street design and are permitted for use provided they do not conflict with required, recommended, or restricted elements.
- **Restricted**: These design elements are not generally desirable for this type of street and should not be used unless a justification can be presented and approved by the Street Design Team.

Critical Elements Required on All Streets

A number of design elements are critical to the integrity and function of all streets and are required elements. This includes:

- Sidewalk and Amenity Zone
- Crosswalks with curb ramps (ADA accessibility)
- Travel lanes and appropriate corner geometry
- Street lighting
- Street trees
- Stormwater management (per city Green Streets Policy)

Chapter 4 provides detailed descriptions of all design elements and is organized according the chart below.

(1) Adjustment to sidewalk width is most likely to occur as part of a public street reconstruction project. Private projects may be required to adjust sidewalk widths when they are narrower than the rest of the street section and/or where a block or more of right-of-way is impacted.
(2) The need for new loading zones shall be reviewed within the context of the larger block or neighborhood.

Table 2.2.1 - Design Elements Priority

LEGEND ✓ Required ! Recommended ■ Opportunity ✗ Restricted

◆ *Design elements marked with an orange diamond box are those commonly impacted by private projects and are of special note for private projects.*

		Destination Commercial	Commercial				Mixed			Civic / University		Near NBH	
	Frontage Context												
	Functional Emphasis	Pedestrian	Pedestrian	Transit	Bicycle	Balanced	Transit	Bicycle	Balanced	Transit	Balanced	Bicycle	Balanced
Section 4.1 - Pedestrian	**Street Zone**	**Ped**	Ped	Tran	Bike	Bal	Tran	Bike	Bal	Tran	Bal	Bike	Bal
◆ Sidewalks + Pedestrian Areas (1)	Pedestrian Area	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Crosswalks	Intersections	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
◆ Curb Ramps	Intersections	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pedestrian Signals	Intersections	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	■	■
Countdown Pedestrian Signals	Intersections	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	■	■
Waste & Recycling Receptacles	Amenity Zone	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	■	■
◆ Benches & Seating	Amenity Zone	!	!	!	!	!	■	■	■	■	■	■	■
Wayfinding	Amenity/Variable	!	!	!	!	!	!	!	!	!	!	!	!
◆ Bumpouts	Curbside Zone	✓	✓	!	✓	✓	!	✓	✓	!	✓	!	!
Mid-Block Crossings	Roadway Zone	■	■	■	■	■	■	■	■	■	■	■	■
Pedestrian Refuge Island	Intersection Zone	■	■	■	■	■	■	■	■	■	■	■	■
Public Art	Varies	■	■	■	■	■	■	■	■	■	■	■	■
Section 4.2 - Commercial Support	**Street Zone**	**Ped**	Ped	Tran	Bike	Bal	Tran	Bike	Bal	Tran	Bal	Bike	Bal
◆ On-Street Parking	Curbside Zone	!	✓	!	■	✓	!	■	✓	!	✓	■	✓
◆ Café Seating & Outdoor Retailing	Amenity/Frontage	✓	✓	!	!	!	!	!	!	■	■	■	■
◆ Loading Zones (2)	Curbside Zone	✓	✓	✓	✓	✓	!	!	!	!	!	■	■
◆ Short-Term Parking & Drop-Off	Curbside Zone	✓	✓	✓	✓	✓	!	!	!	!	!	■	■
◆ Alleys	-	■	■	■	■	■	■	■	■	■	■	■	■
Section 4.3 - Bicycle	**Street Zone**	**Ped**	Ped	Tran	Bike	Bal	Tran	Bike	Bal	Tran	Bal	Bike	Bal
◆ Bicycle Facility Selection	Amenity Zone	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
◆ Separated Bike Lanes	Roadway Zone	■	■	■	!	■	■	!	■	■	■	!	!
Buffered Bike Lanes	Roadway Zone	■	■	■	!	■	■	!	■	■	■	!	!
Conventional Bike Lanes	Roadway Zone	!	!	!	!	!	!	!	!	!	!	!	!
Advisory Bike Lanes	Roadway Zone	■	■	✗	✗	■	✗	✗	■	✗	■	!	!
Sharrows	Roadway Zone	✓	✓	✓	✗	✓	✓	✗	✓	✓	✓	✗	✓
Bike Boxes	Intersections	■	■	■	!	■	■	!	■	■	■	!	!
Two-Stage Turn Queue	Intersections	■	■	■	!	■	■	!	■	■	■	!	!
Bicycle Signal	Intersections	■	■	■	!	■	■	!	■	■	■	!	■
Bicycle Parking	Amenity Zone	!	✓	✓	✓	✓	✓	✓	✓	✓	✓	■	■
Bike Corral	Curbside Zone	!	!	!	!	!	!	!	!	!	!	■	■
Section 4.4 - Transit	**Street Zone**	**Ped**	Ped	Tran	Bike	Bal	Tran	Bike	Bal	Tran	Bal	Bike	Bal
Bus Stops & Shelters	Amenity Zone	!	!	✓	!	!	✓	!	!	✓	!	!	!
Bus Bulbs	Curbside Zone	■	■	!	■	■	!	■	■	!	■	■	■
Transit Lanes	Roadway	✗	✗	!	■	✗	!	■	✗	!	✗	■	✗
Bus Queue Jump Lane	Roadway	✗	✗	!	✗	✗	!	✗	✗	!	✗	✗	✗
Section 4.5 - Vehicle	**Street Zone**	**Ped**	Ped	Tran	Bike	Bal	Tran	Bike	Bal	Tran	Bal	Bike	Bal
Travel Lanes	Roadway Zone	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
◆ Fire Access Lane	Roadway Zone	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Corner Geometry & Design Vehicle	Intersection Zone	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
◆ Driveways & Curb-Cuts	Pedestrian Area	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Medians	Roadway Zone	✗	✗	!	!	!	!	!	!	!	!	!	!
Mini Roundabouts	Intersection Zone	■	■	■	■	■	■	■	■	■	■	■	■
Signals: No Turn on Red	Intersection Zone	✓	■	■	■	■	■	■	■	■	■	■	■
Signals: Leading vs. Lagging Left	Intersection Zone	■	■	■	■	■	■	■	■	■	■	■	■
Signals: Leading Pedestrian Interval	Intersection Zone	!	!	■	■	!	■	■	■	■	!	■	■
Signals: All-Walk Signal Phases	Intersection Zone	■	■	■	■	■	■	■	■	■	■	■	■
Signals: Traffic Signal Priority	Intersection Zone	■	■	■	■	■	■	■	■	■	■	■	■
Section 4.6 - Infrastructure & Landscape	**Street Zone**	**Ped**	Ped	Tran	Bike	Bal	Tran	Bike	Bal	Tran	Bal	Bike	Bal
◆ Street Lighting	Amenity/Frontage	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
◆ Street Trees	Amenity Zone	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
◆ Landscape Planters	Amenity Zone	!	!	!	!	!	!	!	!	!	!	!	!
◆ Lawn Extensions	Amenity Zone	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓
◆ Stormwater Management	Amenity Zone	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
◆ Utilities	Amenity Zone	■	■	■	■	■	■	■	■	■	■	■	■


PICK YOUR SAUCE
WHOLE WHEAT
WEDNESDAY
Any Whole Wheat Panini or Pizza
a boss

2.3



FRONTAGE CONTEXT

Destination Commercial 44

Commercial 46

Mixed 48

Civic & University 50

Near Neighborhood 52

This section describes the five different Frontage Contexts used in the typology framework. For each Frontage Context, the general intent, design objectives, priority users, and key design elements are listed.



DESTINATION COMMERCIAL
FRONTAGE CONTEXT

DESCRIPTION

Destination Commercial is a designation applied to only a handful of blocks in downtown. Designating a smaller and focused number of blocks as a destination strengthens adjacent blocks. "Destinations" are strongest and most catalytic when clear and concentrated. A downtown may have several Destination Commercial areas – each unique, separated and distinct.

Destination Commercial blocks bear both the benefit and burden of concentrated activity. These areas typically experience the highest level of congestion from all modes and struggle most with conflicting demands for limited street space and public rights-of-way.

DESIGN OBJECTIVES & VALUES

- Support and facilitate access **to** and **being at** designated blocks.

  Equitable, Just Access for All People

- Clear connections to and from major through travel corridors and off street parking.

  Safe, Comfortable Downtown Streets

- Distinct character and identity with continuous street edge. Curb-cuts should be avoided entirely on Destination Commercial blocks.

  Connected Community with Streets as Civic Spaces

  Vibrant & Thriving Local Economy

- Flexible and adaptive street design.

  Responsible Design & Implementation

PRIORITY USERS

- Pedestrians moving between destinations as well as sitting, socializing or strolling.
- Service vehicles (loading and deliveries) and short-term, transactional parking.

DESIRED ACTIVITIES

- High attraction destinations and active commercial ground floor use.
- Dining, shopping, theaters, and major civic spaces.
- Outdoor retail and cafe seating.
- Seating and gathering areas (e.g. green landscaped areas or small plazas).

Applicable Functional Emphasis Types
Pedestrian and access emphasis

Example Street Segments
Main Street (William Street to Washington Street)
South University Street (East University Avenue to Forest Avenue)
State Street (William Street to Washington Street)
North Fifth Avenue (at Detroit Street)

DESIGN ELEMENT PRIORITIZATION

The full design element prioritization chart provides the complete reference for design elements. Some critical design elements for this street type are listed below:

Typically Required Design Elements
Sidewalks (minimum 6-8 feet Clear Walk Zone)
Loading zones on street or on nearby streets
Space for cafe dining and outdoor retail
Bi-directional travel lanes, encourage low speed vehicle travel
Pedestrian scaled lighting
Street trees in tree pits or planters
Sharrows (or bicycle lanes)
Short, frequent, well-marked crosswalks (with curb ramps)
Short-term parking and drop-off zones

Typically Recommended Design Elements
Bicycle parking (racks or corrals) and bike share
On-street parking (may convert some parking spaces to alternate uses, e.g. bike corals or parklets)
Frequent seating, benches, or seat-walls
Landscape planters that provide a pedestrian buffer
Bumpouts
Public art
Mid-block crossings
Wayfinding

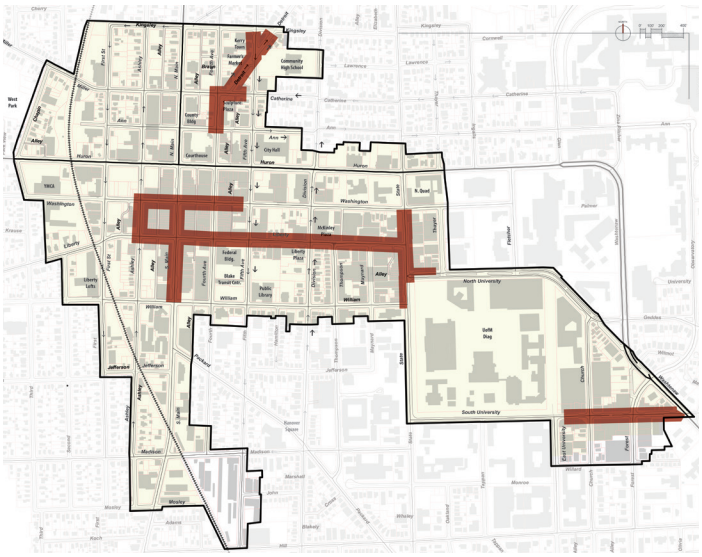


Figure 2.3.1 - Destination Commercial Key Map





COMMERCIAL
FRONTAGE CONTEXT

DESCRIPTION

Commercial blocks are the most typical Frontage Context in downtown. Only slightly less intense than "Destination Commercial," Commercial blocks are characterized by a rich mix of high-activity uses such as retail, dining, major office, and multi-family residential. Commercial blocks may also have lower activity uses such as banks, ground floor office uses and commercial lobbies. Commercial block types, like Destination Commercial, are highly active places with abundant pedestrian activity.

DESIGN OBJECTIVES & VALUES

- Support for higher intensity land uses. Commercial blocks add tremendous value to the city and downtown and their design should support and strengthen this objective.

  Vibrant and Thriving Local Economy

  Affordable and Inclusive Community

- Strong connections to Destination Commercial areas.

  Safe, Comfortable Downtown Streets

- Active ground floor uses with a high degree of ground floor transparency and frequent doorways. Minimal curb-cuts and driveways – access should utilize alleys where they exist.

  Vibrant and Thriving Local Economy

- Slow travel speeds to increase safety and visibility.

  Safe, Comfortable Downtown Streets

- Balanced accommodation of both "to" and "through" travel for all modes.

  Safe, Comfortable Downtown Streets

PRIORITY USERS

- Pedestrians are the highest priority user. Pedestrians support commercially oriented land uses and other modes of travel (bicycling, transit or driving) transition to the pedestrian mode in order to access business or other amenities.
- Accommodating service vehicles (loading and deliveries) and short-term transactional parking are also priorities on commercial streets.
- Commercial streets may have different Functional Emphasis including pedestrians and access, bicycles, transit, or through vehicular movements.

DESIRED ACTIVITIES

- Active ground floor use.
- Outdoor retail and cafe seating.
- High use building entrances and lobbies.
- Seating and gatherings areas such as green landscaped areas or small plazas.

Applicable Functional Emphasis Types
Pedestrian and access
Bicycle
Transit
Vehicle
Balanced street

Example Street Segments
Liberty Street (Fourth Avenue to Division Street)
Washington Street (First Street to Ashley Street)
William Street (Thompson Street to State Street)
Huron Street (First Street to Main Street)

DESIGN ELEMENT PRIORITIZATION

The full design element prioritization chart provides the complete reference for design elements. Some critical design elements for this street type are listed below:

Typically Required Design Elements
Sidewalks (minimum 6-8 feet Clear Walk Zone)
Pedestrian-scaled lighting
Well marked crosswalks and curb ramps
On-street parking for pedestrian and vehicle emphasized streets
Street trees in a landscape strip
High quality transit stops/shelters (on transit emphasized streets)
Bicycle parking (racks or corrals)
Sharrows or higher level bike facility
Wayfinding (vehicular and pedestrian)
Loading zones
Short-term parking & drop-off zones

Typically Recommended Design Elements
Space for cafe seating and outdoor retail
Amenity Zone uses that provide a pedestrian buffer
Public seating (green space or plazas)
Bi-directional travel lanes
Wayfinding

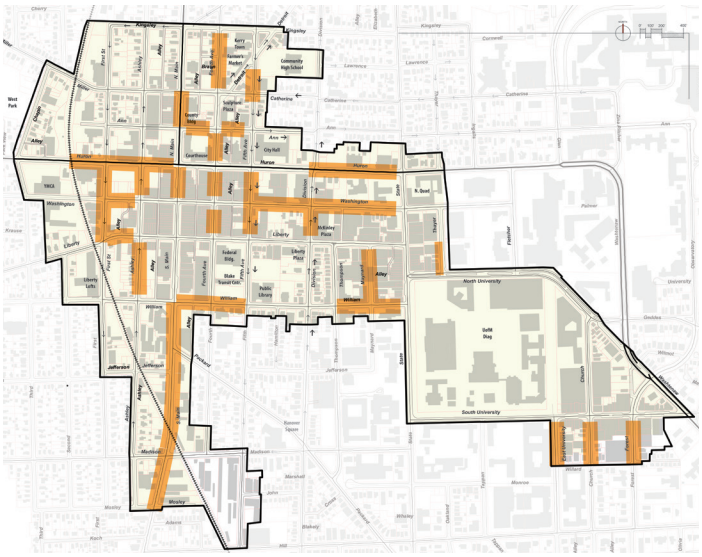
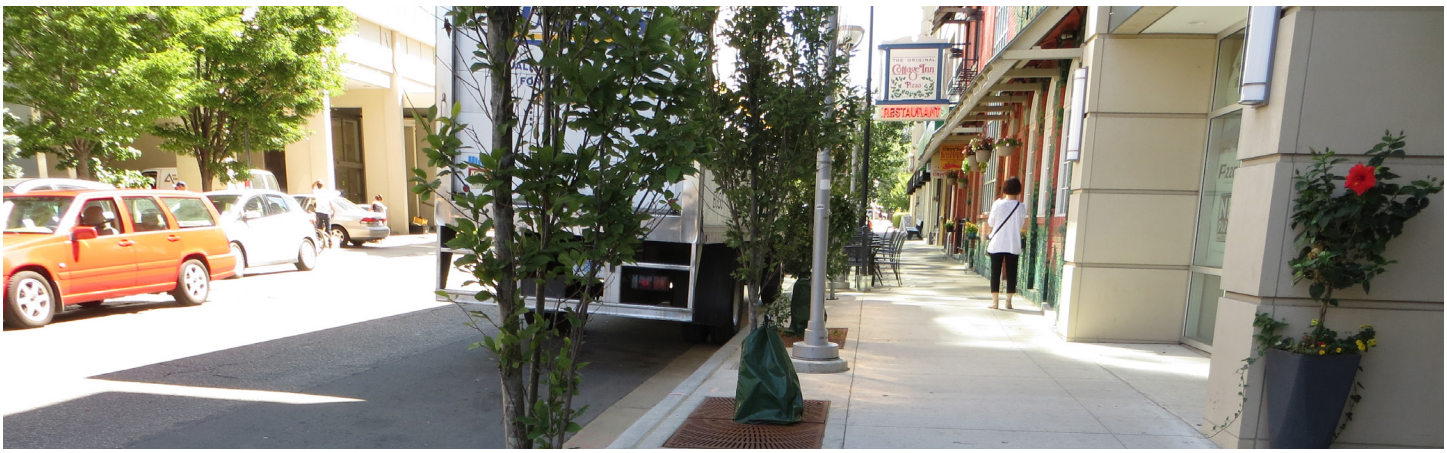


Figure 2.3.2 - Commercial Key Map







MIXED
FRONTAGE CONTEXT

DESCRIPTION

Mixed context blocks are a very common Frontage Context in the downtown area. These areas have a diversity of uses that range from low scale, single use buildings to higher intensity uses. These blocks may also have some or all of their frontages occupied by less active uses such as parking ramps, public services, or the occasional blank wall.

DESIGN OBJECTIVES

- Create a quality and inviting pedestrian place with well designed ground floor uses and landscaping.

  Connected Community with Streets as Civic Spaces

  Equitable, Just Access for All People

- Support, service and augment Commercial and Destination Commercial areas.

  Vibrant and Thriving Local Economy

PRIORITY USERS

- Pedestrian through travel, circulation and access to land uses and transportation services such as bus stops and bicycle stations.
- Vehicular access to properties – curb-cuts are not uncommon.
- Multi-modal through travel.

DESIRED ACTIVITIES

- Lower intensity uses such as commercial office, single- and multi-family residential, public services (fire station, utility structures, etc.).
- Residential and commercial lobbies and recreational uses.
- Quality landscaping including stormwater management and green infrastructure.

Applicable Functional Emphasis Types
Bicycle emphasis
Transit emphasis
Through vehicle travel
Balanced street

Example Street Segments
Miller Avenue (First Street to Fourth Avenue)
William Street (Second Street to Thompson Street)
Ashley Street (Huron Street to Miller Avenue)

DESIGN ELEMENT PRIORITIZATION

The full design element prioritization chart provides the complete reference for design elements. Some critical design elements for this street type are listed below:

Typically Required Design Elements
Sidewalks – minimum 6 feet Clear Walk Zone
Pedestrian-scaled lighting
Marked crosswalks
Bicycle parking (racks or corrals)
Street trees in a landscape planter or tree trench
Bumpouts
Sharrows or higher level bike facility

Typically Recommended Design Elements
Loading zones, drop-off zones, and other temporary parking
Amenity Zone uses that provide a pedestrian buffer
On-street parking on most streets
Bike parking on most-streets

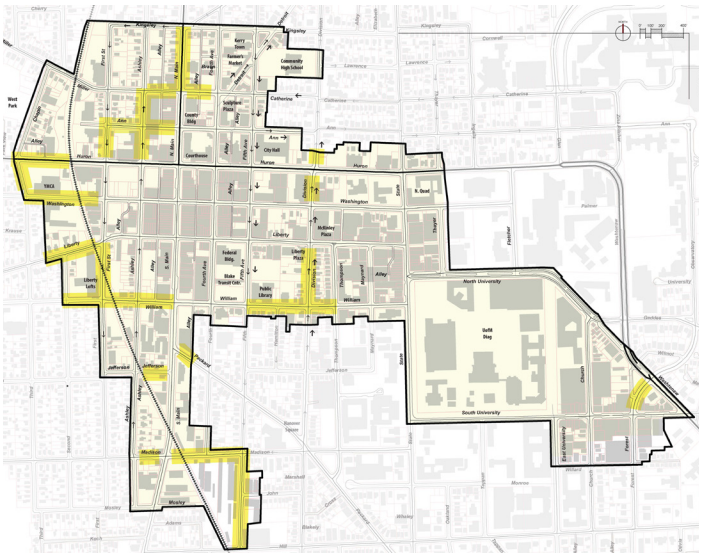
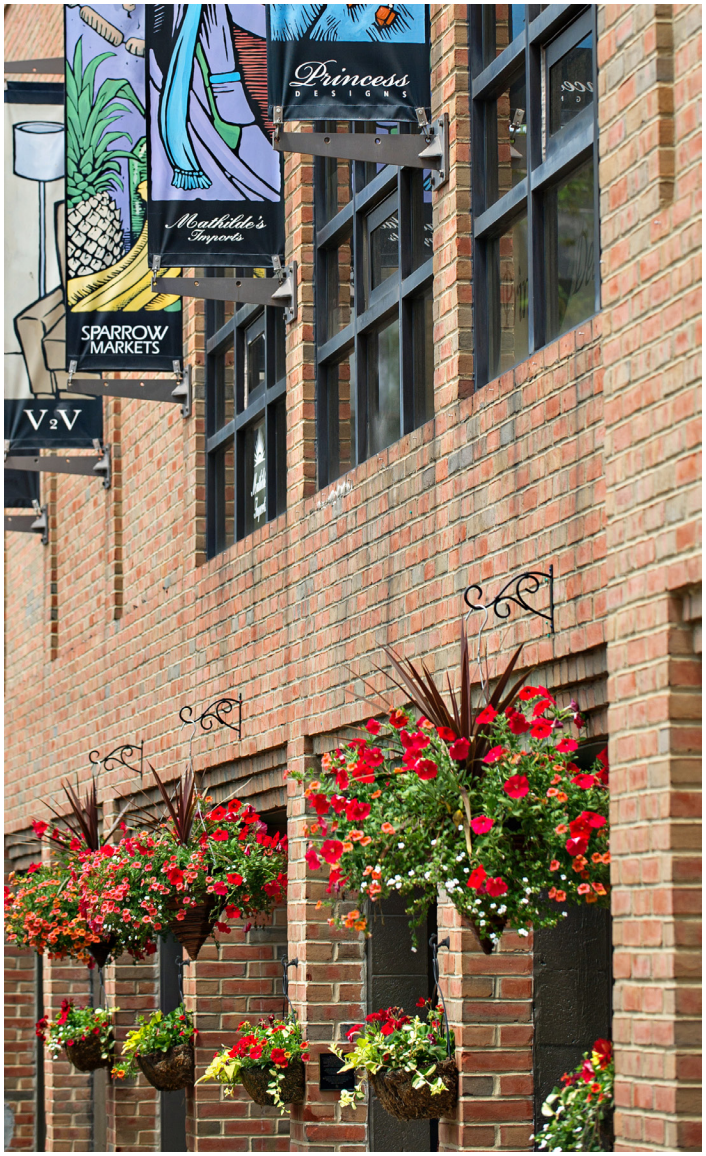


Figure 2.3.3 -Mixed Key Map







CIVIC & UNIVERSITY
FRONTAGE CONTEXT

DESCRIPTION

Civic & University Frontage Context blocks are blocks that are anchored by major civic uses. These are well-known public destinations and icons such as city hall, court buildings, or the public library. Civic & University frontages also encompass the campus environment bordering The University of Michigan. Buildings are often set well back from the street with large gaps in the street wall, but landscaping that frames iconic buildings and institutions contributes to street character.

Pedestrian activity is episodic with a steady stream of activity through much of the day but high concentrations at varying times throughout the day, week and/or year.

DESIGN OBJECTIVES

- Highlight the character, presence and identity of anchor institutions.

  Connected Community with Streets as Civic Spaces

- Provide safe and comfortable pedestrian circulation.

  Safe, Comfortable Downtown Streets

  Equitable, Just Access for All People

- Ensure public access, via a multitude of modes, to these important institutions.

  Safe, Comfortable Downtown Streets

  Resilient, Energy Responsible Downtown

PRIORITY USERS

- Pedestrian through travel, circulation and access to institutions.
- Multi-modal travel (as designated by Functional Emphasis) both to and through Civic & University areas.

DESIRED ACTIVITIES

- Small public spaces that permit sitting or gathering.
- Entrance plazas or walks to civic or university buildings.
- Landscaping and other softscaping.
- Public art, fountains or other anchoring features in the public realm.

Applicable Functional Emphasis Types
Transit
Vehicle
Balanced street

Example Street Segments
State Street (William Street to South University Avenue)
Huron Street (Main Street to Division Street)
North University Avenue (Thayer Street to Church Street)

DESIGN ELEMENT PRIORITIZATION

The full design element prioritization chart provides the complete reference for design elements. Some critical design elements for this street type are listed below:

Typically Required Design Elements
Sidewalks (minimum 6-8 feet Clear walk Zone) - Wider if possible
Pedestrian - scaled lighting
Well marked, regular, and high visibility crosswalks
Bicycle parking (racks or corrals)
Street trees (in pits or landscape planters)
Regular waste receptacles
Sharrows or higher level bike facility
Enhanced transit stops on transit emphasized streets

Typically Recommended Design Elements
Wayfinding
Curbside uses that provide a pedestrian buffer
Wayfinding and public art
Public seating and/or mini plazas
Medians
Larger and high image landscape planters

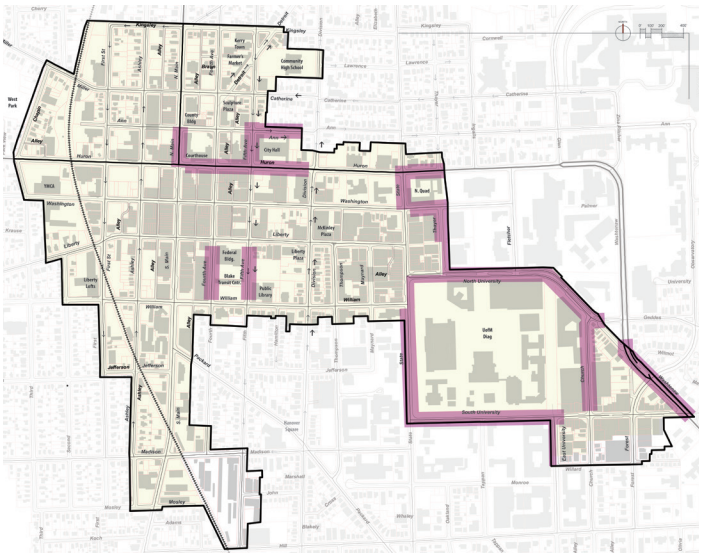


Figure 2.3.4 - Civic & University Key Map









NEAR NEIGHBORHOOD
FRONTAGE CONTEXT

DESCRIPTION

Near Neighborhood blocks are predominantly residential but often include low-intensity commercial or service uses. Lawn extensions, porches, large shade trees, and other uses provide for the interface between the public street and the private land.

Buildings are set far back from the street edge with frequent gaps between them. Driveways are not uncommon and provide access to garages and small parking areas, unfortunately not the way we are set up in Ann Arbor.

Pedestrian activity is lower in these areas and is characterized by neighbors engaging in social exchange or travelers proceeding to other nearby districts and destinations. Vehicle traffic should travel at modest speeds respectful of the residential communities through which they are traveling.

DESIGN OBJECTIVES

- Safe and quiet residential community.

  Safe, Comfortable Downtown Streets

- Quality streetscape with robust landscaping and tree canopy.

  Connected Community with Streets as Civic Spaces

- Short, logical, and multi-modal connections to nearby Commercial Districts.

  Resilient, Energy Responsible Downtown

PRIORITY USERS

- Local pedestrian travel along and across streets with particular awareness of the needs and abilities of children and senior residents.
- Multi-modal travel (as designated by transportation type overlay) through the Near Neighborhood areas.

DESIRED ACTIVITIES

- Yards, porches, large shade trees, and other transitional features between the public street and private properties.
- Low fences or landscaping (below waist height) to define the street edge.
- Community uses such as schools, churches, and recreational uses.

Applicable Functional Emphasis Types
Bicycle emphasis
Balanced street

Example Street Segments
Thompson Street (Liberty Street to William Street)
South Ashley Street (William Street to Madison Street)
East Kingsley Street (First Street to Main Street)

DESIGN ELEMENT PRIORITIZATION

The full design element prioritization chart provides the complete reference for design elements. Some critical design elements for this street type are listed below:

Typically Required Design Elements
Sidewalks – minimum 5 feet Clear Walk Zone
Marked crosswalks
Street trees in lawn strips or landscape planters
Street lighting
Sharrows or bicycle lanes (or higher level bike facility)

Typically Recommended Design Elements
Street trees in landscape strip
On-street parking
Stormwater management via green infrastructure
Landscape planters or lawn strips
Driveways and curb-cuts carefully designed

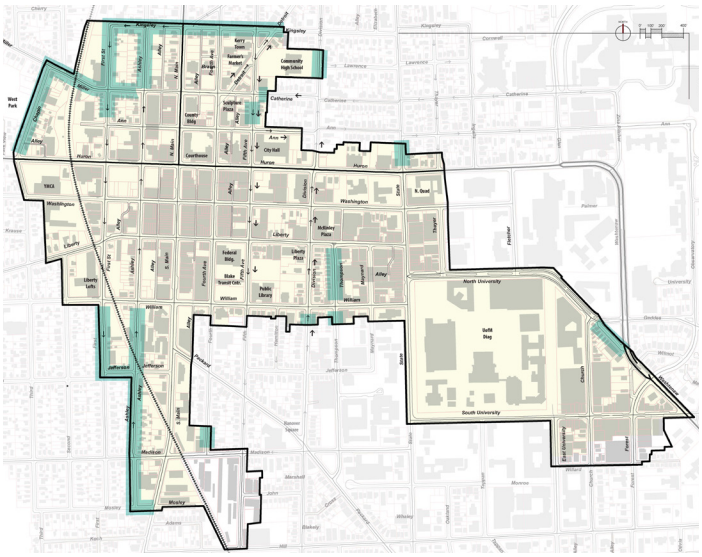


Figure 2.3.5 - Near Neighborhood Key Map




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2.4



FUNCTIONAL EMPHASIS

Pedestrians & Access Emphasis 56
Bicycle Emphasis 58
Transit Emphasis 60
Balanced Emphasis 62
Alleys 64

This section describes the four different Functional Emphases used in the typology framework as well as alleys. For each type, the general intent, design objectives, priority users and key design elements are listed.



PEDESTRIANS & ACCESS

FUNCTIONAL EMPHASIS

DESCRIPTION

The pedestrian and parking emphasis is reserved for areas with high concentrations of pedestrian activity. In these segments, the priority is placed on ensuring adequate space in the right-of-way for both through pedestrian travel as well as gathered pedestrians window shopping, sitting or waiting.

Curbside uses should meet the access needs of the adjacent businesses – particularly frequent and short duration transactional activities, such as loading and very short-term parking.

TRANSPORTATION OBJECTIVES

- Safe and comfortable pedestrian travel and gathering.
  - Safe, Comfortable Downtown Streets
  - Equitable, Just Access for All People
- Support to businesses – particularly loading and very short-term vehicle parking.
  - Vibrant and Thriving Local Economy
- Slow travel speeds to enhance both safety and visibility.
  - Safe, Comfortable Downtown Streets
- Accommodation of through and circulating vehicles.
  - Safe, Comfortable Downtown Streets
- Safe bicycle travel and adequate bicycle parking.
  - Safe, Comfortable Downtown Streets
  - Equitable, Just Access for All People
  - Resilient, Energy Responsible Downtown

Applicable Frontage Contexts
Destination Commercial
Commercial

Example Street Segments
Main Street (Huron Street to William Street)
East Liberty Street (Division Street to State Street)
South University Avenue (East University Avenue of Forest Avenue)

DESIGN ELEMENT PRIORITIZATION

The full design element prioritization chart provides the complete reference for design elements. Some critical design elements for this street type are listed below:

Typically Required Design Elements
Sidewalks – minimum 6-8 feet Clear Walk Zone
Pedestrian-scaled lighting
On-street parking
Bicycle parking (racks or corrals)
Bumpouts
Low speed vehicle travel
Short, frequent, well-marked crosswalks
Travel lanes
Street trees in tree pits or planters
Vehicle travel lanes
Sharrows (or higher level bike facility)

Typically Recommended Design Elements
Public seating
Loading zones, short-term parking and drop-off zones
Landscape planters to buffer pedestrian areas

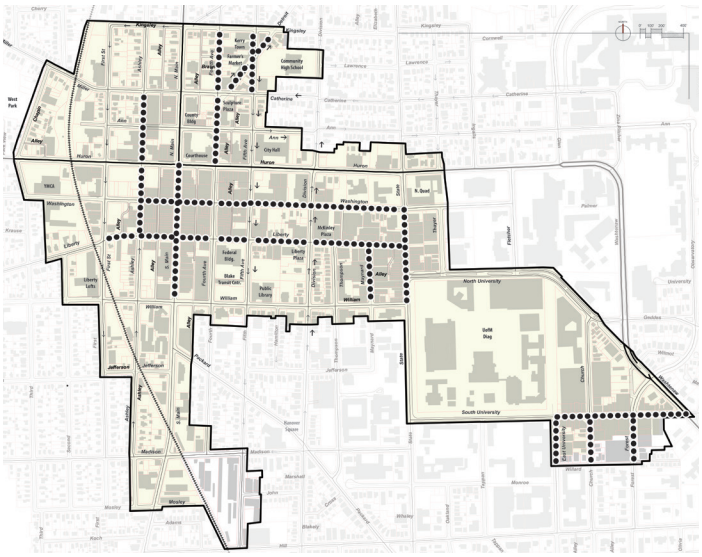


Figure 2.4.1 - Pedestrians & Access Key Map





BICYCLE
FUNCTIONAL EMPHASIS

DESCRIPTION

Bicycle emphasis corridors are those few streets where bicycles are afforded a generous space in the public right-of-way to provide for dedicated and comfortable bicycle travel. While bicycles are permitted and must be accommodated on all streets of downtown, bicycle emphasis streets prioritize bicycle travel. These streets are uniquely designed to make even the least confident cyclists – parents with children, youth, or seniors – can feel comfortable and be safe traveling through the core of downtown.

Bicycle streets in downtown are still pedestrian streets and concurrently support strong commercial activity. To concurrently address land use demands and bicycle emphasis needs, street design may need to transition between different bicycle facility types.

TRANSPORTATION OBJECTIVES

- Safe and comfortable bicycle facilities that accommodate the broadest range of users including cyclists from eight years old to (and beyond!) 80 years old.

  Safe, Comfortable Downtown Streets

  Equitable, Just Access for All People

  Resilient, Energy Responsible Downtown

- Support to adjacent land uses including access and loading.

  Safe, Comfortable Downtown Streets

- Quality public realm and inviting pedestrian environment.

  Safe, Comfortable Downtown Streets

  Connected Community with Streets as Civic Spaces

- Accommodation of through and circulating vehicles.

  Safe, Comfortable Downtown Streets

Applicable Frontage Contexts
Commercial
Mixed
Near Neighborhood

Example Street Segments
William Street
First Street
Ashley Street (except between Washington Street and Liberty Street)
Miller Avenue/Catherine Street (west of Fourth Ave)

DESIGN ELEMENT PRIORITIZATION

The full design element prioritization chart provides the complete reference for design elements. Some critical design elements for this street type are listed below:

Typically Required Design Elements
Dedicated bicycle facility: Bicycle lanes required at a minimum but higher level facilities may be used instead (buffered bicycle lanes or protected bicycle lanes)
Sidewalks – minimum 6 feet Clear Walk Zone
Street lighting
Street trees in tree pits or planters
Bicycle parking (racks or corrals)
Bicycle-oriented wayfinding
Travel lanes
Short, frequent, well-marked crosswalks

Typically Recommended Design Elements
Bike boxes and/or bicycle signals
Bike share stations
Public art
Two-stage turn queues
Transit bumpouts
Landscape planters

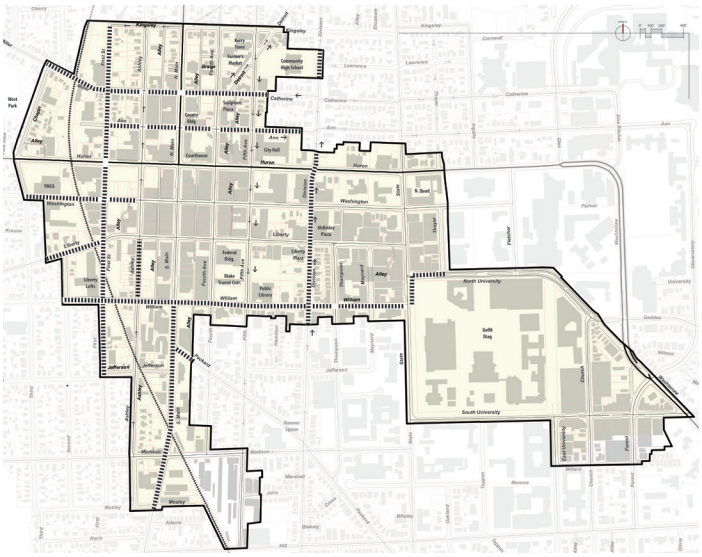


Figure 2.4.2 - Bicycle Key Map







TRANSIT
FUNCTIONAL EMPHASIS

DESCRIPTION

Transit emphasis corridors prioritize the efficient and reliable travel of transit vehicles (i.e. transit operations). Transit emphasis corridors also include streets with high activity transit and bus stops that need to provide adequate space and comfortable passenger amenities such as transit shelters and seating.

Transit emphasis corridors may employ traffic signal priority (TSP) technologies that permit a bus to progress more rapidly down the corridor. In rare instances, transit queue jump lanes are used at congested intersections to permit buses to bypass passenger cars. Bus bulbs enable buses to stop in the travel lane and hold traffic behind them, which reduces transit travel time, enhances reliability, and improves the passenger experience.

Quality pedestrian accommodation is critically important on transit emphasis segments because every transit rider is a pedestrian at the beginning and end of their transit trip.

TRANSPORTATION OBJECTIVES

- Efficient and reliable travel of transit vehicles down the corridor.

  Safe, Comfortable Downtown Streets

  Resilient, Energy Responsible Downtown
- Safe and comfortable passenger waiting, boarding and alighting at transit stops.

  Safe, Comfortable Downtown Streets
- Quality and inviting pedestrian environment.

  Connected Community with Streets as Civic Spaces
- Accommodation of through and circulating vehicles and bicycles.

  Safe, Comfortable Downtown Streets

Applicable Frontage Contexts
Commercial
Mixed
Civic & University

Example Street Segments
Washington Street (Fifth Avenue to Thayer Street)
Fourth Avenue and Fifth Avenue (Huron Street to William Street)
North University Avenue (Fletcher Street to Geddes Road)

DESIGN ELEMENT PRIORITIZATION

The full design element prioritization chart provides the complete reference for design elements. Some critical design elements for this street type are listed below:

Typically Required Design Elements
Sidewalks – minimum 6 feet Clear Walk Zone
Street lighting and pedestrian-scaled lighting
Well marked crosswalks
Transit signs and seating at bus boarding stops
Travel lanes wide enough for transit vehicles
Street trees
Sharrows or higher level bicycle facilities

Typically Recommended Design Elements
Bus bulbs, queue jumps and/or signal priority
Transit shelters
Bicycle parking (racks or corrals)
Bumpouts
Dedicated transit lanes
Trash and recycling receptacles close to bus stops

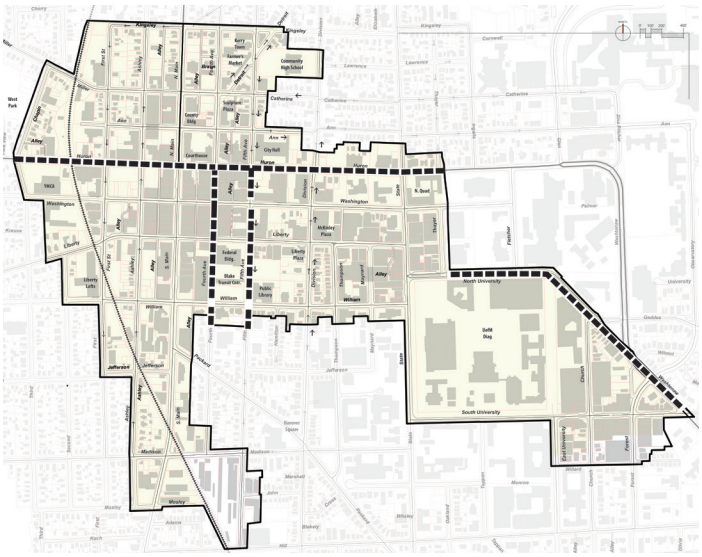


Figure 2.4.3 - Transit Key Map





BALANCED
FUNCTIONAL EMPHASIS

DESCRIPTION

Balanced streets do not default to any particular modal emphasis, but instead balance the needs of many different travel demands on the corridor.

Balanced streets are complete streets. They provide safe and comfortable accommodation for bicycles and pedestrians while concurrently providing reliable progression of vehicle traffic including transit vehicles.

Balanced streets are not, however, identical in their design or approach. For example, some balanced streets may provide a higher quality bicycle facility while others enhance transit accommodation.

All balanced streets are quality streets for walking and local pedestrian activity as this is the foundation of downtown and the vitality of the area.

TRANSPORTATION OBJECTIVES

- Provide for safe travel of all travel modes, preferably enhancing both the efficiency and attractiveness of high volume, sustainable modes.

  Safe, Comfortable Downtown Streets

  Resilient, Energy Responsible Downtown

- Ensure a walking environment and legible pedestrian network that provides for all residents of the area from the very old to the very young of all physical abilities.

  Safe, Comfortable Downtown Streets

  Equitable, Just Access for All People

Applicable Frontage Contexts
Commercial
Mixed
Civic & University
Near Neighborhood

Example Street Segments
South Main Street (south of William Street)
Kingsley Street
Division Street
Thompson Street
State Street (south of William Street)

DESIGN ELEMENT PRIORITIZATION

The full design element prioritization chart provides the complete reference for design elements. Some critical design elements for this street type are listed below:

Typically Required Design Elements
Sidewalks – minimum 6 feet Clear Walk Zone
Street lighting
Marked crosswalks
Travel lanes
Street trees
Sharrows or higher level bike facility
On-street parking

Typically Recommended Design Elements
Bike parking
Bus stops
Curbside uses that buffer the pedestrian ways
Loading zones, short-term parking, and drop-off areas
Benches and seating
Mid-block crossings

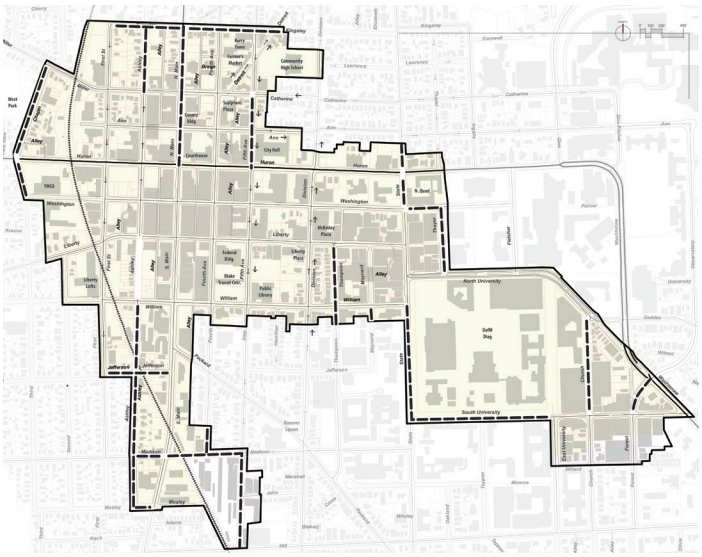


Figure 2.4.4 - Balanced Key Map







ALLEYS

DESCRIPTION

Alleys provide valuable access to multiple parcels and properties without requiring multiple curb-cuts that interrupt the pedestrian way, conflict with bicycles, and hinder the progression of vehicles in the street.

The primary purpose of alleys is to provide access to properties for services including loading and deliveries and waste removal. New alleys must be designed wide enough to facilitate maneuvering of larger service vehicles and must be well managed to minimize blockage or constrained passageways.

Pedestrians and bicycles will utilize alleys either to access properties or to travel through the middle of a block; however, alleys generally do not have any designation of space to separate non-motorized users from the heavier vehicular traffic. Therefore, caution is advised to pedestrians and bicyclists when traveling through an alley. Since many residents access their downtown home through an alley, alley design and improvements should acknowledge this and consider opportunities to make alleys safer and more inviting while first and foremost meeting service needs.

TRANSPORTATION OBJECTIVES

- Provide efficient access and servicing of properties on a common square/block.

  Vibrant and Thriving Local Economy

- Provide space for service functions; keeping them out of view and reducing competition for valuable street and sidewalk space.

  Connected Community with Streets as Civic Spaces

- Minimize curb-cuts, driveways, and other vehicular access drives.

  Safe, Comfortable Downtown Streets

- Integrate art.

  Connected Community with Streets as Civic Spaces

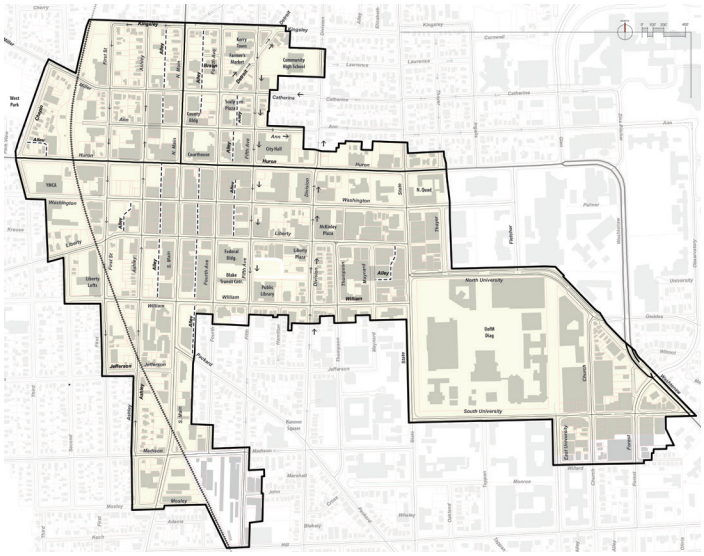


Figure 2.4.5 - Alleys Key Map

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3.0 USER GUIDE

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STREET DESIGN PROCESS 68

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3.1
STREET DESIGN PROCESS

OVERVIEW

Regardless of origin and whether public or private, every project that impacts the street is required to follow the Downtown Street Design Manual. Small- and large-scale projects should be examined and considered for opportunities to advance the vision and goals of the Downtown Street Design Manual.

The Street Design Team

Central to ensuring that street projects are designed, constructed, and maintained in accordance with the Downtown Street Design Manual is the Street Design Team. The Street Design Team is an interdisciplinary group comprised of DDA staff and City staff from multiple city departments, including: Systems Planning Department, Engineering Department, Public Works, Planning and Development, and AAATA (TheRide).

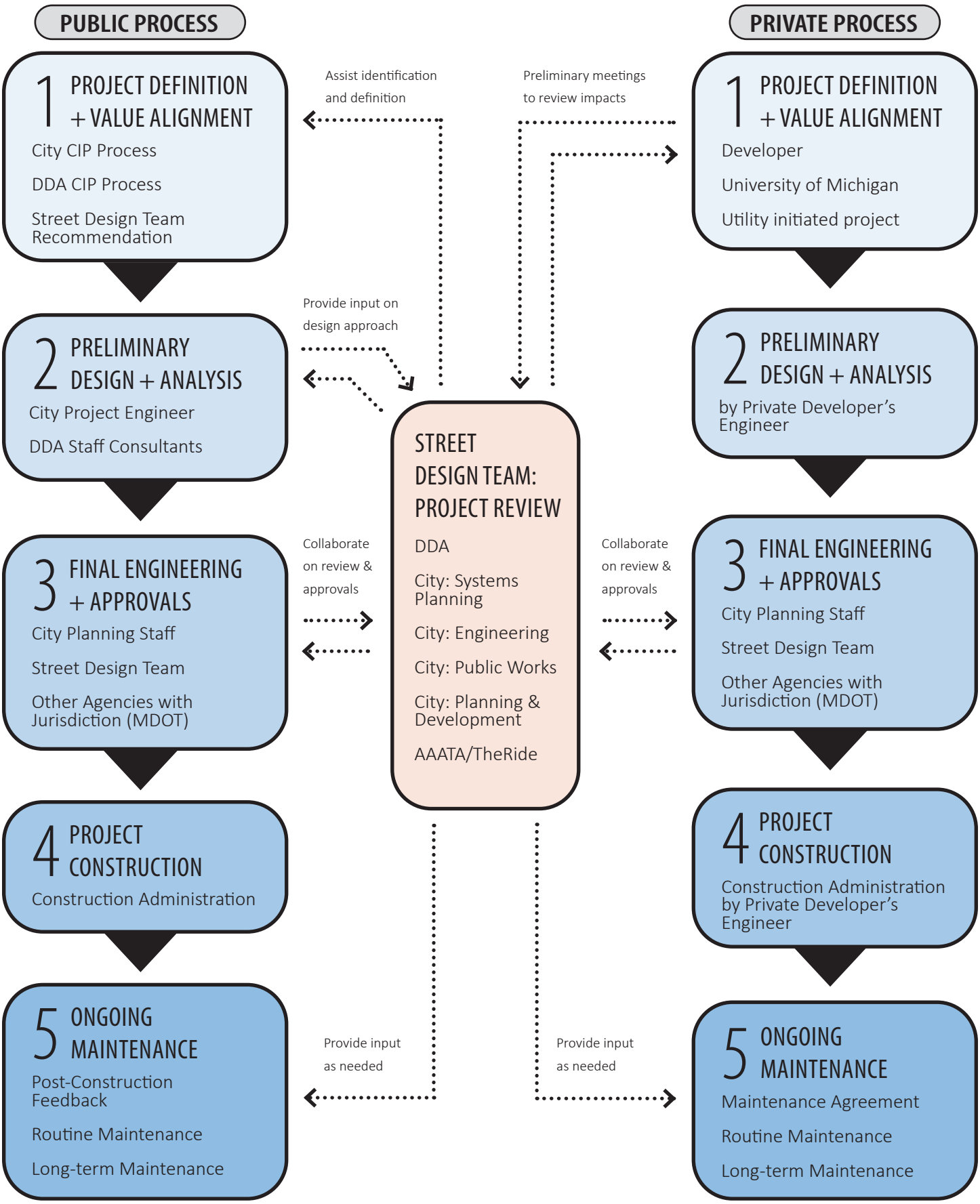
The Street Design Team is responsible for coordinating and assisting with street design and planning decisions for major street projects as well as significant maintenance activities on an as needed basis. The Street Design Team can assist project designers and engineering to verify that design decisions and allocation of uses within the right-of-way fit with the vision and goals of the Downtown Street Design Manual.

Street Design Process

Public and Private Street projects typically proceed through a five step process with input from the Street Design Team at key milestones (Figure 3.1.1). The entities responsible for executing the work associated with each step differs between Public and Private projects.

1. Project Definition + Value Alignment
2. Preliminary Design + Analysis
3. Final Engineering + Approvals
4. Project Construction
5. Ongoing Maintenance

Figure 3.1.1 - Project Street Design Process



STEP 1
PROJECT DEFINITION + VALUE ALIGNMENT

Street design projects typically initiate from one of three project types: maintenance and operations projects; capital improvement projects, or private development projects. Each of these project types has a different set of needs and opportunities that informs physical changes in the street design. Once a project is initiated, the street design process begins by developing the scope of improvements, which includes identifying specific design elements and establishing project budgets. Decisions made during the definiton and value alignment process should align with the seven values, as described in Chapter 01.

- **Maintenance and Operations Projects:**
  - » These projects arise from routine maintenance needs, safety interventions and/or operational changes. Maintenance and operations projects are the majority of street work done in any city.
  - » These projects are generally limited in scale, have relatively small budgets, and generally do not involve major construction.
  - » Despite these limitations, simple street improvements, such as pavement markings, can often be incorporated at relatively little additional cost.
  - » Projects of this type may include, but are not limited to: street resurfacing, pavement markings/re-striping, landscaping, street tree plantings, signage/ signalization changes, street furnishings, sidewalk repairs, curb repairs.
- **Capital Improvement Projects:**
  - » Capital projects typically provide the most profound change in street environment and function, but are also less frequent. Unlike maintenance or operations projects, capital improvements projects typically encompass a large segment of the street or district.
  - » Requirement for a Capital Improvement Plan (CIP) is per the State Planning Enabling Act. Projects supported by local public dollars must be relflected in the City CIP. In 2013, City of Ann Arbor ordinance was changed to reinforce that DDA projects must be in the City CIP. This includes infrastructure projects over $100,000 and studies that will inform infrastructure improvements over $50,000.
  - » The CIP is intended to be used as a tool to implement the City's Comprehensive Plan goals and assist in the City's financial planning. Staff planning meetings to define projects and coordinate scope and schedules take place annually August – November. The CIP outlines public expenditures for a six-year period.
  - » Designs evolve through an intensive public engagement process and broad coordination across city units. Given the typically higher cost and greater complexity of these projects, capital projects may take several months to years to be fully planned, designed, and implemented.
  - » All street design projects should coordinate with other street/road or major construction projects to ensure there are no major issues due to concurrent construction activities, such as simultaneous disruptions to traffic patterns. Whenever possible, capital projects should be phased to coincide with maintenance needs.
  - » Projects of this type may include, but are not limited to: full street reconstruction, major utility improvements (e.g. sanitary, storm, or water

Table 3.1.1 - Street Design Elements Common to Private Projects

Section 4.1 - Pedestrian	Street Zone
Sidewalks + Pedestrian Area	Pedestrian Area
Curb Ramps	Intersections
Benches & Seating	Amenity Zone

Section 4.2 - Commercial Support	Street Zone
On-Street Parking	Curbside Zone
Café Seating & Outdoor Retailing	Amenity/Frontage
Loading Zones	Curbside Zone
Short-Term Parking & Drop-Off Zones	Curbside Zone
Alleys	-

Section 4.3 - Bicycle	Street Zone
Bicycle Parking	Amenity Zone
Bike Corral	Curbside Zone

Section 4.5 - Vehicle	Street Zone
Driveways & Curb-Cuts	Pedestrian Area
Fire Access Lane	Roadway Zone

Section 4.6 - Infrastructure & Landscape	Street Zone
Street Lighting	Amenity/Frontage
Street Trees	Amenity Zone
Stormwater Management	Amenity Zone
Lawn Extensions	Amenity Zone
Landscape Planters	Amenity Zone
Utilities	Amenity Zone

main replacement or upsizing), comprehensive streetscaping (including new lighting and amenities), lane and/or curb reconfigurations.

- **Private Development Projects:**
  - » All private development projects that undergo site plan review must conform to the Downtown Street Design Manual. The exceptions to this are 1) A remodel/addition that does not impact the public ROW through construction or equipment staging and 2) Where a capital project is proposed and budgeted in the near future..
  - » When planned, coordinated and reviewed properly, these provide yet another opportunity to ensure that improvements are made in alignment with community goals. While improvements may occur in only segments of a block, they contribute to the incremental transformation of the street.
  - » Projects of this type may include, but are not limited to: repair or reconstruction of the sidewalk and amenity zones, changes to curbs or curb-cuts, utility infrastructure, landscaping, lighting, street furnishings, repair or reconstruction of the roadway, sidewalk, parking and/or lane closures for construction.
  - » Table 3.1.1 lists Design Elements most commonly related to private development projects. Refer to Table 3.1.1 in Section 3.1- Street Typologies, for the full listing of design elements and their priority.

STEP 2
PRELIMINARY DESIGN + ANALYSIS

Analyzing the existing conditions within a project area allows for an understanding of the necessary considerations to create a successful street design. Typical analyses include multi-modal data collection, bicycle and pedestrian crash data review, sidewalk occupancy permits, parking and loading conditions, non-motorized network review, and community plans (such as the City of Ann Arbor's Transportation Plan, various non-motorized plans).

Findings from the analysis leads into Preliminary Design, which is an exercise in balancing priorities with trade-offs, and aligning desired outcomes with community values. The high activity paired with constrained right-of-way width of downtown streets make it nearly impossible to include every element, every time, everywhere. The street typology approach, presented in Chapter 2, recognizes that all street user needs must be met by the system and district as whole, but individual streets may emphasize certain uses over others as a necessary design balance. Examples of trade-offs include: choices between wider sidewalks or a dedicated turn lane; meeting the needs of trees or the need of transit; parklets or parking; bicycles or bus ways; vehicle volumes or sidewalk vitality.

This manual strives to ensure that street improvements serve the context of adjacent uses and improve access in alignment with city goals. The guidelines of this manual will increase predictability for all users such as: public agencies, private developers, utilities, or members of the public.





To use this manual in street design and decision making, use the following steps:

1. Determine the applicable street type for the project (see Street Framework- Section 3.1).
    - » Understanding the context of the street and its critical role in both the transportation system and development plan of Ann Arbor.
2. Identify required and appropriate street design elements for the project (see Design Element prioritization in Section 3.1).
3. Follow the guidance of Section 3.4, Street Corridor Assembly to determine typical road cross-sections and layouts.
    - » Identifying conflicts between elements and street dimensions.
    - » Exploring modifications to sidewalk width, space allocation, and other alternatives to meet the greatest number of needs.
    - » Evaluate against the performance criteria for both location and function based on the street's typology (see Frontage Context- Section 3.2, and Functional Emphasis - Section 3.3).
    - » Selecting a preferred alternative through the review process outlined in section 2.1.
4. Engage the public and stakeholders to address user needs, such as equity opportunities, safety concerns, and desired uses for the streets.
5. Design and locate specific individual design elements as detailed in Chapter 4.

STEP 3
FINAL ENGINEERING + APPROVALS

Projects will be reviewed to ensure they are both compliant with all city standards and advancing the objectives of this manual. The origin of project identification determines the method of project review.

- **Projects originating from a maintenance, safety or operational need** will generally be identified and prioritized by maintenance and operations staff, which will coordinate with the Street Design Team for opportunities to further align with the manual/meet the goals of the manual.
- **Capital projects** will be reviewed and refined through the Street Design Team which includes both City and DDA staff who consult with maintenance and operations units.
- **Private development projects**:
    - » Project will be reviewed by the City's site plan review staff.
    - » City staff will consult with the Street Design Team as needed.
    - » Project owners are responsible for identifying and following the Downtown Street Design Manual requirements as part of the site plan review process.

After reviews and approvals, projects proceed to complete the Final Engineering. During this step the project designers create Construction Documents for contractors to execute the work.



STEP 4
PROJECT CONSTRUCTION

Successful street projects require significant coordination during the construction phase to ensure that critical services and access are maintained during construction, and that businesses, residents, and other users along the affected corridor are well-informed about construction sequence and activities.

Construction should be coordinated in close collaboration with the project owner, designers/engineers, construction contractors, DDA staff, and city staff. The following types of activities are essential to clarify in advance and during construction:

Construction Planning & Phasing:

Consider the following elements as you develop the MOT, construction phasing, and finalize construction documents. Begin 6-12 months prior to construction:

- Changes in traffic patterns for pedestrians, bikes, and vehicles. Maintenance of Traffic (MOT) plans should be reviewed to ensure critical access. Considerations include construction detouring, decisions about closing full blocks or partial blocks, and timing of closing intersections.
- Coordination around special events, especially the Ann Arbor Art Fair, may require a pause in construction activities or a postponement of street / sidewalk closures. Construction is typically halted in the downtown during Art Fair, regardless of the project location.
- Identify parking, loading, and curbside uses and where impacts to those can be mitigated. Work with DDA parking operator and the City Signs & Signals Unit to create temporary curb-side use zones as needed. Traffic Control Orders (TCOs) may be required if curb side uses are changing. Account for access to solid waste containers and collection operations.
- Determine allowed staging areas and impacts outside of the direct construction zone.
- Coordination of changes to intersection controls (i.e. converting signals to all-way stops). A 90-day flashed red period is required when converting to an all-way stop.
- Coordination with utility providers (DTE, Telcomm) to coordinate any relocations/adjustments of utility lines.
- Coordination with building owners where underground sidewalk vaults may be present and impacted by construction activities.

Ongoing Construction Coordination & Communications

Begin 6-12 weeks ahead of construction:

- Maintain access to the front door of business and avoid closing sidewalks outside of the most critical construction activities (i.e. replacement of sidewalks or when hazardous conditions are present). Coordinate provisions for signage and wayfinding to direct people to businesses.
- Communication protocol for reaching out to businesses, residents, and property owners along the corridor to answer questions, respond to issues, and inform them of upcoming disruptions to traffic patterns.
- Public outreach and communication about the status of construction, schedule, and disruptions due to construction activities.

STEP 5
ONGOING MAINTENANCE + PERFORMANCE EVALUATION

Ongong maintenance after the construction of a project is essential to the performance and longevity of the street. No matter how well the street is designed, routine maintenance, such as snow and ice removal, is critical to ensure the safety and performance of streets.

Monitoring and measurement are critical components of street design. Follow-up monitoring is important not only for verifying that street designs function consistent with their design but also as a basis for informing future design and planning decisions.

Performance metrics should be identified during the initial project definition process and should relate to the purpose of the project and specific desired outcomes. Methods for measurement should be clearly defined. Some metrics may be quantitative (e.g. number of cyclists, valuation of building permits, etc.) while others may be qualitative (e.g. consumer preference surveys, intercept surveys, etc.). Baseline data should be recorded prior to implementation and an appropriate period(s) for post-assessment defined.

This data is invaluable in estimating the value of improvements and guiding future similar projects.

Common challenges faced in measurement and monitoring can be overcome by:

- **Building capacity data collection.** Public agencies do a lot with limited resources. Post-project data collection is often a task that is sacrificed among other needs and demands. When data must be collected from multiple sources (e.g. sales tax information, crash data, and consumer preferences) it makes the task of data collection even more complicated and subject to delay. Create a role for project data collection among City and/or DDA staff to help alleviate these challenges.
- **Establish a system for data management.** Even if data is collected, it may be retained by individual project managers or units without institutional knowledge or the ability to access for future projects. Create a standard set of spreadsheets for projects that can be tailored to fit specific project needs but still allow for equivalent comparisons. Ensure that data is distributed back to City and/or DDA staff for collection.
- **Define time-lines and methods for data collection** – For two data points to be compared, they must be collected in the same way both times. However, given the long lag time between project identification (when baseline measurement should occur) and project delivery (when post assessment should occur) it is common for staff to change or methods to be overlooked. As part of creating a system for data management, create details time lines and procedures for monitoring.
    - » The DDA's Downtown Benchmarking project could be used as a model for monitoring and measurement.



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3.2
DESIGN STRATEGIES

Designing streets is a complicated process and must balance the need of many different street users across a diversity of land use contexts. As public or private development projects are identified, designed, and reviewed, a number of key strategies can be utilized to aid the design process and make informed, holistic decisions regarding the future of downtown streets.

1. **Be honest about trade-offs.** We are so used to thinking about streets as places to move cars that we often fail to notice when the trade-offs we are negotiating are only between the other elements. We often make tough choices between quality pedestrian facilities, trees, parking/loading, bicycle facilities or transit accommodation while failing to scrutinize vehicle demands to the same extent. While vehicles are an important and even vital user of downtown streets, giving equal consideration to each street user type will lead to a more balanced network and better streets overall.

2. **Integrate street and urban design.** The best streets compliment what is on the pavement and what is along the block. High vehicle volume is kept out of quiet neighborhoods, adequate lighting is provided on heavy pedestrian streets, large canopy trees are provided on high speed streets, crosswalks are on all streets, on-street parking is available for storefront commercial, driveways are restricted along destination commercial streets. Street and urban design must compliment one another.

3. **Strive for consistency.** Consistency in facility design increases the legibility of a street and makes it more predictable and inviting for travelers. However, the context of a street commonly changes as it transitions from one area of downtown to another. The street design may also change along the corridor. If implementation is incremental, as through maintenance or development projects, ensure transitions are logical and intuitive.

4. **Understand the circulation network.** Streets do not exist in isolation. They are part of networks, such as stormwater drainage, bus routes, parking/loading, Shopping District, bicycle routes. If a particular element does not “fit” on a particular street, perhaps it can be moved to another. Conversely, some elements are necessary to complete a network. Working in multiple scales helps to understand a street and its network.

5. **Consider maintenance.** Each of the elements includes consideration of maintenance, but good street design must consider the maintenance of the total street design as a whole. Does it introduce any complications for snow removal? Will it add additional cost when the street must be repaved? How many pavement markings, signs, signals and lights are there that must be kept up? Are there opportunities for efficiencies? Are there partnerships in place to maintain landscaping, art or other unique elements?

   Maintenance Tasks include: snow clearing, sweeping, waste management, repairs, patching, utility maintenance, cleanouts, landscape care, furnishings upkeep, pavement markings repainting.

6. **Phase in funding.** Streets are expensive and budgets are limited, but with strategic phasing, collaboration, and creative approaches to design, budget constraints do not have to preclude street improvements. Pavement markings and non-permanent fixtures (e.g. bike corrals, planters, and rubber curbing) dramatically change the character of a street quickly and at relatively low cost. More permanent improvements can be phased over time as development projects come on line, utility upgrades are conducted, or routine maintenance projects advance.

7. **Try before you buy.** Pilots, temporary installations, are a great way to test street concepts and evaluate the trade-offs empirically rather than theoretically. Most pilots can be safely and attractively implemented with minimal cost. Additionally, pilots can generate and engender positive public outreach. Keys to a successful pilot include:

   » **Clear communication.** Make sure all stakeholders and the public know about the pilot, its objectives, its duration, and who to contact with any comments or concerns. Provide stakeholders and the public with the post-pilot findings and recommendations.

   » **Defined measures for evaluation.** A pilot is a test of a concept and as such requires evaluation. Relate evaluation measure to the objectives for the street as defined in the Street Type section. Establish clear methodology and accountability for data collection prior to the pilot.

   » **Finite duration.** Pilots are temporary and may only last for a couple of days over a single weekend or for months. Communicate to all stakeholders the duration of the pilot and ensure the pilot does not exceed this period, unless it is made permanent.

   Potential issue: The limited timeframe is a potential problem with pilot studies, as some use scenarios may not be tested. For example, a temporary installation will not be tested in all seasons and may miss special events.

8. **Design for future adaptation.** Wherever possible, streets should be designed with flexibility and adaptability in mind. Where safety, accessibility, and other project goals can be achieved, minimizing permanent improvements and/or designing flexible spaces that respond to changing needs overtime can reduce infrastructure costs and allow for greater resilience.

9. **Control traffic stress based on the target users.** The amount of traffic stress influences the way people use streets and the modes by which they travel. Streets should be designed to control traffic stress for the target users. Refer to Table 2.1.1 and Section 2.1 for information on All-Ages & Abilities Street Design.







3.3
CORRIDOR ASSEMBLY GUIDE

This Corridor Assembly Guide provides guidance for establishing overall cross-section widths for a street in the downtown in consideration of the pedestrian area, curbside lanes, bike facilities, and roadway elements. Chapter 4 provides additional detailed guidance for design elements that should also be referenced and used.



STREETS AND RIGHT-OF-WAY WIDTH

Ann Arbor Downtown street rights-of-way are typically 66 feet wide, although some corridors are wider. Right-of-way width should be verified at the start of project through a survey. GIS or property records may used at the preliminary design stages.

Critical Elements

Streets in the downtown should be designed with the following minimum characteristics:

- One vehicle travel lane in each direction of travel. One-way streets currently exist that may deviate from this pattern. Creation of one-way streets should be avoided.
- Curbing to separate the roadway and vehicle space from pedestrian traffic.
- Continuous, ADA accessible sidewalks on both sides of the street.
- Additional street elements affecting overall assembly may include: dedicated bike lanes, on-street parking (and loading) zones, amenity zones, additional vehicle lanes (left/right turn lanes), medians, and landscaped areas.

KEY TERMS

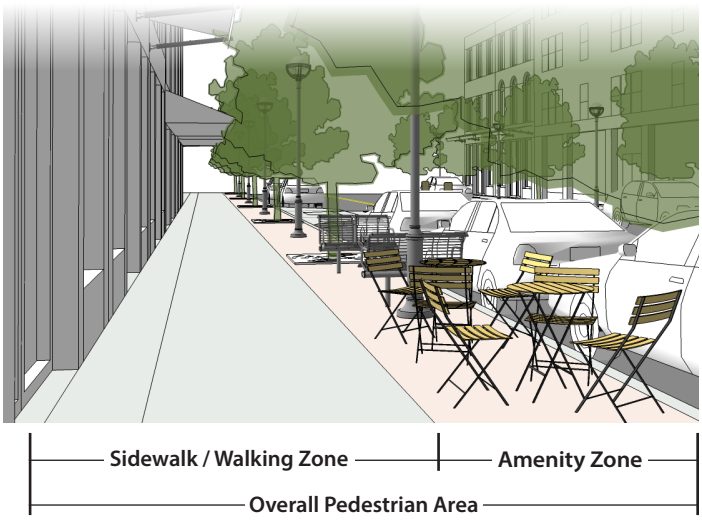
- **Standard Dimensions:** The starting point for roadway assembly based on preferred dimensions.
- **Truck / Bus Routes:** Where there is frequent bus / truck traffic additional widths may be provided where challenges are anticipated.
- **Constrained Conditions:** Applies to lower volume, secondary streets where existing roadway space is limited and standard dimensions cannot be achieved.
- **Face of Curb:** Line where the curb rises at a near-vertical angle from the roadway.
- **Edge of Gutter:** Line where the gutter (concrete) transitions into the asphalt area of the roadway. Concrete roadways may be designed with integral gutters.
- **Center of Pavement Marking:** Line along which pavement markings are centered, whether it is a 4" or 6" marking.

PEDESTRIAN AREA

Table 3.1.1	Min. Overall Pedestrian Area Width		Sidewalk / Walking Zone	Amenity Zone
	Next to curbside lane or bikeway	Next to vehicle travel lane	Minimum Standard	Minimum Standard
Destination Commercial	16'	19'	8'	8'
Commercial	14'	19'	6'	8'
Mixed	14'	19'	6'	8'
Civic / University	14'	19'	8'	6'
Near Neighborhood	12'	19'	5'	7'

- The width of the clear sidewalk zone should be driven based on the street typology as well as anticipated pedestrian volumes, as shown in Table 3.1.1.
- The sidewalk clear zone shall be located adjacent to the outside edge of the right-of-way / property line and be consistent along the length of the block.
- The overall width of the pedestrian zone (sidewalk to the road curb) should provide adequate space for the sidewalk and amenity zone uses while providing separation from the roadway. A wider pedestrian area is appropriate when directly adjacent to the vehicle travel lane. The desired overall width of the pedestrian area in these contexts is 19 feet where possible.
- The minimum sidewalk and amenity zone widths may be modified at the discretion of city and DDA staff in cases where they are in conflict with zoning setback lines and/or maintaining a consistent street wall.

Figure 3.3.1 - Sidewalks

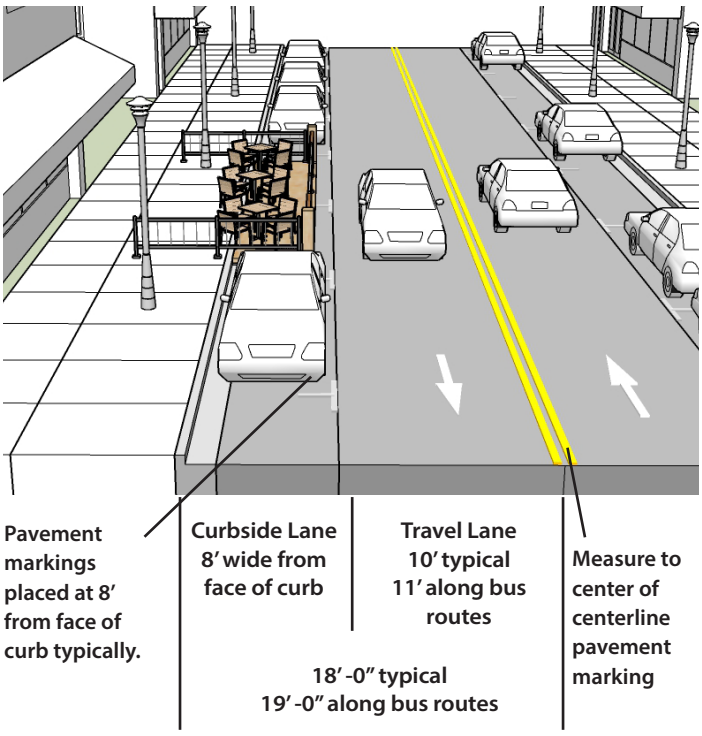


TRAVEL LANES AND CURBSIDE LANES

Table 3.1.2	Standard	On Bus / Truck Routes	Constrained Condition	Point of Measurement
Travel Lane Width (1) (including dedicated turn lanes)	10’	11’	10’	Center of defining pavement markings and/or to the edge of asphalt.
Curbside Lane Width (2)	8’	8’	7’	Face of curb to center of curbside pavement marking
Combined Travel + Curbside Width (3)	18’	19’	17’	(see above)
Curb & Gutter Width (4)	2’ (5)	2’	0.5-1.5’	Back of curb to the edge of gutter (aka “edge of metal” line.

1. When a travel lane is adjacent to a curb and no gutter is present, widen travel lane by 1-foot.
2. Wider curbside lanes may be used where there is excess space in the roadway and/or where larger commercial vehicle loading is anticipated.
3. Where parking tighter to the curb is desired, parking lane width can be reduced to 7-feet with the adjacent travel lane widened by the corresponding amount.
4. Constrained locations, with approval, may utilize 12” wide gutters and/or straight curb sections without a gutter with correspondingly smaller drainage inlet structures.
5. For curbless street designs, 2-feet wide valley gutters should be used.

Figure 3.3.2 - Curbside Lanes

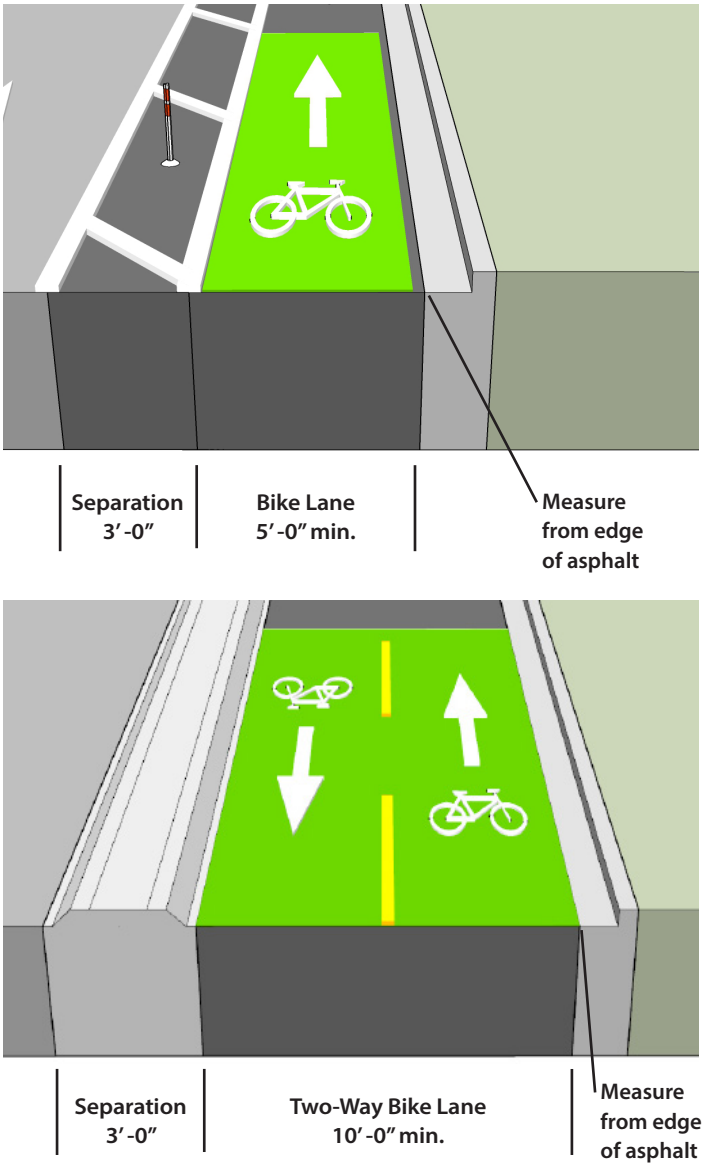


DEDICATED BIKE FACILITIES

Table 3.1.3	Standard	Maximum	Constrained Condition	Point of Measurement
Bike Lane Width (1, 2, 3) (for 1-way bike lanes or as a part of 2-way bikeway)	5’	8’ (4)	4’	Center of defining pavement markings and/or to the edge of asphalt.
Bike Buffer - Painted (5)	3’ (6)	10’+ (7)	1’	Center of defining pavement markings.
Bike Buffer - Curbed Median (or other vertical treatment is used)	3’ (8)	10’+	2’ (9)	Edge to edge of the curbed median (including any integral gutters).

1. Lane widths should not include the width of adjacent gutters. The presence of gutters can provide additional flexibility and clearance from adjacent obstructions (e.g. vertical curbs)
2. When directly adjacent to a curb, provide an additional 1’ of bike lane width for clearance from curb
3. Bike lanes adjacent to parking (without a buffer) should be widened by at least 1’ if space allows.
4. 7’ to 8’ wide bike lanes can allow for passing within the bike lane itself.
5. Painted buffers may incorporate surface mounted vertical delineator posts to create a seperated bike faciliity.
6. When on-street parking is present, buffers should be prioritized between the bike lane and parking to provide separation from the door zone. Width should be at least 3’.
7. If a wide (10’+) buffer may result, consider incorporating other roadway uses (e.g. curbside lane) and/or wider bicycle lanes.
8. Buffers should wide enough to accomodate any needed signage without signage enroaching outside of the raised portion of the buffer.
9. Where buffers must accommodate waste carts, the flat area on top of the buffer should be least 2’-6” wide.

Figure 3.3.3 - Bike Lane Configuration Preferred Widths



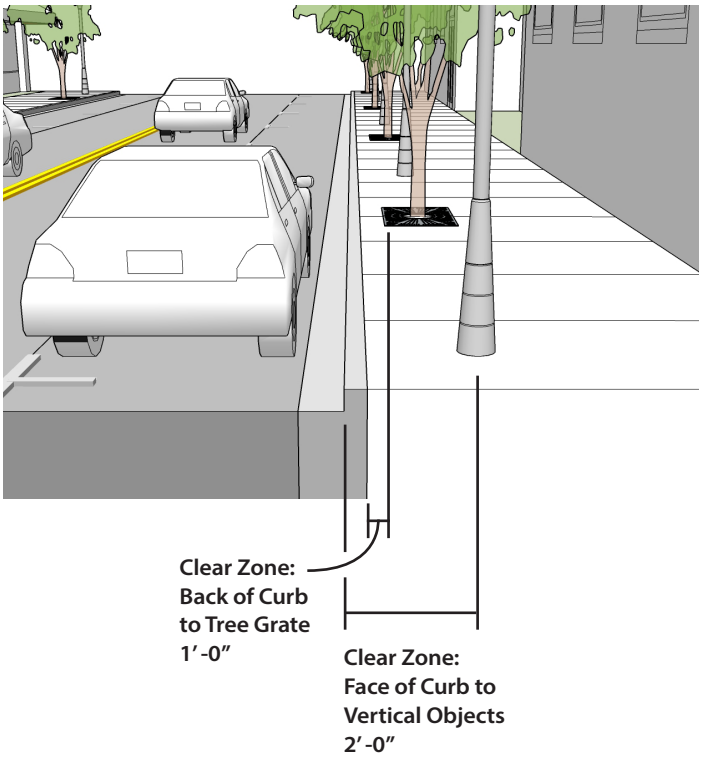
OTHER DETAILS / ITEMS

- **Excess Roadway Width**
  - » If there is excess roadway width, look to incorporate on-street bike lanes and/or widen and buffer existing bicycle lanes further.
  - » If roadway curbs are scoped to be relocated, excess width can be allocated to the pedestrian area.
  - » If providing or widening bicycle facilities is not desired, curbside lanes may be widened.
  - » If no curbside lanes are present or they would be excessively wide (10-feet or more in width) consider zebra striping along the curb edge to maintain narrower lanes or incorporate a roadway median.
- **Clearance Behind the Curb**
  - » The center of parking meter posts, street lights, signage, and other vertical objectives should be at least 2’ from the back of curb.
  - » Tree grates should be placed at least 1’ away from the back curb.

AMENITY PLACEMENT & CLEAR ZONES

- Tree grates should be offset 1’-0” away from the back of curb at a minimum to allow for proper mounting of tree grates and clearance from the roadway and opening doors.
- Signs, parking meter posts, street lights, and other vertical objects must be at least 2’-0” away from the face of the street curb.

Figure 3.3.4 - Amenity Placement & Clear Zones



PROJECT PLANNING & DESIGN CHECK-LIST

This check-list should be utilized throughout the street design process- including during project scoping and budgeting- to ensure that goals, values, and critical needs are addressed and fully considered. Work through the check-list and answer each question to the extent possible, and note which questions require follow-up or should be addressed a later stage in the design process.

Roadway Uses

- □ Who are the primary roadway users?
- □ Is the street a high pedestrian traffic area? Are there gaps in the sidewalk network?
- □ Are there businesses along the street that want to conduct commercial activity on the sidewalk (e.g. outdoor dining or retailing).
- □ Is the street part of the city's non-motorized network? Is it a target for a low-stress connection?
- □ Does the street carry or allow truck traffic?
- □ Does the street have designated bus routes? Are buses turning onto or off of the roadway?
- □ Is the street part of an emergency access route or snow plow route?
- □ Is the street a non-local right-of-way (i.e. MDOT)?
- □ Is the road currently or anticipated to be used for special events, street closures, festivals, etc.?

Intersection Controls

- □ How is the intersection currently controlled?
- □ Are there improvements that can be made to signalization to improve safety (e.g. countdown timers, leading pedestrian intervals, protected left turns)
- □ Should the intersection be evaluated for conversion from a signalized to a stop-controlled intersection?
- □ Are there any sight distance and/or visibility concerns at the intersection? What, if any, obstructions are there to clear visibility?
- □ Does signal infrastructure need to be upgraded, replaced, or modified?
- □ Does the project include any railroad crossings?

Roadway Operations & Safety

- □ Are there areas of excess pavement (e.g. overly wide travel lanes, over-sized turning areas)?
- □ Can excess pavement areas be repurposed (e.g. converted to additional sidewalk space)?
- □ Are there safety issues and concerns along the corridor? What is the nature of these concerns and what are possible mitigation measures?
- □ Are additional turn lanes warranted and/or is there an opportunity to repurpose turn lanes?
- □ Is there an opportunity to advance a road diet or lane narrowing project?
- □ How does traffic flow, generally, through intersections? Is there evidence for frequent disruptive backups?
- □ Do sidewalk curb ramps meet ADA requirements?
- □ Does the sidewalk width meet ADA requirements?

Bike Facility Design

- □ What is the target level of comfort / accessibility for potential bike facilities?
- □ Is a separated facility desired (2-way bikeway or separated 1-way bike lanes?)
- □ What intersection controls will be needed (2-stage turn queues, bike boxes, bike signals, etc.)
- □ What type of maintenance resources as available for maintaining separated facilities?
- □ Are special accommodations for curbside uses next to bike facilities needed (e.g. transit stop access, loading zones, etc.)
- □ Is there adequate bike parking? Is there more bike parking needed?
- □ Are there micro-mobility and/or bike share facilities that need to be accommodated?
- □ Does parking need to be removed for the bike facility?
- □ Does this project require City Council approval?

Curbside Uses & Management

- □ How are parking zones being used? What type of metered/non-metered spaces exist?
- □ Is there adequate commercial loading/unloading zones?
- □ Is there evidence of regular illegal parking/loading (e.g. encroachment into bikeways, parking on the pedestrian zone, blocking travel lanes)
- □ Are accessible parking spaces available nearby or needed along the corridor?
- □ Where is waste management occurring (e.g. picking up trash, recycling, and compost bins)? What types of waste management are occurring (e.g. street pedestrian receptacles, private owner's curbside carts)? What is the frequency of pick up? Do bins block the sidewalk or other roadway use zones?
- □ Are the amenity zone materials suitable given curb side uses (e.g. is there lawn used in areas with frequent curbside foot traffic).
- □ Is there a need for passenger pick-up / drop-off, or short-term parking?
- □ Is there a desire or need for outdoor seating? How frequent?

Materials

- □ What is the condition of the roadway paving? Can it accommodate new pavement markings?
- □ What resurfacing treatments/methods would be used to restore the pavement condition to an acceptable level?
- □ Are there special existing materials (paving, historic curbs, markers, plagues, etc.) that need to be maintained, salvaged, or re-installed?

Lighting & Electrical

- □ Is the project in a location where more consistent and/or brighter pedestrian-level lighting needed?
- □ Can existing lighting circuits be used for supplying power? Are new electrical supply connections needed?
- □ Is the project identified by the city's IT infrastructure plan? Does IT conduit need to be provided?
- □ What overhead utilities (power lines, telecom, etc.) are present? Does the project provide an opportunity to bury overhead lines?
- □ Are there opportunities and/or a desire for specialty lighting?

Utilities: Water, Hydrants, Sanitary

- □ What is the condition of water mains?
- □ Do water mains need to be upsized and/or is there an opportunity to upsize?
- □ Do existing fire hydrants provide proper coverage? Are new fire hydrants needed? How do these impact the layout and/or curb side uses?
- □ Are there improvements that need to be made to the sanitary sewer infrastructure?

Green Infrastructure & Stormwater

- □ Will the project be affected by the city's Green Streets Policy (i.e. is the roadway being fully reconstructed?)?
- □ What is the target level of stormwater management that is needed? What level is desired and what was budgeted?
- □ Are there improvements that need to be made to the stormwater infrastructure (catch basins, manholes, pipes, etc)?
- □ Is the project in the floodplain? Will it require a floodplain permit through EGLE?
- □ What type of soils are present? What is the infiltration rate?
- □ Is the project an opportunity for above ground, below ground, or both types of green infrastructure?
- □ What is the condition and extent of tree canopy along the corridor?
- □ Are there trees that will be impacted and/or removed by construction? Are any of these landmark or otherwise protected trees?
- □ What sizes and types of new street trees are suitable for the project?

Signage, Wayfinding, and Public Art

- □ Is there a desire for banner poles and banners to be used along the corridor?
- □ Is there a need for banners to stretch across the street?
- □ Is there special signage (beyond required regulatory signage) that is needed or desired?
- □ Are there special wayfinding signs that are needed?
- □ Is there existing public artwork on the corridor that must be protected and/or relocated?
- □ Are there opportunities for new public art installations to be explored?
- □ Has the Public Art Commission identified the project for the inclusion of public art?

Implementation

- □ What cost share agreements are needed with the City of Ann Arbor or other agencies?
- □ Does the project connect to affordable housing opportunity sites?
- □ How does the project align with other CIP projects on the corridor or on nearby streets?
- □ What TCO (Traffic Control Orders) will be needed?
- □ How will the project affect adjacent properties? What construction easements or grading permits are needed?
- □ What is the anticipated construction phasing and timeline?
- □ What property, business owners, and residents need to be involved in the process (planning, design, review, implementation correspondence?)

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SIDEWALK / AMENITY / FRONTAGE ZONE

SIDEWALKS & PEDESTRIANS AREAS

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	✓			
Transit		✓	✓	✓	
Bicycle		✓	✓		✓
Balanced		✓	✓	✓	✓

DESCRIPTION & INTENT

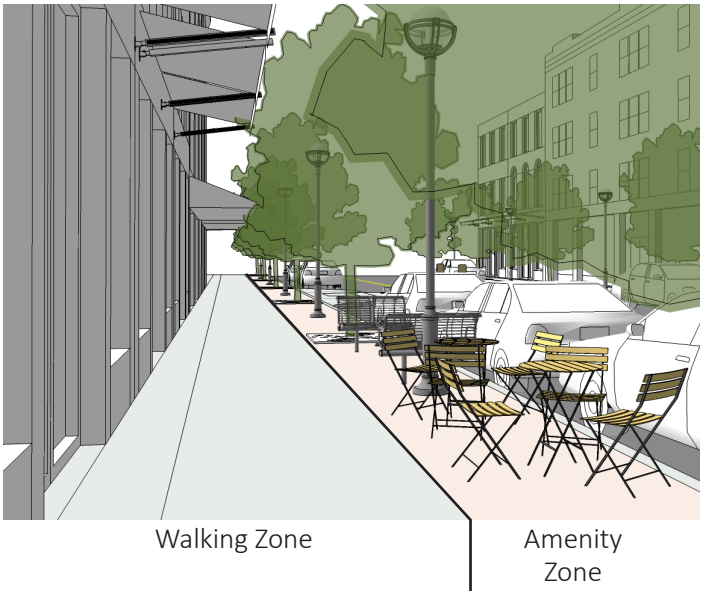
The pedestrian area is the portion of the street right-of-way set aside for use primarily by pedestrians. This area is typically from the curb edge to either the building wall or property line. The pedestrian area has two distinct zones, each running parallel to the right-of-way (figure 4.1.1):

- **Walking Zone**: This is the portion of the pedestrian area dedicated to through pedestrian travel and where sidewalks are typically located. Sidewalk refers specifically to the paved, continuous, walking area for use by pedestrians. Typically the walking zone and the sidewalk are one and the same.
- **Amenity Zone**: This area is located adjacent to the street curb. It is a location for street fixtures such as street lights, street trees, parking meters, bicycle racks, newspaper boxes, bus stops and shelters, signage, signal poles, and landscaping. Cafe seating is often located in the Amenity Zone. The Amenity Zone is often used for depositing snow cleared from roadways during winter months. The Amenity Zone is the point of transfer between pedestrians and transit vehicles, bicycles parking at racks, or autos parked at the curb.

Pedestrian areas should be inviting places. Pedestrian areas are usually set several inches above roadway grade and have a curb designed to deflect vehicles back into the vehicular travel way. Adequate light and shade create a more comfortable pedestrian environment. Ground floor activities, transparent windows ,and frequent doors promote observation of and interaction with the sidewalk giving the perception of many “eyes on the street” which, in turn, enhances the sense of safety.

Sidewalks, the paved areas designed for through pedestrian movement, are used by people of all ages and abilities and for a variety of purposes. Well-designed sidewalks support and enable walking as an appealing form of urban transportation. Sidewalks must, at a minimum, provide a clear, unobstructed pathway sufficient to accommodate persons with disabilities. The best sidewalk design is wide enough to enable small groups to walk side by side engaging in conversation and pass oncoming pedestrians without significant conflict. Walking in a downtown is inherently a social activity and adequate sidewalk width supports this objective.

Figure 4.1.1 - Pedestrian Areas



USE & APPLICATION

Location

- In a downtown area, sidewalks must be provided on both sides of every street, regardless of type or transportation priority. Few conditions and justifications warrant the omission of a sidewalk.
- Pedestrian areas have a total assumed width and an actual effective width. Typically the total assumed width is the width of the paved portion between the curb and property line.
  - » The effective width, however, is the width of the sidewalk (walking zone) itself. The effective width is typically calculated by drawing two lines. The first line is drawn straight, parallel to the curb, from the center-most fixed objects or occupied areas (e.g. cafe seating or retail displays) down the length of the block. The second line is drawn at the building face or inside edge of the Walking Zone.
- Pedestrians are the priority users of the sidewalk. While bicycling on the sidewalk is not prohibited in Ann Arbor, it should largely be discouraged for all but the most vulnerable cyclists. When cycling on the sidewalk, cyclists must travel at a very low rate of speed, provide pedestrians a comfortable buffer, always yield to pedestrians, and call out or signal that they are approaching.
- Sidewalks should not be used for parking or travel by any motorized vehicle except assistance devices for persons with disabilities.



Policy References

- The City of Ann Arbor Comprehensive Transportation Plan (2021) provides guidance on policies, programs, and priority investments.
- The City of Ann Arbor Non-Motorized Transportation Plan (2013 Update) provides policy for pedestrian accommodation and level of comfort evaluation.
- The Downtown Ann Arbor Design Guidelines (2011) provide guidance on ground floor design where buildings engage the sidewalk.
- The Recommended Vision & Policy Framework for Downtown Ann Arbor (2005) provides urban design guidance to improve the pedestrian experience in downtown.
- Sidewalk occupancy permits typically require maintaining a 6-foot wide clear walking area to accommodate pedestrian traffic. The required clear width may be wider for some street types.

DESIGN & OPERATIONS

Design Requirements

- **Continuous**: Sidewalks shall be continuous throughout downtown, connecting to one another via well marked crosswalks with curb ramps.
- **Sidewalk Width**: Sidewalks shall have a minimum clear, unobstructed Walking Zone width as indicated in Table 4.1.1A.
- **Height Clearance**: Objects overhanging the sidewalk, such as signs, banners, planter boxes or baskets, or other features shall provide at least 7.5 feet of clear vertical height.
  - » City and building codes may require additional overhead clearances.
- **Materials**: The sidewalk shall be paved concrete, 6 inches thick or thicker where vehicles may encroach (such as at driveways or alley ways). The sidewalk must be smooth, stable, non slippery, and free from tripping hazards. Materials may vary in the Amenity Zone. Acceptable materials include brick, concrete, neither stamped nor stained, or landscape. Any pavers used in the Amenity Zone must also be non slip. See Table 4.1.1B.
- **Separation**: Pedestrian areas shall be separated from the vehicular travel way via a raised curb. Exceptions may occur where the street is specifically designed to share space freely between all street users including vehicles and pedestrians.
- **Lighting**: Pedestrian areas shall be well lit, preferably with pedestrian-scaled lighting rather than relying on ambient light from roadway lighting systems or building windows. Reliance on privately owned buildings to light the sidewalk via building-mounted lights is not a desirable alternative to pedestrian lighting. *See Lighting Section for more details*.
- **Cross-slope**: Sidewalks must have adequate cross slope to facilitate stormwater run off, but not so great as to introduce a noticeable and uncomfortable slope to sidewalk users. ADA requirements limits cross slopes to a maximum of 2%. The cross slope of the Amenity Zone shall not exceed 5%.
- **Street Tree Accommodations**: Amenity zones shall provide adequate space for street trees to provide shade and buffer for pedestrian comfort. *See Street Tree Design Element for more details.*



Table 4.1.1A	Min. Overall Pedestrian Area Width		Sidewalk / Walking Zone	Amenity Zone
	Next to Parking or Bikeway	Next to Vehicle Travel Lane	Minimum	Minimum
Destination Commercial	16’	19’	8’	8’
Commercial	14’	19’	6’	8’
Mixed	14’	19’	6’	8’
Civic / University	14’	19’	8’	6’
Near Neighborhood	12’	19’	5’	7’

Table 4.1.1B Sidewalk & Amenity Zone Materials

	Sidewalk (Walking Zone)		**Amenity Zone**	
	Standard	Optional	Standard	Optional
Destination Commercial	Concrete	Porous concrete; Special District Paving *	Concrete	Brick or precast pavers; Special District Paving *
Commercial				
Mixed				
Civic / University				
Near Neighborhood			Concrete; Lawn Strip	

- **Achieving Overall Pedestrian Area Widths:**
  - » Overall pedestrian area widths are identified in Table 4.1.1A, as measured from the outer edge of the pedestrian area to the face of the roadway curb.
  - » When streets are reconstructed and curbing is replaced, moving the curb line to achieve the minimum overall pedestrian area widths should be assessed and pursued to extent feasible. This may require narrowing and/or removal of vehicle travel lanes and the feasibility of this change may require a traffic analysis investigation.
  - » Where new development along the street is planned, buildings shall be set back from the lot line in order to achieve the minimum overall pedestrian area width. Exceptions may be granted, per city staff discretion, where changes are planned to the roadway that can achieve the minimum pedestrian area width within the roadway and/or where setting back the building face would negatively impact the overall character and consistency of the street wall.
  - » The width of the sidewalk (walking zone) should be sufficient to achieve a minimum Pedestrian Level of Service D (Figure 4.1.2) throughout most of the day. Occasionally times of Level of Service E in the densest areas is acceptable, but not desired.
  - » A wider pedestrian area is appropriate when directly adjacent to the vehicle travel lane. The desired overall width of the pedestrian area in these contexts is 19 feet where possible.
  - » Where minimum overall pedestrian area width cannot be achieved, due to (a) existing building configurations, (b) existing curb lines that cannot be relocated, or (c) limited space in the public right-of-way, the minimum sidewalk width should first be achieved and the remaining space allocated to the amenity zone.

*** Special District Paving**: Use of pre-established special district paving materials is encouraged to reinforce the identity of the Downtown Character Districts, such as historic brick materials or porous pavers that are unique to a specific district.

The Street Design Team is responsible for reviewing and approving special paving materials and details for suitability within the Character Districts.

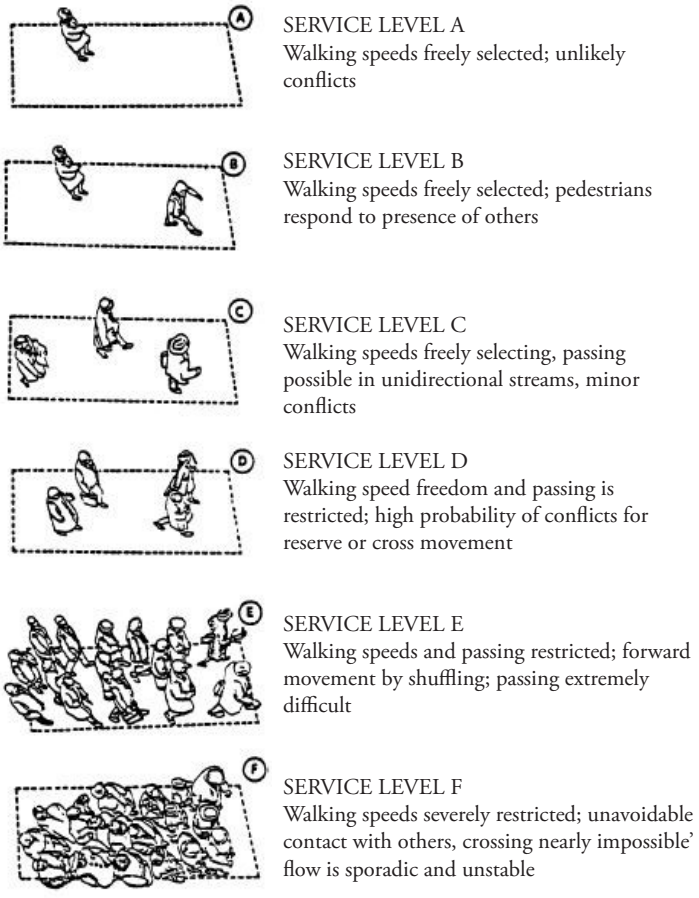


Figure 4.1.2 - Pedestrian Level of Service

- **Pedestrian Buffer**: Pedestrian areas should be adequately buffered from roadway traffic. This buffer may by provided via curbside parking, curbside bicycle facilities, or landscape strips. If landscape strips are the only buffer, the width necessary to provide pedestrian comfort on the sidewalk increases proportional to vehicle travel speeds in the roadway.
- **Construction Impacts**: Continuous pedestrian accommodation and connectivity should be maintained where feasible. Refer to applicable City and Building code documents for further information on sidewalk protections and closures.
- **Street Wall**: Where private property abuts the pedestrian area, landscaping and fencing should be kept below 42 inches to maintain the panorama of the right-of-way and enjoyment of the linear park-like character. Landscaping, fencing, and structures at the corner must preserve minimum sight distance standards.
- **Standard Paver Detail & Specification**: Pavers should be installed in accordance with the DDA's standard paver details and specifications to ensure performance and design consistency.

Utility Considerations

- Utility vaults should be avoided in the Walking and Amenity Zones. Where vaults cannot be avoided, they should be located in the Amenity Zones. Vaults should be discrete and, where possible, screened by landscaping. If a vault must be located in the Walking or Amenity Zone due to site restraints, it must be ADA compliant. The tops of vaults must be solid and cannot be slippery when wet or during cold conditions.

Sustainability Considerations

- May explore permeable sidewalk materials. Grass strips, low impact design (LID) features, or pavers in the Amenity Zone can increase permeability ans lower impervious surface. Specific maintenance plans and commitments must accompany non-standard applications.
- Sidewalk material that increases the reflectivity, and thereby lowers the urban heat island effect, may be considered and utilized.
- Amenity Zones provide opportunities for landscaping and stormwater management features. The pedestrian area may also provide space for landscaping and stormwater management where buildings are set back from the right-of-way and there is adequate space available for landscaping.
- Street trees can dramatically lower the urban heat island effect and retain stormwater.

Design References

- The City of Ann Arbor Public Services Standard Specifications, also known as the Orange Book, provides detailed requirements for materials, design, and construction of sidewalks in downtown.
- The National Association of City Transportation Officials (NACTO) Urban Street Design Guide provides guidance on urban sidewalk design to support downtowns.
- The American Association of State Highway and Transportation Officials (AASHTO) "A Policy on Geometric Design of Highways and Streets," 6th Edition, (2011), also known as the Green Book, offers detailed guidance on the appropriate placement and configuration of sidewalks.



MAINTENANCE & MANAGEMENT

General Maintenance

- Day to day sidewalk maintenance is generally the responsibility of the property owner.
- The City of Ann Arbor repairs and replaces sidewalks as a component of the sidewalk millage.
- The DDA repairs brick pavers in the Amenity Zone.

Seasonal Use & Maintenance

- **Special Uses**: Sidewalks are utilized year round. The Frontage and Amenity Zones of the sidewalk may have seasonal variations in use including outdoor cafes, parklets or platform dining, and/or bicycle corral parking in spring/summer and temporary snow storage in winter months.
- **Snow Removal**: Efficient removal of snow and ice from the sidewalk is critical. *See Ann Arbor Sidewalk Snow/ Ice Ordinance for more information.*

Special Maintenance

- Sidewalks are prone to many incidences that degrade accessibility and the quality of the walking environment. Sidewalk heaving due to tree roots and shifting sidewalk pavers, including historic bricks, are two very common special maintenance needs. Providing adequate soil volume, quality non-compacted soil, and sufficient growing space can minimize the potential for adverse impacts on sidewalk pavement.
- Sidewalk pavers, even in historic areas, may be reset to smooth sidewalk surfaces. Quality workmanship at installation is essential.
- Innovative materials, such as porous concrete or rubber pavement blends, provide some distinct advantages but require special monitoring and maintenance. Maintenance plans and commitments must be in place prior to the use of these materials.

Reviews & Approvals

- Sidewalk materials and dimensions are reviewed and approved by the Ann Arbor Engineering Unit.
- Sidewalk Occupancy Permits may be obtained to allow for special uses within the Frontage or Amenity Zones. *See Cafe Seating and Outdoor Retail Design Element.*
- Special paving materials in the Amenity Zone are reviewed and approved by the DDA.





INTERSECTION ZONE

CROSSWALKS

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	✓			
Transit		✓	✓	✓	
Bicycle		✓	✓		✓
Balanced		✓	✓	✓	✓

DESCRIPTION & INTENT

Crosswalks are the portion of the roadway zone designated for pedestrian use while crossing the roadway. Marked crosswalks provide pedestrians a safe, clear, place to cross the street on foot, while requiring motorists to stop for pedestrians entering or about to enter the crosswalk. Crosswalks signal to other road users, especially motorists, that pedestrians are, or may be, present. Frequent crossings support a walkable place, and encourage more walking.

State law generally provides that when a pedestrian pathway meets a roadway and continues on the other side, pedestrians may cross legally regardless of the provision of a crosswalk or not. In Ann Arbor, code requires a vehicle to stop for a pedestrian standing "at the curb" at a crosswalk location or "within the crosswalk." Pedestrians entering an unmarked crosswalk must yield to vehicles[1]. While they are not the only legal place to cross, marked crosswalks guide pedestrians to the safest crossing locations and increase predictability for motorists and other road users.

Supporting a walkable downtown and making pedestrian connectivity logical, safe, and convenient relies on well-designed crosswalks.

[1] Michigan Uniform Traffic Code "Pedestrians must yield the right-of-way to vehicles when crossing outside of a marked crosswalk at an intersection."

USE & APPLICATION

Location

- Crosswalks are appropriate and necessary in all Frontage Contexts and Functional Emphasis corridors. Crosswalks may be located at either signalized intersections or unsignalized (e.g. stop controlled, uncontrolled or roundabout) crossings. Crosswalks may be utilized at mid-block locations.
- Marked crosswalks should be provided on streets with traffic volumes above 3,000 Average Daily Traffic (ADT), speeds higher than 20 mph, or corridors with multiple travel lanes. Additionally, crosswalks should be provided in the vicinity of schools, parks, senior centers or other facilities that have concentrations of more vulnerable pedestrians.
- Marked crosswalks should be provided across all legs of all intersections, except those with very low volumes. Pedestrians desire direct crossings wherever sidewalks lead to and continue from an intersection.
- Space crosswalks frequently, ideally every 300 to 400 feet, as pedestrians may choose unsafe and unprotected crossing points if marked crosswalks are too far out of the way. Typically, crosswalks closer than 200 feet are unnecessary unless they need to link important pedestrian destinations or corridors.
- Safe pedestrian crossings require more than just marked crosswalks. Comprehensive street design is necessary to manage driver speed, promote visibility, minimize exposure, and maximize safety for all users.

Related Design Elements

- **Bumpouts**: Bumpouts reduce the length of crosswalks, and thus the crossing time for pedestrians. Use bumpouts with crosswalks either at intersections or at mid-block crossings.
- **Signals**: At high volume or high concern crossings where there is no signal or other traffic stop controls, use other appropriate means of highlighting crosswalks, such as hybrid beacons, rapid flash beacons, raised crossings, medians, and other safety measures.
- **Medians**: Where median refuges are used, the crosswalk should "break" through the median with a level, walking surface flush with the crosswalk itself. Detectable warning surfaces should be placed where the crosswalk enters the median refuge to let pedestrians with visual impairments know they are entering a different portion of the crosswalk. A raised "nose" should extend beyond the crosswalk, protecting pedestrians from traffic within the intersection.
- **Bike Boxes**: On streets with a bicycle emphasis, place a bike box between the crosswalk and stop bar. Crosswalks should allow between 10 and 16 feet for bike boxes.

Policy References

- The City of Ann Arbor Public Services Standard Specifications provides multiple recommendations to improve pedestrian crossings.

DESIGN & OPERATIONS

Design Requirements

A **Width**: Crosswalks shall be as wide, if not wider, than the walkways they connect. Crosswalks shall be at least 6 feet wide and ideally 10 feet wide.

B **Length**: Crossing distance shall be as short as possible to minimize exposure and risk. Utilize bumpouts, medians, or crossing islands where appropriate.

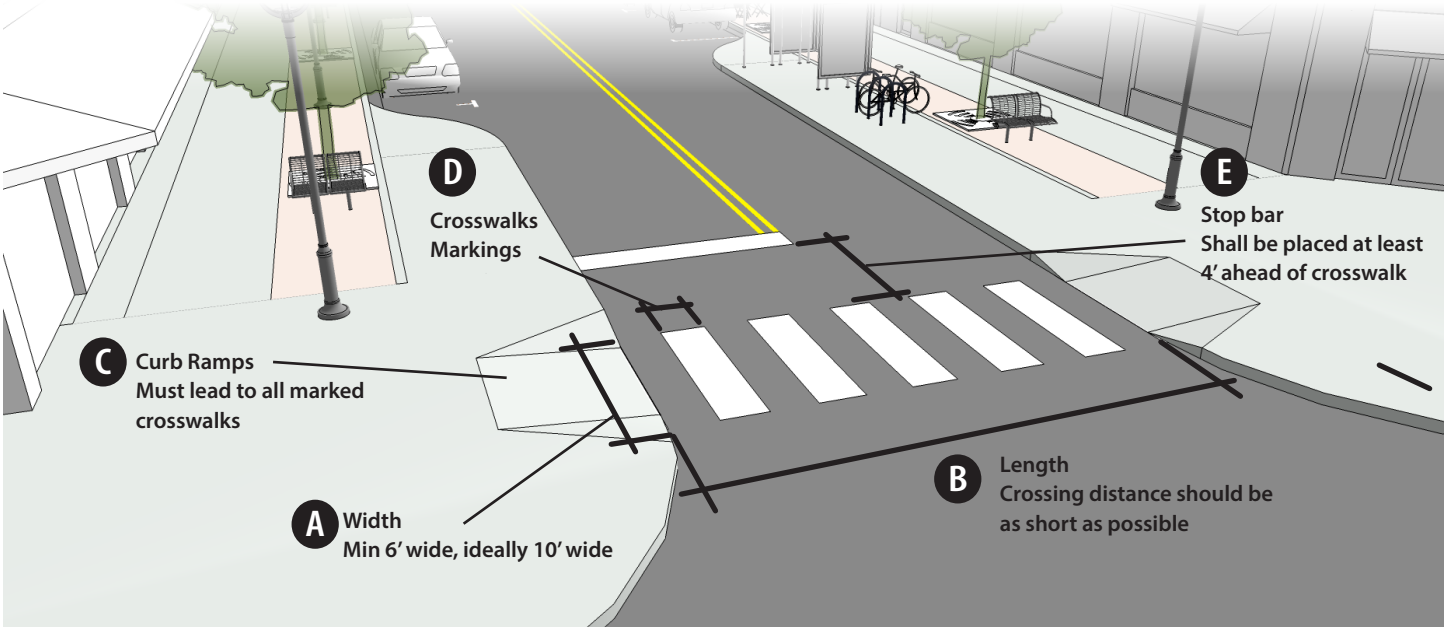
C **Curb Ramps**: Curb ramps shall lead to all marked crosswalks to meet accessibility requirements.

D **Crosswalk Pattern Markings**: Markings shall be clear and legible. The standard crosswalk marking in downtown Ann Arbor adheres to the MDOT standard, which is the "continental" design (*See Figure 4.1.2*). The crosswalk is a series of lines perpendicular to the vehicle travel lane proceeding from curb ramp to curb ramp. Lines shall be of reflective material 12 inches wide and spaced 24 inches apart, extending the width of the crosswalk. In the downtown, the width is typically 8 feet however 10 feet is preferred. Recess markings below finish grade.

E **Stop bars**, solid white bars 12 inches wide that extend across all lanes approaching a crosswalk, should be placed at least 4 feet ahead of the crosswalk line.

» If a bike box is present, the stop line should be at least 8 feet behind the crosswalk.

Figure 4.1.3 - Crosswalks



Additional Design Considerations

- **Refuge Islands**: Where the crossing involves four or more lanes (roughly 40 feet), crossings should include refuge islands, which make it easier for pedestrians, especially those with limited mobility, to cross safely. Refuge islands allow pedestrians to make a two-stage crossing improving safety and ease.
- **Signals**: Signalized crosswalks should include pedestrian signals with pedestrian countdowns. Where pedestrian signals are not provided, pedestrians should follow vehicular traffic signals. *See Pedestrian Signals Design Element*

F **Raised crosswalks** may be used. Raised crosswalks elevate the crosswalk slightly above the typical grade of the street and provide a ramp up and down for vehicles. Raised crosswalks are used at high volume pedestrian crossings or at locations that have demonstrated a significant safety risk. Place bumps at the edges of the raised section to alert pedestrians with visual impairments of where the crosswalk ends.

- **Special Paving**: Projects can utilize temporary decorative crosswalk treatments to enhance place making or introduce public art elements (e.g. such as crosswalk tattoos). These modifications, however, must not degrade the visibility nor the legibility of the MMUTCD compliant crosswalk markings. Glow in the dark paint materials may be contemplated, but require coordination with approving agencies.
  - » Stamped or colored asphalt or concrete crosswalks treatments can increase maintenance requirements and decrease night time visibility and legibility. These treatments are typically discouraged.

Utility Considerations

- There should be a clear path from the crosswalk to the curb ramp and onto the sidewalk. Ensure that utility infrastructure, such as signal boxes, signal poles, light fixtures, or fire hydrants are outside of the Walking Zone at the end of the crosswalk to create a clear path.

Design References

- The City of Ann Arbor Public Services Standard Specifications provides guidance on crosswalk design and materials.
- MMUTCD specifies crosswalk dimensions, spacing, markings and signage including stop and yield lines.
- The U.S. Access Board and the FHWA provide guidance for designing crosswalks to meet the needs of persons with disabilities.

Figure 4.1.4- Raised Crosswalks

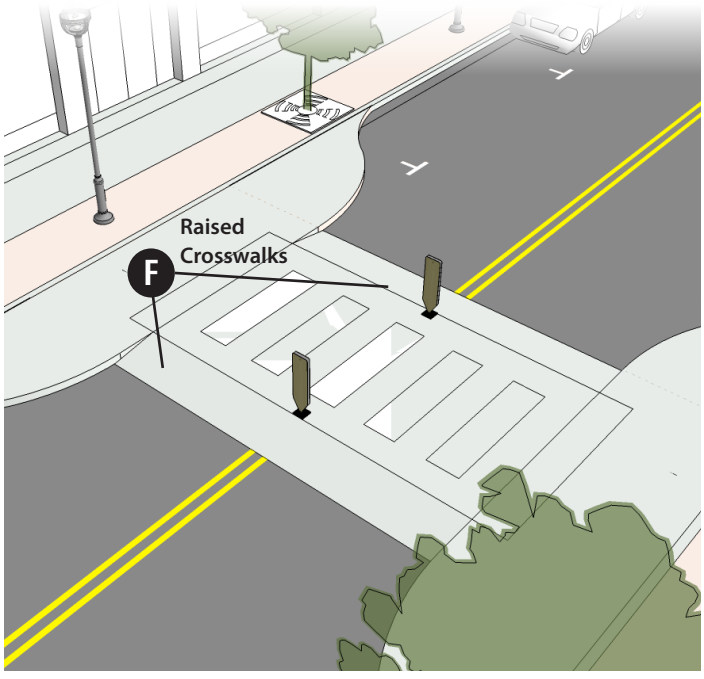


Figure 4.1.5- Crosswalk Pattern Markings



MAINTENANCE & MANAGEMENT

General Maintenance

- **Signalization**: Use countdown signals and shorter cycle lengths to increase compliance, as pedestrians are less likely to comply with crosswalks with delays over 40 seconds at a signalized crosswalk (or 20 at an unsignalized crosswalk). However, signal cycles should be long enough that all pedestrians can cross in a single cycle. Countdown signals are the preferred treatment and shall be installed wherever possible wherever possible to tell pedestrians how much time they have to cross.
    - » Refer to the Pedestrian Signals Design Element for additional guidance.
- **Crosswalk Re-striping**: Crosswalks are in the travel way of the roadway. As such, they are subjected to substantial wear and tear and fading. Crosswalk markings should be refreshed at regular intervals.
- **Street Resurfacing**: After repaving, crosswalks should be remarked as soon as possible. Use repaving as an opportunity to install higher-visibility patterns.

Seasonal Use & Maintenance

- **Snow Removal**: Crosswalks must be cleared of snow and ice. Crosswalk curb ramps should not be blocked by obstacles of snow, ice or large pools of water.

Reviews & Approvals

- The Ann Arbor Engineering Unit in collaboration with the Ann Arbor Systems Planning Unit are responsible for determining where crosswalks are installed.



INTERSECTION ZONE

CURB RAMPS

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	✓			
Transit		✓	✓	✓	
Bicycle		✓	✓		✓
Balanced		✓	✓	✓	✓

DESCRIPTION & INTENT

Curb ramps are a short ramp cutting through a curb or built up to it.[1] Curb ramps provide the transition from the sidewalk to the street, and benefit all users, especially those in wheelchairs, people pushing strollers or luggage, and children on bicycles.

USE & APPLICATION

Location

Curb ramps are appropriate, encouraged, and required on all streets of all street types. Curb ramps are required to be installed during road resurfacing projects or corner construction impacts. They are also required by law with any sidewalk construction or reconstruction at intersections or other crossing points.[2]

Curb ramps should be provided at every marked crosswalk.

Curb ramps should be used along a sidewalk length if the sidewalk is cut by vehicle paths located below the grade of the sidewalk, such as alleys. However, in general, driveways and curb cuts should maintain the sidewalk at grade across them.

Curb ramps, including temporary ones, should be provided when a pedestrian detour is needed to maintain access during sidewalk closures.

Related Design Elements

- Curb ramps should be designed as an integral part of an overall intersection. They should work in concert with crosswalks, pedestrian refuge islands, stormwater drainage and all other features of the intersection.

Policy References

- Title II of the Americans with Disabilities Act (ADA) requires state and local governments to provide access for persons with disabilities to utilize pedestrian crossings. The U.S. Access Board provides detailed guidance on the use, design and location of curb ramps.[3]

[1] 28 C.F.R. Part 36, Appendix A, § 3.4.

[2] Michigan Public Act 8 of 1973

[3] http://www.ada.gov/pcatoolkit/chap6toolkit.htm#fn1

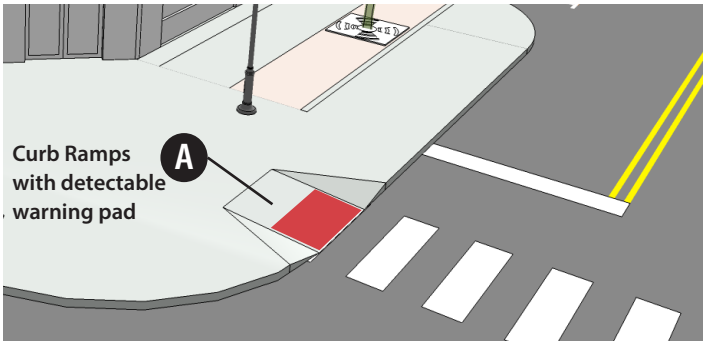


Figure 4.1.6- Curb Ramps

DESIGN & OPERATIONS

Design Requirements

A **Standard Design**: Curb ramps shall adhere to standards established by the Michigan Department of Transportation (MDOT) in compliance with Public Right-of-way Accessibility Guidelines (PROWAG).

- **Crosswalk Alignment**: The curb ramp shall lie within the area of the crosswalk. Side flares may extend beyond the width of crosswalk if necessary.
  - » Wherever possible, curb ramps should be constructed in such a manner that provides an individual ramp in each direction that is oriented perpendicular to the path of travel along the centerline of the crossing.
- **Crosswalk Accessibility**: Where curb ramps provide access to a crosswalk, they shall be provided at both ends of the crosswalk to prevent entrapment within the intersection. Additionally, detectable warning pads are required per ADA code.
- **Refuge Islands**: At crossings that pass through pedestrian refuge islands or medians crossings, 2 feet of detectable warning strips shall be placed at each end of the refuge island.

Additional Design Considerations

- Curb ramps should be designed to avoid pooling of water at the base of the ramp along the gutter pan.
- Increase the width of the curb ramp in areas of high pedestrian volume and crossing activities. Curb ramps facilitate the movement of all pedestrians and their benefit is not limited only to pedestrians with mobility impairments.
- Strengthen the curb section and curb ramp to handle heavy vehicles (e.g. trucks and buses) that may frequently mount the curb during turning movements.
- Do not use pedestrian actuated signals at downtown crossings. Frequent pedestrians crossings should be common and expected.

Utility Considerations

- Provision of ADA curb ramps take precedence and utilities should be moved to permit the provision of the ramp.

Design References

- Public Right-of-way Accessibility Guidelines (PROWAG).
- The FHWA has developed detailed guidance on the design and installation of curb ramps.[4]
- The City of Ann Arbor follows MDOT standards regarding the provision and design of curb ramps.[5]

MAINTENANCE & MANAGEMENT

Seasonal Use & Maintenance

- **Special Events**: When seasonal events take place – such as festivals or street closures – temporary curb ramps should be installed to provide access and circulation throughout the event space.
- **Snow removal**: Perpendicular curb ramps on tangent or directional ramps on radius of corner aid snow removal because plows are traveling straight along the edge of the ramp. Ramps that are located on the radius of the ramp are more susceptible to plows leaving a wedge of snow in front of ramp from traveling past.
  - » Snow clearance of sidewalks should also include clearing of curb ramps to ensure that snow does not block access from the sidewalk to and across the street at crosswalk locations.

[4] **http://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalk2/sidewalks207.cfm**

[5] **MDOT Ramp Details R-28-F dated October 20, 2008.**



INTERSECTION ZONE

PEDESTRIAN SIGNALS

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	✓			
Transit		✓	✓	✓	
Bicycle		✓	✓		■
Balanced		✓	✓	✓	■

DESCRIPTION & INTENT

Pedestrian signals, like vehicle signals, tell people when to cross the street and when to stop and wait. Pedestrian signals, also called "pedheads," consist of a white "WALK" symbol and a flashing and/or steady "DON'T WALK" symbol.

Intersection operations in a downtown should anticipate the presence of pedestrians, ensure that pedestrian crossings are logical and predictable to all users, and provide adequate time for pedestrians to fully cross the street.

In downtown Ann Arbor, pedestrian count downs and/or accessible pedestrian signals enhance basic pedestrian signals. "Pedestrian count downs" provide information on the number of seconds remaining in a pedestrian cycle. Accessible Pedestrian Signals (APS) are "an integrated device that communicates information about the "WALK" and "DON'T WALK" intervals at signalized intersections in non-visual formats (e.g. audible tones and vibrotactile surfaces)."[1] Signals aid pedestrians with visual impairments and are generally required retrofits when improvements are made to a signalized intersection.

MMUTCD permits pedestrian signals to be fixed (a.k.a."pre-timed") or actuated. Pre-timed signals provide a pedestrian walk phase for every leg of an intersection during every cycle, whether pedestrians are present or not. Actuated signals provide a walk phase only when pedestrians are present. Most actuated signals require the pedestrians to explicitly request the phase by pushing a button. Downtown Ann Arbor is a pedestrian place. Actuated signals are not desirable in the downtown core and should not be used.

USE & APPLICATION

Location

- Pedestrian signals should be installed at all signalized intersections with crosswalks. In some cases, such as mid-block crossings, signals for pedestrians only may be warranted. In high-volume locations, a new traffic signal may be warranted due to pedestrian volumes.
- Crossings in Near Neighborhood crossings may not need to be signalized (e.g. at four-way stops) where pedestrian and traffic volumes are both much lower.

Related Design Elements

- Please see the crosswalk section for details on crossing dimensions, which will affect necessary pedestrian crossing time.
- Required pedestrian crossing time is dependent on the total distance of pedestrian exposure. This is the distance where a pedestrian is off the curb and in the vehicle zone. Pedestrian crossing distances, and therefore required pedestrian crossing times, may be reduced through the use of curb extensions.

[1] **Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG), Advisory R209**

DESIGN & OPERATIONS

Design Requirements

- **Signal Type**: Provide pedestrian signal heads for every leg of a signalized intersection.
  - » **Countdown pedestrian signals** provide greater information and predictability to pedestrians, motorists and cyclists. *See the Countdown Pedestrian Signal Design Element for additional guidance*.
  - » **"Actuated" pedestrian signals** require pedestrians to push a button in order to request crossing are undesirable in downtown and shall not be used. [2]
- **Timing**: In the DDA District, pedestrian crossings shall be pre-timed. Pre-timed signals ensure that pedestrians are provided sufficient time to cross every leg of an intersection every cycle.
  - » Pedestrian crossing time shall, minimally, meet the current MMUTCD standard, but additional pedestrian time may be needed or desired, especially at crossings with high pedestrian volumes or crossings used by a number of children, seniors, or persons with disabilities.
- Install accessible signals at newly constructed or reconstructed intersections where visual pedestrian signals are installed.
- Clearly mark crossings and provide curb ramps for accessibility.

Additional Design Considerations

- **Longer Crossing Time**: Pedestrian time should be increased at areas with significant volumes of pedestrians or where pedestrians are the dominant users and/or areas where leisurely pedestrian speeds are welcomed or desired.
- **Accessible Pedestrian Signals (APS):** The standard practice for downtown is for pedestrian signals to be pre-timed (i.e. on recall) as part of normal signal phasing. APS that is activated with a push button may be used in combination with the normal pedestrian signal timing to assist pedestrians with visual and/or auditory disabilities in crossing safely.
  - » APS signals should be used in locations where there are unique circumstances and/or additional concerns related to pedestrian crossings for those with disabilities.
  - » The APS push button must be located such that it meets ADA guidelines for push-button access.
  - » The APS auditory messaging should emanate from the push button box itself, and be oriented to provide audio detection for the intended crossing direction and minimize it for non-intended crossings.
  - » The APS push bottom box should indicate through tactile surfacing the direction of crossing, and provide a vibro-tactile feature to assist those with hearing disabilities.

[2] **Accessible pedestrian signals (APS) should not be confused with actuated signals, although both may appear physically similar. Both commonly feature a push button, however actuated signals must accompanied by a sign indicating that the pedestrians must push the button in order to cross. Accessible signals may not have signage and provide a walk phase when the button is not pushed.**

Sustainability Considerations

- Use of light-emitting diodes (LED) or other low energy signal fixtures to lower energy use.

Policy References

- The MMUTCD provides standards for the design and operation of intersection signals.
- The draft PROWAG provides guidance on the use of accessible pedestrian signals.

MAINTENANCE & MANAGEMENT

Special Maintenance

- Pedestrian crossing time should be routinely monitored and adjusted, especially when there is a change in land use near the intersection.

Seasonal Use & Maintenance

- Pedestrian signals should be clear of snow buildup. Clear snow at curb ramps and sidewalks to provide clear access to APS push buttons.

Reviews & Approvals

- The City of Ann Arbor controls all signals on city streets. MDOT oversees signal timing and maintenance on state routes.



INTERSECTION ZONE

COUNTDOWN PEDESTRIAN SIGNAL

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	✓			
Transit		✓	✓	✓	
Bicycle		✓	✓		■
Balanced		✓	✓	✓	■

DESCRIPTION & INTENT

Traditional pedestrian signals have symbols for WALK (a white "walking man") and DON'T WALK (a red hand). Ann Arbor, along with many other communities are adopting enhanced pedestrian signals that also display the number of seconds remaining for pedestrians to cross the intersection.

Pedestrian countdown signals provide greater predictability to the traffic signals in addition to walk phases for pedestrians, cyclists and motorists alike. The additional information provided by pedestrian countdowns enables pedestrians and other travelers to make more informed decisions.

USE & APPLICATION

Location

- Use pedestrian countdown signals anywhere that regular pedestrian signals are used. Pedestrian countdown signals are particularly effective in downtown Ann Arbor.

Related Design Elements

- Pedestrian countdown signals are part of a safe, consistent crossing environment, which also includes crosswalks, curb ramps, pedestrian signal guidance, and sidewalks.
- If pedestrian crossings exceed 90 feet, increase the height of the numerical display to ensure visibility and legibility.

DESIGN & OPERATIONS

Design Requirements

- Activate pedestrian countdown displays at the beginning of the pedestrian change interval together with the flashing “DON’T WALK” symbol.
- Adhere pedestrian countdowns to the current version of the MMUTCD. This requires that numbers must be immediately adjacent (below or beside) to the “DON’T WALK” symbol. Countdown display should be dark at all times except during the pedestrian clearance phase.

Additional Design Considerations

- If signal preemption is utilized, such as by emergency or transit vehicles, the pedestrian countdown display should go dark upon activation of the preemption sequence.

Sustainability Considerations

- Use LED or other low energy signal technologies for more energy efficient countdown displays.

Design References

- The MMUTCD provides standards for the design and operation of intersection signals.

MAINTENANCE & MANAGEMENT

Special Maintenance

- Pedestrian countdown signals introduce no more maintenance needs than other signal devices.

Seasonal Use & Maintenance

- All crosswalks should be kept clear of snow and other obstacles in the pedestrian’s path.

Reviews & Approvals

- The City of Ann Arbor controls all signals on city streets. MDOT oversees signal timing and maintenance on state routes.



AMENITY ZONE

WASTE & RECYCLING RECEPTACLES

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	✓			
Transit		✓	✓	✓	
Bicycle		✓	✓		■
Balanced		✓	✓	✓	■

DESCRIPTION & INTENT

Waste and recycling receptacles keep downtown environment as clean as possible and free from loose trash and refuse. Waste and recycling receptacles should be provided regularly throughout downtown so that pedestrians encounter them frequently when walking. Receptacles should be durable, visible, and placed conveniently. In addition, receptacles should be easy for maintenance workers to access and empty.

USE & APPLICATION

Location

- Recommended in all areas of downtown. Located within the Amenity Zone, Frontage Zone or the equivalent in the Intersection Zone but set back from all crosswalks.
- Waste and recycling receptacles must be placed such that they do not block major pedestrian movements (sidewalk clear zones), building entries, loading zones or other street functions.
- Place receptacles in locations accessible to curbside pickup and maintenance crews.
- The frequency of waste receptacles is as follows depending on the street Frontage Context:

Frontage Context	Waste Receptacle - Placement Frequency
Destination Commercial	Each corner of an intersection. Mid-block for blocks longer than 400 feet in length
Commercial	At least two corners of an intersection (diagonally opposite corners)
Mixed	At least one per intersection
Civic/University	At least two corners of an intersection (diagonally opposite corners)
Near Neighborhood	Not required - opportunity only
Near Neighborhood	At least one per intersection when transitioning between Near Neighborhood and a different Frontage Context.

- Separate recycling receptacles should be considered in all locations where waste receptacles are installed to encourage recycling behavior and practices. However, the following minimums are provided:

Frontage Context	Recycling Receptacle Placement Frequency
Destination Commercial	At least two corners of an intersection (diagonally opposite corners)
Commercial	At least one per intersection
Mixed	At least one per intersection
Civic/University	At least one per intersection
Near Neighborhood	Not required - opportunity only

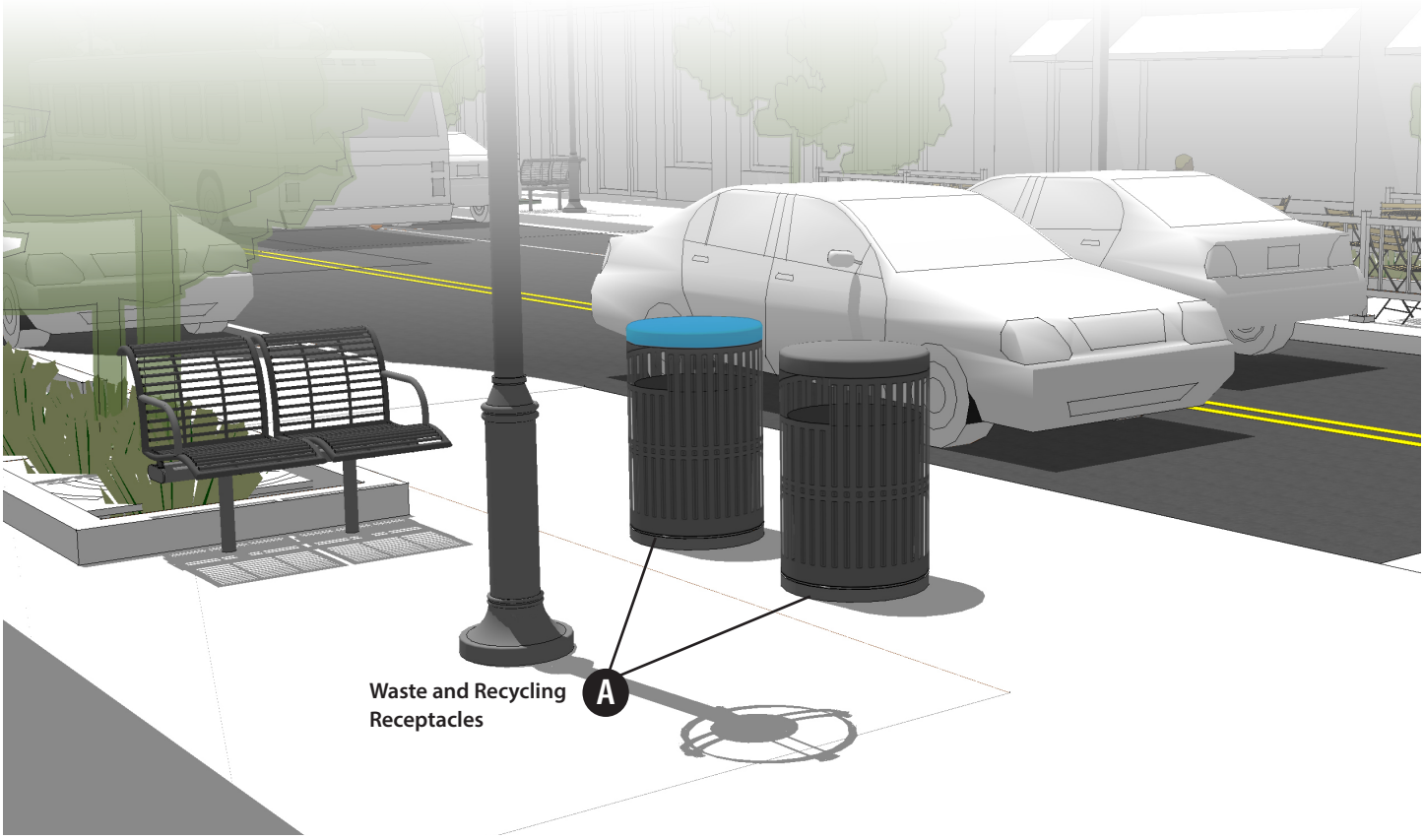
DESIGN & OPERATIONS

Design Requirements

A **Durability**: Waste and recycling receptacles shall be constructed out of durable materials (metals) and finishes with a minimum standard warranty of 3-years.

- **Style**: The style and character of the selected receptacles shall convey a sense of quality consistency with the character of downtown.
  - » Solid plastic receptacles shall not be used in downtown.
- **Functional Design**: Receptacles shall be closed on the top or otherwise covered such that rain, snow, and other precipitation does not enter the receptacles and mix with refuse.
  - » Where recycling receptacles are provided, separate receptacles are required with a different design style and/or coloration to clearly signify the receptacle for recyclable refuse.
  - » Recycling receptacles shall indicate the types of refuse that are recyclable.
- **Security**: Ideally, receptacles shall be secured to the ground and be designed with an inner container or other mechanism that can be removed to facilitate collection of refuge.
  - » Receptacles shall be able to be unlocked and relocated when needed to accommodate special events or maintenance activities.
- **Special Character Districts**: Selection of specific street furnishings shall consider the style of established or preferred site furnishings within downtown Character Districts and/or Historic Districts and chose a style that matches or is deemed compatible.
  - » The Street Design Team shall approve selections for consistency with the different Character Districts in downtown.

Figure 4.1.7- Receptacles



- **Manufactured Furnishings**: Selected receptacles shall be standard manufactured designs that are readily replaceable. Custom designs and other special order receptacles should not be used due to replacement challenges.

Utility Considerations

- Do not place receptacles directly on top of utility covers, vaults, or infrastructure elements that require access.

Sustainability Considerations

- Use receptacles made from recycled, reclaimed, or salvaged materials when possible.
- Receptacles that increase the efficiency of collection (e.g. smart receptacles like the BigBelly) can minimize energy consumption by collection vehicles.

MAINTENANCE & MANAGEMENT

General Maintenance

- **Public Container Waste Collection**: Responsibility of City of Ann Arbor waste collection crews
- **Receptacle Maintenance**: Ownership and responsibility for receptacle maintenance and replacement is on the City of Ann Arbor.

Seasonal Use & Maintenance

- **Snow Removal**: Snow should not be piled or stored on top of receptacles, both to prevent damage as well as to keep receptacles accessible and usable throughout the year.
  - » The ground below and access to receptacles should be kept clear and free of snow and ice to facilitate efficient collection.

Review & Approvals

- **Private Development Projects**: Private development projects can propose public waste and recycling receptacles in association with development projects that are likely to significantly increase foot traffic.. Selected receptacles, their location, and orientation must be included on proposed Site Plans and approved by the City. All receptacles that serve the waste needs of the private building shall be located outside of the public right-of-way.
- **Public Streetscape Projects**: The selection, location and orientation of receptacles should be coordinated with both City and DDA staff.

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AMENITY ZONE

BENCHES & SEATING

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	!	!			
Transit		!	■	■	
Bicycle		!	■		■
Balanced		!	■	■	■

DESCRIPTION & INTENT

Street furnishings include benches, chairs, seat-walls, and other fixed structures that provide places for pedestrians to sit and rest. Street furnishings make using the public streets more accessible for all users and especially those with mobility challenges. By providing places to stop and rest, to wait for services, or just to pause and relax and enjoy the street environment.

Street furnishings include the following types of fixtures:

- Benches (with or without backs)
- Single seats (with or without backs)
- Seat-walls (typically integrated with landscape planters)

USE & APPLICATION

Location

- Site furnishings are appropriate and recommended in most areas of downtown outside of the Near Neighborhood areas. In areas with higher volumes of pedestrian traffic (e.g. Destination Commercial and Commercial), site furnishings can be particularly beneficial although they should be so they do not block major pedestrian movements, building entries, loading zones or other street functions.
- In Mixed and Near Neighborhood areas, seating locations should be carefully evaluated to ensure that they will be visible, and regularly used.
- Street furnishings are to be located within the Amenity Zone. Furnishings may be located in the Frontage Zone where adequate width exists for placing the furnishing and accounting for a clear zone for seating that does not encroach into the Walking Zone (typically 5’ is required necessary). Furnishings and their clear zones should never impact the Walking Zone.
- Ideally, seating should be placed below street trees or other shading elements.

DESIGN & OPERATIONS

Design Requirements

Refer to the Downtown Bench Specifications for more information on design requirements.

- **Durability**: Construct street furnishings from long-lasting and durable materials and finishes that are backed by a minimum 3-year standard warranty.
  - » Allowable materials include metal (with galvanized and powder-coated steel or stainless steel finished) or composite lumber. Seating walls must be constructed from concrete.
- **Number of seats**: When seating is provided, at least two seats shall be provided adjacent to each other. Single seats placed in isolation are not permitted.
- **Clear Zones & Placement**:
  - » A 3-foot minimum clear zones shall be provided to the sides and front of the seat to provide ADA accessibility and clearance for wheelchairs.
  - » Benches shall have a 5-foot minimum distance from fire hydrants and 1 foot minimum distance from other street fixtures.
  - » Seating must not be placed in such a way where people's legs would hang into planting beds or landscape areas.
  - » Free-standing seating (not integrated into a landscape bed) should be purchased from a catalog and easily replaceable. Custom furnishings would require a maintenance agreement with the City.
- **Seating Depth**: Benches and seats shall have a seating depth of at least 18 inches.
- **Installation**: Street furnishings shall be cast-in place or otherwise fixed into the street to prevent unauthorized removal.
- **Special Character Districts**: Selection of specific street furnishings shall consider the style of established or preferred site furnishings within downtown Character Districts and/or historic districts and choose a style that matches or is deemed compatible.
  - » The Street Design Team shall approve selections for consistency with the different Character Districts in downtown.







- **Manufactured Furnishings**: Selected furnishings shall be standard manufactured designs that are readily replaceable. Custom designs and other special order receptacles should not be used due to replacement challenges.
- **Seat-walls**: Refer to the Landscape Planter Design Element for dimensional guidance on seat-wall design.

Additional Design Considerations

- Provide a mixture of seating types, where multiple street furnishings are used in close proximity, to accommodate different users needs. Include both backed and backless bench seating and seating both with and without armrests.
- Cluster groups of seating to face each other to allow for small groups to converse.
- Seating can be integrated into building facades or other street elements provided clear zones remain open.
- Concrete seat-walls can integrate metal banding or obstructions to discourage use for recreational activities (e.g. skateboarding) but shall still allow use as seating.

Utility Considerations

- Placed seating on top of utility covers, vaults, or infrastructure elements that require access.

Sustainability Considerations

- Use site furnishings made from recycled, reclaimed, or salvaged materials whenever possible.

MAINTENANCE & MANAGEMENT

General Maintenance

- **Ownership**: The DDA and Public Works maintain public seating and benches in coordination. Benches and seating should be regularly inspected for damage to ensure that provided seating is safe and comfortable for all users.

Seasonal Use & Maintenance

- **Snow Removal**: Do not pile or store snow on top of street furnishings, both to prevent damage to the furnishings as well as to keep them accessible and usable throughout the year.
    - » Sidewalk snow removal is the responsibility of adjacent property owners; care should be take to keep the ground below and leading up to seating free of snow and ice. The ground below and leading up to seating should be kept clear and free of snow and ice.

Review & Approvals

- **Private Development Projects**: Private development projects can propose street furnishings in association with development projects. Selected street furnishings, their location, and orientation must be included on proposed Site Plans and approved by the Ann Arbor Engineering Unit (for conflicts with utilities, ADA, etc.).
- **Public Streetscape Projects**: The selection, location and orientation of site furnishings should be a coordinated effort; recommended by City or DDA staff with final approvals of DDA and the Ann Arbor Engineering Unit (for conflict with utilities or ADA).



AMENITY ZONE/FRONTAGE ZONE

WAYFINDING

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	!	!			
Transit		!	!	!	
Bicycle		!	!		!
Balanced		!	!	!	!

DESCRIPTION & INTENT

The most basic form of wayfinding is the street sign. Although often forgotten, street signs are essential for locals and visitors alike to get around the city efficiently. Missing, blocked or unreadable signs are a source of frustration for travelers.

However, Ann Arbor has gone far beyond the standard street sign in aiding wayfinding in the city. In 2009 and 2010, the DDA installed over 200 wayfinding signs to provide guidance to the four commercial districts of downtown - Kerrytown, South University, State Street and Main Street. The wayfinding signs are designed for both motorists and pedestrians. Directional signage provides a convenient path to reach destinations. Informational signage provides local area maps and other local information.

Ann Arbor conducted an intensive design process to develop the unique signage system in place today. Signs feature clean lines and simple styling. Name plates are interchangeable to permit updating and modification as needed.

USE & APPLICATION

Location

Vehicle-Oriented Wayfinding:

- Vehicle-oriented wayfinding is used on key corridors of entry into the Downtown District to guide motorists from surrounding highways or other access points and combined with signage in downtown to lead the driver to their destination. Parking wayfinding accompanies destination wayfinding in Ann Arbor to seamlessly guide motorists to the closest public parking facility from which they can walk to their final destination.

Pedestrian-Oriented Wayfinding:

- Pedestrian-oriented wayfinding is generally concentrated within the commercial areas of downtown. Pedestrian wayfinding leads to the various commercial districts and key landmarks, cultural assets and other destinations within them.
- On-street maps give pedestrians an opportunity to orient themselves and discover other destinations in downtown.
- Wayfinding systems enable travelers to navigate downtown independent of mobile devices or physical maps. Visitors, in particular, benefit from wayfinding systems. The information they provide increases visitor level of comfort and confidence in visiting and traveling around downtown.

Related Design Elements

- Consistently locate street signs throughout downtown to be easily and reliably identified. Signs should be visible from both sidewalk and travel ways from all legs of an intersection approach.
- Locate community wayfinding signs proximate to intersections and crosswalks. Pedestrian wayfinding directional signage must lead to safe pedestrian crossings.

Policy References

- The Ann Arbor Downtown Wayfinding Project is the basic reference guide for community wayfinding in downtown.
- The MMUTCD provides standards on street signs and community wayfinding sign design and installation.

DESIGN & OPERATIONS

Design Requirements

- **Clarity**: Wayfinding signs shall be clear and concise with limited text in order to be quickly read, comprehended and react.
- **Pedestrian vs. Vehicle Wayfinding**: Signs shall be designed for use by the intended audience. Vehicle-oriented signs shall have larger letters while pedestrian-oriented signs may have smaller font size. Pedestrian-oriented signs shall be mounted at pedestrian eye level while vehicle-oriented signs will be mounted higher. Vehicle signs should be retro-reflective to increase legibility at night while pedestrian-oriented signs may be otherwise illuminated.
- **Required Signage**: Wayfinding signs shall not obstruct nor take the place of wayfinding signs required in the MMUTCD. Likewise, community wayfinding signs should not themselves be obstructed.
- **Accuracy**: Wayfinding signs shall be accurate and kept up to date. Inaccurate or outdated signs serve as a detriment to downtown navigation.



Additional Design Considerations

- Follow the guidelines and design for wayfinding signs developed by the DDA in the DDA Wayfinding Standards Manual.
- Install wayfinding signs in the Amenity Zone of the sidewalk and may not impede the Clear Walk Zone.
- Signs intended only for pedestrians, should be inconspicuous to motorists in order to avoid confusion. Pedestrian signs may indicate a route available to pedestrians that is precluded for motorists due to one-way street operations or other factors.
- Do not use logos of individual businesses on wayfinding signs. Signs should focus on providing direction to public institutions, transportation facilities, hospitality services, and cultural and entertainment venues. Only recognized iconic private businesses should be included on vehicle wayfinding signs with Street Design Team and DDA approval.

Utility Considerations

- Signage shall not be placed above utility vault, close to fire hydrants, or other infrastructure access points.

Sustainability Considerations

- Green opportunities for wayfinding are generally limited.

Design Reference

- DDA Wayfinding Standards Manual.

MAINTENANCE & MANAGEMENT

General Maintenance

- **Ownership:** The DDA maintains signs installed as part of the Ann Arbor Downtown Wayfinding Project.
  - » Maintaining the currency of wayfinding signs can be a challenge. Signs must reflect current destinations and current traffic operations. Adjusted signs during temporary construction lasting longer than a few days.
  - » Wayfinding signs are a unique structure in the right-of-way, and special protocols or procedures may need to be established to guide sign restoration in the event of a knock-down or need for replacement.
  - » Wayfinding signs are frequently altered by street users. Directions may be changed, additional informal signage added, stickers or paint applied. These should be promptly removed to avoid confusion and maintain the quality image of downtown.

Seasonal Use & Maintenance

- Snow should be cleared around pedestrian wayfinding maps to ensure that pedestrians can access the maps.
- The DDA maintains signs installed as part of the Downtown Wayfinding Project

Reviews & Approvals

- The Ann Arbor Downtown Wayfinding Project is an initiative of the DDA. Additional wayfinding signage in downtown should be coordinated through the DDA which will, in turn, coordinate with the appropriate City units for design, permitting and installation.

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CURBSIDE ZONE

BUMPOUTS

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	✓			
Transit		!	!	!	
Bicycle		✓	✓		!
Balanced		✓	✓	✓	!

DESCRIPTION & INTENT

Bumpouts, also known as curb extensions or bulb-outs, visually and physically narrow the street by extending the sidewalk, reducing pedestrian crossing distance, and increasing pedestrian visibility and line of sight.

At signalized locations, reduced crossing distance enables shorter walk phases and greater flexibility in signal timing. At intersections, the narrower street profile, coupled with the tighter turn radii, can encourage slower driving, calm traffic, and increase safety for everyone.

USE & APPLICATION

Location

Bumpouts are appropriate on all streets and required on all types of streets other than transit emphasis streets. Bumpouts on transit streets will need to carefully consider turner radii of transit vehicles. Regardless of street type, curb extensions may only be used where a curb lane is present and used for parking or loading, not travel.

Bumpouts are particularly beneficial in destination commercial and commercial Frontage Contexts where pedestrian volumes are high and activity concentrated, where traffic calming is desired, on very wide streets, and/or where sidewalks are narrow.

Bumpouts increase safety and pedestrian comfort by increasing visibility and shortening pedestrian crossing distance. They help increase the visibility of pedestrians at unsignalized crossings, or near large institutions that generate a lot of foot traffic, such as schools.

Multiple types of bumpouts exist and have different applications.

- **Corner bumpouts**, located at intersections and typically wrap around the corner extending the curb into both intersecting streets, are the most common type of curb extension. While generally required, the exact extent and feasibility of installing corner bumpouts must be examined at each corner of the intersection. Corner bumpouts on some, or all, corners may not feasible or desired in the following cases:
  - » Where there is a loading zone immediately on the far side of an intersection and larger trucks need to pull straight into the loading zone.
  - » Where the specific geometries of the bump-out (considering the needed corner radius) result in a minimal reduction (i.e. 4-feet or less) to the overall crossing distance, the value of the bumpout may be limited.
- **Mid-block bumpouts** are installed in the Curbside Zone along a block. Mid-block bumpouts can be used to narrow a street for traffic calming, additional sidewalk space, or in conjunction with a mid-block pedestrian crossing. Mid-block bumpouts also provide space for street trees. *See Mid-block Crossing Design Element*.

- **Transit bumpouts,** also known as bus bulbs, extend the sidewalk to enable buses to board and alight passengers from the first travel lane. Bus bulbs provide critical space for a quality transit stop with amenities and modestly decrease transit travel time. Transit bumpouts typically occur at the far corner of intersections and appear to be an elongated corner bumpout; however, they may also be used for near-side or mid-block locations. *See Transit Bumpout Design Element*.

Related Design Elements

- **Curb Ramps:** Bumpouts intended as pedestrian crossings must include curb ramps and marked crosswalks.
- **Bicycle lanes or buffered bicycle lanes** should bend toward the bumpout so that they are against the extended curb at the intersection. This makes cyclists more visible to both pedestrians and motorists. Ideally, bike boxes should be placed at intersections with bumpouts to give cyclists a place to wait.
- **Parklets and Platform Dining**: Bumpouts may be used in conjunction with sidewalk platforms, which can temporarily expand the sidewalk in the parking lane. Sidewalk platforms should be the same width as bumpouts, and should create a flush ground plane with the bumpout for safety and accessibility.
- **Travel Lanes**: Bumpouts should not be used on streets where the curb lane is used as a travel lane during any part of the day.
- **Street Trees**: Street Trees placed in corner bumpouts must be positioned and installed such that they do not create visibility issues at the corner.

DESIGN & OPERATIONS

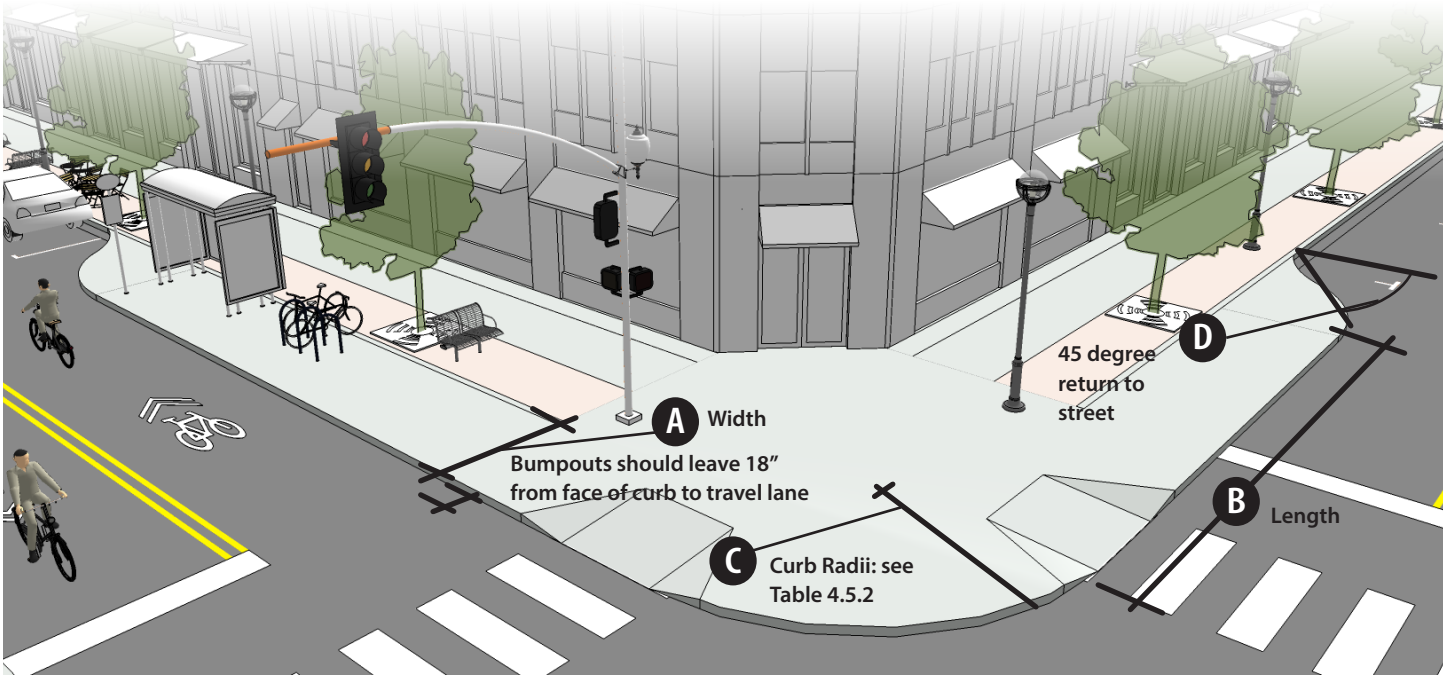
Bumpouts are a tool for increasing pedestrian safety, enhancing the pedestrian experience, and creating additional sidewalk space and calming traffic. Bumpouts may only be used on streets where the curbside lane is not used for travel (e.g. reserved for on-street parking or loading at all hours of the day).

Design Requirements

A **Width**: Bumpouts shall not narrow any bike or general traffic lanes to an unsafe width. When adjacent to a travel lane, the face of the bumpout curb should be set back 18" from the edge of the travel lane. This width accommodates the city standard gutter width of 18." When applied to streets with on street parking, bumpouts are typically 6 feet wide.

B **Length**: Corner bumpouts or mid-block bumpouts with crosswalks shall be at least as wide as the crosswalk, and ideally extend to the stop bar. The curve of bumpouts must fit outside of any crosswalks.

Figure 4.1.8- Bumpouts



» Bumpouts are an effective way to restrict parking near intersections and maintain or increase visibility at corners. Consider making bumpouts at least 20 feet long, from the intersection side of the crosswalk back, to prevent motorists from parking within 20 feet of an intersection.

C **Corner Radius**: Bumpouts are intended to narrow pedestrian crossing distance and slow traffic speeds. To accomplish this, a tight curb radius of 20' is preferred. However, the curb radius may be larger than 20' in order to meet the Design Vehicle's effective turning radius as shown in Table 4.5.2.

D **Returns**: Bumpouts shall have a 45-degree return to the street.

- **Sight Lines**: Any street furniture or landscaping in a bumpout shall maintain clear pedestrian paths and access to ramps. Any objects located in the bumpout such as furnishings or landscaping, must not interfere with corner sight triangles.

Additional Design Considerations

- **Turn Restrictions**:
  - » At corners with turn restrictions, use the turning radii of the bumpout to make that turn more difficult, ensuring that transit vehicles or through traffic is not delayed by motorists turning.
  - » Carefully designed bumpouts at intersections where turning movements by transit vehicles or long wheel base trucks are common. Curb radii may need to be adjusted wider to accommodate the tracking patterns of these vehicles and/or other design or management solutions explored.
  - » Where vehicles may frequently mount the curb during turning, stronger concrete materials should be used to ensure durability.
- **Stormwater**: Bumpouts must be cognizant of stormwater drainage and avoid pooling of water at the curb. Trench drains are not generally permissible stormwater drainage solutions in Ann Arbor. Where bumpouts conflict with storm drains, storm drains must be relocated and/or additional inlets provided to enable proper drainage.
- **Temporary Installation**: Bumpouts can be a temporary installation, using low-cost materials such as paint, bollards and planters. This may be useful for a location where a more expensive installation may not be warranted, or as a trial for a permanent solution.
- **Bicycle Parking**: Bumpouts may be ideal locations for bicycle parking. Ensure parked bicycles do not obstruct pedestrian paths nor block the sight triangle at corners.
- **Outdoor Space Use**: Bumpouts may be used for public seating or outdoor dining, again with careful attention paid to paths of movement and required sight lines.
- **Curbside Uses:** Bumpouts may have an impact on business loading, delivery access, garbage removal, and street sweeping. If well-managed and designed, bumpouts serve as a location to consolidate business waste for removal where alleys do not exist.
- **Flexibility:** Bumpouts may limit the ability to change the street design in the future, such as the location of bus zones, lane layout, and crosswalks. Bumpouts also make the street less flexible for construction routing. While considerations, none of these concerns negate the value of bumpouts to downtown districts.

Design References

- The City of Ann Arbor Non-Motorized Transportation Plan Update provides recommendations on the use of bumpouts. Additional locations in downtown are possible.
- The NACTO Urban Street Design Guide provides additional guidance on how to design a bumpout.
- The Institute of Transportation Engineers "Designing Walkable Urban Thoroughfares: A Context Sensitive Approach" describes in detail how to design a bumpout as part of a complete street.

Sustainability Considerations

- Combine bumpouts with stormwater management features, such as rain gardens or bioswales, to absorb and collect rainwater and reduce impervious surface area.
- Create opportunities for additional plantings through bumpouts, particularly mid-block bumpouts. Plantings at corner bumpouts must not block driver or pedestrian vision. Plantings at bus bumpouts must not conflict with bus doors or transit operations.
- All green applications in bumpouts should have well developed and committed maintenance plans prior to installation.

Utility Considerations

- Bumpouts may require relocating utilities or storm drains. They may also require moving a fire hydrant closer to the extended curb to ensure emergency vehicle access, which may increase cost. If a bumpout impacts a storm drain, the storm drain must be moved.

MAINTENANCE & MANAGEMENT

Seasonal Use & Maintenance

- **Temporary Use**: Temporary bumpouts defined by rubber curbing, flexible posts or similar, should be removed in winter months to facilitate snow removal.
- **Snow Removal:**
  - » Bumpouts may make snow removal more complicated, though special equipment should not be necessary if bumpouts are designed with return radii adequate to accommodate snow removal vehicles.
  - » Bumpouts may be appropriate locations for temporary snow storage if pedestrian pathways and crossings remain clear. Bus bulbs are not generally appropriate locations for snow storage.

Reviews & Approvals

- The Ann Arbor Engineering Unit is responsible for permitting the construction of bumpouts. The Systems Planning Unit, Engineering Unit, and the DDA (for impact to on-street parking, loading, etc) will coordinate review in the case of a private development project.



ROADWAY ZONE

MID-BLOCK CROSSINGS

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	■	■			
Transit		■	■	■	
Bicycle		■	■		■
Balanced		■	■	■	■

DESCRIPTION & INTENT

Mid-block crossings allow pedestrians to safely cross the street away from the intersection. These crossings are used where there is a destination or gap in the street network that generates demand for a crossing. Marking mid-block crossings indicates to both pedestrians and motorists where to cross and tend to concentrate pedestrian activity in that location thus decreasing jaywalking. Mid-block crossings increase predictability and safety for both pedestrians and motorists.

USE & APPLICATION

Location

- Mid-block crossings should be located wherever there is significant pedestrian demand, such as at mid-block bus stops, parks, building entrances to major destinations, or mid-block passageways.
- Mid-block crossings are ideal for corridors with a pedestrian and access or bicycle transport emphasis, but are an opportunity on all street types.
- AASHTO recommends mid-block crossings where there are already a substantial number of uncontrolled mid-block crossing movements, where a new development is expected to produce many mid-block crossings, or where the nearest intersections are at least 660 feet (1/8 mile) apart.
- The City of Ann Arbor Non-Motorized Transportation Plan Update identifies a number of such conditions in Ann Arbor. The plan distinguishes between a minor mid-block crossing (limited infrastructure modification needed) and a major mid-block crossing (which requires more Related Design Elements).

Related Design Elements

- **Raised Crosswalks**: Raised crosswalks (*See Crossings Design Element*) can increase the visibility of the mid-block crossing. At crossings without signals, raised crosswalks can encourage greater compliance on roads where average traffic speeds may exceed posted speeds.
- **Lighting**: Use high-visibility lighting that achieves positive contrast and markings to highlight unsignalized mid-block crossings.
- **Curb Cuts**: Crossings should be carefully placed when close to driveways or loading zones due to potential for conflicts with motor vehicles.

Policy References

- The City of Ann Arbor Non-Motorized Transportation Plan Update recommends crossing islands at all unsignalized marked crosswalks that cross three or more lanes. The plan also recommends active crosswalk warning systems, with a flashing beacon, for mid-block crossings.

DESIGN & OPERATIONS

Design Requirements

- **Crosswalk Marking**: Mid-block crossings shall conform to the requirements of the Crosswalk Design Element for markings. Mid-block crossings shall feel like a deliberate part of the pedestrian network and should show where pedestrians have priority and where motorists should yield. Crossings shall be visible and easily distinguished from other street features. They are an opportunity to calm traffic and reduce speeds.
- **Visibility**: Mid-block crossings can be used to increase visibility, restrict parking or extend the curbs around a crossing (*See Mid-block Bumpout Design Element*) at least 20 feet to either side of the crosswalk.

A **Width**: Mid-block crossings shall be at least 8 feet wide but ideally 10 feet in width.

B **Stop bars** may be provided at mid-block crossings. Stop bars shall be between 12 and 24 inches wide.

C Stop bars or yield lines should be set back 20 to 50 feet back from the crossing to increase the visibility of pedestrians. PEDSAFE 2013 advices that a setback of 30 feet is appropriate for most unsignalized mid-block crossings. At signalized mid-block locations, the 2009 MMUTCD recommends the stop line be placed a least 40 feet from the nearest signal indication.

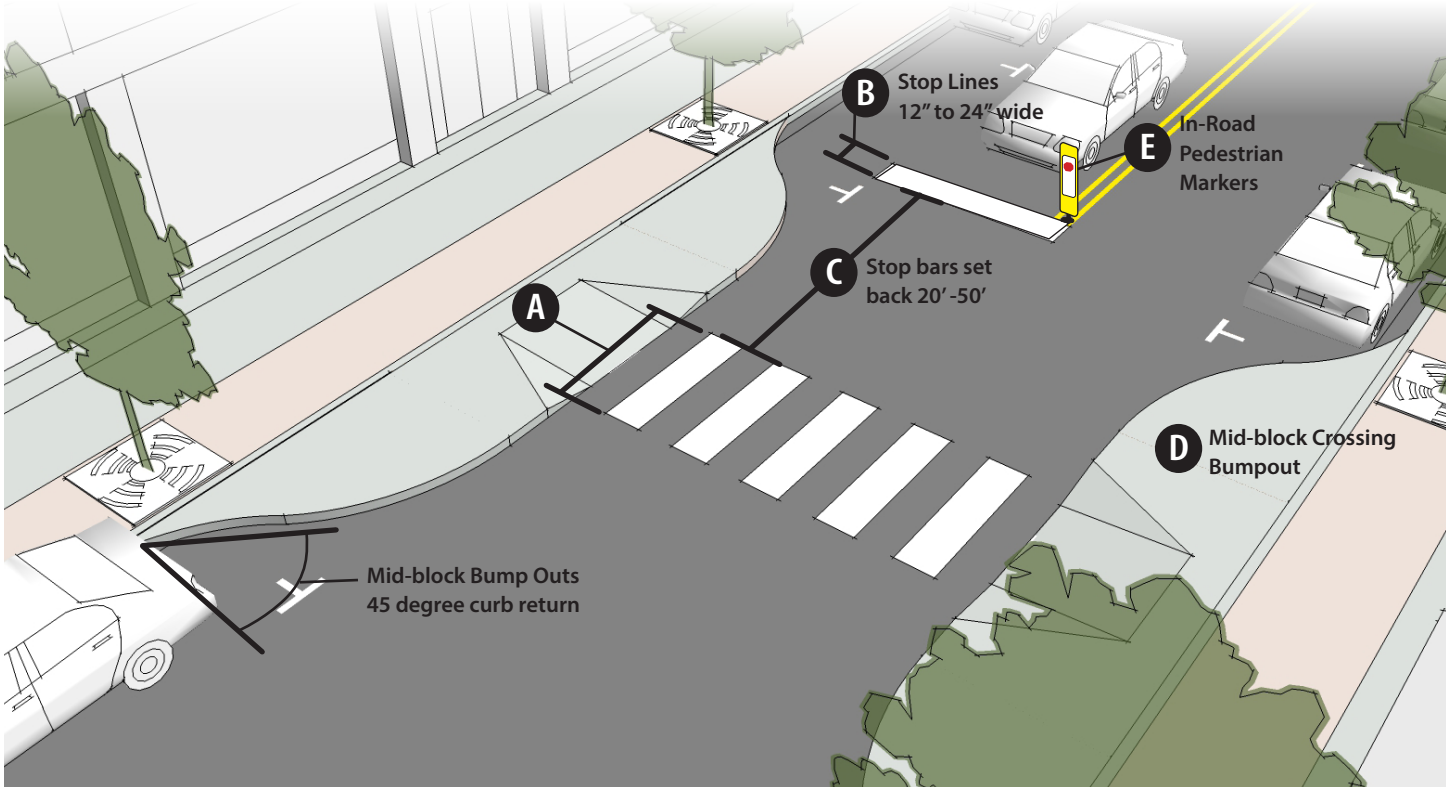
D **Mid-Block Crossing Bumpouts:** Mid-Block crossings occurring in a gap between on-street parking / loading areas shall provide a mid-block bumpout to provide a narrower crossing distance and increase the visibility of pedestrians waiting to cross.

E **In-Road Pedestrian Markers / Gateway Treatment:** In-road pedestrian markers indicating that vehicles must stop for crossing pedestrians, per local ordinance should be used where space allows. Markers shall be placed on the centerline of the roadway and on the edges of the vehicle travel lanes.

Additional Design Considerations

- Mid-block crossings may be signalized or unsignalized. There are many options for pedestrian signalization:
  - » The **standard pedestrian signal** gives oncoming motorists the red light long enough for pedestrians to clear the crossing.

Figure 4.1.9- Mid-Block Crossing



  - » The **HAWK signal**, or High-intensity Activated crossWalK, is a lighted beacon that displays a flashing yellow signal to motorists when a pedestrian attempting to cross the street pushes a button. The beacon runs through a series of cycles ultimately giving approaching motorists a red light. This allows pedestrians to safely cross on their own cycle. A separate pedestrian signal provides information to pedestrians. This type of signal is dark to the roadway users when not in use, which may be confusing for motorists. It typically shows a "DON'T WALK" signal to pedestrians when not activated.
  - » **Rapid flashing beacons** (RRFBs), which are being used extensively in Ann Arbor, are a pedestrian activated light that flashes brightly and rapidly to alert drives that a pedestrian is waiting to cross at a mid-block location and should yield to crossing pedestrians. RRFBs are typically mounted onto the standard pedestrian crossing signage.

- **Refuge Islands**: Where the crossing involves three or more lanes, mid-block crossings should include Pedestrian Refuge Islands, which make it easier for pedestrians, especially those with limited mobility, to cross safely. Refuge islands in the middle of a crossing allow pedestrians to make a two-stage crossing, which is both safer and easier. Refer to Pedestrian Refuge Island design element for more information.
- **Special paving** materials or markings can visually highlight the crossing and alert motorists that pedestrians are present. They can also be used to extend streetscape elements from the sidewalk.

Utility Considerations

- Maintain a clear path from the crosswalk to the curb ramp and onto the sidewalk. Ensure that utility infrastructure, such as signal boxes, signal poles, light fixtures, trash receptacles, and fire hydrants are outside of the Walking Zone at the end of the crosswalk.

Sustainability Considerations

- Mid-block bumpouts and refuge islands that are part of a mid-block crossing provide an opportunity to incorporate stormwater management facilities into the street design.

Design References

- The City of Ann Arbor Public Services Standard Specifications provides guidance on crosswalk design and materials and lists specifications for allowable soil mixtures, mulches, and staking methods for landscaping in median refuge islands.
- The MMUTCD recommends providing a signal at mid-block crossings where pedestrian demand is high.

MAINTENANCE & MANAGEMENT

General Maintenance

- Ann Arbor Public Works is responsible for maintaining mid-block crossings on public streets. Monitor crosswalks for any damage to paint or markings that could reduce their visibility and repair them quickly. Crosswalks should be visible to all road users at all times.

Special Maintenance

- Re-stripe crosswalks as soon as possible after repaving.
- Use repaving as an opportunity to install higher-visibility markings.

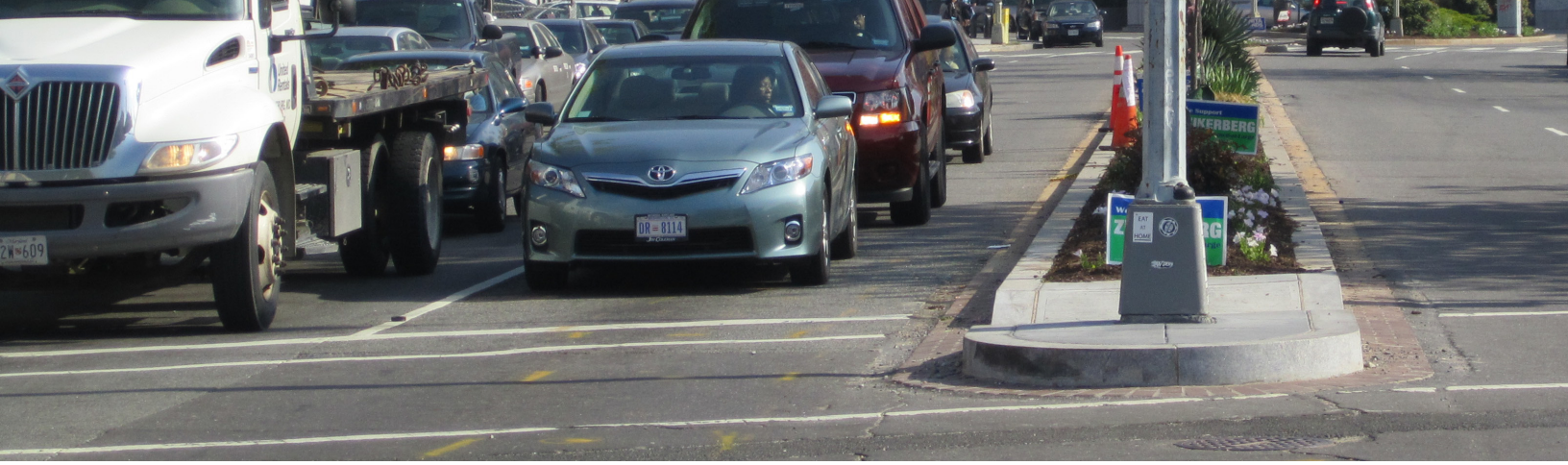
Seasonal Use & Maintenance

- Keep crosswalks and curb ramps clear of snow to facilitate pedestrian movement after a snowfall.

Reviews & Approvals

- Ann Arbor City Engineering Unit, in collaboration with the Systems Planning Unit, is responsible for determining where crosswalks are installed.

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ROADWAY ZONE

PEDESTRIAN CROSSING ISLAND

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	■	■			
Transit		■	■	■	
Bicycle		■	■		■
Balanced		■	■	■	■

DESCRIPTION & INTENT

Pedestrian crossing islands, also called pedestrian refuge islands, are raised sections within the roadway that provide a safe landing zone for pedestrians to use while crossing a street with multiple travel lanes. These protected spaces reduce pedestrian risk by reducing the crossing distance and breaking up longer crossings into two or more stages. Because the pedestrian is crossing fewer lanes of traffic, pedestrians more easily to find gaps to cross at unsignalized crossings. At signalized crossings, it provides a safe place to wait between cycles. Median pedestrian refuges are a sub-category of pedestrian islands.

Pedestrian refuge islands also function as a traffic calming device. The Pedestrian and Bicycle Information Center, a FHWA project, reports that "crossing islands have been demonstrated to decrease pedestrian-vehicle incidents by 46% at marked crossings, and by 39% at unmarked crossings." [1]

USE & APPLICATION

Location

- Pedestrian refuge islands are appropriate on streets with any Frontage Context or transportation emphasis.
- Pedestrian refuge islands are most often used on multi-lane roadways where a pedestrian must cross 40 feet or more of continuous roadway, and their use is further recommended on vehicle emphasis streets. Pedestrian refuge islands are already in place in some of the larger street corridors of downtown (e.g. North University and Huron Street).
- Pedestrian refuge islands may also be used as a channelization device, often in concert with mini roundabouts or acute angle right turns. While most intersections in the downtown area join at right angles, the tool is included here for information.

Related Design Elements

- **Mid-Block Crossing**: Pedestrian refuge islands may occur in the middle of the street, as on Huron Street near the University, as part of a mid-block crossing.
- **Bumpouts:** Pedestrian refuge islands may be used in conjunction with bumpouts, raised crossings or other applications as a traffic calming device.

1 Pedestrian and Bicycle Information Center, Facility Design, http://www.ped-bikeinfo.org/planning/facilities_crossings_islands.cfm Accessed December 2014

DESIGN & OPERATIONS

Design Requirements

A **Crosswalks**: Pedestrian refuge islands shall have marked crosswalks leading to and from them. The pedestrian walk should continue at-grade through a pedestrian island. Use detectable warnings such as raised bumps, where crosswalks intersect islands.

B **Elevation**: Pedestrian refuge islands shall be raised above the level of the roadway and protected with a vertical curb.

C **Width**: Pedestrian refuge islands shall be at least 6 feet wide and preferably 10 feet wide in order to comfortably accommodate single pedestrians, pedestrians with strollers or assisted mobility devices, or pedestrians with bicycles.

D **Signage**: Shall include placement of MMUTCD "Stop Here for Pedestrians" signs and stop bars as needed per crosswalk requirements.

- **Landscaping**: Landscaping on pedestrian refuges shall be less than 18 inches, so as not to impeded sight-lines and visibility.

Utility Considerations

- Pedestrian refuge islands should be carefully coordinated to minimize conflicts. Do not place utility vaults in pedestrian islands with subsurface utilities.

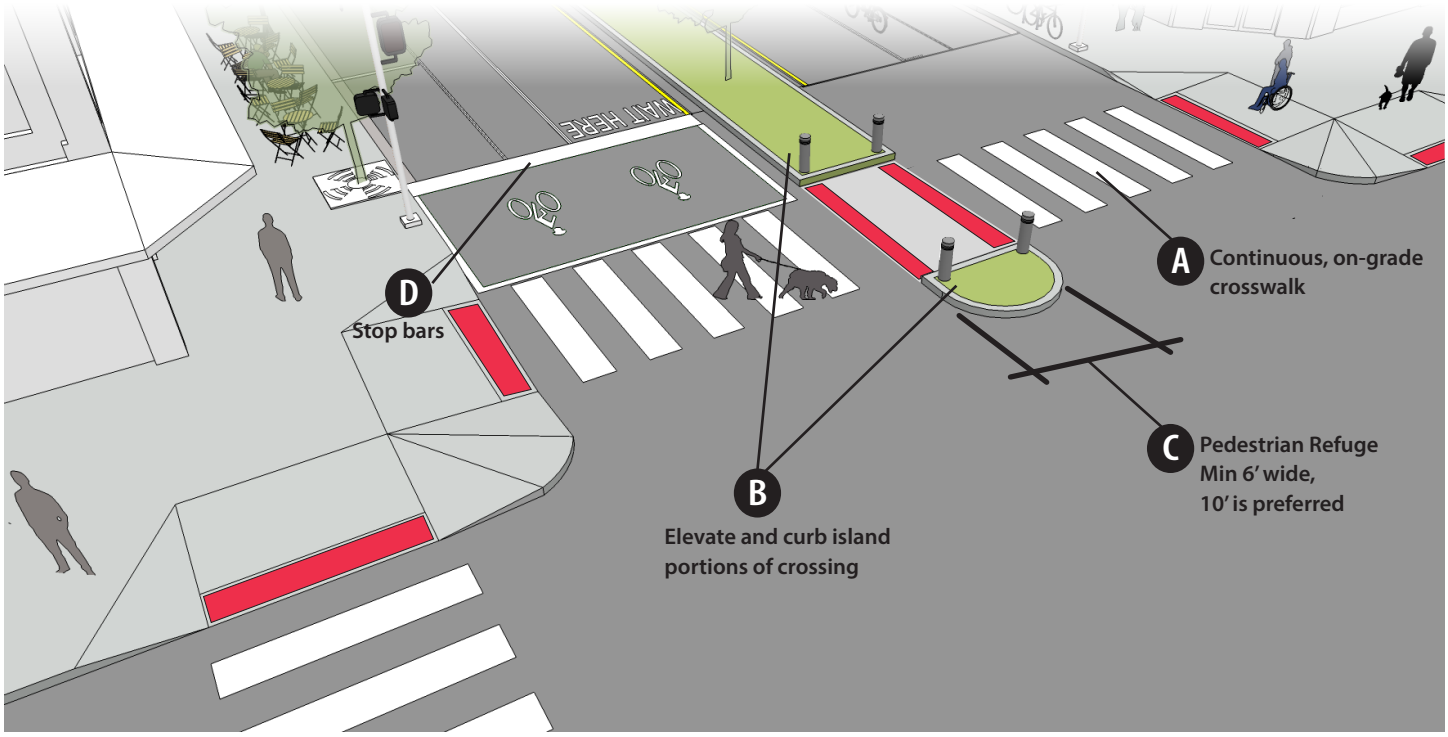
Sustainability Considerations

- Pedestrian refuge islands provide opportunities to introduce stormwater management systems such as infiltration pits, rain gardens, or pervious areas in the roadway.
- Pedestrian refuge islands also provide an opportunity for public art, provided it does not introduce any hazard or safety risk to roadway operations.

Design References

- The NACTO Urban Street Design Guide provides additional guidance on the design of pedestrian islands.
- The MMUTCD provides standards for the design of pedestrian islands and refuges.
- The AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities provides additional guidance.

Figure 4.1.10- Crossing Island



MAINTENANCE & MANAGEMENT

Special Maintenance

- **Repaving**: Pedestrian refuge islands will introduce some additional costs to routine maintenance such as street repaving.
- **Landscape**: Landscaped pedestrian refuge islands will need regular landscape maintenance and may need irrigation.

Seasonal Use & Maintenance

- **Snow Removal**: Pedestrian refuge islands can introduce some complications for snow removal if not properly designed.
  - » Islands should accommodate the turn radii of snow clearance equipment. Pedestrian refuge islands that are lane diverters or channelization features must provide adequate width from curb-to-curb to enable snow plows to proceed through the gap.
  - » Pedestrian refuge islands should not generally be used for snow storage; however, portions of the island not used for walking surface may accommodate some temporary snow storage as long as it does not impede sight lines.
  - » Clearly assign responsibility for removing snow from walking surfaces on pedestrian islands.
  - » Walking surfaces should be designed for adequate drainage to avoid the pooling of water and propensity to ice over. Walking surfaces should be wide enough to accommodate snow removal equipment.
  - » Use vertical reflective delineators to alert snow removal crews to the presence of the island, median or refuge.

Reviews & Approvals

- As with other features in the road travel lanes, pedestrian refuge islands will be reviewed and approved by the Ann Arbor Engineering Unit and the Systems Planning Unit. If facilities are proposed on a state route, MDOT will govern approvals.




THE
BARN



VARIES

PUBLIC ART

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	■	■			
Transit		■	■	■	
Bicycle		■	■		■
Balanced		■	■	■	■

DESCRIPTION & INTENT

Public art in downtown can create more vibrancy and interest for pedestrians and other users of the public right-of-way. Public art can assume many different forms, from murals on the sides of buildings, to fixed sculptures, artistic crosswalks, to temporary exhibits and installations. Incorporating public art into other street elements, such as light post banners, the sides of waste receptacles, and signal boxes, can transform common street elements into unique features. Public art helps activate less intensely used areas and fosters care and investment in downtown.

USE & APPLICATION

Location

- Public art can be incorporated in any place downtown and is appropriate to all street types and contexts.
- Public art can be freestanding works in the Amenity Zone or Frontage Zone, visible to pedestrians and road travelers alike. Artwork can also be horizontal surface treatments on walking surfaces, parking surfaces, or travel lanes provided it does not cause hazards or confusion for street users. Public art can also be incorporated into building facades.

DESIGN & OPERATIONS

Design Requirements

- Works of public art shall not infringe or impede on the free flow of pedestrian traffic in the Walking Zone.
- A minimum clear zone in the sidewalk of 6 feet shall be maintained. This minimum clear zone may be wider in certain locations where wider sidewalks are stipulated. *See the Sidewalk and Amenity Zone Design Element.*
- Public art shall not interfere or obstruct the safe use and operations of the public streets for vehicles, pedestrians, cyclists, and other users of the street.
- Artwork on horizontal surfaces, such as sidewalks, crosswalks, or roadways, should be temporary installations, recognizing that street projects and general wear will degrade the art work overtime.

Utility Considerations

- Works of public art cannot impede access to utility access panels, vaults, or other infrastructure services areas.

MAINTENANCE & MANAGEMENT

General Maintenance

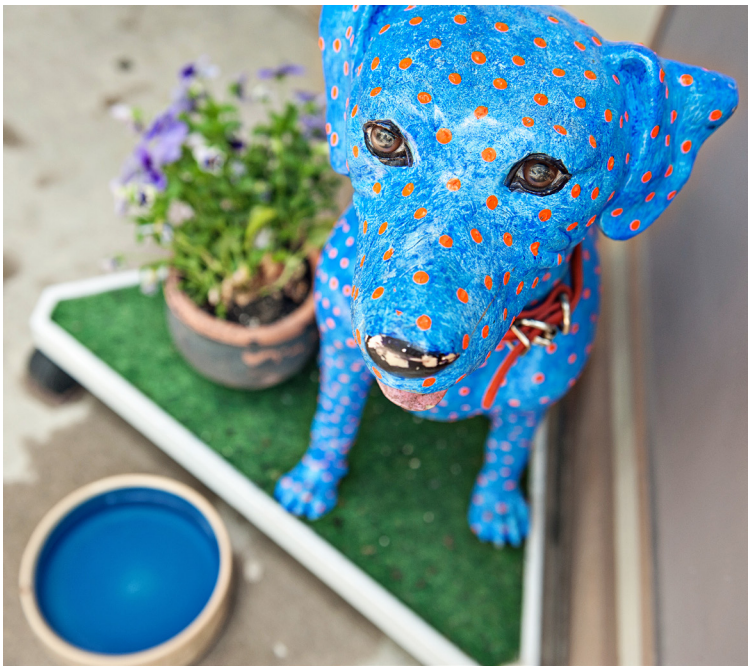
- Works of public art are required to be maintained for the duration of their installation by the entity responsible for sponsoring art. Public art must be maintained so that it does not pose on-going safety concerns or other nuances on uses within downtown.

Seasonal Use & Maintenance

- Temporary works of public art are allowed.
- Sponsors of public art are responsible for maintaining the condition of installed works during the winter months.

Review & Approvals

- Permanent works of art occupying any part of the street right-of-way must be approved by the Ann Arbor Engineering Unit and a maintenance agreement may be required.
- If permanent works of art are gifted to the City or DDA (and accepted), the accepting unit or agency will be responsible for maintenance.
- Sidewalk occupancy permits are required for temporary art installations that are within the Frontage, Sidewalk, or Amenity Zones of the street.
- Temporary works of art intending to occupy parking spaces must be approved by the DDA, and the parking meter must be rented consistent with other alternative uses in parking spaces (e.g. construction closures, platform dining, bike corrals).






ROBERTO



4.2

COMMERCIAL DESIGN ELEMENTS

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CURBSIDE ZONE

ON-STREET PARKING

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	!	✓			
Transit		!	!	!	
Bicycle		■	■		■
Balanced		✓	✓	✓	✓

DESCRIPTION & INTENT

On-street parking, also referred to as curbside parking, is permissible space in the public right-of-way in which drivers may leave their car, motorcycle, or other vehicle and visit the shops, offices, and residences of downtown. Curbside parking has a profound influence over the character, operation, and comfort of downtown streets.

Public curbsides are in high demand for a wide variety of uses including curb bumpouts or sidewalk extensions, vehicle parking and loading, commercial deliveries, waste and recycling removal, bicycle parking and in some cities public seating, mobile vending and/or cafe dining. In higher intensity Commercial or Mixed use areas on-street parking is typically limited to short-term, higher turnover parking activities. Longer duration stays are better accommodated in off-street lots or parking ramps.

Where parking demands are high, metering (pay to park) is a best practice management strategy to optimize use of the spaces and encourage the balanced use of both on- and off-street parking resources.

Parking may be permitted at all times of day or only during non-peak travel hours. On-street parking can be used as a buffer for other street uses including protecting sidewalks and/or bicycle facilities from traffic moving in the travel lanes, and on-street parking can have a traffic calming effect. This protection generally increases the sense of comfort and enjoyment of these street spaces and modes of travel. Permanently reserving curbsides for on-street parking enables flexibility for future street design strategies (e.g. bumpouts and bike lanes). When parking is restricted and the curb lane is converted to a travel lane or solid waste removal site, even for a few short hours of the day, future use is constrained.

USE & APPLICATION

Location

- On-street parking is appropriate and beneficial to most street types and contexts. Vehicle emphasis corridors may prohibit on-street parking or restrict it during peak travel hours in order to increase vehicle capacity.
- On-street parking can be designated or managed to provide curbside access for persons with disabilities. In the State of Michigan, people who need handicap parking can apply for a disability parking placard. People meeting certain criteria can apply for a free parking sticker.
- Increasingly cities are adopting Ann Arbor's approach and designating metered, curbside spaces reserved for drivers displaying valid disability placards concurrent with installation of accessible, multi-space payment machines. Regardless of the method, curbside parking for persons with disabilities should be proximate to major destinations including principal commercial areas and civic buildings.
- Metered (paid) curbside parking is most appropriate in or adjacent to areas with high curbside demand and a high level of activity throughout most hours of the day. Curbside parking need not be metered in areas of

lower demand (e.g. Near Neighborhood contexts), and parking can be managed to provide a sufficient level of access to those who need it (e.g. through Residential Parking Permits).

- While beneficial, on-street parking is only one use of the public curbside. Alternative uses of the curbside may provide a greater public good in appropriate areas, including conversion to bicycle facilities, transit lanes, bumpouts, bicycle parking or other uses. The use of the public curbside must weigh the needs of the uses on that block face against the role and necessity of the street as a link in a larger networked system.

Related Design Elements

- **Bicycle Lanes**: Curbside parking conflict with cyclists within the first 2 to 3 feet of a parked car. This is known as the "dooring zone," the area where vehicle drivers or passengers may inadvertently open their door into a passing cyclist. Parking lanes and adjacent facilities should be designed with adequate space, such as a 2 to 3 feet wide buffer zone between the parking lane and the bicycle lane, to minimize this risk.
- **Cafe Seating and Outdoor Retail**: Access into and out of vehicles parked at the curbside may conflict with cafe seating in the Amenity Zone of the sidewalk. Similarly bicycle racks, parking meters, street light poles, and other fixtures in the Amenity Zone should provide sufficient space to enable access and egress from vehicles parked curbside. Typically 18 to 24 inches is sufficient clearance between parked vehicles and Amenity Zone elements.
- **Curbside Zone Uses**: On-street parking may be combined with bumpouts, parklets, platform dining, bike corrals or other Curbside Zone uses to enhance the pedestrian experience, safety and multi-modal access.
- **Waste Collection:** The on-street parking lane is not suitable for solid waste collection. New private developments consisting of more than 2 units shall not place solid waste in parking lane

DESIGN & OPERATIONS

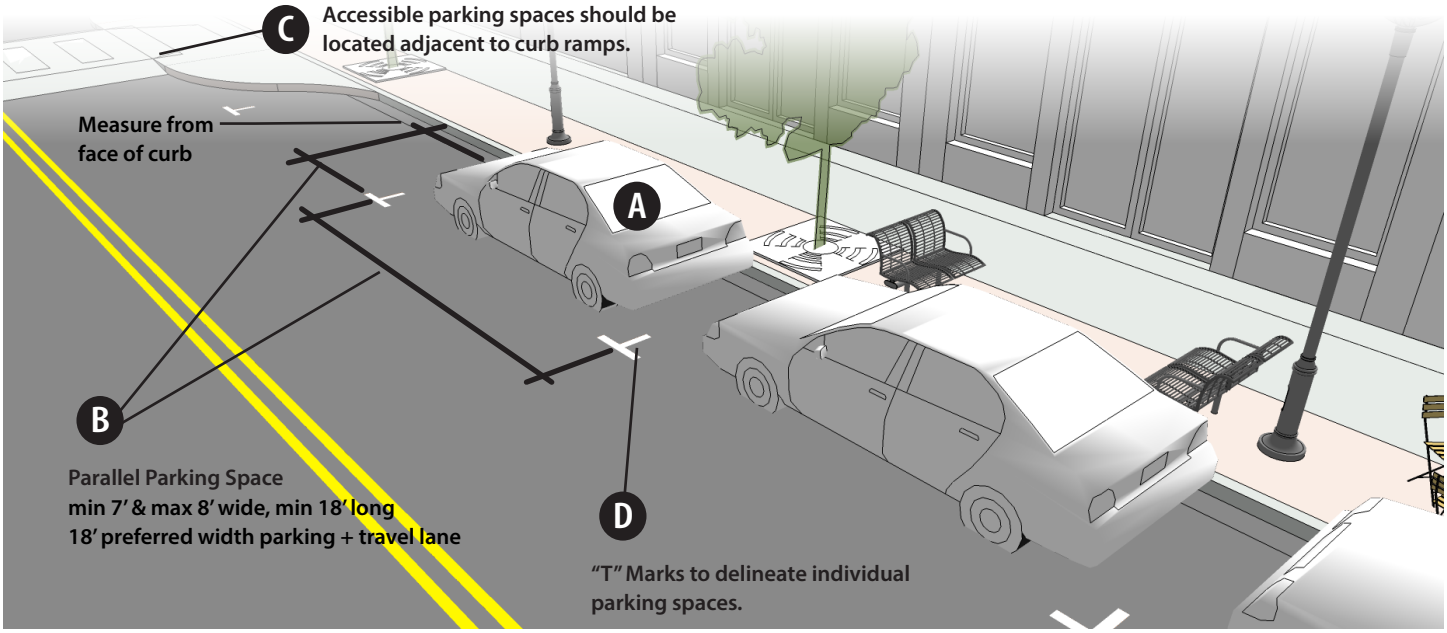
Design Requirements

A **Parking Angle**: On-street parking shall align parallel to the curb. While perpendicular or angled parking are also acceptable configurations, in narrow street rights-of-way like downtown Ann Arbor parallel parking provides more benefits and fewer conflicts with other street users.

B **Parking Space Size**: Parallel curbside parking spaces shall be a minimum of 7 feet of width and 20 feet of length. Width shall be measured from the face of curb to the center of the parking lane markings. The length of spaces may be reduced down to 18 feet in constrained locations.

C **ADA Accessibility**: Parking spaces designated for use by persons with disabilities should be located adjacent to curb ramps to facilitate access to and from the sidewalk space by persons of all abilities.

Figure 4.2.1- On-Street Parking



- **Intersection Clearance**: Parking spaces shall not be located within 20-feet of the nearest edge of a crosswalk.
- **Meters**: When parking is metered, standard Ann Arbor multi-space, pay by space, metering system shall be utilized.
  - » **Pay Stations**: The metering system shall use centralized pay stations.
  - » **Space Number Signs**: The space number for each individual space shall be marked with a fixed sign. Signs should be in between parking spaces and identify the two adjacent spaces.
- **Special Parking Zones**: Temporal curbside parking, parking that is restricted for some periods of the day, and/or converted to a travel lane, shall require additional signage and enforcement.

D **Parking Space Pavement Markings:** Individual parking spaces may be marked with "T" pavement markings at their outside edge. Alternatively parking may be defined with a solid white line to discourage encroachment of parked vehicles into adjoining travel ways.

Design References

- The U.S. Access Board Draft PROWAG provides guidance for on-street accessible parking spaces.[1]
- The DDA establishes policy for on-street metered parking in downtown Ann Arbor. The City of Ann Arbor oversees the Residential Permit Parking Program.

Sustainability Considerations

- Alternative uses of on-street parking, such as bike corrals, can encourage other modes of transit and reduce vehicle emissions and fuel consumption.

Utility Considerations

- Ensure that curbside parking elements (meters, stall markets, and pay-stations) do not obstruct access to underground utilities or electrical transformer vaults.

[1] http://www.access-board.gov/guidelines-and-standards/streets-sidewalks/public-rights-of-way/background/access-advisory-committee-final-report/x02-6-vehicular-ways-and-facilities

MAINTENANCE & MANAGEMENT

Seasonal Use & Maintenance

- **Snow Removal:** Snow should be removed from curbside parking areas as they provide vital access to the businesses and activities of downtown.
  - » The City of Ann Arbor clears snow from curbside parking spaces.
  - » Snow can be temporarily stored in curbside parking spaces, but for no more than 24 hours.





Reviews & Approvals

- The City of Ann Arbor Customer Services Unit is responsible for issuing permits for residential permit parking.
- The DDA is responsible for managing curbside space and permitting uses in the DDA Parking Area.
- Private Development and UM Projects:
  - » Projects that impact on-street parking spaces will be evaluated under the City Council Resolution to Approve a City Policy Regarding Removal of On-street Metered Public Parking Spaces and DDA Policy Regarding On-street Meter Removal.
  - » Projects should not impact an on-street parking meter space unless a compelling, broad community benefit can be established.
  - » If a proposed project impacts on-street parking, DDA staff will evaluate the need for removal.
  - » If removal is approved, the project will be charged $45,000 and 10 years of lost revenue per space unless there is a community benefit as defined by the above policies.



AMENITY ZONE / FRONTAGE ZONE

CAFE DINING & OUTDOOR RETAIL

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	✓			
Transit		!	!	■	
Bicycle		!	!		■
Balanced		!	!	■	■

DESCRIPTION & INTENT

Sidewalks and the adjacent Frontage and Amenity Zones are important spaces within the street environment for pedestrian and commercial activity.

Cafe dining and outdoor retail allows private business owners to occupy a portion of the public right-of-way in front of their business or commercial operation for purposes of economic activity. Cafe dining enables restaurants, bars, and other establishments to provide outdoor seating space to serve patrons. On the retail side, outdoor retail enables the display and sale of retail goods within the public right-of-way.

USE & APPLICATION

This Design Element relates to providing well-designed space and accommodation for cafe dining and outdoor retail to occur within the public realm downtown; but does not require such activities to occur.

Location

- Space for cafe dining and outdoor retail is encouraged within areas of downtown with relatively high levels of pedestrian and commercial activity. *See Pedestrian & Access Emphasis Streets.*
- Adequate space for outdoor commercial activity is recommended on all other Commercial and Mixed Frontage Context streets.
- In Civic & University and Near Neighborhood areas, providing space for cafe dining and outdoor retail can be an opportunity on a case-by-case basis in consideration of the specific land use-mix on the street. In general, cafe dining or other potentially loud activities should be limited when close to residential housing.

Related Design Elements

- **Curbside Occupancy**: Parklets or platform dining, that extend the pedestrian space temporarily into the parking lane can be combined with cafe dining and outdoor retail to provide additional space for public seating and/or commercial use. *See the Policy & Management chapter for additional guidance.*
- Parking Spaces and Meters: Public access to parking meters, pay stations, and from parking spaces to the sidewalk needs to be considered in the layout and design of any sidewalk occupancy activities.

Policy Guidance

- The Sidewalk Occupancy Permit documentation contains additional guidance and permitting requirements for cafe dining and outdoor retail within the public right-of-way.

DESIGN & OPERATIONS

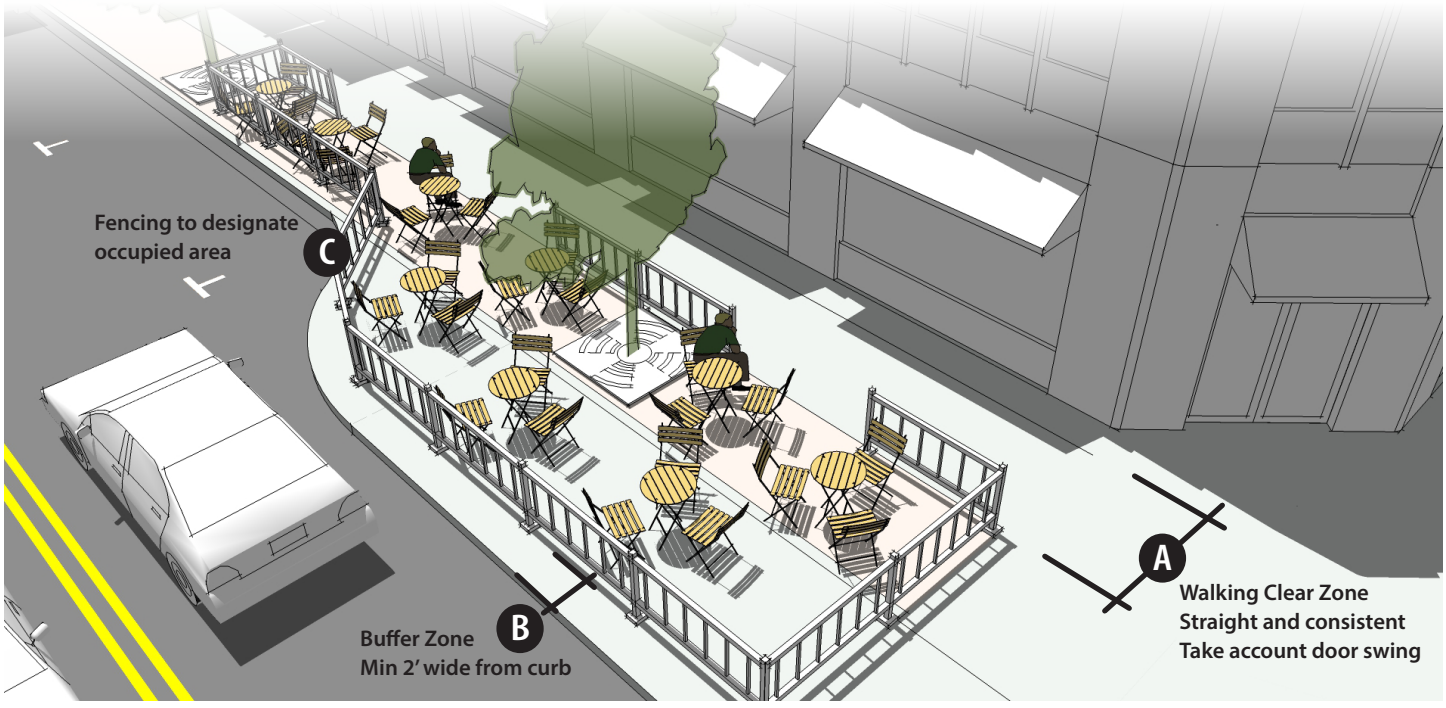
Design Requirements

A **Clear Walk Zone**: A clear Walking Zone / Sidewalk within the Pedestrian Area shall be maintained with absolutely no encroachments in a straight, consistent alignment along the entire block face. The minimum width varies depending on the Street Frontage Context, see Table 4.1.1.A for the required widths. The clear walking zone shall be free of any encroachments such as tables, chairs, fencing, planters boxes, sales racks, signs, or any other physical obstructions.

» In locations where doors into buildings swing out into the clear zone, the clear zone shall take into account the door swing areas and provide additional clearance.

B **Curb Clearance:** A minimum of 2 feet from the edge of curb shall be kept clear at all times from occupancy uses to buffer against parked cars or travel lanes or to maintain parking meter access or other needs for the immediate curb areas, unless the entire street is closed as part of a larger special event and street closure.

Figure 4.2.2- Cafe Dining







- **Location**: All cafe seating and outdoor retail activities shall be located within the Amenity Zone of the street to provide a clear and straight Walking Zone.
  - » Occupied areas must provide free and clear access to parking meters and parking pay stations.
  - » Activities may occur in the Frontage Zone provided that the specific street segment has been designed specifically, and with Street Design Team approval, to accommodate occupancy in the Frontage Zone.

C **Fencing Requirements**: For cafe dining occupancy uses serving alcohol, a ridged fence enclosure with at least two horizontal stringers along the entire run shall be used to define the edges of the occupied zone. Fencing shall run completely along the curbside edge of the occupied area, maintain in the 2-foot clear zone off the curb, and along the ends of the occupied area. Fencing is encouraged along the edge of the sidewalk to maintain clear separation between sidewalk traffic and the occupied area, although it is not required.

  - » Fencing must be made of durable materials and construction. Fencing must be self-standing and may not be attached or bolted to pavement surfaces, landscape planters, buildings, or other street fixtures.

- **Plan Requirement**: Areas designated for dining and outdoor retail must submit a scaled graphic plan indicating the area designated for sidewalk occupancy Must conform to other requirements identified in the permit application.

Additional Design Considerations

- **Amenity Zone Width**: Streets where cafe dining and outdoor retail is recommended should consider providing a wider Amenity Zone to accommodate outdoor retail. *See Sidewalk & Amenity Zone Design Element*.
- **Heaters**: Outdoor heaters may be used within occupied areas provided they are free standing, do not generate noise, and do not require cables, wires, or other hookups to cross the clear Walking Zone.

Utility Considerations

- Provide ready access to utilities if needed for maintenance or other utility operations. Occupied areas must make note of where utility access panels, vault covers, and other utility connection points are located.

MAINTENANCE & MANAGEMENT

General Maintenance

- Sidewalk occupants are required to ensure that their occupancy conforms to the layout stipulated in their permit at all times. Fencing, seating, sales racks, or other features must be maintained and checked to ensure that no encroachment into clear zones occur.
- Sidewalk occupants are required to keep areas free from trash, debris, food scraps, or other refuse on a daily basis.

Seasonal Use & Maintenance

- Sidewalk occupancy permits are valid from May 1 to April 30. Most sidewalk occupancy uses are not well-suited during the winter months, and Amenity Zones used for sidewalk occupancy often provide snow storage functions during the winter. Permit holders may continue occupancy provided the occupied area is kept free from snow, ice, and other seasonal hazards.

Review & Approvals

- Business, property owners, or other individuals wishing to occupy a sidewalk for commercial purposes are required to submit a Sidewalk Occupancy Permit to the City of Ann Arbor Community Services Permit Desk.
- Permits are issued by the City of Ann Arbor Community Services Unit.



CURBSIDE ZONE

LOADING ZONES

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	✓			
Transit		✓	!	!	
Bicycle		✓	!		■
Balanced		✓	!	!	■

DESCRIPTION & INTENT

A loading zone is a dedicated space at the curbside intended for short duration use to directly service nearby businesses or properties. In this context, loading zone primarily refers to use of the curbside space for material deliveries. Zones for the loading and unloading of passengers are addressed in the “drop-off zone” section; however, loading zones may serve both purposes.

Loading zones help promote a strong economy and a vibrant retail environment. A sufficient number of loading zones, appropriately located and designed, can dramatically improve the safety, operation, and vitality of a street. Loading zones may reduce the incidence of truck double-parking and the cost of goods delivery borne by local businesses and their consumers. However, loading zones also take up space that could otherwise be used for parking, pedestrian, or transit space and therefore should be well managed to optimize use.

USE & APPLICATION

Location

- Loading zones are generally used by a number of businesses or properties on a block and are a shared resource. The need for new spaces should be reviewed in the context of a block or neighborhood.
- Loading zones can be located wherever curbsides are not used as travel lanes.
- Loading zones are appropriate and necessary in Commercial and Mixed use contexts and may be used on all Functional Emphasis corridors, though special caution should be used on pedestrian, bicycle and transit emphasis streets.
- Loading zones should be considered carefully in Near Neighborhood areas such that truck traffic is not encouraged on quieter residential focused streets.
- Loading zones are intended for short duration parking – typically 30 minutes or less. Loading zones are typically reserved for only a portion of the day and used for general parking or travel at other times. If loading zone installations impact on-street parking, parking removal may be subject to meter removal and loss revenue fees.
- Alleys should be used for loading whenever possible. Off-street loading facilities are generally required for new developments and should be designed and managed to facilitate their use. Despite the presence of alleys and/or off-street loading, on-street loading zones may still be required.

Related Design Elements

- **Sidewalks**: Sidewalks near loading zones should be wide enough to accommodate delivery people moving items from the vehicle to the business without disrupting pedestrian traffic.
- **Bicycle Lanes**: Loading zones should not block any part of an adjacent bicycle lane.
  - » Adjacent travel lanes should be wide enough to permit passing a commercial vehicle parked at curbside.
- **Bumpouts**: On-streets where a parking lane may no longer be warranted, consider bumpouts or flexible use of parking lane around the loading zone to expand pedestrian space.
- **On-Street Parking**: If loading zone installations impact on-street parking, parking removal may be subject to meter removal and loss revenue fees.
- **Cafe Seating and Outdoor Retail**: Cafe seating should not be placed near loading zones, as movement from deliveries may negatively impact dining activities.
- **Transit/Protected Bicycle Lanes**: Do not use loading zones on curbsides where a transit lane or protected bicycle lane is present.

DESIGN & OPERATIONS

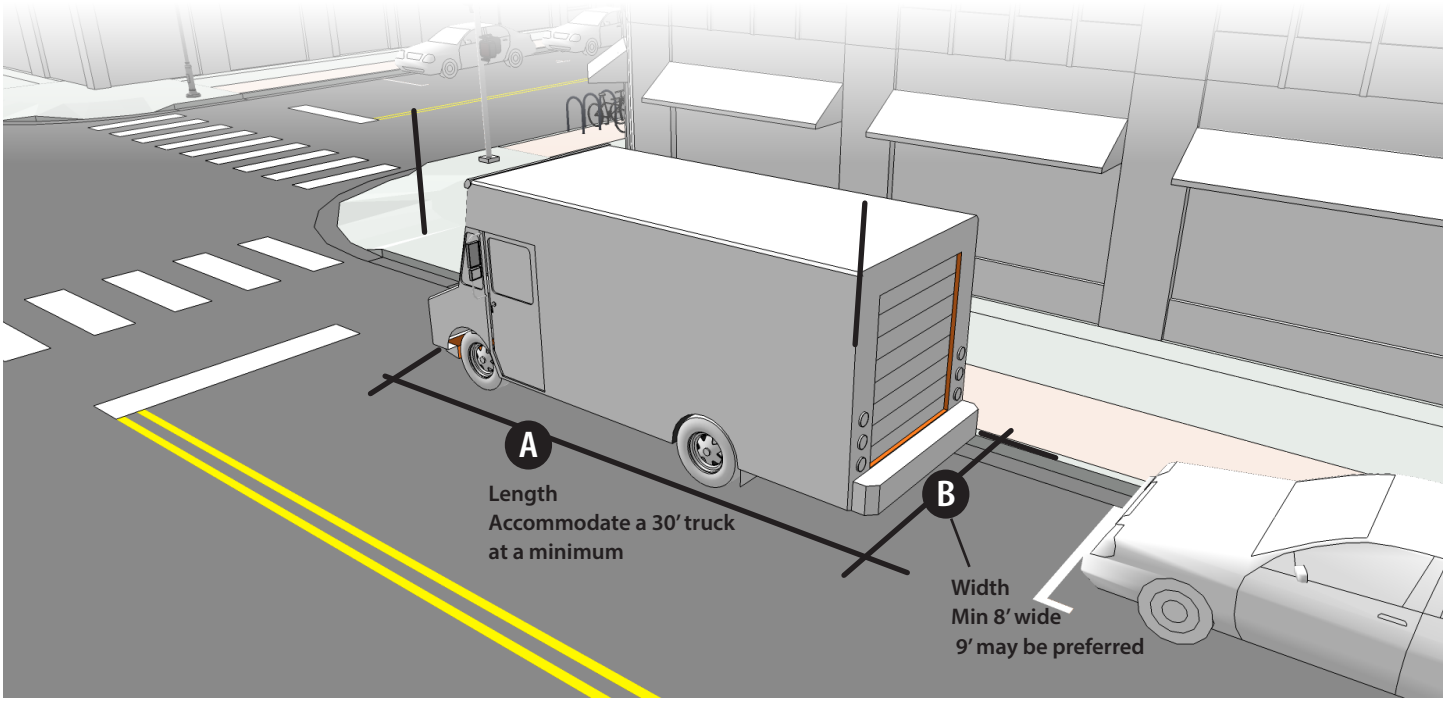
Design Requirements

A **Length**: Loading zones intended for material deliveries shall be designed to accommodate, at minimum, a single unit 30-foot delivery vehicle (SU-30).

B **Width**: Loading zones shall be a minimum of 8 feet wide; however, 9 feet is desirable. If 9 feet cannot be accommodated, travel lanes on streets with loading zones should anticipate potential affects from loading vehicles.

- **Markings and Signage**: Use MMUTCD standards for appropriate loading zone signage. Loading zones shall be well-marked to indicate to other drivers that they cannot park there.
- **Pedestrian Access**: Loading zones shall not be located within 30-feet of the nearest edge of a crosswalk on the approach side, or within 20-feet of the nearest edge on the far side of a crosswalk.
- **Street trees**: Carefully consider the selection and placement of street trees to avoid conflicts with larger delivery vehicles. Ensure there is adequate space and/or use narrower tree species.

Figure 4.2.3- Loading Zones



Additional Design Considerations

- **Intersection Clearance:** Parking spaces shall not be located within 30-feet of the nearest edge of a crosswalk.
- **Location**: Place loading zones near intersections, and preferable on the far side of intersections to facilitate access to and from the rear of trucks and to have close access to curb ramps for moving materials into buildings.
- **Sidewalk Obstructions**: Sidewalk space adjacent to loading zones should be reasonably clear of furnishings, landscaping and other obstacles.
- Operations & Timing:
  - » **Use Time Limit**: Restrict deliveries in the loading zone to 30 minutes maximum to ensure turnover and prevent double-parking from other delivery vehicles. Consider metering loading zones to encourage turn over.
  - » **Coordination**: Encourage collaboration among businesses to coordinate and/or stagger delivery times to discourage double-parking if multiple businesses are sharing the loading zone.
  - » **Off-Peak Loading**: Encourage loading during off-peak hours (typically early morning or late evening). Consider reserving zones for loading only during these preferred times.
- Non-Loading Uses:
  - » **Parking, Taxi-Stands, Valet**: Permit use of loading zones for other uses during non-delivery hours. Typical uses include curbside parking (after normal metered hours), taxi stands, or valet parking operations.
  - » **Passenger Drop-Off**: Loading zones may be used for passenger drop-off provided trucks are not actively seeking access.

Design References

- The MMUTCD provides standards for pavement markings and signage in loading zones.

MAINTENANCE & MANAGEMENT

General Maintenance

- **Enforcement**: Enforcement can be a significant concern and challenge for loading zones. Clear signage is necessary, but reliable enforcement is also required to ensure loading zones are not used for auto parking or longer duration parking by commercial vehicles.

Seasonal Use & Maintenance

- **Snow Removal**: Clear loading zones of snow. Do not use for snow storage.

Reviews & Approvals

- The DDA is responsible for overseeing curbside uses/programming through the parking contract with the City.
- The Ann Arbor Engineering Unit coordinates to issue Traffic Control Orders for enforcement purposes.
- New private or The University of Michigan developments that require new loading zones as a result of building use and activity will be subject to meter removal fees and revenue replacement if preexisting on-street parking spaces are impacted.



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CURBSIDE ZONE

SHORT-TERM PARKING & DROP-OFF ZONES

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	✓			
Transit		✓	!	!	
Bicycle		✓	!		■
Balanced		✓	!	!	■

DESCRIPTION & INTENT

A short-term drop-off zone is a dedicated space at the curbside for vehicles to drop-off or receive passengers. Drop-off zones can receive taxicabs or private vehicles, and increase the accessibility of a pedestrian-oriented district, accommodating visitors with limited mobility who may not be able to walk long distances. Drop-off zones are generally open to the public and are sometimes used for brief loading as well.

Drop-off zones may also accommodate short-term parking, typically 15 minutes, allowing people to pick up goods (e.g. carry-out orders) without having to park in a more remote location or search extensively for an open parking space.

USE & APPLICATION

Location

- Drop-off zones are suitable for all Frontage Zones and all Functional Emphasis street types.
- Short-term parking located in the curbside lane is suitable for all Frontage Zones and all Functional Emphasis street types to provide greater access for quick pickups from nearby businesses and to reduce congestion and safety conflicts, especially near dense residential and retail.
- Drop-off spaces are located in the curbside parking lane. Given high and competing demand for curbside space, the need for and benefit of drop-off spaces must be clearly demonstrated. Common criteria include greater access for more people and where need cannot be otherwise met. Drop-off zones established to serve a particular property will be subject to fees and/or revenue replacement.
- Drop-off zones are appropriate near buildings that may receive a large number of visitors, particularly visitors with limited mobility, or a high number of short-term trips such as medical or institutional buildings, hotels or large residential buildings.
- Drop-off zones and the vehicles entering and exiting them must not degrade safe and efficient operation of the adjacent travel lanes, including bicycle facilities, and Walking Zones.
- The curb should be reserved for drop-off for the shortest duration possible. Drop-off zones may be used for other purposes during the balance of the day. Common uses include commercial loading, taxi stands, and metered parking.

Related Design Elements

- **Cafe seating** should not be placed near loading zones due to conflicts between diners and passenger loading.
- **Drop-off zones** should not be placed on curbsides where a transit lane or protected bicycle lane is present.

Policy References

- The MMUTCD provides standards for pavement markings and signage in drop-off zones.

DESIGN & OPERATIONS

Design Requirements

- **Intersection Clearance:** Parking spaces shall not be located within 30-feet of the nearest edge of a crosswalk.
- **Length**: Drop-off zones shall be at least 25 feet long and located in front of the building entrance where the zone is requested. If multiple buildings on a block request a drop-off zone, consider a single, common loading area.
- **Width**: Drop-off zones shall be the width of adjacent on-street parking, else a minimum of 8 feet wide. Parking lanes with drop-off zones may need to be wider to accommodate people with special needs. Consider a minimum 8-foot parking lane on-street parking areas with drop-off zones.
- **Sidewalk Clearance**: Maintain an 8-foot wide clearance zone on the sidewalk adjacent to loading zones restricting site furnishings to allow passengers to enter and exit vehicles. Exceptions can be made for benches, which allow passengers to sit and wait for their ride.
- **Location**: Passenger drop-offs should generally be located at the curb line. Exceptions may be made where the curb lane is used for travel.
- **Time Limits**: Limit drop-offs to 15 minutes to encourage turnover and discourage double parking.
- **Markings and Signage**: Drop-off zones should be well-marked to indicate to drivers that they cannot park there. MMUTCD provides standards for appropriate drop-off zone signage. For city standard signage, refer to the Standard Specifications (PSSS / "The Orange Book").

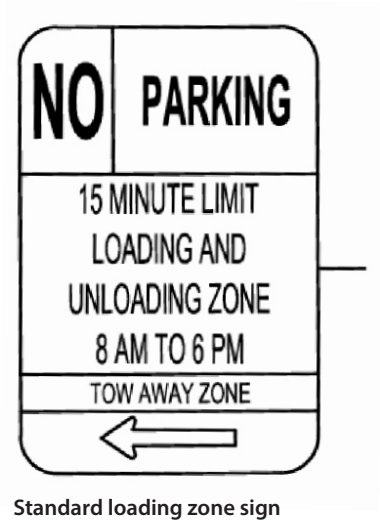
MAINTENANCE & MANAGEMENT

Seasonal Use & Maintenance

- **Snow Removal**: Loading zones do not require any special equipment for snow removal. The adjacent property owner is responsible for snow removal in the Walking Zone. Drop-off zones should not be used for snow storage.

Reviews & Approvals

- The DDA is responsible for overseeing curbside uses/ programming through the parking contract with the City.
- The Ann Arbor Engineering Unit coordinates to issue Traffic Control Orders for enforcement purposes.
- New private or The University of Michigan developments that require new drop-off zones as a result of building use and activity will be subject to meter removal fees and revenue replacement if on-street preexisting parking spaces are impacted.



Standard loading zone sign



ALLEYS

DESCRIPTION & INTENT

Alleys are an important part of the downtown transportation network, providing space for loading, waste removal, and circulation away from the street. They reduce or eliminate the need for driveways that can create conflicts with people walking or cycling on the street, and free up sidewalk and curb space for other uses.

While alleys are often considered unattractive and unpleasant places to be, they can provide valuable opportunities to expand public space. As the number of downtown residents increases, alleys function as an entry door and backyard. Due to their low speeds and typically intimate scale, alleys may offer safe, comfortable pedestrian and bicycle circulation, or "shared streets" that accommodate landscaping and outdoor seating. Good alleys have extensive, pedestrian-oriented lighting, good sight lines, and allow loading and utility functions to continue while inviting other uses.

Although alleys can be attractive, low volume, low speed intra-block connectors the primary function of alleys is to service buildings off the public street.

Alleys may be public, private or a combination of both, with multiple owners sharing different segments of an alley. Access, use, and maintenance of an alley may vary widely based on ownership and governance; however, safety and efficiency remain common priorities across all alley ownership types.

USE & APPLICATION

Location

- Alleys are appropriate for all Frontage Contexts, and are especially important in Destination Commercial and Commercial areas. Alleys should provide through-connections between streets where possible.
- Where alleys are present, loading and unloading should take place there and not in the street or sidewalk. Where alleys do not provide adequate room for loading, set aside a designated loading zone on the curbside and an appropriate place(s) for container storage. As new development occurs, projects should be required to service solid waste on site or in a public alley and avoid placement of carts or dumpsters in the public street or sidewalk space.
- While not the primary user, pedestrian and bicycle traffic may occur in alleys that provide through-connections, thus they should be designed and regulated as shared environments.

Related Design Elements

- **Lighting**: Focus lighting into the alley and away from building windows.
- **Crosswalks** should be provided wherever an alley intersects a street. Use pavement markings or a change in pavement materials to denote the area where pedestrians and motorists may cross paths.
- **Curbside Loading**: Do not provide curbside loading zones on streets where the adjacent buildings have access to alley service; loading should occur in the alley.

Policy References

- The NACTO Urban Street Design Guide provides guidance on how to design alleys as shared streets in both residential and commercial environments.

DESIGN & OPERATIONS

Design Requirements

A **Alley Width**: The following minimum widths apply for new alleys, recognizing that opportunities for new alleys are sparse.

» One-way alleys shall be a minimum of 20 feet wide, allowing travel around vehicles stopped in the alley for loading or other commercial purposes.

» Two-way alleys should be a minimum of 24 feet wide to allow vehicle passage. New alleys are unlikely to be constructed.

B **Vertical Clearance**: Maintain a clearance of at least 16 feet above surface grade of the alley to ensure trucks can pass through safely.

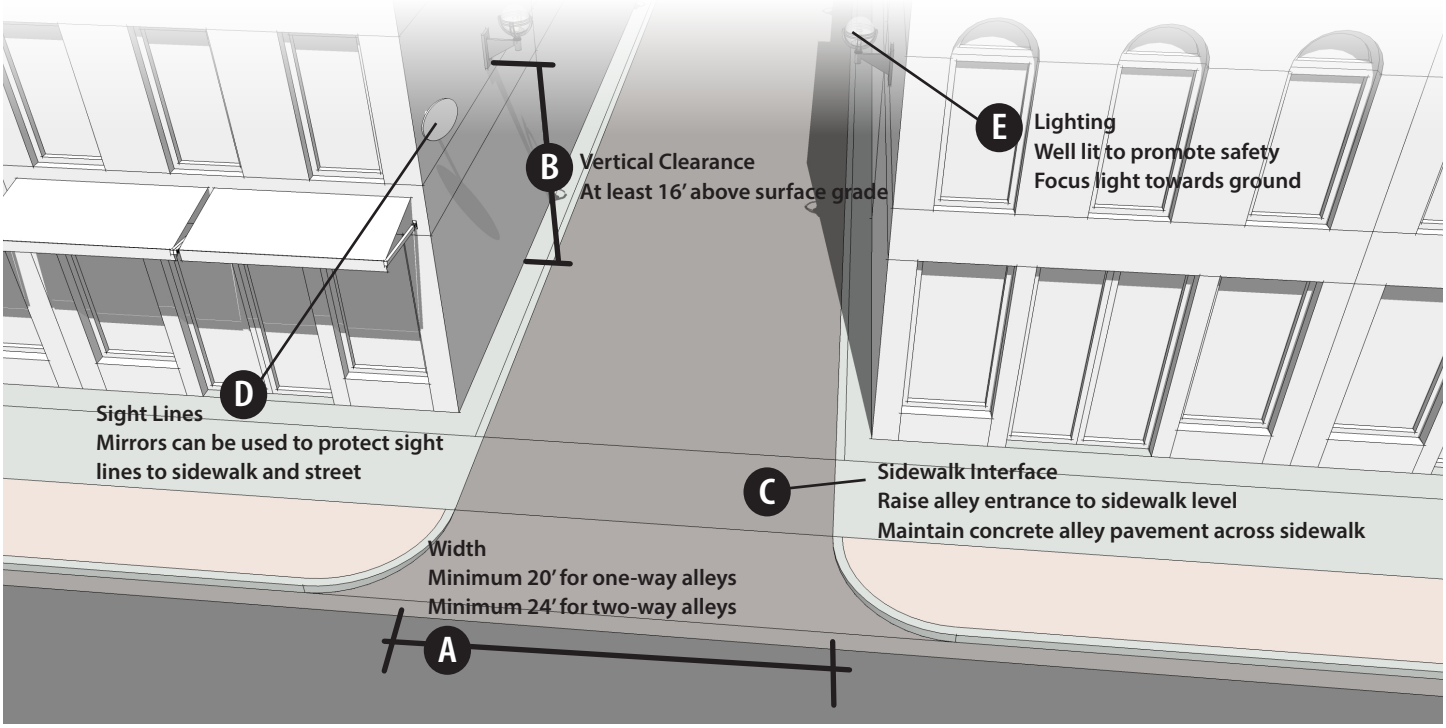
C **Sidewalk Interface**: Intersections between alleys and sidewalks can create conflicts between vehicles entering or exiting the alley and people walking on the sidewalk.

» Raise alley entrances to sidewalk level to make motorists aware of on-coming pedestrians.

» Maintain concrete alley pavement across sidewalk to signal to pedestrians an alley entrance.

» Provide adequate signage and visual cues to improve safety.

Figure 4.2.4- Alleys



- **Turning Movements:**
  - » Maintain easy access for trucks and other delivery vehicles. Ensure that the placement of street furniture, landscaping, or curbs leaves a clear zone for freight vehicle movements entering alleys.
  - » Carefully design corners within an alley system to ensure large vehicles can complete turns without damage to vehicle or property. Avoid blind turns.

D **Sight Lines**: Protect sight lines to the sidewalk and public street at alley egress points. Mirrors and/or audible signals can be used to alert motorists and pedestrians about potential conflicts.

E **Lighting**: Well light alleys to promote safety. Focus lighting into the alley and away from building windows. Lighting should be overhead and higher than 16 feet to allow for truck clearance.

Additional Design Considerations

- **Access and Egress:**
  - » Ensure alleys at least two points of access and/or egress in combination, preferably on two different block faces. Dead-end alleys shall be avoided.
  - » Streamline movement and reduce congestion in alleys through one-way alley operations.
- **Alley Use Designation**: Use bollards, signage, and pavement markings to denote alley right-of-way from adjacent properties. Such fixtures can ensure parking and other uses in the alley are kept clear of the alley through zone.
- **Service Hours**: Restrict/reserve hours of use to facilitate essential services like waste removal. Separate hours for waste removal from deliveries.
  - » Restrict traffic during non-delivery hours allowing alleys to operate as more of a shared space, creating room for outdoor seating.
- **Materials**: Design alleys as shared spaces by using higher quality pavement treatments (e.g. concrete, brick pavers), distinctive lighting, and providing public amenities such as seating or plantings.

Utility Considerations

- Alleys are appropriate places for utility lines, particularly above-ground electrical wires, as long as they are at least 16 feet above ground to allow for adequate clearance. Design alleys not to interfere with loading movements or to impede pedestrian or bicycle circulation.

Sustainability Considerations

- Use low-impact paving materials, such as pervious pavers, to reduce heat island effects, eliminate puddles, and collect and filter stormwater. Special consideration should be given to weight bearing and durability.



MAINTENANCE & MANAGEMENT

General Maintenance

- Ann Arbor Public Works is responsible for maintaining public alleys.
- The users of the alley are responsible for waste receptacles and access. Adjacent property owners who use the alley for solid waste storage or grease receptacles are responsible for proper container placement, disposal, cleanliness, and service access.

Seasonal Use & Maintenance

- Alleys may not be used for snow storage. Ensure that clear paths to properties, trash receptacles, and loading zones are maintained. Snow removal responsibilities depend on ownership. Alley users who have trash service in an alley may need to clear snow adjacent to the trash receptacles, if it impedes service access.

Reviews & Approvals

- Ann Arbor Planning and Development Services is responsible for approving private alleys created by new developments as part of the site plan review process.
- The City's Solid Waste Coordinator approves trash collection alleys.





4.3

BICYCLE FACILITY DESIGN ELEMENTS

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BICYCLE FACILITIES

BICYCLE FACILITY SELECTION

DESCRIPTION & INTENT

Important to the vitality of the downtown is that streets, business, residences, and other destinations be accessibly by all modes of transportation, including bicycles. However, downtown is a busy and complex urban environment, so providing bicycle facilities that create an intuitive network and that are safe and comfortable is essential.

There are two important considerations for the downtown bicycle network. First, each roadway is unique and how cyclists can be accommodated safely and comfortably given site constraints will vary from street to street. Second, not all bicycle riders have the same level of comfort and risk tolerance when cycling on streets, which means that a facility that works for one type of cyclist may not work for another. Taken together, there is not a one-size fits all solution.

When implementing bicycle facilities, it is important to consider connectivity and the overall routes. More specifically, determining which type of facility is appropriate given project's target audience and its role within the bicycle network is critical. Bicycle facilities fall broadly into two categories:

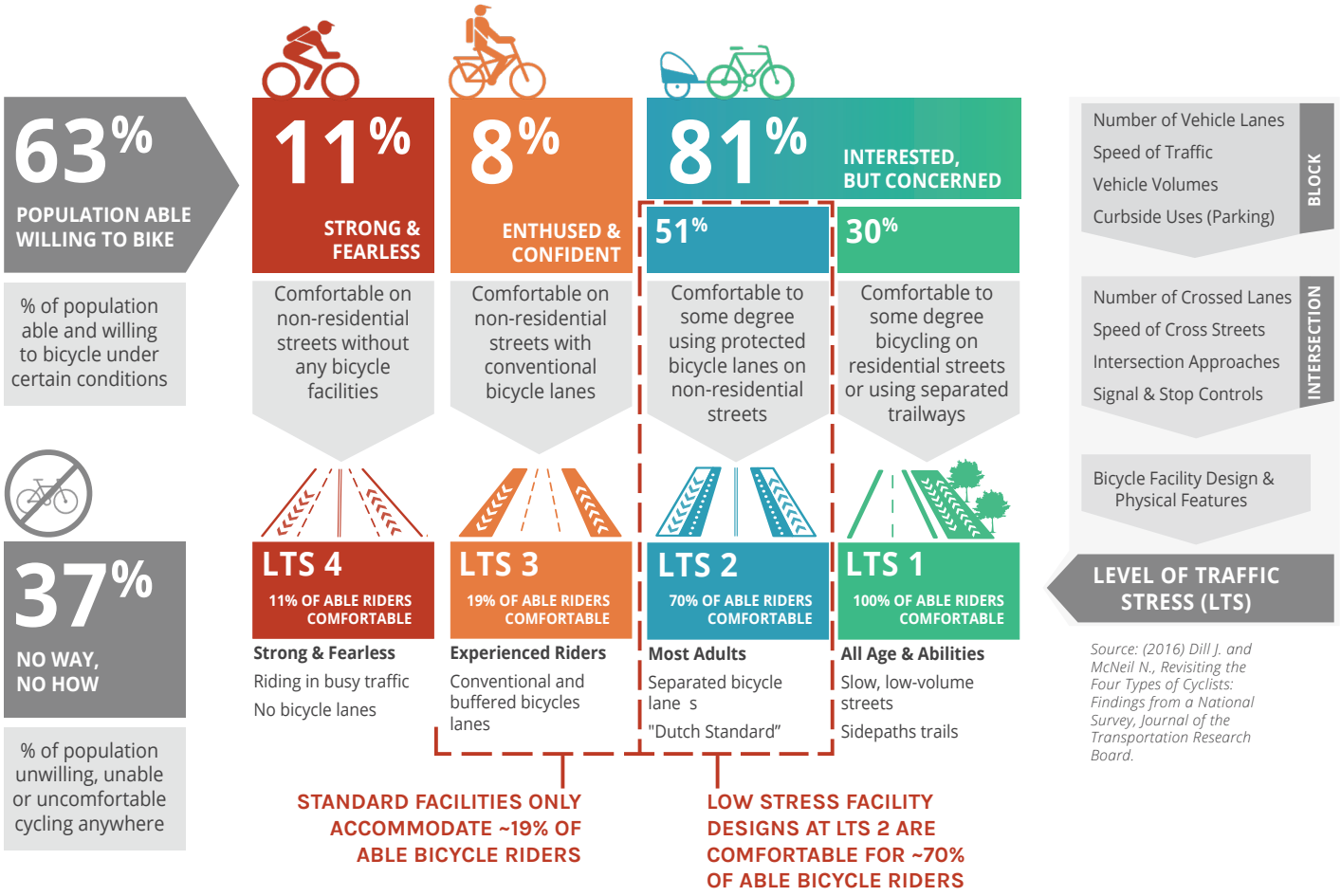
- **Low Stress Bicycle Facilities**: Low stress facilities, sometimes called "all ages and abilities" facilities, are those that are designed to be safe, comfortable, and welcoming to the majority of the bicycle-inclined populace. This includes people are that "interested but concerned" with riding their bicycles on major roads, the youth, elderly, and other less confident but willing riders. This typically reflects 50% or more of a city's willing bicycle riding population. Selecting the appropriate low stress facility depends on the roadway conditions and context, intersection treatments, and careful attention to the overall route.
- **Standard Facilities**: Standard bicycle facilities are those where the design treatments seek to reduce stress and maximize safety and comfort to the greatest extent possible. Yet, due to site conditions or right-of-way constraints, the facility may not be comfortable for the majority of riders. Standard facilities on major roads typically serve only about 19% of the willing bicycle riding population. In addition, standard bike lanes may not adequately deter illegal parking in bike lanes in areas with high demand for curbside space (Destination Commercial and Commercial Contexts).

The graphic on the next page summarizes the relationship between type of bicycle rider and their Level of Traffic Stress (LTS) tolerance and associated facility types.

USE & APPLICATION

- How cyclists are accommodated on streets must be assessed on every street project. Even simple resurfacing and re-striping projects can be an opportunity to improve bicycle access, comfort, and safety, through the following methods:
  - » Providing more dedicated space for bicycles to travel by creating dedicated facilities;

STANDARD VS LOW STRESS BICYCLE FACILITIES & RIDER ALIGNMENT



Source: (2016) Dill J. and McNeil N., Revisiting the Four Types of Cyclists: Findings from a National Survey, Journal of the Transportation Research Board.

  - » Raising the visibility and awareness of bicycle rider presence to drivers through pavement markings, signage, and other treatments; and,
  - » Creating calmer, safer street environments for all users but employing best practices for safe roadway design (e.g. appropriate lane widths, speed management techniques).
- Non-motorized network or connectivity plans in the city (i.e. Transportation Comprehensive Plan) should identify bicycle routes and a desired level of traffic stress. Determining which routes should be "low stress" versus which are "standard" is important for guiding facility selection.
- The level of stress of a bicycle route may be perceived by its potential users only as stressful as its most stressful location. Intersections design is vitally important for achieving low stress routes.

BICYCLE INFRASTRUCTURE TOOLS & REFERENCES

- FHWA (2019) Bicycle Selection Guide provides guidance on selecting appropriate bicycle facilities for the road condition.
- Designing for All Ages & Abilities: Section 3.2 provides a chart (NACTO, 2017) for aligning roadway conditions (traffic volume, speed, lane configuration, curbside uses) with potential facility types.
- Southwest Michigan Region Non-Motorized Transportation Plan 2020: Identifies regional trails and connections.
- The City of Ann Arbor Transportation Comprehensive Plan provides guidance planned bicycle routes, facility type, and other safety strategies.

FACILITY SELECTION GUIDANCE

The chart below (Table 4.3.1A) identifies the functional emphasis of typologies in the downtown and indicates a typical "low stress" versus "standard" facility that should be considered.

- This chart should be used as a starting point for establishing a baseline approach for accommodating bicycles and in consideration of the street's network role.
- Depending on the available right-of-way space, scope of the street project (e.g. full reconstruction versus repaving and re-striping), and specific roadway conditions, different facilities may be used to achieve the desired stress target.

Bicycle Facility Types

Detailed design guidance for each of the listed facility types are described subsequently in this section. The chart on the next page (4.3.1B) shows some additional criteria that can be used to help identify appropriate low stress bicycle facilities. Briefly, these facility types include the following:

- **Sidepaths:** Sidepaths are shared-use facilities for non-motorized use, mixing both bicycle and pedestrian traffic. Sidepaths are separated from the roadway and are typically located in the sidewalk zone of the street, often being substituted for normal sidewalks.
- **Separated Bicycle Lanes:** Separated bicycle lanes are either one-way or two-way dedicated bicycle lanes which are separated from vehicle travel lanes by a physical, vertical buffer, such as delineator posts, raised curbing, bioswales, landscape medians or decorative planters.
- **Buffered Bicycle Lanes:** Buffered bicycle lanes are one-way dedicated bicycle lanes with a painted buffer zone in between the bicycle lane and vehicle lane, providing additional separation and clearance between bicycle riders and motor vehicles.
- **Bicycle Lanes/Conventional Bicycle Lanes:** Conventional bicycle lanes are dedicated one-way bicycle lanes that are typically positioned between the curb and a vehicle travel lane. There are no buffers between the bicycle and vehicle lanes, so the level of comfort for cyclists can vary significantly based on vehicle speeds, traffic volumes, and the proximity of passing vehicles.
- **Advisory Bicycle Lanes:** Advisory bicycle lanes are one-way bicycle lanes demarcated with a dashed line and combined with shared bi-directional vehicle lanes. The advisory bicycle lane is periodically shared with motor vehicles during passing operations. Advisory bicycle lanes are typically used on low volume and low speed (25 MPH or less) neighborhood streets to help raise the visibility of cyclists and manage vehicle behaviors.
- **Sharrows:** Sharrows or "share the road" markings are pavement markings placed within a vehicle travel lane to indicate the potential presence of cyclists.

GENERAL BICYCLE FACILITY DESIGN CONSIDERATIONS

Pavement Markings

Bicycle facilities, particular more elaborate ones such as separated bicycle lanes, requires additional pavement markings and the maintenance of such markings should be considered during project development.

Table 4.3.1A

Street Functional Emphasis	Typical Low Stress Facility (1)	Typical Standard Facility	Notes
Pedestrian & Access Emphasis	Separated Bicycle Lanes or Shared/slow street designs	Bicycle Lanes or Sharrows	
Transit Emphasis	Separated Bicycle Lanes	Buffered Lanes, Bicycle Lanes or Sharrows	Low speed/volume or shared space streets
Bicycle Emphasis	Separated Bicycle Lanes or Sidepaths	Buffered Bicycle Lanes	
Balanced	Separated Bicycle Lanes or Sidepaths	Conventional Bicycle Lanes	Separated bicycle lanes vs. sidepaths depends on overall connectivity and curbside uses.
Public Alley	N/A	N/A	

- *(1) Exact selection of low stress facilities should utilize NACTO (2017) Designing for All Ages & Abilities chart "Contextual Guidance for Selecting All Ages & Abilities Bikeways" See chart on next page.*

- Where bicycle facility markings cross between vehicle travel lanes, consider recessing pavement markings so that snow plows traverse over them and do not wear them down more quickly.
- Durable markings materials should be used. Avoid using waterborne paint products. Polyurea, MMA, epoxy, and polymer cement surfacing (e.g. Endurablend) should be used.
  - » Green paint markings used in larger solid areas (such as within bike boxes, turn boxes, or intersections) should be specified with materials that reduce loss of traction for cyclists.

Utilities

- Where the bicycle lane must travel over inlet structures, use bicycle-friendly grate designs, such as Type-L vane inlet covers or ADA accessible inlet covers. Must ensure that selected inlet covers meet required drainage criteria in consideration of stormwater flows.
- Where bicycle facilities incorporate curbed medians, planters, concrete medias/dividers, or other linear vertical elements, the design must address stormwater flows and ensure that drainage can be maintained.

Parking & Loading

- Preserve a parking and loading lane on one side of the street to maintain access for delivery and businesses where it is feasible within the right-of-way.
- Assess curb conditions to understand spillover effects on adjacent streets from removing a parking and loading lane.

Contextual Guidance for Selecting All Ages & Abilities Bikeways

Roadway Context				All Ages & Abilities Bicycle Facility
Target Motor Vehicle Speed*	Target Max. Motor Vehicle Volume (ADT)	Motor Vehicle Lanes	Key Operational Considerations	
Any		*Any*	*Any of the following:* high curbside activity, frequent buses, motor vehicle congestion, or turning conflicts‡	**Protected Bicycle Lane**
< 10 mph	Less relevant	No centerline, or single lane one-way	Pedestrians share the roadway	**Shared Street**
≤ 20 mph	≤ 1,000–2,000		< 50 motor vehicles per hour in the peak direction at peak hour	**Bicycle Boulevard**
≤ 25 mph	≤ 500–1,500			
	≤ 1,500 – 3,000	Single lane each direction, or single lane one-way	Low curbside activity, or low congestion pressure	**Conventional or Buffered Bicycle Lane, or Protected Bicycle Lane**
	≤ 3,000 – 6,000			**Buffered or Protected Bicycle Lane**
	Greater than 6,000			**Protected Bicycle Lane**
	Any	Multiple lanes per direction		
Greater than 26 mph†	≤ 6,000	Single lane each direction	Low curbside activity, or low congestion pressure	**Protected Bicycle Lane, or Reduce Speed**
		Multiple lanes per direction		**Protected Bicycle Lane, or Reduce to Single Lane & Reduce Speed**
	Greater than 6,000	*Any*	*Any*	**Protected Bicycle Lane, or Bicycle Path**
High-speed limited access roadways, natural corridors, or geographic edge conditions with limited conflicts		*Any*	High pedestrian volume	**Bike Path with Separate Walkway or Protected Bicycle Lane**
			Low pedestrian volume	**Shared-Use Path or Protected Bicycle Lane**

* While posted or 85th percentile motor vehicle speed are commonly used design speed targets, 95th percentile speed captures high-end speeding, which causes greater stress to bicyclists and more frequent passing events. Setting target speed based on this threshold results in a higher level of bicycling comfort for the full range of riders.

† Setting 25 mph as a motor vehicle speed threshold for providing protected bikeways is consistent with many cities' traffic safety and Vision Zero policies. However, some cities use a 30 mph posted speed as a threshold for protected bikeways, consistent with providing Level of Traffic Stress level 2 (LTS 2) that can effectively reduce stress and accommodate more types of riders.[18]

‡ Operational factors that lead to bikeway conflicts are reasons to provide protected bike lanes regardless of motor vehicle speed and volume.

Table 4.3.1B

The chart at left provides guidance on potential bicycle facility selection in consideration of the roadway configuration (i.e. # of travel lanes), roadway speeds and traffic volumes.



ROADWAY

SEPARATED BICYCLE LANES

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	■	■			
Transit		■	■	■	
Bicycle		!	!		!
Balanced		■	■	■	!

DESCRIPTION & INTENT

Separated bicycle lanes, also known as cycle tracks or protected bicycle lanes, are exclusive bicycle facilities that are physically separated from general traffic. Separated bike lanes provide a vertical barrier of some type, commonly a curb, parked vehicles, planted medians, or flexible posts. These physical protections distinguish separated bicycle lanes from buffered bicycle lanes.

Separated bicycle lanes may be one directional on one or both sides of a street or bi-directional in the center or on either side.

The physical protection increases the sense of safety and comfort for cyclists. Separated bicycle lanes correlate positively with increased cycling activity, as separated facilities improve comfort for more timid, less experienced, and/or more vulnerable cyclists. Separated facilities dramatically reduce the risk of bicycle/vehicle conflicts, as well as the risk of "dooring" from parked cars.

Separated bicycle lanes may be one directional with one separated lane on each side of the street, or may be designed as a two-way facility with both directions in a combined facility.

USE & APPLICATION

Location

- Separated bicycle lanes are appropriate where there are high levels of bicycle activity (or where cycling activity is expressly desired to be concentrated or accommodated).
- Separated bicycle lanes are recommended on bicycle emphasis streets and/or as a common facility type where low stress (all ages & abilities) bicycle connections are desired. Separated bicycle lanes have the most attraction and impact when implemented for multiple contiguous blocks.
- While separated bicycle lanes offer more protection and attraction than standard on-street bicycle lanes, they also require a greater amount of street space. Separated bicycle lanes often require the conversion of curbside parking or a travel lane for implementation. Accommodation and relocation of loading and drop-off spaces must be accounted for. See Loading and Short-Term Parking Design Elements for more details.

Related Design Elements

- **Crosswalks**: Separated bicycle lanes are exclusively for bicycle travel and should not be used as pedestrian walkways or waiting areas. Pedestrian medians may be provided in near the separated area to provide additional refuge opportunities for pedestrians when crossing the street.

- **Two-stage turn queues** should be used to facilitate left turns from separated bicycle lanes to other bicycle corridors or facilities.
- **Bicycle Parking**: Provide bicycle parking regularly along separated bicycle lanes.
- **Sidewalk Furnishings**: Place sidewalk curbs and furnishings in such a way to discourage pedestrians from walking on the separated bicycle lane.
- **Wayfinding** systems will allow separated bicycle lane users to navigate the bicycle network and find their way to local destinations.
- **Traffic Signals**: Due to the increased likelihood of bicycle activity where separated bicycle lanes are used, traffic signals should be timed cognizant of bicycle speeds. Reducing delays for cyclists will increase the likelihood that cyclists using the separated bicycle lane will comply with the traffic signal.
- **On-Street Parking:** On-street parking may be used as a form of separation, but must provide clearance for door swing into the bike lane (e.g. a 3-foot wide buffer) and should utilize curbing or other vertical elements to prevent vehicles from parking with the bikeway or buffer. These features can create additional obstacles for pedestrian access.
  - » Installation of separated bikeway may also require the removal of on-street parking to create right-of-way space. Consider using a two-way facility to save space and still provide parking on one side of the road.
- **Curb Cuts**: Driveways, alleys, curb cuts and frequent loading activity introduce conflict into a separated facility. Separated bicycle lanes work best on corridors with minimal conflicts.
- **Mid-block pedestrian crossings** may introduce conflict between bicycles and pedestrians. Design solutions should be sought where this condition is necessary.

DESIGN & OPERATIONS

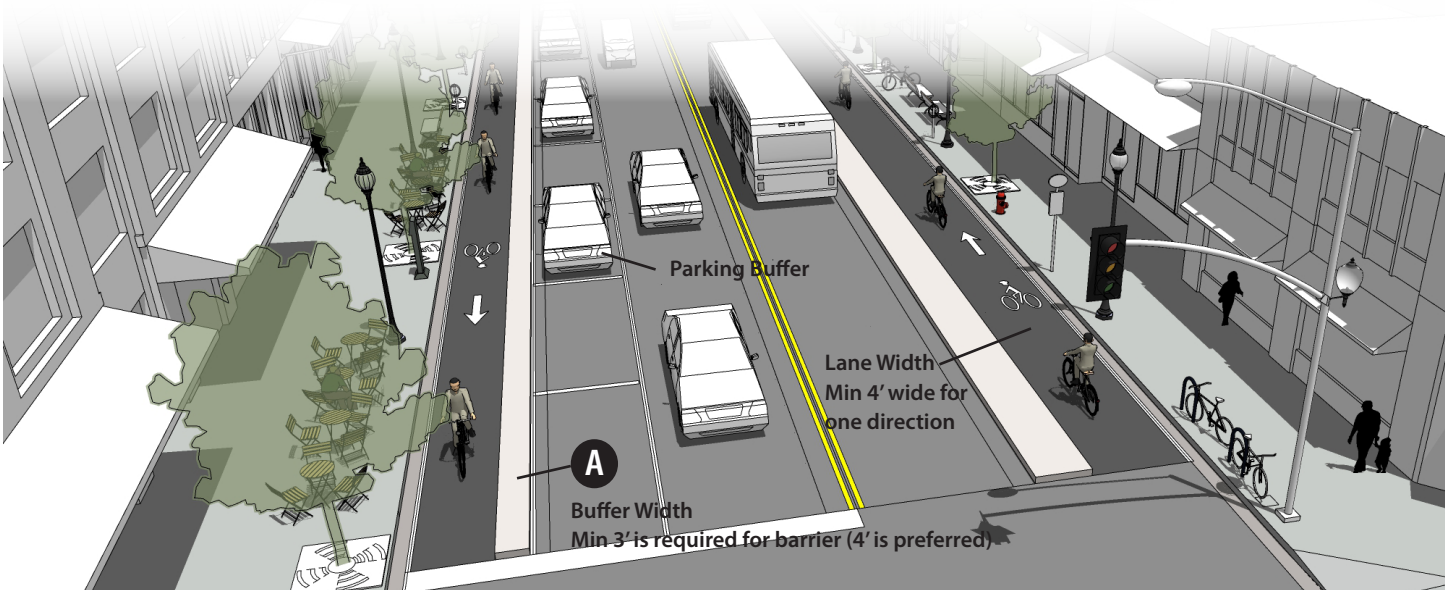
Bike Lane Separation

- **Separation Method:** Separated bicycle lanes shall be separated from vehicle traffic and clearly distinct from pedestrian zones.

  A A minimum of 3-feet is desired for the buffer (4-feet is preferred) between the bicycle lanes and travel lanes. 2-feet is allowed under constrained conditions for limited lengths.

  - » Separation should use delineators and painted buffers, curbing, planters, and/or raised medians. Gaps in the buffer should be minimized to the extent possible.
  - » Where bike lanes are adjacent to a curb face, provide an additional 1-foot of lane width and/or lower curb height to less than 3” and/or provide an angled curb face to reduce pedal strikes.

Figure 4.3.1- Separated Bicycle Lanes



One-Way Separated Bicycle Lanes

- **Lane Width**: Separated bicycle lanes shall have a minimum of 4-feet of with for a one-directional facility. 7-feet of width should be considered where higher bicycle volumes are anticipated to allow for bicycles to pass.

Two-Way Separated Bikeways

Where available right-of-way width precludes using one-way separated bicycle lanes, two-way separated bicycle lanes (called bikeways) may be used. Two-way bikeways introduce additional complexities in the design and operations and should be considered carefully.

B **Lane Width**: Each direction of bicycle travel in the bikeway shall be a minimum of 4-feet wide (8-feet total width). 5-foot wide lanes are preferred (10-feet total).

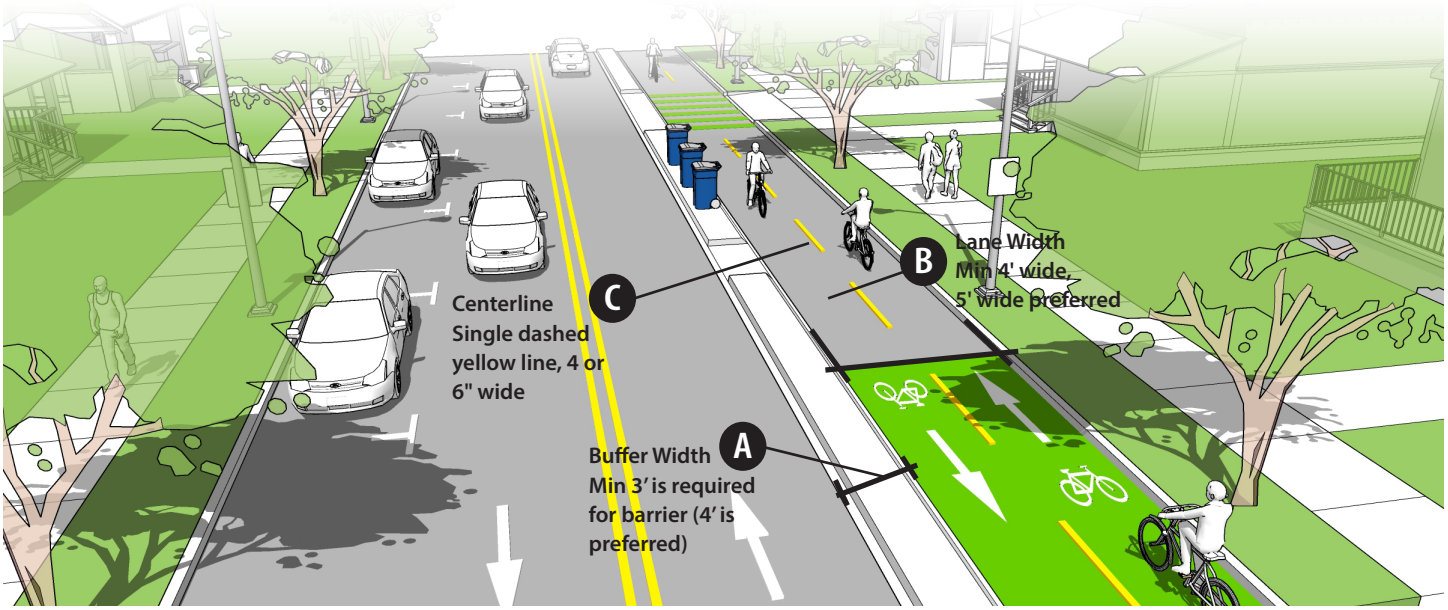
C **Centerline**: The centerline of the bikeway shall be a single dashed yellow line, 4 or 6 inches wide. When approaching intersections, the centerline shall be solid within 20-feet from the stop bar.

- **Bicycle Turning Movements:** For two-way bikeways, turning movements into and out of the bikeway require careful consideration. Use two-stage turn queues located in a manner clear from cross street traffic where cyclists can wait for a signal change (see Two-Stage Turn Queues for additional guidance).
- **Vehicle Management**: Encroachment by vehicles into the wider two-way bikeway must be discouraged.
  - » Use delineator posts placed on the centerline of the bikeway at the start of each block or at larger gaps in the buffer to prevent vehicles from entering. Specifications, below:
    - » Pexco City Post (Surface Mount). Color: Yellow. Height: 28 inches. Part #8SM28YEL235 (Yellow Tape) 2 Wraps of 3 inches.
    - » Where delineators are installed in Art Fair zones, posts shall be installed with a 4-inch embedded anchor cup to allow removal during Art Fair.
  - » If delineators are used to provide separation, where there are concerns about vehicles parking in the bikeway, they shall be placed 10-feet apart.
  - » **No Turn on Red**: No Turn on Red signage shall be used where right turning may cross over the two-way bikeway and/or turn queue boxes.

Pavement Markings and Signage

- Pedestrian Crosswalks shall pass through buffers or barriers to provide a continuous ADA accessible path of travel for pedestrians.
- **Intersection Markings:** To raise visibility of bicycle riders in intersections, separated bicycle lanes shall be painted solid green traversing through an intersection and within 20-feet of the approach.
  - » One-way facilities shall include dashed white lines highlighting the edge of the bikeway.

Figure 4.3.2- Two-Way Separated Bikeways



» Two-way facilities shall use "elephant feet" (12x12 or 18x18) white squares along the edge of the painted crossing zone.

- **Driveways and Curb Cuts:** Use dashed green bars where the bicycle lanes cross driveways, alleys, curb cuts, or minor street crossings.

Raised Bikeways

- Separated bicycle lanes may be flush with the street-level, raised to the sidewalk-level, or at an intermediary-level between street and sidewalk.
  - » When used at an intermediary-level, use sloping curbs/transitions (1:4 max slope) between the bikeway and the sidewalk level.
- For sidewalk-level bicycle lanes, use different colors, materials or pavement markings to differentiate the bicycle lanes from pedestrian space. At conflict points, use yield-marks and "Bikes Yield to Peds" signage to indicate that pedestrians have the right-of-way.
- Two-way bikeways can be raised up to the sidewalk-level, using ramps to transition back down to street-level at intersections.

Intersections

Separated bicycle lanes require careful design at intersections to minimize conflicts with turning vehicles and improve legibility, visibility, and predictability for all travelers.

- **Protected Corners**: Separated bike lanes should utilize protected corner treatments wherever space allows to create comfortable, separated spaces for bicyclists to wait.

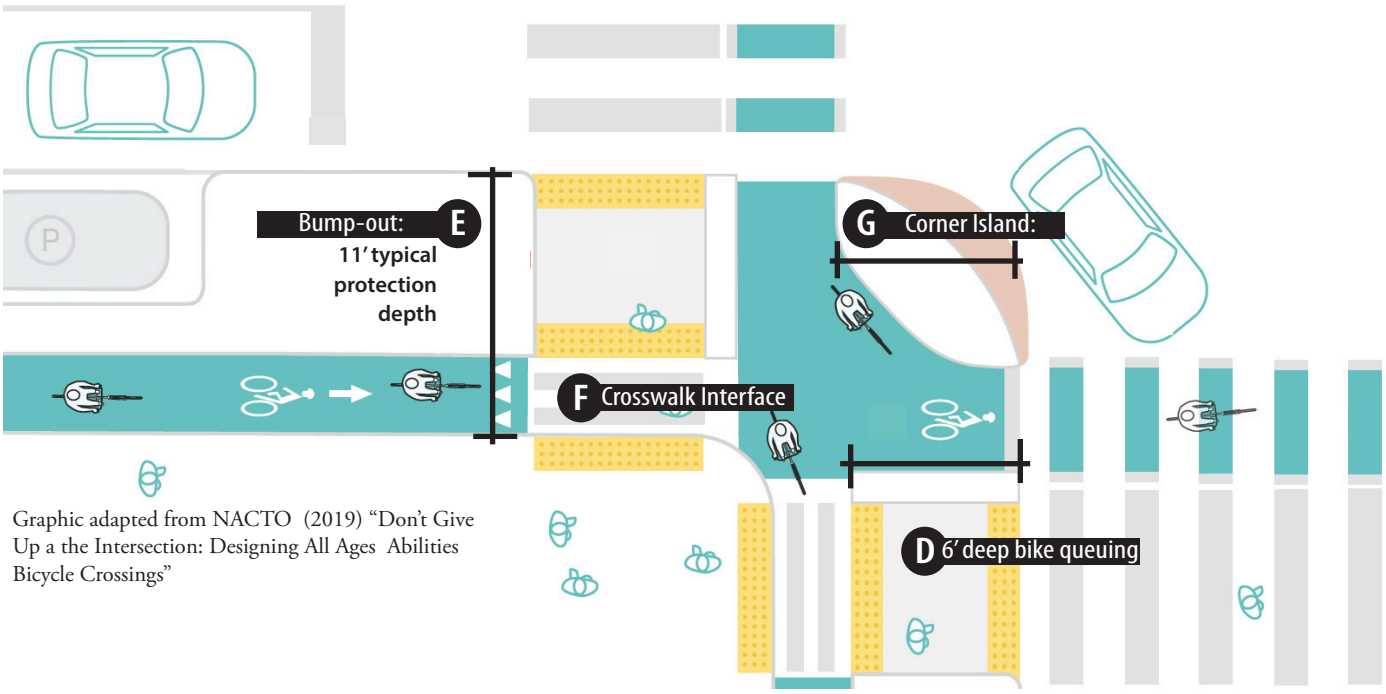
D **Bicycle Queuing Area:** The bicycle queuing area should be at least 6-feet deep to provide space for cyclists to wait and be clear from cross traffic. This also provides adequate width for a pedestrian waiting zone between the roadway curb and bicycle lanes.

E **Protection Depth:** The overall depth will depend on the queuing depth plus the width of the incoming bicycle lane. This should be a minimum of 11-feet (6-feet for the bicycle queuing area plus 5-feet for the bicycle lane width).

F **Crosswalk Interface:** Approaching bicycle lanes should use yield markings and signage ahead of pedestrian crosswalks. Crosswalks should use detectable warning pavement flanking the bicycle lane crossing and at the normal edge of the roadway.

G **Corner Island:** The corner island should be designed to accommodate the roadway design vehicle based on an appropriate effective turning radius. Where larger vehicles must be accommodated, use a mountable apron adjacent to the curb to accommodate larger turning radii.

Figure 4.3.3- Separated Bicycle Lanes at Intersections



Graphic adapted from NACTO (2019) "Don't Give Up a the Intersection: Designing All Ages Abilities Bicycle Crossings"

  - » On-Street Parking Used as a Buffer shall be stopped at least 30-feet back from nearest crosswalk edge to provide visibility to bicyclists approaching the intersection.

- **Bicycle Signals:** Bicycle signals may be necessary for two-way separated bicycles lanes. A traffic and signal analysis should be conducted to determine the necessity for bicycle signals (see Bicycle Signals).
- **Sight Lines:** Maintain visibility and sight triangles at driveways, alleys, or intersections.
- **Traffic Signal Timing**: On streets where signals are coordinated, consider adjusting timing to account for bicycle travel times to encourage continuous bicycle movement.

Additional Design Considerations

- Curbing: The face of new curbs directly adjacent to the bikeway should be designed with a chamfered 45-degree angle to reduce pedal strikes.

Utility Considerations

- Configure gutter seams, drainage inlets, and utility covers so they do not impede bicycle travel. Make the separated lane wider where gutter seams extend more than 12 inches from the curb. Barriers should be designed as not to impede effective roadway drainage.

Sustainability Considerations

- Curbed medians or buffer areas can be designed to capture stormwater runoff and provide additional storage or infiltration capacity.

Design References

- FWHA (2015) Separated Bike Lane Planning & Design Guide: Provides detailed guidance on the design of separated bike lanes.
- FHWA (2019) Bikeway Selection Guide: Provides guidance on whether separated bicycle lanes may be an appropriate design treatment.
- NACTO (2019) Don’t Give up at the Corner: Provides detailed guidance on designing protected corner treatments.
- The NACTO Urban Bikeway Design Guide provides additional guidance on how to design separated bicycle lanes and where to use them.
- The MMUTCD offers standards on signage and pavement markings for separated bicycle facilities.



MAINTENANCE & MANAGEMENT

General Maintenance

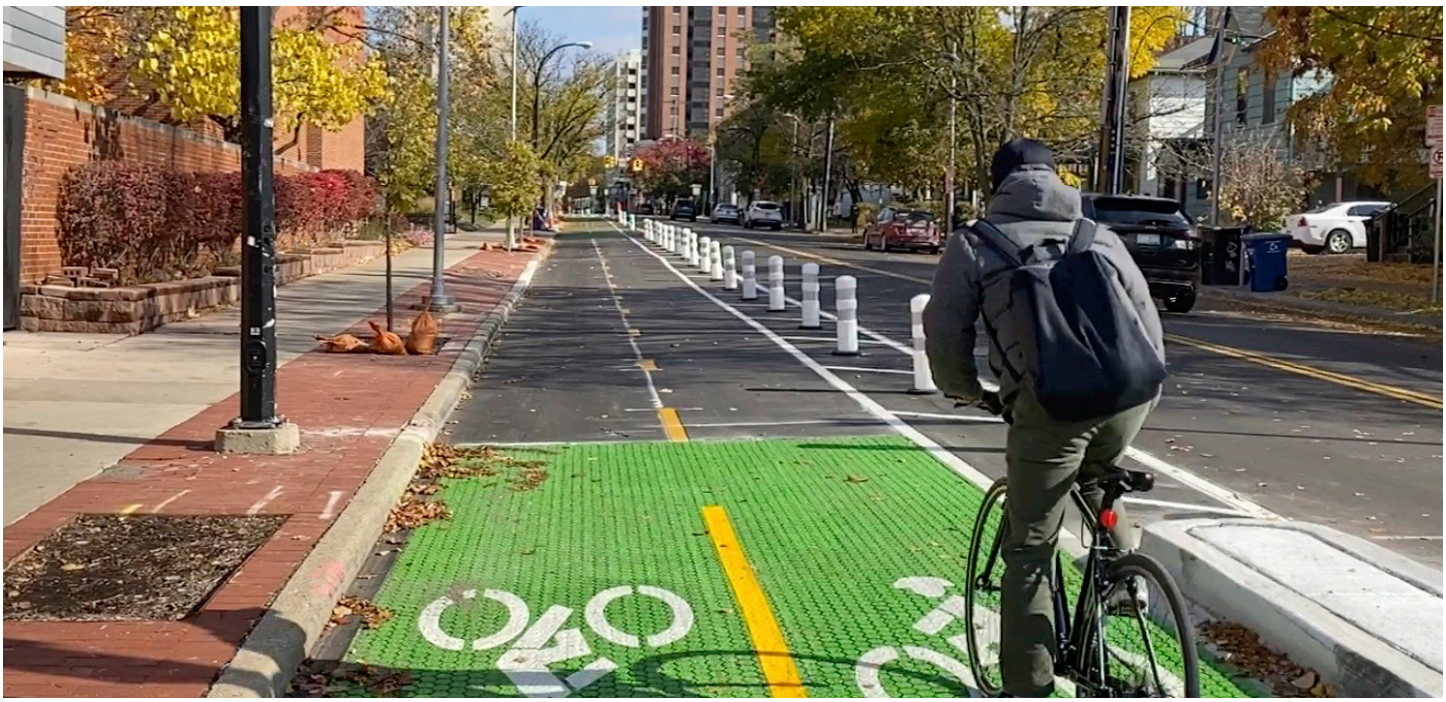
- Separated bicycle lanes require street sweeping and should be designed to accommodate existing equipment.

Seasonal Use & Maintenance

- Design separated bicycle lanes to accommodate snow removal equipment (or enter into special maintenance agreements to independently remove snow from bicycle facilities).
- Removable barriers such as flexible posts or rubber curbing should be removed prior to the winter snow season. Do not store snow in bicycle facilities.

Reviews & Approvals

- The Ann Arbor Engineering and Systems Planning Units oversee bicycle lane installation. For public projects, the project manager should coordinate with the Ann Arbor Engineering and Systems Planning Units.
- Ann Arbor Public Works is responsible for maintaining bicycle lanes.





ROADWAY

BUFFERED BICYCLE LANES

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	■	■			
Transit		■	■	■	
Bicycle		⚠	⚠		⚠
Balanced		■	■	■	⚠

DESCRIPTION & INTENT

Buffered bicycle lanes are on-street bicycle facilities with separation between the bicycle facility and other roadway uses. Buffered bicycle lanes are distinct from separated bicycle lanes in that no physical separation or protection is provided. Buffering is provided by a flush, painted zone between the bicycle facility and vehicular travel lanes.

Buffered bicycle lanes, or other bicycle facilities offering an enhanced level of comfort and safety, are an important tool in creating a bicycle network that meets the needs and demands of cyclists of all abilities from young novices, to casual cyclists, experienced riders and cautious older bikers.

Buffered bicycle lanes increase comfort over conventional bicycle lanes by providing greater separation from conflicting uses. Buffered bicycle lanes may not offer the same level of comfort as separated bicycle lanes, but may be installed at a lower cost, offer lower maintenance challenges, and require a modestly smaller cross-section.

Buffered bicycle lanes increase the distance between vehicles and cyclists. The additional buffer may also reduce the risk of cyclists getting "doored" by parked cars and allows cyclists to pass one another without entering the general traffic lane. Buffers significantly reduce driver encroachment on bicycle facilities increasing safety, operations, and comfort; in turn, helping increase the appeal of cycling and share of bicycle trips for people of all ages and abilities.

USE & APPLICATION

Location

- Buffered bicycle lanes are most appropriate on bicycle emphasis streets and should be used over conventional bicycle lanes if there is sufficient room. Buffered lanes should be considered as an alternative to conventional bicycle lanes whenever bicycle lanes are proposed.
- Buffered bicycle lanes may be used on one- or two-way streets with or without on-street parking. Buffered bicycle lanes require more space than conventional bicycle lanes. Implementing them may require reduction of other street elements such as narrowing or converting a travel or parking lane.
- Buffered lanes are more effective and appealing on streets with longer blocks and few interruptions, such as driveways or transit stops. Buffered facilities should ideally extend for several contiguous blocks along a corridor.

Related Design Elements

- **Intersections**: Buffered bicycle lanes require additional considerations in the design of intersections and associated pavement markings.

- **Bike Boxes**: Consider using a bike box at intersections to give cyclists in the buffered bicycle lane additional protection.
- **Bicycle signals** can provide cyclists with their own signal phase, giving them a conflict-free path across the intersection.
- **Traffic Signal Timing**: Due to the increased likelihood of bike traffic where buffered bicycle lanes are used, consider timing traffic signals to accommodate bicycle speeds.

Incompatible Elements

- **Bus Bulbs**: Buffered bicycle lanes can conflict with bumpouts, especially at transit stops. When approaching a bus bulb, a buffered bicycle lane should move between the sidewalk and bus bulb so cyclists do not cross paths with passengers stepping on or off the bus. *See Bus Bulb Design Element for Additional Guidance.*
- **Mid-Block Crossings**: Buffered bicycle lanes may conflict with mid-block pedestrian crossings.
- **Curb cuts** and driveways can erode the attraction and operation of buffered bicycle facilities. Curb cuts should be avoided or minimized wherever possible.

DESIGN & OPERATIONS

Design Requirements

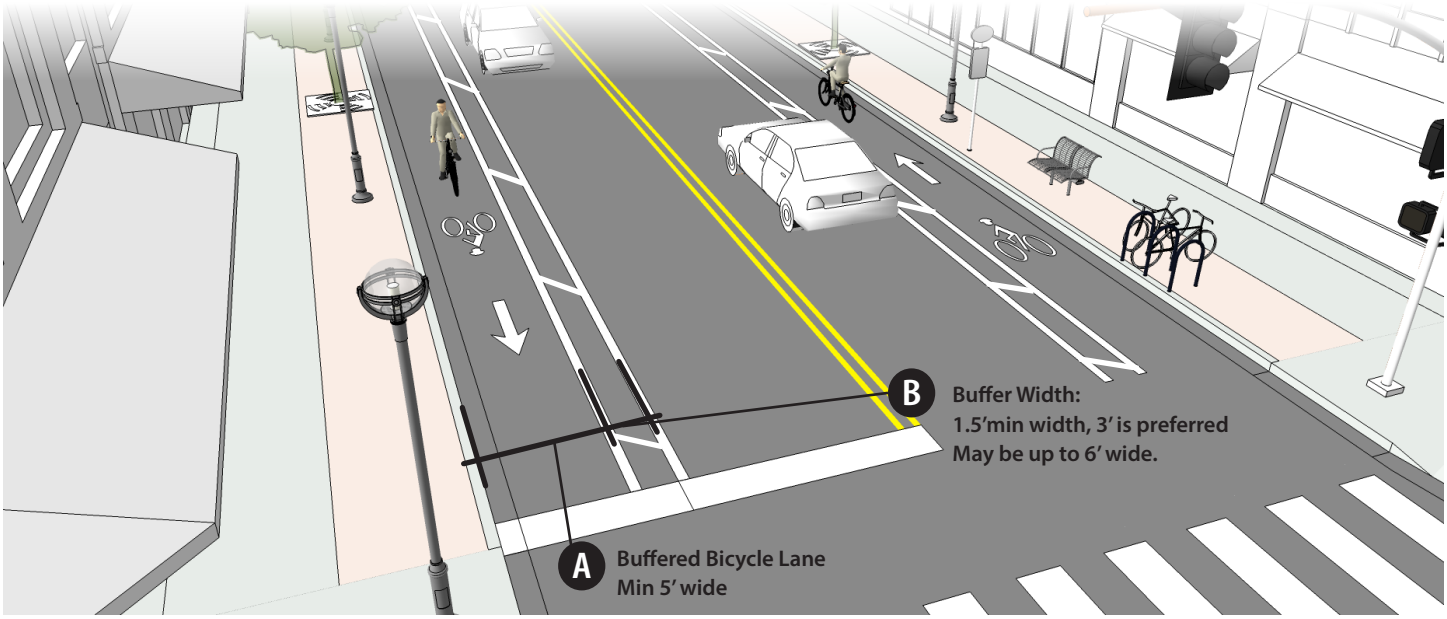
A **Lane Width**: The bicycle travel way or lane shall be at least 5 feet wide, clear from any gutters or longitudinal lines in the pavement.

B **Buffer Width**: The buffer shall be a minimum of 1.5 feet wide measured from the center of the bicycle lane stripe. 3-foot width is preferred. Buffer may be up to 6 feet wide.

  - » Buffered area consists of two solid painted lines (6-8 inch outside line, 4 inch inside line) with diagonal stripes in between at 30- to 45-degrees and spaced 10’ to 40’ apart on center.
  - » When adjacent to on-street parking, consider placing a 2- to 3-foot wide buffer against the parking side to protect against “dooring” instead of or in addition to the travel lane side buffer.
  - » The total width of the bike lane and buffers should not be less than 7-feet.

- **Intersection Transitions**: Address transition and/or conflicts at intersections. Treatments may include conversion to a conventional curbside bicycle lane, cross-over through lane, or shared space, among other applications.

Figure 4.3.4- Buffered Bicycle Lanes



Additional Design Considerations

- **Marking Recess**: Recess marking to minimize maintenance requirements and maintain reflectivity.
- **Parking Lane Markings**: Use "T" markings or solid lines next to a parking lane to show where parked cars should be placed.
- **High Visibility Paints**: Green paint may be used along the buffered bicycle lane as follows:
  - » **Roadway and driveway/curb-cut crossings:** Use 2-foot wide bars (with 2-foot wide gap between) and aligned with dashed white lines at the edge of the bike lane.
  - » **Intersection Approaches:** Use solid green zone in the bike lane at least 20-feet long, at the approach to an intersection.
- Delineator post can often be installed readily as part of the buffer installation or added onto the facility later. This can help transition the buffered lane into a separated bicycle lane, accessible for lower stress riders.
  - » When delineators are added, they should be placed in a sufficiently wide buffer such that the bicycle lane and portion of the buffer can accommodate street sweeping and snow clearing operations.
- **Advanced Stop Bars**: Where a bicycle lane carries through an intersection, the bicycle stop bar should be positioned adjacent to the crosswalk and 4-feet or more in advance of the vehicle stop bar. This allows bicycles to be positioned with better visibility to drivers.

Design References

- FHWA (2019) Bicycle Selection Guide provides guidance on selecting appropriate bicycle facilities for the road condition.
- NACTO (2017) Designing for All Ages & Abilities
- The City of Ann Arbor Non-Motorized Transportation Plan Update provides guidance on buffered bicycle facilities and priority bicycle corridors.
- MMUTCD provides standards on markings and signage associated with buffered bicycle facilities.
- The NACTO Urban Bikeway Design Guide provides additional guidance on how to design buffered bicycle lanes and where to use them.

Utility Considerations

- If trenching is done in a buffered bicycle lane, repair the entire width of the bicycle lane to avoid an uneven surface, which can be dangerous for cyclists.

Sustainability Considerations

- Buffered bicycle facilities may offer an opportunity for porous concrete or asphalt treatments; however, use of non-standard materials in the roadway must be carefully reviewed and specifically approved.

MAINTENANCE & MANAGEMENT

Special Maintenance

- Buffered bicycle facilities introduce additional pavement markings that must be maintained. Buffered bicycle facilities should be swept of debris.

Seasonal Use & Maintenance

- Providing a flush painted buffer facilitates snow removal. Bicycle lanes of any type should not be used for snow storage.

Reviews & Approvals

- The Ann Arbor Engineering and Systems Planning Units oversee bicycle lane installation. For public projects, the project manager should coordinate with the Ann Arbor Engineering and Systems Planning Units.
- Ann Arbor Public Works is responsible for maintaining bicycle lanes.

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ROADWAY ZONE

CONVENTIONAL BICYCLE LANES

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	!	!			
Transit		!	!	!	
Bicycle		!	!		!
Balanced		!	!	!	!

DESCRIPTION & INTENT

Bicycle lanes are dedicated bicycle facilities delineated by striping, signage, and pavement markings. Distinct from buffered or separated bicycle lanes, conventional bicycle lanes are typically immediately adjacent to a motor vehicle travel lane.

On-street lanes alert motorists to the presence of a bike route, allow cyclists to use the street with less interference from traffic, and increase comfort for cyclists and predictability for all roadway users. The provision of bicycle lanes or other dedicated bicycle facilities may reduce the incidence of cyclists riding on sidewalks in downtown Ann Arbor. However, conventional bicycle lanes alone may not provide a high enough level of comfort for the most risk intolerant or vulnerable cyclists who desire a higher level of separation from traffic.

Bicycle lanes are typically located on the right-hand side of the street running in the same direction as motor vehicle traffic, but alternative configurations are possible. *See Left-Side Bicycle Lane and Contra-flow Bicycle Lane.*

USE & APPLICATION

Location

- Bicycle lanes are appropriate for all Frontage Contexts and Functional Emphasis streets but may be most common on balanced and bicycle emphasis streets.
- Conventional bicycle lanes, given the traffic volumes of most down streets, are not likely to function as a low-stress bicycle facility.
- Bicycle lanes require the least amount of space of any dedicated on-street bicycle facility, but in the narrow corridors of downtown, installation of bicycle lanes may only be possible with the removal of parking or travel lanes. This must be weighed against other needs and priorities for unique Frontage Context areas.
- On bicycle emphasis streets, dedicated bicycle lanes are required at a minimum unless a higher level dedicated facility is used (i.e. buffered bicycle lanes, separated bicycle lanes, or side paths). On non-bicycle emphasis streets, other competing space uses (e.g. parking lanes) may be a priority where space is limited.

[1] http://safety.fhwa.dot.gov/ped_bike/univcourse/pdf/swless19.pdf

Related Design Elements

- **Transit**: Buses and bicycles may conflict at curbside bus stops. Sensitive design and/or location may reduce conflicts.
- **Roadway Widths**: Wider bicycle lanes may improve cyclist comfort and safety, but may also contribute to wider pedestrian crossings or encourage illegal parking or travel in the bicycle lane.
- **Intersection Treatments**: Using bike boxes or two-stage turn queues at signalized intersections with high bicycle usage or turn demand may increase the comfort and attraction of cycling in downtown.
- **Bumpouts**: Additional consideration is required where bicycle lanes intersect with bumpouts, both at corners and mid-block, due to potential conflicts with pedestrians. Bumpouts should not extend into the bicycle lane. *See Bumpouts*.
- **Driveways and Curb Cuts**: Motorist entering or exiting may not see approaching cyclists. Pavement markings can identify conflict zones. Pavement markings should use a dashed line when crossing driveways and curbcuts to alert drivers and cyclists to the conflict.
- **Diagonal Parking**: Front-in diagonal parking conflicts with safe and comfortable use of a bicycle lane and should be avoided where bicycle lanes are provided. Parallel parking is preferred in downtown.

DESIGN & OPERATIONS

Design Requirements

- **Lane Width:**

A The preferred width of bicycle lanes shall be 5-feet wide for clear operational width, exclusive of any gutters or longitudinal pavement lines. This may be reduced to a minimum of 4-feet wide under constrained conditions.

B When adjacent to curbside parking or loading zones, bike lanes should incorporate an additional 3' foot wide buffer to protect against door swing where space allows (see ***Buffered Bike Lanes***)

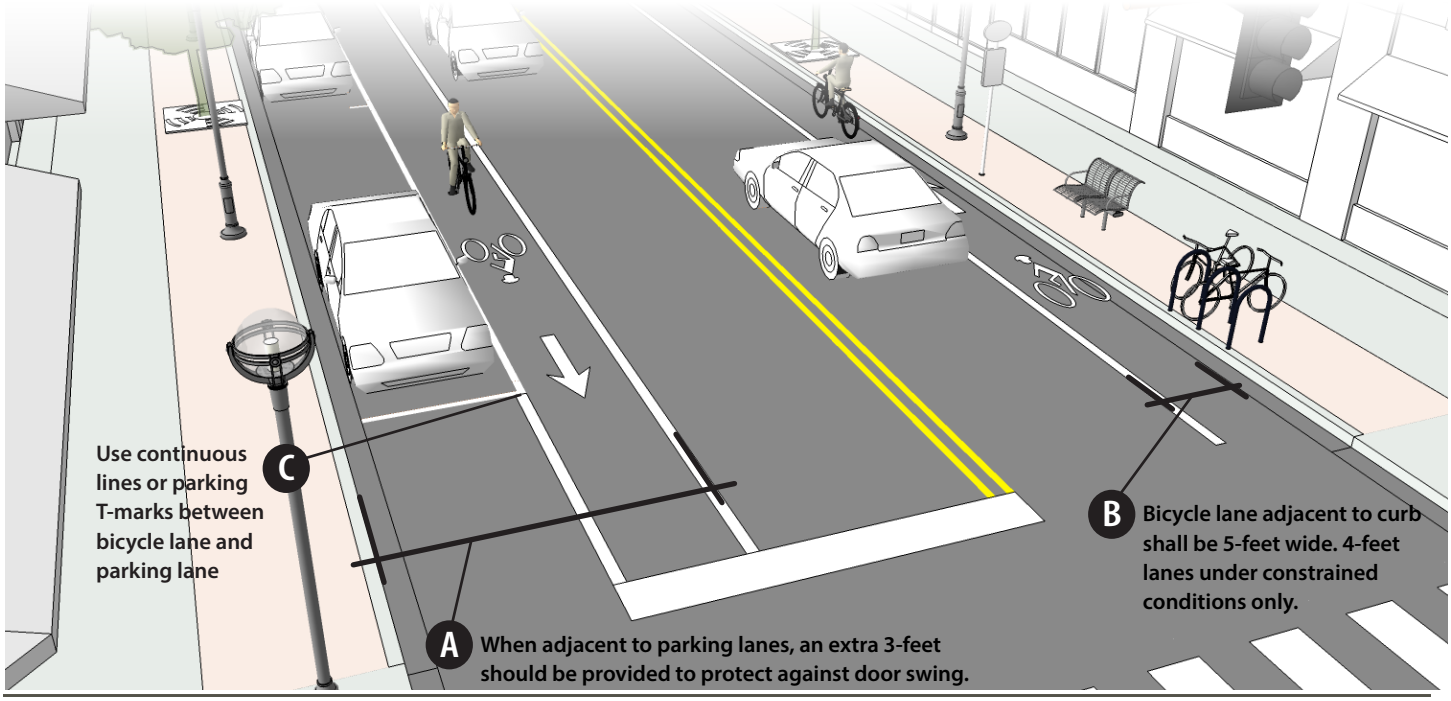
» Provide a 3-foot shy zone adjacent to bicycle lanes when directly adjacent to guardrails, walls or other vertical barriers.

- **Markings**: A solid white 6" wide line shall be used to differentiate the bicycle lane from the general traffic lane.

» **Intersection Crossing Markings:** Use two dashed white lines to indicate the sides of bike lanes when they carry through and across an intersection.

C **Parking Lane Marking**: Use a continuous solid line or place "T" marks between the bicycle lane and the parking lane to mark the inside of the bicycle lane and discourage motorist from encroachment.

Figure 4.3.5- Conventional Bicycle Lanes



- **Location**: Bicycle lanes shall be placed on the right-hand side of the street, between the travel lane and the parking lane, or between the travel lane and the curb.
  - » Avoid placing bicycle lanes to the right of a right-turn lane or the left of a left-turn lane unless a separate bicycle signal is provided.

Additional Design Considerations

- **Lane Markings**: Use dotted/dashed lines to indicate areas of bicycle/vehicle conflict, such as bicycle lane markings continuing through intersections or where right turning lanes cross bicycle lanes.
- **Surface Transitions**: Make gutter seams, drainage inlets, and utility covers flush with the ground to prevent conflicts with bike tires. Ensure openings in grates are perpendicular to the bicycle direction of travel to avoid trapping bicycle tires.
- **High Visibility Paint**: Use green paint to further distinguish bicycle lanes in areas where there is a particular need.
  - » **Roadway and driveway/curb-cut crossings:** Use 2-foot wide bars (with 2-foot wide gap between) and aligned with dashed white lines at the edge of the bike lane.
  - » **Intersection Approaches:** Use solid green zone in the bike lane at least 20-feet long, at the approach to an intersection.
- **Signs**: Additional signage may be used to indicate presence of bicycle lanes.
- **Advance Stop Bars:** Where a bicycle lane carries through an intersection, the bicycle stop bar should be positioned adjacent to the crosswalk and 4-feet or more in advance of the vehicle stop bar. This allows bicycles to be positioned with better visibility to drivers.

Design References

- The MMUTCD provides standards for bicycle lane design.
- The City of Ann Arbor Non-Motorized Transportation Plan Update provides guidance on bicycle lanes and locations for recommended installation in downtown.
- The NACTO Urban Bikeway Design Guide provides additional guidance on the use and design of conventional bicycle lanes.

Utility Considerations

- If trenching is done in the bicycle lane, repair the entire width of the bicycle lane so there is not an uneven surface.
- Avoid locating manholes in bicycle lanes.
- Ensure any utility or vault covers are flush with the road surface and properly set and maintained.

Contra-Flow Bike Lanes - Design Considerations

In some situations, primarily on one-way streets, it may be desired to provide bike lanes that go in the opposite direction of the adjacent travel lane. These can help complete gaps in a bicycle network where routing would otherwise be much longer for cyclists.

Location:

- Contra-flow bicycle lanes should only be considered where this a clear observed need for the connection and where lane widths and separations can ensure adequate safety and comfort for cyclists and visibility for drivers. Contra-flow lanes should be as short as possible to complete the connection, even if just a single lane.

Design Considerations (in addition to those for conventional bicycle lanes):

- Contra-flow bicycle lanes should be positioned outside of the vehicle travel lanes and separated with a double-yellow line.
- Contra-flow lanes shall be a minimum of 5-feet wide, clear of any gutters lines and longitudinal pavement lines. Wider lanes are encouraged to provide better separation for bicyclists from oncoming traffic.
- Use high-visibility green paint markings along the entire length of the contra-flow bicycle lane.



Left-Side Bike Lanes - Design Considerations

Left-side bicycle lanes are conventional bicycle lanes placed on the left-hand side of a one-way street. Left-side bike lanes may be considered where it reduces conflicts with loading zones, curb cuts, turning vehicles, and/or better aligns with desired routes for bicycle traffic. However, since they are less common, it is important that they be visible and signed to alert roadway users to the unusual configuration.

Location:

- Shall only on one-way streets where conventional bicycle lanes would otherwise be an appropriate bicycle facility type.
- Can be especially suitable where there is frequent transit service occurring on the right-side of the road that would interfere with a bicycle lane.

Design Considerations (in addition to those for conventional bicycle lanes):

- Use high-visibility green paint markings along the entire length of the contra-flow bicycle lane.
- Consider using signage alerting drivers and pedestrians to watch for bicycles on the left side of the road, especially for left turning vehicles that will be turning across the bicycle lane.



MAINTENANCE & MANAGEMENT

General Maintenance

- Bicycle lanes and associated signs and symbols are additional markings that will require maintenance and replacement.

Seasonal Use & Maintenance

- Bicycle lanes should always be plowed during snow events and should never be used for snow storage.

Reviews & Approvals

- The Ann Arbor Engineering and Systems Planning Units oversee bicycle lane installation. For public projects, the project manager should coordinate with the Ann Arbor Engineering and Systems Planning Units.
- Ann Arbor Public Works is responsible for maintaining bicycle lanes.



Green paint used to make a conventional bicycle lane more visible.



Bicycle lane markings, with green paint, carrying through an intersection.



ROADWAY ZONE

ADVISORY BICYCLE LANES

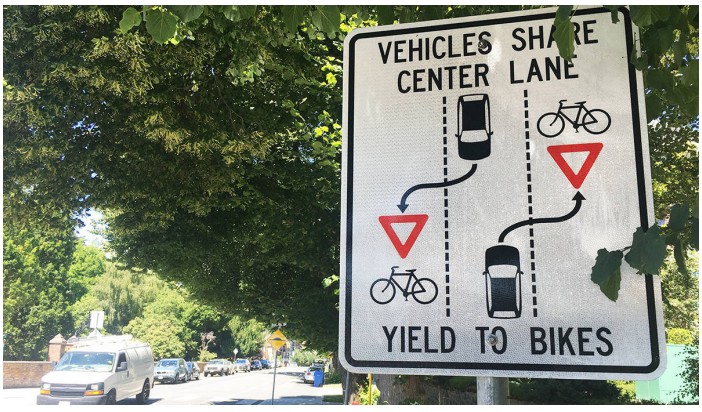
Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	■	■			
Transit		✕	✕	✕	
Bicycle		✕	✕		!
Balanced		■	■	■	!

DESCRIPTION & INTENT

On lower volume neighborhood streets without lane markings, vehicles tend to drive in the middle of the roadway (staying clear of any on-street parking). When vehicles approach in opposing directions, they both slow down and bear right to pass each other.

Advisory bicycle lanes are a way to formalize the above behavior through pavement markings while incorporating a designated zone for cyclists to ride. When vehicles traveling in only a single direction are present, bicycles effectively have dedicated lanes in which to travel. When opposing car traffic is present, vehicles will slow down and share a portion of the bicycle lane (yielding to cyclists if they are ahead of the vehicle) until the vehicles pass each other.

Beyond formalizing roadway behaviors on such neighborhood streets, the use of a narrow defined travel lane can incite vehicles to drive at calmer speeds and help raise the visibility of cyclists along the corridor, putting drivers on the alert.



USE & APPLICATION

Location

- **Usage:** Advisory bicycle lanes are only appropriate on streets that do not have delineated and marked travel lanes. Typically this will be on lower volume and lower speed (25 MPH or less) residential streets.
- Advisory bicycle lanes should be considered along low stress neighborhood routes, and as part of neighborhood greenways or bicycle boulevards. Advisory bicycles lanes are a treatment that can go beyond merely signing “designated bike route” in that the pavement markings can change driver behavior and create a street condition where the priority of cyclists is elevated.

Related Design Elements

On-Street Parking: Advisory bicycle lanes can be designed alongside on-street parking on one or both sides of the street.

Bumpouts: At intersections with bumpouts, the approach to the intersection should transition to more conventional demarcated travel lanes with sharrow markings or kept wide enough to allow the bicycle lane to carry through the intersection in a conventional manner.

DESIGN & OPERATIONS

Design Requirements

A **Vehicle Lane Width**: The shared travel lane for vehicles should be a minimum of 10-feet and a maximum of 18-feet wide, with a preferred range of 13.5- to 16-feet [1].

- » Narrower shared lanes (closer to 10-feet) have a greater impact on controlling vehicle speeds.
- » Widths wider than 18-feet should consider using narrow but fully delineated separate travel lanes.

B The overall clear width between the edge of any parking lanes or gutter lines, including both the shared travel lane and the bicycle lanes, should not be less than 20-feet, in order to allow the full range of vehicles to pass each other.

C **Advisory Bicycle Lane Width:** The advisory bicycle lanes should be a minimum of 5-feet wide.

- » Where space allows, provide a 2-foot buffer adjacent to on-street parking to reduce dooring risk.
- » Excess vehicle lane width can be allocated to bicycle lanes to provide greater passing space.

D **Pavement Markings:**

- » The line separating the vehicle travel lane and the bicycle lane should be a white dashed line (3-foot segments with 6-foot gaps) [1].
- » For the shared vehicle lane, do not use centerline markings during the mid-block portions of the roadway. When approaching an intersection that is stop or signal controlled, terminate the advisory lanes 30- to 50-feet from the stop bar and use sharrow markings (see Sharrows) with a normal vehicle lane centerline on the approach.

- **Signage**: Use signage (see example on prior page) to indicate the proper yield behavior for drivers. Using two-way traffic signs can also help reinforce that the roadway is intended for two-way travel.

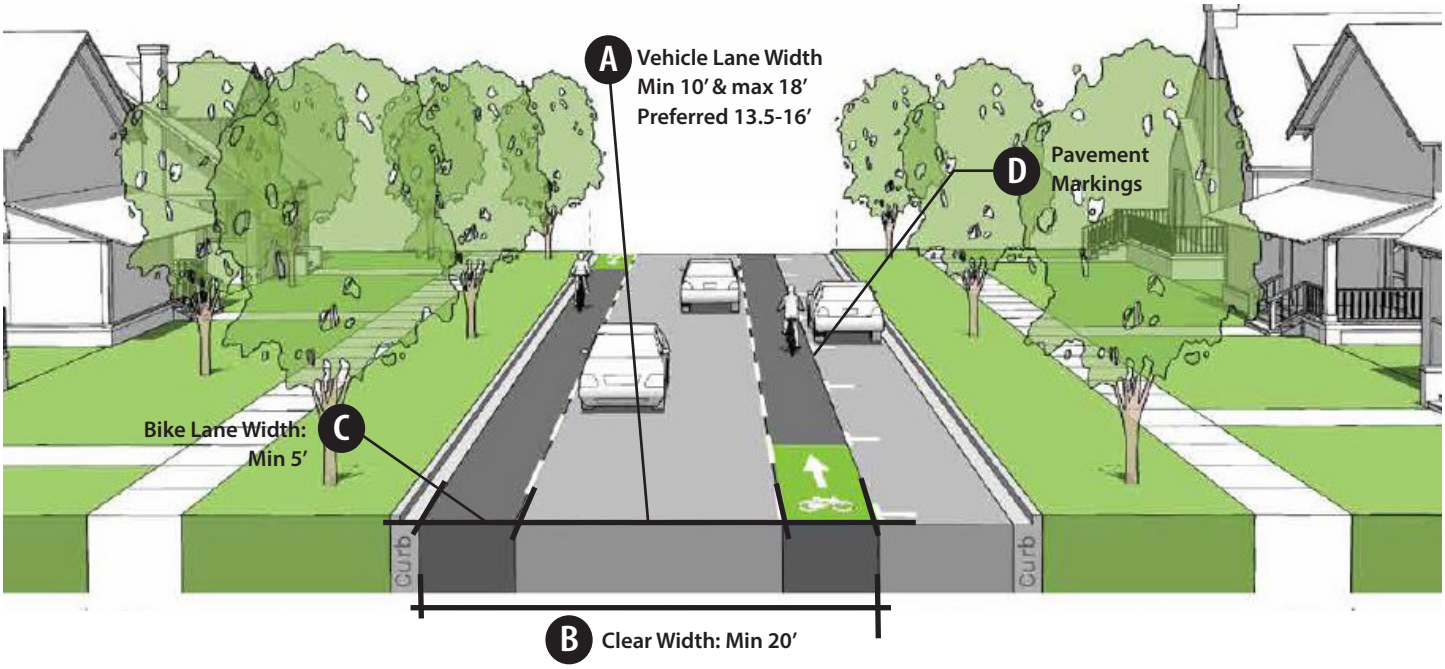
Design References

- Small Town and Rural Multi-modal Network (FHWA, 2016) document provides additional design and geometric guidance on “advisory shoulders,” which are advisory bicycle lanes.
- Advisory Bike Lanes in North America (Alta, 2017) provides extensive review of case studies and findings, supporting effective design and implementation of advisory bicycle lanes.

MAINTENANCE & MANAGEMENT

- The Ann Arbor Engineering and Systems Planning Units oversee bicycle lane installation. For public projects, the project manager should coordinate with the Ann Arbor Engineering and Systems Planning Units.
- Ann Arbor Public Works is responsible for maintaining bicycle lanes.

Figure 4.3.6- Advisory Bicycle





ROADWAY

SHARROWS

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	✓			
Transit		✓	✓	✓	
Bicycle		✗	✗		✗
Balanced		✓	✓	✓	✓

DESCRIPTION & INTENT

Sharrows, or shared lane markings (SLMs), are pavement markings that indicate a lane explicitly intended to be shared by motor vehicles and significant numbers of cyclists. Sharrows alert motorist to expect cyclists, remind motorist of the legitimacy of cyclists to use the roadway, and orient bicycles to the preferred line of travel outside the dooring zone. Sharrows also remind cyclists to ride with traffic, not against it.

Sharrows are not a dedicated bicycle facility and not all cyclists will be comfortable riding in travel lanes and relying on sharrows to alert motorist.



USE & APPLICATION

Location

- Sharrows may be used on all street types where road width is too narrow to accommodate a bicycle lane, except for bicycle emphasis streets which require dedicated bicycle facilities (e.g. bicycle lane, buffered bicycle lane).
- When sharrows are used, they should be used in conjunction with the narrowest feasible travel lane width, ideally 10-feet. Sharrows in wider lanes encourage vehicles to try and pass bicyclists, which is not a safe behavior.
- Because cyclists remain in mixed traffic, sharrows generally do little to enhance comfort for the most vulnerable or risk intolerant cyclists and should be used cautiously on streets with high traffic volumes and higher speeds, such as vehicle emphasis streets.
- Sharrows are most appropriate for streets with modest traffic volumes and slower travel speeds. Sharrows are not appropriate on streets with high traffic volumes and higher speeds, and dedicated bike facilities should be used or bike traffic routed onto other streets.
- Sharrows typically are not used on roadways with very low vehicle volumes and speeds, such as Near Neighborhood residential streets, except when part of a bicycle emphasis route.

Related Design Elements

- **Travel Lanes**: Sharrows are applied in otherwise typical vehicle travel lanes and do not affect overall dimension or assembly of the typical section.
- **Intersection Treatments**: Bike boxes or two-stage turn queues may be used in conjunction with sharrows.
- **Street Lighting**: Streets with sharrows should be adequately lit to enhance safety.

Policy References

- The City of Ann Arbor Non-Motorized Transportation Plan Update is the city policy document on bicycle accommodations.

DESIGN & OPERATIONS

Design Requirements

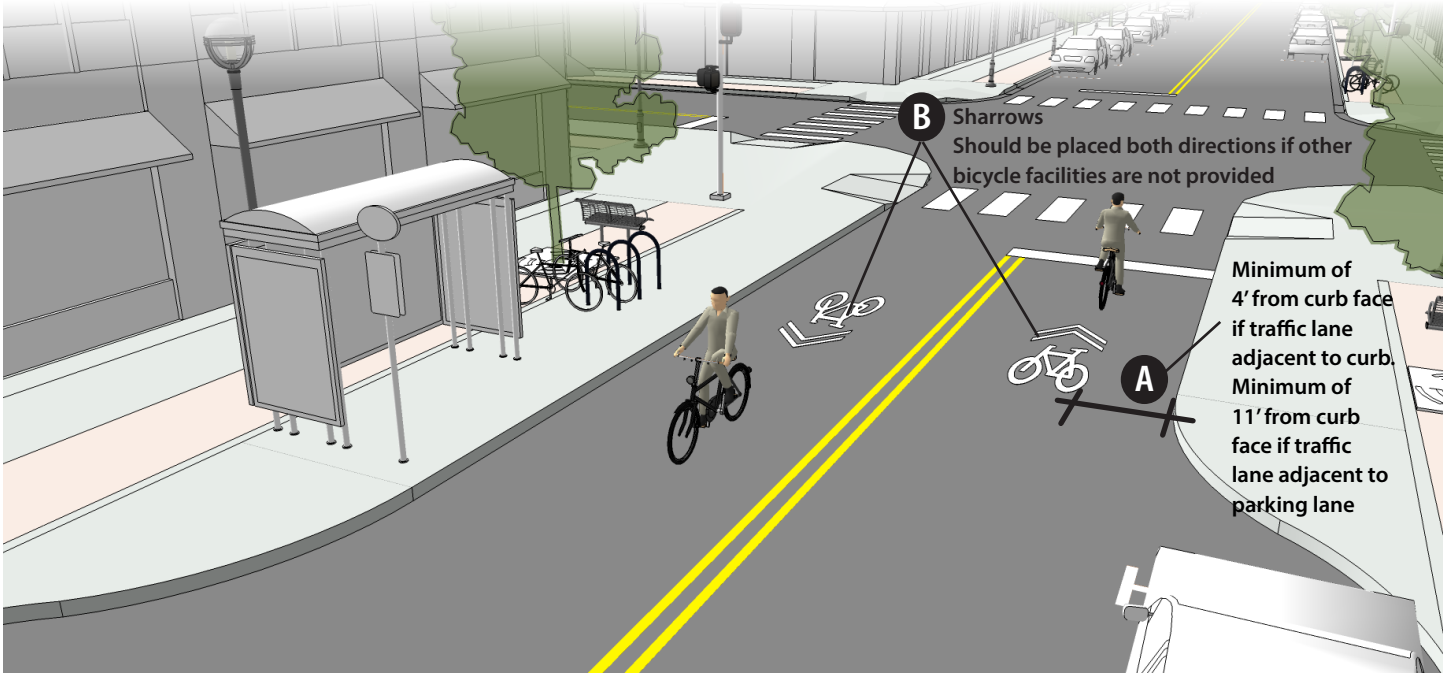
- **Marking Pattern**: Sharrows markings are two chevrons positioned above a bicycle symbol. See MMUTCD for detailed marking design.

A **Position from Curb**: Sharrows should be positioned within the center of the travel lane to reinforce that bicycles are able to utilize the full lane width and that cars should not pass the bicycle. Alignment in the center also provides additional buffering from "door swing" when on-street parking is present.

» MMUTCD notes that sharrows must be a minimum of 4-feet from the curb (and can be more further away) where there is no on-street parking, and a minimum of 11-feet from face of curb (and can be further away) when on-street parking is present.

B **Placement along Street**: Sharrows shall be placed in both directions of travel (unless other dedicated lanes are provided on just one side of the street). Sharrows should be placed at the start of a lane after an intersection, and spaced at 250-foot intervals or less (down to a minimum of 100-feet)

Figure 4.3.7- Sharrows



Additional Design Considerations

- Sharrow use is not affected by seasonal variations.
- Additional street signage, such as a "Share the Road" signs, may be used in conjunction with sharrow markings to further reinforce the shared use of the road for motorist.

Utility Considerations

- Locate manholes outside of identified bicycle lines of travel as they can produce a rough, slippery, and uncomfortable ride.

Sustainability Considerations

- Because sharrows are located in an otherwise typical vehicle travel lane, they do not present any obvious opportunities for green street treatments.

Design References

- The MMUTCD provides standards on shared lane markings.
- The NACTO Urban Bikeway Design Guide provides additional guidance on designing and using sharrows.

MAINTENANCE & MANAGEMENT

Special Maintenance

- Sharrows are additional pavement markings in the roadway that and additional maintenance to ensure they remain highly visible. Use of dotted lines and/or colored paint add further maintenance requirements.
- Placing sharrows toward the center of the lane may reduce wear and fading because the sharrows are located between the primary wheel track of vehicles.

Seasonal Use & Maintenance

- Shared lanes do not require any unique snow removal procedures. The travel lane and parking lane (where provided) should be cleared of snow for the full width to reduce vehicle encroachment onto the line of travel established by sharrows.

Reviews & Approvals

- The Ann Arbor Systems Planning Unit in collaboration with other units determines appropriate use of sharrows. For public projects, the project manager should coordinate with the Ann Arbor Engineering Unit and Systems Planning Unit.

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INTERSECTION ZONE

BIKE BOXES

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	■	■			
Transit		■	■	■	
Bicycle		!	!		!
Balanced		■	■	■	!

DESCRIPTION & INTENT

A bike box is a dedicated area for cyclists at the front of a traffic lane at a signalized intersection. Bike boxes make cyclists more visible to motorist by positioning them at the head of a queue during a stop cycle. They provide a space for cyclists to queue outside of crosswalk areas. Bike boxes enable cyclists to safely position for a left turn during a stop cycle at an intersection. On corridors of high bicycle activity, bike boxes cluster multiple cyclists and enable them to progress forward at the onset of the green signal cycle. This clears a bicycle lane more quickly allowing for a sooner progression of right turning vehicles. Bike boxes can improve safety by reducing or eliminating the need for bicycles to weave across travel lanes to make a left turn and reducing conflicts with right turning vehicles, “right hooks.”

Bike boxes can significantly increase the visibility and appeal of bicycling in a downtown area and support increased bicycling activity.

USE & APPLICATION

Location

- Bike boxes are used only at signalized intersections.
- Bike boxes must be used in conjunction with “No Right Turn on Red” (and “No Left Turn on Red”) restrictions. This limitation must be considered when determining appropriate locations for the use of bike boxes.
- Bike boxes are most beneficial on streets with high bicycle volumes[1] (5 or more in queue during peak hours), locations with significant left turn bicycle activity, and/or intersections where conflicts between right turning vehicles and bicycles are common.
- Bike boxes may be appropriate in any street type but generally should be reserved for areas where high bicycle activity is anticipated or desired, such as on bicycle emphasis streets.
- Bike boxes may also be desirable in high pedestrian zone areas to protect crosswalks from encroachment by bicycles or vehicles.
- While relatively logical, straightforward and easy to use, education and outreach to motorist, cyclists and pedestrians may be necessary to ensure their safe and appropriate use.

[1] “High bicycle volume” is a subjective measure. Precise warrant thresholds for bike boxes do not presently exist. Typically bike boxes are applied at locations where several cyclists (5 or more) may queue in a bicycle lane during the peak hour, though bike boxes may also serve an important purpose at lower volume locations and should not be precluded based on volumes alone.

Related Design Elements

Incompatible Elements:

- **Right on Red**: Bike boxes may not be used where a right-turn on red is permitted.
- **Unsignalized Intersections**: Bike boxes may not be used at unsignalized intersections.

DESIGN & OPERATIONS

Design Requirements

A **Box Size**: The bike box is formed by two parallel pavement marking lines at least 6 inches thick forming a box at least 6-feet in depth (10-foot preferred) and extending from the outside of the bicycle lane across all travel lanes in the direction of travel.

- **Placement**: Bike boxes are located between the crosswalk and the vehicle advance stop bar.

B » The vehicle stop bar shall be moved back to the rear of the bike box. Stop bars may be moved back up to an additional 7 feet to prevent encroachment into the bike box.

C » Bike boxes shall be separate and distinct from the crosswalk and may be moved further back from the crosswalk to create more separation and prevent cyclists from blocking the crosswalk.

D **Bicycle Markings**: Bicycle symbol pavement markings are located within the bike box in all lanes over which it extends.

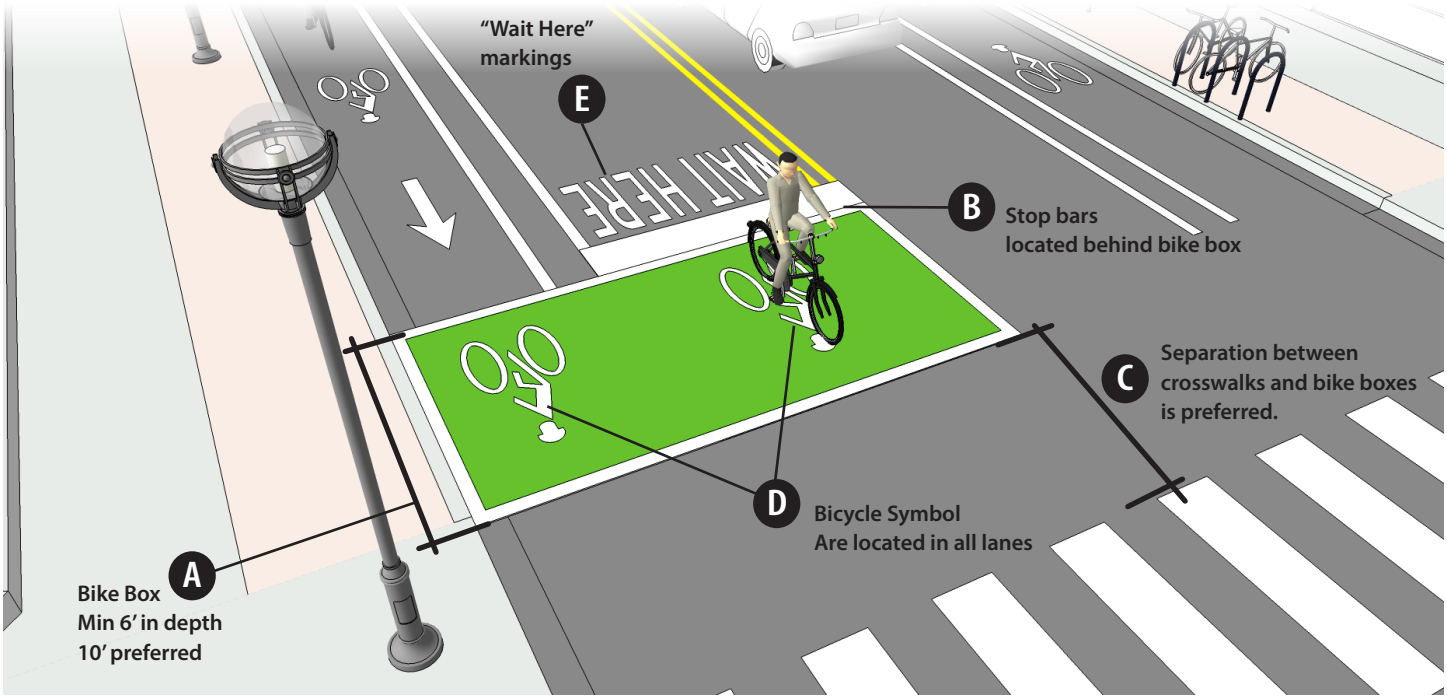
- **No Right Turn on Red**: Right turn on red shall be prohibited where bike boxes are used and shall be signed accordingly.

Additional Design Considerations

E **"Wait Here"** pavement marking or signs may be used to indicate to vehicles where to stop to avoid encroachment on the bike box.

- **Special Pavement Markings**: Green pavement marking is commonly used in bike boxes but is not required.
- **Bike Boxes Without Bike Lanes**: When bicycle lanes are not present, bike boxes can still be used by providing a short ingress bike lane to provide bicycles access to the bike box as they approach the intersection. Green pavement marking may be used in the bicycle approach lane.

Figure 4.3.8- Bike Boxes



- Bicycle egress lanes may continue into the intersection to indicate the area of potential conflict between motorists and cyclists. Green pavement marking may be used.
- **Two-Stage Turn Queues**: While bike boxes facilitate the positioning of cyclists to make left-hand turns, lateral movement by a cyclist after the initiation of the green phase could introduce conflicts with motorists. Two-stage turn queues are an alternative to accommodate left turning cyclists.
- **Enforcement:** Driver encroachment into bike boxes is typically no more common than encroachment into crosswalks and typically requires no additional enforcement.

Design References

- Bike boxes are currently experimental treatments The National Committee on Uniform Traffic Control Devices (NCUTCD) Bicycle Technical Committee has proposed draft guidance for bike boxes to be adopted into the MUTCD.[2]
- The NACTO Urban Bikeway Design Guide provides further guidance on the use and design of bike boxes.

MAINTENANCE & MANAGEMENT

General Maintenance

- Bike boxes are additional pavement markings that will require maintenance.

Reviews & Approvals

- The Ann Arbor Engineering and Systems Planning Units work collaboratively to determine locations for installation of bike boxes in coordination with the Street Design Team.[3]

[2] **http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_guidance/mutcd/bicycle_box.cfm**

[3] **http://nacto.org/cities-for-cycling/design-guide/intersection-treatments/bike-boxes/**

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INTERSECTIONS

TWO-STAGE TURN QUEUE BOX

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	■	■			
Transit		■	■	■	
Bicycle		!	!		!
Balanced		■	■	■	!

DESCRIPTION & INTENT

A two-stage turn queue box provides a protected area for cyclists to move out of the through traffic lane on the right hand side of a street and wait for the green cycle of the intersecting road before proceeding across to complete the turn.

Left turns can be a difficult challenge for cyclists who typically travel along the right side of a roadway. Merging across travel lanes can be dangerous and stressful, particularly for novice or concerned cyclists. Two-stage turn queues reduce bicycle/vehicle conflicts and provide a less stressful left-turn option.

While two-stage turn queues increase bicycle comfort and accommodation at multi-lane intersections, they do require two separate stages for a cyclist to complete a left-turn (first proceeding across, then proceeding through to the left). This may increase travel time for cyclists, although the benefit of comfort outweighs the time penalty. This makes two-stage turn queues a net positive in expanding cycling in downtown and making cycling more accessible to a broader range of cyclists.

Even where two-stage turn queues are provided, their use is optional. Cyclists may still lawfully complete a left turn from the left-most travel lane where vehicular left turns are also permitted.

USE & APPLICATION

Location

- Two-stage turn queues may be used on any street type, but are especially appropriate where there are significant volumes of turning cyclists, along preferred travel routes where the City wishes to encourage cyclists, and/or where accommodation of less confident cyclists is needed.
- Two-stage turn queues are beneficial where traffic volumes can make it difficult to get into a normal left-turn position and/or where cyclists frequently need to pause in the intersection to wait for on-coming traffic to clear before turning. This is a common situation on many downtown streets in congested Destination Commercial and Commercial areas.
- Two-stage turn queues are particularly beneficial on multi-lane streets (e.g. streets with more than one travel lane in any one direction including turn lanes).
- Two-stage turn queues are commonly used to provide left turns where cyclists typically travel on the right-hand side of the street but may similarly be used to accommodate right turns from a left-side bicycle facility.
- Two-stage turn queues are generally used in conjunction with other bicycle facilities, such as bicycle lanes or separated bicycle lanes, but may be used on any corridor where safe and comfortable accommodation of left-turning bicycles is needed.

Related Design Elements

- **Intersections**: Two-stage turn queues rely on a safe and protected location for bicycle queuing prior to completing the turn. Two-stage turn queues must be considered in the complexity of an intersection and must not block through travel during the first stage crossing (including through bicycle travel).
- **Curbside Uses**: Two-stage turn queues work well on streets with on-street bicycle parking (corrals), bumpouts or other reserved curbside use, but may be used elsewhere as well.
- **Signals**: Two-stage turn queues may be used at signalized or unsignalized intersections. While typically unnecessary at stop-controlled intersections, they may be used. If signals are actuated, locate detectors and/or turn queues where bicycles will be detected.

Incompatible Elements

- Two-stage turn queues should not be placed in front of right-turning vehicle lanes when right turns on red are allowed.
- Two-stage turn queues should not be placed adjacent to transit stops, as there may be a conflict between passengers boarding and cyclists waiting in the queue.

DESIGN & OPERATIONS

Design Requirements

A **Bicycle Movement**: A two-stage turn queue shall consist of a "first stage" bicycle travel facility, a bicycle lane, and a "second stage" queue box that accommodates cyclist waiting for the signal prior to completing the turn.

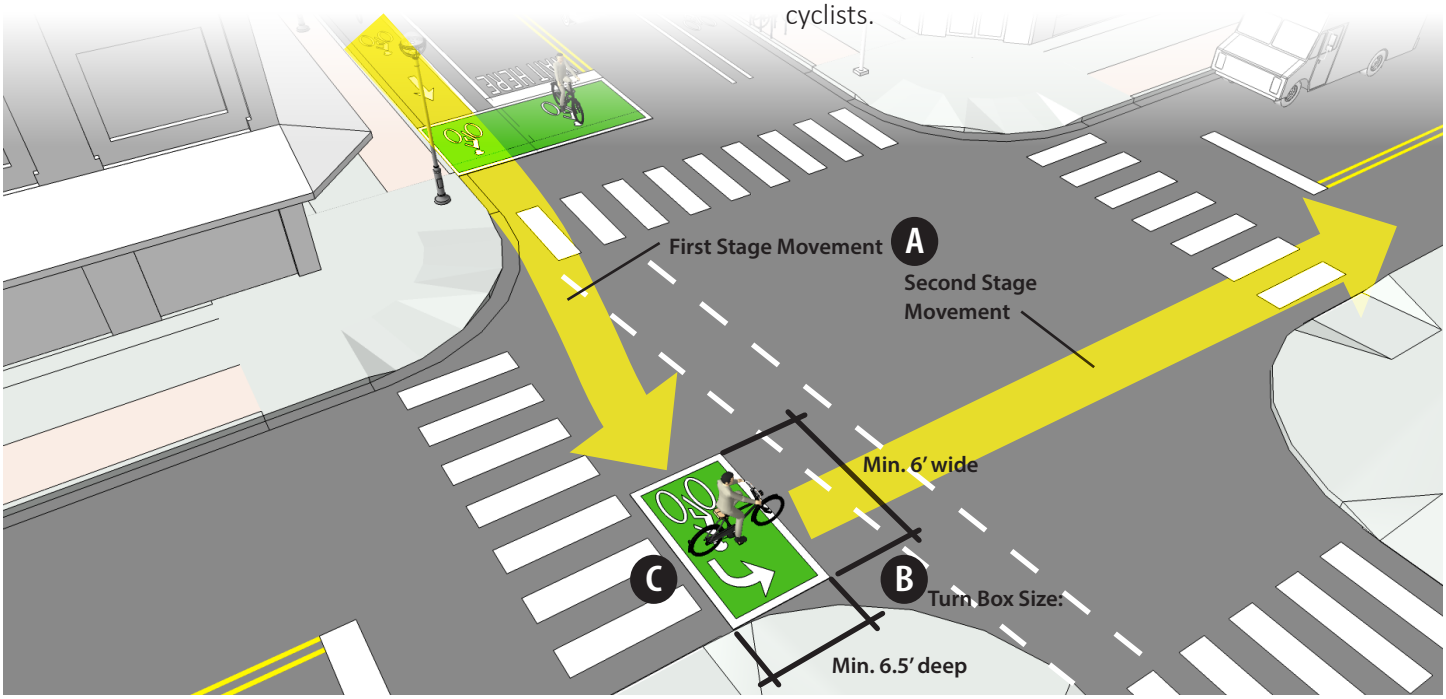
B **Turn Box Size**: The turn box shall be at least 6.5-feet deep in the direction of egressing travel. The turn box shall be at least 6-feet wide, but may be widened out to the width of aligned travel lane and/or where space permits.

C **Turn Box Location**: The turn queue box shall be positioned on the intersection side of the crosswalk and clear from any through bicycle movements from the receiving direction, to allow cyclists progressing through the intersection to avoid those using the turn queue box.

  » Relative to the cross-street, the turn queue box should be positioned in alignment with the cross-street bicycle lane or, if none is present, in alignment with the thru-vehicle travel lane.

- **Pavement markings** in the two-stage turn queue shall include a bicycle signal and an arrow indicating the proper ingress and turning direction.
- **Right on red turn** shall be prohibited where turn boxes are used to avoid conflicts with queued and waiting cyclists.

Figure 4.3.9- Two-Stag Turn Queue Box



Additional Design Considerations

- **High-Visibility Markings**: Use green pavement to increase visibility and legibility of the two-stage turn queue.
- **Bicycle Lane Markings**: If bicycle lanes are present, use dashed lines to indicate bicycle lane through the intersection and ensure queued cyclists stay clear of this travel facility.
- **Signal Detection**: If detectable/actuated signals are used, ensure bicycles will be detected in the two-stage turn queue. Bicycles should not be required to use pedestrian actuation to gain crossing.
- **Crosswalks and Bike Boxes**: Under constrained circumstances, crosswalks may be adapted to enable space for bicycle queuing. Alternatively a standard bike box (see Bike Box) may be used; this, however, requires cyclists to cross the pedestrian line of travel and should only be used where pedestrian volumes are low.

Design References

- MMUTCD provides standards on pavement marking and signage standards.
- The NCUTCD Bicycle Technical Committee has proposed draft guidance for two-stage turn queues to be adopted into the MUTCD.[1]
- The NACTO Urban Bikeway Design Guide provides additional guidance on the use and design of two-stage turn queues.[2]

MAINTENANCE & MANAGEMENT

General Maintenance

- Two-stage turn queues result in additional pavement marking that will require maintenance. The use of green markings may add additional maintenance complexity.
- Placing markings between vehicle tire tracks may reduce wear and tear.

Seasonal Use & Maintenance

- **Snow Removal**: Two-stage turn queues should be cleared of snow concurrent with all other street snow removal activities. Bicycle facilities should not be used for snow storage.

Reviews & Approvals

- The Ann Arbor Engineering and Systems Planning units work collaboratively to determine locations for installation in coordination with the Street Design Team.



[1] http://www.ncutcdbtc.org/sponsors.html

[2] http://nacto.org/cities-for-cycling/design-guide/intersection-treatments/two-stage-turn-queue-boxes/

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INTERSECTIONS

BICYCLE SIGNAL

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	■	■			
Transit		■	■	■	
Bicycle		!	!		!
Balanced		■	■	■	■

DESCRIPTION & INTENT

Bicycle signals are separate traffic signals used to guide and direct cyclists at intersections. Instead of the standard circle or arrow symbols, bicycle signal heads display a bicycle outline in each color phase. Bicycle signals are designed to reduce conflicts by separating bicycle and motor vehicle movements.

USE & APPLICATION

Location

Bicycle signals are used only at signalized intersections and when bicycle-only and/or leading bicycle intervals are required during a signal cycle. This may occur:

- Where contra-flow bicycle lanes join or cross an intersection.
- Where bicycle and pedestrian volumes are sufficiently high that a bicycle leading interval would be advantageous to safety and/or operations.
- Where two-way separated bicycle lanes s are used.
- At intersections with high bicycle volumes, a significant number of vehicle/bicycle crashes and/or geometrically complex intersections.

At present, there are no nationally established thresholds or warrants for bicycle signals. The California MUTCD is a leading state example that provides warrants for volume and collision and volume and geometric thresholds (at least 50 bicycles per peak hour, two or more bicycle/vehicle collisions within a 12-month period of types that could be reduced by a bicycle signal, and/or a movement or connection not open to vehicles is required). [1]

Some jurisdictions have adopted signs instructing cyclists to follow pedestrian signals in lieu of bicycle signals.

Use of bicycle signals will generally be limited to bicycle emphasis street intersections. At present, few, if any, intersections in downtown Ann Arbor exist where bicycle signals are necessary. However, with enhanced bicycle facilities and anticipated increased bicycle activity, installation of bicycle signals may be desired.

Related Design Elements

- Bicycle signals shall not be used in conjunction with sharrows.
- Bicycle signals and their associated stop zone should not impede the Sidewalk or crosswalk zone.
- Bicycle signals may necessitate prohibition of right on red.

[1] State of California Department of Transportation. California Manual on Uniform Traffic Control 11 Devices. State of California Department of Transportation; 2010. Pp. 831.

DESIGN & OPERATIONS

Design Requirements

- **Orient signal heads** to be clearly visible to on-coming cyclists.
- **Signal Activation**: Automatic detection is preferred. If manual activation is required, push buttons shall be located where cyclists can easily access them without leaving the bicycle facility. If the bicycle signal is not programmed into each light cycle actuate bicycle signal manually (e.g. push button) or automatically (e.g. in-pavement loop detector).

Additional Design Considerations

- **Right-Turn On Red**: If the bicycle signal separates bicycle movements from motor vehicle turning movements, right turn on red should be prohibited.
- **Signage**: Bicycle signals may be accompanied by unique signage targeted at the cyclist to explain the function and use of the signal. This is particularly valuable if bicycle signals are uncommon or if the movement governed by the signal is unique to bicycles.
- **Signal Timing:** The introduction of bicycle signals may require overall signal re-timing and periodic timing reassessment. There is no specific established guidance at present as to bicycle clearance intervals or other phasing.
- **Bicycle Symbol Face:** Use of the bicycle symbol face inside of the signal head requires obtaining FHWA interim approval. Alternatively, solid color signal faces may be used in conjunction with a sign next to the signal indicated that it is a "BICYCLE SIGNAL."

Design References

- MassDOT (2015) Separated Bike Lane - Planning & Design Guide: Provides guidance on the installation and application of bicycle signals.
- The FHWA has provided interim approval for the optional use of a bicycle signal face (December 2013).[1]
- The NACTO Urban Bikeway Design Guide provides additional guidance on the use and design of bicycle signals. [2]
- MMUTCD provides standards for traditional traffic signals, however not all guidance may be applicable specifically to bicycle signals.

MAINTENANCE & MANAGEMENT

General Maintenance

- Bicycle signals will require additional infrastructure and maintenance and long-term maintenance will be the same as other signalized intersections.

Seasonal Use & Maintenance

- Bicycle signals do not demand any special snow removal protocols.

Reviews & Approvals

- The Ann Arbor Engineering Unit, in collaboration with Systems Planning and Public Works, will review proposed signals and recommend installation if needed.

[2] http://mutcd.fhwa.dot.gov/resources/interim_approval/ia16/index.htm

[3] http://nacto.org/cities-for-cycling/design-guide/bicycle-signals/bicycle-signal-heads/



AMENITY ZONE

BICYCLE PARKING

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	!	✓			
Transit		✓	✓	✓	
Bicycle		✓	✓		■
Balanced		✓	✓	✓	■

DESCRIPTION & INTENT

Bicycle parking provides cyclists with a safe, secure, and reliable place to park bikes whether commuting, running errands, or patronizing downtown businesses. Bicycle parking is an essential component of the downtown's multi-modal transportation network.

Ann Arbor city code establishes requirements for bicycle parking[1] and identifies three types of bicycle parking (A, B and C):

- **Long-Term Bicycle Parking (A)**: Long-term bicycle parking is typically fully enclosed, secured and sheltered storage intended to accommodate a personal bicycle for a period of several hours or days. Spaces may be individually assigned and reserved and often require prearranged authorization to access (for example via a code, card or key). Long-term bicycle parking is generally necessary at places of work or residence, and most appropriately accommodated on private property. Typical means of providing for long-term bicycle parking include bicycle lockers, bicycle cages, sheds, or rooms.
- **Mid-term Bicycle Parking (B)**: Mid-term bicycle parking accommodates daily bicycle parking demands, such as parking during typical work shifts, school days, or other activities of two to eight hours in duration. Mid-term bicycle parking is not intended for bicycle storage. This parking is sheltered, but full enclosure is not necessary as parking should be accessible to, and shared by, many uses. Mid-term bicycle parking is best located on private property but immediately accessible and visible from the public street. Mid-term bicycle parking is typically satisfied by bike racks located within a parking structure, under an eave or overhang, or fitted with a stand-alone roof.
- **Short-Term Bicycle Parking (C)**: Short-term bicycle parking supports quick trips to destinations around downtown. Short-term bicycle parking is typically appropriate in the public right-of-way either in the Amenity Zone of the sidewalk or in the Curbside Zone of the street. It should be dispersed across downtown and easily accessible to every property on a commercial block. This type of parking is most often accommodated by bicycle hoops provided singly, in clusters of two or three, or in a public bike corral.

[1] Ann Arbor City Code, Chapter 59, section 5:167 Required Parking

USE & APPLICATION

This design element section primarily considered Short-term bicycle parking (type C) provided by bike racks located within the street right-of-way.

Location

- Bicycle parking is potentially needed in any frontage type, but is particularly necessary in Commercial, Civic & University, or Mixed use areas.
- In Destination Commercial areas, there may be competing depends for use of the Amenity Zone (e.g. for cafe dining & outdoor retail) and bicycle parking should be located to keep those areas open. Consider placing bicycle parking closer to intersections and not immediately in front of potential occupancy areas.
- Bicycle parking should be plentiful, dispersed, visible and conveniently located.
- Bicycle parking should facilitate transfers between modes. It should be accessible to major transit stops, transfer points and the Blake Transit Center.
- Locating bicycle parking near to corners improves visibility, access to curb ramps, and accessibility to more block frontages. Parking should be located far enough away from the corner to avoid conflicts with curb ramps or sight lines.

Related Design Elements

- **Pedestrian Area**: Bicycle parking must be located and aligned in a way that does not impede the pedestrian clear zone or block access between the curbside and clear Walking Zone.
- **Bicycle lanes**: Bicycle parking complements bicycle travel facilities and should be amply located along bicycle routes, lanes, separated bicycle lanes, and trails.
- **Bumpouts**: Bicycle parking works well in bumpouts or bike corrals that extend the pedestrian environment into the parking lane, freeing up space on the sidewalk for circulation or other amenities.

Policy References

- The Association of Pedestrian and Bicycle Professionals (APBP) Bicycle Parking Guidelines.





DESIGN & OPERATIONS

Design Requirements

A **Location**: Locate bicycle parking near building entrances in direct line of sight to the point of entry. Bicycle parking should be in areas that are well lit and have many eyes on the street to improve safety, comfort, and security. Avoid placing bicycle parking along blank walls where there is limited visibility from inside the building to the racks.

- **Bike Rack Durability**: Racks shall provide secure parking for a bicycle. Bolted down racks (utilizing anti-theft bolts) are preferred. In brick environments, embedding is necessary. Racks shall resist cutting, damage, or disassembly with typically available implements.

B **Bike Rack Design**: A 2 inch galvanized or powder coated steel "inverted U" is the preferred bicycle rack design in Ann Arbor. Other styles, including custom or artistic designs, are acceptable provided they meet the below requirements. Maintenance responsibilities must be clear when using any non-standard bike rack ; an encroachment permit or licensing may be required.

» Racks shall support a bicycle in an upright position, supporting a bicycle frame in at least two places for common bicycle frame types.

» Rack design and installation shall enable bikes to be easily, intuitively, and securely locked. If artistic bicycle rack designs are used, ensure that U-locks or other typical locking devices can be conveniently used securing both wheels and frame of a bicycle.

» Racks should permit locking of both tires and accommodate "front in" and "back in" bicycle parking.

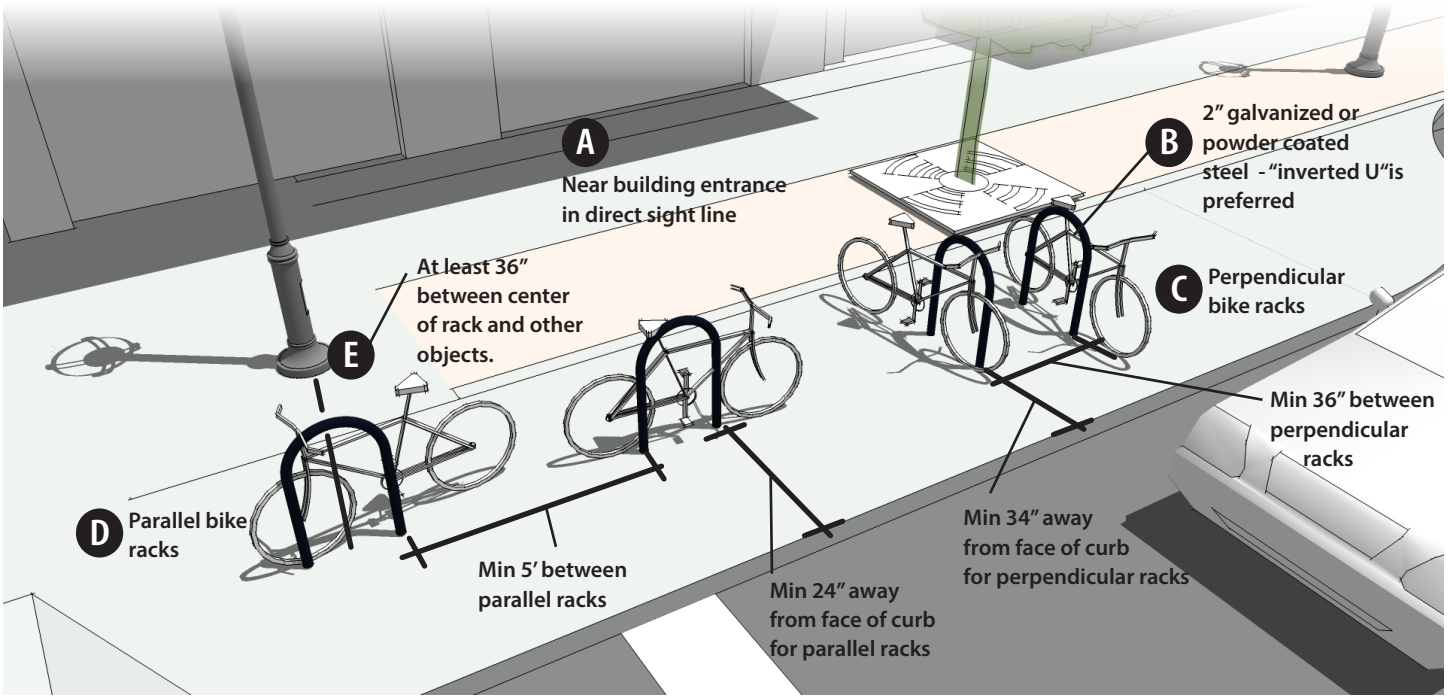
- **Bike Rack Orientation and Clearance**: Bicycle racks may be placed parallel, perpendicular or at an angle to the curb line singly or in groups of two or more.

C When perpendicular to the curb, racks shall be at least 36 inches apart on center and shall be at least 34 inches from the face of curb and edge of the sidewalk.

D When placed parallel to the curb, racks shall be at least 5 feet apart at their nearest point. Bike racks shall be at least 24 inches from the face of curb (30 inches is preferred where width permits) and 18 inches from the edge of the sidewalk.

» When at a 45 degree angle, hoops should be at least 42 inches apart at center and shall be at least 34 inches from the face of curb at the closest point.

Figure 4.3.10- Bicycle Parking



- **Clearance From Other objects:**
  - » Install racks with a minimum clearance of at least 36 inches between the center of the rack and any other fixed object.
  - » Bicycle racks adjacent to bus stops shall be located at least 5 feet in front of a bus flag mounted on a post or shelter or 30 feet behind it.
  - » Racks must be located to maintain the clear pedestrian zone when bicycles are parked.

Additional Design Considerations

- Short-term bicycle parking is typically accommodated in the Amenity Zone of the sidewalk. Other acceptable locations include bumpouts and the Frontage Zone.
- Bicycle parking may be integrated with other street features such as parking meter posts, light poles, planters, parklets or tree guards.
- **Lighting:** Adequate lighting around bike parking is important for safety and security. Illuminate areas around bike parking to a minimum of 0.4 foot candles and max uniformity ratio of 10 to 1.
- Consider unobtrusive ways to provide cover or shelter to bicycle parking.

Utility Considerations

- Ensure that bicycle racks do not block access to utility boxes or hand holes.

Sustainability Considerations

- Bicycle parking promotes and enables human-powered, emission-free travel options providing a number of environmental benefits.
- Bicycle parking should be located proximate to street trees to avoid the temptation to lock bicycles to street trees and to reduce damage to the tree.
- Where bicycle parking is covered, consider incorporating solar panels, green roofs, and white roofs.

Design References

- The APBP Bicycle Parking Guidelines provide recommendations on the design and location of bicycle parking.[2]
- The City of Ann Arbor Bicycle Parking Manual for Businesses provides design guidelines for placement and lighting of bike parking.

MAINTENANCE & MANAGEMENT

Special Maintenance

- Durable material and quality installation can significantly reduce maintenance demands. The DDA cooperates with the City of Ann Arbor Community Services Unit to track and remove abandoned bicycles.

Seasonal Use & Maintenance

- Bicycle parking should be available year-round and in all types of weather. Covered bicycle parking can promote year-round cycling.
- Property owners are responsible for snow removal adjacent to their property; bicycle parking should be kept clear after a snow event.
- Avoid snow storage that precludes the use of bicycle racks.

Reviews & Approvals

- The City of Ann Arbor Engineering Unit oversees permanent infrastructure installations on public sidewalks and coordinates with the DDA regarding bicycle parking. The two agencies evaluate proposed bicycle parking in the public right-of-way as part of site plan review.
- The City of Ann Arbor Planning and Development Services review compliance with city code requiring bicycle parking on private property for all new construction projects.
- The DDA supports maintenance of standard bicycle hoops in the public right-of-way. The AAATA manages activities on transit authority property, including the Blake Transit Center.

[2] http://www.apbp.org



CURBSIDE ZONE

BIKE CORRAL

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	!	!			
Transit		!	!	!	
Bicycle		!	!		■
Balanced		!	!	!	■

DESCRIPTION & INTENT

A bike corral is a designated area for short-term bicycle parking. Bike corrals provide parking for a number of bicycles in a compact area. Bike corrals may be located on sidewalks, in parking lots, or other areas behind the curb, but are often placed in the curb lane of the street. By converting a parking space into space for a bike corral, cities can accommodate parking for 12 to 20 patrons on bicycles in the space typically used to park one automobile.

Bike corrals can replace bicycle hoops, bike racks, freeing up sidewalk space for other uses such as additional pedestrian space or cafe dining. Bike corrals are an excellent solution for accommodating a large number of bicycles near specific activity areas and in areas with narrow sidewalks.

Bike corrals are often highly valued by ground floor businesses. Despite removing a valuable curbside parking space, many businesses have found that bike corrals improve accessibility and visibility to their establishment(s) in addition to relieving pressure on limited sidewalk space.

In downtown Ann Arbor, the DDA provides bike corals and the use of the on-street parking space free of charge to businesses that request a corral and show demand (as can be accommodated).

USE & APPLICATION

Location

- Bike corrals should be used in areas of high volume of bicycle traffic, or near significant destinations such as business districts, schools or civic buildings.
- Bike corrals are suitable for all functional emphases and frontages contexts but demand for bicycle parking is likely to be highest in Destination Commercial, Commercial and Civic & University areas.
- Bike corrals are unlikely to be necessary in Near Neighborhood contexts.
- Bike corrals placed in the street may only be utilized in streets with reserved curbsides. Typically this means they will only be used on streets with on-street parking.
- Bike corrals in a northern climate like Ann Arbor may be temporary installations removed during the winter months to facilitate snow plowing activities. For this reason, additional bicycle parking alternatives may be necessary in areas where bike corrals are commonly used to continue to meet the need for bicycle parking even during winter months.

Related Design Elements

- **Bicycle Lanes**: Bicycle parking complements bicycle travel facilities and should be amply located along bicycle routes and facilities proximate to major generators or destinations.
- **Bicycle Parking**: Bicycle parking works well in bumpouts or bike corrals that extend the pedestrian environment into the parking lane, freeing up space on the sidewalk for circulation or other amenities.
- **On-Street Parking**: On-street bike corrals may only be used on streets where the curb lane is not used for travel.
- **Loading Zones**: While bike corrals convert an on-street parking space, they should not be located in spaces reserved for loading.

DESIGN & OPERATIONS

Design Requirements

A **Corral Design**: Ann Arbor has a standard bike corral design. To facilitate maintenance, this standard corral shall be used. Alternative designs may be possible with specific sponsorship and maintenance agreements and with Street Design Team approval.

B
» Racks shall be oriented perpendicular to the curb, placed 36 inches apart, and provide 42 inches between the rack and the face of curb.

» Bike corrals shall be immovable once placed, but capable of being removed and stored during winter months.

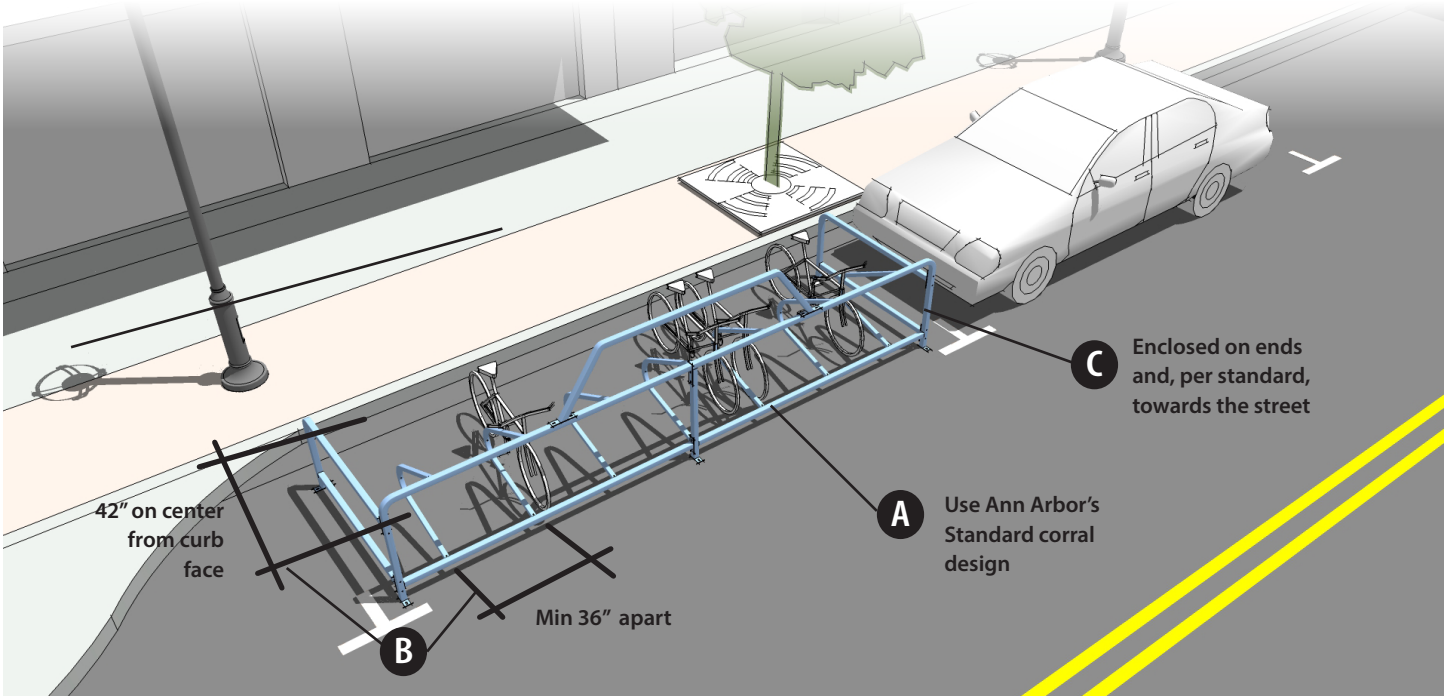
- **Location**: Bike corrals shall be placed within a standard on-street parking space. Corrals placed at the end of a bank of parking can prevent parked cars from creeping too close to the intersection area.

C **Corral Enclosure:**

» Provide protection on either end of the bike corral to prevent damage by autos parking or traveling.

» The Ann Arbor standard is to have the enclosed side of the standard bike corral toward the travel lane of the street with access from the sidewalk side.

Figure 4.3.11- Bike Corral



Additional Design Considerations

- **Alternate Corral Designs**: There are many types of bike corral designs. Alternative designs are possible provided the design complies with above guidelines and provides protection from the travel lane (per Ann Arbor standards), and provides protection on either end of the bike corral. DDA manages and maintains since we are the only one who puts them in.
  - » An alternative design,used in many cities, is an open design permit bicycle parking access from either the street or sidewalk side.
- **Shelters**: Bike corrals with roofs may provide sheltered bicycle parking as long as they do not interfere with sight lines..
- **Bumpouts**: Bike corrals may be located on bumpouts or where there is adequate space.
- **Bicycle Repair Stations**: Consider placing a bicycle repair station adjacent to or integrated with the corral. A repair station is an outdoor frame that contains tools for fixing a bicycle, such as a tire pump. Individual tools can be secured to the station with a flexible band that allows cyclists to use them on their bike without the potential for theft. There is a bicycle repair station located at city hall.

Utility Considerations

- Do not locate bike corrals over vaults.
- Consider stormwater facilities when siting.

Sustainability Considerations

- Bike corrals not only accommodate demand for bicycle parking but also promote the visibility of this low-emission form of travel.
- If bike corrals are covered, consider incorporating solar panels, green roofs, and white roofs.

MAINTENANCE & MANAGEMENT

Special Maintenance

- Durable material and quality installation can reduce maintenance demands for bike corrals.
- The DDA cooperates with the Ann Arbor Community Standards Unit to track and remove abandoned bicycles.

Seasonal Use & Maintenance

- On-street bike corrals are typically removed and stored during winter months to facilitate snow removal.

Reviews & Approvals

- The DDA is responsible for installation and maintenance of standard parking corrals in on-street parking spaces. Outside of parking lanes or parking facilities, placement of bike corrals should be coordinated through the Ann Arbor Engineering Unit, Systems Planning Unit, and the DDA.



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Blake Transit Center



4.4

TRANSIT

Bus Stops & Shelters 198
Bus Bulbs 204
Transit Lanes 208
Bus Queue Jump Lane 212



AMENITY ZONE

BUS STOPS & SHELTERS

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	!	!			
Transit		✓	✓	✓	
Bicycle		!	!		!
Balanced		!	!	!	!

DESCRIPTION & INTENT

Bus stops are designated places where riders can board or alight the bus. Bus stops may be as simple as a as a signpost along a curb edge or may be a distinct sub-place that includes distinct features such as a shelter, seating and/or public art.

Bus stops typically occur in the pedestrian zone of the street. Bus stops may be located at the curb line or may be accommodated on a bus bulb, an extension of the curb that permits the bus to safely board passengers from the travel lane. The location and design of bus stops depends on passenger volume and available space, among other factors. Bus stops typically share space on the sidewalk with other uses and should be considered in the overall context of the sidewalk area.

Bus stops should be located proximate to designated crosswalks since riders often cross the street to get to or return from the transit stop. Transit stop design should also consider cyclist access to the stop including bicycle route connections and bicycle parking.

Bus stops are most successful when they are appropriately scaled to the volume of riders, provide comfortable places to wait, and deliver sufficient information to transit riders to understand the services provided. A well-designed stop calls attention to the availability of transit service, explains how it works, and makes transit an appealing travel option.

USE & APPLICATION

Location

- Bus stops are appropriate and recommended for all street types and are essential to provide access and mobility for downtown users.
- The type of bus stop (sign only or shelter) and provided amenities will depend largely on the number of passengers utilizing that location (primarily waiting to board), as well as the width and pedestrian volume of the adjacent curbside and sidewalk areas, whether the space can accommodate transit amenities.
  - » On transit emphasis streets and in locations with high ridership, stops should provide an enhanced waiting environment, such as covered waiting shelter, formal seating, informal seating, rider information, and real-time information.
- Bus stops may be located at near-side, far-side, or mid-block locations.
  - » Where buses operate in mixed traffic and stop at the curb line, far-side stops are generally considered preferable unless located at a stop-controlled intersection or if a bus bulb is utilized.
  - » The location of the bus stop will be the result of multiple factors including operations, routing and transfers, and local land use and right-of-way context.

Related Design Elements

- **Sidewalks**: Bus stops must be co-located with continuous sidewalks and adjacent crosswalks connecting them to the larger pedestrian network. Transit stops should be accessed by ample sidewalks and wide, well-marked crosswalks in appropriate locations. Bus stops are complemented by a lively public realm with active building fronts and street activity. On multi-lane streets, pedestrians traveling to and from transit stops should have median refuges at the crosswalk.
- **Bus Bulb**: In locations where sidewalk space is tight, buses have difficulty re-merging into travel lanes, and/or large volumes of pedestrians wait, bus bulbs may be used.
- **Bicycle Parking**: Where possible, bus stops should include bike racks to accommodate bicycle access. Bike share stations should be located proximate to bus stops and/or provide wayfinding to nearby transit stops.
- **Bicycle Lanes**: On bicycle priority streets, bus stops should be designed to minimize conflicts with cyclists. This may include routing bicycle lanes onto the sidewalk and behind the transit stop to reduce conflicts between cyclists and transit passengers.





Policy References

- The AAATA follows guidelines promulgated by the Transit Cooperative Research Program (TCRP) for transit stop location and design (Report 19).
- The Downtown Ann Arbor Design Guidelines require that transit "be considered in the design of streetscapes" and that transit patrons have a "comfortable environment" at transit stops. The guidelines recommend providing trash receptacles and seating or leaning walls for waiting passengers, as well as nearby bicycle racks.
- The Non-Motorized Transportation Plan Update recommends that the walking distance to transit stops not exceed 1,300 feet (1/4 mile), that transit stops be located close to the main entrance of activity generators, and not areas with high numbers of transit users, particularly the elderly and persons with disabilities.

DESIGN & OPERATIONS

Design Requirements

A Stop Location:

- » Stops shall be at least 50 feet past (downstream from) a crosswalk whenever possible.
- » Bus stops should not be placed immediately before (upstream of) a crosswalk as the stopped bus can prevent pedestrians and traffic from seeing each other.
- » Bus stops should be located at least 100 feet from alleys or frequently used curb cuts, such as those servicing parking decks, to minimize conflicts with vehicles entering and exiting, however in dense urban contexts such as Ann Arbor, this is not always possible.

B Stop Length: Bus stops shall be at least 60 feet long.

- » Longer stops may be necessary if articulated buses are used and/or there is a high volume of buses utilizing a stop location. The bus zone is longer than the bus to accommodate buses maneuvering to the curb and/or back into the travel lane.

C Signage Location: Bus stops should have a flag sign on a sign post embedded in the sidewalk a minimum of 2 feet from the curb edge.

- » At far-side or mid-block stops, the sign should be located 25 to 35 feet from the front edge of the bus zone to give the bus room to pull out from the stop and reenter traffic from its stopped position
- » Basic route information shall be provided including service operator, route(s) servicing that stop, schedule information, and major stops serviced.

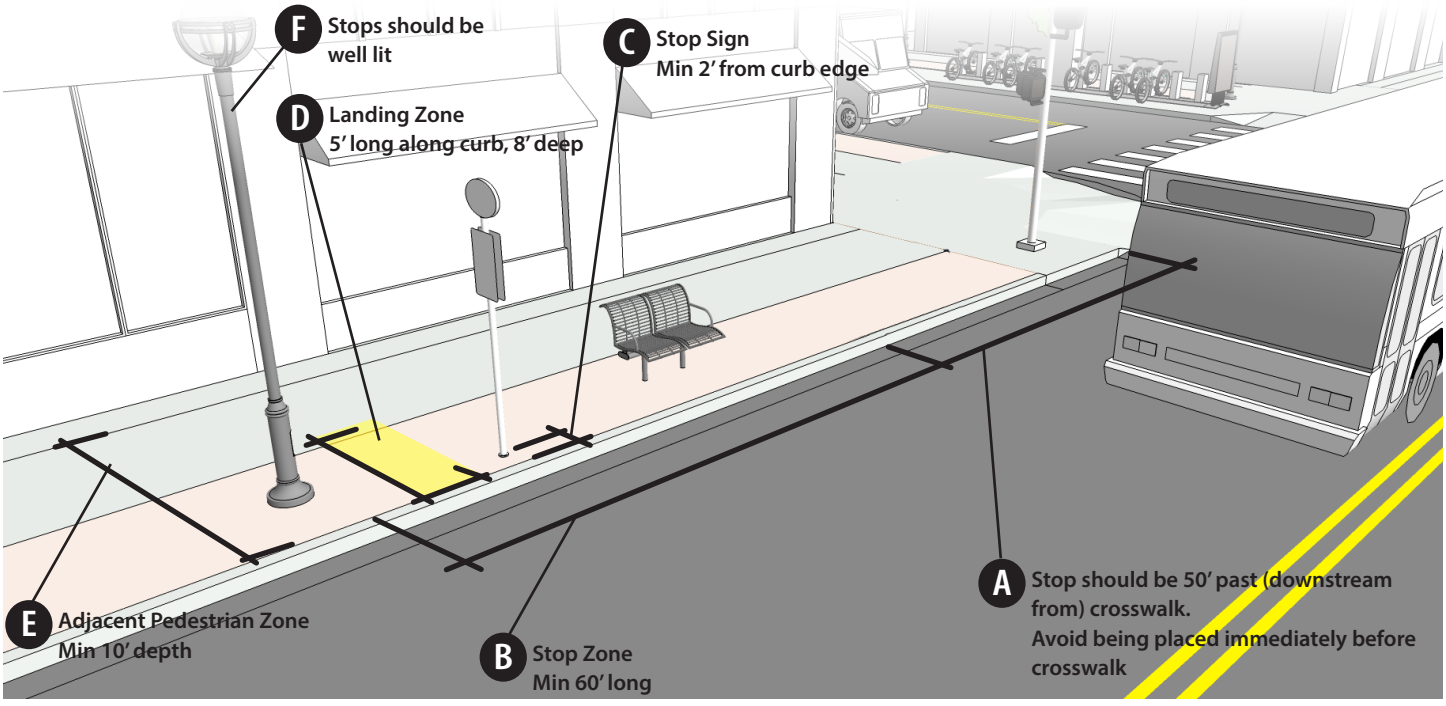
D Landing Zone: Bus stops shall have a landing zone at every door that is at least 5 feet wide parallel to the curb and 8 feet deep. This allows enough room for the bus to extend its ramp for riders with mobility impairments.

- » Landing zones shall be clear of any curbside obstacles, such as street trees, planters, planting beds, light poles, or sign posts.
- » In Near Neighborhood areas where the Amenity Zone may be a planting strip, using a hard paving surface for the landing zone is encouraged.

E Pedestrian Area: Adjacent pedestrian areas (Amenity Zone and Walking Zone) shall be at least 10 feet in total depth. 10 feet provides adequate space for passenger waiting while still providing comfortable room for pedestrians to travel through the bus stop zone.

- » Along sidewalks with greater pedestrian density, the width may need to be larger.

Figure 4.4.1- Bus Stops



F **Lighting**: Bus stops shall be well lit by the surrounding street light system. See Section 4.6- Street Lighting Design Element for recommended light levels.

  - » The City of Ann Arbor Bike Parking Manual for Businesses recommends Illuminating areas around bike parking to a minimum of 0.4 foot candles and max uniformity ratio of 10 to 1. This light level would benefit transit stop locations as well.

- **Sidewalk Connectivity**: Bus stops shall be contiguous with a continuous sidewalk network.
- **ADA Accessibility**: Bus stops shall meet accessibility requirements including providing a smooth, level, and clear zone for boarding, alighting, waiting, and access and egress from the bus stop.

Additional Design Considerations

- **Safety**: Bus stops should be located and oriented to promote real and perceived personal safety for passengers waiting for transit service.
- **Shade**: Ideally bus stops will have some degree of shade, whether provided by adjacent buildings, street trees, or bus shelters.



- **Bus Shelters-Design**: Bus shelters may be provided at higher volume stops where sidewalk space permits.
  - » Shelters are typically 10 to 12 feet wide and between 5 feet deep.
  - » Shelters can be fully or partially enclosed on one or more sides to provide protection from wind and rain.
  - » Transit shelters should use transparent materials like glass, to improve security and reduce sight obstructions.
  - » Bus shelters provide the opportunity for additional information such as real time bus arrival displays, advertising panels, and larger maps of the stop area and/or transit system.
- **Bus Shelter - Position & Clearances**
  - » Shelters should be located in the Amenity Zone, with at least 4 feet of clear space between the shelter and the curb.
  - » Alternatively, shelters may be placed in the Frontage Zone at least 1 foot from a blank building face and/or be integrated features of the building wall, such as an alcove or awning.
  - » Shelters can be oriented facing out to the street or out to the sidewalk. When located close to the curb, sidewalk facing shelters can provide pedestrian protection against vehicle splashes.
  - » Shelters should be located 10 feet, parallel to the curb, from any vertical obstructions such as street trees, street lights, and utility poles.
  - » Transit shelters should not be utilized where they would result in less than 6 feet of pedestrian through zone for the adjacent sidewalk.
  - » Use of a bus bulb may be an appropriate treatment to provide for shelter siting and sufficient sidewalk clear space.
- **Amenities**: Bus stops may include additional passenger amenities such as waste or recycling receptacles, benches or leaning rails, wayfinding signs, street trees, and/or special lighting.
  - » Fixtures should be at least 18 inches from landing zones and 3 feet from benches to accommodate circulation.
  - » Trees should be planted no closer than 10 feet from landing zones.

- **Information Displays**: Increasingly, major bus stops are designed to be "mobility hubs" provide information on the range of area transportation services, including nearby bike share and car share services, information for taxis and ride sharing providers, and wayfinding to local civic destinations or businesses.
- **Special Materials**: Stops may use special paving patterns, plantings, public art, or street furniture to further highlight and distinguish the bus stop. This would be most common on transit priority corridors or at the most significant bus stops.

Utility Considerations

- Coordinate bus shelters, tree pits, and any amenities anchored in the pavement of the sidewalk with underground utilities.
- Locate bus shelters at least 1 foot from manholes and other utility access and 10 feet from fire hydrants.
- Do not locate utility vaults in bus stop areas.

Sustainability Considerations

- Consider green roofs, white roofs, or include solar or wind generators to power advertising displays or real time information.

MAINTENANCE & MANAGEMENT

General Maintenance

- Simple bus stops introduce few significant maintenance needs.
- Bus stops are used year-round. Bus stops may be temporarily relocated to accommodate seasonal events such as festivals or other street closures; however, significant advance notice should be provided to riders and signage placed at the stop indicating the location of the temporary stop.
- Bus shelters require rapid repair if glass panels are broken or damaged. The shelter must also be regularly washed and any litter accumulating in and around the shelter should be removed.
- If waste or recycling receptacles are provided, clear responsibilities for waste removal must be established.

Seasonal Use & Maintenance

- **Snow Removal**: Bus stops must be cleared of snow and ice both in their landing zones as well as clear pathways provided to cleared sidewalk paths. Adjacent property owners are responsible for snow and ice clearing at bus stop.
  - » A pathway from the landing zone to the cleared roadway space must be maintained at a width sufficient to enable deployment of wheelchair lifts. This can be particularly challenging as roadway plowing tends to pile snow up at the curb line. This berm of snow must be cut through to enable a clear path for passenger boarding and alighting.

Reviews & Approvals

- Bus stops are approved and located on a case-by-case basis by the AAATA and the City Engineering Unit.
- City Code requires the city traffic engineer to approve bus stop locations. Citing a bus stop depends on several, sometimes competing, factors including available space, sidewalk width, traffic and pedestrian volumes, street width, turning movements, sight distances, and the presence of parking, bicycle facilities, crosswalks, impacts on adjacent property owners, nearby transit trip generators, and public input.

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CURBSIDE ZONE

BUS BULBS

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	■	■			
Transit		!	!	!	
Bicycle		■	■		■
Balanced		■	■	■	■

DESCRIPTION & INTENT

Bus bulbs extend the bus stop space into the roadway space for the length of the bus stop. Bus bulbs provide additional space for passenger waiting and queuing and transit amenities. They are generally used to address one or more conditions:

- Where sidewalk space is constrained and insufficient space is available to adequately accommodate both transit passenger and through pedestrian needs.
- On corridors where buses have difficulty re-merging into travel lanes after stopping for passengers.

USE & APPLICATION

Location

- Bus bulbs may be warranted on any street type where sidewalk space is constrained given the volume of pedestrians (transit riders and walkers) and where bus operations are reduced due to difficulty re-merging into travel lanes.
- On transit emphasis streets, bus bulbs are recommended to increase the visibility and efficiency of transit service.
- Bus bulbs should only be used in association with on street parking and/or dedicated on street bicycle facilities.
- Bus bulbs, like bus stops, may be located at near-side, far-side or mid-block locations. Bus bulbs located at near- or far-side locations are typically integrated with and appear as elongated bumpouts.

Related Design Elements

- **Bicycle Lanes**: Bicycle facilities should be routed behind the bus bulb and transit stop area. If bus bulbs are used at near-side locations, careful design is necessary to ensure safe bicycle progression through the intersection.
- **Travel Lanes:**: Bus bulbs should not be utilized on two-lane roadways that have only one travel lane in each direction.
- **Traffic Impact**: Because buses stop in the travel lane of a roadway while boarding and alighting passengers, bus bulbs can reduce the vehicle flow of that lane. Therefore study of traffic operations is advised before the installation of bus bulbs.
- **Street Lighting**: As with all transit stops, bus bulbs should be well lit and proximate to safe pedestrian crossings and bicycle parking.
- **Bike Share**: Bus bulbs are typically only applied on higher volume routes and thus benefit from co-location with bike share stations.

DESIGN & OPERATIONS

Design Requirements

A **Length**: The length of bus bulbs depends on the type and volume of buses using the stop. For Ann Arbor bus bulbs will typically only need to accommodate a single, standard 40-foot bus. Bus bulbs shall extend from the front of the vehicle to beyond the back door, at least 30 feet in length.

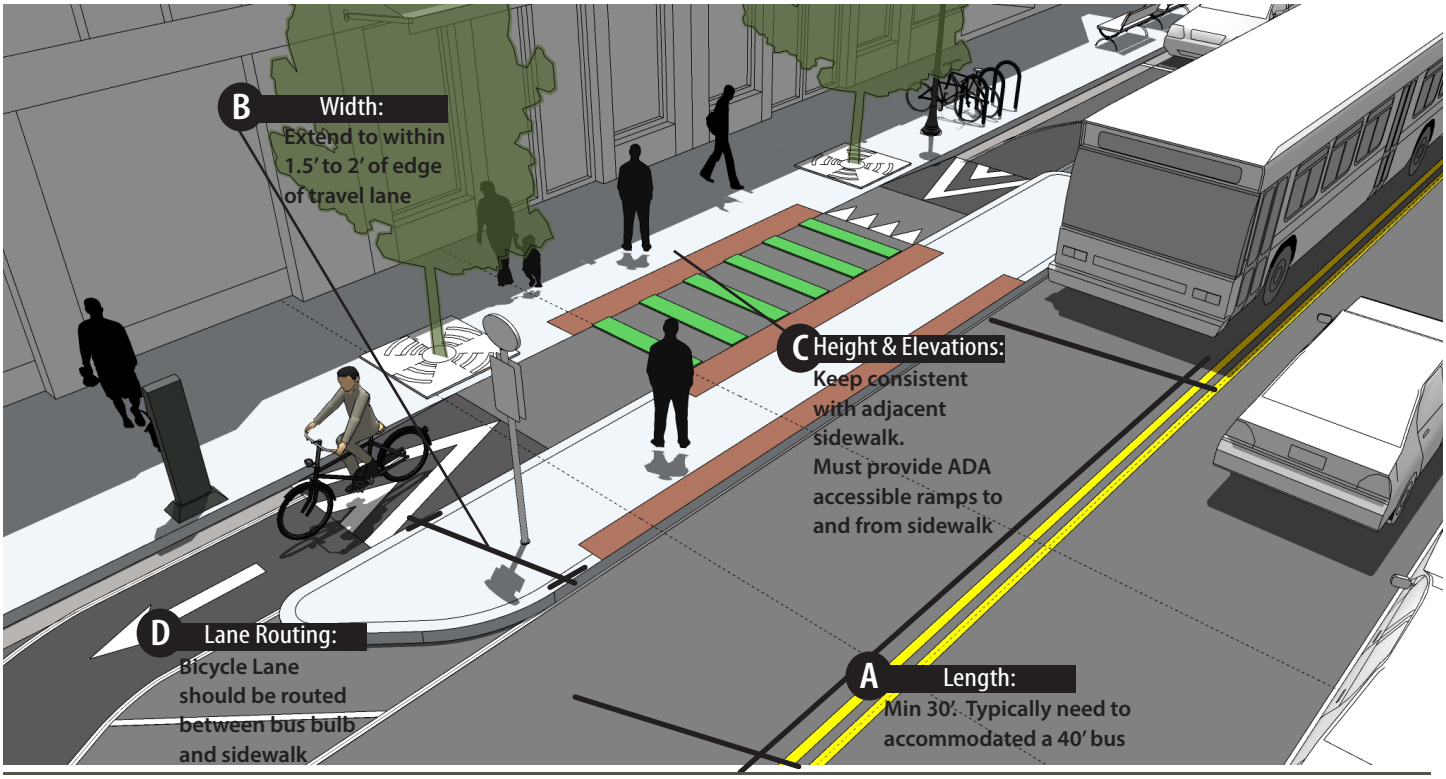
B **Width**: The width of a bus bulb will depend on the typical curbside use of the street and outside travel lane. A bus bulb shall extend from the curb edge out to within 1.5 feet to 2 feet of the outside of the travel lane.

C **Height and Elevations**: Bus bulbs shall be designed at a curb height consistent with the rest of the street and level with the adjacent sidewalk.

  » Bus bulbs may also be designed at a greater height to facilitate level bus boarding. In this case, railings may be required at the back of the bus bulb and ADA accessible ramps must be provided for access to and from the adjacent sidewalk.

- **Bus Stop Design Requirements**: Bus bulbs are typically utilized with near-side or mid-block bus stops. Bus bulbs shall follow other design guidance required of typical bus stops.

Figure 4.4.2- Bus Bulbs



D **Bicycle Lanes Routing:** Bicycle lanes should be routed behind the bus bulb so that bicycle traffic can be maintained and separated from the roadway.

  - » Bicycle lanes should be raised and ramped up ahead of the bus bulb to provide a level surface for pedestrians. The ramps will help slow bicycle speeds as they enter a pedestrian area.
  - » Use color pavement markings throughout the length of the bicycle and pedestrian mixing area (green bars or checkered patterns).
  - » Use "BIKES YIELD TO PEDS" and yield markings on the bicycle lane to give pedestrians the priority.

- **Returns:** Design bus bulbs with a 45 degree return angle to facilitate street sweeping and snow plowing around the bulb.

Additional Design Considerations

- **Amenities:** Because bus bulbs provide additional pedestrian space, bus shelters and other passenger amenities should generally be provided. Bus bulbs may include bicycle racks, provided they do not conflict with clear landing zone requirements.
- **Curb Cuts:** Bus bulbs may be located adjacent to driveways, alleys and other curb cuts provided that adequate space and return angle is provided for their access and egress.

Utility Considerations

- Bus bulbs should be designed not impede stormwater drainage from the street.
- Bus bulbs may introduce utility conflicts and must be carefully coordinated.
- Utility vaults should not be located in bus bulbs.

Sustainability Considerations

- Bus bulbs may include pervious pavement and landscaping. Landscaping may include opportunities for stormwater retention and/or filtration provided it does not conflict with transit landing zones.

Design References

- The NACTO Urban Street Design Guide provides additional guidance on how to design a bumpout.
- The AASHTO Green Book offers guidance on the appropriate placement and configuration of transit bumpouts.
- More information on bus bulbs can be found in the TCRP Report 65 "Evaluation of Bus Bulbs" sponsored by the Federal Transit Administration.





http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_65-a.pdf

MAINTENANCE & MANAGEMENT

Special Maintenance

- Bus bulbs, like other curb extensions, may complicate street repaving and other maintenance activities.

Seasonal Use & Maintenance

- Like bus stops, bus bulbs will need to be cleared of snow in such a way that maintains clear passenger access to and from bus doors, including providing for the deployment of wheelchair lifts.
- Bus bulbs should be designed with roadway snow removal and storage in mind and ensure that the design angles do not inhibit plowing or street sweeping.

Reviews & Approvals

- Bus bulbs, like bus stops will be approved the AAATA and the Ann Arbor Engineering Unit.



Case Study: Seattle Dexter Avenue

Transit bumpouts can improve the transit riding experience while increasing space for pedestrians. Built in 2011, the reconstruction of Dexter Avenue in Seattle turned a three-lane street into a two-lane street with bus bulbs and buffered bicycle lanes. A shared parking/bicycle lane, as well as a center turn lane, were reconfigured to create the bumpouts and 6-foot wide bicycle lanes with 2-foot buffers. 10 of the 12 bus stops along the 1.5 mile long corridor have bus bulbs, which allows buses to stop without pulling out of traffic. Each bus bulb is 10 feet wide and approximately 80 feet long.

Since the project was implemented, the street has become a primary transit and bike corridor. Over 300 cyclists use the lanes going southbound towards downtown Seattle, more than one-third the number of motorists. While bus travel times have not changed significantly, ridership increased by 30% between 2010 and 2013.



ROADWAY

TRANSIT LANES

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✗	✗			
Transit		!	!	!	
Bicycle		■	■		■
Balanced		✗	✗	✗	✗

DESCRIPTION & INTENT

Transit may operate in lanes shared by general traffic or in dedicated facilities. Dedicated bus lanes are used to speed up bus service on busy streets with frequent transit service. A single bus can carry 40 or more passengers, allowing a bus lane to drastically increase the amount of people a street can move.

Transit lanes reduce traffic delays and increase the reliability of high-quality transit service. Transit lanes are an important part of encouraging transit use, making the service faster, more reliable, and more enjoyable.

Transit lanes can occupy several different places on a street, depending on the type of service offered and the available space. The variety of options are described here, though curbside and offset lanes are the most likely in the DDA District.

- **Curbside lanes** are immediately adjacent to the curb on the right-hand side of the street. They work best on streets with few driveways and high volume right turns.
- **Offset lanes** operate outside of a parking lane. Bus stops are located in bumpouts in the parking lane. Offset lanes are compromised by vehicles entering, exiting, and waiting for curbside parking.
- **Median lanes** occupy the center of the street. They may operate within a median, typically then separated from general traffic by median islands, or adjacent to a median with doors on both sides of the transit vehicle to permit left and right side boarding. Given the narrow right-of-way typical of most downtown Ann Arbor streets, median lanes are unlikely and therefore not discussed.
- **Contra-flow bus lanes** are generally implemented on one-way streets where the transit lane operates in the opposite direction of general traffic and is located adjacent to the curb.
- **Transit streets or plazas** are street segments that prohibit private vehicle traffic and reserve the entire travel way for transit vehicles only. Bicycles and pedestrians are generally permitted. Transit plazas are typically used where transit services are extremely frequent, transit use is concentrated, and right-of-ways are severely constrained.

USE & APPLICATION

Location

- Transit lanes are used only on corridors where transit service is very frequent (10 minutes or less), ridership is high, and traffic congestion significantly and routinely impedes transit operations.
- Transit lanes are recommended on transit emphasis streets and can be an opportunity on vehicle emphasis streets where there is room. Transit lanes are generally discouraged on other street types, particularly destination commercial and commercial streets.

- Transit lanes may be permanent or temporal – reserved for transit vehicles only at peak hours of the day and permitted for other uses (such as parking or general traffic) at other times. They may be reserved exclusively for the use of transit vehicles or may have shared use.

Related Design Elements

- **Auto Travel**: Transit lanes may be exclusive for transit use or may be in mixed traffic. Although high-occupancy vehicle (HOV) facilities are not common in Michigan at present, MDOT continues to explore their use. In some instances bus lanes are shared with HOV vehicles to provide advantage to both.
- **Transit Signals (Bus Queue Jump Lanes)**: Implementing transit signal priority in conjunction can provide even further advantage to transit service.
- **On-Street Parking**: Offset bus lanes where the curbside is used for parking can cause conflicts with drivers entering and exiting the parking lane. Drivers parking can cause significant delays to the bus service, reducing its reliability and efficiency.
- **Loading Zones**: Removing parking for a bus lane can make loading access difficult for commercial buildings. Assess curb conditions to understand spillover effects on adjacent streets from removing a loading lane and/or parking.
- **Bicycle Facilities:** Transit lanes should generally not be shared with bicycle facilities. The benefit of transit lanes is in allowing buses access to unencumbered lanes, which would be impacted by the presence of cyclists sharing the lane.

DESIGN & OPERATIONS

Design Requirements

A **Lane Width**: The minimum acceptable width for a bus lane is 10 feet for an offset lane or 11 feet for a curbside lane. 12 feet is preferred.

» Shared bus/bicycle lanes shall be at least 13 feet wide. 15 feet is preferred to allow room for passing.

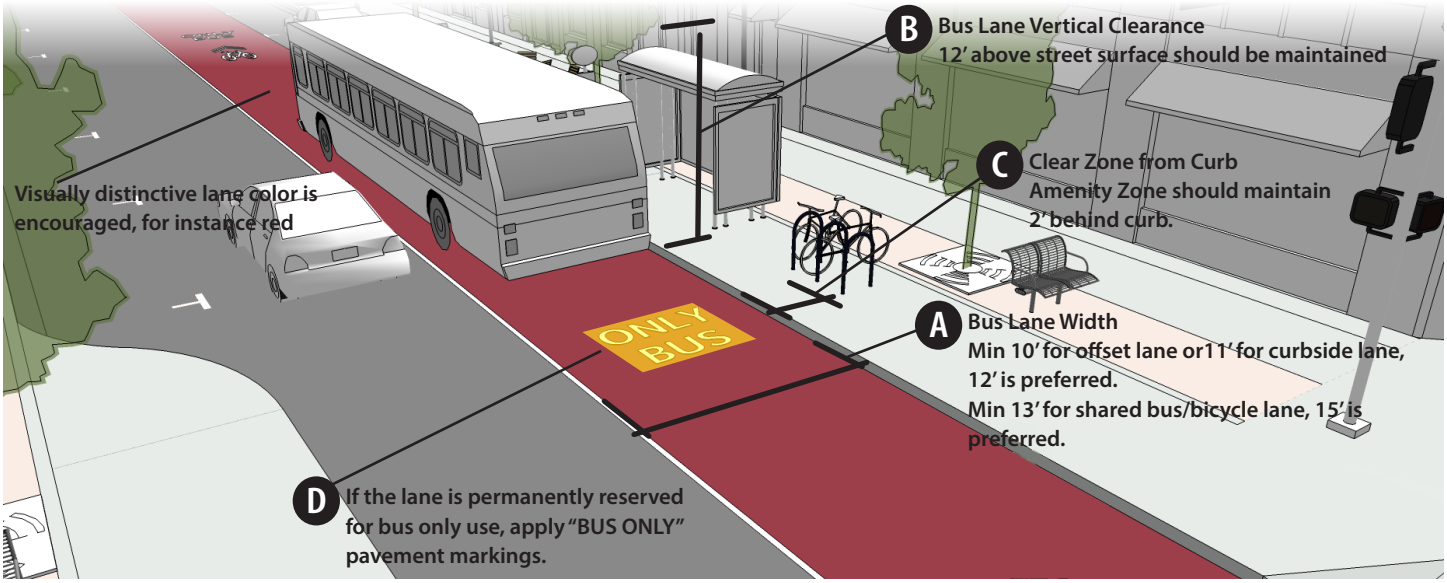
» Gutters may be included in the calculated dimension of a curbside transit lane.

B **Vertical Clearance**: The street shall be clear for a vertical distance of 12 feet above the street surface. Banners or trees overhanging a Curbside Zone used for bus travel shall be maintained above this height.

C **Horizontal Clearance**: Fixtures or plantings in the Amenity Zone shall maintain a 2-foot clear zone behind the curb where buses or other vehicles travel in the curb lane.

D **Pavement Markings**: If the lane is permanently reserved for bus only use, apply "BUS ONLY" pavement markings. If the Transit Lane is shared for HOV or bicycle use, include appropriate markings.

Figure 4.4.3- Transit Lanes



Additional Design Considerations

- **High Visibility Marking**: Making bus lanes visually distinctive may discourage encroachment by other road users. Red paint can color dedicated transit lanes, but is not required.
- **Right Turn Lanes**: At intersections, bus lanes may become right-turn only lanes. Use a dotted line to denote where private vehicles may enter the bus lane.
- If the dedicated lane is only in effect for certain hours, consider restricting right turns to keep the lane clear.
- **Barriers**: Transit lanes may be separated from general traffic by soft barriers, such as rumble strips or physical barriers like concrete curbs or rubber bumpers. Given the narrow dimensions of Ann Arbor streets, physical separation is not generally expected.

Utility Considerations

- When utility work requires occupying part or all of a dedicated transit lane, have a plan in place to prevent a significant disruption of transit service. Consider re-purposing a general traffic lane temporarily, signal changes, or other efforts to reduce delays.

Design References

- The NACTO Urban Street Design Guide provides recommendations on how to design bus lanes and necessary considerations for installing them.
- The AASHTO Green Book describes how to design transit lanes, including operational issues, dimensions, and metrics for measuring success.
- The TCRP Report 19 provides guidance for roadway design factors for bus service.



MAINTENANCE & MANAGEMENT



General Maintenance

- Colored pavement may require more frequent maintenance than regular pavement.

Seasonal Use & Maintenance

- **Snow Removal:** Transit lanes should not be used for snow storage.
- Keep access to transit lanes and transit stops clear for both the vehicles and riders.
- Physically separated transit lanes may require additional or special equipment for snow removal.

Reviews & Approvals

- The Ann Arbor Engineering Unit is responsible for permitting bus lanes on city streets, while MDOT is responsible for permitting transit facilities on state-owned roads. The AAATA would most likely determine which corridors are most appropriate for bus lanes, based on where significant bus routes are located and where existing and projected ridership is highest and coordinate identification and designation of such lanes.



ROADWAY

BUS QUEUE JUMP LANE

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✗	✗			
Transit		!	!	!	
Bicycle		✗	✗		✗
Balanced		✗	✗	✗	✗

DESCRIPTION & INTENT

A bus queue jump lane, also known as a bus bypass lane, is a short bus lane located at the approach to a traffic signal. Buses use a bus queue jump lane to bypass waiting traffic queues, significantly improving transit travel time.

In a compact downtown area like Ann Arbor, right turn bays may be used as a bus queue jump lane. While other vehicles must turn right, the bus is allowed to proceed straight through from the turn lane to the bus lane. These facilities may need to be combined with a dedicated transit signal, such as an advanced green light for buses, and a merge lane to permit transit vehicles to reenter general travel lanes on the other side of the intersection.

There are three configurations of bus queue jump lanes that may be appropriate for Ann Arbor:

- **Transit Exemption for Right-Turn Lanes**: The bus queue jump lane shares space with the right-turn lane, but transit vehicles are allowed to proceed straight through the intersection.
- **Advanced Stop Bar**: In this configuration, the main stop bar is pushed back several car lengths and a transit-only or "right and transit" lane is placed along the curb ahead of the stop line, so that transit vehicle can pull ahead of other traffic.
- **Shared Right-Turn/Bus Lane**: The entire curbside lane is reserved for transit vehicles, but drivers are allowed to use it for right turns at intersections. This gives buses even more priority, but requires the removal of parking or travel lanes.

Bus queue jump lanes can contribute to faster, more reliable transit service that increases ridership and supports the development of a more vibrant public realm in downtown Ann Arbor. However, they also may require additional street space for buses, which may mean narrowing general traffic lanes or re-purposing general traffic lanes or parking, which may have a negative effect on the street environment.

USE & APPLICATION

Location

- Bus queue jump lanes are only applicable on transit emphasis and vehicle emphasis streets at congested intersections where transit vehicles are likely to experience significant delays.
- Bus queue jump lanes will generally have very limited applicability in downtown and should only be used in conjunction with well developed transit priority plans.

Related Design Elements

- **Traffic Signals**: To be fully effective, use transit signal priority alongside a bus queue jump lane to speed buses through the intersection.
- **Transit Lanes**: Where right-of-way is available, consider upgrading bus queue jump lanes to full transit lanes, which increase the speed and reliability of transit and reduce the risk of drivers encroaching on the lane.

- **On-Street Parking**: Place bus queue jump lanes in a parking lane, which preserves parking space while creating an opportunity to give transit priority over other vehicles.
- **Bus Stops and Shelters:** Provide substantial bus stops with shelters, seating areas, and real-time information. Consider instituting other elements of bus rapid transit, such as off-board fare collection that can reduce wait time at stops.

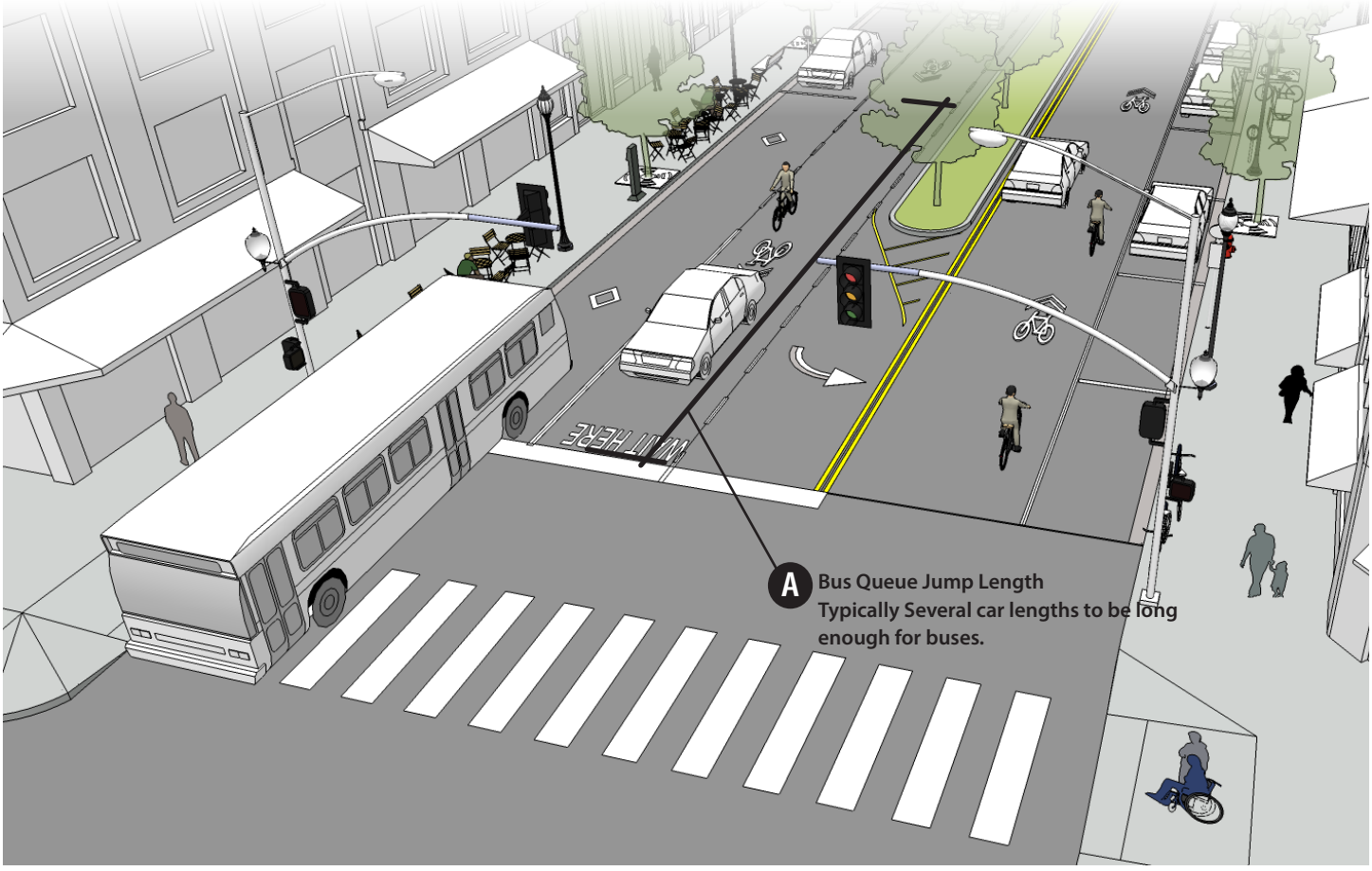
DESIGN & OPERATIONS

Design Requirements

A Design bus queue jump lane long enough so that buses can move ahead of vehicles stopped at an intersection.

- Place an advanced stop bar in the bus queue jump lane to give buses a head start. The stop bar shall be placed at least 2 car lengths ahead of the main traffic stop bar, depending on the length of the queue.
- Consider special pavement markings for the bus queue jump lane to indicate that the space is exclusively for transit vehicles.
- Provide space on the other side of the intersection for the bus to reenter traffic.
- Place bus stops at the far-side of the intersection to allow buses to take advantage of the bus queue jump lane on the near-side of the intersection. If the bus stop is on the near-side, place it behind the bus queue jump lane.

Figure 4.4.4- Bus Queue Jump Lane



- Use signal timing to allow right-turning drivers to clear the bus queue jump lane in order for transit vehicles to use it. This may require an additional right-turn signal phase. Shorter traffic phases may also help to reduce backups at the intersection, making transit signal priority more efficient.

Additional Design Considerations

- Bus queue jump lanes can give priority to both transit vehicles and cyclists. However, if the bus queue jump lane is physically separated from the rest of the street, bikes should not be allowed to share the lane due to the higher speeds transit vehicles will be able to achieve.
- Exercise caution when placing bicycle lanes next to shared bus queue jump lane/right-turn lanes due to conflicts with drivers merging in and out of the lane. Use colored pavement markings to identify the conflict zone.
- Parking or other uses of the curbside lane should be set back a far distance from the stop line, depending on the typical length of the traffic queue, to ensure that transit vehicles are able to enter the lane.

Utility Considerations

- Ensure that the construction of a bus pad does not interfere with underground utilities. Bus queue jump lanes may require a bus pad or other strengthening of the road surface to support standing or waiting transit vehicles.

Design References

- The NACTO Urban Street Design Guide provides guidelines on how to design a bus queue jump lane.

MAINTENANCE & MANAGEMENT

General Maintenance

- Frequent police enforcement is required to ensure that drivers do not attempt to use the queue jump lane.

Special Maintenance

- Maintain signage and markings for bus queue jump lanes to ensure visibility and encourage driver compliance.

Seasonal Use & Maintenance

- Bus queue jump lanes can be cleared of snow using regular snow equipment. Bus queue jump lanes should never be used for snow storage.

Reviews & Approvals

- The Ann Arbor Systems Planning Management Unit, in close consultation with the AAATA, will determine when and if queue jump lanes are advised.
- The Ann Arbor Engineering Unit is responsible for permitting the construction of queue jump lanes.

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4.5

VEHICLE DESIGN ELEMENTS

Travel Lanes 218

Fire Access Lanes 222

Corner Geometry and Design Vehicle 226

Driveways & Curb Cuts 230

Medians 234

Mini Roundabouts 238

Signals: No Turn on Red 242

Signals: Leading & Lagging Lefts 243

Signals: Leading Pedestrian Interval 244

Signals: All Walk Phase 245

Signals: Traffic Signal Priority 246



ROADWAY ZONE

TRAVEL LANES

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	✓			
Transit		✓	✓	✓	
Bicycle		✓	✓		✓
Balanced		✓	✓	✓	✓

DESCRIPTION & INTENT

Travel lanes are the portion of the roadway marked for the movement of vehicles. The width of travel lanes is a critical dimension that affects many aspects of the street including vehicle speed, pedestrian crossing distances, signal cycles, and the amount of roadway impervious surface.

In most cases, the minimum acceptable lane width should be used in urban street design. This minimum dimension may vary depending on the street type and the type and frequency of vehicles using the lane.

Travel lanes may be used by both motorized vehicles and bicycles. Lanes intended for travel are not to be used for loading or parking.

Turn lanes provide a space for vehicles to move out of the general flow of traffic into a dedicated space to wait for a gap in pedestrian and/or on-coming vehicle traffic in order to complete a turn. Turn lanes, particularly center-turn lanes, significantly improve vehicle flow. Often, reducing four-lane, bi-directional streets one-lane in each direction with a center-turn still maintains vehicle capacity and creates space for other uses such as bicycle facilities, wider sidewalks, or a parking lane.

USE & APPLICATION

Location

- Travel lanes are required on all street types irrespective of Frontage Context or Functional Emphasis to allow public and privately owned vehicles transportation access through the public right-of-way.

Related Design Elements

- Travel lanes must be assembled together with other roadway elements, such as additional lanes in the same or opposing directions, turning lanes, parking lanes, bicycle facilities, transit lanes and/or stops, and sidewalk facilities.
- The assemblage of travel lanes can have a substantial effect on the street experience, especially for pedestrians. Although a “typical section” taken at a mid-block location may result in a relatively narrow cross-section, inclusion of right- and/or left-turn lanes at intersections can dramatically increase the total roadway width and pedestrian crossing distances.

DESIGN & OPERATIONS

Design Requirements

- The width of travel lanes varies based on the type of street, land uses, and typical vehicles expected to use them. Research has shown that narrower lane widths reduce traffic speeds without decreasing safety, and that wider lanes are not correlated with safer streets.

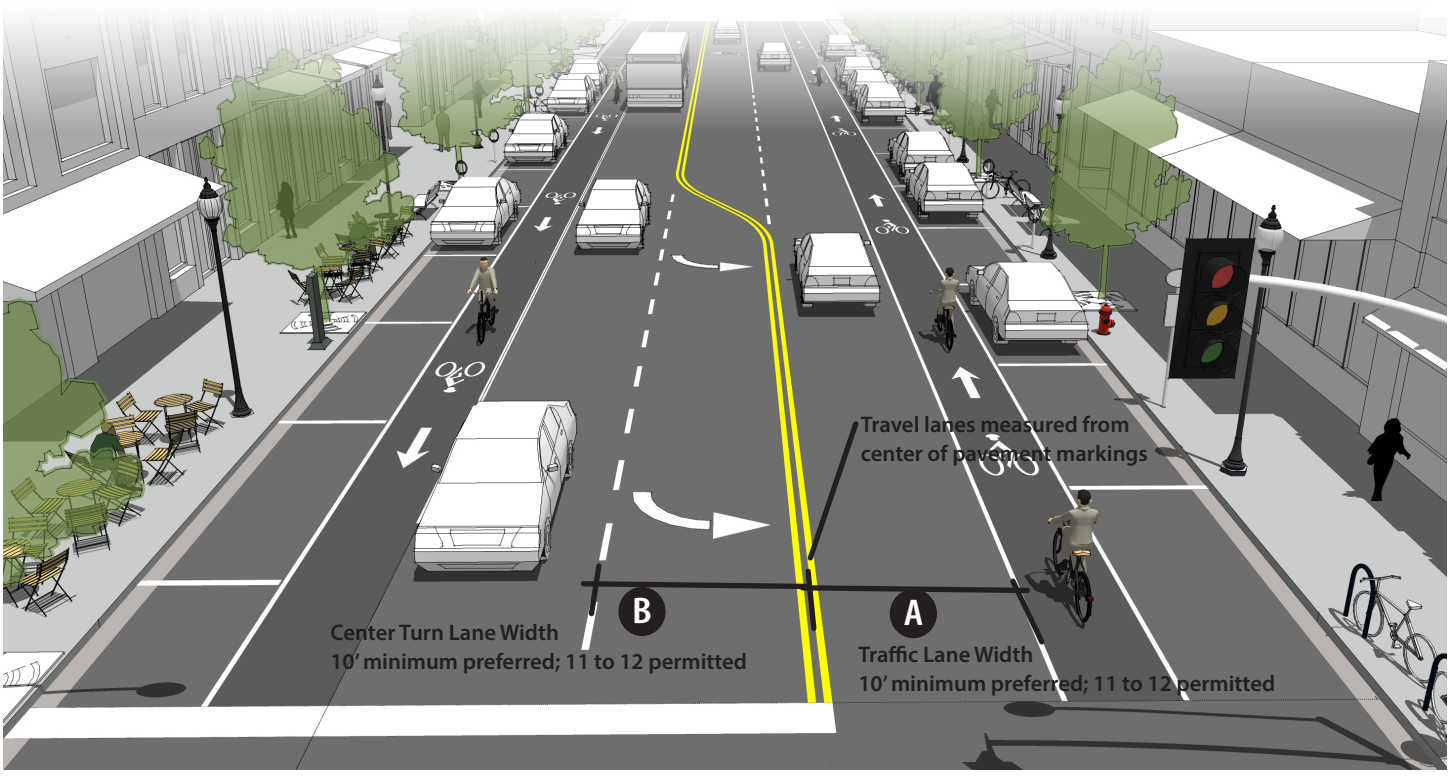
A **Travel Lane Width**: The width of travel lanes shall be 10-feet on all streets, with the following deviations allowed as described below:

  - » For designated transit and truck routes, the outermost travel lane in each direction may be widened to 11-feet to accommodate larger vehicles. Wider lanes for trucks and transit should be evaluated on a case-by-case basis and considers trade-offs with other modes of travel and the overall street context.
  - » Wider travel lanes may be necessary at tight turns as vehicles require more horizontal space while turning than while traveling straight.
  - » Travel lane widths need to be considered within the assemblage of the full street. When adjacent to parking or curbside lanes, the total width of the combined travel lane and curbside lane shall be at least 18-feet. This shall be increased to 19-feet where frequent transit or truck traffic needs to be accommodated.

B **Center Turn Lane Widths**: Center-turn lanes can vary from 10 to 12 feet in width. 10 is generally preferred but may be increased to 11 or 12 feet where transit and/or truck traffic is frequent.

- **Lane Width Measurement:** Travel lanes should be measured from the center of lane markings on either side of the travel lane (including where on-street parking is present). When a travel or turn lane is adjacent to a curb and gutter, measure to the nearest edge of the gutter (i.e. "edge of metal"). If no gutter is present, measure to the face of curb, adding 18 inches to required lane width to account for drainage inlets and clearance from the curb face.

Figure 4.5.1- Travel Lanes



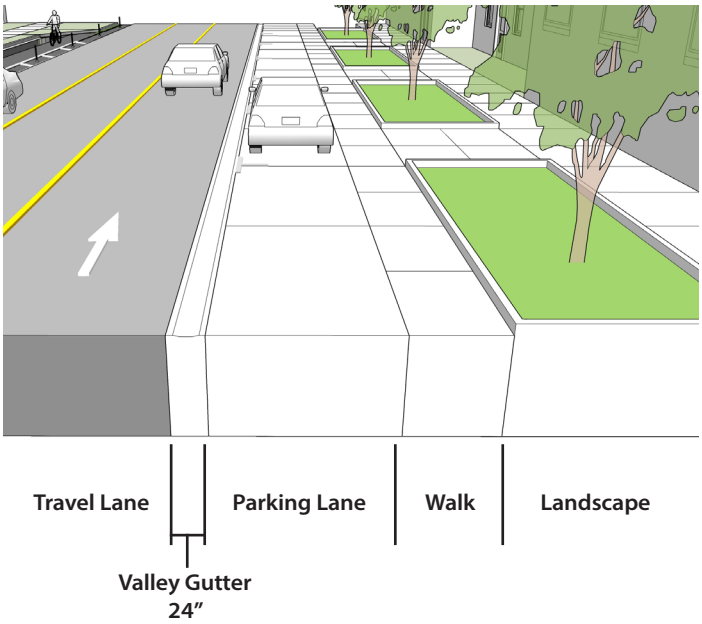
Additional Design Considerations

- **Special District Materials**: Established Downtown Character Districts may require or recommend certain paving materials be used in lieu of standard asphalt treatments. For example, reinstalled and/or continuing the extent of historic brick paving in the Kerrytown district may be recommended for street projects in that character district.

Smooth / Curb-less Streets

- Streets that are intended to be used frequently for special events may consider the use of flush curbs, roll curbs, or special material treatments to delineate roadway uses and facilitate drainage in lieu of vertical curbs. In such cases, also consider the following:
  - » Use of bollards, signs, light posts, planers and/or other physical elements to prevent vehicles from entering sidewalk spaces.
  - » Where on-street parking is present, the gutter line / drainage lines may be placed outside of parking lane (next to the travel lane)
  - » Positive drainage away from buildings must be maintained until at least the edge of the pedestrian zone (12'-14' away from property line typically).

Figure 4.5.2 - Curbless Street



Utility Considerations

- Utilities will often be located under travel lanes. Manholes and access portals must be flush with the roadway surface. Utility work in a travel lane should resurface the whole of the travel lane for a smooth travel surface.

Sustainability Considerations

- Minimizing lane widths minimizes overall paved and impervious surfaces, which contribute to stormwater runoff and water quality.

Design References

- Policy guidelines recommend travel lane widths in the range of 9 to 12 feet, with 9-foot lanes only used on very low volume residential local streets. The AASHTO Green Book recommends 10 to 12-foot travel lanes and 10 to 12-foot turn lanes.
- A number of states have endorsed narrower lanes. The Florida Department of Transportation found that narrower lane widths do not impact street capacity "So long as all other geometric and traffic signalization conditions remain constant, there is no measurable decrease in urban street capacity when through lane widths are narrowed from 12 feet to 10 feet."
- The Institute of Transportation Engineers "Designing Walkable Urban Thoroughfares: A Context Sensitive Approach" recommends a range of 10 to 12 feet for travel lanes on urban arterial and collector streets. Narrower travel lane widths are recommended on lower volume and lower speed streets.
- The MMUTCD provides standards and specifications on travel lane marking and signage.

MAINTENANCE & MANAGEMENT

General Maintenance

- Travel lanes require periodic sweeping and pavement marking re-striping.

Seasonal Use & Maintenance

- **Snow Removal**: Travel lanes, together with bicycle lanes and sidewalks, are the top priority for snow removal and may not be used for snow storage. Black ice and other dangerous conditions are common in Michigan. Pavement surfaces are designed and treated to minimize these risks.
- **Special Events:** Travel lanes may be used for seasonal events such as the Ann Arbor Art Fair and other street closures. Design of the assembled roadway width may wish to take layouts of special events into account.

Reviews & Approvals

- The Ann Arbor Engineering Unit determines appropriate travel lane number, design and operation on city-owned streets. MDOT governs these decisions on state routes.



ROADWAY ZONE

FIRE ACCESS LANES

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✗	✓			
Transit		✓	✓	✓	
Bicycle		✓	✓		✓
Balanced		✓	✓	✓	✓

DESCRIPTION & INTENT

Fire access lanes (aka Fire Lanes) are locations proximate to buildings that enable fire trucks and other emergency vehicles to quickly access buildings in case of emergencies. Fire access lanes may be designated and marked zones within the public right-of-way or on private property, or alternatively the roadway travel lanes themselves may serve as a fire access lane. In Ann Arbor's downtown, the roadway itself frequently serves as the fire access lane, as development patterns and limited alley way width typically precludes use of fire access lanes outside of the right-of-way.

Aerial fire apparatus access roads (sometimes referred to as an "Aerial access lane") are a specific type of fire access lane that is adjacent to buildings where the highest roof surface exceeds 30-feet in height. Aerial fire apparatus access roads are wider and provide the needed clear space for larger fire ladder trucks to deploy their stabilizers and outriggers.

Providing adequate fire access lanes is important for maintaining the safety and health of the public in downtown Ann Arbor. Unobstructed roads and intersections help maintain effective response times and efficient emergency operations.

USE & APPLICATION

Location

- **Fire access lanes** are required on all downtown streets. When streets are reconstructed, resurfaced, and/or pavement markings are refreshed, compliance with the fire access lane requirements (see Design & Operations below) shall be achieved. Fire access lanes can be achieved on most downtown streets without trade-offs with other street design values.
- **Aerial fire apparatus access roads**, which requires additional fire lane width, are required when adjacent to new buildings where the roof surface exceeds 30-feet in height. At least one face of the building must be accessible by an aerial fire apparatus access road, either within the road right-of-way itself or on private-property.
    - » The additional width required for fire apparatus roads may pose challenges for meeting other street design requirements. This design trade-off may result in value trade-offs as well, particularly those correlated to street width and curbside use. For this reason, aerial fire apparatus access roads are prohibited on Destination Commercial Street Typologies. Private development with multiple frontage streets shall locate their aerial fire apparatus access road accordingly. Those without an approved Street Type adjacent, shall work with the Street Design Team staff reviewers to determine the most appropriate solution.

Related Design Elements

- **On-Street Parking & Loading Zones:** Vehicles occupying the curbside lanes are obstacles to fire access lanes and should not be factored into the required width of a fire lane (including aerial access lanes).
- **Bicycle Facilities:** Bicycle facilities, including curb-separated bike lanes, may be counted towards the required width of fire access lanes and aerial apparatus roads if the curb, gutter, and bike lane are designed with the same load bearing capacity of a standard roadway (in order to support the weight of the fire apparatus.
- **Sidewalks & Pedestrian Areas:** The pedestrian area (primarily the amenity zone), may be counted as part of the required width for a fire lane if the amenity zone has been designed to support the weight of the fire apparatus and it is contiguous with roadway portion of the fire lane. The portion of the pedestrian area that can be counted must be free of vertical obstructions such as street lights, street trees, sign posts, outdoor dining tables, etc.

DESIGN & OPERATIONS

Design Requirements

- **Width – Fire Access Lanes:** Fire access lanes shall be 20-feet wide. Typically, a two-lane road with 10-foot wide travel lanes will meet this requirement. One-way streets or residential streets without center-lane markings shall still meet this requirement.
- **Width – Aerial fire apparatus access roads:** The width of a fire lane adjacent to buildings with a roof surface over 30-feet in height shall provide a 26-foot wide fire lane in order accommodate aerial access.
  - » **Setback:** Aerial fire apparatus access roads shall be setback 15- to 30-feet from the face of the building (and/or the building setback from the fire access lane).
  - » **Overhead Obstructions:** There shall be no overhead utility or power lines over the roadway or between the roadway and building face where the aerial access lane is required. Other overhead obstructions, such as trees or street lights, must be placed with input from the Fire Marshal and other corresponding department.
  - » **Achieving Required Aerial Access Lane Width:** The chart below indicates the first and second priority treatments that should be used to achieve the required width for aerial access fire lanes.

Table 4.5.1 Street Typology	New Building	Existing Condition to Remain
Pedestrian & Access Streets	Widen Pedestrian Area or Curbless Street Design	Maintain curbside lanes
Transit Streets	Widen Pedestrian Area	Maintain curbside lanes
Bicycle	Bicycle Facilities	Bicycle facilities
Balanced	Widen Pedestrian Area	Maintain curbside lanes

  - » **Widen Pedestrian Area**: This may be achieved by removing curbside lanes or excess roadway pavement areas, relocating the curb, and providing additional pedestrian area width that is free from obstructions.
  - » **Curbless Street Design**: Curbless street designs may be appropriate for certain streets (e.g. Destination Commercial) and the use of valley gutters adjacent to the roadway can provide sufficient width for aerial access lanes. This should only be considered when a curbless design is supported broadly by the project for other reasons as well and can be implemented for multiple blocks (e.g. flexibility needs of the street for events, commercial activities, etc.).
  - » **Bicycle Facilities**: The specific type of bicycle facility used shall be determined using the Bicycle Facility Selection process (see Bicycle Facility Selection design element) and in consideration of the overall bicycle network. Curbed, concrete buffers and gutters, if designed with the same load bearing capacity as the roadway, can be included in the aerial access lane width. Curbed, concrete buffers must not exceed a width of 3 feet. Any utilized delineators or other vertical separation elements shall be flexible and sacrificial so as to not impede emergency vehicle operations.
  - » **Maintaining Curbside Lanes**: Maintaining the existing curbside lanes is only acceptable when part of a pre-existing roadway or when the required access width can be achieved with keeping the curbside lane in place.

- **Length – Aerial Fire Apparatus Access Roads:** When the face of a new building comprises 50% or more of the block face, any required right-of-way treatments must be applied to the entire block face.
- **Access to Building Fire Department Connection (FDC):** Access to FDCs shall provide a 3-foot radius clear zone directly around the FDC, and shall be directly accessible from the fire access lane.
- **Fire Aisles** – Where static uses occur within the curbside zone and/or pedestrian area (e.g. outdoor dining or event booths), a 10-foot wide break in these uses shall be provided every 75-feet to provide emergency access from the fire lane to building uses.
  - » Fire Aisles are in addition to providing access to FDCs and Fire Hydrants from the fire lane normally required.

Design References

- Ann Arbor adopted fire code – International Fire Code (2015 Edition)

MAINTENANCE & MANAGEMENT

Seasonal Use & Maintenance

- It is important that snow and ice buildups be cleared from the roadway and curbside lanes so that the road doesn't "pinch in" during the winter and reduce the available width of fire access lanes.

Reviews & Approvals

- The Ann Arbor Fire Marshall is typically responsible for reviewing development plans as part of the site plan review process, and will also participate in reviews of publicly-initiated street projects for compliance with fire code and this design manual. When compliance with the fire access requirements results in the removal of/inhibits the installation of another required street element, the corresponding department shall be consulted for additional review and input.

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INTERSECTION ZONE

CORNER GEOMETRY AND DESIGN VEHICLE

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	✓			
Transit		✓	✓	✓	
Bicycle		✓	✓		✓
Balanced		✓	✓	✓	✓

DESCRIPTION & INTENT

Every element of a street influences and affects how travelers behave on the street and the comfort, safety, and operational efficiency of the street. Lane widths and corner turn radii significant impact driver behavior and their interaction with other users.

As discussed in the travel lane section, wider travel lanes do not necessarily correlate with fewer crashes and improved flow. In fact, research has found that lanes as narrow as 10 feet have little to no discernible affect on vehicle flow but these narrower lanes have substantial positive effects in reducing vehicle speed. Slower travel speeds are positively correlated with reduced severity of crashes and reduced pedestrian crossing distance which making walking safer and more pleasant.

Corner curb radii also directly affect pedestrian crossing distances and vehicle turning speeds.

Corner curb radius refers to the arc of the curb protecting the sidewalk at an intersection. For comparison, a 5-foot curb radius is a very tight corner that comes almost to a point where two streets intersect, while a 50-foot curb radius is a wide sweeping curb.

Three factors play the greatest role in determining the geometry of corner curb radii:

- **Intersection Angle**: Where two streets meet at an angle, the acute angle corners of the intersection commonly have very tight curb radii, while the obtuse angle corners have much larger curb radii. Angled intersections may result in very long pedestrian crossing distances. Downtown Ann Arbor is fortunate that the majority of intersections join at near 90 degree angles and permit short crossing distances.
- **Roadway and Distribution**: Roadway refers to only that portion of the street between the typical curb lines. Distribution refers to how that roadway space is allocated, for example a roadway may be distributed between parking lanes, bicycle lanes, and travel lanes. The point in the roadway from which a vehicle begins to make its turn and the width and function of the receiving street determine how wide (or not) a vehicle may safely swing in order to complete the turn without adversely affecting other roadway operations.
- **Design Vehicle:** Larger vehicles make wider turns. Large vehicles include municipal and school buses, tractor trailers, and larger fire trucks. The largest vehicle routinely using a turn is referred to as the "design vehicle." See table 4.5.1 for Design Vehicles based on Frontage Context.

There are two measures of curb radius – the actual curb radius and the effective curb radius. The actual curb radius is the actual radius of the built curb at an intersection. The effective curb radius is the arc that is possible for a vehicle to follow from the departing travel lane to the receiving lane. Because vehicles may begin their arc from a travel lane located outside of a bicycle facility and/or a lane of parking, it is common that the effective curb radius is significantly larger than the actual curb radius.

Curb radii directly affect pedestrian crossing distances. Larger actual curb radii, without bumpouts, result in wider crossings and reduce the amount of pedestrian space at a sidewalk corner. This forces pedestrians to wait further from the motorist's line of sight.

Corner radii affect the location and design of accessible curb ramps. Small radii typically permit the ramp and both flares on the straight edge curb. As radii size increases, ramps either become integrated into the corner or crosswalks must be moved back.

Using the smallest possible curb radii helps manage vehicle turning speeds and increase. Wide corner radii may facilitate smoother and faster turns by large vehicles but concurrently permit or even invite private autos to take turns faster.

Although corner bumpouts typically have larger curb radii than the underlying natural curb, they nonetheless help to manage vehicle turning speeds by establishing a tighter effective radius. Corner bumpout radii are designed to accommodate the necessary design vehicle.

USE & APPLICATION

Location

- Corner geometries exist wherever two streets intersect. They are ubiquitous throughout downtown.

Related Design Elements

- **Intersections**: Curb radii and corner geometries are critical in the assemblage of intersections. Radii affect pedestrian crossing distances, traffic turning speeds, and overall safety and operation of the intersection.

DESIGN & OPERATIONS

Determine Design Vehicle

- **Design Vehicle:** A frequent user of a given street that dictates the minimum required turning radius. The design vehicle can turn using one incoming and one receiving lane
- **Accommodation Vehicle:** An occasional user of a street. The vehicle may need to turn partially from or onto an adjacent lane as a minor encroachment (typically 5’ or less overlap).
  - » May require moving stop bars further back from intersections to accommodate turns.

A **Minimum Effective Turning Radius:** The effective turning radius should be based on the Design Vehicle. The effective turning radius is impacted by a variety of factors, including: lane width, lane configuration, ROW width, curb radius. See Table 4.5.1.

- » At signalized intersections, larger vehicles may be permitted to use all available receiving lanes to complete their turn. This should be reflected in turn modeling. If so, large vehicles may not turn right on red. Vehicles must complete turn into the nearest receiving lane.

Table 4.5.2 - Curb Radii and Design Vehicles

STREET TYPOLOGY	DESIGN VEHICLE	ACCOMMODATION VEHICLE	MIN. CURB RADIUS	MIN. EFFECTIVE TURNING RADIUS
NEAR-NEIGHBORHOOD STREETS	**PASSENGER CAR** **15’ inside radius min.** **26’ outside radius min.**	**SU-30** **20’ inside radius min.** **42’ outside radius min.**	**20’**	**26’**
NOT NEAR-NEIGHBORHOOD STREETS	**SU-30** **20’ inside radius min.** **42’ outside radius min.**	**WB-40 / CITY BUS** **20’ inside radius min.** **40’ outside radius min.**	**20’**	**42’**
STREETS WITH DESIGNATED TRANSIT ROUTES	**WB-40 / CITY BUS** **20’ inside radius min.** **40’ outside radius min.**	**WB-50** **20’ inside radius min.** **45’ outside radius min.**	**20’**	**40’**

B **Minimum Curb Radius:** The curb radius should be kept to a minimum while accommodating the largest possible vehicle. See Table 4.5.1.

  » Curb radii may be simple or complex curves.

Design Requirements

C **Reinforced Corners**: Corners can be designed to accommodate heavier vehicle loads where transit vehicles or trucks may occasionally mount the curb.

D **Stop Bars:** Vehicle lane stop bars shall be positioned a minimum of 4-feet back from the nearest edge of a crosswalk.

  » Stop bars may need to be moved further away in order to allow larger vehicles to complete turns where space is limited. Stop bars may also be moved further back in order to accommodate bike boxes or to provide advanced stop bars for bike lanes.

  » Stop bars shall be 2-feet wide and extend across the full width of the travel lane.

- **No-Turn Corners**: Corners where no legal turn is possible, such as from a one-way street onto another one-way street, can have a very minimal curb radius.
- **Parking Lane**: On-street parking permits tighter actual curb radii as no vehicle will be turning directly from curb lane to curb lane along the actual curb radius, vehicles will be turning from outside the parking lane to outside the parking lane. Where permanent on-street parking exists on both streets, bumpouts may be utilized.

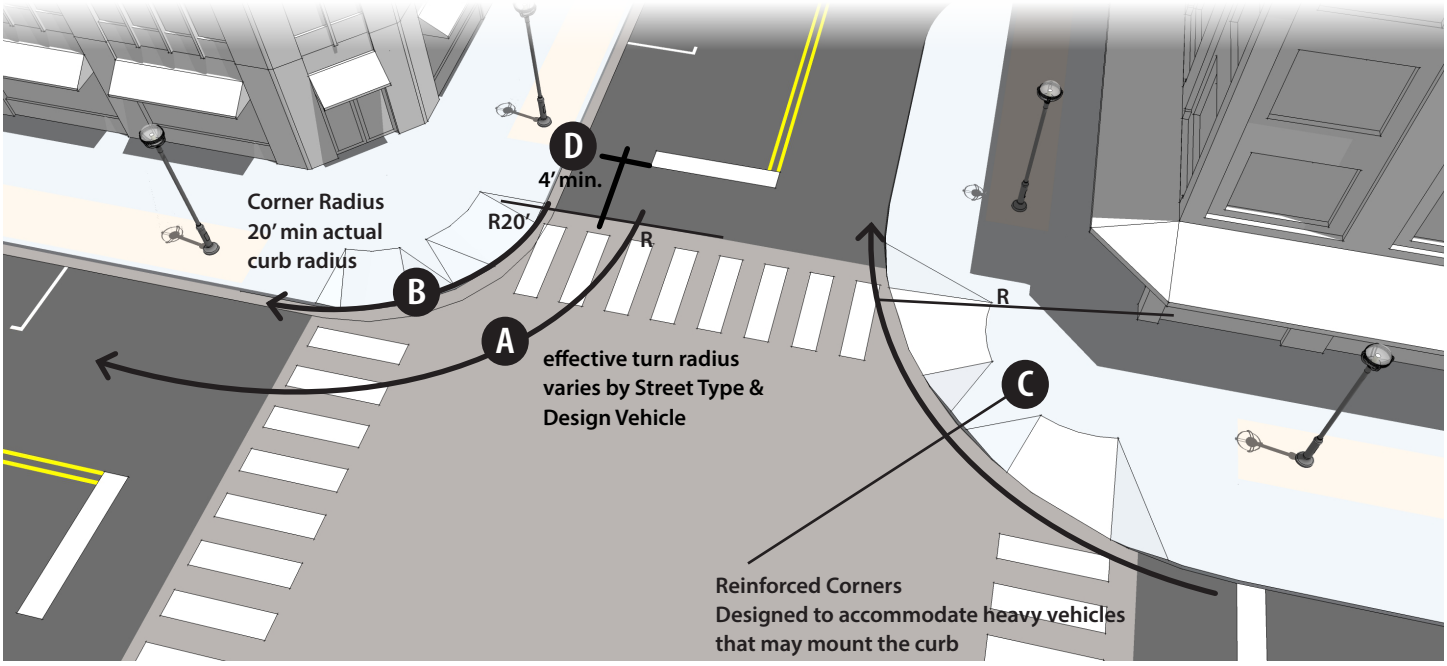
Utility Considerations

- Keep utility cabinets, hand holes and other fixtures off corner curb areas to the extent possible. Where utility cabinets are necessary, they should be in subsurface vaults or in nearby locations clear from the intersection.
- Locate stormwater inlets to effectively drain the street while not precluding curb ramps and corner bumpouts.

Design References

- The NACTO Urban Street Design Guide provides additional guidance on corner geometries.

Figure 4.5.3- Corner Geometry



MAINTENANCE & MANAGEMENT

Seasonal Use & Maintenance

- Snow should be removed all the way to the vertical curb face of a corner.
- "Sneckdowns" are tracks in fresh snow that reveal precisely the actual turn radii and frequency of turning vehicles and may inform locations where tighter curb radii and/or bumpouts are viable.

Reviews & Approvals

- The Ann Arbor Public Management Unit designs and/or approves corner geometries.



PEDESTRIAN AREAS

DRIVEWAYS & CURB CUTS

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✕	✕			
Transit		✕	✕	✕	
Bicycle		✕	✕		✕
Balanced		✕	✕	✕	✕

DESCRIPTION & INTENT

Driveways provide access in and out of private property. While they are an important part of the public realm, too many driveways create an unpleasant pedestrian environment and increase conflicts between motorists and other street users. They also take away space that may otherwise support planting, street furniture, and curbside parking. Coordinating the design of driveways together with the sidewalk contributes to a higher-quality pedestrian realm and reduces dangerous conflicts.

USE & APPLICATION

Location

- **Restricted:** Driveways and curb cuts generally conflict with the safe and comfortable operations of downtown streets, and are restricted on all street types in the downtown. The following conditions and exceptions may apply, pursuant to city staff discretion:
  - » Mixed-use and multi-family buildings with alley access should utilize alleys for building services (e.g. waste handling, deliveries) and access to on-site parking.
  - » Where no access to an alley exists, exceptions may be granted to allow curb cuts, consistent with the City of Ann Arbor Unified Development Code, in order to provide access to building services and/or where access to publicly accessible parking is needed.
  - » Curb cuts onto pedestrian emphasis streets is strictly prohibited and exceptions shall not be granted. Curb cuts on these streets would have a detrimental impact on pedestrian comfort and commercial operations of the street.
  - » Curb cuts may not be located where it would create a break in a separated bikeway. Exceptions may be granted per city staff discretion.
  - » On near neighborhood streets, curb cuts may be permitted at city staff discretion.

Related Design Elements

- **Traffic Calming**: As a location where vehicles frequently enter and exit a street, driveways are excellent opportunities to introduce traffic calming elements to the street (e.g. mid-block bumpouts) to ensure that motorists are aware of their surroundings and do not drive in a way that endangers other road users.
- **Bumpouts**: Driveways can be used in conjunction with bumpouts. Move the driveway apron out to the bumpout and make it flush with the sidewalk level."

Policy References

- The Downtown Ann Arbor Design Guidelines provide guidance on how to manage driveways on public streets. It recommends providing a continuous street edge at street level to reduce the number of interruptions by driveways.
- Ann Arbor Unified Development Code, Chapter 55, Article IV, Section 5.21.2 provides requirements on curb cuts and driveway approaches, including the number of openings allowed based on the total street frontage.

DESIGN & OPERATIONS

Design Requirements

While driveways are often necessary for building access and loading, their design should indicate to motorists that pedestrians, cyclists, and through vehicle traffic have the right-of-way across a driveway. Driveway entrances and curb cuts are an opportunity to provide traffic calming to reduce the potential for conflicts.

A **Driveway Width**:

» Single-lane driveways shall be at least 10 feet wide, but no wider than 12 feet.

» Bi-directional driveways shall be at least 20 feet wide and no wider than 24 feet.

B **Driveway aprons** shall be placed between the sidewalk and the curb in the Amenity Zone. The apron should not encroach on the clear sidewalk (walking zone). If there is a bumpout or parking lane planter, the apron should lie within the bumpout. Bumpouts should be used if the sidewalk is too narrow to accommodate a safe driveway intersection.

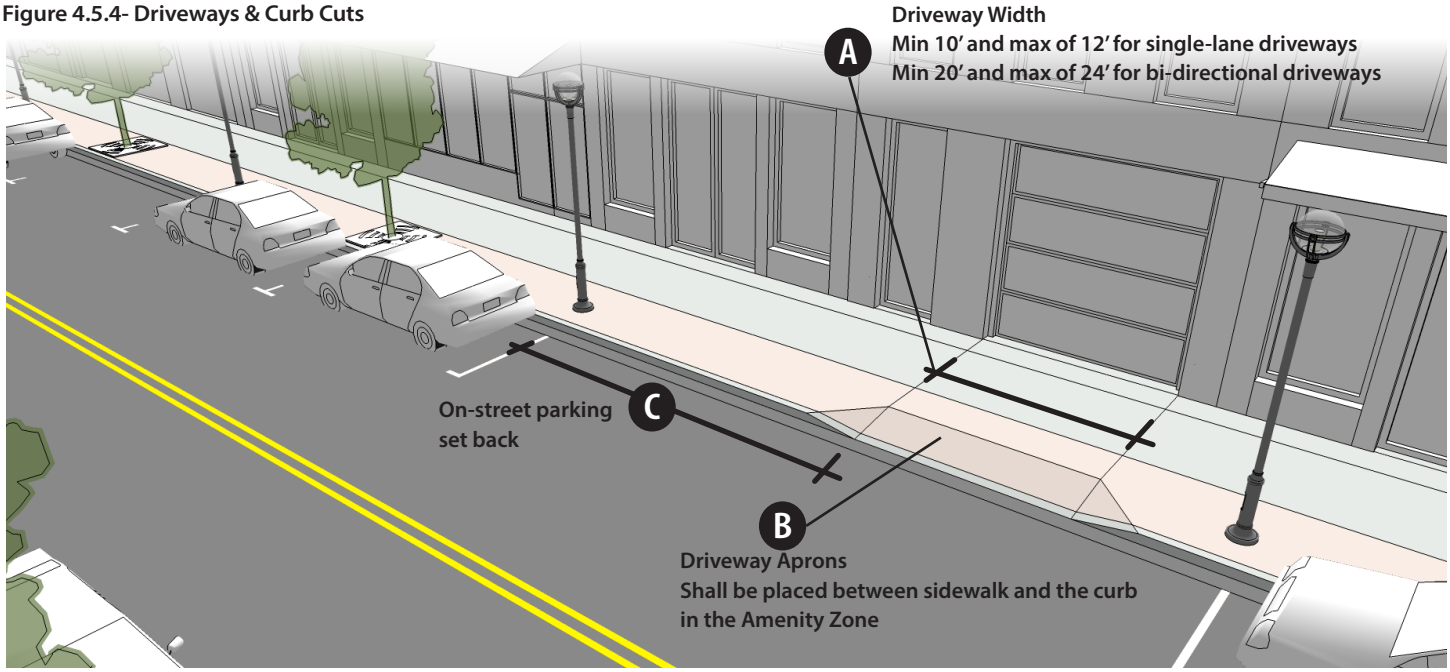
- **Sidewalk Interface**: Driveways shall be flush across the sidewalk to maintain a level and consistent walking path.
- **Sidewalk Materials**: Continue sidewalk paving material across the driveway to indicate that pedestrians will be crossing this space.
- **Visibility Sight Lines**: Curb cuts shall provide adequate visibility to and from the sidewalk and street. Ideally, vehicles should not need to block the sidewalk while gaining clear lines of sight, but this may be unavoidable.

» Where sight lines are limited, include appropriate signage indicating where the driver is to stop and wait.

» Mirrors, audible signals, or other devices to assist with visibility of pedestrians are encouraged.

C **On-Street Parking:** On-street parking shall be set back which ever distance is greater: (a) least 5-feet from the nearest edge of a driveway or (b) where the driveway curbing radius meets the straight segment of the road curb.

Figure 4.5.4- Driveways & Curb Cuts



- **Curb Cuts:** Curb cuts shall be located a minimum of 40-feet back from the nearest edge of a crosswalk to reduce interference with intersection operations.

Additional Design Considerations

- **Alley Access**: Curb cuts are not appropriate where alleys can provide rear access to residences and businesses. Where large new development occurs along a significant portion of a block face, provide a central alleys to reduce the need for multiple driveways and curb cuts.
- **Bike Lane Markings**: Where a driveway crosses a bike facility, paint bicycle markings on the pavement to indicate where there is a conflict.
- **Major Driveways**: Ensure driveways that function as an intersection, such as onto private alleys or drives, contain all of the features of a conventional intersection, including crosswalks, tight corner radii, and a signal, if deemed necessary.

Utility Considerations

- Design new curb cuts as to not impede drainage from the street.

Sustainability Considerations

- Consider using permeable materials for driveways, which can reduce stormwater runoff and improve water quality.

MAINTENANCE & MANAGEMENT

General Maintenance

- Driveway aprons with special paving materials may need additional maintenance from property owners.

Seasonal Use & Maintenance

- **Snow Removal:** Property owners in Ann Arbor are required to shovel their sidewalks, including where sidewalks cross a driveway, within 24 hours of a snow event.
  - » Snow from driveways should never be stored in the street and doing so is illegal in Michigan. While snow removal vehicles clearing the street may pile snow into a driveway apron during plowing operations, sidewalks crossing a driveway should never be used for snow storage.

Reviews & Approvals

- The Ann Arbor Planning and Development Services office is responsible for reviewing the creation of new driveways as part of the site plan review process.

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ROADWAY ZONE

MEDIANS

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✗	✗			
Transit		!	!	!	
Bicycle		!	!		!
Balanced		!	!	!	!

DESCRIPTION & INTENT

A median divides lanes of traffic. In a downtown, medians are generally in the center of the right-of-way, dividing opposing directions of traffic. They may also be located on the side, separating local access or special purpose lanes such as dedicated travel ways.

Medians increase safety and enhance roadway operations by reducing vehicular movement conflicts, limiting turning movements, and providing a refuge for pedestrians crossing the street.

Medians take on many forms. They may be flush with the pavement and consist of painted markings, a space protected with bollards, or a raised curb. Striped or painted medians may precede more permanent improvements, providing localities an opportunity to test travel behaviors before making a significant capital investment. Raised medians within the travel zone provide opportunities for landscaping, street trees, and two-stage pedestrian crossings.

USE & APPLICATION

Location

- Given the relatively narrow dimensions of streets in downtown Ann Arbor, limited opportunities for the incorporation of medians into the street exist. Medians are generally applied to vehicle emphasis streets as a means to reduce conflicts and facilitate flow while providing an attractive streetscape environment.
- Medians are not well suited to pedestrian & access emphasis streets as they can impede visibility of businesses and make commercial support activities (e.g. deliveries) more challenging.
- Medians may be used as an access management tool, a means to limit vehicle conflicts on a corridor to facilitate traffic flow and safety. Medians may also be used as a traffic calming and beautification device.

Related Design Elements

- **Traffic Calming**: Used in isolation, roadway medians do not have a significant impact in reducing vehicle speeds. For the purpose of slowing traffic, medians are generally used in conjunction with other traffic calming measures, such as bumpouts or roadway lane narrowing.

- **Pedestrian Crossings**: Medians provide an important refuge, but do add to the overall width of the Roadway Zone. While providing a median can shorten each leg of a crossing, a wide median increases the total street crossing distance, which adds time to the signal sequence and causes traffic delay. Two-stage pedestrian crossings should be avoided whenever possible. Consider foregoing a median in order to narrow the pedestrian crossing width and enable safe single-stage crossing.
- **Sidewalks and Bicycle Lanes**: Do not remove or narrow sidewalks or bicycle facilities to provide medians or pedestrian refuges. Medians should not compromise the ability to accommodate other street uses. It may not be possible to add medians to streets with narrow driveways.

DESIGN & OPERATIONS

Design Requirements

A **Median Width**: Medians should be a minimum of 6 feet wide to provide adequate width for pedestrians crossing with strollers, bicycles or wheelchair devices.

» Medians must be at least 10 feet wide if they are to provide turn pockets at intersections.

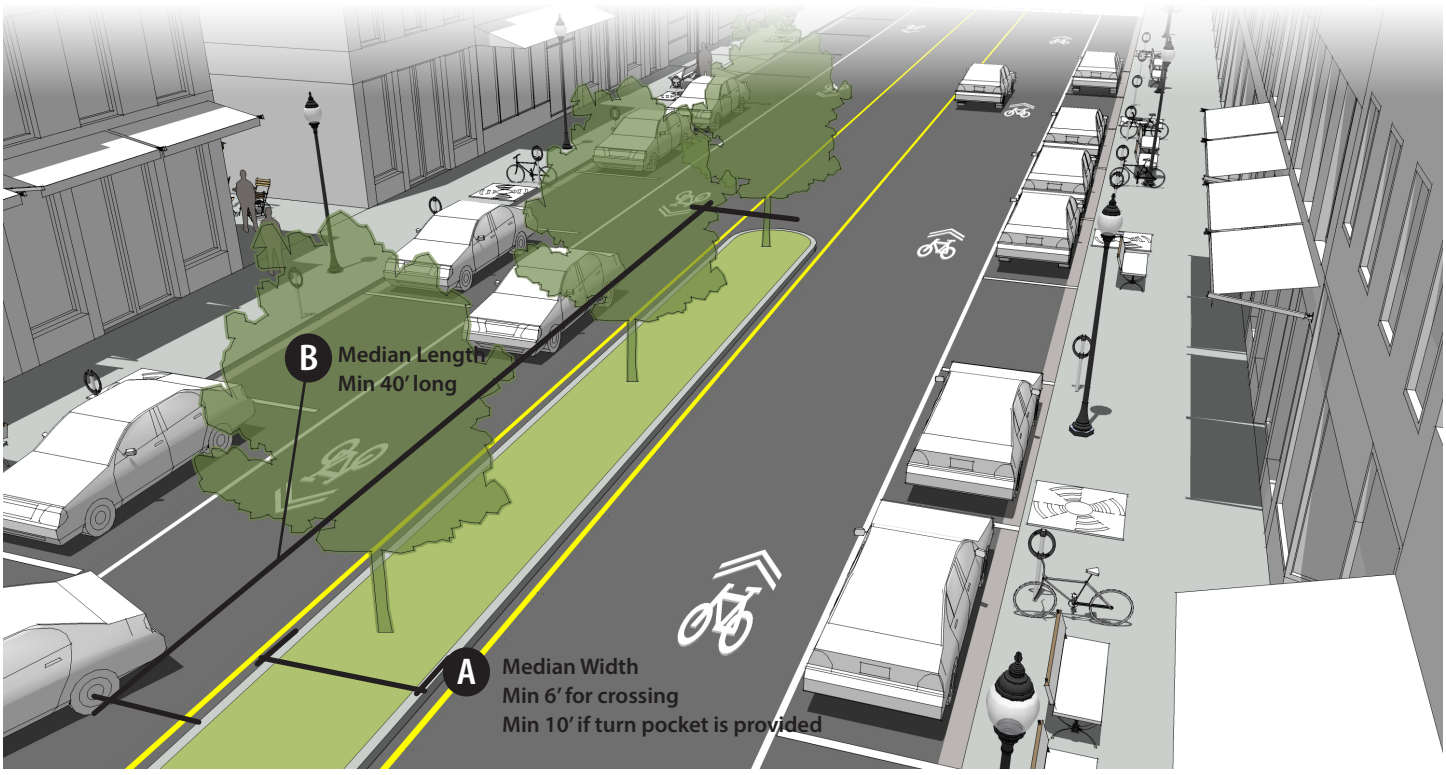
» Where a 6-foot median width cannot be provided, a narrower raised median can still improve crossing safety. In these instances, signals should be timed so that pedestrians can cross in one signal phase.

B **Median Length**: Medians should be a minimum of 40 feet long.

- **Crosswalks**: Crosswalks should cross medians at street level. The resulting cut-through should equal the width of the crosswalk and be wide enough to accommodate snow removal.

» Provide a median nub at crosswalks to buffer and protect pedestrians from traffic in the intersection. See Pedestrian Refuge Island for additional guidance.

Figure 4.5.5 Medians



- **Planting**: Design plantings to avoid blocking sight lines for pedestrian, cyclists, and motorists near intersections and crossings.

Utility Considerations

- Do not locate utilities below planted medians as plantings may impact utility lines and repair or replacement is challenging. Utilities under striped, painted or paved medians are easier to access with minimum disruption to roadway operations.

Sustainability Considerations

- Landscaping medians reduce the impervious surface area in the roadway, allowing stormwater infiltration or retention in the exposed soil. Curbed medians more than 4.5 feet wide, should be landscaped and used for stormwater management where possible. To support street trees, medians should be at least 6 feet in width and a minimum of 15 feet in length per tree. Refer to Street Tree design elements (Section 4.6) for additional information.
- Providing vegetation helps motorists identify medians. Varying the types of plantings or trees can give motorists a clue to the type of environment they are passing through, leading them to adjust their behavior and speed accordingly. Street trees located within the intersection should avoid blocking sight lines to ensure safety.

Design References

- The NACTO Urban Street Design Guide provides further information on the design of medians and pedestrian crossing islands in urban environments.
- The Institute of Transportation Engineers offers guidance on medians and other traffic calming devices.

MAINTENANCE & MANAGEMENT

General Maintenance

- **Landscape Care**: Planted medians will require landscape stewardship to ensure well maintain planting beds. Ann Arbor has an “Adopt-a-Median” program coordinated through the Adopt-a-Park program.
  - » In the early years, it may be necessary to irrigate or water by hand, any planting, especially trees, established in the median.

Seasonal Use & Maintenance

- **Snow Removal**: Medians should be designed with snow removal in mind. Medians can be used for snow storage when necessary, although this may negatively impact planted materials, can block sight lines along the roadway, and can trap pedestrians trying to cross at unmarked locations.
  - » Medians should allow adequate width in the adjacent travel lane to accommodate snow removal vehicles, as well as turn radii that facilitates snow clearing and removal.

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INTERSECTION ZONE

MINI ROUNDABOUTS

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic& Uni.	Near NBH
Pedestrian	■	■			
Transit		■	■	■	
Bicycle		■	■		■
Balanced		■	■	■	■

DESCRIPTION & INTENT

Mini roundabouts, also referred to as mini circles or neighborhood traffic circles, are small diameter traversable or protected islands[1] in the middle of an intersection. Mini roundabouts subtly deflect the path of traffic, slowing traffic speeds while maintaining vehicle progression. The slower speeds and angle of the vehicles provide greater visibility to pedestrians as well as a safer, easier crossing. Mini roundabouts have demonstrated significant safety benefits and reduction in the number and severity of crashes.

Mini roundabouts can be attractive focal points in a streetscape environment and some communities, like Seattle, WA, even have competitions between neighborhoods for the most attractive mini roundabout design and maintenance.

USE & APPLICATION

Location

- Mini roundabouts are appropriate in all Frontage Contexts, and pedestrian and bicycle emphasis streets, as well as balanced street types.
- Use mini roundabouts at the intersection of lower speed, bi-directional streets with only one lane of traffic per direction.
- Mini roundabouts may be used at physically-constrained locations as they can generally be accommodated in the existing bounds of most streets.
- Mini roundabouts are commonly used as an alternative to four-way stop signs but may also be used in lieu of two-way stop controls.
- Mini roundabouts may be used at isolated locations or may be applied in sequence along multiple intersections of a corridor.
- Mini roundabouts may be used to improve safety and flow at intersections like Fourth Avenue and Catherine Street where the mixing of drivers, pedestrians and cyclists cause confusion at the four-way stop.
- Mini roundabouts may be piloted and tested as temporary installations through the use of paint and/or temporary flexible curbing, sand bags, or other acceptable materials.[2]
- Mini roundabouts typically do not adversely affect bicycle facilities, emergency responders, or other special vehicles. Any unique challenges can typically be addressed through design adjustments.

[1] http://safety.fhwa.dot.gov/intersection/roundabouts/fhwasa10007/

[2] The "Living Preview" of the Yellow Brick Road project in Richmond, CA is a great example of a temporary and test installation of a mini roundabout. http://richmondconfidential.org/2014/10/24/residents-test-yellow-brick-road-and-proposed-walkable-streets-within-the-iron-triangle/ (Accessed January 2015)

Related Design Elements

- **Crosswalks**: Place crosswalks across all approaches so motorists know where to look for pedestrians and pedestrians know where to cross safely.
- Carefully design bicycle facility approach as entering the mini roundabout. A bicycle lane may be provided around the mini circle; however, it is more common that bicycles share the lane in a mini roundabout.
- Mini roundabouts on emergency vehicle framework streets or transit routes must be designed to accommodate the sweep of these vehicles.

Policy References

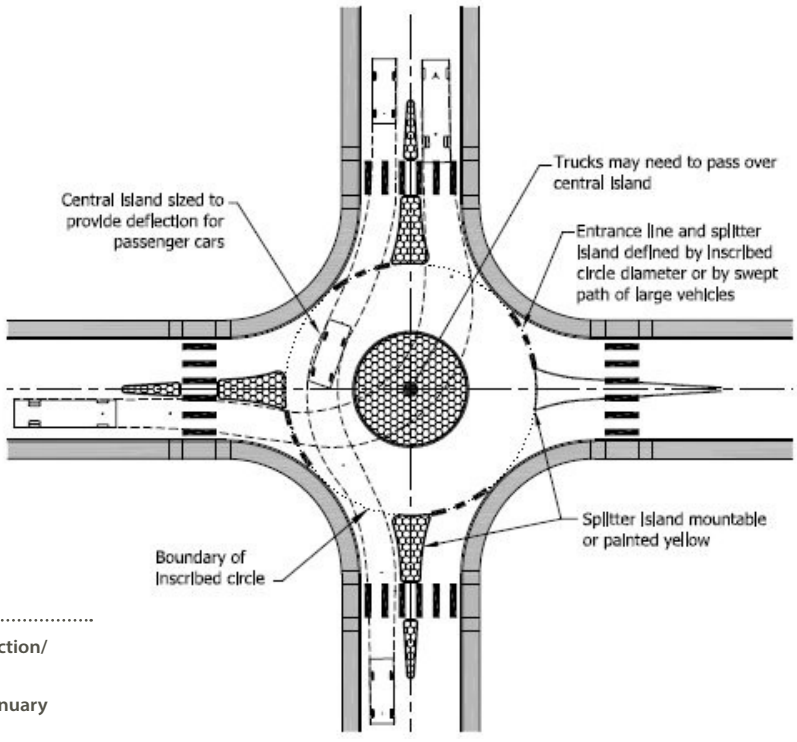
- The FHWA, through its Office of Safety, has developed guidance for the design and use of mini roundabouts.[3]
- The Seattle Department of Transportation Neighborhood Traffic Control Program is one of the most extensive and mature in the nation providing robust resources for peer communities, including standard specifications for construction.[4]

DESIGN & OPERATIONS

Design Requirements

- **Geometry**: Make mini roundabouts as large as possible. Design the inscribed circle with radii large enough to deflect travel lanes, but small enough to stay within the existing curb lines. Properly designed, mini roundabouts should not require the realignment of existing street curbs.
- **Mountable Apron**: Create a protected area in the center surrounded by a mountable apron that accommodates the larger turning radii required by trucks, buses, and other larger vehicles.
  - » Design the mountable apron to accommodate and withstand snowplow blades. The City of Seattle standard is for a 2-foot wide concrete ring no more than 4 inches high.
- **Signage**: Use yield control on all entries.
- **Approaches**: Use raised channelization to guide approaching traffic into the circle. Pavement markings may be used as an alternative.
  - » Rumble strips should be used in advance of any integrated crosswalks to alert pedestrians of on-coming cars.

Figure 4.5.6 - Mini Roundabouts



[3] Report number "FHWA-SA-10-007" http://safety.fhwa.dot.gov/intersection/roundabouts/fhwasa10007/ (Accessed January 2015)

[4] http://www.seattle.gov/transportation/trafficcircles.htm (Accessed January 2015)

Additional Design Considerations

- **Center Landscape Area**: The central island may be fully traversable (typically with a paved circle) or may permit landscaping inside of a wide apron.
- **Stop Controlled Entry**: Some communities use stop controlled entries which is then more appropriately called a neighborhood traffic circle, rather than mini roundabout.

Utility Considerations

- Ensure mini roundabouts do not conflict with sub-surface utilities, particularly if landscaping beds or curbs are provided as elements of the roundabout design.
- Do not locate utility vaults in mini roundabouts.

Sustainability Considerations

- Mini roundabouts can provide a unique opportunity for street greening and the removal of impervious surfaces. Place landscaping in the center portion of the mini roundabout. Ground cover should remain low, though trees may be used if the line of sight through the mini roundabout.

MAINTENANCE & MANAGEMENT

Special Maintenance

- Any landscaping in mini roundabouts should be regularly maintained and potentially irrigated. If community partners participate in landscape maintenance, clear safety protocols must be put in place and maintenance agreements should be adopted.
- Mini roundabouts may complicate street repaving projects.
- Roundabouts require both additional signage and pavement markings, which also must be maintained.

Seasonal Use & Maintenance

- If mini roundabouts are planted, seasonal landscape care is required.
- Mini roundabouts can introduce some challenges to snow removal. A mountable apron on the roundabout allows snowplows to maneuver around them. The center island of mini roundabouts may be used for temporary snow storage.

Reviews & Approvals

- The Ann Arbor Systems Planning and Engineering Units will review and approve mini roundabout applications in the city.

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INTERSECTION ZONE

SIGNALS: NO TURN ON RED (LEFT AND/OR RIGHT)

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	■			
Transit		■	■	■	
Bicycle		■	■		■
Balanced		■	■	■	■

DESCRIPTION & INTENT

"Right on Red" operations permit vehicles to complete a right-hand turn even when the signal governing their leg is displaying red. Vehicles may only proceed when the intersection is clear of on-coming vehicles and pedestrians in the crosswalk.

Conversely No Right on Red operations prohibit vehicles from making this turn. All vehicles must wait for the appropriate green signal.

In Michigan, vehicles are permitted to make a Left on Red, but only onto a one-way street.

Right on Red operations are generally used to aid in progressing vehicle traffic. The reduced idling time can have modest air quality benefits but, Right on Red may increase conflicts with and risk to pedestrians in a concentrated downtown area where pedestrians are common.

USE & APPLICATION

Location

- Right on Red is specifically prohibited at most signalized intersections in downtown Ann Arbor.
- No Turn on Red is typically employed at locations with relatively high pedestrian volumes. This treatment is advised for intersections in Destination Commercial street types and should be considered at all other Commercial street types.
- Where separated bicycle facilities are used and/or where two-stage turn queue boxes or bike boxes are used, No Turn on Red must be used.
- Right on Red can be temporal, prohibiting right turns only during peak hours of pedestrian activity (for example 7AM to 7PM). Right on Red may be further qualified with signage that indicates "No Right on Red When Pedestrians Present."
- Priority users like public transit operators may be exempted from No Turn on Red restrictions at intersections that are specifically signed.

Policy References

- The MMUTCD is the definitive guide for all signal operations and design.[1]



INTERSECTION ZONE

SIGNALS: LEADING VS. LAGGING LEFTS

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	■	■			
Transit		■	■	■	
Bicycle		■	■		■
Balanced		■	■	■	■

DESCRIPTION & INTENT

Designated signal phases for left turns are common in many locations. Left turns may be accommodated through an exclusive signal phase, where only opposing left turns are permitted, or as an early or elongated period for the through green time for one approach of the intersection. These left turns are known as "leading lefts" if they occur at the beginning of the through vehicle phase or "lagging lefts" if they occur at the end of the phase.

Leading lefts tend to be less intuitive to pedestrians accustomed to being given a walk phase at the conclusion of the red phase for opposing traffic. Pedestrians may jump the signal and find themselves in direct conflict with left turning vehicles. Pedestrian/vehicle conflict have been found to be almost six times higher with leading lefts as compared to lagging left signal operations.[1]

USE & APPLICATION

Location

- Leading or lagging lefts allow time for turning vehicles to clear the intersection. They are generally used in locations that have a high volume of pedestrians or through traffic that inhibit the completion of the left-turn.
- Lagging lefts are generally preferred for pedestrian progression. Leading lefts are generally preferred for vehicle progression.

Policy References

- The MMUTCD is the definitive guide for all signal operations and design.[2]

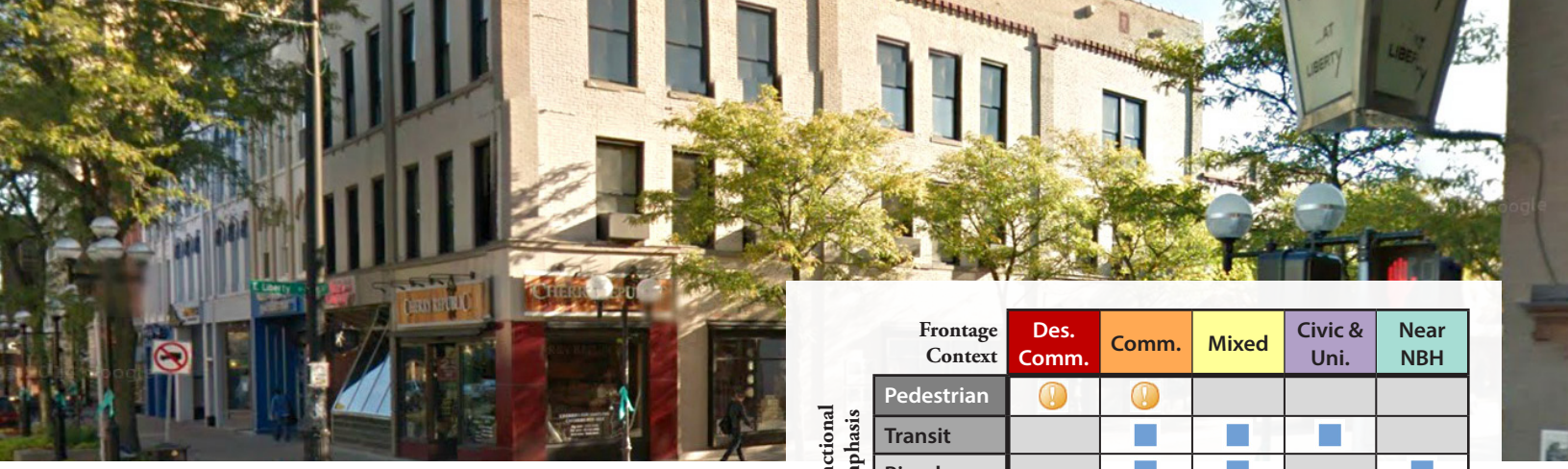
DESIGN & OPERATIONS

Design Requirements

- Intersections with leading left phases should provide more generous sidewalk space to accommodate pedestrian queuing. Pedestrians are generally at their greatest concentration at the beginning of any signal cycle. Lagging lefts permit the majority of pedestrians to clear the intersection before left turns proceed.
- Leading Pedestrian Intervals (LPI) may not be used in conjunction with leading left signal operations, but may be combined with lagging left signals.

[1] Hummer, J. E., Montgomery, R. E., and Sinha, K. C. Guidelines for Use of Leading and Lagging Left-Turn Signal Phasing, Transportation Research Record, No. 1324, TRB, National Research Council, Washington, D.C., 1991.

[2] http://mutcd.fhwa.dot.gov/htm/2009/part4/part4e.htm



Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	!	!			
Transit		■	■	■	
Bicycle		■	■		■
Balanced		!	■	!	■

INTERSECTION ZONE

SIGNALS: LEADING PEDESTRIAN INTERVAL

DESCRIPTION & INTENT

A leading pedestrian interval (LPI) is a brief time at the beginning of a signal phase that permits pedestrians to enter the crosswalk before any other traffic is permitted to advance. LPIs improve the visibility of pedestrians by putting them more clearly in the sight of right and left turning vehicles. Studies show that LPIs reduce pedestrian/vehicle collisions by up to 60%.[1]

USE & APPLICATION

Location

- LPIs are appropriate for use on any street type; however, are typically used at intersections with significant pedestrian volumes and high volumes of conflicting turning vehicles, such as Destination Commercial and other Commercial areas and areas of high student concentrations.
- LPIs may also be used on streets approaching vehicle flow corridors to improve the visibility of pedestrians crossing parallel to high volume, higher-speed streets.

Policy References

- The MMUTCD is the definitive guide for all signal operations and design."

DESIGN & OPERATIONS

Design Requirements

- Require the concurrent use of pedestrian signal heads.
- May not be used with leading left turns.
- Must be a minimum of three seconds in duration, but more commonly provide five or more seconds to permit pedestrians to cross at least one lane of vehicle traffic.
- Should be accompanied by audible and/or vibrotactile signals for visually impaired pedestrians.

Optional Design Considerations

- Eliminate Right on Red at locations were LPIs are used. Right on Red is generally undesirable at intersections with high and regular pedestrian volumes.
- At locations with extremely high pedestrian volumes, combine the LPI with signal timing that displays the "DON'T WALK" signal for pedestrians even while the green phase is still shown for parallel traveling vehicles. This brief period at the end of the cycle provides an opportunity for vehicles to complete turns after the majority of pedestrians have completed their crossing.
- Combine LPIs with bumpout to further increase pedestrian visibility and safety.
- Bicycles may also benefit from LPIs and clear an intersection to permit vehicle turns.

[1] A.C. Fayish and Frank Gross, "Safety effectiveness of leading pedestrian intervals evaluated by a before–after study with comparison groups," Transportation Research Record No. 2198 (2010): 15–22.



Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	■	■			
Transit		■	■	■	
Bicycle		■	■		■
Balanced		■	■	■	■

INTERSECTION ZONE

SIGNALS: ALL-WALK SIGNAL PHASES

DESCRIPTION & INTENT

All-walk signal phases, also called pedestrian scramble lights, diagonal crossing or Barnes Dance, stop all vehicle movements on all legs of an intersection and permit pedestrians to cross in any direction – including diagonally across the intersection. Conceived by Flint, MI native Henry Barnes, the pedestrian scramble was first used in Denver, CO.[1]

All-walk signal phases may be the only opportunity in a signal cycle when pedestrians are permitted to cross since pedestrians are held during all other phases to remove their conflicts with turning vehicles. All-walk signal phases may also serve as an additional phase, with pedestrians still permitted to cross concurrent with parallel traffic during typical signal cycles.

- All-walk signal phases are generally unfamiliar operations to most pedestrians and may take some time for motorists and pedestrians to adapt.

USE & APPLICATION

Location

- All-walk signal phases should only be used where high volumes of pedestrians are expected on a routine basis.
- All-walk signal phases may also be used at locations where there are a high number of conflicting movements between crossing pedestrians and turning vehicles. In this case, the all-walk phase may be the only time when pedestrians are permitted to cross the intersection. Pedestrians are held on the sidewalk during vehicle phases. Although the all-walk phase permits movements in all directions and single-cycle crossings, it may also decrease pedestrian level of service as pedestrians must wait through two or more signal cycles before getting permission to cross.

Policy References

- The MMUTCD is the definitive guide for all signal operations and design.[2]

DESIGN & OPERATIONS

Design Requirements

- Instructive signage is generally necessary at all-walk signal phase locations, as this is a non-standard traffic operation.
- All-walk signal phases should be accompanied by audible and vibrotactile indicators for visually impaired pedestrians.
- Sidewalks should be large enough to comfortably provide space for queuing pedestrians waiting to cross.
- All-walk signal phases s should be routinely monitored and reassessed. Given the longer delays for both vehicles and pedestrians, there may be reductions in signal compliance.

[1] Jeremy Meyer, "Denver to eliminate diagonal crossings at intersections," The Denver Post. April 06, 2011 http://www.denverpost.com/ci_17780418 (Accessed January 2015)

[2] http://mutcd.fhwa.dot.gov/htm/2009/part4/part4e.htm



INTERSECTION ZONE

SIGNAL: TRAFFIC SIGNAL PRIORITY

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	■	■			
Transit		■	■	■	
Bicycle		■	■		■
Balanced		■	■	■	■

DESCRIPTION & INTENT

Traffic signal priority (TSP) prioritizes the progression of select vehicles, typically transit or emergency vehicles, over the standard progression of typical transit. TSP may be active or passive.

Passive TSP times traffic signals and corridor progression to the average bus speed rather than vehicle speed.

Active TSP is an Intelligent Transportation System (ITS) that enables an approaching bus to communicate with a traffic signal and alter the signal timing to improve transit progression. Active TSP may extend the signal green time, truncate the red phase, swap signal phases, insert a transit-only phase, or skip signal phases. The margin of signal time prioritized for transit is typically made up in modifications to the remaining signal phases with the overall signal cycle length remaining generally unchanged and fully recovered in the following cycle. TSP uses transponders on buses that communicate with traffic controllers. Prioritizing transit at intersections creates more reliable and efficient service. This makes transit a more attractive mode of transportation for users and reduces operating costs for the City and service area.

Ideally, TSP should be deployed in concert with, and as an integrated component of, an overall ITS Comprehensive Plan for the city as a whole.

USE & APPLICATION

Location

- TSP is generally used on high frequency, high ridership transit corridors, and transit emphasis streets.
- TSP should be installed only when there is documented schedule adherence issues.

Related Elements

- **Traffic:** Active TSP modifies pre-timed signals. Industry practice indicates that TSP generally has minimal disruption on vehicle traffic; however, may briefly interrupt traffic progression on intersecting corridors with synchronized lights. The benefits and potential effects of TSP should be examined and considered before deploying this technology.
- **Transit:** Active TSP requires that surface transit vehicles or emergency vehicles be equipped with signal communication devices.
- **Queue Jump Lanes:** TSP is often used in conjunction with bus queue jump lanes, though they are not a prerequisite for use.
- **Bus Stops:** Far-side bus stop locations tend to benefit the most from TSP systems, as they reduce delays from buses waiting at the near-side of the intersection for a green signal.

Policy References

- Transit Signal Priority: A Planning and Implementation Handbook (May 2005) funded by the U.S. Department of Transportation and published by ITS America provides comprehensive guidance on TSP for transit.
- The FHWA Traffic Signal Timing Manual (Publication Number: FHWA-HOP-08-024) includes a section on planning and implementing traffic signal priority.

DESIGN & OPERATIONS

Design Requirements

- TSP does not require any physical modifications to the intersection, but it is often utilized in conjunction with bus queue jump lanes.
- TSP may be implemented at individual intersections, along a continuous corridor or route, or throughout the signal system.
- TSP typically cannot be activated for more than two signal cycles in a row and then cannot be activated until two to three additional signal cycles have passed to enable overall intersection and network recovery.

Sustainability Considerations

- TSP does not introduce any unique opportunities for green infrastructure installation, although it can increase transit service and use and this minimize vehicle traffic and idling.

MAINTENANCE & MANAGEMENT

Special Maintenance

- TSP does require both on-board vehicle equipment and signal system components. ITS does not normally, introduce any additional maintenance burdens than standard signal maintenance. Typically the TSP will maintain on-board equipment while the city or state will maintain signal equipment, though both must work in concert.

Reviews & Approvals

- TSP systems would be deployed in collaboration between the AAATA and the City of Ann Arbor and/or MDOT.





4.6

INFRASTRUCTURE & LANDSCAPE DESIGN ELEMENTS

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Stormwater Management 270

Site Utilities 274



STREET LIGHTING

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	✓			
Transit		✓	✓	✓	
Bicycle		✓	✓		✓
Balanced		✓	✓	✓	✓

DESCRIPTION & INTENT

Lighting is an essential element of street design and safety. Street lighting is used to illuminate the street, sidewalks, and bike facilities. Street lighting is critically important at intersections and crosswalks.

Lighting levels are important. Lighting should be sufficient for people to see comfortably and correctly distinguish persons and objects in the street, but lighting should not be so great as to create deep shadows or pronounced areas of light and dark.

Street lighting should be efficient in both energy use and direction of light. Consistent with Ann Arbor's endorsement of the Dark Skies Initiative, street lights should minimize sky glow (casting or reflecting light up into the night sky).

Street lights are important elements of street character during all hours. The verticality of light poles helps to distinguish the curb line of the street and establishes a particular rhythm to the street edge. The spacing of light poles often dictates the spacing of other street elements as well, notably street trees. In dark conditions, warm color temperatures promote an inviting ambiance.

There are two broad categories of street lights used in downtown:

- **Roadway lighting** is typically mounted higher (18 to 24 feet above the roadway) and poles have an arm that extends the streetlight over the travel way.
- **Pedestrian-scale lighting** is typically mounted lower (12 to 16 feet above the sidewalk) and is primarily used to illuminate the Walking Zone, although on the narrow streets of Ann Arbor, light from pedestrian lighting may be sufficient to serve as both roadway and pedestrian lighting.

USE & APPLICATION

Location

- Street lighting is required on all street types although the type and intensity of lighting may vary.
- Pedestrian-scale lighting is generally desired in areas with more intense pedestrian activity in Destination Commercial, Commercial, and Civic & University frontages, which makes up the majority of downtown.
- Typical roadway lighting may be sufficient and desirable for both Roadway and the Walking Zone in the Near Neighborhood context, as light is focused towards the roadway and causes less light to enter homes.

Frontage Context	Preferred Lighting Scale
Destination Commercial	Pedestrian-scaled, with roadway lighting at intersections as needed
Commercial	Pedestrian-scaled, with roadway lighting at intersections as needed
Mixed	Pedestrian-scaled, with roadway lighting at intersections as needed
Civic & University	Pedestrian-scaled, with roadway lighting at intersections as needed
Near Neighborhood	Intersection and Roadway lighting

DESIGN & OPERATIONS

Design Requirements

A **Light Levels**: Street lighting shall be used to provide sufficient illumination, particularly at crosswalks and intersections. The target light levels for roadway luminance and intersection / pedestrian area illumination shall be based on the ANSI/IES RP-8 standards as indicated in the table below.

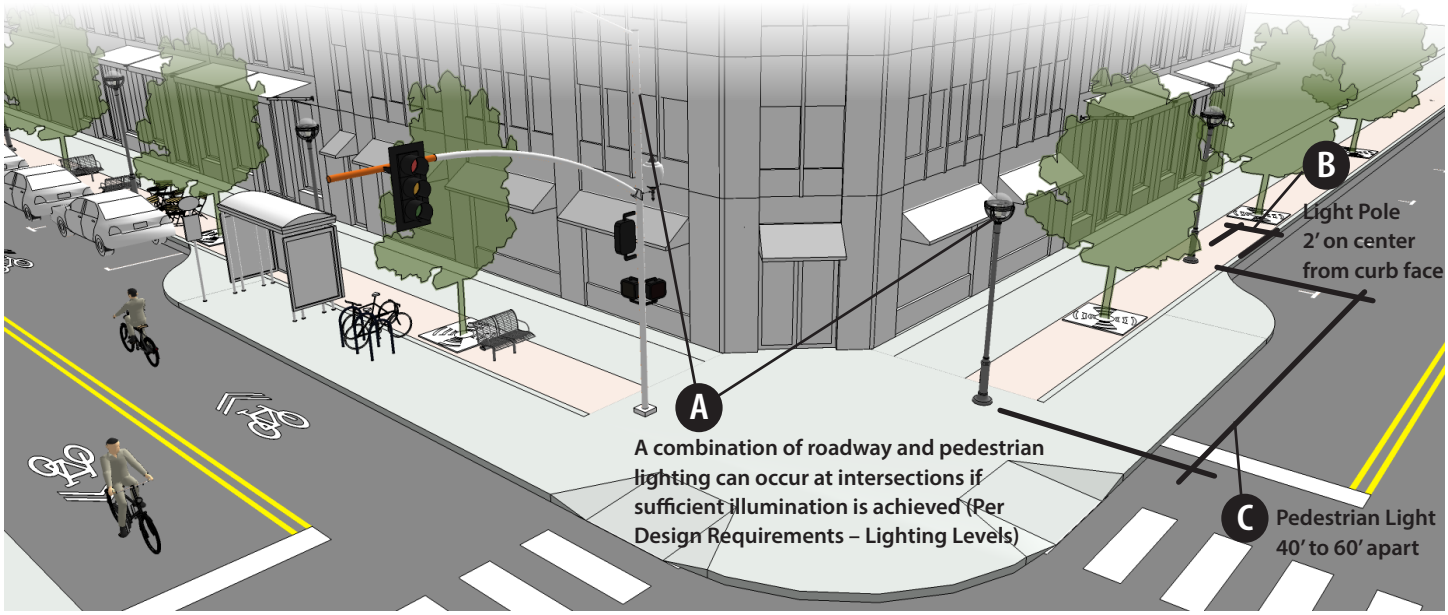
- » Higher levels of lighting may be desired at bus stops, bicycle share stations, or other areas of concentrated pedestrian activity. Supplemental lighting may be provided by sources other than street lights, such as from lit bollards, building-mounted lighting, or other accent lighting.
- » Adaptive Control: New installations of street lighting may be regulated with adaptive controls.

B **Placement**: Light poles shall be placed in the Amenity Zone of the street at least 2-feet back from the face of curb and from the walking zone of the sidewalk.

- » Where bumpouts are present, light placement should typically be consistent with the curb line outside of the bumpouts.
- » **Positive Contrast Lighting:** Positive contrast lighting should be utilized at mid-block crossings. This is usually achieved by placing lights in advance of the crosswalk from both directions to provide vertical illumination of pedestrians at the crosswalk.

TABLE 4.6.1 Street Typology	Average Roadway Luminance (cd/m^2)	Target Light Level (average foot candle)			
		Signalized Intersections	Unsignalized Intersections	Pedestrian Area / Sidewalk	Mid-Block Crossings
Destination Commercial	1.2	3.2	3.2	2.0	3.2
Commercial	1.2	3.2	3.2	2.0	3.2
Mixed	1.2	3.2	3.2	2.0	3.2
Civic & University	1.2	3.2	3.2	2.0	3.2
Near Neighborhood	0.6	1.7	1.5	1.0	1.5 (same as for unsignalized intersections)

Figure 4.6.1- Street Lighting



C **Spacing**: Lighting placement and levels should be sufficient for personal safety, permitting recognition of people and objects while avoiding the creation of excessive shadows. Exact spacing will depend on the selected light fixture and target light level to be achieved. The spacings below can be used for planning purposes:

  - » Pedestrian scale lighting is typically placed 30-60 feet apart, depending on the design of the fixture and arrangement of intervening street features (e.g. street trees).
  - » Where roadway lighting is used, lights are placed at intersections and typically every 150 to 250 feet between, although this may be less depending on the desired light level.

- **Energy Efficiency**: Ann Arbor pioneered the use of LED light fixtures as a means to reduce energy consumption and costs. Effective, high efficiency lighting is required using LED lighting and/or the best available technology.
- **Light Color:** Lights shall have a Correlated Color Temperature of no greater than 3000K and shall have a minimum Color Rendering Index (CRI) of 70.
- **Illuminance:** In D1 Downtown Core and D2 Downtown Interface districts, the Illuminance shall be measured facing up, at a distance three feet above the ground. In any other district, the illuminance shall be measured facing the Luminaire and measured at any point within the receiving property, including at any height above grade at the property line.
- **Light Shielding:** Street Lighting in the downtown should be partially or fully shielded in order to minimize up-light.
  - » Pedestrian lighting shall be fully or partially shielded. Where lighting illuminates features on an above grade or vertical target, including but not limited to architectural features, signs, landscaping, fountains, and sculptures, Luminaires shall be Partially Shielded and shall be installed and aimed to minimize their output past the object being illuminated, skyward or otherwise. Such lighting shall not cause Light Trespass as specified in this Section, or Glare.
  - » Roadway lighting shall be fully shielded. Where lighting targets primarily the ground or horizontal targets, including but not limited to parking areas, loading docks, recreational areas, and site entrances, Luminaires shall meet Fully Shielded criteria, so that no light will cause Light Trespass.
  - » All lighting on streets in exclusively residential zoned areas shall be shielded to minimize light trespass into residences.
- **Materials and Finishes:** Light poles and fixtures should use durable metal material (galvanized and powder-coated steel, aluminum or stainless steel finishes).

Additional Design Considerations

- **Light Fixture Style**: A variety of light fixtures are found throughout downtown. Since 2019, a focused effort has been made to standardize all pedestrian scale lighting. Specifications, below.
  - » The ornamental "globe" light is the most common pedestrian light and standard fixture for downtown streets in all non-Near Neighborhood streets. Exceptions to using this standard will be considered at staff discretion based on the road and specific design criteria that is needed. Poles with multiple globe luminares may be used as needed to achieve target light levels.
  - » Ornamental Pedestrian Globe light specification: Lumecon Thirty-Five West, 54 watt, Type V Distribution, 120v- 277v, 3000k, Cut-Off Litelid, Black. Model number: L35W-1-1-OW-B-C. Equipped with a Phillips programmable driver.
  - » Ornamental Pedestrian Pole specification: catalog number: SPSCCD-SC4-18-13.00-TN3.50/6.00-PP-GFWI-CU, style: Center City with Steel Shaft Assembly, height: 13'-0", base: 18", finish: powder coated gloss black. Must include a GFI outlet.
  - » Ornamental Pedestrian Pole Cross Arm specification: Catalog number: AARANN-2S-22-TN2.88/3.00-CU, style: Ann Arbor Twin, height: 10", width: 22", material: fabricated aluminum, finish: powder coat gloss black, tenon: 2 7/8" dia. x 3" height.
  - » Roadway light fixtures may be used on dedicated poles and/or on traffic signal masts/posts in order to achieve intersection/mid-block crossing light levels when such lighting can not easily be achieved with the use of globe fixtures alone. Shall meet all design requirements as described on pages 251-252.

[2] **RP-8-21 is the most current report issued November 2021 and available at www.ies.org/store. The last two digits of the report correspond to the year of publication. Go to www.ies.org/store to find the latest version.**

[3] **http://www.a2gov.org/departments/engineering/Pages/Engineering-and-Contractor-Resources.aspx**

[4] **"Ann Arbor Streetlights: Past, Present, Future." Report prepared by the Systems Planning Unit. September 2013. http://www.sabrabriere.org/Ann%20Arbor%20Streetlights%20Whitepaper_%209-12-13.pdf**

  - » Consistent light fixtures within a character district will reinforce the image of the place, facilitate maintenance and provide more uniform lighting.

- **Arrangement**: The type and arrangement of light fixtures can reflect the character and hierarchy of the street. Light poles may be arranged in an “alternate” or “opposite” configuration.
- **Accessory Functions:**
  - » Brackets for banners, hanging baskets, or other ornamentation may be affixed or integrated into the light pole.
  - » Light poles shall provide electrical outlets to support downtown activities or seasonal displays.
  - » Street signage, bicycle parking and/or parking meter markers may be integrated into light poles to reduce sidewalk clutter.
  - » EV charging in conjunction with streetlighting is being explored.
- **Specialty Lighting:** Specialty and/or decorative accent lighting, such as festoon lighting, catenary lighting, light wands, lighted bollards/seating, or artistic installations may be permitted at city staff discretion. Specialty lighting should be shielded and is most appropriate in gathering or pedestrian plaza areas.

Sustainability Considerations

- Shielded lights reduce light pollution and allow lower wattage.
- Solar-powered or other emerging technology lights offer additional alternatives to consider.
- Lighter street surfaces and/or higher levels of reflectivity may lower lighting requirements and associated costs.

Design References

- The Illuminating Engineering Society of North America (IES) authors the nationally recognized “Recommended Practice for Roadway Lighting” – the standard for roadway, pedestrian and bicycle facilities approved by the American National Standards Institute (ANSI).[2]
- The City of Ann Arbor Public Services Standard Specifications provides design and construction specifications for street lighting.[3]
- FHWA Lighting Design for Mid-block Crosswalks (2008) provides guidance on lighting and visibility considerations at crosswalks to improve pedestrian safety.

MAINTENANCE & MANAGEMENT

General Maintenance

- The majority of pedestrian scale lighting is city-owned and maintained by the Signs and Signals group.
- The majority of roadway lights in Ann Arbor are owned and maintained by DTE with operation paid for by the City of Ann Arbor.

Seasonal Use & Maintenance

- **Snow Removal**: There are no special requirements for snow removal associated with street lighting.

Reviews & Approvals

- Street lighting should be coordinated through the Public Services Administration but may involve multiple other city units and Detroit Edison (DTE).
- It may also be necessary to engage Washtenaw County and the Michigan Department of Transportation (MDOT) in certain circumstances.





STREET TREES

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	✓			
Transit		✓	✓	✓	
Bicycle		✓	✓		✓
Balanced		✓	✓	✓	✓

DESCRIPTION & INTENT

Street trees are critical component of the downtown environment and part of the City's overall green infrastructure system. Street trees provide a broad range of benefits, such as managing stormwater volumes, providing shade for pedestrians, making streets safer and more appealing, enhancing the aesthetic character of the street, and reducing the urban heat island effect. Maintaining healthy street trees is a challenge in dense urbanized environments, but proper consideration of the growing environment yields large and healthy street trees that provide maximum benefit.

USE & APPLICATION

Location

- Street trees are required on all streets in the downtown environment unless an exception is granted due to technical in-feasibility of planting trees. *See Minimum Planting Area in Design Guidelines Below.*
- Trees are especially important to locate near seating, bus stops, and other locations where pedestrians may be sitting, resting, or waiting and can take advantage of the shade trees provide.
- Limited space at the curbside on urban streets may not allow for street trees in all desired locations. Streets need to balance space for trees with a bus stop, on-street parking, seating, and other uses.

Street trees can be planted in one of two different conditions:

1. **Within a Landscape Planter (Curbed) or Lawn Extension**: Landscape planters are curbed or raised planting beds with exposed soil/mulch within the Amenity Zone. *See Landscape Planter Design Element for More Information.* Lawn extensions are on-grade, typically lawn, planting areas in the Amenity Zone used primarily in Near Neighborhood zones. *See Lawn Extension Design Element for More Information.*

   » Open landscape planters are the preferred method for accommodating trees downtown as they provide more soil surface for water and air to access to tree roots. Curbed landscape planters also help reduce salt during the winter from running off into the tree planting area.

2. **Within a Covered Tree Trench**: Tree trenches use a combination of grates and covered soil areas within the Amenity Zone to provide an area for root growth beneath a hardscape surface.

   » Covered Tree Trenches are best-used in locations where significant foot traffic – such as high on-street parking turnover, loading/unloading zones, bus stops, taxi stands, and other intense uses compete for limited space, such as in Destination Commercial, Commercial, and some Civic & University frontage areas.

Requirements and graphic representations for each condition are provided in the Design Guidelines below.

Table 4.6.2 - Street Tree Character Goals

Frontage Context	Street Tree Character Goals
Destination Commercial	Street trees are important for providing shade for shoppers, outdoor dining/ retail and making an attractive pedestrian environment. However, it is also important that street trees minimize obstructions to business signage wherever possible. Larger street trees should be used, with larger initial plantings, to more quickly provide bigger and taller canopy coverage. Healthy tree pruning and maintenance is critical in high use areas.
Commercial	As with Destination Commercial streets, Commercial streets also benefit from larger street tree plantings where trees can provide shade while minimizing obstructions to business signage.
Mixed	Mixed streets afford greater flexibility in street tree plantings due to generally lower pedestrian volumes and less retail/ storefront visibility concerns. While larger trees and a larger canopy is generally preferred wherever possible, small trees and ornamental species may also be incorporated into the street tree planting, especially when selected species can provide attractive foliage or flowering to enhance the visual quality of mixed streets. Many mixed streets also include service access to building (utilities, loading docks, etc.) and street trees can be used to screen less visually appealing features.
Civic & University	Civic & University streets generally have minimal commercial activity yet provide a high quality pedestrian experience for people accessing institutional uses. Street tree plantings should complement the scale and articulation of Civic & University buildings create a more cohesive streetscape character. Larger groupings of species should be considered to create a stronger "promenade" feel. Both larger canopy trees and ornamentals can be appropriate, and should be placed to provide shade for seating nodes or plaza spaces along the Civic & University streets.
Near Neighborhood	Near Neighborhood streets are primarily residential in nature, and larger canopy trees should be utilized whenever possible over smaller tree types. The tree canopy is important for shading smaller scale residential buildings and providing a more calm residential street feeling.

Tree Species Selection and Application

- **Street Character**: Selecting the right tree for a given street type is important and must consider the overall Frontage Context of street as well as specific conditions, space, and growing environment for the planting itself. Trees play a critical role in defining the street character, as such congruency with the street Frontage Context is critical.
  - » Table 4.6.2 describes intended character goals for street tree plantings depending on the street's Frontage Context.
- **Site Selection**: Trees grow in many different sizes and forms, and not all trees are appropriate to all types of streets. Proper selection of tree species for a given site shall consider:
  - » Size of available growing areas and growing medium (soil and drainage).
  - » Width and height of the tree relative to the distance between trees (tree spacing) and between trees and adjacent building faces.
  - » Presence of other street elements that would adversely impact trees or be adversely impacted by trees, such as signs, light posts, and overhead or underground utilities.
- **Tree Sizes**: Table 4.6.3 provides tree sizes and placement recommendations.
  - » These recommendations should be utilized in a flexible manner, recognizing that specific design conditions and constraint may require deviation (with approval of Ann Arbor Urban Forestry & Natural Resources staff) in order to accommodate street tree planting. For example, parking meters, street signs, utility vaults/connections, building entrances, and other fixed street elements may require adjusting street tree placement and spacing.

Table 4.6.3 - Street Tree Size and Placement

	Small Trees	Medium Trees	Large Trees
Typical on-center spacing	20'	25'	30'
Minimum distance from curbs or clear Walking Zone	2'	2.5'	3'
Minimum distance from edge of driveways / alleys	10'	10'	10'
Minimum distance from light poles and hydrants	5'	5'	5'
Minimum horizontal distance from nearest edge of crosswalks	10'	10'	10'

- **Species Selection**: The tree species must be on the City of Ann Arbor's list of Approved Street Trees by Size. The list classifies trees by size class, including Small Trees (mature height under 30'), Medium Trees (mature height 25-40'), and Large Trees (mature height >40'). Note that Small Trees are suitable for streets constrained by overhead utility lines.
- **Planting Design**: Trees should be planted in a sequence of two to three of the same species in a row to provide a consistent character for a given segment of the street. Where conditions allow, planting trees for symmetry across the street should be considered (e.g. the same sequence of two to three trees repeats on the opposite side of the street) .
    - » Street tree planting downtown should coordinate with any specific tree plantings identified in street tree comprehensive plans that are part of the Urban and Community Forestry Management Plan.

DESIGN & OPERATIONS

Design Requirements – Soil Volume

- Trees typically need 2 cubic feet of growing soil for every square foot of canopy area for healthy growth (see: Urban, Jim. Up By Roots, Healthy Soils and Trees in the Built Environment. International Society of Arboriculture, Champaign Illinois. 2008). In the downtown environment, the following approximate canopy sizes are anticipated for street trees:
    - **Small Trees** = 10-foot diameter canopy (approx. 150 cubic feet of soil)
    - **Medium Trees** = 15-foot diameter canopy (approx. 350 cubic feet of soil)
    - **Large Trees** = 20-foot diameter canopy (approx. 600 cubic feet of soil)
- The soil volume for a tree can be achieved through a combination of the primary planting area in which the tree is placed and open access to surrounding soil areas that extends under the amenity zone, sidewalk, or roadway.



Design Requirements – Trees in Landscape Planters or Lawn Extensions

Landscape planters are areas within the streetscape with exposed soils and mulches for trees and other vegetation to be planted and contained within a curbed perimeter and/or raised seating walls. *See Landscape Planters Design Element and Lawn Extension Design Element for additional guidance on the design, layout, and construction details for landscape planters.*

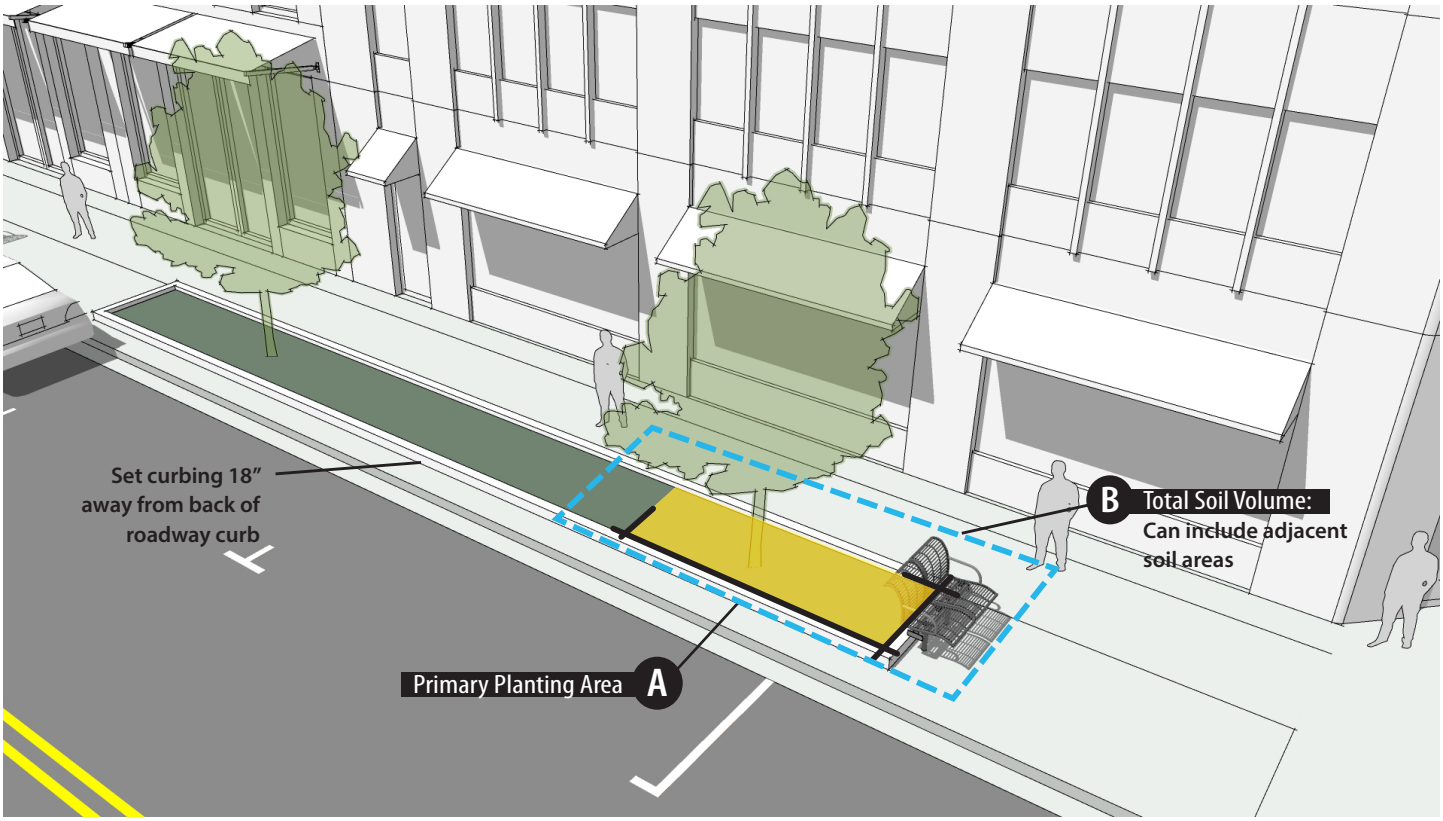
A **Primary Planting Area**: Trees planted within an open planting area (planters and lawn extensions) shall have a minimum soil surface area of approximately 30-square feet around the tree.

B **Total Soil Volume:** The desired soil volume for trees depends on the size of the tree used in the planters (see Soil Volume). Trees should be planted in the middle of their allocated soil volume.

- » Depth of the soil is based on the size of the root ball, with the top of the root ball flush with the finished grade of the planter (absent of mulch cover) and accounting for a 6 to 12 inches of compacted planting soil below the root ball. Do not place root ball directly on undisturbed grade.
- » For trees up to 3 inches in caliper, a minimum of 12 inches of new planting soil mix must surround the root ball (e.g. 2-foot diameter root ball requires a minimum 4-foot diameter area of planting soil). For trees 3 inches in caliper or larger, 18 inches of planting soil mix must surround the root ball. These minimums may determine the minimum possible width for the planter based on the specific size of the root balls for specified plant materials. *See Planting Detail Below for Additional Information.*

- **Drainage**: Provide subsurface drain lines connected to the stormwater system in areas with poorly drained surrounding soils.

Figure 4.6.2- Trees in Landscape Planters



Design Requirements – Covered Tree Trenches

Covered tree trenches provide a method for growing trees in the higher intensity urban environments. Covered tree trenches combine a primary planting area of soil covered by a grate and an extended soil zone comprised of additional grate-covered planting soil and/or accessible soils below paved surfaces.

A **Primary Planting Area**: Primary planting area shall be sized as follows:

» The primary planting area covered by the tree grate should be as large as feasible to encourage air exchange and a large growing area for the tree. Tree grates shall have a minimum surface area of 30-square feet (e.g. 4' x 8' grate). Grates narrower than 4-feet or that provide less than 30-square feet of surface area should only be considered under constrained conditions.

- **Tree Grates:** The primary planting area shall be covered by a tree grate with the following characteristics:

» Tree grates shall be constructed out of solid steel or cast iron and able to meet the load bearing capacity and requirements of the surrounding sidewalk area.

» Tree grates should provide regular holes and openings to allow for water and air to pass through. These holes or openings should have gaps no wider than 1/2" in order to provide a usable surface for walking and/or cafe dining.

» Tree grates shall be able to be locked in place to prevent vandalism, but still removable in order to provide maintenance access below the tree grate.

» Tree grates shall provide a 18" diameter circular or 18" x 18" rectangular opening around the tree truck to allow for tree growth. The grate system shall be able to be removed and replaced with a larger opening grate in the event the tree trunk grows too large for the opening.

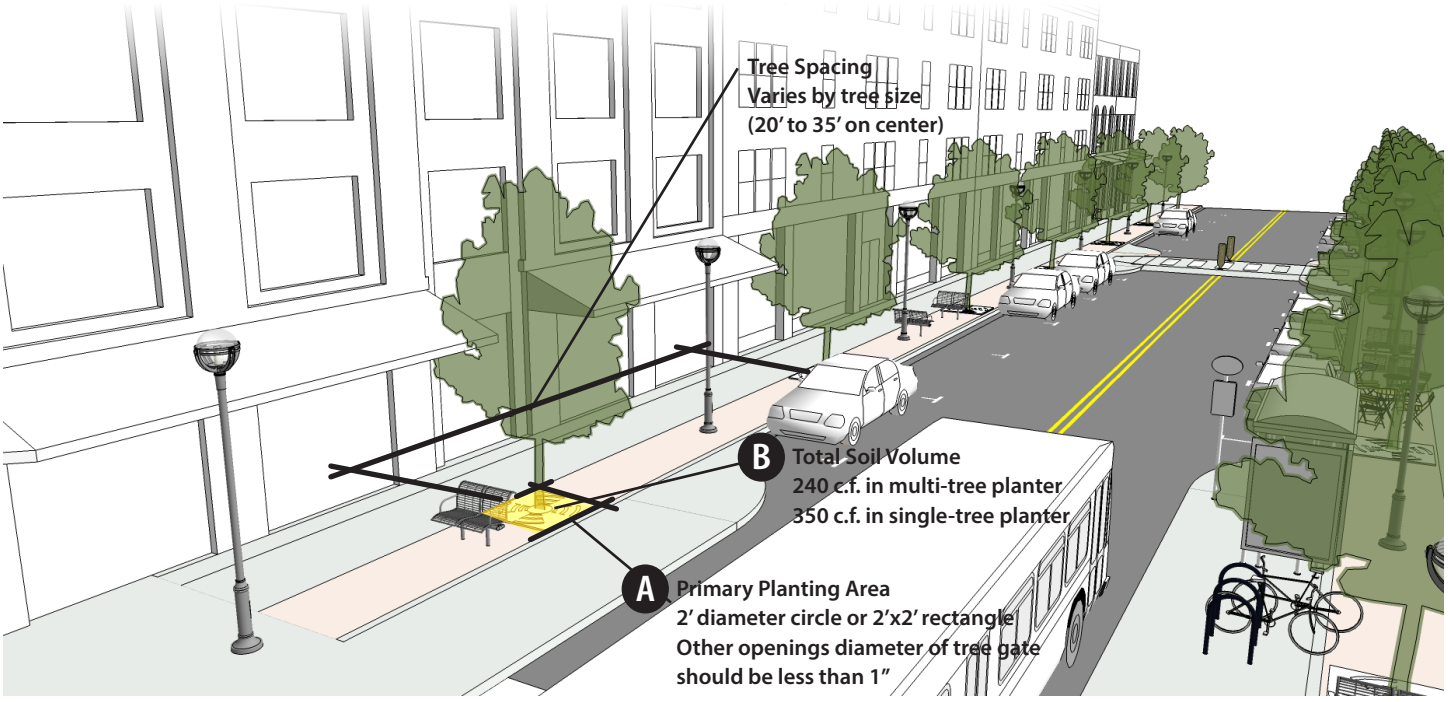
» Tree grates shall provide openings within the tree grate to allow air and water to enter the planting soil. These other openings should not allow an object greater than 1 inch in diameter to pass through (e.g. a chair leg).

» The distance between the finished soil grade and the top of the tree grate may not be no more than 6 inches in height.

» Tree grates should be offset from the back of road curbs by at least 12"

» For Ann Arbor's standard Tree Grate detail, see the Standard Specifications (PSSS / "The Orange Book").

Figure 4.6.3 - Trees in Covered Tree Trenches



- **Drainage:** Provide subsurface drain lines connected to the stormwater system in areas with poorly drained surrounding soils.

B **Extended Soil Zone** The total soil needed volume should be achieved through a combination of the primary planting area and an extended soil zone (see Soil Volume). This volume can be achieved by extended the grated surface area with additional tree grate panels, using a geo-engineering system, or providing access to surrounding soil areas.

  - » **Grated Surface**: Use additional grated area with normal planting soil. Grates must meet the same requirements as those listed above for the primary planting area – with the exception of the opening for the tree trunk.

    OR

  - » **Geo-Engineering**: Use structural soils and/or other geo-engineering solutions (e.g. Silva Cells) to provide a load bearing sub-grade suitable for root growth and supporting the surface pavings. Consider using porous surface pavement material such as porous concrete or pavers (see sidewalks) for areas above structural soils. Geo-Engineering is optional.

  - » Use of structured soils or other geo-engineering solutions is a non-standard treatment and requires special permission of the City of Ann Arbor Urban Forestry and Natural Resources Coordinator and Engineering Unit.

Design Requirements – Tree Installation

- Where street trees are placed within landscape planters with curbs or seat-walls, the undisturbed ground may be concrete or other hard surfaces forming the planting pit area.
- Planted street trees must be approved with a two-year warranty period and maintenance contract providing tree care (watering, etc.) for the first two years following installation.
- At least 20-gallons of water should be provided to each tree immediately following planting. Regular watering shall be maintained over the two-year maintenance period to ensure that the tree is successfully established.

Additional Design Considerations

- Hybrid designs containing part open landscape planters and part covered tree trenches may be utilized with approval of the City's Urban Forestry & Natural Resources Coordinator.
- The sides of landscape planters and covered tree trenches should be open to existing sub-grade wherever possible to provide for additional root zone space. Expanded use of structural soils or other treatments around tree plantings is highly desirable.
- Provide water connection spigots in close proximity to tree planting areas.

Utility Considerations

- Do not plant trees directly on top of major utilities, utility leads, vaults, access panels, or other utility infrastructure that are within the soil growth zone.

Sustainability Considerations

- Explore opportunities for using structural soils below existing paved Sidewalk and Amenity Zone areas when they can be connected to the growing zone of tree roots.
- Use permeable pavements to encourage infiltration of stormwater into the root zone around trees.

Design References

- City of Ann Arbor Standard Specifications (PSSS / "The Orange Book")
- City of Ann Arbor Urban & Community Forest Management Plan.
- Boston Complete Streets.
- City of New York Department of Parks and Recreation Street Tree Planting Standards (2014).

MAINTENANCE & MANAGEMENT

General Maintenance

- For the first two years following tree installation, trees must be maintained as required by a tree maintenance agreement.
  - » Trees must be watered throughout the growing season (May 15th to October 31st) at two-week intervals. Each watering must provide at least 20-gallons of water for each tree. Watering frequency may be adjusted based on drought or excessive rainfall conditions.
  - » Weeding, trash removal, and mulching must be maintained to keep the tree area free from weeds, trash, and other debris.
- After the first two years following tree installation, the City oversees tree maintenance responsibilities. The City and DDA are collaborating to create programs to engage citizens and businesses in tree care, including volunteer and business outreach programs. These maintenance activities include:
  - » Tree pruning and disease/pest management. Tree pruning in Destination Commercial and Commercial areas for storefront and signage visibility is important.
  - » Regular watering, especially during drought conditions
  - » Mulching around the tree
  - » Weed and litter removal
- Use of Gator Bags for tree watering should refer to Ann Arbor Urban Forestry & Natural Resources staff for current practices.

Seasonal Use & Maintenance

- **Snow Removal**: Snow should be cleared from landscape planters and grated tree areas as soon as possible to minimize salt and other pollutant loading from entering exposed soil areas. Snow should not be stored on top of landscape planters and grated tree areas.

Reviews & Approvals

- Public street trees are reviewed by the Ann Arbor Urban Forestry & Natural Resources Planning Coordinator.
- Private projects planting new public street trees must have their plans and planting details reviewed and approved by the Ann Arbor Urban Forestry & Natural Resources Planning Coordinator.



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LANDSCAPE PLANTERS

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	!	!			
Transit		!	!	!	
Bicycle		!	!		!
Balanced		!	!	!	!

DESCRIPTION & INTENT

Landscape planters are curbed or raised soil areas designed to accommodate decorative plantings in a clean and clearly maintained fashion within the streetscape. Landscape planters soften the urban environment and provide foliage and flowers to make the street environment more appealing and engaging for all types of users.

Landscape planters typically contain a variety of suitable and tolerant perennial plant species and may be used to accommodate street tree plantings. Annual plants can be suitable for landscape planters provided that arrangements for their maintenance and replacement have been made.

Landscape planters are either curbed or raised in order to deter pedestrian traffic from moving through the landscaped area and harming or impacting plant materials. Curbing landscape planters provides a strong edge for the planter, improves soil and mulch containment, and discourages pedestrians from cutting through the planting beds. Raised planter designs provide an opportunity to incorporate informal seating areas into the streetscape design.

The use and abundance of landscape planters within the Amenity Zone must be carefully considered alongside other competing uses.

USE & APPLICATION

Location

- Landscape planters are well suited to the downtown environment and are recommended on all types streets. Near neighborhood streets often utilize lawn extensions as an alternative to landscape planters, as they may better fit a residential character.
- Landscape planters occur primarily within the Amenity Zone between the sidewalk and the curb.
- Where buildings are setback from the sidewalk, landscape planters are also appropriate in the Frontage Zone, and can be incorporated into building facades.

Related Design Elements

- **Amenity Zone Uses**: Locate landscape planters in coordination with street lighting, signs, parking meters, and other elements within the Amenity Zone that may need to be present. In destination commercial areas, café dining, outdoor retailing, and other uses in the Amenity Zone competes for space with landscape planters. Street design in these areas should accommodate both elements by utilizing planters that support commercial activity, such as raised seatwall planters.
- **Public Seating**: Incorporate landscape planters within seat-walls. Seat-walls are especially beneficial at intersections and when used in conjunction with bulb outs at the corner or in a mid-block location to provide a seating zone close to intersections.

DESIGN & OPERATIONS

Design Requirements

- **Planter Type**: Design landscape planters as either a curbed planting bed, a raised planter, or a hybrid design.

  A **Curbed Landscape Planters:** For a curbed planting bed, edge the planter box with a 6 inch to 10 inch wide and 4 inch to 6 inch high concrete curb with chamfered edges following the grade of the Sidewalk and Amenity Zone.

  B **Raised Landscape Planters:** For a raised planter, surround the planter box by a 12 inch to 16 inch wide and 15 inch to 22 inch (18 inches preferred) tall concrete seat-wall with chamfered edges. Design seat-walls to provide a level surface for seating.

  » **Hybrid Landscape Planters**: Design hybrid planters as a curbed planter except with one, two, or three sides of the landscape planter designed with seat-walls.

C **Width**: The width of landscape planters must provide at least a 2-foot 6 inch wide zone for soil and plantings, not accounting for the width of curbing or seat-walls.

  » Street trees require a minimum soil area width of 4 feet. Refer to the Street Tree design element for additional information.

D **Curb Strip**: Provide a minimum 18" wide offset from the back of the existing street curb to the face of a landscape planter to provide adequate clearance from the roadway. This paved zone provides a place for people to walk around the planter to access on-street parking and/or provide clearance for vehicles to pull against the curb.

  » Where space is limited, the surface of the planter and associated curbs may be tapered down to a flush level to match the existing road curb height.

- **Planting Mulch**: Provide a minimum a 1 inch thick mulch surface for all exposed planting soils.

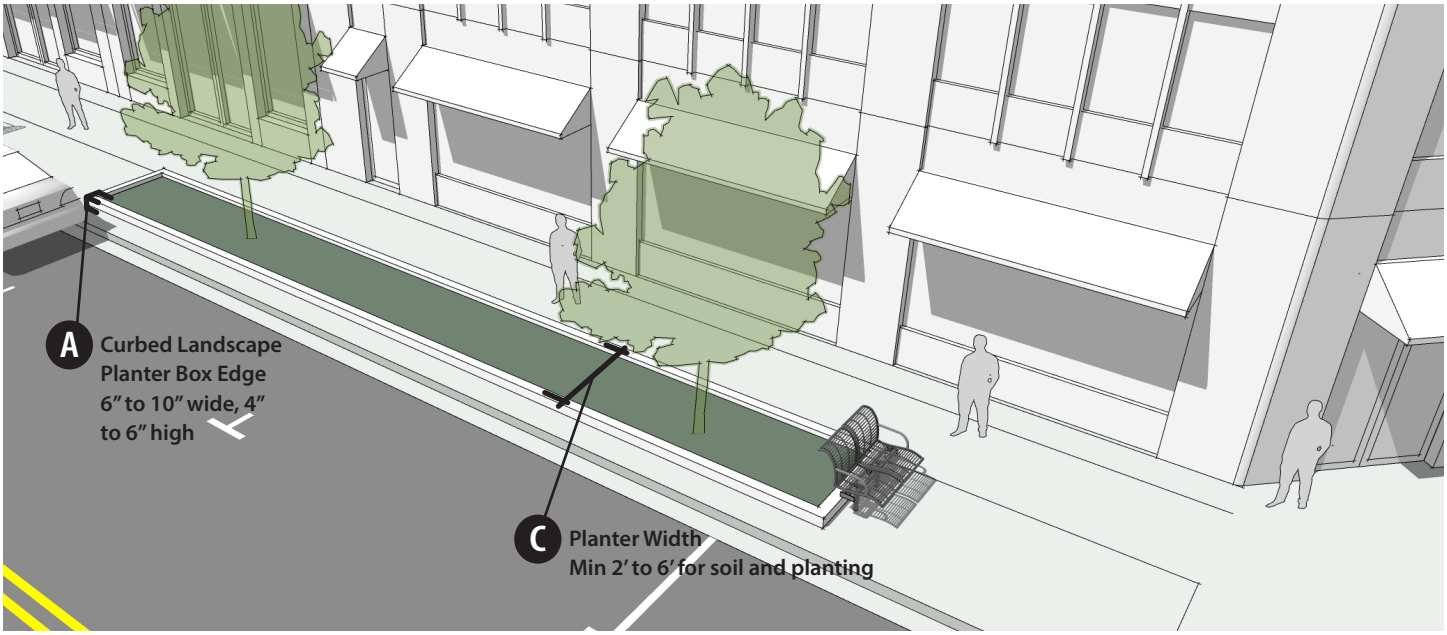
  » Keep mulch surfaces for planting between 2 inches and 6 inches below the edge of and curbs or seat-walls to prevent mulches from spilling outside of the landscape planter.

- **Plantings**: Planters use a combination of herbaceous plants and street trees.

  » Select perennial species suited to specific site conditions, including sun/shade, water availability, and salt tolerance for plantings within landscape planters.

  » Suitable herbaceous annuals may be planted by private entities but only with a maintenance agreement and approval of the Urban Forestry and Natural Resources Coordinator.

Figure 4.6.4- Landscape Planter



» Street Trees are required on all streets and can be incorporated into landscape planters. Refer to the Street Tree design element for more information.

Additional Design Considerations

- **Seat-walls**: Raised landscape planters with seat-walls, if space is available, should be setback at least 1' from the through sidewalk areas so that people sitting on the seat-wall minimize impacts to the flow of pedestrian traffic.
- **Special Character Districts**: In historic or other character districts, the concert curb or seat-wall design may use other materials appropriate to that character areas. In all cases, use materials that are ridged, mortared together, and set in a concrete base to create a solid curb or seat-wall unit.
- **Street Trees**: Consider locating street trees in landscape planters. *See Street Tree Design Element Section for Additional Detail.*

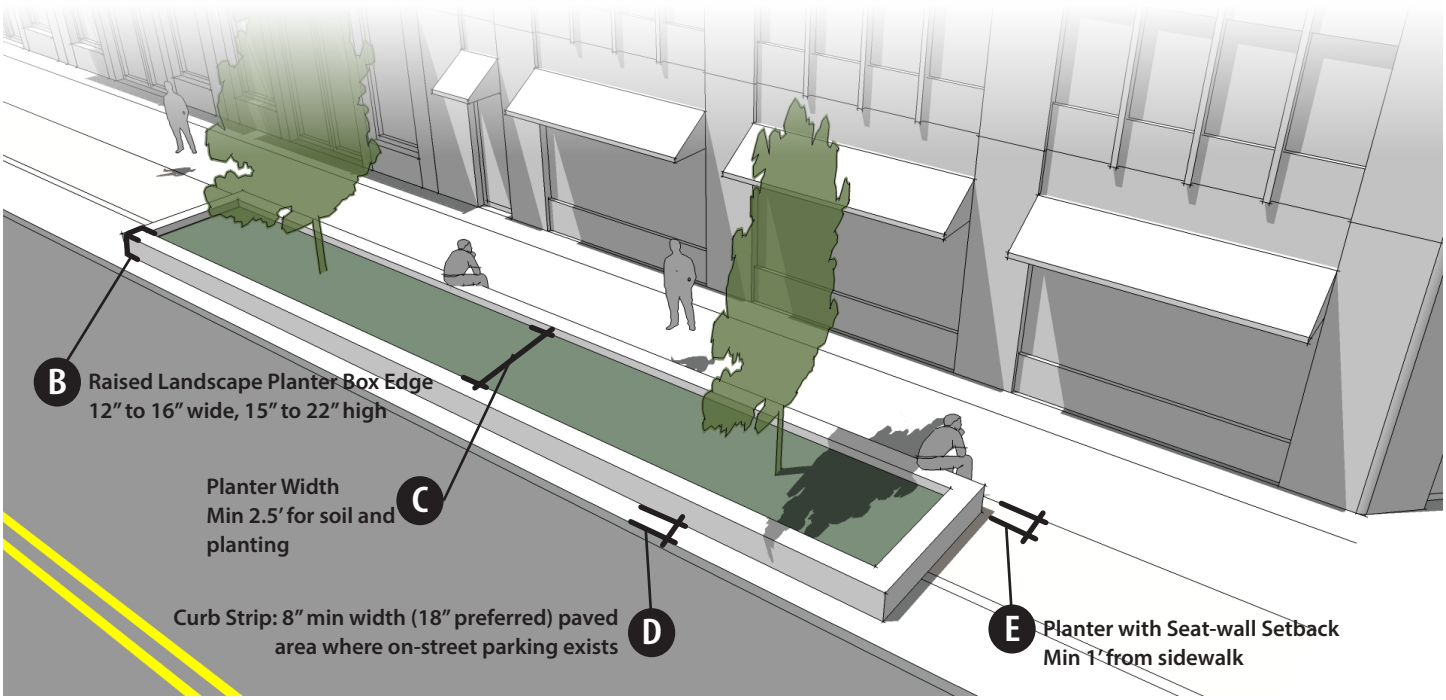
Utility Considerations

- Landscape planters should not be located in areas where utility access panels, vaults, or other regular utility maintenance and access occurs.
- Street lights may be set within curbed landscape planters when the width of the landscape planter is at least three times the needed width of the street light base and footing to still provide sufficient soil volume and planter width.

Sustainability Considerations

- Consider drought tolerant plant materials that do not require extensive watering outside of their establishment period (typically two years).
- Design landscape planters into stormwater infiltration planters. Lower the soil surface elevation to below the sidewalk and/or street grade and provide a break in the curb or seat-wall with an inlet structure to divert stormwater into the planter. Design the planter to handle anticipated rainfall and water quantity volumes. *See Stormwater Management Design Element Section for Additional Guidance.*

Figure 4.6.5- Raised Landscape Planter



MAINTENANCE & MANAGEMENT

General Maintenance

- **Plant Care**: Plant materials shall be maintained in accordance with a maintenance agreement established as part of the planter design and construction process. As with lawn extensions, plantings in adjacent landscape planters (except for street trees) should be maintained and cared for by the adjacent property owner.
  - » Maintaining at least a 1 inch mulch cover over the landscape planter.
  - » Weeding, removing litter, and maintaining plants (deadheading, cutting, et.)
  - » Clearing, sweeping, and removing mulch and other materials that spill outside of the landscape planter.
  - » Regular watering, especially during dry periods.
- **Establishment Period**: Following new landscape planter construction, water new plant materials regularly during the growing season for the first two-years during plant establishment.

Reviews & Approvals

- For private projects, the Ann Arbor Urban Forestry & Natural Resources Planning Coordinator is responsible for reviewing and approving plant materials used in landscape planters.
- For public projects, the Ann Arbor Urban Forestry & Natural Resources Planning Coordinator and the Street Design Team are responsible for reviewing and approving landscape planter designs and plant materials.



LAWN EXTENSIONS

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✗	✗			
Transit		✗	✗	✗	
Bicycle		✗	✗		✓
Balanced		✗	✗	✗	✓

DESCRIPTION & INTENT

Lawn extensions are panels of grass lawn in the Amenity Zone between the sidewalk and street curb. Lawn extensions are characteristic of detached housing residential areas where pedestrian volumes are general low and a desire for more greenery to soften the street edge experience exist. Lawn extensions are not generally suited to highly urban environments, such as Ann Arbor's downtown, since heavy pedestrian traffic can quickly wear down and erode lawn surfaces. In addition, lawn extensions require regular maintenance (watering, mowing, weed control) that is more suited for private residential landowners to maintain. Nevertheless, in many downtown locations lawn extensions are a viable street design element.

USE & APPLICATION

Location

- Lawn extensions are restricted in all areas of downtown outside of a Near Neighborhood Frontage Context areas.
- In Near Neighborhood locations, lawn extensions shall only be used in situations where the fronting property owners or occupants acknowledge responsibility for proper care and maintenance.
- In addition, lawn extensions should be a minimum of 3 feet wide in order to provide sufficient room for lawn to establish. Narrower lawn extensions are more susceptible to erosion and wear and should use a hard surface treatment instead (i.e. concrete or pavers).
- Lawn extensions should occur along the majority of the block side where they are being used to provide a cleaner and more consistent look for that portion of the street.

DESIGN & OPERATIONS

Design Requirements

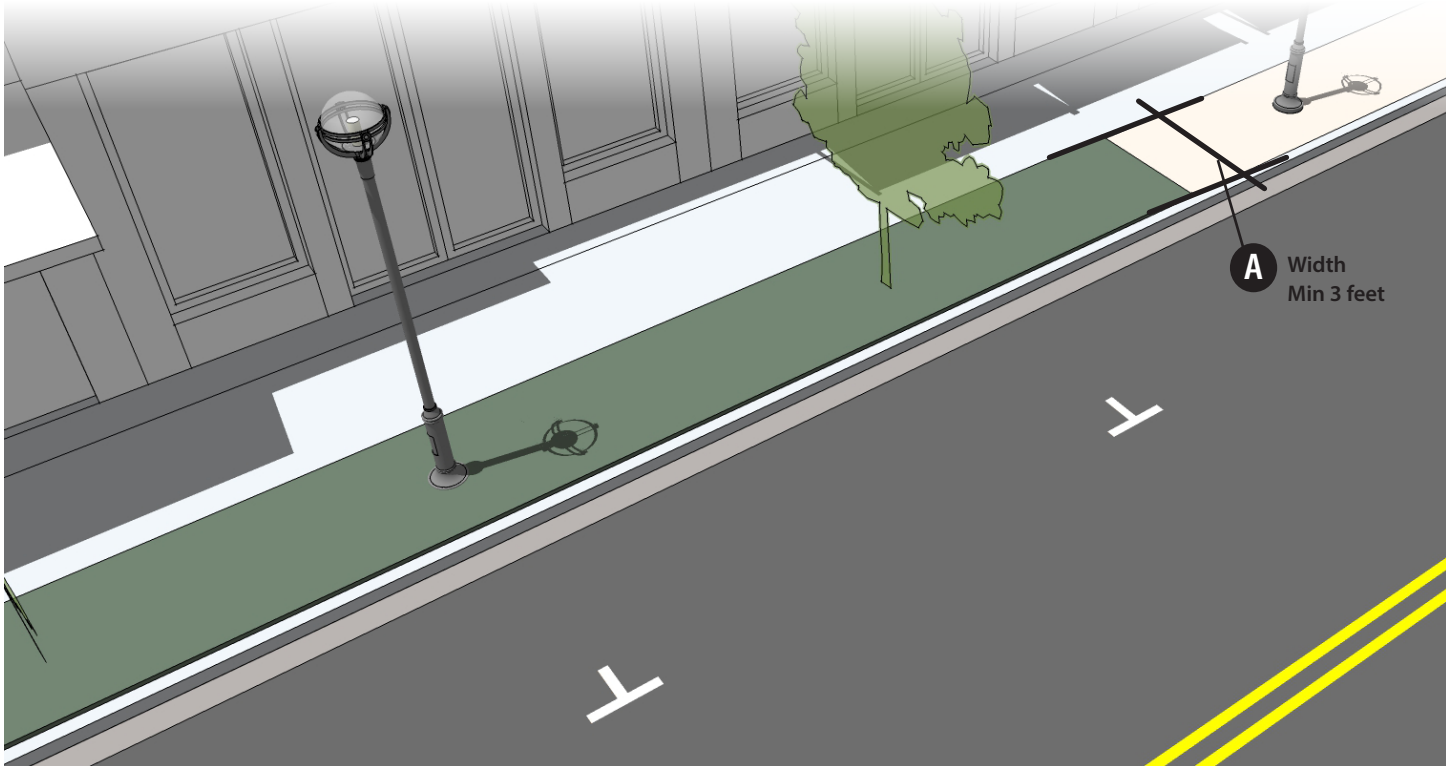
A **Width**: Lawn extensions shall be a minimum width of 3 feet between the back of the street curb and edge of the sidewalk.

- **Lawn Seeding**: Lawn areas shall be seeded or sodded with a species mix suitable for Ann Arbor's climate region and consistent with the sun/shade availability of the specific planting site.
  - » When installing lawn extensions with seeding, a straw cover shall be used to minimize soil runoff and pedestrian traffic.
- **Soil**: Lawn areas shall contain at least 4 inches of topsoil and the topsoil or soil surface for sod applications must be flush to the edge of the sidewalk and back of curb. Lawn extensions shall be smooth and not result in water pooling or ponding on their surface or on the surface of adjacent sidewalk areas.

Additional Design Considerations

- **Plantings**: Lawn extensions may be planted with perennials beds or ground covers in addition to or complimenting lawn areas. These plantings shall not be in excess of 36 inches above the adjacent road surface, or as permitted by Ann Arbor City Code. Shrubs or other low woody plants may not be used.
  - » Where perennials and ground covers are used, periodic clear zones or pathways connecting from the street edge to the sidewalk are important where on-street parking occurs to minimize foot traffic impacts on ornamental plantings. Gaps should be provided at least every 40 feet.
  - » Where perennials and ground covers are used, at least 1 inch of mulch should be applied to cover and protect exposed soil areas. Stone, cobble, pea gravels, and other hard mulches should not be used as mulching materials.
- **Street Trees:**: Larger lawn extensions are ideal locations for planting street trees. Street trees are required on all streets. *See Street Tree Design Element for more Information on Street Tree Plantings*.

Figure 4.6.6- Lawn Extensions



Utility Considerations

- Lawn extensions may be located on top of most utilities. Identify and avoid placing soil and lawn planting on top of water valves or other utility access panels that may be found in the utility zone.

Sustainability Considerations

- Pursue use of “no mow” plant species as an alternative to traditional lawn turf species can be pursued. Such alternatives should be selected based on their ability to withstand foot traffic when used as a lawn substitute.
- Use xeriscaping and other low water need plants to conserve water compared to typical lawn plantings.
- Avoid the use of synthetic fertilizers and herbicides to avoid impact on water quality and pollutant exposure to people touching lawn areas. City Code prohibits the use of phosphorous fertilizers.

MAINTENANCE & MANAGEMENT

General Maintenance

- **Plant Care**: Lawn extensions and any plantings within that zone must be maintained by the fronting property owners. Regular maintenance includes mowing to maintain lawn areas , watering, weeding, and maintaining mulch.
  - » Lawn extensions covered in turf grass must be maintained with an average height not in excess of 12 inches.
- **Street Trees:** Street trees are maintained by Public Works.

Reviews & Approvals

- Installation of lawn extensions in areas that were not previously lawn extensions is discouraged unless part of a comprehensive street reconstruction or design process. Outside of this context, lawn extensions for public and private projects can only be created with approval of the DDA, Street Design Team, and the Ann Arbor Urban Forestry & Natural Resources Planning Coordinator.









Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	✓	✓			
Transit		✓	✓	✓	
Bicycle		✓	✓		✓
Balanced		✓	✓	✓	✓

STORMWATER MANAGEMENT

DESCRIPTION & INTENT

Managing stormwater in the urban environment is critical for protecting water quality and reducing the volume of stormwater entering rivers and other water bodies. In Ann Arbor, managing stormwater within the right-of-way is guided by the City's Municipal Separate Storm Sewer System (MS4) Permit and the City's Green Streets Policy ("Stormwater Management Guidelines for Public Street Construction and Reconstruction").

Stormwater management techniques, often referred to as Green Infrastructure, include many different types of facilities designed to infiltrate, store, and filter runoff. Within the downtown environment, a variety of stormwater management techniques may be applied in order to achieve the management targets identified in the Green Streets Policy. Typically, these techniques will include infiltration planters and underground infiltration and/or storage systems.

USE & APPLICATION

Location

- All public street construction and re-construction projects are subject to the Green Streets Policy, with maintenance and street resurfacing projects exempt from the Green Streets Policy. Regardless, any projects which impact a significant portion of the street environment should still consider stormwater management improvements.

- The Green Street Policy establishes specific infiltration management goals:

Site Conditions	Infiltration Standard management goal)
• Within the floodplain, or • Slopes > 20%, or • Soil infiltration < 0.6in/hr	First 1 inch
• Not in the floodplain, and • Slopes < 20%, and • Soil infiltration rate between 0.6in/hr and 2.0 in/hr	50% annual change, 24 hour event (2.35 inches)
• Not in the floodplain, and • Slopes < 20%, and • Soil infiltration rate >2.0in/hr	10% annual chance, 24 hour event (3.26 inches)

- Stormwater management facilities in the right-of-way can use a variety of Stormwater Best Management Practices (BMP) to reach the management goals. The Southeast Michigan Council of Governments (SEMCOG) "Low Impact Development Manual for Michigan" identifies a number of structural BMPs to consider within urban environments.

Stormwater BMP	Typical Location	Example
Infiltration Planters	Amenity Zone, Curbside Zone	Bioswales, rain gardens, bioretention
Subsurface Infiltration	Underground: Amenity/ Curbside Zones, Roadway Zone	Infiltration or storage vaults, infiltration trenches

- Multiple stormwater BMPs can be used in an integrated system to accomplish the management goals. Any proposed BMP must be approved by the City to ensure sustained maintenance.

- Private development projects that impact the street right-of-way or require reconstruction of portions of the public right-of-way are subject the Green Streets Policy for those right-of-way areas at the discretion of the Ann Arbor Water Quality Manager.
- Coordinating private development projects and public street projects should be explored to provide as much stormwater management as possible. Managing additional stormwater runoff from private property, such as buildings or parking lots, with BMPs located within the public right-of-way may be allowed provided that the minimum management targets for private and public land areas are both met appropriately.

DESIGN & OPERATIONS

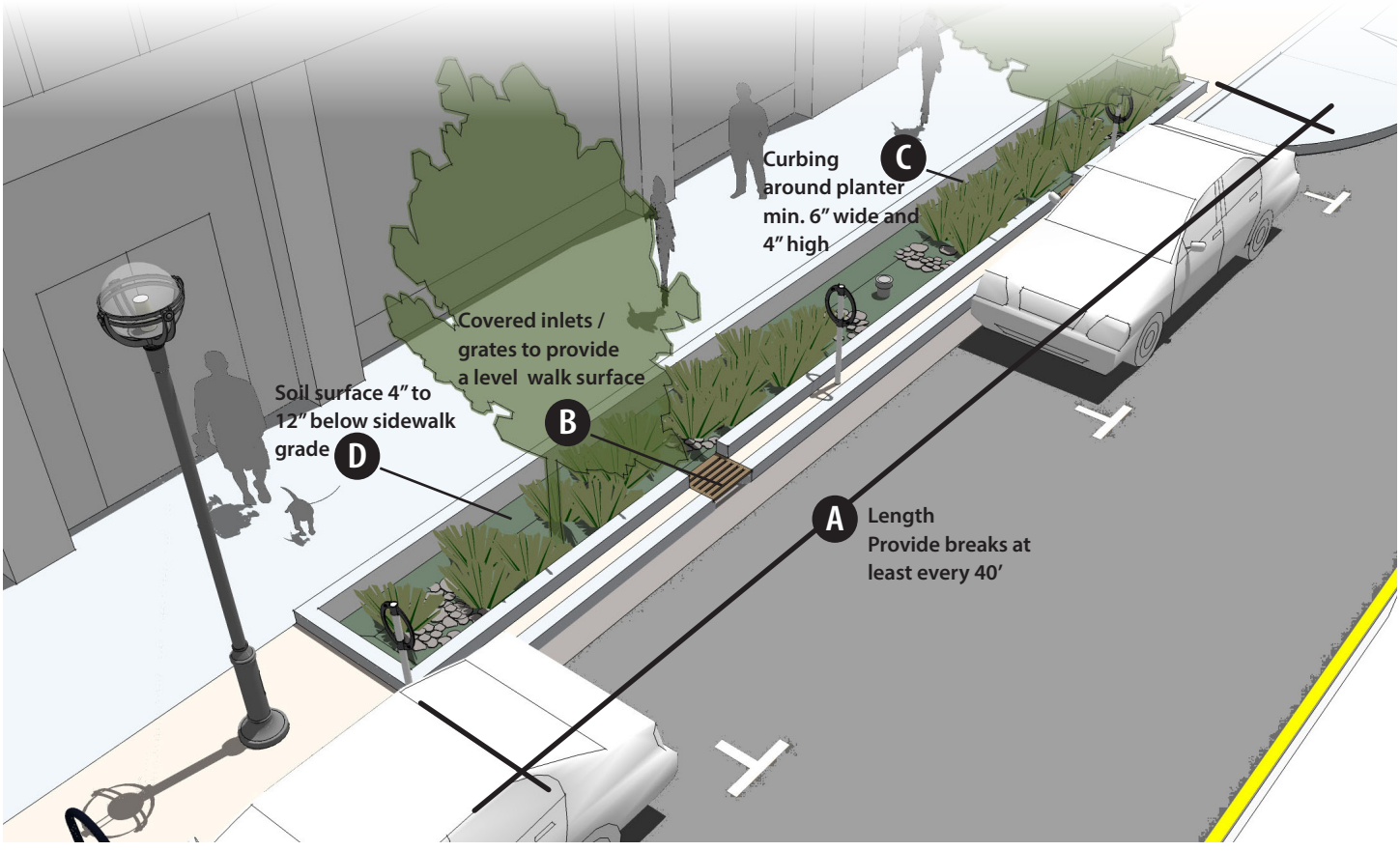
Design Requirements – Infiltration Planters

Infiltration planters are open landscaped areas typically in the Amenity Zone of the street. They may also be located in other zones depending on the overall design of the street. Infiltration planters are designed to capture runoff from the roadway and other impervious areas of the street. Captured water is filtered through plants and soil and infiltrated completely through the planter or into an overflow under-drain and can be treated in a secondary stormwater system.

- **Management Volume**: Infiltration Planters shall be designed, in conjunction with other stormwater systems to infiltrate the required stormwater quantities per the Green Streets Policy.

A **Length**: Stormwater planters may line the entire street length, however where on-street parking is provided, breaks shall be provided at least every 40 feet (approximately two car lengths) to allow access from parked cars to the sidewalk.

Figure 4.6.7- Stormwater Management



B **Inlets**: When water runoff is captured from the street, it must be brought into the infiltration planter through a covered flow inlet structure that does not break the top surface of the curb or walkable pavement surfaces.

C **Curbing**: Infiltration planters must be curbed with a minimum of 6 inches wide and 4 inches high curb when adjacent to Sidewalk and Amenity Zone areas. When adjacent to the road curb, this additional curbing is not required along that side of the infiltration planter.

D **Soil Surface**: The finished soil height must be recessed at least 4 inches but not more than 12 inches below the grade of the surrounding Sidewalk and Amenity Zone areas.

- **Soil Mix**: Soil mix must be specified to infiltrate stormwater and have sufficient depth to store and infiltrate the targeted water volume.
- **Drainage**: Infiltration planters must include a positive overflow drain to divert water accumulation in excess of the infiltration rate of the planter to another treatment system such that areas adjacent to the landscape planter do not get flooded or eroded.
    - » For infiltration planters unable to drain collected water within 12 hours of the end of rain event, under-drains must be provided to drain excess water into the storm sewers.
- **Plant Materials**: Plant materials must be tolerant of salt and other common runoff pollutants.

Design Requirements – Subsurface Infiltration

Subsurface infiltration can take a number of forms, including underground infiltration vaults, infiltration trenches, and dry wells. These systems can be used to provide stormwater infiltration and constrained urban areas with limited surface area available for landscape planters and/or in conjunction with surface treatments to add additional storage and infiltration capacity.

- **Management Volume**: Subsurface infiltration systems must be designed, in conjunction with other stormwater systems to infiltrate the required stormwater quantities per the Green Streets Policy.
- **Load Bearing**: Subsurface infiltration system must be designed to accommodate the load bearing requirements of the roadway or other accessible surfaces above the infiltration system.
- **Conveyance**: Water shall be conveyed to the subsurface infiltration systems through piping and conventional curb and gutters and/or through a grated inlet channel system.
- **Pre-treatment**: Water being conveyed into a subsurface infiltration system shall be pre-treated through a sump, stormwater flow-through planter, or comparable facility to remove large debris and materials.

Design Requirements – Porous Pavers

Porous pavers may be utilized within the amenity zone and/or the curbside lane of the roadway as part of the overall stormwater management system. Porous pavers provide opportunities for infiltration and filtration before water enters the stormwater management system.

- **Load Bearing:** Porous pavers and the constructed base materials shall meet the load bearing specifications consistent with the areas where they are to be applied (i.e. vehicle loads within the curbside lane and pedestrian / light vehicle loads in the amenity zone.
- **Base material** should facilitate infiltration. Under drainage should be provided to supplement storage and conveyance of stormwater.
- **Proximity to Basements / Vaults:** Porous pavements installations must be mindful of the proximity to building basements and/or underground building vaults. Infiltration in close proximity to basements and vaults can cause seepage.
- **Maintenance needs** of porous paver installations should be reviewed and approved by the DDA and Public Works.

Additional Design Considerations

- Locate pre-treatment material, such as cobble and stone, to capture debris just inside the inlet point and provide easily access to clean out.
- Incorporate appropriate trees into the infiltration planter to enhance the stormwater benefits. Trees must be approved by the Ann Arbor Water Quality Manager.
- Incorporate stormwater planters with traditional landscape planters, and integrate seat-walls and other vegetation into the design.
- Consider locating special signage along the street at key locations to tell people there is an underground stormwater management facility present and educate them about their operation and benefits.

Utility Considerations

- Consider the location and condition of existing utility infrastructure and access points.
- Ensure overflows into existing stormwater pipe infrastructure do not result in additional flooding or bottlenecking.
- Install water proof vault covers or other utility access points if located within an infiltration planter.

Design References

- SEMCOG Low Impact Development Manual for Michigan (2008)
  - » See: Planter Boxes, Native Vegetation, Constructed Filters, and Bioretention sections for more specific design guidance.
  - » See: Infiltration Practices, Constructed Filters

Reviews & Approvals

- Ann Arbor Water Quality Manager.
- Site Plan Review for private projects.
- Ann Arbor Engineering Unit.

MAINTENANCE & MANAGEMENT

General Maintenance

- Regularly (quarterly, at a minimum) remove excess sediment, litter, and debris, particularly within any pre-treatment facilities, to maintain a clean appearance and preserve effective functioning.
- Quarterly Inspection of inlets, sumps and outlet points to ensure there are no blockages or impediments to designed water flows (including sediment buildup and excess debris).
- Sumps or pre-treatment areas should be cleaned out at least once per year unless excess debris and sediment build up occurs requiring more frequent service.
- Regular landscape maintenance, such as deadheading, weeding, and leaf removal is important to maintaining the health and attractiveness of infiltration planters.

Seasonal Use & Maintenance

- **Winter Conditions:** Inspect inlet and outlet points more frequently in winter to ensure they are clear of excess snow and ice and remain open, particularly positive overflow drains.



SITE UTILITIES

Functional Emphasis \ Frontage Context	Des. Comm.	Comm.	Mixed	Civic & Uni.	Near NBH
Pedestrian	■	■			
Transit		■	■	■	
Bicycle		■	■		■
Balanced		■	■	■	■

DESCRIPTION & INTENT

The public right-of-way is home to the utilities that serve the buildings and uses of downtown, and their presence is typically unremarkable to the average downtown visitor. The location and design of public utilities in the streets of downtown is regulated through the City of Ann Arbor Public Services Standard Specifications. The intent of this section is to supplement the Orange Book standards and provide guidance for locating private and public utility services, particularly as they relate to the pedestrian environment.

USE & APPLICATION

Location

Almost all public streets projects impact utilities mains and services in some way. A few examples include:

- Sidewalk reconstruction and streetscape improvements which impact utility service lines, hand holes and valves, and catch basin inlets.
- Utility main replacement and subsequent service line adjustments.
- Utility repairs to mains and service lines.
- Street resurfacing, which may impact manholes and catch basin inlets.

Private Development

Private development projects that impact the street right-of-way or require reconstruction of portions of the public right-of-way will typically impact public and private utilities in the following ways:

- Installation of new water and sanitary service leads from existing mains.
- Connection to the stormwater system.
- Replacement or upsizing utility mains to provide for the new development's needs. When replacement or upsizing is required to address new use patterns, mains must be replaced or upsized across the full property frontage.
- Streetscape reconstruction, which may include new lighting.
- Electrical and communication service connections.

DESIGN & OPERATIONS

Design Requirements – Manhole, Valves, and Hand Holes

Access to utility service junctions through manholes, hand holes and water service valves are critical to the maintenance, emergency management, and safety of the utility systems. The cover of these access points are typically flush with adjacent pavement.

- Hand holes are used for electrical and communications cable junctions and have specific design requirements. Constructed hand holes should be polymer concrete rated for light duty traffic.
- Size hand holes to be as small as necessary for the number of wires passing through and junctions being made.
- Locate hand holes as follows:
  - » Conduits should be located at least 12 inches from the planting soils of the beds and trees. Where handholes and lights are located in landscape planters, care should be taken to limit the area of the planter impacted, and in any case conduits should not be located within 48 inches from the center of any proposed tree.
  - » In streets with tree grates or walk openings for trees, the conduit should be located 12 inches beyond the limits of the urban street tree soil treatment or the edge of the tree grate or sidewalk opening.
  - » Avoid placing hand holes on barrier-free ramps or at grade breaks in the sidewalks, as the long rectangular shape of most hand holes makes it difficult to pour the concrete in these situations without grade issues.
  - » Place the top of the conduits at least 30 inches below the proposed sidewalk grade, 72 inches below the grade of the tree planting area, or as directed by the City and DDA.
- Where electrical junctions occur in vehicular traffic areas use precast concrete structures and cast iron frames and lids designed to carry heavy traffic loads, in lieu of hand holes.
- Locate manholes and water main valves within vehicular travel lanes, where new main construction allows.

Design Requirements – Storm Inlets

The placement of stormwater inlets/catch basins at crosswalks and intersections is important for efficient storm drainage as well as providing an accessible street environment. Of particular concern is ensuring universal access, avoiding the puddling of water at the base of curb ramps and on sidewalks during the snow season, and providing for maintenance of the drains, inlets, and catch basins.

- Place Inlets/catch basins at the point of curvature (spring point) of each intersection, thus requiring two inlets/catch basins for each corner.
- Adjust the location of inlets/catch basins so that they are:
  - » Not within the travel lane of curb ramps.
  - » Placed on the higher elevation side and directly adjacent to curb ramps so that ice and snow are less likely to block drainage to the inlets and to catch water before crossing a curb ramp.
- Locate inlets/catch basins directly adjacent to mid-block crossing curb ramps on the higher elevation side of the curb line from the curb ramp.
- If inlets/catch basins must be placed in the travel lane of curb ramps, design the cast grate of the structure to accommodate universal access.
- **Trench Drains**: The use of trench drains is highly discouraged and they should not be used unless there is no adequate storm drainage alternative. While the use of trench drains and sidewalk inlets should be avoided, where they are deemed necessary they should meet the following design requirements:
  - » The accessible body of all trench drains and sidewalk drains must be a minimum of 8 inches wide for maintenance purposes.
  - » Trench drains and sidewalk drains must be rated for light duty traffic. Non-metal drain grates are not allowed.
  - » The grate of the structures must accommodate universal access.

» Lateral pipes draining the trench drains and sidewalk inlets must be a minimum of 8 inches in diameter, and be no longer than 40 feet before tapping into a City standard inlet/catch basin or manhole.

Design Requirements – Fire Hydrants

Providing for fire safety is critical to protecting historic architectural resources and providing for new development and growth. Providing adequate number and spacing of fire hydrants is an important element in ensuring for adequate fire protection. Given that the typical block length on downtown Ann Arbor is less than 300-foot long, hydrant spacing standards are generally met with hydrants located at each intersection; however, downtown corners are often crowded with lights, pedestrian amenities, cross walks, bicycle parking and other elements, which may impede access to the hydrants.

- The City of Ann Arbor Public Services Standard Specifications requires a clear 20-foot access path to each hydrant and no parking within 15 feet of a hydrant when locating behind the curbside lane. The center line of hydrants must be a least 4, but not more than 10, feet back from the curb.
- Each fire hydrant shall have a 3-foot clear zone around it for access. Fire hydrants may not be hidden or covered.
- The typical pattern found in downtown is for two hydrants per intersection, located on opposite corners across the diagonal of the intersection.
- Hydrants located closer to the short end of the range allowed from the curb will allow more flexibility in the design and use of the intersection, and will typically place the hydrants outside of the Sidewalk Zone, and in the Amenity Zone.
- Ann Arbor's Orange Book requires a hydrant within 100 feet of a Fire Department Connection to a commercial building's fire suppression system.

Design Requirements – Above Ground Utility Appurtenances

New building construction and electrical and communications services often require above grade utility boxes, panels and transformers.

While these appurtenances provide for important private utility service, they can hamper the pedestrian use of downtown streets and sidewalks.

- Where such appurtenances are required for a specific private development, they should be located on private property.
- If appurtenances are serving public amenities and/or multiple properties and private buildings, they should still be located on private land, alleys, or parking lots. If this is not technically feasible, as determined by the Ann Arbor Planning and Development staff during the site plan review process, they should be located in the Amenity Zone and out of the primary pedestrian flow.
- Co-locate surface mounted utilities and share boxes or pedestals wherever possible.

Additional Design Considerations

- City of Ann Arbor Public Services Standard Specifications
- City of Ann Arbor Approved Materials List for Utilities and Roadways.
- City of Ann Arbor Code of Ordinances Chapter 47-Streets and Chapter 49-Sidewalks.

Sustainability Considerations

- Coordination of utility main upgrade and the need for street or streetscape reconstruction is itself a technique of sustainability as it minimizes the use (and expenditure for) construction materials and the energy and resources used to install them.
- The City of Ann Arbor currently coordinates the need for utility upgrades with street and streetscape improvements through the Capital Improvement Process and collaboration with the DDA, and this approach should be continued and streamlined as needed.

MAINTENANCE & MANAGEMENT

General Maintenance

- Complete inspection of the condition of hand hole and valve covers annually, particularly after the winter snow removal season, to assess any damage or impact to the walkability of the sidewalk surfaces.

Reviews & Approvals

- Michigan Department of Environmental Quality (MDEQ)
- Site Plan Review for private projects
- Ann Arbor Engineering Unit