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CITY OF MONTICELLO

**Standards for the Design and Construction of Sanitary Sewers,
 Storm Sewers, Water Works Projects and Public Streets and Alleys**
 May 2001 Revised October 2019

A Wealth of Resources to Master a Common Goal.

CITY OF MONTICELLO, INDIANA

STANDARDS FOR THE DESIGN AND CONSTRUCTION OF SANITARY SEWERS, STORM SEWERS, WATER WORKS PROJECTS AND PUBLIC STREETS AND ALLEYS TABLE OF CONTENTS

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SECTION 1

INTRODUCTION

SECTION 1

INTRODUCTION

1.1 General

The instructions and directives included in this manual cover the design and construction of streets, alleys, water facilities and sanitary sewer facilities. The City of Monticello is responsible for these and issues this manual as a guideline. The purpose of these Standards is to establish a minimum criterion for design and workmanship.

All water lines and facilities shall be designed and constructed in full accordance with these Standards, Indiana Department of Environmental Management (IDEM), and Ten States Standards for Water Works, latest edition. The jurisdiction of the Standards includes the entire water distribution system and its appurtenances.

All sanitary sewer collection facilities shall be designed and constructed in full accordance with these Standards, 327 IAC Article 3, Indiana Department of Environmental Management (IDEM), and Ten States Standards for Sewage Works latest edition. The jurisdiction of the Standards includes the entire sanitary system and its appurtenances from the point of connection with the building plumbing to the final point of discharge at the treatment facility.

All storm sewer facilities shall be designed and constructed in full accordance with these Standards. The jurisdiction of the Standards included the entire storm system and its appurtenances.

All streets and alleys shall be designed and constructed in accordance with these Standards as well as applicable State and Federal regulations. The jurisdiction of the Standards is as follows:

All street and alley construction within or abutting City rights-of-way, including pavement, curbs, gutters, sidewalks, and all street appurtenances.

It shall be the Developer's/Contractor's responsibility to comply with all requirements of the City or other authority having jurisdiction on work if such authority imposes greater requirements. Furthermore, the Developer shall be responsible for procuring all necessary permits and licenses, pay all charges and fees for acquiring and recording all easements, and giving all notices necessary and incidental to the work.

Any conflicts between these Standards and any applicable State laws shall be superseded by such law. If any conflict arises between these Standards and applicable City or County Ordinances, the Ordinance shall prevail. These Standards are approved and adopted by the City of Monticello City Council. The City reserves the right to add/modify/revise/delete standards and specifications at any time. Furthermore, Project Specific Specifications for Publicly Bid Projects in conflict with these City Standards shall be brought to the attention of the City Engineer, Public Works Director, or relevant Project Manager. If there are any errors or omissions in the standards, the City has the right to provide clarification/adjustments necessary.

Addenda and/or revisions to these Standards may be issued periodically and will be distributed and made available to the public and developers/contractors at the City Hall. Users shall be responsible to keep apprised of any changes and revisions to these Standards.

SECTION 2

DEFINITIONS AND TERMS

SECTION 2

DEFINITIONS AND TERMS

2.1 Definitions and Terms

Whenever in these Standards or in any documents the following terms, abbreviations, or definitions are used, the intent and meaning shall be interpreted as follows:

A. Abbreviations

ASTM	American Society of Testing and Materials
AASHTO	American Association of State Highway and Transportation Officials
AWWA	American Water Works Association
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ACI	American Concrete Institute
NEMA	National Electrical Manufacturers Association
INDOT	Indiana Department of Transportation
OSHA	Federal Occupational Safety and Health Act

B. Definitions

1. **Acceptance:** The formal written acceptance by the City of an entire project which has been completed in all respects in accordance with the approved Plans, Specifications and these Standards including any previously approved modifications thereof.
2. **Backfill:** Earth and/or other material used to replace material removed from trenches during construction which is above the pipe bedding.
3. **Bedding:** That portion of the trench backfill which encases the water or sewer pipe to a minimum depth above and below the bell/barrel of the pipe, as provided in the **Bedding** section of these Standards, for the purpose of properly supporting the pipe.
4. **Building Service - Water:** The conduit for transporting water from the water main into the building.
5. **Building Sewer (lateral):** The conduit for transporting waste discharged from the building to the public sewer commencing three (3) feet outside the building walls and ending at the exclusive of the wye or tee fitting at the connection to the public sewer.

6. **City:** The City of Monticello, Indiana and their representatives.
7. **City Engineer:** Authorized Agent by the City of Monticello.
8. **Contractor:** Any Contractor who meets the City requirements and is licensed to enter into contracts for and to perform the work.
9. **County:** The county of White, State of Indiana.
10. **City Representative:** The authorized agent of the City of Monticello assigned to make detailed observation of any or all portions of the work.
11. **Developer:** Any individual, partnership, firm, corporation or other entity who, as property owner or representatives of property owner, is initiating the work.
12. **Director:** Director of the Planning Department or his/her authorized representative.
13. **Easement:** Easements are areas along the line of all water or sewer lines which are outside of dedicated easements or rights-of-way and are recorded and dedicated to the City granting rights along the water or sewer line. Easements shall be exclusively for water and/or sewer lines and no private utilities shall be constructed or encroach upon the easement except with the expressed written approval of the City.
14. **Engineer:** The Engineer for the Developer/Contractor.
15. **Infiltration/Inflow:** The total quantity of water from both infiltration and inflow in a sanitary sewer line without distinguishing the source.
16. **Inspector:** A direct or indirect employee of the City assigned to make detailed inspection of any or all portions of the work and materials. The inspector has full authority to reject materials and/or any portion of the work not supplied and installed in accordance with these Standards.
17. **Lift Station:** Any arrangement of pumps, valves and controls that lift and/or convey wastewater to a higher elevation.
18. **Other Specifications and Materials:** Wherever in these Standards other specifications or regulations are mentioned; it shall be understood that the materials and methods mentioned therewith shall conform to all requirements of the latest revision of the specifications so mentioned.
19. **Permits:** Clearance to perform specific work under specific conditions at specific locations. The Developer or his duly authorized representative shall furnish to the City all necessary plans and documents required by the City to make application for permits.

20. **Plans:** Construction plans, including system maps, water main plans and profiles, cross sections, utility plans, detailed drawings, etc., or reproductions thereof, approved or to be approved by the City and/or City Engineer which show location, character, dimensions and details of the work to be done.
21. **Record Drawing (As-Built):** Plans certified, signed and dated by a professional engineer registered in the State of Indiana, indicating that the Plans have been reviewed and revised, if necessary, to accurately show all as-built construction and installation details including, but not limited to, key elevations, locations and distances.
22. **Right-of-Way:** All land or interest therein which by deed, conveyance, agreement, easement, dedication or process of law is reserved for or dedicated to the use of the general public, within which the City shall have the right to install and maintain water mains and appurtenances.
23. **Sewer:** A pipe or conduit for carrying wastewater (sanitary sewer).
24. **Standard Drawings:** The drawings of structures, pipes, components, details or devices commonly used and referred to on the Plans and in these Standards.
25. **Standards:** The Standards Specifications design and construction of public streets and alleys, water facilities and sanitary sewer facilities within the City of Monticello as contained herein and all subsequent additions, deletions or revisions.
26. **Ten State Standards:** Recommended Standards for Water Works, latest edition, developed by the Committee of the Great Lakes - Upper Mississippi River Board of State Public Health and Environmental Managers.
27. **Uniform Plumbing Code:** The Uniform Plumbing Code adopted by the International Association of Plumbing and Mechanical Officials, current edition.
28. **Work:** All the work to be done under City's permit, in accordance with the approved Plans, Specifications, these Standards and permit conditions.

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SECTION 3

GENERAL RULES AND REQUIREMENTS

SECTION 3

GENERAL RULES AND REQUIREMENTS

3.1 General

This Section provides the general rules and policies for the design and construction of sanitary sewer systems, water works projects, storm sewers and drainage, and public streets and alleys, including permit requirements and inspection.

3.2 Sanitary Sewer Connections (laterals)

The following paragraphs provide a highlight of the provisions contained in the applicable Ordinances. If any conflicts between these Standards and the Ordinances shall be superseded by the Ordinances.

A. Sewer Connection Permit

The City requires connection permits to be issued by the City for all repairs and modifications to or connection of a building sewer to a public sewer.

B. Permit Fee

A fee per each connection to the sanitary sewer shall be charged for each new connection. Repairs of an existing service shall require a permit that will not be subject to any fee. However, modifications to an existing service shall require a permit and will be subject to a permit fee.

This fee shall cover the costs of mandatory inspection and any reinspection that may be necessary because of remedial construction, not including the contractor costs for CCTV. The City Council shall determine and may revise the amount of such connection fees.

These fees shall be additive if more than one water meter is provided.

C. Application for Connection Permit

An application for a Connection Permit shall be made on the Form provided by the City and available at the City Hall.

D. Prohibition Against Clean Water Discharges

No person shall discharge or cause to be discharged to any sanitary sewers either directly or indirectly:

- Storm Water
- Surface Water
- Ground Water
- Roof Runoff
- Subsurface Drainage (gravity or pumped)

- Cooling Water
- Unpolluted Water
- Unpolluted Industrial Process Water

E. Mandatory Inspection of Building Connections

It shall be the responsibility of the Holder of a Connection Permit to notify the City that the sewer work is available for inspection. The City will conduct inspections on connections from 8:00 AM to 3:00 PM Monday through Friday except on observed City holidays. The building sewer shall be fully exposed from the foundation to the point of connection with the public sewer.

The City shall take a minimum of two (2) construction "as-built" photos for City record prior to backfilling.

The City and its authorized representative shall have the right of entry upon or through any premises for purpose of inspection of sewer work and any other construction activity performed on or associated with the connection of the building sewer to the City sewer, including inspection for clear water discharges into the sewer.

F. Building Sewer Responsibility

It shall be the responsibility of the property owner(s) whose property is benefitted to provide for, install and make private connections for the use of their premises to an existing public or building sewer. Further, it shall be the responsibility of the property owner to make all necessary repairs, extensions, relocations, changes or replacements thereof, and of any accessories thereto. These requirements may be altered, modified or waived at the discretion of the City when it is shown that compliance is not possible due to extenuating circumstances.

Installation and maintenance of building laterals is the property owner's responsibility from the building/house to the main line. Private sump pumps shall be required when gravity connections are not possible and are to be owned, operated, and maintained by the property owner. Force mains are required to discharge to the nearest sanitary manhole.

3.3 Water Service Connections

The following paragraphs provide a highlight of the provisions contained in the applicable Ordinances. If any conflicts between these Standards and the Ordinances shall be superseded by the Ordinances.

A. Application for Connection Permit

An application for a Connection Permit shall be made on the Form provided by the City and available at the City Hall.

B. Mandatory Inspection of Building Connections

It shall be the responsibility of the Holder of a Connection Permit to notify the City that the water service is available for inspection. The City will conduct inspections on connections from 8:00 AM to 3:00 PM Monday through Friday except on observed City holidays. The building service line shall be fully exposed from the foundation to the point of connection with the water main.

The City shall take a minimum of two (2) construction "as-built" photos for City record prior to backfilling.

The City and its authorized representative shall have the right of entry upon or through any premises for purpose of inspection of water line work and any other construction activity performed on or associated with the connection of the building service line to the City water distribution system.

C. Building Service Line Responsibility

It shall be the responsibility of the property owner(s) whose property is benefitted to provide for, install and make private connections for the use of their premises to an existing public or building service lateral. Further, it shall be the responsibility of the property owner/developer to make all necessary repairs, extensions, relocations, changes or replacements thereof, and of any accessories thereto. These requirements may be altered, modified or waived at the discretion of the City when it is shown that compliance is not possible due to extenuating circumstances.

3.4 Design/Construction Approval for Development

A. Requirements for Construction Permits

It shall be the responsibility of the Developer/Contractor to obtain a valid Construction Permit for the construction of new projects (or the modification of existing infrastructure) from INDOT, IDEM or any other applicable regulatory agency.

A copy of this permit shall be filed with the City.

B. Technical Review

The Developer/Contractor shall submit design drawings for review and approval of the City. During this review the City Engineer and/or the City, or the authorized agent of the City, may recommend approval of the project or request formal revisions. Revised drawings and specifications shall be resubmitted to the City Engineer and/or the City, or the authorized agent of the City, for final approval.

For drainage plans approval for properties within the corporate boundary plans need to be formally submitted to the County Surveyor's Office. The County Surveyor will then submit those plans to the City Engineer for City review. The

process can be expedited by submitting two sets of plans (one directly to the County Surveyor and one copy directly to the City Engineer). To process a full set of plans including drainage and civil plans indicating existing conditions and proposed modifications to structures, utilities, grade, impervious/pervious surfaces (parking areas, roof lines, building footprint(s), etc.), sidewalks, general site modifications.

Building plans for properties within the Corporate Boundary need to be formally submitted directly to the County Area Plan Department and they will make the City aware of any significant items such as change of use.

C. Final Plan Approval

The City Engineer and City shall issue final approval for all projects.

D. Posting of Bond

1. The City and City Engineer may, as a prerequisite to the issuance of project approval, require the posting of a performance bond from a company licensed by the State of Indiana to provide such surety. Such bond shall be equal to one hundred (100) percent of the contract amount or an amount established by the City to provide surety for the satisfactory completion of the improvements required by the Construction Permit and shall name the City of Monticello who can enforce the obligations thereunder.
2. The City and City Engineer may as a prerequisite to acceptance of a project governed by these standards require the posting of a maintenance bond in an amount not to exceed twenty-five (25) percent of the contract amount or, subject to the approval by the City or City Engineer, provision for maintenance, for a period of time as specified herein. Said time period shall begin with the date of acceptance by the City. Said bond shall name the City of Monticello who can enforce the obligations thereunder.
3. In instances where the City and City Engineer have required a bond pursuant to this section, the City may, as an alternative to the posting of such bond, accept other appropriate security such as properly conditioned irrevocable letter of credit which meets the same objective as the bonds described in this section, subject to approval of any other department or agency whose interests are protected by the same bonding requirement.
4. If the surety on any bond furnished to the City becomes a party to a supervision, liquidation, rehabilitation action pursuant to I.C. 27-9 et. seq. or its right to do business in the State of Indiana is terminated, it shall be required that, within thirty days thereafter, a substitute bond and surety be provided, both of which must be acceptable to the City. Failure to obtain a substitute bond within the stated time frame shall be cause for revocation or suspension of the project approval until such time that the

bond is furnished to the City Engineer or the City's designated representative.

E. Construction Inspection

Prior to issuance of the final project approval and commencement of any construction activities pertaining to projects covered by these Standard Specifications, the Developer/Contractor shall, if requested by the City, execute an Agreement with the City for said projects which will provide that:

1. The City may contract for construction inspection service to ensure that materials and workmanship meets the requirements of the approved plans and specifications.
2. The contracted engineer (City representative) will be responsible for submitting and certifying all tests required by these Standards.
3. The Developer/Contractor will reimburse the City for the cost of such services which shall be determined at the time of execution of the Agreement and verified by the Owner or his representative throughout construction.
4. Upon completion of construction, the contracted engineer (City representative) shall execute and file with the City a Certificate of Completion and Compliance certifying to the City and the Developer/Contractor as to the compliance of such construction with the requirements of the approved construction plans and approved change orders.
5. No action with regard to the acceptance of the construction and release of the improvement bond pursuant to this section shall be taken until the Developer/Contractor has reimbursed the City in full for the inspection services.

All construction of any capital improvements or infrastructure intended for dedication to the City shall be observed and certified pursuant to the Agreement.

The Developer/Contractor shall furnish the City with three (3) copies of the approved construction plans at the time the Agreement is executed.

F. Requirements for Project Acceptance and Dedication

Capital improvements or infrastructure will not be accepted and building connection permits shall not be issued until all documents, as required by the City, are submitted to and approved by the City and City Engineer, including the following:

1. Maintenance Bond;
 - One (1) year Maintenance Bond for sanitary sewer and water projects

- Three (3) year Maintenance Bond for public streets and alleys
2. Recorded Covenant and Easement Documents;
 3. Certificate of Completion and Compliance;
 4. The completion of a final inspection which confirms that the project has been constructed and tested in accordance with the City's Standards; and
 5. As-Built/As-Constructed drawings on reproducible mylars.
 6. Provided as-builts must include GPS location of project components.

SECTION 4

SANITARY SEWER DESIGN STANDARDS

SECTION 4

SANITARY SEWER DESIGN STANDARDS

4.1 General

The City and City Engineer shall issue final approval for the installation of all sanitary sewer facilities. All sanitary sewer facilities shall be designed and installed in accordance with the Indiana Department of Environmental Management (IDEM) and Ten States Standards for Sewage Works.

4.2 Sanitary Sewer Design Criteria

A. General

All sanitary sewers shall be designed to carry the estimated flow from the area ultimately contributing to the respective service area of the sanitary sewer. The required capacity shall be established by City Engineer or at the City's option by means of a study conducted by the Owner/Contractor or his authorized representative engineer.

1. Residential

For the purpose of design, the average family unit is considered to generate three hundred ten (310) gallons per day per single family home. Peak flows shall be determined by Ten States Standards.

2. Commercial/Institutional

The average daily flow for these facilities shall be based on 327 IAC Article 3. Peak flow shall be determined by multiplying the average flow by a factor of four (4).

3. Industrial

For those industries which do not have any process wastewater discharge, flows shall be calculated as stated above in "Commercial/Institutional". For industries which will have a process discharge, the Owner shall submit detailed flow estimates for each process, duration and frequency.

Peak capacity shall be determined by multiplying the average discharge by a factor of two (2).

4. Infiltration

Sanitary sewer design capacity must include an allowance to carry unavoidable amounts of groundwater infiltration or seepage in addition to the peak sanitary flows. Collector and trunk sewers shall be designed to include an allowance of two hundred (200) gallons per day per inch diameter mile of pipe.

B. Pipe Capacities

1. Collector Sewers

Collector sewers shall be classified as any sewer ranging between eight (8) inches and twelve (12) inches. Peak design flow capacities shall be based upon sewer flowing full without head.

2. Trunk Sewers

Trunk sewers shall be classified as any sewer fifteen (15) inches and larger.

Peak design flow capacities for trunk or interceptor sewers shall be based on sewers flowing full, without head, using the design population density and appropriate land use determined by the City and City Engineer, and shall include an allowance for infiltration which will be reviewed on a case-by-case basis and is subject to the approval of the City and City Engineer.

C. Minimum Pipe Sizes and Standards

1. Pipe Diameter

The required diameter of gravity sewers shall be determined by Manning's formula using a roughness coefficient, "n", of 0.013 or required by the latest Ten States Standards. The minimum pipe diameter for public gravity sanitary sewers shall be eight (8) inches.

2. Minimum Slopes and Velocities

All sanitary collector and trunk sewers shall be designed and constructed to provide a minimum velocity when flowing full of two (2) feet per second. The slope of the water pipe shall be such that these minimum velocity requirements are attained. The minimum acceptable slopes for the design and construction of sanitary sewers are as follows:

Pipe Size (inches)	Minimum Slope (ft. per 100 ft., %)
8	0.40
10	0.28
12	0.22
15	0.15
18	0.12
21	0.10
24	0.08
30	0.058
36	0.046
42	0.037

Sewers forty-eight (48) inches or larger should be designed and constructed to give mean velocities, when flowing full, of not less than three (3.0) feet per second based on Manning's formula using an "n" value of 0.013.

3. Minimum Depth

For the protection of the sanitary sewer lines from damage caused by utilities installed after the sanitary sewer has been constructed, the minimum depth to crown of all gravity sanitary sewers shall be four (4.0) feet, and the minimum depth to crown of all force main sanitary sewers shall be five (5.0) feet.

4. Building Sewers

Building sewers shall conform to the latest edition of the Uniform Plumbing Code and to these Standards.

The building sewer shall connect to the public sewer at a mainline fitting. Direct connections to manholes shall not be allowed.

Building sewers within the right-of-way or easement shall be a minimum of six (6) inches in diameter. Building sewers shall have a wye cleanout located within three (3) feet of the building's exterior wall and extended to grade.

Cleanouts installed under concrete or asphalt paving shall be made accessible by yard boxes or extended flush with paving with approved materials and be adequately protected.

Building sewers installed for future connections shall be terminated at the right-of-way or easement and plugged to ensure one hundred (100) percent water tightness. A one-half (1/2) inch metal locator rod or a magnetic locator tape shall be installed at the end of the plugged line to within three (3) feet of the finished grade.

If approved by City a service may be cut into a public sewer sanitary sewer service tap saddle of four (4) or six (6) inches. Service tap saddle options include a PCX Saddle Y or a Fernco Tap Saddle with Wye preferred and tee acceptable.

D. Sewer Structures

1. Manholes

a. General

Manholes shall be installed at the end of each line; at all changes in grade, size, materials or alignment; at all sewer intersections. The maximum distance between manholes shall be four hundred (400) feet.

The minimum inside diameter of manholes shall be forty-eight (48) inches.

Flow channels shall be shaped and formed in each manhole to provide a smooth transition of flow from all inlets to the outlet. The bench wall shall be formed to the crown of the inlet and outlet pipes to form a "U" as shown in the Standard Details.

At changes in sewer alignment and/or sizes, the energy gradient elevation shall not increase. This shall be accomplished by keeping the crown elevation continuous where possible for changes in sewer sizes.

Manholes proposed to be installed in unpaved areas shall be designed and constructed such that the top of the casting is a minimum of two (2) inches above the finished grade to prevent ponding of water over the casting. Positive drainage away from the manhole shall be provided.

Manholes receiving discharge force mains shall have an internal drop connection. Manholes which have force main discharge lines shall have an internal epoxy coating to prevent corrosion.

b. Outside Drop Connections

Outside drop pipe connections shall be provided for all sanitary sewers entering a manhole at an elevation greater than twenty-four (24) inches above the invert of the manhole.

In areas where future residential, commercial and/or industrial growth can occur, the City shall determine which new manholes fifteen (15) feet deep or deeper shall be equipped with outside drop connections. These shall be of a size and at an elevation to

be determined by the City at the time of design to allow for future connections at these points. The drops shall extend from the base to within ten (10) feet of the final graded surface elevation.

2. Lift Stations

If approved by City and City Engineer, all lift stations shall have pre-cast concrete wet wells and separate valve pits. All stations shall, as a minimum, have two (2) submersible pumps.

3. Grease/Sediment Traps

All businesses where consideration of grease and/or sediment is necessary (i.e. food service operations, carwashes, bars, banquet facilities, restaurants, etc.) shall install a grease/sediment trap as shown in the Standard Details. If there is any question if said grease/sediment trap is required, the Developer/Contractor shall resolve the question by contacting the City.

4.3 Easements

A. General

Whenever possible, sanitary sewers shall be constructed within a dedicated easement. The minimum permanent easement widths are as follows.

Depth of Sewer from Finished Grade	Minimum Easement (ft.)
up to 15 feet	20
> 15 feet to 25 feet	25
greater than 25 feet	30

All sewers shall be centered in the easement. For those sewers constructed in the public right-of-way, the easement shall extend the distance outside of the right-of-way necessary to provide the required easement width.

A minimum thirty (30) foot by thirty (30) foot easement shall be provided for all submersible lift stations with wet wells up to thirty (30) feet deep.

Ingress and egress shall be available to the City's crew at all times. All plan sheets shall clearly identify the easement and the location of all other proposed utilities. The horizontal and vertical plans shall identify all utilities proposed to cross the easement.

B. Right-of-Way Plan Sheet

1. Geographic location map showing the extent of the project and including where applicable:

- a. Directional North Arrow and Scale;
 - b. County;
 - c. Civil Township;
 - d. Section, Township and Range Identification;
 - e. Subdivision Names, Recording Information and Lot Numbers;
 - f. Highway, Road and Street Identification;
 - g. Rivers, Creeks and Named Ditches;
 - h. Assigned Parcel Numbers Arranged in Ascending, Numerical Order from the Project Beginning to End; and
 - i. List of Apparent Owners (last deed of record) by Assigned Parcel Numbers.
2. In addition to the above, there should be sufficient information on the design drawings to properly correlate with the right-of-way plan sheet; i.e., property lines, subdivision information, parcel number or name, width of right-of-way, permanent or temporary and special conditions; for example, structures, trees, shrubs to be removed or replaced, sodding, riprap, etc.

C. Legal Description Sheets

The following shall be provided:

1. Parcel Number;
2. Project Number;
3. Project Name;
4. Identification as to permanent or temporary easement;
5. Separate descriptions on separate sheets are required where both permanent and temporary easements are to be taken;
6. Metes and bounds descriptions shall be clear, concise and complete with sufficient detail to positively establish from known and referenced points, monuments, lines, etc. Area of taking should be stated at end of description. Areas should be given in acres;
7. Descriptions of easements from platted subdivision lots, including strips off sides of lots should include name of subdivision and recording information for the subdivision as well as affected lot number(s). NOTE: These are usually small areas; therefore, area should be stated in square feet; and

8. Registered land surveyor's licensed in the State of Indiana, seal and signature.

D. Property Plats

1. Parcel Number;
2. Project Number;
3. Project Name;
4. County;
5. Civil Township;
6. Section;
7. Township;
8. Range;
9. Owner;
10. Permanent or Temporary Legends;
11. Permanent or Temporary Easement Areas;
12. Total area of property out of which easement is to be taken;
13. Drawn By;
14. Directional North Arrow;
15. Scale;
16. Unplatted properties: complete boundaries of property description out of which easements are to be taken, including properly identified referenced corners, P.O.B.'s, monuments, roads, bearings, distances, etc.;
17. Platted subdivisions: dimensions of lot(s) as well as the lot number(s) and including the subdivision name and recording information;
18. Easement boundaries as described in Item A. of this subsection, including referenced bearings, distances, etc., and identified as in legend; and
19. Registered land surveyor seal and signature.

4.4 Drafting Standards

A. General

These Standards have been established for the purpose of ensuring uniformity in the design and drafting techniques of projects to be submitted for review and acceptance.

1. All projects submitted, having more than two (2) sheets, shall have a title sheet which will include:
 - a. General Overall Area Map;
 - b. Vicinity Location Map;
 - c. A Site Plan Map Detailing the Project;
 - d. Name/Title of Project, including Section Number if applicable;
 - e. Owner and Engineer's Name; and
 - f. Professional Engineer's Seal and Signature.
2. All plan and profile sheets are to be certified and dated by a professional engineer of the State of Indiana.
3. All sheets are to be numbered, with total number of sheets included.
4. Include detail sheet(s)/specification sheet(s), as applicable.
5. Design drawings shall be twenty-four (24) inch by thirty-six (36) inch.

B. Scales

The following scales for drawings are required:

1. Plan and Profile: Variable; Not to Exceed 1" = 50' Horizontal and 1" = 5' Vertical
2. Cross Sections: 1" = 5' Horizontal and Vertical.

C. Materials

Mylar type drafting film shall be used for all reproduction "originals" to be submitted as record drawings. They shall be of a quality suitable for blue printing.

D. Plan and Profile Drawings

All plan sheets shall include the following information when applicable:

1. A North Arrow;

2. The Scales Used;
3. Project Name and Number, Sheet Number, Date Drawn, Date and Nature of Revisions;
4. All topography in the area affected by construction;
5. Right-of-Way lines, property lines and easements;
6. Locations of benchmarks and their descriptions;
7. Locations of all existing and proposed utilities in the project area; and
8. Match lines shall be easily identifiable.

All profiles shall include the following:

1. Existing and finished grade lines;
2. Inverts at all manholes;
3. Length and size of pipe between manholes;
4. Slope of pipe in percent;
5. Elevations to USGS datum;
6. Top of casting elevations;
7. Types of materials used;
8. Profile of existing and proposed utilities; and
9. Special construction required due to unfavorable soil conditions.

E. Lift Station Drawings

Lift station plans shall, at a minimum, contain the following:

1. At least two views of the station, plan view and cross section;
2. Electrical panel detail;
3. Pump and alarm control elevations;
4. Inlet and outlet pipe elevations;
5. Finished grade and foundation elevations;
6. Special construction required due to unfavorable soil conditions;

7. Design pump capacity, rated horsepower, total dynamic head, manufacturer and model number;
8. Sump capacity and cycle time;
9. Also, the Owner's Engineer shall submit a copy of the head discharge curve and the complete design calculations for the lift station and force main;
10. Fence and access drive detail; and
11. Scada Unit

F. **Record Drawings**

At the completion of the construction, a revised set of drawings shall be submitted to the City providing all "as-built" details. These details shall include, but not be limited to, invert elevations, top of casting elevations, manhole locations with tie down improvements, final dimensions and elevations, pipe sizes, and location of utilities encountered. All project components submitted within the record drawings shall include GPS locations.

The record drawings ("as-built") shall have all laterals shown on the plan view with their locations properly scaled. Lateral measurements shall be indicated by their distance from the downstream manhole in the form of stationing. Lateral stationing shall begin at 0+00 at each downstream manhole.

All sheets shall have the phrase "as-built" or "record drawing" boldly printed on them with the date and shall be stamped and signed by a professional engineer registered in the State of Indiana.

4.5 Sanitary Sewer Crossing Drainage Ways

Sanitary sewers shall be constructed of ductile iron pipe or shall be encased in a minimum of six (6) inches of concrete wherever the sanitary sewer crosses under a naturally occurring drainage way (i.e., creeks, rivers, streams, etc.). Wherever applicable, the sanitary sewer crossing the drainage way shall be pressure tested to assure one hundred (100) percent water tightness prior to backfilling.

SECTION 5

SANITARY SEWER MATERIALS

SECTION 5

SANITARY SEWER MATERIALS

5.1 General

This section provides a description of the materials acceptable for the construction of sanitary sewer facilities. Use of other materials which are not specified herein shall only be permitted with the written approval by the City and City Engineer.

5.2 Gravity Sanitary Sewer

A. General

The City currently allows the use of the following pipe material:

- Polyvinyl Chloride Pipe (PVC)
- High Density Polyethylene Pipe (HDPE)
- Gravity Centrifugally Cast, Fiberglass Reinforced, Polymer Mortar Pipe (CCFRPM)

All pipe shall be the bell and spigot type with elastomeric seal joints.

All pipe shall be required to withstand a hydrostatic pressure of twenty (20) feet of water (8.6 psi) for two (2) hours while being deflected to the maximum amount recommended by manufacturer. Continuing the hydrostatic pressure, a shear load of one hundred (100) pounds per inch of nominal pipe diameter shall be applied to an unsupported spigot immediately adjacent to joint. During testing period, there shall be no visible leakage at joint.

B. Sanitary Sewer Pipe Materials

1. Polyvinyl Chloride Pipe (PVC)

All PVC pipe shall be constructed using watertight joints and methods. The gravity sanitary sewers shall be PVC SDR 35 solid wall pipe. Polyvinyl chloride (PVC) gravity sanitary sewer pipe shall be the integral wall bell and spigot type with elastomeric seal joints and smooth inner walls meeting or exceeding all of the requirements set forth in ASTM D-3034 for pipe diameters 15-inches or less and meeting or exceeding all of the requirements set forth in ASTM F-679 for pipe diameters greater than 15-inches.

For diameters 15-inches or less, the pipe shall have a minimum cell classification of 12454-B and for diameters greater than 15-inches the pipe shall have a minimum cell classification of 12454-C; with all pipe having a minimum tensile strength of 34.50 Mpa as defined in ASTM D-1784.

PVC sanitary sewer pipe shall have a minimum pipe stiffness of 46 psi for each diameter when measured at 5% vertical ring deflection and tested in accordance with ASTM D-2412.

Fittings shall be made of the same class as the pipe they are installed along and shall be manufactured by the pipe manufacturer. Fittings shall meet the same ASTM requirements as the pipe.

Only manufactured fittings made of PVC plastic having a cell classification of 12454-B as defined in ASTM D-1784 shall be used.

Tee/Wye service connections for sewers where existing or proposed grade (to sewer invert) as shown on plans, exceeds 15 feet shall be heavy wall.

SADDLE CONNECTIONS SHALL NOT BE ALLOWED FOR NEW CONSTRUCTION.

Flexible gasket joints shall be compression type so that when assembled, the gasket inside the bell will be compressed radially on the pipe spigot to form a watertight seal. The assembly of joints shall be in accordance with the pipe manufacturer's recommendations and ASTM D-3212. The gaskets sealing the joint shall be made of rubber of special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five (5) years' experience in the manufacture of rubber gaskets for pipe joints. The gasket shall be a continuous ring of flexible joint rubber of a composition and texture which is resistant to common ingredients of sewage, industrial wastes and groundwater and which will endure permanently under the conditions imposed by this service. The gasket shall conform to the requirements of ASTM F-477.

NO SOLVENT CEMENT JOINTS SHALL BE ALLOWED.

All field-cutting of pipe shall be done in a neat manner as per manufacturer's recommendations and the cut end shall be beveled using a file or wheel to produce a smooth bevel of approximately 15° and be a minimum depth of one-third the pipe wall thickness. Field cut pipe will only be allowed to be installed at manholes, at prefabricated tees and wyes, and at the connection of new sanitary sewer to existing sanitary sewer.

The date of manufacture, class of pipe, specification designation, size of pipe, name or trademark of manufacturer, and identification of plant/location shall be legibly marked on the outside of each pipe section in accordance with the ASTM D-3034.

2. High-Density Polyethylene Pipe (HDPE)

All high-density polyethylene (HDPE) pipe shall be a triple wall pipe with a smooth interior and exterior surfaces with annual inner corrugations. The HDPE pipe shall have a minimum pipe stiffness of 46 PSI when tested in accordance with ASTM D2412. The pipe shall have a Manning's "n" value of 0.012.

The HDPE pipe shall be joined using a bell and spigot joint that meets the requirements of ASTM F2764. The joint shall be watertight in accordance with ASTM D3212 and withstand 15 psi of pressure. Gaskets shall meet the requirements of ASTM F477 and shall be installed by the pipe manufacturer. A joint lubricant provided by the manufacturer shall be used on the gasket and bell during assembly. The bell joint shall be reinforced with a polymer composite band installed by the manufacturer.

Fittings shall conform to ASTM F2764. Bell and spigot connections shall utilize a welded or integral bell and valley or inline gaskets meeting the watertight joint performance requirements of ASTM D3212.

Polypropylene compound for pipe and fitting production shall be an impact modified copolymer meeting the material requirements of ASTM F2764.

3. Gravity Centrifugally Cast, Fiberglass Reinforced, Polymer Mortar Pipe (CCFRPM)

This specification covers fiberglass sewer pipe defined by raw materials in the structural wall and liner, surface layer material and pipe stiffness.

The pipe materials designation code shall consist of the standard designation, ASTM D3262, followed by type, liner and grade indicated in Arabic numerals, and pipe stiffness by a capital letter. Minimum pipe stiffness, when tested in accordance with ASTM D 2412 shall be 46 psi. A complete material code shall conform to ASTM D 3262, three numerals, and a capital letter. Pipe shall be furnished with elastomeric gaskets conforming to ASTM F477.

Pipe section lengths shall be determined based on a length determined by the Contractor, and approved by the Engineer, that will provide ease of installation.

Pipe shall be manufactured and rated at a stiffness class great enough to handle all forces involved for the installation.

Joint type shall be selected by the Contractor, and approved by the Engineer, based on the installation being utilized to install the pipe. In any case, the joint must meet the requirements of ASTM D4161.

The CCFRPM pipe must be specifically designed for the conditions experienced during and after construction of the interceptor system. The Contractor will be responsible for obtaining the correct design from their selected manufacturer.

5.3 **Sanitary Sewer Force Mains**

A. **General**

The City currently allows the use of the following types of pipe for force mains:

- Polyvinyl Chloride Pipe
- Ductile Iron Pipe
- High Density Polyethylene Pipe

B. **Air/Vacuum Relief Valves**

The design of sanitary force mains shall prevent the need for air vacuum relief valves. If high points cannot be eliminated an air relief valve shall be installed at each point. Each valve shall be installed in a manhole structure.

C. **Force Main Materials**

1. **Polyvinyl Chloride (PVC) Force Main**

a. **Type 1**

PVC plastic pipe shall conform to ASTM Specification D 2241, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe (SDR PR). The material used shall conform to ASTM Specification D 1784, Standard Specification for Rigid Polyvinyl Chloride and Chlorinated Polyvinyl Chloride compounds, Class 12454-B (PVC 1120). Pipe O.D. shall conform with that of steel pipe (IPS).

The pipe fittings shall be pressure rated in accordance with recommendations of the Plastic Pipe Institute. Pressure Class and Standard Dimension Ratios (SDR) shall be as follows:

Class 200 - SDR 21
Class 250 - SDR 17

b. **Type 2**

This pipe and fittings shall be PVC 1120 pressure pipe made from Class 12454-A or B material and conform with O.D. dimensions of steel pipe (IPS) or cast iron (C.I.). Pressure class and dimension ratio shall be as follows:

Class 200 - DR 14

Type 2 PVC shall comply with AWWA Standard C 900.

All plastic pipe and couplings shall bear identification markings in accordance with Section 2.5.2 and 2.5.3 of AWWA C 900, which shall include the National Sanitation Foundation (NSF) seal of approval. In addition, the plain end of each pipe length shall have two (2) rings, one (1) inch apart, painted around the pipe at the proper location to allow field checking of the correct setting depth of the pipe in the bell or coupling.

The Push-On Joint for PVC and joint components shall meet the requirements for ASTM Specification D 3139, Joint for Plastic Pressure Pipe Using Flexible Elastomeric Seals. The joint shall be designed so as to provide for the thermal expansion and contraction experienced with a total temperature change of seventy-five degrees Fahrenheit (75°F) in each joint of pipe. Details of the joint design and assembly shall be in accordance with joint manufacturers standard practice.

Lubricant shall be non-toxic and shall not support the growth of bacteria and shall have no deteriorating effects on the gasket or the pipe. The lubricant containers shall be labeled with the manufacturer's name.

Gaskets shall meet all applicable requirements of ASA Standard A 21.11.

Gasket dimensions shall be in accordance with the manufacturer's standard design dimensions and tolerances. The gasket shall be made of such size and shape as to provide an adequate compressive force against the spigot and socket after assembly to affect a positive seal under all combinations of joint and gasket tolerances. The trade name or trademark, size, mold number, gasket manufacturer's mark, and year of manufacture shall be molded in the rubber on the back of the gaskets.

Gaskets shall be vulcanized natural or vulcanized synthetic rubber. No reclaimed rubber shall be used. When two (2) hardness's of rubber are included in a gasket, the soft and hard portions shall be integrally molded and joined in a strong vulcanized bond. They shall be free of porous areas, foreign material, and visible defects.

2. Ductile Iron

All ductile iron pipe shall conform to the ANSI A21.51 and AWWA C 151, latest revisions. Ductile iron pipe shall be Class 350 for eight (8) inch through twelve (12) inch. For fourteen (14) inch through eighteen (18) inch Class shall be 250.

Pipe shall have either of the following interior coatings:

- a. polyurethane in accordance with ASTM D16 Type V (1000 microns minimum total thickness)

- b. epoxy (40 mils minimum)
- c. polyethylene (1500 microns minimum total thickness)

Fittings shall be standardized for the type of pipe and joint specified and shall comply with ANSI A21.10 and AWWA C110. Fittings shall be either mechanical joint or push-on type. Pipe joints shall use O-ring gaskets in accordance with ANSI 21.11 and AWWA C 111.

3. High Density Polyethylene

A. Pipe

Materials used for the manufacture of polyethylene pipe shall be extra high molecular weight, high density ethylene/hexane copolymer PE 4710 polyethylene resin meeting the requirements of ASTM D-3350 with a cell classification of PE 345434C. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All material shall be listed by the Plastic Pipe Industry in the name of the pipe manufacturer and shall be based on ASTM D2837 and PPI TR-3 testing and validation for samples of the pipe manufacturer's production pipe. Pipe shall be in compliance with ASTM F714 DIPS minimum 160 psi (DR 11) for 3" and greater and ASTM D-3035 IPS minimum 256 psi (DR 13.5) for all mains less than 3" in diameter.

B. Joints

HDPE pipe shall be the joined into continuous lengths on the jobsite above ground per ASTM D2657, Heat Joining Polyolefin Pipe and Fittings. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements, alignment, and interracial fusion pressure. Socket fusion shall not be used.

C. Pipe Packaging, Handling and Storage

The manufacturer shall package the pipe in a manner designed to deliver the pipe to the project site neatly, intact and without physical damage. The transportation carrier shall use appropriate method to ensure the pipe is properly supported, stacked and restrained during transport. On-site the pipe shall be stored on clean, level ground to prevent undue scratching or gouging. When lining fused sections of pipe, chains or cable type chokers must be avoided, nylon slings are preferred. Care must be exercised to avoid cutting or gouging the pipe.

D. Installation

Force main installation shall be in conformance with specifications for installation of flexible pipe as per all applicable ASTM requirements including F-412, D-2321, D-2412, D-3212 and D-3350.

E. Locator Tape

All HPDE pipe shall be installed with a metallic locator tape. Tape shall be color coded and installed above the pipe in accordance with the tape manufacturer's instructions.

F. Certification

The Contractor shall furnish, upon request, certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable standards.

G. Markings

During the extrusion production, the HDPE pipe shall be continuously marked with durable printing noting the nominal pipe size, dimension ratio, pressure rating, trade name, material classification, certification bases and date.

H. Fittings

Fittings shall be ductile iron per Section C > 2.0.

D. Locator Wire

Locator wire shall be dual (2), #12 standard solid copper wire with thermoplastic insulation and capable of carrying six hundred (600) volts. Wire shall be installed as set forth under **Section 7**.

5.4 **Building Services/Service Laterals**

Building services shall be SDR 35 PVC pipe conforming to ASTM D 3034. Joints shall be gasket push-on, compression type conforming to ASTM D 3212. Gaskets shall conform to ASTM F 477.

Joint couplings between the new sewer service lateral and existing service lateral shall be manufactured by Fernco or approved equal.

5.5 Sanitary Sewer Manholes

A. General

Location of manholes shall be as required in **Section 4.2(D)(1)**.

B. Types of Manholes

Manholes shall be either monolithic (cast-in-place) or precast. If monolithic manholes are to be used, the Contractor shall submit drawings showing all reinforcement, dimensions, and connections for City approval. All drawings shall be certified by a registered Professional Engineer.

C. Precast Manholes

Manholes shall be constructed in accordance with the ASTM Specifications for "Precast Reinforced Concrete Manhole Risers and Tops", Designation C 478. The minimum wall thickness shall be five (5) inches for manholes four (4) feet in diameter. When the depth of the manhole exceeds twelve (12) feet, then the depth in excess of twelve (12) feet shall be reinforced with two cages of reinforcement the same as required for reinforced concrete sewer pipe of same diameter as the riser of the manhole per ASTM Specification Designation C 76 for Class III Pipe. The precast tops shall be of the eccentric cone type. Precast flat covers shall be not less than eight (8) inches thick and reinforced with two layers of steel with a minimum area of 0.39 square inches per linear foot in both directions in each layer. Precast flat bottoms of manholes shall also be reinforced the same as specified herein for precast flat top. Hoisting lugs or hooks shall be cast in place for handling and setting of the rings. Openings of proper sizes and suitable design shall be cast in place for receiving the sewer and/or drop pipes and connections. Adjusting riser rings shall be provided as approved by the City.

All manhole joints shall be tongue and groove and they shall be sealed with an O-ring and joint sealer conforming to Federal Specifications SS-S-00210 and similar to "Kent-Seal No. 2" as manufactured by the Hamilton Kent Manufacturing Co., of Kent, Ohio; "RAM-NEK" as manufactured by the K.T. Snyder Co. of Houston, Texas, or equal. Cracked or damaged barrel joints shall be rejected.

D. Manhole Steps

The steps provided shall be manufactured of reinforced plastic and shall be twelve (12) inches wide and one (1) inch square.

E. Manhole Bases

Manhole bases shall be of cast-in-place monolithic concrete or precast concrete. Where sewer lines pass through or enter manholes, the invert channels shall be smooth and semi-circular in cross section and may be formed directly in the concrete of the manhole base, may be half tile laid in the concrete, or may be

constructed by laying the sewer lines continuously through the manhole and break-hardened and neatly trimming the edges. Changes of direction of flow within the manholes shall be made with a smooth curve with as long a radius as possible. The floor of the manhole outside the channels shall be smooth and slope toward the channel not less than one (1) inch per foot.

No mortar or concrete shall be placed in water, and no water shall be allowed to flow over or against the concrete before it has set for a period of time deemed sufficient by the City to prevent damage to the structure. The invert channel through manholes should be made to conform in shape and slope to that of the sewer. All invert channels are to have a properly mortared apron on either side, sloped to prevent solids deposition.

F. Adjusting Rings

Where one (1) solid riser or barrel section cannot be used, final adjustments in elevation of the frame and cover shall only be accomplished by the use of precast concrete adjusting rings conforming to ASTM C 478.

Rings shall be of a nominal thickness of not less than four (4) inches. Not more than twelve (12) inches total of adjusting rings shall be allowed for adjustment of the manhole frame and cover to required elevation. Adjustment rings are required in situations with round, solid steel sized for casting. Expandable rings are not a suitable alternative.

G. Sewer Pipe to Manhole Connections

To connect a sanitary sewer to a manhole, either a flexible boot KOR-N-SEAL 1 or 2, flexible connector, cast-in-place Dura-Seal gasket, "A"-lock gasket or an approved equal shall be used. Connections to an existing manhole shall be a flexible boot KOR-N-SEAL or approved equal.

If the flexible boot connection is used, it shall be placed in the reinforced concrete manhole base and secured to the pipe by a stainless-steel clamp. Flexible connectors shall conform to ASTM C 923.

The cast-in-place inflatable gasket shall conform to ASTM C 923.

All connections shall provide for a watertight seal between the pipe and manhole. The connector shall be the sole element relied upon to assure a flexible watertight seal of the pipe to the manhole.

The rubber for the connector shall comply with ASTM C 923 and shall be resistant to ozone, weather elements, chemicals, including acids and alkalis, animal and vegetable fats, oils and petroleum products.

The stainless-steel elements of the connector shall be totally non-magnetic Series 305 stainless steel. The stainless-steel clamp shall be capable of sustaining applied torque in excess of eighty (80) inch-pounds. It shall be the

responsibility of the Contractor to submit details of the proposed connection to the City for approval. Connections not approved by the City shall be subject to removal and replacement with an approved adapter.

H. Castings

Standard manholes shall have a R-1772 C frame and lid by Neenah Foundry, 1875-3 by East Jordan Iron Works, or approved equal. Material shall be in compliance with ASTM A 48, CL 35B. Each lid shall have two (2) inch high letters indicating "Sanitary Sewer".

Where watertight castings are required, the manholes shall have a R-1916F frame and lid by Neenah Foundry, 1045 HD by East Jordan Iron Works, or approved equal. The frame shall be anchored to through the riser rings (if provided) to the cone section with four (4) galvanized rods.

I. Frame Chimney Seal

An external rubber seal shall be installed on all sanitary manholes. A rubber seal extension, to cover any additional heights of chimney not covered by the seal itself, shall be used when required. The external rubber seal and seal extensions shall be as manufactured by Cretex Specialty Products, or equal.

The sleeves shall be extruded from a high-grade rubber compound conforming to the applicable requirements of ASTM C 923. The bands used for compressing the sleeve and extension against the manhole shall be fabricated from 16-gauge stainless-steel conforming to ASTM A 240 type 304, any screws, bolts or nuts used on this band shall be stainless steel conforming to ASTM F 593 and 594, type 304.

The joint between the manhole frame and chimney or cone shall be 3/4" thick and made using cement mortar. Any sealant used between the adjustment or grade rings of the chimney shall not be used in this joint. Installation of these rubber seals shall be in accordance with the manufacturer's recommendation.

SECTION 6

SANITARY LIFT STATIONS

SECTION 6

SANITARY LIFT STATIONS

6.1 General

This section pertains to the requirement for sanitary lift stations constructed as part of a private development. The City shall review and approve the use of any lift station. The Owner must show that it is not physically possible or economically feasible to provide gravity service into a public sewer.

All stations shall be designed for and operate on three (3) phase power. All stations shall be submersible type, including a minimum of two (2) pumps with a minimum capacity of one hundred (100) GPM and a minimum four (4) inch force main. Voltage shall be two hundred eight (208) or two hundred forty (240), three (3) phase.

6.2 General Requirements

- A. All of the mechanical and electrical equipment shall be an integral package supplied by the pump manufacturer with local representation so as to provide undivided responsibility. The package shall be furnished by Flygt Pump or approved equal.
- B. The Contractor shall submit to the City for review and approval two (2) sets of shop drawings, detailed specifications, pump warranty and performance characteristics for all of the equipment and fixtures to be furnished and installed. The shop drawings and equipment data shall be submitted with a cover letter or Contractor's stamp of approval, indicating that he has reviewed, checked and approved the data submitted. The City and City Engineer will review the submittal and render a decision in writing as to the acceptability of the equipment.
- C. Design plans for sanitary lift station shall include aesthetic details of all components, to be approved by the City on a case by case basis. Lift stations and associated appurtenances, such as control centers, must blend with the surrounding environment such that eyesore they don't become an eyesore.
- D. Any exceptions to this Standard or associated approved Plans shall be submitted in writing and clearly stated. The exceptions must be approved by the City Engineer and the City prior to proceeding with the work.
- E. All components of the lift station that are exposed to weather shall be constructed of material that is resistant to corrosion and will not require surface protection throughout the expected life of the lift station. In general, these materials are stainless steel, aluminum, fiberglass reinforced polyester (FRP) and ultraviolet stabilized PVC.
- F. All valves and piping coming in contact with sewage or installed in the pump or valve chambers shall be coated as follows:
 - 1. Primer - Aromatic Urethane Zinc-Rich 2.5 - 3.5 mil

2. Field Coats - Aliphatic Acrylic Polyurethane 2 coats @ 2.0 - 4.0 mil per coat

6.3 **Operating Conditions**

Prior to installation the Contractor shall submit the following information for each pump to the City for review and approval:

- A. Pump Capacity in Gallons Per Minute;
- B. Total Dynamic Head (TDH) and Operating RPM;
- C. Motor Horsepower;
- D. Motor RPM;
- E. Motor Voltage, Phase and Cycle;
- F. Make and Model Number; and
- G. Pump Curves for the Pumps to be Provided.

6.4 **Pump Design**

A. **Pump Construction**

Major pump components shall be of gray cast iron, ASTM A 48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. The lifting handle shall be of stainless steel. All exposed nuts or bolts shall be AISI Type 316 stainless steel or brass construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.

Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

B. **Cooling System**

Motors shall be sufficiently cooled by the surrounding environment or pumped media. A water-cooling jacket is not required.

C. Cable Entry Seal

The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

D. Motor

The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air or oil filled, watertight chamber, NEMA B type. The stator windings and stator leads shall be insulated with moisture resistant Class H insulation rated for 365°F (180°C). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least ninety-five (95) percent. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 104°F (40°C) and capable of no less than thirty (30) evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 260°F (125°C) shall be embedded in the stator end coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber containing the terminal board, shall be hermetically sealed from the motor by an elastomer compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanent affixed to a terminal board. Wire nuts or crimping type connection devices are not acceptable. The motor and pump shall be designed and assembled by the same manufacturer.

All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 125°C (260°F) the thermal switches shall open, stop the motor and activate an alarm.

The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus ten (10) percent. The motor shall be designed for operation up to 104°F (40°C) ambient and with a temperature rise not to exceed 176°F (80°C). A performance chart shall be provided showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on

starting and no-load characteristics.

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be chloroprene rubber. The motor and cable shall be capable of continuous submergence under water without loss of watertight integrity to a depth of sixty-five (65) feet.

The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

E. Bearings

The pump shaft shall rotate on two (2) bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two (2) row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.

F. Mechanical Seal

Each pump shall be provided with a tandem mechanical shaft seal system consisting of two (2) totally independent seal assemblies. The seals shall operate in an oil reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the oil chamber, shall contain one stationary and one positively driven rotating tungsten-carbide ring. The upper, secondary seal unit, located between the oil chamber and the motor housing, shall contain one stationary tungsten-carbide ring and one positively driven rotating carbon seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable.

The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. Cartridge type systems will not be acceptable. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

Each pump shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall be designed to prevent overfilling and to provide oil expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.

Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral

concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action. Seal lubricant shall be FDA approved, non-toxic, and non-hazardous.

G. Pump Shaft

Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be stainless steel – ASTM A479 S43100-T.

If a shaft material of lower quality than stainless steel – ASTM A479 S43100-T is used, a shaft sleeve of stainless steel – ASTM A479 S43100-T shall be used to protect the shaft material. However, shaft sleeves only protect the shaft around the lower mechanical seal. No protection is provided in the lubricant housing and above. Therefore, the use of stainless-steel sleeves shall not be considered equal to stainless steel shafts.

H. Impeller

The impeller(s) shall be of Hard-Iron TM (ASTM A-532 (Alloy III A) 25% chrome cast iron), semi-open, multi-vane, back-swept, non-clog design. The impeller vane leading edges shall be mechanically self-cleaned upon each rotation as they pass across a spiral groove located on a replaceable insert ring. The impeller shall have vanes hardened to RC 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of sludge and rag-laden wastewater.

The impeller shall be capable of momentarily moving axially upwards a distance of 15mm/0.6-in. to allow larger debris to pass through and immediately return to normal operating position.

I. Wear Rings

A wear ring system shall be used to provide efficient sealing between the volute and suction inlet of the impellers. Each pump shall be equipped with a brass, or nitrile rubber coated steel ring insert that is drive fitted to the volute inlet.

J. Volute

Pump volute(s) shall be single-piece grey cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be four (4) inches. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged grooves. The spiral grooves shall provide trash release pathways and sharp edges across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of Hard-Iron TM (ASTM A-532 (Alloy III A) 25% chrome cast iron) and provide effective sealing between the multi-vane semi-open impeller and the

volute housing.

K. Mixed Flush Valve

All pumps shall be capable of having a mixed flush valve installed on the pump volute. The mixed flush valve shall open when pumping starts allowing water from the pump to be forced through the valve as a powerful jet-flushing stream. After flushing for approximately thirty (30) seconds, the valve shall close, and the pump shall empty the station to the preset stop level. When required by the City, the mixed flush valve shall be installed upon the pump chosen by the Owner. The mixed flush valve shall be a Flygt Flush Valve 4901, or equal.

L. Rail/Removal System

The pump mounting base shall include adjustable guide rail supports and a discharge connection with a one hundred twenty-five (125) pound standard flange. The base and the discharge piping shall be permanently mounted in place. The base plates shall be anchored in place utilizing epoxy type anchors with stainless steel studs and nuts as manufactured by HILTI Fasteners, Inc. or equal.

A rail system shall be provided for easy removal of the pump and motor assembly for inspection and service. The system shall not require a man to enter the wet well to remove the pump and motor assembly. Two (2) rails of two (2) inch stainless steel pipe shall be provided for each pump. The guide rails shall be positioned and supported by the pump mounting base. The guide rails shall be aligned vertically and supported at the top by attachment to the access hatch frame. One (1) intermediate guide rail support is required for each fifteen (15) feet of guide rail length.

The pumps shall be equipped with sliding brackets or rail guides. To ensure easy removal of the pumps, the rail guides attached to each pump shall not encircle the rails. A stainless-steel lifting chain or manufacturer's pump removal system (similar to the Flygt Lift) of adequate length for the basin depth shall be provided for each pump. Each pump shall be equipped with a permanent, stationary lifting handle with a minimum clearance of twelve (12) inch between the top of pump and bottom of handle.

The rails and the rail guides shall function to allow the complete weight of the pumping unit to be lifted on dead center without binding and stressing the pump housing. The rail system shall function to automatically align the pumping unit to the discharge connection by a simple downward movement of the pump. No twisting or angle approach will be considered acceptable. The actual sealing of the discharge interface may be of the hydraulically sealing diaphragm type assembly with removable Buna-N diaphragm as supplied by Hydromatic Pump or may be of the metal-to-metal contact as provided by Flygt Pump.

M. Pump Warranty

Pump warranty shall be provided by the pump manufacturer and shall warrant the units being supplied to the Owner against defects in workmanship and materials for a period of five (5) years under normal use, operation, and service. The warranty shall be in printed form and apply to all similar units. A copy of the warranty statement shall be submitted with the approval drawings.

6.5 Protection

All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 260°F (125°C) the thermal switches shall open, stop the motor and activate an alarm.

A leakage sensor shall be provided to protect water in the stator chamber. The Float Leakage Sensor (FLS) shall be a small float switch to detect the presence of water in the stator chamber. When activated, the FLS shall stop the motor and send an alarm. **USE OF VOLTAGE SENSITIVE SOLID-STATE SENSORS AND TRIP TEMPERATURE ABOVE 260°F (125°C) SHALL NOT BE ALLOWED.**

The thermal switches and FLS shall be connected to a Mini CAS (Control and Status) monitoring unit. The Mini CAS shall be designed to be mounted in any control panel.

6.6 Wet Well and Valve Pit

A. General

The walls of the pump station and valve pit structures shall be constructed of reinforced concrete pipe which shall conform to the latest ASTM Specifications C-76, with a minimum compressive strength of concrete equal to four thousand (4000) psi. Reinforcement of the pipes shall be of the circular type. All of the pipe for the pump chambers and the access tubes shall be Class III and of the diameter shown on the Plans. Handling or lifting lugs and/or devices shall be provided in the pipe shells for ease of unloading and setting in place. All joints between pipes and between ends of pipes and concrete slabs shall be made watertight.

The pipes utilized for the pump station wet well or valve pit shall be jointed with a rubber O-ring type seal conforming to the ASTM Standard C-443 (latest revision). The joint shall be designed to provide a maximum infiltration/exfiltration limit of .158 gallons (200 gpd/in-mile). The interior and exterior joint spaces shall be grouted to a smooth surface using a sand-cement mixture mortar. The mortar-grout shall have one (1) part cement to two (2) parts sand mix ratio. The completed interior and exterior joints shall have a smooth troweled waterproof finish.

The top concrete slab of the pump station and valve pit shall have cast into it a socket for receiving the end of each concrete pipe. The joint shall be made watertight. An access ladder shall be provided with rungs spaced twelve (12) inches on center from top to bottom of the station and shall be of welded steel

construction, and hot-dipped galvanized after fabrication or aluminum. The vent shall be a four (4) inch PVC air vent with corrosion proof insect screen. In the valve vault the integral floor drain shall have a two (2) inch drainpipe and slope to the wet well with duckbill check valve.

Concrete for the foundation and roof slabs shall be made of Class A concrete. See Figure S-11 for additional details.

B. Access Hatches

The Contractor shall furnish and install for both the wet well and valve pit aluminum access doors complete with frames, hinged and hasp-equipped covers, upper guide holders, drain hole and cable holder. The frames shall be securely mounted above the pumps. The doors shall be torsion bar loaded for ease of lifting and shall have safety locking handles in the open position. The access doors shall be capable of withstanding a three hundred (300) pound live load per square foot. The lift station wet wells are to be provided with two (2) separate access hatches or a two (2) door hatch. The valve pit access hatches are to be single door type.

C. Pipe, Valves and Fittings

The suction and discharge pipe and fittings shall be ductile and cast-iron Class 150. Inside pipe and fittings shall be flanged. Bell end pipes or fittings with mechanical joints shall be provided at or near the outside face of the station well. Piping shall be supported independent of the sewage flanges. All inside plug valves shall be provided with handwheels. All check valves shall be rubber flapper type.

All metal piping other than cast or ductile iron and copper tubing shall be galvanized steel pipe.

6.7 Disconnect Switch

- A. A single main fusible or breaker disconnect switch of adequate size to provide power for the "control center" and its related components shall be provided by the Contractor.
- B. The disconnect switch shall be housed in a NEMA 4X stainless steel enclosure with an external operation handle capable of being locked in the ON position.

6.8 Control Center

- A. The control center shall be built in a NEMA 4X stainless steel enclosure and shall be suitable for the specified horsepower and voltage for the pumping equipment. The outer door of the panel shall be hinged dead front with provisions for locking with a padlock. Inside shall be a separate hinged panel to protect all electrical components. H-O-A switches, run lights, circuit breakers, etc. shall be mounted such that only the faces protrude through the inside swing panel and no wiring is connected to the back side of the inside swing panel.

- B. A circuit breaker and magnetic starter with three (3) leg overload protection and manual reset shall be provided for each pump. Starters shall have auxiliary contacts to operate both pumps on override condition. A separate circuit breaker shall be supplied for power to the control circuit. The control center shall include an extra circuit breaker of adequate size to provide one hundred fifteen (115) volt, single (1) phase power for a future remote monitor panel. The control center shall include a control voltage transformer to reduce supply voltage to one hundred fifteen (115) volt, single (1) phase to be used for all control functions except the level circuit and associated relays which shall be provided with twenty-four (24) volt control voltage. An alternating relay shall be provided to alternate pumps on each successive cycle of operation. A green run light and H-O-A switch shall be provided for each pump. A terminal strip shall be provided to make field connections of pump power leads, float switches, seal sensor leads, heat sensor leads, and remote monitor panel interconnections.
- C. A time delay relay shall be provided to delay start of second pump should power outage occur.
- D. The control system shall incorporate the level monitoring system.
- E. The control center shall incorporate connections for heat sensors which are installed in the pumps. The connection shall disconnect the starter upon high temperature signal and will automatically reconnect when condition has been corrected.
- F. The control center shall incorporate connections for seal failure sensors which are installed in the pumps. The panel will have a seal failure alarm light for each pump. This alarm indicates failure of the lower mechanical seal in the pump. This will be an alarm light only and will not shut down the pump.
- G. The control center shall include an hour meter for each pump to register the elapsed operating time of each pump.
- H. The control center shall have a high and low water alarm built into the main enclosure. The alarms shall consist of a flashing alarm light with red Lexan plastic cover or red glass globe with metal guard mounted on top of the enclosure such that it is visible from all directions. An alarm horn shall be mounted on the side of the enclosure. A push to test horn and light button as well as a push to silence horn button shall be provided and mounted on the side of the enclosure.
- I. The control center shall include a condensate heater to protect against condensation inside the enclosure. The heater shall be placed so as not to damage any other component or wiring in the control center.
- J. The control center shall include lightning protection and a phase monitor relay to shut down the control circuit and protect the equipment due to loss of phase or phase reversal. The three-phase sequence voltage relay shall be of the eight (8) pin connector type.

- K. The control center shall incorporate an alternator selector switch to allow selection of automatic alternation or manual selection of the lead pump.
- L. The control center shall include a GFI convenience outlet with twenty (20) amp breaker and suitable transformer or power supply to provide one hundred ten (110) volt single (1) phase power to the convenience outlet.
- M. The control center shall have an exterior, lockable one hundred twenty (120) volt , twenty (20) amp, waterproof, receptacle for use with a City furnished portable mixer. Receptacle cover shall have a slot or opening to "lock" plug into receptacle.
- N. The control center shall be suitable for connection to a remote monitor package. The main control must include the following interconnections:
 - 1. Circuit breaker to power remote monitor panel.
 - 2. Relay contacts to signal high and low water alarms.
 - 3. Relay contact to signal tripping of the overload of any of the pumps.
 - 4. Relay contact to transmit signal of seal failure or heat sensor trip of any of the pumps.
- O. A minimum four (4) inch PVC Schedule 40 wall conduit shall be provided from the wet well basin to the control center which will allow the pump power cables, sensor cables and level monitoring cables to be pulled through without difficulty and allow the use of one (1) piece cables from the pumps and level system to the control center. The conduit shall be sealed at the control center to avoid entrance of sewer gases into the control panel.
- P. The control center and associated components shall be mounted on a non-maintenance type pedestal or mounting stand constructed of aluminum or pressure treated wood. The control center shall be located so as to provide safe access to the panel while wet well hatch doors are opened and shall be positioned so as not to be between the access drive and the wet well.
- Q. All components of the control center shall be available from local sources. In particular, items such as circuit breakers, overload protection, relays, etc. shall be available and in stock by local sources.
- R. In order to maintain unit responsibility and warranty on the pumping equipment and control center, the control center must be furnished by the pump manufacturer as suitable for operation with the pumping equipment.
- S. The City may require in specific cases, that a Series 500 Stow-Away panel be furnished and installed.

6.9 Level Monitoring System

A. Components

The wet well level shall be monitored by either:

1. Flexible bulb electrode type level controller by Warrick, or equal.
2. Electrode probe and controller by Multi Trode Model MTIPC 2.2, or equal.

A back-up high level mercury type float switch shall be provided for high level alarm.

B. System Operation

On sump level rise, the lower level one (1) shall first be energized, then the upper level 2 shall next energize and start the lead pump. With the lead pump operating, sump level shall lower to lowest switch and turn off the pump. The alternating relay in the control center shall index on stopping of the pump so that the lag pump will start on the next operation. If sump level continues to rise when lead pump is operating, the level three (3) shall energize and start the lag pump.

Both lead and lag pumps shall operate together until low level turns off both pumps. If level continues to rise when both pumps are operating, alarm level 4 shall energize and signal the alarm. If one pump should fail for any reason, the second pump shall operate on the override switch. All levels shall be adjustable for level setting from the control panel.

6.10 Remote Monitoring Panel

The Developer Contractor shall install one (1) remote monitoring telemetry panel to monitor the alarms listed in paragraph 6.08 "Control Center". The Contractor shall be responsible to install all power and control wiring between the pump control center and the remote monitoring panel. This panel shall be like to the City's existing panels, furnished by the City, and the Owner Contractor shall reimburse the City based on direct costs.

6.11 Operation and Maintenance Manuals

A. Two (2) operation and maintenance manuals shall be submitted to the City.

B. Manuals shall include, at a minimum:

1. Operation Instructions
2. Maintenance Instructions
3. Recommended Spare Parts List
4. Lubrication Schedules
5. Structural Diagrams

6. As-Built Wiring Diagrams
7. Bill of Materials

6.12 Spare Parts

- A. The Contractor shall supply one set of spare parts for each station, including at a minimum the following:
 1. Wear Rings
 2. O-Rings and Gaskets (two [2] sets)

6.13 Design Requirements

A. Sizing of Wet Basin

1. The wet well storage below the lowest inlet shall be a minimum of five (5) feet and shall also meet the following criteria:
 - a. OFF level to be set at the pump manufacturer's recommended level but no less than one (1) foot from the bottom of the wet well.
 - b. The distance between the OFF level and the lead pump ON level shall be set to provide storage capacity equal to:
$$\frac{15 \times \text{Rated Pump GPM}}{4}$$
(i.e. 15-minute cycle minimum)
 - c. The lag pump ON level shall be set a minimum of six (6) inches above the lead pump ON level and a minimum of six (6) inches below the lowest inlet invert.
 - d. The high-water alarm float shall be set a minimum of six (6) inches above the lag pump ON level and a minimum of six (6) inches below the lowest inlet invert.
 - e. All levels shall be set below the lowest inlet invert.

B. Station Warranty

Station warranty shall be two (2) years from the date of acceptance per City maintenance bond requirements.

6.14 Residential Grinder Stations

A. General

Small diameter pressure sewer systems incorporating the use of individual home grinder pump units will be allowed on a case-by-case basis subject to the written approval of the City and the Indiana Department of Environmental Management

(IDEM). In general, these systems shall only be considered in areas where the surrounding areas are currently served by sanitary sewers and the site cannot be serviced by gravity sewers.

The maintenance of the grinder pump station and force main, from the grinder station to to the discharge location, shall be the responsibility of the homeowner. Grider pump station force mains must discharge to the nearest sanitary manhole. The City shall only be responsible for the maintenance of the sewer main.

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SECTION 7

SANITARY SEWER INSTALLTION & CONSTRUCTION

SECTION 7

SANITARY SEWER INSTALLATION AND CONSTRUCTION

7.1 General

This section shall provide general, minimum requirements for the installation and construction for City service area.

7.2 Dewatering and Control of Surface Water

Where groundwater is encountered, the Contractor shall make every effort necessary to secure a dry trench bottom before laying pipe. The Contractor shall provide, install and operate sufficient trenches, sumps, pumps, hose, piping, well points, etc. necessary to depress and maintain the groundwater level below the base of the excavation. If the Contractor is unable to remove the standing water in the trench, the Contractor shall over-excavate the proposed bottom grade of the sewer bedding, and place not less than three (3) inches of Class No. 2 crushed stone (Indiana Department of Transportation aggregate classification) in the over-excavated area.

The Contractor shall keep the site free of surface water at all times and shall install drainage ditches, dikes, pumps and perform other work necessary to divert or remove rainfall and other accumulation of surface water from excavations. The diversion and removal of surface and/or groundwater shall be performed in a manner which will prevent the accumulation of water within the construction area.

UNDER NO CIRCUMSTANCES SHALL SURFACE WATER AND/OR GROUNDWATER BE DISCHARGED TO, DISPOSED OF, OR ALLOWED TO FLOW INTO THE CITY'S SANITARY SEWER SYSTEM.

A. Clearing

Preparatory to excavation, the site of all open cut excavations, embankments, and fills shall be first cleared of obstructions and existing facilities (except those which must remain temporarily or permanently in service). On all public or private property where grants or easements have been obtained, and on the property of the City, the Contractor shall remove and keep separate the topsoil, and shall carefully replace it after the backfilling is completed.

B. Pavement Cutting

Prior to excavating paved areas all excavation edges falling within the pavement shall be saw cut in a neat, straight manner. Cutting shall be performed with a saw designed specifically for this purpose. The cut shall penetrate the entire pavement thickness where possible. If the existing pavement is more than 6 inches thick, then a cut of not less than six (6) inch depth shall be made. If pavement cuts are made in streets which are opened to traffic prior to excavation, then the cuts shall be thoroughly filled with sand and maintained full until the

excavation is performed. Contractor shall be required to obtain pavement cut permit prior to any excavation.

C. Protection of Existing Improvements

Before any excavation is started, adequate protection shall be provided for all existing utilities and City structures.

D. Protection of Trees and Shrubs

No existing trees or shrubs in street right-of-way's and easements shall be damaged or destroyed. Where branches of trees or shrubs interfere with the Contractor's operations, they shall be protected by tying back wherever possible. No limbs or branches shall be cut. If his operations will not permit saving certain trees, the Contractor shall be wholly responsible for satisfying all claims for restoration or restitution resulting from their damage or removal.

If small trees and shrubs are moved or pruned to permit more working space, pruning shall be done in accordance with Home and Garden Bulletin No. 83, U.S. Department of Agriculture, "Pruning Shade Trees and Repairing Their Injuries". However, the Contractor shall obtain, in writing, the City's permission to move or prune trees or shrubs.

E. Maintenance of Public Travel

The Contractor shall carry on the WORK in a manner which will cause a minimum of interruption to traffic and may close to through travel not more than two (2) consecutive blocks, including the cross street intersected. Where traffic must cross open trenches, the Contractor shall provide suitable bridges to street intersections and driveways. The Contractor shall post suitable signs indicating that a street is closed and necessary detour signs for the proper maintenance of traffic. Prior to closing of any streets, the Contractor shall notify responsible municipal authorities.

F. Utility Interruption

The Contractor shall proceed with caution in the excavation and preparation of the trench or pit so that the exact location of underground structures may be determined. Prior to proceeding with trench excavation, the Contractor shall contact all utility companies in the area to aid in locating their underground services.

The Contractor shall take all reasonable precautions against damage to existing utilities. However, in the event of a break in an existing water main, gas main, sewer or underground cable, he shall immediately notify the responsible official of the organization operating the utility interrupted. The Contractor shall lend all possible assistance in restoring services and shall assume all costs, charges, or claims connected with the interruption and repair of such services.

G. Open Cut Excavation

Open cut excavation shall be safely supported and of sufficient width and depth (and only to such width and depth) to provide adequate room for the construction or installation of the work to the lines, grades and dimensions.

1. Trench Dimensions

The bottom width of the trench at and below the top of the pipe and inside the sheeting and bracing, if used, shall not exceed the recommendations as contained in the applicable ASTM Standard for the pipe being used.

Trench sheeting and bracing or a trench shield or box shall be used as required by the rules and regulations of OSHA. The bottom of the trench shall still meet the above standards.

If the trench widths are exceeded without the written permission of the City Engineer and the City, the pipe shall be installed with a concrete cradle or with concrete encasement or other ASTM approved methods as approved by the City Engineer and the City.

2. Excavations with Sloping Sides, Limited

The Contractor may, at his option, where working conditions and right of way permit (as determined by the City Engineer and the City), excavate pipeline trenches and pits for structures with sloping sides, but with the following limitations:

- a. In general, only braces and vertical trenches will be permitted in traveled streets, alleys, narrow easements and for pit excavations more than ten (10) feet deep.
- b. Where pipeline trenches with sloping sides are permitted, the slopes shall not extend below the top of the pipe, and trench excavations below this point shall be made with near-vertical sides with widths not exceeding those specified herein before.
- c. Slopes shall conform to all OSHA regulations.

H. Earth Excavation

Earth materials shall be excavated so that the open cuts conform with the required lines, grades and dimensions.

1. Unsuitable Foundation

When the bottom of the excavation is unsuitable as a foundation, it shall be excavated below grade and then refilled with concrete or crushed stone to the grade as the City or its representative may direct. The

crushed stone refill shall be mechanically compacted in six (6) inch layers or as directed by the City.

2. Unauthorized Excavation

Unauthorized excavation below grade shall be filled with crushed stone or concrete and compacted as ordered and directed by the City or its representative.

3. Excavated Earth for Backfill

Excavated earth materials may be used for Backfill subject to the approval of the City Engineer and the City. Such material may be used only where its class is allowed. For example: Excavated material conforming to "Class II" description may be used where "Class II" material is required.

I. Boring and Jacking

Construction of the pipeline by boring and jacking methods will be permitted unless otherwise specified on the plans.

1. Backstop

The backstop shall be of sufficient strength and positioned to support the thrust of the boring equipment without incurring any vertical or horizontal displacement during such boring operations.

2. Guide Rails

The guide rails for the boring equipment may be of either timber or steel. They shall be laid accurately to line and grade and maintained in this position until completion of the boring operations.

3. Casing Pipe

Steel casing pipe shall be new, conform to ASTM A 139 and shall be of the size (diameter) shown on the plans. The lengths of pipe shall be welded as they are installed. Where lengths of casing pipe are joined during the boring operations, care shall be taken to ensure that the proper line and grade is maintained.

The minimum wall thickness for casing pipes under highways, railroads and streams shall be 0.375 inches. Steel shall be Grade B under railroads and Grade A at all other locations.

7.3 **Bedding and Backfill**

A. **General**

All trenches or excavations shall be backfilled to the original surface of the ground or such other grades as required or directed. In general, the backfilling shall be carried along as speedily as possible.

B. **Backfill Materials**

The following materials shall be used for Backfill in accordance with and in the manner indicated by the requirements specified herein.

Class I - Angular, six (6) to forty (40) mm (1/4 to 1½ inch), graded stone such as crushed stone.

Class II - Coarse sands and gravel with maximum particle size of forty (40) mm (1 ½ inch), including various grades of sands and gravel containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class.

Class III - Fine sand and clayey gravel including fine sands, sand-clay mixtures and gravel-clay mixtures. Soil types GM, GC, SM and SC are included in this class.

Class IV - Silt, silty clays and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH and CL are included in this class. These materials are not recommended for bedding. This class shall also include any excavated material free from rock (three (3) inches and larger), concrete, roots, stumps, rubbish, frozen material and other similar articles whose presence in the backfill would cause excessive settlement.

C. **Backfill of Trench Excavations for Pipes and Conduits**

Bedding and Backfill materials samples shall be submitted to the City Engineer and the City prior to start of construction.

D. **Bedding**

1. **Rigid Pipe and Conduit Bedding**

For purposes of this specification, rigid pipe and conduits shall include those made of steel, ductile iron, concrete, RCP, PVC/ABS Truss and other materials as determined by the City Engineer and the City.

All rigid conduit and pipe shall be laid to the lines and grades unless otherwise directed by the City. All rigid conduit and pipe shall be bedded in compacted Class I or II material, placed on a flat trench bottom. The bedding shall have a minimum thickness of four (4) inch or one-fourth (1/4)

the outside pipe diameter below the pipe and shall extend halfway up the pipe barrel at the sides. All material shall be placed in the trench in approximately six (6) inch layers. Each layer, shall be leveled and evenly distributed on both sides of the pipe so as not to disturb, displace or damage the pipe and shall be thoroughly compacted. When Class I or II materials is used compaction may be accomplished by hand or mechanical tamping or by "walking" the material in. Bedding from the halfway point on the pipe to a point twelve (12) inches above the top of the pipe shall be a Class I, II, III, or IV material placed in six (6) inch layers and thoroughly compacted to prevent settlement. Class III and IV material shall not be used when the trench is located in an area subject to vehicular traffic.

2. Flexible and Semirigid Conduit Bedding

For purposes of this specification, flexible and semirigid conduits and pipes shall include those made of PVC, HDPE, and other materials as determined by the City Engineer and the City.

All flexible and semirigid pipe shall be laid to the lines and grades unless otherwise directed by the City. All flexible and semirigid conduit shall be bedded in compacted Class I or Class II material, placed on a flat trench bottom. The bedding shall have a minimum four (4) inch thickness or one-fourth (1/4) the outside pipe diameter below the pipe and shall extend to twelve (12) inches above the top of the pipe level the full width of the trench. All material shall be placed in the trench in a maximum of six (6) inch layers (before compaction). Each layer, shall be leveled and evenly distributed on both sides of the pipe so as not to disturb, displace or damage the pipe and shall be adequately compacted. When Class I materials are used compaction may be accomplished by hand or mechanical tamping or by "walking" the material in. When Class II materials are used compaction shall be accomplished only by hand or mechanical tamping to a minimum eighty-five percent (85%) Standard Proctor Density.

E. Backfill Above Pipe

1. Method A - Backfill in Areas Not Subject to Vehicular Traffic

For purposes of this specification, trenches shall be considered subject to vehicular traffic if all or any portion of the excavation is located within four (4) feet of a roadway or alley which is routinely traveled by powered vehicles. In the event of any question regarding the susceptibility of an area to traffic, the City Engineer's and the City's decision shall govern.

The trench between a level twelve (12) inches above the top of the pipe and the ground surface shall be backfilled with Class I, II, III or IV materials, as described above, deposited with mechanical equipment in such a manner that it will "flow" onto the bedding and not free fall. The

Contractor shall consolidate the backfill by the back and forth travel of a suitable roller, wheeled device or other similar heavy equipment until no further settlement is obtained. Heavy equipment shall not be used until there is a cover of not less than three (3) feet over the pipes. To assist in promoting maximum settlement, the surface of the trench shall be left in a slightly rounded condition. Periodical dressing of the backfill in the trench to promote the drainage and safety conditions shall be made during the course of the work.

2. Method B - Backfill in Areas Subject to Vehicular Traffic (Mechanical Compaction)

The trench between a level of twelve (12) inches above the top of the pipe and the surface, which are located in areas subject to or possibly subject to vehicular traffic, shall be backfilled with Class I or II materials, deposited in uniform horizontal layers of two (2) feet +/- six (6) inches. Each layer shall be thoroughly compacted by mechanical tamping utilizing a crane mounted hydraulic vibratory compactors. Each layer shall be thoroughly compacted before the next succeeding layer is placed. This procedure shall be followed where trench walls remain stable during compaction. If in the opinion of the City Engineer and the City and/or their representative (inspector), the trench walls become unstable during compaction, then the City Engineer, City, and/or their representative (inspector) may authorize the Contractor to push from the back of the trench the Class I or II material into the trench the full depth, not to exceed twenty (20) lineal feet horizontally along the trench bottom and compact using the vibratory compactor in two (2) foot diagonal lifts.

The crane mounted vibratory compactors shall be capable of producing 1900 cycles per minute and have a compaction plate with the minimum dimensions of twenty-three by thirty-one (23 x 31) inches. The compactor shall be similar to those as manufactured by Allied, Ho-Pac, or equal.

When Class I or II materials do not contain sufficient moisture to obtain proper compaction, in the opinion of the City Engineer, the City and/or their representative, it shall be moistened or wetted as directed by the City Engineer, the City and/or their representative.

3. Method C - Backfill in Areas Subject to Vehicular Traffic (Jetting and Water-soaking)

In lieu of the Mechanical Compaction described in Method B above, the Contractor may compact the Class I or II materials by jetting and water-soaking in the manner described below. Except for compaction procedures of the Class I or II materials, all provisions of Method B described above shall apply to this Method C. The trench compaction shall be started at the point of lowest elevation of the trench and work up along the trench. Jetting and water-soaking shall not begin until the trench have been backfilled to within eight (8) inches of the finished surface.

Jetting and water soaking are not allowed when the groundwater table is above the spring line of the pipe.

The holes through which water is injected into the backfill shall be centered over the trench backfill and at longitudinal intervals of not more than six (6) feet. Additional holes shall be provided if deemed necessary by the City Engineer to secure adequate settlement. All holes shall be jetted and shall be carried to a point one (1) foot above the top of the pipe. Drilling the holes by means of augers or other mechanical means will not be permitted. Care shall be taken in jetting so as to prevent contact with, or any disturbance of the pipe.

The water shall be injected at a pressure and rate just sufficient to sink the holes at a moderate rate. After a hole has been jetted to the required depth, the water shall continue to be injected until it begins to overflow the surface. An approved soil auger shall be used for boring test holes. As soon as the jetting and water-soaking has been completed, all holes shall be filled with soil and compacted. Surface depressions resulting from backfill subsidence caused by jetting and water-soaking shall be filled and recompacted by tamping or rolling to the satisfaction of the City Engineer.

The Contractor shall provide all piping, fittings, etc., necessary to deliver the water along the site of the work and shall arrange with the Water Company for making the necessary taps and metering.

F. Temporary Surfaces Subject to Traffic

The Contractor shall open streets to traffic immediately after completing the backfill operation. He shall accomplish this by installing the compacted aggregate base immediately after granular backfill. The use of class II backfill as a temporary surface is specifically prohibited. When using Method C backfilling, the Contractor may elect to delay the jetting operation until just prior to installing the permanent pavement. This shall not relieve the Contractor from the responsibility of maintaining the temporary surface in accordance with these specifications.

G. Maintaining Trench Surfaces

All surface settlement of the backfill along trenches located beneath streets, roads, alleys, driveways and parking lots which are subject to traffic shall be kept filled level with or slightly above the original paved surface at all times with compacted aggregate base material until the permanent pavement is satisfactorily restored. When temporary asphalt pavement is used, depressions and "potholes" shall be promptly filled with the temporary asphalt material. Special attention shall be given by the Contractor to the timely and proper maintenance, leveling and grading of the surface of all backfilled trenches, especially those subject to traffic and especially following rains. The surface of streets, roads and alleys shall be maintained smooth and free of ruts and water trapping depressions by periodic power blading, scarifying; and/or filling settled

areas, ruts, pockets, or holes with compacted aggregate base material or temporary asphalt where used.

As a dust preventive, the Contractor shall apply, calcium chloride over the surface of the compacted aggregate base in such amounts and at such times as are necessary to avoid or eliminate dust complaints from nearby residents. In event of any question regarding the existence or nonexistence of a dust nuisance, the City Engineer's and the City's decision on the matter will govern. The material used shall be Regular Flake Calcium Chloride having a minimum chemical content of Calcium Chloride of seventy-seven percent (77%). Unless otherwise specified or ordered by the City Engineer and the City, the rate of application shall be one and one half (1½) pounds per square yard of surface covered.

Wherever surface settlement is not important, unless otherwise specified or directed, the backfill shall be neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation. Just prior to the completion of all work under the contract, any surface settlement below original ground surface shall be refilled in a satisfactory manner and reseeded as specified if required.

7.4 Laying of Sewers

A. General

This section on the Laying of Sewers shall be divided into two (2) classifications - rigid and nonrigid conduit. Pipe materials such as concrete, steel, PVC/ABS truss, and ductile iron pipe are considered rigid conduits. Thermoplastic (PVC) shall be considered nonrigid or flexible conduits.

B. Rigid Conduit Installation

All rigid conduit for sewer pipe shall be laid to the lines and grades, unless otherwise directed by the City Engineer and the City. All rigid pipe shall be laid in accordance with the details for the First-Class Pipe Laying Method. This First-Class Pipe Laying Method may be achieved by Class B bedding methods as shown in the ASCE Manual of Practice No. 37, latest edition. Under this Class B bedding Method, the pipe shall be bedded in compacted granular material (Class I or Class II) placed on a flat trench bottom. The bedding shall have a minimum thickness of one-fourth (1/4) the outside pipe diameter below the pipe and shall extend halfway up the pipe barrel at the sides. All granular bedding material shall be placed in the trench in approximately six (6) inch layers. Compaction shall be accomplished by hand or mechanical tamping or by "walking" the granular material in. From the halfway point on the pipe (Springline) to a point twelve (12) inches above the top of the pipe, backfilling methods A or B or C shall be used depending on the trench location. In addition, all rigid conduit shall be installed in accordance with "Standard Recommended Practice for Installing Vitrified Clay Sewer Pipe" (ASTM Designation C 12 and ASTM D2321).

The laying of pipe in finished trenches shall be commenced at the lowest point, proceeding upstream, with the spigot ends pointing the direction of flow.

No blocking under pipes will be permitted, except as approved by the City Engineer or the City for pipe to be encased in concrete or laid in concrete cradles.

The practice of blocking pipe up to grade with bedding material, then backfilling under is prohibited. The entire length of the bed section is to be at proper grade before installing pipe.

The supporting strength of the pipe is dependent upon its foundation and trench width. To develop normal strength, the pipe shall have a firm uniform foundation under the entire lower quadrant of the barrel. No weight should be supported by the bell. The maximum trench width as recommended by ASTM at the level of the top of the pipe shall be maintained as narrow as possible, taking into consideration the limitation of the excavation equipment except as may be permitted by the City Engineer upon investigation of the soil conditions, laying methods and earth loadings.

All pipes and specials shall be carefully inspected before being laid, and no cracked, broken or defective pipe or special shall be used in the work. All pipe shall be carefully inserted in the bell in such a manner that there will be no unevenness of any kind along the bottom half of the pipes and so that there is a uniform joint space all around.

All pipe that is field cut shall have the homing-marks reestablished, insuring for proper seating depths. Pipes that are field cut shall have the cut ends retapered, by grinding or filing, as close to the original taper provided by the manufacturer as possible. When homing pipe with a spud-bar or other mechanical equipment, other than by hand, place a piece of wood between pipe and tool to prevent damage to bell end-section.

Pipe laid in open cut shall have all trench spaces and voids solidly and completely filled with suitable earth materials from the excavations which shall be thoroughly and solidly rammed into place, unless otherwise specified.

The ends of the pipes shall be protected to prevent the entrance of dirt or other foreign substances. Such protection shall be placed at night or whenever pipe laying is stopped for any reason. Suitable plugs designed for use with the pipe material shall be provided and properly secured and used to cap all slants and branches.

C. Flexible Conduit Installation

Plastic sewer pipe (PVC) and other flexible pipe shall be carefully installed in accordance with the above specification for Rigid Conduit Installation, except where the following paragraphs modify those specifications.

Flexible conduit for sewer pipe shall be installed in accordance with "Underground installation of Flexible Thermoplastic Sewer Pipe" ASTM Designation C 2321.

The Contractor shall take special precautions when joining PVC pipe not to over-seat past the home-marks. The pipe installation must include adequate bedding to hold its proper placement, prior to installing the next section.

The Contractor shall use caution when stringing thermoplastic pipe. Excessive spans, in sunlight, will cause bowing damage; and said damaged spans will be rejected.

In addition to the construction and testing procedures outlined in other sections of these specifications, the Contractor shall be required to install the flexible pipe in such a manner so that the diameter deflection of the pipe shall not exceed five percent (5%) when tested in accordance with the Final Acceptance Test. Bedding materials surrounding the pipe shall be compacted to the densities required to meet the five percent (5%) maximum deflection requirement. The area requiring compaction shall be included in the bed and side fill material and also the material placed above the pipe for a distance of twelve (12) inches over the top of the pipe.

The First-Class Pipe Laying Method for Flexible conduit may be achieved by Class B Bedding Methods as shown in the ASCE Manual of Practice No. 37, latest edition. Under this class B Bedding Method, the pipe shall be bedded in compacted granular material (Class I or II) placed on a flat trench bottom. The bedding shall have a minimum thickness of one-fourth (1/4) the outside pipe diameter below the pipe and shall extend twelve (12) inches above the top of the pipe level and full width of the trench. All granular bedding material shall be placed in the trench in approximately six (6) inch layers.

Compaction shall be accomplished by hand or Mechanical Tamping or by "Walking" the granular material in for Class I materials only. When Class II materials are used compaction shall be accomplished by hand or mechanical tamping only to a minimum eighty-five percent (85%) Standard Proctor Density. Backfill from a point twelve (12) inches above the top of the pipe to the trench surface shall be in accordance with "backfilling Methods A or B or C" depending on the trench location.

Plastic pipe shall not be blocked, except where the plans or specifications call for concrete encasement or concrete cradles for the pipe. Blocks shall be encased in concrete also or removed. Where plastic pipe is to be installed below maximum ground water table, adequate weights shall be provided to prevent flotation of the pipe.

Pipe and fittings shall be carefully inspected before being installed. Cracked, broken or otherwise defective pipe, shall not be used.

7.5 Laying of PVC Force Mains

A. Installation of Buried PVC Pipe

In general, the installation of buried mains shall conform to the requirements of the manufacturer or the AWWA standard for the pipe being installed.

PVC pipe shall generally be installed to conform with Laying Condition F as defined by ANSI A 21.1 and conform with the backfilling and trench maintenance requirements as specified under these specifications.

Plastic pipe shall be firmly bedded in Class II or Class III materials and the bedding thoroughly compacted. Bedding shall be carefully formed by hand to provide complete support of full length of pipe barrel and shall extend to a point twelve (12) inches above the top of pipe. Bell holed shall be formed as necessary. Plastic pipe fittings shall be blocked as required. Backfill above the bedding zone shall be as required. The maximum size of gravel or stones permitted within the embedment zone of the pipe is specified in the table below.

Pipe Diameter (in)	Maximum Particle Size (in)
4	1/2
6 - 8	3/4
10- 16	1
greater than 16	1 ½

Pipe and fittings shall be carefully inspected before being installed. Cracked, broken, bent or otherwise defective pipe shall not be used in work. Exposure to sunlight will be avoided where possible.

Jointing of PVC pipe shall be performed in the ditch, in accordance with recommendations of manufacturer.

Where metal harnesses for thrust protection are necessary, only cast-iron fittings with slotted hydrant lugs, specially made for use with plastic pipe shall be used.

B. Fittings

All fittings of twenty-two and one half (22½) degree bends and greater, including tees shall be properly anchored by concrete thrust blocks of sufficient size not to exceed a soil pressure of two (2) tons per square foot. This blocking shall be installed prior to backfilling and testing.

C. Locator Wire

A continuous wire shall be taped to the top of any non-metallic force main to facilitate line location. Beginning at the lift station, and every five hundred (500) feet thereafter, the wire shall be accessible from the surface. This shall be accomplished by bringing the two ends of the locator wire to the surface by a four (4) inch ductile iron riser installed vertically from the pipe to the ground surface. To facilitate the connection of the riser to the force main, a saddle tee, banded to the force main shall be used. The locator wire shall have at least two and one half (2½) feet of excess which shall be coiled inside of the riser. The riser shall have a ductile iron lid. Said lid shall be flush with the finish grade in yards. Any splicing of the wire underground shall be done in a watertight and insulated manner so that the wire doesn't ground. A continuity test shall be performed at the completion of construction to confirm proper installation.

7.6 Structure Installation

All manholes, inlets and catch basins shall be installed on a minimum of a six (6) inch No. eight (8) stone base. This material shall be compacted. All manholes shall receive a bitumastic coating. This coating shall be applied in the field prior to backfilling. Contractor shall exercise caution to completely cover the entire manhole.

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SECTION 8

SANITARY SEWER INSPECTION, TESTING & ACCEPTANCE

SECTION 8

SANITARY SEWER INSPECTION, TESTING AND ACCEPTANCE

8.1 General

This section describes the minimum requirement and general procedures for the inspection, testing and acceptance of systems dedicated to the City.

Connection Permits for sanitary service will not be issued until all the requirements of this section are fulfilled.

8.2 Inspection

Inspection of the construction shall occur for the duration of the project, including the installation of service laterals. The Owner shall execute the Agreement with the City for such services. Inspection fees shall be as set forth in **Section 3**.

A. General Requirements

1. Contractor and/or Owner shall provide notice to the City and his representative of the planned commencement of construction forty-eight (48) hours prior to such commencement.
2. Once the construction starts, the Contractor shall be responsible for informing and/or notifying the inspection representative assigned of the following:
 - a. Daily work schedule, including any changes in schedule;
 - b. Prior notification if work is to be performed on weekends and/or holidays;
 - c. Date tests are to be performed; and
 - d. Date as-built verification is to be performed.
3. The City, upon request of the Contractor and/or Owner, will schedule the Final Inspection.

All testing required shall be performed under the observation of the City or the City's representative. It shall be the Contractor's responsibility to schedule the testing with the City representative and/or City. Test results obtained in the absence of the presence of the City will not be accepted.

8.3 Testing Gravity Sanitary Sewers

- A. Once constructed, all sanitary sewers and manholes shall be watertight and free from leakage. The rate of infiltration into the sanitary sewer system between any two adjacent manholes or the entire system shall not be in excess of one

hundred (100) gallons per inch of pipe diameter per mile per day (100 gpd/in/mi). The Contractor shall be required to repair all visible leaks.

- B. Any leakage found during the infiltration test shall be corrected at Contractor's expense. Grouting of the joint or crack to repair the leakage shall not be permitted for flexible or semi-rigid pipe. If the defective portion of the sanitary sewer cannot be located, the Contractor shall remove and reconstruct as much of the work as is necessary to obtain a system that passes infiltration requirements.
- C. All gravity sanitary sewers constructed of flexible pipe and Truss pipe shall be deflection tested no sooner than thirty (30) days after installation.
- D. The Contractor shall bear the complete cost and supply all equipment necessary to perform the tests required.
- E. All tests shall be conducted under the observation of the Engineer. It shall be the Contractor's responsibility to schedule testing. The first one thousand (1,000) feet shall be leakage tested within fifteen (15) days after installation and deflection tested within forty-five (45) days after installation.

1. Low Pressure Air Test (All Approved Gravity Sanitary Sewer Pipe Materials Except Concrete)

All gravity sanitary sewers shall be tested for infiltration by means of a low-pressure air test as generally described herein. Any other infiltration test procedure will only be allowed following the submittal of the procedure to the Engineer for review and upon written approval by the Engineer.

a. Equipment

The Contractor shall be responsible for providing all equipment and supplies necessary for the performance of a Low-Pressure Air Test including but not limited to the following:

- 1) Pneumatic Plugs
- 2) Air Control Panel
- 3) Shut-Off Valve, Pressure Regulative Valve, Pressure Relief Valve and Input Pressure Gauge — The pressure regulator or relief valve set shall be set no higher than ten (10) psig to avoid over pressurization
- 4) Continuous monitoring pressure gauge having a range of zero (0) to ten (10) psi — The gauge shall be no less than four (4) inches in diameter with minimum divisions of 0.10 psi and an accuracy of ± 0.04 psi.

To reduce the potential for sewer line over-pressurization, two (2) separate hoses shall be used to: ❶ connect the control panel to the sealed line for introducing low pressure air, and ❷ a separate hose connection for constant monitoring of air pressure buildup in the line.

If pneumatic plugs are utilized, a separate hose shall be required to inflate the pneumatic plugs.

b. Groundwater Elevation and Air Pressure Adjustment

Groundwater monitoring methods shall require the approval of the Engineer. Groundwater depth shall be determined in the field by the Contractor.

1) Air Pressure Adjustment

The air pressure correction, which must be added to the 3.5 psig normal test starting pressure, shall be calculated by dividing the average vertical height, in feet of groundwater above the invert of the sewer pipe to be tested, by 2.31. The result gives the air pressure correction in pounds per square inch to be added.

The allowable pressure drops of 1.0 psig and the timing in **Table 8-1** are not affected and shall remain the same.

2) Maximum Test Pressure

In no case should the starting test pressure exceed 9.0 psig. If the average vertical height of groundwater above the pipe invert is more than 12.7 feet, the section so submerged may be tested using 9.0 psig as the starting test pressure. The 9 psig limit is intended to further ensure workman safety and falls within the range of the pressure monitoring gauges normally used.

2. Test Procedure

Following are general procedures to be employed in the performance of the test.

a. Plug Installation and Testing

After a segment of pipe has been backfilled to final grade, prepared for testing, and the specified waiting period has elapsed, the plugs shall be securely placed in the line at the ends of each segment to be tested.

It is advisable to seal test all plugs before use. Seal testing may be accomplished by laying one length of pipe on the ground and sealing it at both ends with the plugs to be checked. The sealed pipe should be pressurized to nine (9) psig. The plugs shall hold against this pressure without bracing and without any movement

of the plugs out of the pipe. No persons shall be allowed in the alignment of the pipe during plug testing.

It is advisable to plug the upstream end of the line first to prevent any upstream water from collecting in the test line. This is particularly important in high groundwater situations.

When plugs are being placed, the pipe adjacent to the manhole shall be visually inspected to detect any evidence of shear in the pipe due to differential settlement between the pipe and the manhole. A probable point of leakage is at the junction of the manhole and the pipe. This fault may be covered by the pipe plug and thus not revealed by the air test.

b. Line Pressurization

Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches the “starting air pressure” of 4.0 psig greater than the average back pressure of any groundwater above the pipe, but not greater than 9.0 psig. Groundwater Elevation and Air Pressure Adjustment to determine the internal pressure to be applied.

c. Pressure Stabilization

After the starting air pressure is reached, the air supply shall be throttled to maintain that internal pressure for at least 2 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall.

d. Timing Pressure Loss

When temperatures have been equalized and the starting pressure stabilized, the air hose from the control panel to the air supply shall be shut off or disconnected. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 0.5 psig from the starting air pressure. At a convenient reading between 0.5 psig less than starting air and starting air pressure, timing shall commence with a stopwatch.

A predetermined required time for a specified pressure drop shall be used to determine the lines acceptability. A pressure drop of 1.0 psig shall be used.

e. Determination of Line Acceptance

If the time shown in **Table 8.1**, for the designated pipe size and length elapses before the air pressure drops 1.0 psig, the section undergoing test shall have passed and shall be presumed to be free of defects. The test may be discontinued once the prescribed time has elapsed even through the 1.0 psig drop has not occurred.

f. Determination of Line Failure

If the pressure drops 1.0 psig before the appropriate time shown

in **Table 8-1** has elapsed, the air loss rate shall be considered excessive and the section of pipe shall be determined to have failed the test.

3. Test Times

a. Test Time Criteria

The Ramseier test time criteria requires that no test section shall be accepted if it loses more than “Q” cubic foot per minute per square foot of internal pipe surface area for any portion containing less than 625 square feet internal pipe surface area. The total leakage from any test section shall not exceed (625 x Q) cubic feet per minute.

b. Allowable Air Loss Rate

A “Q” value of 0.0015 cubic feet per minute per square foot shall be utilized to assure the OWNER of quality pipe materials, good workmanship, and tight joints.

c. Test Time Calculation

All test times shall be calculated using Ramseier’s equation:

$T = 0.085$	$\frac{D \times K}{Q}$
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Where:

T = Shortest time, in seconds, allowed for the air pressure to drop 1.0 psig

K = 0.000419 DL, but not less than 1.0

Q = 0.0015 cubic feet/minute/square feet of internal surface

D = Nominal pipe diameter in inches, and

L = Length of pipe being tested in feet

For more efficient testing of long test sections and/or sections of larger diameter pipes, a timed pressure drop of 0.5 psig may be used in lieu of the 1.0 psig timed pressure drop upon approval of the Engineer. If a 0.5 psig pressure drop is used, the appropriate required test times shall be exactly half as long as those obtained using Ramseier’s equation for “T” cited above.

d. Testing Main Sewers with Building Sewers

In general, the Engineer will only approve the construction of the main line sewer and wye connections with the lateral stubbed-off to the property line. Building sewers will be allowed to be installed during the construction of the main line sewer only upon the written request to and written approval of the Engineer. This shall be clearly delineated on the design plans and specifications submitted for approval by the Engineer.

If building sewers are approved for construction by the Engineer as part of the main line sewer, they shall be included in the test and their lengths may generally be ignored for computing the required test times. This can be done because in practice, ignoring the branch, lateral, or house sewers will normally increase the severity of the air test whenever the tested surface area is less than six hundred twenty-five (625) square feet so that the total rate of rejection may only be increased about 2%. If the total tested surface area is greater than six hundred twenty-five (625) square feet, ignoring the lateral sewers will only slightly decrease the severity of the test.

e. Specified Timetables

To facilitate the proper use of this recommended practice for air testing, the following tables are provided. **Table 8-1** contains the specified minimum times required for a 1.0 psig pressure drop from a starting pressure of at least 3.5 psig greater than the average back pressure of any groundwater above the pipe's invert. **Table 8-2** contains specified minimum times for required for a 0.5 psig pressure drop from a starting pressure of at least 3.5 psig greater than the average back pressure of any groundwater above the pipe's invert.

4. Water Infiltration Test for Air Test Failures (and for Concrete Gravity Sanitary Sewer Pipes)

The Contractor may conduct a water infiltration test (weir test) when an air test fails to establish whether the one hundred (100) gal/in/mi/day maximum allowable infiltration rate is being exceeded. Water infiltration test may also be used for concrete pipe. If field conditions do not allow for infiltration test, an exfiltration test may be used upon written approval from the Engineer.

If the air test on the sewer system or any segment thereof fails, but the water infiltration or exfiltration test on the sewer system or any segment thereof passes; the sewer system or segment thereof shall be deemed acceptable. However, the Contractor shall be responsible for repairing all visible leaks regardless of ability of the sewer system or segment thereof to pass any established test criteria enumerated in these Standards.

The infiltration test shall not be considered a valid leakage test unless the top surface of the groundwater level is at least two (2) feet above the pipe during the test measurement. The Contractor may simulate this condition by flooding the trenches.

The rate of infiltration of water into the sewer, including appurtenances, shall not exceed one hundred (100) gallons per day, per inch diameter, per mile of sewer. The infiltration between any two adjacent manholes shall not be greater than two hundred fifty (250) percent of the allowable

infiltration rate.

The infiltration allowance for manholes shall be computed using the total number of vertical feet of manhole expressed as the equivalent diameter sewer.

The maximum allowable infiltration expressed in gallons per hour is shown below for various pipe and manhole sizes.

Dia. of Sewer (inches)	Infiltration Per Ft./Per Hr. (gals.)	Dia. of Sewer (inches)	Infiltration Per Ft./Per Hr. (gals.)
4	0.0032	21	0.0166
6	0.0048	24	0.0189
8	0.0063	27	0.0213
10	0.0079	30	0.0237
12	0.0095	36	0.0284
15	0.0119	42	0.0332
18	0.0142	48	0.0379

48" diameter manhole = 0.0379 gal per vertical foot per hour

5. Deflection Test for Select Pipe

A five percent (5%) vertical Mandrel Deflection Test shall be performed on all PVC and Truss Pipe gravity sanitary sewer pipe.

These pipes shall be mandrelled with a rigid device sized to pass five (5) percent or less vertical deflection (or deformation) of the base inside diameter of the pipe. The mandrel test shall be conducted no earlier than thirty (30) days after reaching final trench backfill grade.

Each pipe material/type required to be Mandrel tested shall be tested with a mandrel approved by the pipe manufacturer and meeting the requirements of this Section.

The mandrel shall be pulled through all sewer lines in a manner acceptable to the Engineer and any section of sewer not passing the mandrel shall be uncovered, replaced or repaired to the Engineer's satisfaction and retested.

The Contractor shall provide proving rings to check the mandrel. Drawings of mandrels with complete dimensions shall be furnished to the Engineer upon request for each diameter and specification type.

TABLE 8-1
Specification Time Required For a 1.0 PSIG Pressure Drop
For Size and Length of Pipe Indicated For Q = 0.0015

Pipe Dia. (in)	Min. Time (min:sec)	Length for Min. Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	
4	3:46	597	0.380L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24	
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24	
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48	
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38	
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04	
18	17:00	133	7.692L	17:00	17:00	25:38	32:03	38:27	44:52	51:16	57:41	
21	19:50	114	10.470L	19:50	19:50	34:54	43:37	52:21	61:00	69:48	78:31	
24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33	
27	25:30	88	17.306L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48	
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15	
33	31:10	72	25.852L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53	
36	34:00	66	30.768L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46	

TABLE 8-2
Specification Time Required For a 0.5 PSIG Pressure Drop
For Size and Length of Pipe Indicated For Q = 0.0015

Pipe Dia. (in)	Min. Time (min:sec)	Length for Min. Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	0.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.472L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	0.760L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	46:54
30	14:10	80	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23

8.4 Sanitary Manhole Testing

All manhole vacuum tests shall be conducted in the presence of a representative of the City.

The vacuum test equipment shall consist of: inflatable plugs for all incoming and outgoing sewer lines; an inflatable test collar to seal the manhole at the manhole frame; and a vacuum pump. A vacuum gauge shall be located in-line between the test collar and the pump to accurately indicate the vacuum in inches of mercury within the manhole. The vacuum gauge shall have a range to no more than thirty (30) inches of mercury, with scale markings of no greater than one-half (1/2) inch of mercury vacuum and an accuracy to within \pm two percent (2%) of true vacuum.

The vacuum test shall be conducted by plugging all incoming and outgoing sewer lines in the manhole at a location beyond the connection of the sewer pipe with the manhole. All plugs shall be blocked in place so as not to move during the test. The vacuum testing collar shall be inflated in the frame in accordance with the equipment manufacturer's recommendations. A vacuum of ten (10) inches of mercury shall be drawn and the vacuum pump turned off and the valve between the vacuum pump and the vacuum gauge shall be turned off.

The time period which is taken for the vacuum to fall from ten inches (10") of mercury to nine inches (9") of mercury shall be determined. If the time taken for the vacuum to reduce the ten inches (10") of mercury to nine inches (9") of mercury is less than the time indicated in the following Table, then the manhole work shall be considered not acceptable and shall be rejected. If the time is equal to or exceeds the time indicated below, the manhole work shall be accepted.

Manhole Dept (ft.)	Diameter		
	48"	60"	72"
	Time (sec)		
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	65
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121
For each add'l 2' add:	5	7	8

Contractor shall submit to the City the results of each manhole vacuum test. Such reports shall include a description of the location of the manhole, the time, date and weather of the test, a list of all persons' present, the diameter and depth of the manhole and the allowable test results, and the actual test results.

All manholes shall be repaired by Contractor and retested as described above until a successful test is made. After each test, the temporary plugs shall be removed.

Once all manholes have been tested, the manholes will be given a field visual inspection. The inspection shall be performed at the discretion of the City during the warranty period following a rainfall sufficient enough to raise the groundwater table above the problem areas. All leakage problems determined by this inspection shall be corrected by the Contractor within an agreed upon time to the satisfaction of the City. Where necessary to complete the work, the Contractor shall be responsible for the bypassing and/or blocking of the flow in the manholes and must have prior approval by the City Engineer or City. It will be the Contractor's responsibility to supply his own traffic control as required by the particular location and/or jurisdiction.

8.5 Force Main Testing

A. General

After the pipe has been laid and partially backfilled, all newly laid pipe or any valved sections of it shall be subjected to a hydrostatic pressure test. The duration of each pressure test shall be for a period of not less than two hours and not more than six hours. The basic provisions of AWWA C-600, Section 4 shall be followed for all pressure testing.

The test pressure shall not exceed pipe and/or thrust resistant design pressures. The test pressure shall not vary by more than plus or minus five (5) psi for the duration of the test.

All newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing or fifty (50) psig whichever is greater.

B. Pressurization

Each valved section of pipe shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge shall be applied by means of a pump connected to the pipe in a manner satisfactory to the City. The pump pipe connection and all necessary apparatus, including gauges and meters shall be furnished by the Contractor. Before applying the specified test pressure, air shall be expelled completely from the test section.

Any exposed pipe, fittings, valves, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or joints that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated until it is satisfactory to the City or his representative.

C. Leakage Test

After the completion of the pressure test a leakage test shall be conducted to determine the quantity of water lost by leakage under the specified test pressure. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within five (5) psi of the specified test pressure after the pipe has been filled with water and the air has been expelled.

Leakage shall be measured by a drop-in pressure in a test section over a period of time.

For sanitary pressure lines, no leakage shall be permitted during the 2-hour test period.

8.6 Lift Station Pump Testing

Lift station pump test will be performed by the City or his representative during the lift station's final inspection. The Contractor shall be responsible for providing the clean water to run the pumps and perform the test(s).

A. Manufacturer's Start-Up

Prior to the City's final inspection of the lift station equipment, the Contractor shall be responsible for coordinating start-up activities with the pump manufacturer's representative in accordance with the manufacturer's requirements. The City or his representative must be present at the time of manufacturer's start-up.

Any deficiencies in equipment and/or workmanship noted during the manufacturer's start-up shall be remedied by the Contractor prior to final inspection.

Upon successful completion of the manufacturer's start-up, the manufacturer shall deliver to the Contractor:

1. Three (3) copies of a letter certifying that all pumping and electrical equipment has been installed and is operating in accordance with manufacturer's requirements;
2. Two (2) sets of Operation and Maintenance Manuals; and
3. One (1) complete set of Spare Parts as specified.

B. Final Inspection

The Contractor shall provide the following pump test equipment and materials:

1. Water to conduct test;
2. Amp/voltmeter;
3. Stopwatch;
4. Tape or level rod to measure float settings;
5. Keel to mark float settings on lift station wall;
6. Calibrated test gauge to measure operating head. The gauge shall be calibrated in feet of water from zero (0) to one hundred (100) feet in one (1) foot increments; and
7. Manufacturer's pump performance curves.

The City's representatives attending the final inspection shall re-check any deficiencies. The City's representatives shall then complete a cursory final inspection checklist and perform pump down tests which shall include the following:

1. Manual check of all level ON-OFF operation, alarm and run lights;
2. Determination of inflow rate (if any);
3. Determination of pump capacity for each pump individually and both/all pumps simultaneously;
4. Determination of pump capacity with force main full. Verification of full force main shall be determined by pressure gauge provided by Contractor. Force main shall be considered full when the line pressure stabilizes; and
5. Plot performance of each pump or pump curves provided by Contractor.

Contractor shall provide all water necessary to conduct the pumping tests and shall provide a connection for the test gauge on the blind flanged tee in the valve vault. The stem connection shall be equipped with a plug valve to close the connection after testing is complete. The connection shall be left in place and shall be suitable for use as an air bleed off.

The pumping test results must meet or exceed the design pumping criteria approved by the City to successfully pass the final inspection. Any deficiencies noted during the final inspection shall be repaired/replaced by the Contractor to the satisfaction of the City and reinspected/retested prior to final acceptance.

8.7 Lateral Location Forms

The Developer/Contractor shall submit a lateral location form for each lot, measuring from the nearest upstream and downstream manhole to the lateral. The form shall be completed and signed by the Contractor, the City or his representative during lateral inspection. This form shall include one (1) digital photograph taken from the point of connection to the public sewer, looking back along the lateral to the building.

8.8 Acceptance

In order for the City to issue final acceptance, the following items shall be submitted, completed or on file:

- A. Copies of all testing reports and data;
- B. Copies of all O & M Manuals for lift station(s) (if applicable);
- C. Pump manufacturer's certification letter (if applicable);
- D. Lift station final inspection checklist (if applicable);
- E. Final payment for inspection services;
- F. Lateral location forms;
- G. As-Built drawings;
- H. Maintenance bonds; and
- I. Daily inspection reports.

FINAL INSPECTION

SUBMERSIBLE LIFT STATION CHECK LIST

Job No.:
Address:
Contractor:
Engineer:
Pump Supplier:
KW Meter No.:
Date:

I. ELECTRIC

- A. Is the power system 3 phase or 1 phase?
- B. If 3 phase, is grounded neutral provided? YES () NO ()
- C. If above answer is "No", is transformer installed? YES () NO ()
- D. Voltage Readings:
1. Between phases: L1, L2 _____ L1, L3 _____ L2, L3
 2. High phase to ground:
 3. Other legs to ground:
- E. High leg (L₃) is connected to motor only and not to any auxiliary circuits:
YES () NO ()
- F. Do latches on control panel work smoothly? YES () NO ()

Remarks

II. PUMP AND MOTOR CONTROLS

- A. Breaker switches operate properly:
1. No. 1 Pump YES () NO ()
 2. No. 2 Pump YES () NO ()
 3. Control Circuit YES () NO ()
 4. Remote Monitor Circuit YES () NO ()
- B. Hand-Off-Automatic Switches:
1. No. 1 Pump Hand Position Operates YES () NO ()
 2. No. 2 Pump Hand Position Operates YES () NO ()
- C. Amperage:
1. Name Plate Rating (amps) No. 1 Motor
 2. Amps Pulled By No. 1 Motor
 3. Name Plate Rating (amps) No. 2 Motor
 4. Amps Pulled By No. 2 Motor
- D. Automatic Operation:
1. No. 1 Pump Automatic Position Operates YES () NO ()
 2. No. 2 Pump Automatic Position Operates YES () NO ()

3. Do the level controls sequence pumps properly properly with relation to lead pump on, lag pump on, and alternation? YES () NO ()
- E. Seal Failure/Heat Sensor:
 1. Seal failure wires connected properly to seal failure circuit? YES () NO ()
 2. Test seal failure circuit OK: YES () NO ()
 3. Heat sensor wires connected properly to heat sensor circuit? YES () NO ()
 4. Test heat sensor circuit OK: YES () NO ()
- F.
 1. High water alarm light and horn activate with test button: YES () NO ()
 2. Horn silence with silence button? YES () NO ()
 3. High water alarm light and horn activate with float? YES () NO ()
- G. Level Setting:
 1. Lead pump kicks **on** at EL ____ (____' ____") from wet well bottom.
 2. Lead pump kicks **off** at EL ____ (____' ____") from wet well bottom.
 3. Lag pump kicks **on** at EL ____ (____' ____") from wet well bottom.
 4. Lag pump kicks **off** at EL ____ (____' ____") from wet well bottom.
 5. Height of influent sewer above floor of wet well ____' ____".
 6. Height of high water above floor of wet well ____' ____".
 7. Top of basin EL _____.
Total basin depth ____' ____".

Remarks

III. PUMPS AND MOTORS

A. Operation

- | | | |
|------------------------------------|---------|--------|
| 1. Are pumps running quietly? | | |
| a. No. 1 | YES () | NO () |
| b. No. 2 | YES () | NO () |
| 2. Are motors running quietly? | | |
| a. No. 1 | YES () | NO () |
| b. No. 2 | YES () | NO () |
| 3. Is excessive vibration noticed? | | |
| a. No. 1 | YES () | NO () |
| b. No. 2 | YES () | NO () |

Remarks

IV. REMOTE MONITOR PANEL (if required)

- | | | |
|---|---------|--------|
| A. Verify start-up procedure completed properly and put "On-Line" by remote monitor panel supplier: | YES () | NO () |
|---|---------|--------|

V. VALVES

A. Check Valves

- | | | |
|--|---------|--------|
| 1. Do clappers swing freely? | YES () | NO () |
| 2. Does packing leak? | YES () | NO () |
| 3. Are counterweights adjusted properly? | YES () | NO () |

B. Plug Valves

- | | | |
|---|---------|--------|
| 1. Do valves open and close properly? | YES () | NO () |
| 2. Does packing leak? | YES () | NO () |
| 3. During operation, are all gates completely open? | YES () | NO () |

Remarks

VI. PUMP DOWN TEST

A. Diameter of wet well _____' _____".

(Re: 6'0" = 212 gallon/ft) (7'0" = 288 gallon/ft) (8'0" = 376 gallon/ft)

<u>ITEM</u>	<u>LEVEL</u>	<u>LEVEL</u> <u>DIFFERENCE</u>	<u>GAL.</u>	<u>TIME</u> <u>DIFFERENCE</u>	<u>GPM</u>
Pump #___ ON	_____	_____	_____	_____	_____
Pump #___ OFF	_____	_____	_____	_____	_____
Pump #___ ON	_____	_____	_____	_____	_____
Pump #___ OFF	_____	_____	_____	_____	_____
Pump #___ ON	_____	_____	_____	_____	_____
Pump #___ OFF	_____	_____	_____	_____	_____
Pump #___ ON	_____	_____	_____	_____	_____
Pump #___ OFF	_____	_____	_____	_____	_____
Pump #___ ON	_____	_____	_____	_____	_____
Pump #___ OFF	_____	_____	_____	_____	_____
Pump #___ ON	_____	_____	_____	_____	_____
Pump #___ OFF	_____	_____	_____	_____	_____
Pump # _____ Average GPM					
Pump # _____ Average GPM					
Pump # _____ Average GPM					
Pump # _____ Average GPM					

VII. ALARM SYSTEM

A. Code Indication - Functioning

- | | | |
|------------------------------|---------|--------|
| 1. Pump overload trip: | YES () | NO () |
| 2. Wet well high water: | YES () | NO () |
| 3. Submersible seal failure: | YES () | NO () |
| 4. Power failure: | YES () | NO () |
| 5. Open: | YES () | NO () |
| 6. Restore to normal: | YES () | NO () |
| 7. Low battery: | YES () | NO () |

Remarks

VIII. EQUIPMENT

- | | Manufacturer | Model | Size | Serial # |
|-----------------------------|--------------|-------|------|----------|
| A. Pumps: | | | | |
| B. Motors: | | | | |
| C. Pump Circuit Breaker: | | | | |
| D. Starters: | | | | |
| E. Heaters: | | | | |
| F. Control Circuit Breaker: | | | | |
| G. Remote Monitor: | | | | |
| Circuit Breaker: | | | | |
| H. Alternator: | | | | |
| I. H-O-A Switches: | | | | |
| J. Plug Valves: | | | | |
| K. Check Valves: | | | | |
| L. Other: | | | | |
| 1. | | | | |
| 2. | | | | |

Remarks

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SECTION 9

**SANITARY SEWER
&
MANHOLE REHAB-CIPP**

SECTION 9

SANITARY SEWER AND MANHOLE REHABILITATION

9.1 General

This section pertains to the maintenance and rehabilitation of sanitary sewers and manholes. The common form of sanitary sewer rehabilitation is the process of cured-in-place pipe, or CIPP. Manhole rehabilitation includes a variety of methods with appropriate uses described in this section.

9.2 General Sewer Requirements

A. Description

1. The intent is to have a resin impregnated flexible felt tube installed and cured in place in the designated mainline sewers. The tube shall be inverted into the mainline sewer utilizing a vertical inversion standpipe and hydrostatic head or mechanically installed. Curing of the mainline sewer shall be accomplished by circulating hot water to cure the resin into a hard-impermeable conduit. When cured, the tube shall extend over the length of the existing line in a continuous tight-fitting watertight pipe within a pipe. The rehabilitation of the sewer main shall be performed without the need for excavation or demolition of existing structures and be able to re-establish lateral services without excavation. The pipe lining method shall have sufficient structural strength to support all dead loads, live loads, and ground water loads imposed with the assumption that the existing pipe cannot share any loading or contribute to structural integrity of the liner. The liner shall provide the least possible thickness or decrease in pipe diameter to meet the strength and other design requirements of this specification.
2. The Contractor shall be responsible for a site visit before the submittal of the bid package to determine the existing field conditions. Contractor shall be responsible to verify the pipe diameter before or during CIPP lining segments.
3. Steam-cured lining is acceptable where applicable in the field, in accordance with ASTM standards, and as determined by Contractor and his/her respective Engineer's recommendations.
4. Installed liners that fail shall be removed and reinstalled by Contractor at no additional cost to City.
5. This section references ASTM D5813 (Standard Specification for Cured-in-Place Thermosetting Resin Sewer Pipe), ASTM F1216 (Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube, ASTM F1743 (Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-In-Place Installation of Cured-In-Place Thermosetting Resin Pipe),

and ASTM D790 (Test Methods for Flexural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials).

B. General Requirements

1. Submit manufacturer's product data, including physical and chemical properties, installation instructions, application limitations, and field quality control.
2. Manufacturer's certificate of compliance certifying compliance with the applicable specifications and standards.

Certification on manufacturer's letterhead stating applicator is factory trained and approved by manufacturer in application of the specified products.
3. Certified copies of all test reports on the properties of the selected resin, including structural tests and chemical resistance test performed on each installation run.
4. Liner wall thickness and design criteria and criteria, seal by a professional engineer, for each location.
5. Proposed location to "wet out" the CIPP liner.

C. Chemical and Physical Properties

1. Unless otherwise specified, the Contractor shall furnish a general purpose, unsaturated, polyester or vinylester resin and catalyst system compatible with the CIPP process that provides cured physical strengths specified herein. The long-term flexural modulus to be used shall not exceed 50% of the short-term value for the resin system unless the tube contains reinforcements.
2. The finished Cured-In-Place Pipe (CIPP) shall be fabricated from materials which when cured will be chemically resistant to withstand internal exposure to domestic sewage.
3. The CIPP shall conform to the minimum structural standards in the Modified ASTM D-790

D. Material and Equipment Acceptance

1. At the time of manufacture, each lot of liner shall be inspected for defects. At the time of installation, the liner shall be homogeneous throughout, uniform in color, free of holes, foreign materials, blisters, or deleterious materials.

2. No sewer segment shall be lined without prior notification of the City. Each liner shall be subject to inspection by the City immediately before it is installed and defective liner shall be rejected.
3. The Contractor shall furnish, prior to use of the lining materials, satisfactory written guarantee of his/her compliance with the manufacturer's standards for all materials and techniques being used in the cured-in-place lining process. The Contractor shall provide certified test results from the manufacturer showing the material conforms with the applicable requirements. Materials not complying with requirements shall be rejected.

9.3 Sewer Rehabilitation Materials

B. General

1. The Felt Tube shall be fabricated to a size that, when installed, will neatly fit the internal circumference of the conduit. Allowance shall be made for circumferential stretching during insertion. Contractor is responsible to confirm pipe diameters and roundness for liner material calculations for each specific pipe location.
2. The minimum thickness for the liner material shall be verified by design calculations prepared by a Professional Engineer familiar with CIPP design for each specific pipe location. Design of the liner shall be based on the conditions of the existing pipe which shall be classified as fully deteriorated based on the definitions thereof contained in ASTM F1216 Appendix X1. The liner shall be designed to withstand all imposed loads, including live loads if applicable and hydrostatic pressure. The groundwater elevation above the invert of the existing sewer to receive lining shall be actual depth to crown. The proposed cured-in-place liner to be used shall be designed for a minimum fifty (50) year service life under continuous loading conditions.
3. The minimum length shall be that deemed necessary by the Contractor to effectively span the distance from the inlet to the outlet of the respective manholes unless otherwise specified. The Contractor shall verify the lengths in the field before impregnation. Individual inversion runs can be made over one or more manhole sections as determined in the field by the Contractor and approved by the City.

B. Tube

1. The sewn tube shall consist of one or more layers of absorbent non-woven felt fabric and meet the requirements of ASTM F1216, Section 5.1 or ASTM F1743, Section 5.2.1 or ASTM 5813, Section 5 and 6. The tube shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe, and stretch to fit irregular pipe sections.

2. The wet-out tube shall have a relatively uniform thickness so when compressed at installation pressures will equal or exceed the calculated minimum design CIPP wall thickness.
3. The tube shall be manufactured to a size that when installed will tightly fit the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during installation.
4. No material shall be included in the tube which may cause delamination in the cured CIPP. No dry or unsaturated layers shall be evident.
5. The tube shall be marked for distance at regular intervals along its entire length, not to exceed five (5) feet. Such markings shall include the Manufacturer's name and identifying symbol.

C. Resin

The resin system shall be corrosion resistant polyester, vinyl ester, or epoxy, with initiators so when cured within the tube create a composite meeting the requirements of ASTM F1216, ASTM D5813 and ASTM F1743.

9.4 General Manhole Requirements

A. Summary

1. The Contractor shall perform the various types of manhole rehabilitation where shown on the plans and as specified in this section.
2. The rehabilitation of manholes shall be accomplished by the application or installation of a number of components either individually or together with other components. These may include but are not limited to grouts, bulkheads, protective coatings, linings, inserts, seals, castings and mechanical devices that, when installed, shall protect the structure from infiltration and inflow.
3. The manhole rehabilitation components shall not cause any adverse effects to any of the Owner's processes or facilities during or after application. The use of the product, by the Contractor, shall not result in the formation or production of any detrimental compounds or by-products at the wastewater treatment plant. The Contractor shall notify the City and identify any by-products produced as a result of the installation operations, test and monitor the levels, and comply with any and all local waste discharge requirements.
4. The Contractor shall cleanup and restore existing surface conditions and structures to original or better condition. Any rehabilitation component determined to be defective shall be repaired by the Contractor at no additional cost to the City. The Contractor shall conduct rehabilitation operations and cleanup in a manner to minimize obstruction and inconvenience to traffic, pedestrians, businesses, and property owners.

5. Regardless which activity occurs last, manhole rehabilitation or sewer main CIPP, all sewers and manholes within project shall be cleaned of all construction debris.

B. Description

1. These specifications cover all work necessary to furnish and install all manhole rehabilitation components. The Contractor shall deliver a finished product(s) including all materials, labor, and equipment for all dewatering, cleaning, removal of steps, bypass pumping, surface restoration, masonry work, cementitious lining, manhole bench/channel modifications or construction, protective coating of manhole interiors, frame, chimney, and cover repair; pipe and fittings, pipe seals, interior manhole drops, manhole inserts, external chimney seals, external joint seals, manhole frame seals and/or chimney seals, sanitary sewer manhole marking devices, new manhole castings, casting adjustments, grading and seeding needed to restore the area around the manholes to equal or better condition, root removal & prevention regardless of additional component work, and all other materials and operations necessary to complete the manholes and connections as shown on the plans, as specified, and as ordered by the City, except work which is specifically included under other contract items.
2. Lining of manholes shall include the bench unless manhole is to receive a new bench and channel as noted in the construction plans. Cost of work shall be included in the appropriate bid item as there will be no additional vertical linear foot calculation for payment of the bench lining.
3. Any obstruction(s) prohibiting access to a manhole shall be the Contractor's responsibility to remove at no cost to the City. The removal shall be coordinated with the property owner. No change order shall be given for obstruction removal and is the Contractor's responsibility to investigate site conditions and manholes prior to bid submittal and commencement of construction activities.

C. Requirements

1. Design drawings shall be submitted to the City Engineer for approval in accordance with the **Section 3** of these standards, General Rules and Requirements.
2. Product data, including manhole rehabilitation component, manufacturer, data sheets, ASTM references, material composition, manufacturer's recommended specifications, component physical properties and chemical resistance.
3. Manufacturer's recommended procedures for storing and handling materials, including Contractor's proposed method for complying to the storage and handling requirements.

4. Manufacturer's detailed description of the recommended material installation/application process including mixing, additives, set time, and all equipment required for quality product installation.
5. Technical data sheet on each manhole rehabilitation component applied/installed, stating the expected longevity of the component in a wastewater environment. Data sheet shall be based on independent third-party tests.
6. Manufacturer's detailed description of all required field-testing processes and procedures.
7. Copies of independent testing performed in the rehabilitation component, indicating that the product meets the requirements of these specifications.
8. By-pass pumping plan.
9. Certified statement from the manufacturer that the Contractor is approved to install the manhole rehabilitation component with certificates of completed training from each worker involved with the installation of the rehabilitation component.
10. Shop drawings shall be submitted to the City Engineer for approval for manhole castings, inside drop components, internal chimney seals, external joint sealants and wraps, epoxy frame and chimney seal, cementitious lining, sanitary sewer manhole markers, hydraulic cement mortar and extrudable gasket material. The submittal shall include documentation that the Contractor field verified the condition and sizes of all manhole frames and covers requiring replacement, along with the sizes of the proposed replacement frames and covers to insure the proper fit of all replacement castings. See Section 3, General Rules and Requirements, for more details on shop drawing submission.
11. A complete and accurate record of all work performed, and all components installed for each manhole rehabilitated.

9.5 Manhole Rehabilitation Products General

- A. "Interior Manhole Lining" includes cementitious products only as detailed herein.
- B. "Corrosion Barrier" includes either a Polymer/Polyurethane product as detailed herein or the Cementitious Coating AND an Epoxy coating as detailed herein. Both methods shall include cleaning and manhole repair as specified below.
- C. Manholes indicated to be both "Raised" and lined, shall receive lining on the existing manhole structure only.
- D. For details on initial manhole installation and product choice see **Section 5**.

9.6 Interior Manhole Lining

A. Hydraulic Cement Restoration Mortar

1. Restoration mortar and manhole frame seal/chimney seal shall be from a single manufacturer.
2. Materials shall be compatible with manhole substrate and with each other. Material shall also have a minimum of three years of successful service history in aggressive sewer environments where the restoration mortar and corrosion barrier coating were applied together.
3. Hydraulic Cement Mortar shall be used to stop leaks through cracks and holes. Material shall be Mainstay ML-10 as manufactured by Madewell Products Corporation, Strong-Plug by The Strong Company, Inc., or equal.
 - a. Composition: Blend of hydraulic cements and fillers
 - b. Compressive Strength – Conforming to ASTM C109
 - 1) One (1) Day: three thousand five hundred (3,500) psi
 - 2) Seven (7) Days: four thousand nine hundred (4,900) psi
 - 3) Twenty-Eight (28) Days: five thousand five hundred (5,500) psi
 - c. Tensile Strength – Conforming to ASTM C496
 - 1) Seven (7) Days: two hundred ninety (290) psi
 - 2) Twenty-Eight (28) Days: five hundred seventy-five (575) psi
 - d. Working Time: Forty-Five (45) to Ninety (90) seconds at seventy-seven degrees Fahrenheit (77° F)
 - e. Color: Dark Grey

B. Cementitious Coating

1. Cementitious Liner
 - a. Cementitious liner shall be a low shrinkage, high strength, polymer modified, sprayable microsilica mortar. Material shall be Mainstay ML-72 Sprayable Microsilica Cement Mortar as manufactured by Madewell Products Corporation or equal.
 - 1) Composition: Blend of cements, microsilica, thermoplastic fibers, densifiers, polymer admixtures and modifiers. Mortar shall not contain calcium aluminate cements or aggregates.

- 2) Thickness shall be a minimum of three quarters ($\frac{3}{4}$) inch and conform to manufacturer's direction.
- 3) Compressive Strength – Conforming to ASTM C109
 - a) One (1) Day: three thousand (3,000) psi
 - b) Twenty-Eight (28) Days: ten thousand (10,000) psi
- 4) Flexural Strength – Conforming to ASTM C-293
 - a) One (1) Day: five hundred thirty-five (535) psi
 - b) Twenty-Eight (28) Days: one thousand five (1,505) psi
- 5) Tensile Strength – Conforming to ASTM C-496
 - a) One (1) Day: three hundred thirty (330) psi
 - b) Twenty-Eight (28) Days: nine hundred ten (910) psi
- 6) Shrinkage – Conforming to ASTM C-490
 - a) Twenty-Eight (28) Days: @ 90% Rh percent – 0%
- 7) Uniaxial Tensile Bond Strength – Conforming to ASTM • C-882
 - a) Twenty-Eight (28) Days: three thousand four hundred forty (3,440) psi
 - b) Color: Dark Gray

2. Work Required

- a. Remove manhole steps.
- b. Prior to any repair work inside the manhole, all interior wall and invert surfaces shall be cleaned using a minimum of five thousand (5,000) pounds per square inch (psi) water to blast and remove all foreign matter, loose mortar, grease, oil residues, and to etch the surfaces. After pressure cleaning, surface is to be cleaned with degreaser or other solvents as needed in order to remove any film or residue on the surface. Structure shall then be pressure rinsed with water.
- c. Material removed from the manhole during cleaning capable of being washed down the sewer without causing any potential obstruction in the sewer may be washed down the sewer unless chemicals are used as part of the cleaning process. Objects that cannot be washed down the sewer shall be physically removed and disposed of at the Contractor's expense.
- d. If the initial water blast cannot be utilized due to structural conditions in the manhole or it does not remove all deposits, then a solution of muriatic acid (hydrochloric acid) at a ratio of one-part acid to ten parts water shall be applied by spraying from above the manhole.

After the acid solution is applied, it shall be washed off completely, and the manhole shall be allowed to dry. The mixing, application, and removal of the acid solution shall be done in strict accordance with the manufacturer's specifications and safety procedures. All waste materials resulting from the cleaning operation shall be removed from the manhole being cleaned and properly disposed of by the Contractor.

- e. Examine surface to receive restoration mortar. Notify the City if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.
- f. Prepare surfaces in accordance with lining manufacturer's instructions.
- g. Provide the City with a minimum of three (3) days advance notice of completion of surface preparation and start of application.
- h. Inspect cleaned surfaces to identify and mark corroded reinforcing steel, and to locate cracks, leaks and joints.
- i. Replace or treat corroded reinforcing steel, repair cracks and leaks and treat joints in accordance with manufacturer's instructions and as approved by the Engineer.
- j. All pipes penetrating manhole wall shall have exposed perimeters sealed.
- k. Refer to ICRI Technical Guideline No. 03730 – Surface Preparation Guidelines for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion.
- l. Apply Madewell Products Corporation's 1312P Epoxy Putty or approved equal after cleaning any exposed reinforcing steel to protect steel from contamination and re-rusting.
- m. Hydrostatic Leak Correction – All visible leaks shall be sealed by application of hydraulic cement mortar.
 - 1) Mix only one (1) to two (2) pounds hydraulic cement mortar at a time.
 - 2) Add water to form a viscous mass with consistency of modeling clay.
 - 3) Apply by hand trowel.
 - 4) Press mixed material firmly into place, starting at top of leak and working downward.
- n. Inject flowing leaks or cracks using a suitable polymer gel or foam approved by hydraulic cement mortar manufacturer. Remove excess or spilled material from concrete surface before application of cementitious liner.
- o. Inspect surfaces for soundness

- p. Prepare surfaces to have a minimum profile of $\frac{1}{16}$ -inch, with aggregate exposed.
- q. Before application of each material, surfaces to be lined will be inspected. Correct defects or deficiencies before application of subsequent material.
- r. Inspection by the City or the waiver of inspection of any portion of the work shall not relieve the Contractor of responsibility to perform the work as specified.
- s. Saturate all surfaces thoroughly with clean water.
- t. Apply restoration mortar, cementitious lining, as soon as water sheen is no longer visible.
- u. Apply cementitious liner in accordance with manufacturer's installation instructions. Apply coating to a point from below the cover's lip to a point where the bench and channel meet.
- v. Apply by one of the following methods:
 - 1) Low pressure, low volume spray equipment (rotor/stator or piston pumps).
 - 2) Wet mix shotcrete equipment.
 - 3) Hand trowel into place.
 - 4) Centrifugal application.
- w. Apply uniformly to substrate to the specified thickness. Do not apply to manhole frame.
- x. Do not trap air in corners, behind exposed reinforcing steel or between lifts.
- y. Finish surface with wood float, sponge float, broom or brush to produce textured surface upon which to apply corrosion barrier.
- z. Hot weather application:
 - 1) Follow manufacturer's instructions to reduce evaporation rate of surface moisture until Corrosion Barrier Mortar can be applied, if required.
 - 2) If applying mortar under conditions such as high temperatures of mortar, substrate or air, high winds and/or low humidity rapid evaporation of surface moisture can occur, causing plastic shrinkage cracking. Apply epoxy corrosion barrier a maximum of one (1) hour after placing cementitious liner.
 - 3) If conditions prevent application of epoxy corrosion barrier, refer to ACI 305R-91, Figure 2.1.5 to estimate the evaporation rate of surface moisture from the mortar. Cover with plastic film or wet burlap to limit evaporation rate to a maximum of 0.1 pounds per square foot per hour.

aa. Cold weather application:

- 1) Follow manufacturer's instructions for minimum application temperature and minimum number of days to protect from freezing.
- 2) During cold weather, a period of three (3) or more days the average temperature drops below forty degrees Fahrenheit (40° F), place cementitious liner at a minimum temperature of fifty-five degrees Fahrenheit (55° F) and protect material from freezing for a minimum of three (3) days at a temperature between fifty-five degrees Fahrenheit (55° F) and seventy-five degrees Fahrenheit (75° F). Gradually reduce mortar temperature during the protection period so that the final twenty-four (24) hours is held as close to fifty-five degrees Fahrenheit (55° F) as practical.
- 3) During periods not defined as cold weather, but when freezing temperatures may occur, protect the mortar against freezing as specified for cold weather for the first twenty-four (24) hours after application.

bb. Clean manhole frame with a wire brush to remove all loose rust and any cementitious lining. Surface shall be clean and dry before application of manhole frame seal material.

C. Corrosion Barrier - Polymer/Polyurethane Foam Coating

1. Materials and Equipment

- a. The materials to be utilized in the lining of manholes shall be designed and manufactured to withstand the severe effects of hydrogen sulfide in a wastewater environment. Manufacturer of corrosion protection products shall have long proven experience in the production of the lining products utilized and shall have satisfactory installation record.
- b. Three thousand (3000) psi hydro blasting equipment shall be suited to remove corroded materials from the existing concrete/brick structure. Material removed from the manhole during cleaning, capable of being washed down the sewer without causing any potential obstruction in the sewer, may be washed down the sewer unless chemicals are used as part of the cleaning process. Objects not able to be washed down the sewer shall be physically removed and disposed of at the Contractor's expense.
- c. Equipment for installation of lining materials shall be high quality grade and be as recommended by the manufacturer.
- d. The lining system to be utilized for manhole structures shall be a multi-component stress skin panel liner system as described below:

e. Liner

Installation	Liner
Moisture Barrier	Modified Polymer
Surfacer	Polyurethane / Polymeric blend foam
Final corrosion barrier	Modified Polymer

- f. Modified polymer shall be sprayable, solvent free, two-component polymeric, moisture/chemical barrier specifically developed for the corrosive wastewater environment.
- g. Polyurethane Rigid Structure Foam, low viscosity two-component, containing flame retardants.
- h. Total thickness of multi-component stress skin panel liner shall be a minimum of five hundred (500) mils.

2. Inspection

- a. Prior to conducting any work, perform inspection of structure to determine need for protection against hazardous gases or oxygen depleted atmosphere and the need for flow control or flow diversion.
- b. Submit plan for flow control or bypass to the City for approval prior to conducting the work.

3. Surface Preparation

- a. Conduct surface preparation program to include monitoring of atmosphere for hydrogen sulfide, methane, low oxygen or other gases, approved flow control equipment, and hydro blasting equipment.
- b. Remove manhole steps.
- c. Hydro blasting equipment shall remove all corrosion from structure. Final product shall be a cleaned, dry surface ready for liner application.
- d. After completion of surface preparation, blasting phase, perform the seven-point check list, which is the inspection for:
 - 1) Leaks
 - 2) Cracks
 - 3) Holes
 - 4) Exposed Rebar
 - 5) Ring and Cover Condition
 - 6) Invert Condition
 - 7) Inlet and Outlet Pipe Condition
- e. After the defects in the structure are identified, repair all leaks with a chemical or hydraulic sealant designed for use in field sealing of

ground water. Severe cracks shall be “repaired with a urethane based chemical” sealant. Product to be utilized shall be as approved by City prior to installation. Repairs to exposed rebar, defective pipe penetrations or inverts, etc. shall be repaired utilizing non-shrink grout or approved alternative method.

4. Material Installation

- a. The limits of the corrosion protection system shall be all exposed concrete/brick surfaces including walls, tap sections, risers, etc., unless otherwise directed by the City.
- b. Application of multi-component system shall be in strict accordance with manufacturer’s recommendation. Final installation shall be a minimum of five hundred (500) mils. A permanent identification number and date of work performed shall be affixed to the structure in a readily visible location.
 - 1) Provide final written report to City detailing the location, date of report, and description of repair.

5. Inspection

- a. Final concrete/brick structure corrosion protection system shall be completely free of pinholes or voids. Entire exposed concrete/brick surface shall be protected with corrosion protection system. Liner thickness shall be the minimum value as described here.
- b. No leakage at base of sanitary system shall be acceptable.

6. Repair of Defects

- a. All defects identified during inspection such as pinholes, low film millage, etc. shall be repaired with same material.

D. Corrosion Barrier - Cementitious Coating and Epoxy Coating

1. Shall be either a Polymer/Polyurethane product OR a Cementitious Coating as specified herein AND an Epoxy coating as detailed as follows:
2. Epoxy coating - Material shall be Mainstay DS-5 Ultra High Build Epoxy Coating as manufactured by Madewell Products Corporation or approved equal.
 - a. Composition: one hundred (100) percent solids, modified epoxy coating.
 - b. Thickness: Minimum of one hundred (100) mils applied in one (1) or two (2) coats, depending on manufacture’s recommendation.
 - c. Number of Components: two (2)
 - d. Finish: Gloss
 - e. Color: White sky blue

9.7 Construct Manhole Channel or Bench

- A. Where indicated, the Contractor shall repair existing bench, adjust bench height, or create a new bench.
- B. The Contractor may be required as part of this work to temporarily restrict or eliminate flow from the existing sewer through the manhole while making the bench and flow channel modifications. It is anticipated this may be accomplished with the use of bypass pumping. At no time during the work shall raw sewage be discharged to the ground or any other location that would be in violation of the City's NPDES permit requirements.
- C. Bench shall be constructed using a high-strength cementitious product specifically designed for the intended use. Contractor shall supply Engineer with product data, including manufacturer and brand name, laboratory test results to verify twenty-eight (28) day compressive strengths, and a list of similar projects in which the product was used.
- D. All voids, irregularities, and leaks in the existing manhole shall be repaired with a high-strength, fast setting, hydraulic cement mortar prior to constructing bench.
- E. All surfaces shall be free of dirt, oil, grease, or other contaminants. Use a high-pressure washer to remove all foreign materials from the bench construction/repair areas. Construct bench (using form boards if required) in such a manner so as to produce a gradual slope towards the flow channel. Ensure that the thickness of the bench shall increase by no less than one (1) inch per foot from the top of the invert and continues in the direction of the wall so as to provide the required slope. The bench shall be free of voids. Level and smooth the surface of the bench.
- F. The cement material shall be given sufficient time to cure in accordance with the manufacturer's requirements prior to being subjected to active flow.

9.8 Interior Manhole Drop

- A. Internal drop pipes shall be installed where indicated in these specifications and on the plans in existing manholes following the installation of the manhole liner.
- B. Inside drop shall be constructed using RELINER Inside Drop Components as manufactured by Duran Inc., or equal. The bowl size shall be determined by incoming pipe size, flow rates, and manhole diameter and in accordance with manufacturer's recommendations. The bowl shall be installed as per manufacturer's instructions using stainless steel fasteners.
- C. The appropriately sized drop pipe of SDR 35 PVC shall be per **Section 5** and shall be securely attached to the manhole wall using stainless steel adjustable clamping brackets and stainless-steel fasteners. The connection of drop bowl to drop pipe shall be by flexible external pipe coupler. The turn-out at the base end of the drop pipe shall be accomplished with an appropriately angled PVC pipe elbow.

- D. Drop pipe will be installed where incoming invert of a pipe is greater than two (2) feet above the invert of the outgoing pipe. Interior drop component connections made to manhole walls shall be watertight.

9.9 New Manhole Castings and Covers

- A. Manhole frames and covers shall be in compliance with **Section 5** "Sanitary Sewer Materials."
- B. Manhole lids shall be solid with two (2) inch letters stating, "Sanitary Sewer".
- C. Manhole lids shall provide a gasket at the frame-lid interface for water tightness (Neenah self-sealing or Engineer approved equal).
- D. Frame to manhole seal shall be manufactured by Cretex Specialty Products of equal.
- E. Pick holes shall be concealed.
- F. Frames shall be placed on concrete rings or concrete cone, not on metal rings.
- G. All replaced castings shall be returned to the City.

9.10 Adjust Manhole Castings

- A. Castings shall be adjusted flush to ground level and be seated center to manhole entrance (cone, etc.). The ground surface shall slope away from the raised casting to prevent ponding and surface runoff from occurring over the casting.
- B. Castings to be adjusted above final grade per plans/specifications (or is pre-existing in this manner) with frame joint exposed shall receive an external chimney seal. All external joint(s) shall receive an external joint wrap.
- C. Precast adjustment rings, cone sections, barrel sections, etc. shall be used to adjust the top of the castings horizontal/vertical as needed to ground level or above grade as designated per the plans and/or specifications. Reposition the frame and seal to the manhole structure. The adjusting rings and top of casting are to be sealed with ½-inch extrudable gasket to produce watertight joints after casting has been wire brushed to remove all dirt and rust prior to being reinstalled. Adjustment rings shall be limited to one (1) foot of depth. Castings shall not be placed on metal rings.
- D. The Contractor shall be responsible for all demolition and surface restoration work required to complete raising the frame. Surface demolition and restoration work shall be in accordance with these specifications.

9.11 Raise Manholes

- A. Manholes shall be raised the height specified or shown in the Construction Plans.

- B. Four (4) foot diameter manhole riser sections and new flat top shall be provided, installed, and tested per **Section 8** and meet all applicable standards. Joints shall be sealed and wrapped per **Section 8**. Manhole casting riser rings up to twelve (12) inches shall be provided as necessary for final elevation.
- C. Existing castings and covers shall be re-set on the new flat tops unless casting and/or cover is noted to be replaced in the Existing Structure Rehabilitation Table in the Construction Plans.
- D. Payment shall be made based on vertical foot of increased elevation from current top of casting elevation to new top of casting elevation. Some existing manholes have cone sections. No additional payment shall be made for new riser sections necessary to replace current cone sections on existing manholes. This shall be included in vertical foot price for this item.
- E. The Engineer shall be notified if any existing manholes are determined to be structurally insufficient to support the extension. Direction on how to proceed will be provided by Engineer on a case by case basis.

9.12 Manhole Frame Seal/Chimney Seal

- A. A flexible epoxy shall be used to seal manhole frames and chimneys. The material shall be manufactured by Cretex Specialty Products or approved equal.
- B. Clean manhole frame with a wire brush to remove all loose rust, dirt and any cementitious lining. All surfaces shall be clean and dry before application of manhole frame seal material.
 - 1. If frame is loosed and/or offset, reposition the frame and seal to the manhole structure using one-half ($\frac{1}{2}$) inch extrudable gasket to produce a watertight joint. Frames shall be cleaned, and wire brushed to remove all dirt and rust prior to being reinstalled.
 - 2. Apply flexible epoxy manhole frame seal to a point two (2) inches above lower portion of manhole frame (e.g., where frame seats to cone) and to a point four (4) inches below lowest adjusting ring where there is no chimney. If adjusting rings are not present apply four (4) inches below joint between cone section or flat top section and frame. If chimney abuts frame, apply four (4) inches below said joint. Chimney shall be defined as any portion of manhole opening below the frame that has the same diameter as frame opening itself; therefore, epoxy coating shall cover entire portion to a point where it opens out to cone section or flat top section. Apply material with a putty knife to a uniform thickness and texture. Application shall be according to manufacturer's recommendations.
 - 3. Allow manhole frame seal to cure at least twenty-four (24) hours in load bearing applications. Do not apply below fifty degrees Fahrenheit (50 ° F). Protect from freezing for at least forty-eight (48) hours after application.

9.13 **Structural Cone or Chimney Repairs**

- A. Where indicated in these specifications and on the plans, the Contractor shall perform manhole cone or chimney repairs. The repairs shall generally consist of replacing missing mortar and brick. **Structural cone repairs shall be completed before installing interior manhole liner.**
- B. The manhole cones shall be repaired using a high-strength material specifically designed for the intended use. Contractor shall supply Engineer with product data, including manufacturer and brand name, laboratory test results to verify compressive strengths, and a list of similar projects in which the products were used.
- C. The cone areas requiring repair shall be thoroughly cleaned to remove all loose mortar and brick, dirt, vegetation, and other contaminants.
- D. Loose and/or offset frames shall be removed. Frames shall be cleaned, and wire brushed to remove all dirt and rust prior to being reinstalled.
- E. Voids resulting from missing brick and mortar shall be repaired with new brick and mortar. All brick used for the cone repairs shall be designed for use in the construction of sanitary manholes and sewers and be capable of withstanding the corrosive environments associated with wastewater. High strength mortar suitable for use in the construction of manholes and capable of withstanding the corrosive environments associated wastewater shall be used in the cone repairs.
- F. The original, cleaned frames shall be reset during the cone repairs. A watertight seal shall be provided between the frame and masonry.
- G. Exposed, exterior cone shall be coated with the same product used for the interior manhole lining to give the manhole a smooth finish. Exterior cone shall be lined from the rim to existing grade.

9.14 **Pipe Seals**

Where manholes do not receive interior manhole lining, pipes designated to be sealed on the plans shall be sealed along its outer perimeter (at wall of manhole) with a watertight, hydraulic sealant. No excavation will be allowed, unless authorized by the Engineer.

9.15 **Reset Frame**

If frame is loose, offset or otherwise directed to be performed as indicated in the plans, reposition the frame and seal to the manhole structure using one-half (½) inch extrudable gasket (Kent Seal or approved equal) to produce a watertight joint. Loose and/or offset frames shall be removed. Frames shall be cleaned, and wire brushed to remove all dirt and rust prior to being reinstalled.

9.16 Experience

Onsite supervisor shall have twenty-five thousand (25,000) feet and/or two hundred (200) line sections of lining experience installing the listed product, and the product should have a minimum of two hundred thousand (200,000) feet and/or one thousand (1,000) line sections installed. The Contractor and the Contractor's key personnel shall have a minimum of one hundred thousand (100,000) feet and/or three hundred (300) line sections of lining experience. The Contractor, supervisor and product shall have a minimum history of five (5) years together.

9.17 Sanitary Sewer Rehabilitation General Installation Procedures

The following installation procedures shall be adhered to unless otherwise approved by the Engineer.

A. Inspection of Pipelines

Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles and service connections by closed circuit television (CCTV). The interior of the pipeline shall be carefully inspected to determine the location of any condition, which may prevent proper installation of the new pipe. Defects shall be noted so that these conditions can be corrected. The City shall keep a suitable log for later reference.

B. Safety

The Contractor shall carry out his operations in strict accordance with all applicable OSHA standards. Particular attention is drawn to those safety requirements involving working with scaffolding and entering confined spaces.

C. Cleaning and Root Treatment of Sewer Line

It shall be the responsibility of the Contractor to remove all internal debris and root growth from the sewer line necessary to complete this work (Refer to **Section 10**). All general cleaning shall be covered in this section.

D. Bypassing Sewage

The Contractor shall provide for the flow of sewage around the section or sections of pipe designated for liner. The bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. The Contractor shall be responsible to notify all property owners that will be affected by the diversion and/or the temporary loss of service two (2) weeks in advance. The Contractor shall not temporarily interrupt service from any one property owner for more than twenty-four (24) hours.

If required for service laterals, the contractor will be responsible to furnish all the necessary equipment to safely divert the flow around the work area. The diversion

shall be Engineer approved. No flow shall be discharged on the surface, into storm sewers, ditches, or in waterways.

E. Line Obstructions

It shall be the responsibility of the Contractor to clear the line of obstructions such as solids that will prevent the insertion of the liner. If inspection reveals an obstruction that cannot be removed by conventional sewer equipment, then the Contractor shall hydraulically re-round the pipe using a trenchless method or make a point repair excavation to uncover and remove or repair the obstruction. Such repair shall be approved in a Change Order prior to the commencement of the work.

9.18 Sanitary Sewer Mainline Liner Installation Procedures

A. Set-Up

1. In general, the CIPP installation shall be in accordance with ASTM F1216, Section 7 or ASTM F1743, Section 6.
2. The Contractor shall designate a location where the felt tube will be vacuum impregnated prior to installation. The Contractor shall allow the City to inspect the materials and "wet out" procedure. A catalyst system compatible with the resin and tube shall be used.
3. The wet-out tube shall be inserted through an existing manhole or other approved access by means of an inversion or cable and winch process. In the case of the inversion method, the application of a hydrostatic head shall be sufficient to fully extend the tube to the next designated manhole or termination point. The tube shall be inserted into the vertical inversion standpipe with the impermeable plastic membrane side out. At the lower end of the inversion standpipe, the tube shall be turned inside out and attached to the standpipe so that a leak proof seal is created. The inversion head will be adjusted to be of sufficient height to cause the impregnated tube to invert from manhole to manhole and hold the tube tight to the pipe wall, produce dimples at side connections and flared ends at the manholes. The Contractor shall use a lubricant as necessary. Care shall be taken during the elevated curing temperature so as not to over stress the felt fiber.

B. Curing

1. After installation is completed the Contractor shall supply a suitable heat source and hydrostatic water pressure recirculation equipment. The equipment shall be capable of delivering hot water throughout the section by means of a pre-strung hose to uniformly raise the temperature above the temperature required to effect a cure of the resin. This temperature shall be determined by the resin/catalyst system employed.
2. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another such

gauge shall be placed between the impregnated tube and the pipe invert at the remote manhole to determine the temperatures during cure. Temperature in the line during the cure period shall be as recommended by the resin manufacturer.

3. Initial cure shall be deemed to be completed when inspection of the exposed portions of CIPP appears to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm. The cure period shall be of a duration recommended by the resin manufacturer, as modified for the CIPP process, during which time the recirculation of the water and cycling of the heat exchanger to maintain the temperature continues.

C. Cool-Down

The Contractor shall cool the hardened CIPP to a temperature below 100°F before relieving the static head in the inversion standpipe. Cooldown may be accomplished by the introduction of cool water into the inversion standpipe to replace water being drained from a small hole made in the downstream end. Care shall be taken in the release of the static head so that a vacuum will not be developed that could damage the newly installed CIPP.

D. Finish

1. The finished CIPP shall be continuous over the entire length of an inversion run and be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes, folds, lumps, and delamination.
2. During the warranty period any defects which will affect the integrity or strength of the CIPP shall be repaired at the Contractor's expense, in a manner mutually agreed by the Engineer and the Contractor.
3. Alternate methods of installing and curing the tube shall be submitted to the Engineer for approval.

E. Sealing the CIPP at Manholes (Watertight Seals)

The CIPP liner joint at all incoming pipes and outgoing pipes at manhole walls shall be made watertight (no exceptions) by the use of an injection grout such as Avanti 202 or Engineer approved equal and further sealed with a hydraulic mortar such as Mainstay ML-10 or Engineer approved equal.

F. Sewer Lateral Reinstallments

After the liner has been cured in place, the Contractor shall reconnect any existing active connections (laterals, outside drops, etc.). The Contractor shall be responsible to confirm the active laterals prior to reconnection. This shall be done without excavation from the interior of the pipeline by means of a television camera and a cutting device that re-establishes the service connections to not less than ninety-five (95) percent capacity. If after reconnection the lateral connection

continues to actively leak, the Contractor shall inform the Engineer and provide Engineer with CCTV video of the leaking lateral connection. After review of the CCTV video and if deemed not a result of Contractor activities, and If directed by the Engineer, the Contractor shall perform a point repair on the lateral connection. Such repair shall be approved in a Change Order prior to the commencement of the work. The Contractor is responsible for paying for any and all repairs if it is deemed to be damaged during the cut-out process for the service lateral or during CIPP installation. All work for trenchless lateral reconnection shall be paid for on a unit price basis based on the number of laterals reinstated. The City reserves the right not to reinstate a lateral determined to be inactive in the field. Under no circumstances shall a cookie from a lateral reinstatement be allowed to pass through the sanitary sewer system. Contractor shall capture all cookies at time of reinstatement.

9.19 Clean-Up

- A. Upon acceptance of the installation work and testing the Contractor shall restore the project area affected by his/her operations. The Contractor shall restore or replace all removed or damaged paving, curbing, sidewalks, gutters, or other disturbed surfaces or structures to a condition equal to that before the work began, to the satisfaction of the City. The Contractor shall furnish all labor and material incidental thereto, at no additional cost to the City.
- B. The Contractor shall remove surplus pipe, tools and temporary structures. All dirt, rubbish and pipe material from the operation shall be legally disposed of by the Contractor.

9.20 Patents and Warranties

- A. Sanitary Sewer Rehabilitation Warranty
 - 1. The Contractor shall warrant and save harmless the City against all claims for patent infringement and any loss thereof.
 - 2. The Contractor shall warrant all work to be free from defects in workmanship and materials for a period of one year from the date of substantial completion of all construction.
- B. Manhole Rehabilitation Warranty
 - 1. The materials used for the project shall be certified by the manufacturer for the specified purpose. The manufacturer shall warrant all manhole rehabilitation components to be free of defects in raw materials for one (1) year from the date of substantial completion. The Contractor shall warrant the installation of the manhole rehabilitation component for a period of one (1) year. During the one (1) year warranty period if any rehabilitation component fails, delaminates, peels, fractures or shows defect which may affect the integrity, strength, function, and/or operation of the manhole it shall be repaired at the Contractor's expense equal to better than the original condition.

2. Manhole lining and corrosion barrier shall have a ten (10) year warranty for leaks.

9.21 Pipe Liner Sections

All sections of pipe shall be the responsibility of the Contractor to verify the size, material, location of structures, number and location of laterals, and existing condition of the pipe prior to construction. The bid proposal contains estimates of the sizes and quantities of liner which will be installed. It shall be the Contractor's responsibility to verify the exact lengths necessary after the segments have been selected and prior to ordering or fabricating any liner materials.

9.22 Quality Assurance

A. Sanitary Sewer Quality Assurance

1. Contractor shall be responsible for implementing quality assurance/quality control procedures necessary to ensure that all post-CIPP CCTV inspection video and observation data meet the requirements of the specification. The City will compare the work products submitted as the Five Percent Submittal against the specification requirements contained herein. Necessary quality improvement requirements will be returned to the Contractor within five working days after the City receives the submittal. Thereafter, the City will conduct a quality review of the submittal and notify the Contractor of any deficiencies or rejected work products. The Contractor shall be responsible for correcting or re-televising any rejected segments identified by Engineer. No sewer pipe segment (manhole to manhole run) shall undergo CIPP lining until Engineer has reviewed and approved the respective pipe segment. Contractor shall be responsible for review of post-CIPP videos for accuracy, clear to view and completeness before submitting to Engineer for review and approval. Incomplete and/or inaccurate post-CIPP videos will be returned to Contractor for resubmittal.
2. Contractor shall resubmit videos to Engineer for review and approval that are accurate and complete and at no additional cost to City. No CIPP payment for installation will occur until accurate and complete post-CIPP books containing logs and videos are submitted, reviewed and approved by Engineer. Both log and video screen data shall be complete, clear to view and accurate.

B. Manhole Quality Assurance

1. A detailed quality assurance plan shall be submitted to the Engineer that conforms to the requirements of these specifications. At minimum the quality assurance plan shall include the following:
2. A detailed description of the proposed quality assurances to be performed by the Contractor.

3. Proposed procedures for quality assurance, product sampling and testing shall be defined.
4. Proposed methods for product performance controls, including method of and frequency of product sampling and testing both in raw material form and cured product form as applicable.
5. A scheduled performance and product test result reviews between the Contractor and the Customer at a scheduled job meeting.

9.23 Testing

A. Sanitary Sewer Testing

1. The water tightness of the CIPP shall be gauged while curing and under a positive head. Any leaks shall be repaired and retested to the satisfaction of the City. The finished liner shall be continuous over the entire length of the installation and conform to the walls of the host pipe.
2. As part of the testing requirement, upon completion of the installation and lateral reconnection, a visual inspection of the expanded in place pipe shall be performed via a closed-circuit television camera. Digital CCTV Recordings on DVD of the inspection shall be provided to the City.
3. At minimum Contractor shall perform one test per manhole to manhole. Section of CIPP placed and cured per NASSCO Standards. Contractor shall provide Engineer with written test report immediately for City records.

B. Manhole Testing

1. The liner system shall be visually inspected to be free of pinholes or voids.
2. The liner thickness shall be the minimum value as specified herein. Contractor shall test four (4) individual locations of liner for proper minimum thickness and provide written documentation to Inspector for each manhole.

9.24 Qualifications

The Contractor shall submit his/her qualification package detailing their experience and resumes of employees that will be performing the work within five (5) days after the submittal of the bid. The submittal shall include a minimum of three (3) projects similar in size and include the amount of pipe rehabilitated as well as contacts for those projects.

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SECTION 10

**SANITARY SEWER CLEANING
&
CCTV INSPECTION**

SECTION 10

SANITARY SEWER CLEANING AND CLOSED-CIRCUIT TV INSPECTIONS

10.1 General

A. Description

Under this Item, the Contractor is required to furnish all materials, labor, equipment, power, etc. to implement sewer cleaning and closed-circuit television (CCTV) pre-cleaning and post-cleaning inspections. The City shall review the CCTV videos prior to any CIPP installation.

B. Scope

Work under this section includes preparing the sewers for relining and performing closed-circuit television (CCTV) inspection. It is anticipated all sewer lines will require heavy cleaning. Heavy cleaning shall be defined as cleaning requiring more than three passes through the sewer line and the use of mechanical cleaning equipment (roots, rocks, debris, gaskets, protruding taps, etc.). Protruding taps that cannot be removed by mechanical methods will be clearly noted on log report and video and Contractor shall immediately notify the City in writing.

Regardless which activity occurs last, manhole rehabilitation or sewer main CIPP, all sewers and manholes within project shall be cleaned of any construction debris.

The work covered within this specification shall be for internal CCTV inspection of sanitary sewer pipes regardless if performing a pre-CCTV or post-CCTV video. The Contractor shall perform sewer televising work as necessary to thoroughly document the condition of all sewers and service laterals connections. The sanitary sewer and service laterals shall be carefully inspected to determine alignment, grade variations, separated joints, location and extent of any deterioration, breaks, obstacles, obstructions, debris, quantities of infiltration/inflow, and the locations of service connections.

Each lateral shall be fully visible in a window view at a fully stopped position before immediately proceeding with a closer, full perimeter pan-view of the lateral reinstatement. Condition of each lateral must be established through video.

10.2 Quality Assurance

Contractor shall be responsible for implementing quality assurance/quality control procedures necessary to ensure that all CCTV inspection video and observation data meet the requirements of the specification. The City will compare the work products submitted as the Five (5) Percent Submittal against the specification requirements contained herein. Necessary quality improvement requirements will be returned to the Contractor within three working days after the City receives the submittal. Thereafter, the City will conduct a quality review of the submittal and notify the Contractor of any deficiencies or rejected work products. The Contractor shall be responsible for correcting or re-televising any rejected segments identified by Engineer. No sewer pipe segment (manhole to manhole

run) shall undergo CIPP lining until Engineer has reviewed and approved the respective pipe segment. Contractor shall be responsible for review of CCTV videos for accuracy, clear to view and completeness before submitting to Engineer for review and approval. Incomplete and/or inaccurate CCTV videos will be returned to Contractor for resubmittal. Contractor shall resubmit videos to Engineer for review and approval that are accurate and complete and at no additional cost to City. No CIPP installation will occur until accurate and complete CCTV videos are submitted, reviewed and approved by Engineer. Both log and video screen data shall be complete, clear to view and accurate.

A. Requirements

1. The Contractor shall inspect the sewer interior using a color CCTV camera and document the inspection on a digital recorder. All inspection video shall be captured in either MPED or Windows Media Video (WMV) file format and saved to DVD for submittal. Each inspected sewer segment, referenced manhole to manhole, should have an associated MPEG or WMV file. Digital photographs (JPG files), inspection reports (PDF files) and any handwritten inspection logs or field maps shall accompany the video inspections for each sewer segment (manhole-to-manhole).
2. The quality of all work specified in this specification shall meet or exceed the requirements of the National Association of Sewer Service Companies (NASSCO) Recommended Specifications for Sewer Collection System Rehabilitation (latest edition), except as described in this specification. Applicable portions of this specification that inadvertently fall below those standards shall be corrected and maintained at the NASSCO standards as a minimum requirement, at no additional cost to the City.
3. Contractor shall provide inspection video, data, and reports in accordance with the requirements specified herein. Contractor shall provide all video on DVD as specified. All work shall conform to current NASSCO Pipeline Assessment Certification Program (PACP) coding conventions and all software used by the Contractor shall be PACP compliant.
4. Contractor shall notify Engineer in writing of any buried structures observed during CCTV activities and shall note such on respective video and log.

B. Major Problems and Emergency Situations

1. The Contractor shall notify the City immediately of any major problems or emergency situations encountered in the field, including collapsed or severely broken pipe, sewer overflows or significant surcharge, sewer blockages, equipment stuck in pipe that cannot be removed, or injury to Contractor personnel or members of the public during Contractor's operations.
2. The Contractor shall provide a twenty-four (24) hour-a-day contact with required available resources to travel to the site within sixty (60) minutes of notification of a problem.

C. Damage

The Contractor will be held responsible for any damage that occurs as a result of the Contractor's work. Any repair of such damage shall be approved by the City prior to its execution. All costs associated with such repairs are solely the responsibility of the Contractor.

D. List of Submittals

1. Contractor shall submit example of log that will be used during project for Engineer's review and approval.

2. Five Percent Submittal (all work products)

The Contractor shall submit a completed work product (CCTV inspection logs, CCTV inspection database, digital photographs, and digital CCTV inspection recording) at the five (5) percent mark [five (5) percent of total CCTV inspection footage] to the City for formal quality review as described above.

3. Final Sewer Cleaning Field Logs

The Contractor shall record data about the cleaning operation on field logs provided to the City. The data will include date of cleaning, type of nozzle used, maximum water pressure used, and a qualitative description of the nature of the material removed by the cleaning, using the same types of observations as those used for the CCTV inspection (e.g., heavy grease, light roots, etc.).

4. Final CCTV Inspection Logs

5. Final CCTV Inspection Database

Final Digital CCTV Inspection Recordings on DVD (analog to digital conversion is allowed as long as requirements regarding "CCTV Equipment" are met)

10.3 National Association of Sewer Companies Certification

Contractor's personnel operating CCTV camera and other equipment required to develop the end product shall hold current certification by the National Association of Sewer Companies (NASSCO) Pipeline Assessment Certification Program (PACP).

- NASSCO Certification number shall be present for each certified operator on all submitted CCTV logs to the City Engineer.

10.4 Equipment

A. Sewer Cleaning Equipment

1. High-Velocity Jet (Hydrocleaning) Equipment: All high velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two (2) or more nozzles. The nozzles shall be capable of producing a scouring action from fifteen (15) to forty-five (45) degrees in all size lines designated to be cleaned. The equipment will have a minimum working pressure of two thousand (2,000) psi at a sixty (60) gpm rate. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall carry a nominal eight hundred (800) gallon minimum water tank, auxiliary engines, pumps, and a minimum of six hundred fifty (650) feet of high-pressure hose on a hose reel.
2. Mechanically Powered Equipment: Bucket machines shall be used when the High-Velocity Jet (Hydrocleaning) Equipment is inadequate. Machines shall be belt operated or have an overload device. Machines with direct drive that cause damage to the pipe will not be allowed. A power rodding machine shall be either a sectional or continuous rod type capable of holding a minimum of seven hundred fifty (750) feet of rod. The rod shall be specifically heat-treated steel. To ensure safe operation, the machine shall be fully enclosed and have an automatic safety clutch or relief valve.

B. Closed-Circuit TV Equipment

The Contractor shall provide the necessary equipment to perform closed circuit television inspection of the designated sewer pipes. The equipment will meet the following specifications:

1. A studio containing the controls for the inspection equipment will be large enough for two (2) people to view a television monitor of the inspection procedure. The studio will be insulated from outside noises that could be inadvertently recorded on the audio channel.
2. A color television monitor will be available to view live camera action and recorded playback. The displayed picture must be capable of providing a clear, stable image free of electrical interference. The television monitor will measure at least fifteen (15) inches across diagonally.
3. The camera used for sewer pipeline inspections will be one specifically made for the purpose. The camera will operate in one hundred (100) percent humidity, be waterproof and able to withstand long periods of submergence in wastewater. The camera will be able to pan, tilt and rotate three hundred sixty (360) degrees. The tilt arc should not be less than two hundred twenty-five (225) degrees. A variable intensity control of the camera lights and remote-control adjustments for focus and iris shall be located at the monitoring station. The remote control of focus and iris will

range from one (1) inch to infinity. The camera and monitor shall be able to produce a minimum of four hundred sixty (460) lines of horizontal resolution and four hundred (400) lines of vertical resolution and capture images in full color. The image pick-up device shall contain in excess of three hundred seventy-nine thousand (379,000) picture elements (pixel). Geometrical distortion of the image shall not exceed one (1) percent. Contractor shall present on DVD a continuous image of not less than ninety (90) percent of the internal pipe circumference at all times.

4. Lighting. Illumination shall be adjustable and even around the sewer perimeter without loss of contrast, flare out of picture or shadowing. Lighting and camera quality shall be suitable to allow a clear in-focus picture of a minimum of ten lineal feet of the entire periphery of the sewer pipe. The lighting for the camera shall minimize glare. Lighting sensitivity shall be three (3) lux or less.
5. Transporters. The camera should be mounted on skids or a tractor suitably sized for the pipe to be televised that will position the camera lens above the liquid flow line, near the center axis of the pipe. Any motorized transporters should have adjustable speed control. The televising may also be accomplished using camera equipment mounted on a raft or floating pontoon, if the required pipe condition information cannot be obtained by tracked camera equipment within the maximum allowable flow depths.
6. Cable and Footage Counter. A minimum one thousand five hundred (1,500) feet of TV cable on the spool reel shall be provided. The TV cable will be supported by an equal length tag line for removal of the equipment from the pipeline.
7. Computer System. The computer system shall be capable of recording, indexing, and processing inspection data; printing CCTV inspection logs; and recording, storing, and playing video and images of pipe observations as required for the data documentation requirements of these specifications.
8. Software. Inspection software shall be PACP compliant versions of CUES Granite XP, WinCam, Flexidata, or approved equal.

10.5 Execution

A. Safety

The Contractor shall adhere to all local, state, and federal health and safety standards.

B. Sewer Cleaning

1. The intent of sewer line cleaning is to remove all sludge, dirt, sand, rocks, grease, and other solids or semisolid material from the pipe so that the sewer lines are ready for relining.

2. Sewer cleaning shall be performed with hydraulically propelled high velocity jet designed for cleaning sewers. The equipment shall be capable of removing dirt, grease, rocks, sand, and other materials and obstructions from the sewer lines and manholes. As a minimum, jetting of lines must be performed by pulling the high velocity spray nozzle in the direction opposite to the force created by the water pressure.
3. During sewer cleaning operations, satisfactory precautions shall be taken in the use of cleaning equipment. Precautions shall be taken to ensure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer. Whenever hydraulically propelled cleaning tools, which depend upon water pressure to provide their cleaning force or any tools which retard the flow of water in the sewer line are used, precautions shall be taken to ensure that the water pressure created does not cause any damage or flooding to public or private property being served by the manhole reach involved.
4. The Contractor shall be responsible for obtaining water at locations designated by the City. No fire hydrant shall be obstructed in case of a fire in the area served by the hydrant.
5. It is anticipated heavy cleaning will be needed. If hydrocleaning is ineffective in removing debris and roots, mechanically powered equipment shall be used to clean the pipe. No additional payment to Contractor will be made for cleaning of sewer pipes.
6. If cleaning of an entire section cannot be successfully performed from one manhole, the equipment shall be set up on the other manhole and cleaning again attempted. The cost of additional manhole set-ups shall be borne by the Contractor. If, again, successful cleaning cannot be performed or the equipment fails to traverse the entire manhole section, it will be assumed that a major blockage exists and the City shall be notified as soon as possible.
7. All sludge, dirt, sand, rocks, grease and other solid or semi-solid material resulting from the cleaning operation shall be removed at the downstream manhole of the reach being cleaned. Passing material from manhole reach to manhole reach which could cause line stoppages, accumulations of sand in wet wells, or damage pumping equipment shall not be permitted. Material removed with heavy cleaning shall be disposed of offsite at permitted facilities to handle such wastes. All materials shall be removed from the site at a minimum of the end of each workday. Under NO circumstances will the Contractor be allowed to accumulate debris, etc., on the site of work beyond the stated time, except in totally enclosed containers acceptable to the City.

C. Sewer Flow Control

The Contractor is allowed to provide bypass pumping and flow control, and these costs shall be included in the unit cost per linear feet for CCTV inspection. If flows are too high for CCTV inspection (greater than twenty (20) percent of the pipe diameter for ten (10) inch and smaller pipe, greater than twenty-five (25) percent for twelve (12) to twenty-four (24) inch pipe, and greater than thirty (30) percent for twenty-seven (27) inch and larger pipe, the Contractor shall evaluate if flows are low enough at a different time of day or night to complete the inspection. The Contractor shall notify the City in advance when performance of the inspection at night is required. If flow levels do not drop below the maximum flow depths noted above, the Contractor shall provide alternate means of flow control.

D. Closed-Circuit TV Inspection

1. After cleaning, the pipe sections shall be visually inspected by means of closed-circuit television. The inspection shall be done one (1) manhole-to-manhole pipe section at a time if possible, and the flow in the section being inspected shall be suitably controlled as specified. Each series of runs shall be recorded on a separate DVD.
2. The camera shall travel in the direction of flow unless access to the upstream manhole is not possible or the camera cannot pass through the pipe from end-to-end in the direction of flow, in which case a reverse setup shall be allowed.
3. If severe defects such as collapses, severe offset joints, or severe sags are encountered that preclude the inspection being completed in one direction, the Contractor shall attempt a reverse setup. If the entire segment cannot be inspected, Contractor shall notify the City immediately.
4. If a buried manhole is encountered during the course of the CCTV inspection, the Contractor shall attempt to CCTV through the buried manhole or conduct the inspection in the reverse direction if possible. The Contractor shall notify the City of the buried manhole and/or if the manhole needs to be exposed in order to complete the inspection.
5. If, during a run, the camera lens becomes soiled or fogged, the camera should be shut down and the lens cleaned, even if this requires removing the camera from the line. If the camera is removed from the line for lens cleaning or for cleaning the line of fog, the camera shall be returned to the point where acceptable footage was obtained. Footage of the camera being pulled out of the line for lens cleaning should not be included in the video. If fog is encountered during a run, the Contractor shall stop the camera and ventilate the line to remove the fog.

Unclear footage shall not be accepted by the City.

6. The camera shall be moved through the line at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition.

When a defect or other feature is encountered, the progress of camera should be slowed and stopped for a minimum of fifteen (15) seconds or as needed so that the observation can be panned with the camera, the data recorded, narration made, and still picture captured if required. In no case shall the television camera be pulled at a speed greater than thirty (30) feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices not obstructing the camera view or interfering with proper documentation of the sewer conditions shall be used to move the camera through the sewer line. If, during the inspection operation, the television camera will not pass through the entire segment, the Contractor shall set up his equipment so that the inspection can be performed from the opposite manhole. If, again, the camera fails to pass through the entire segment, the inspection shall be considered complete and no additional inspection work will be required. The contractor shall only be paid for the linear feet that were televised if a large section of pipe is inaccessible. Double payment is not permitted!

7. When manually operated winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two (2) manholes of the segment being inspected to insure good communications between members of the crew.
8. The “zero” (0) point of the inspection shall be the centerline of the manhole where the camera is inserted. The footage counter shall be set accordingly by adding the footage from the centerline of the manhole to the edge of the manhole plus the camera length (or the camera length plus the camera focal length). The importance of accurate distance measurement is emphasized. During any inspection procedure, the television cable shall only be removed from the reel by a motorized system. At no time during the inspection is cable to be removed manually, by hand. The television cable between the counter and the camera shall be taught at all times.
9. The Contractor shall allow the City to observe CCTV inspection work for purposes of verifying that all required CCTV inspection procedures are being followed and CCTV inspection observations are being properly coded. The Contractor shall provide comfortable viewing access to the video monitor during the video inspection recording to allow the City to compile a log of the inspection. The City may make both scheduled and unannounced visits to CCTV inspection operations while work is in progress. Notwithstanding any such observations of the CCTV inspection work by the City, the Contractor shall be responsible for the quality of video and documented observations.

E. Documentation

1. CCTV Inspection Logs

Printed location records shall be kept by the Contractor for each inspected pipe segment. The logs shall indicate, at a minimum, the pipe location, including the street name, addresses if applicable, starting and ending

manholes, date and time of inspection, direction of inspection, pipe diameter, material, and joint length, and final inspected length. The logs shall clearly show the distance from the centerline of the starting manhole of each observation and other points of significance such as locations of building sewers or other connections, broken or cracked pipe, separated or offset joints, vertical misalignment (sags), presence of roots, scale, corrosion, grease, sediment, debris, or infiltration, and other discernible features or unusual conditions, using standard NASSCO PACP codes. Comments shall be noted to document atypical conditions not otherwise described by the observation codes. A copy of each CCTV inspection log will be supplied to the City in hard copy and PDF format on standard DVD.

2. CCTV Inspection Database

The data obtained for all inspections shall be provided in digital format compatible to Microsoft Excel. The database shall contain two tables: one containing a single record or row for each inspection (Site Data Table) and one containing a single record or row for each observation (Observation Data Table). At a minimum, the database tables shall contain the following fields or columns:

a. Site Data Table

- 1) Site ID – Contractor's unique ID number for inspected segment, cross-referenced to Observation Data Table
- 2) Project – Contractor's project ID
- 3) Starting Manhole ID
- 4) Ending Manhole ID
- 5) Camera Direction – downstream (Dwn) or reverse (Rev)
- 6) Street name/location where the inspection is occurring
- 7) Easement – yes or no
- 8) Date of Inspection
- 9) Video disc (DVD) number
- 10) Inspection complete? – yes or no
- 11) Inspection abandoned due to prohibiting fault? – yes or no
- 12) Inspected pipe length (to nearest 0.1 foot)
- 13) Pipe diameter
- 14) Pipe material
- 15) Pipe joint length
- 16) Video file name
- 17) Television inspection log file name
- 18) Comments

- 19) PACP Certification Number
- b. Observation Data Table
 - 1) Site ID – cross reference to inspected pipe segment in Site Data Table
 - 2) Observation ID – Contractor's unique ID number for observation
 - 3) Footage position of observation (to nearest 0.1 foot)
 - 4) Observation code (using NASSCO codes)
 - 5) Clock position of observation (if applicable) – one (1) through twelve (12)
 - 6) JPEG file name for observation photograph (if applicable)
 - 7) Comments (if applicable)

3. Digital Photographs

Digital format JPEG on standard DVD photographs of all problems, severe defects or atypical observations shall be taken by the Contractor.

4. Digital CCTV Inspection Recording

The purpose of digital CCTV inspection recording shall be to supply a visual and audio record of the sewer condition. Format is DVD with 352 X 240 resolution, thirty (30) frames per second, and 1.5 Mbits per second data rate. Other resolution, frame and data rates are acceptable as long as similar or better image quality and acceptable file size are obtained.

Each individual pipe segment must be included in a single file, except if a reverse set up is required due to an obstruction, in which case the reverse inspection shall be contained in a separate file.

- a. The following information must be provided as screen text on the video recording:
 - 1) Upstream and downstream node numbers
 - 2) Direction of camera travel
 - 3) Purpose of CCTV
 - 4) Location
 - 5) Date and time of day
 - 6) Job number and/or project name
 - 7) CCTV company
 - 8) Operator's name

- b. The text should be clearly displayed on a contrasting background (e.g., white text on dark background or black text on white background). This text should be displayed for approximately 15 seconds or for the duration of the start-up narration, whichever is longer. If an inspection is being performed on consecutive pipe segments with the same setup, this information must be provided at the start of each pipe segment. Note: If the CCTV software being used can only display the “from” and “to” manhole numbers rather than upstream and downstream numbers (as in the case of a reverse inspection), then the upstream and downstream manhole numbers should be clearly stated in the startup video narration.
- c. During CCTV, the running screen must include the following information. The display of this information must in no way obscure the central focus of the pipe being inspected.
 - 1) Running footage (distance traveled)
 - 2) Upstream and downstream (or “from” and “to”) node numbers of inspected pipe segment
- d. The end point of the inspected pipe segment should be indicated with screen text for approximately fifteen (15) seconds. The ending screen text should indicate:
 - 1) Ending Footage
 - 2) Date and time of day
 - 3) Upstream and downstream node numbers of inspected pipe segment
- e. The CCTV video recordings should not contain inappropriate language, idle chatter, background noise, and discussions between the operator and other crew members. A voice narration must be included in the video recording. All video narration must be live by the CCTV operator. Digital voice narration is only allowed if specifically approved by the City. This narration must include the following information at the beginning of each pipe segment:
 - 1) Upstream and downstream node numbers
 - 2) Direction of camera travel
 - 3) Purpose of inspection
 - 4) Location
 - 5) Date
 - 6) Job number (if applicable) and/or project name
 - 7) Pipe size
 - 8) Pipe material

- 9) CCTV company
- 10) Operator's name

- f. All observations along the length of the pipe shall be narrated, with a description of the type of defect or feature, clock position, footage, extent or other pertinent data. At the conclusion of the inspection of a pipe segment, the operator should state the final CCTV footage and indicate that the CCTV inspection of the pipe segment is complete. If the inspection had to be abandoned before reaching the ending manhole, then a statement to this effect should be made as part of the ending narration with a reason given as to why the inspection could not be completed.
- g. The audio and video shall be free of electrical interference and excessive background noise. Digital video recording playback shall be at the same speed that it was recorded. The Contractor shall have all digital video and necessary playback equipment readily accessible for review by the City during the project, after which time the digital video shall be given typed labels and presented to the City. All DVDs, submitted to the City, shall remain property of the City. The Contractor may, at the discretion of the City, retain a copy. Should any portion of the inspection DVDs be of inadequate quality or coverage, as determined by the City, the Contractor will re-inspect the unacceptable portion at no additional expense to the City.

5. DVD Labels

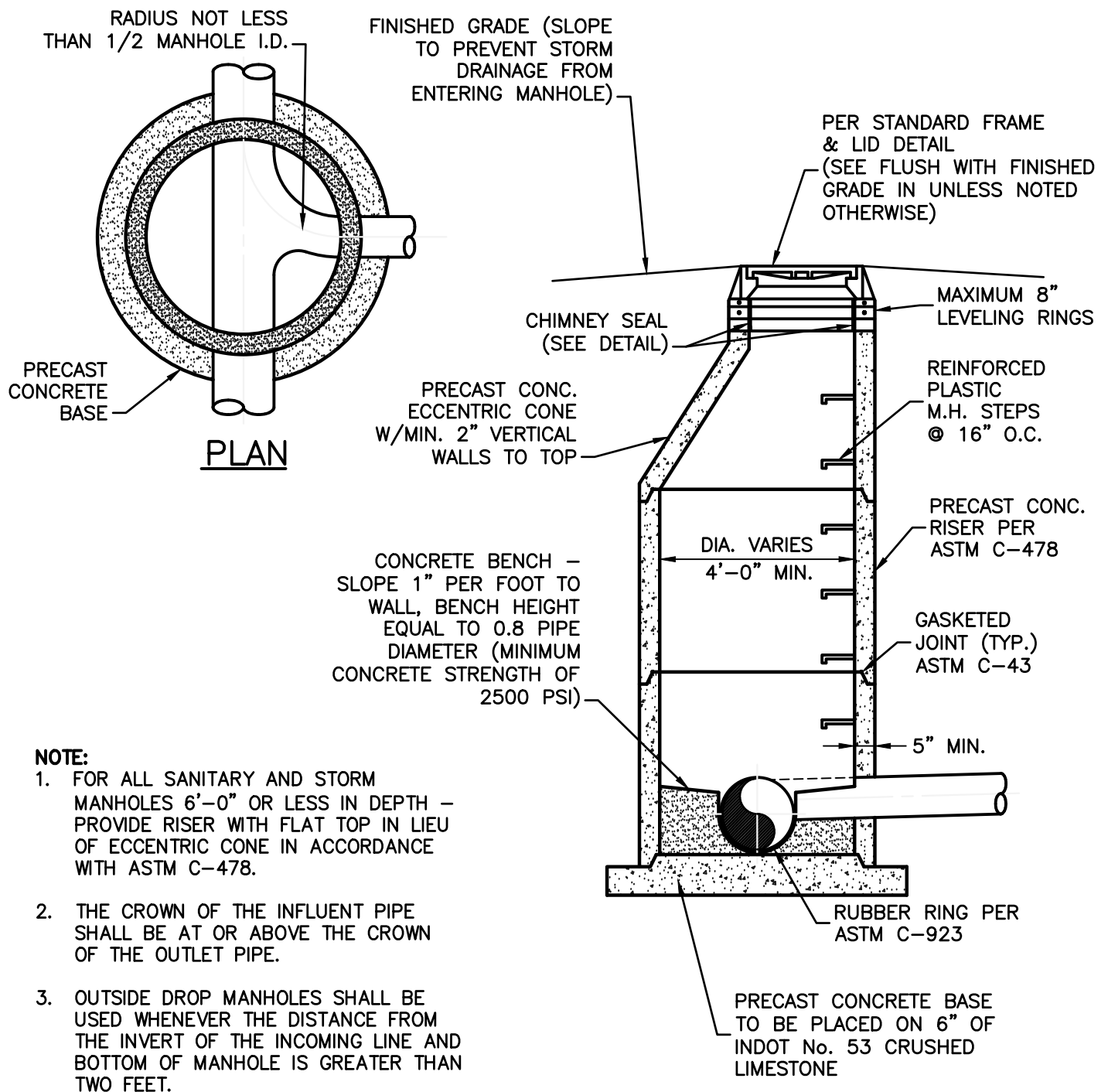
DVD labels shall identify the disc number; city name; project name and contract (if applicable); Contractor name, address and phone number; date of inspection; and sewer segment by upstream and downstream manhole numbers (followed by "Rev" if a reverse set-up). All labels shall be typed, or computer generated. Handwritten labels are not acceptable.

SANITARY SEWER STANDARD DETAILS

SANITARY SEWER STANDARD DETAILS

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STANDARD MANHOLE DETAIL

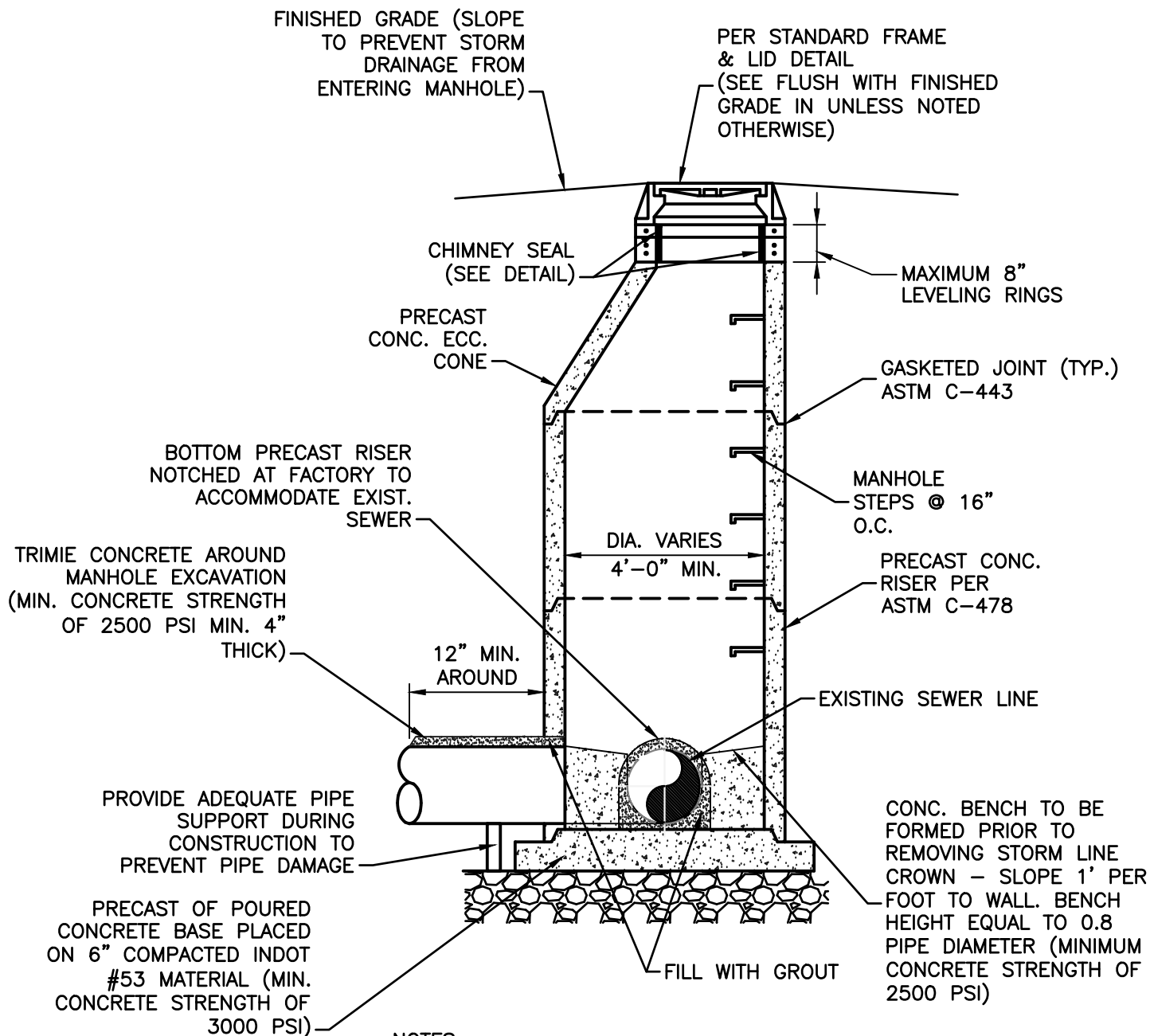
REVISION DATE

CITY of MONTICELLO, INDIANA STANDARD DETAILS SANITARY SEWER

FIGURE

S-1

DATE: AUGUST 2019



NOTES:

1. FOR ALL MANHOLES 6'-0" OR LESS IN DEPTH - PROVIDE RISER WITH FLAT TOP IN LIEU OF ECCENTRIC CONE IN ACCORDANCE WITH ASTM C-478
2. DROP MANHOLES SHALL BE USED WHENEVER THE DISTANCE FROM THE INFLUENT PIPE INVERT TO THE MANHOLE INVERT EXCEEDS 2'-0"

PRECAST MANHOLE ADDED OVER EXISTING SEWER

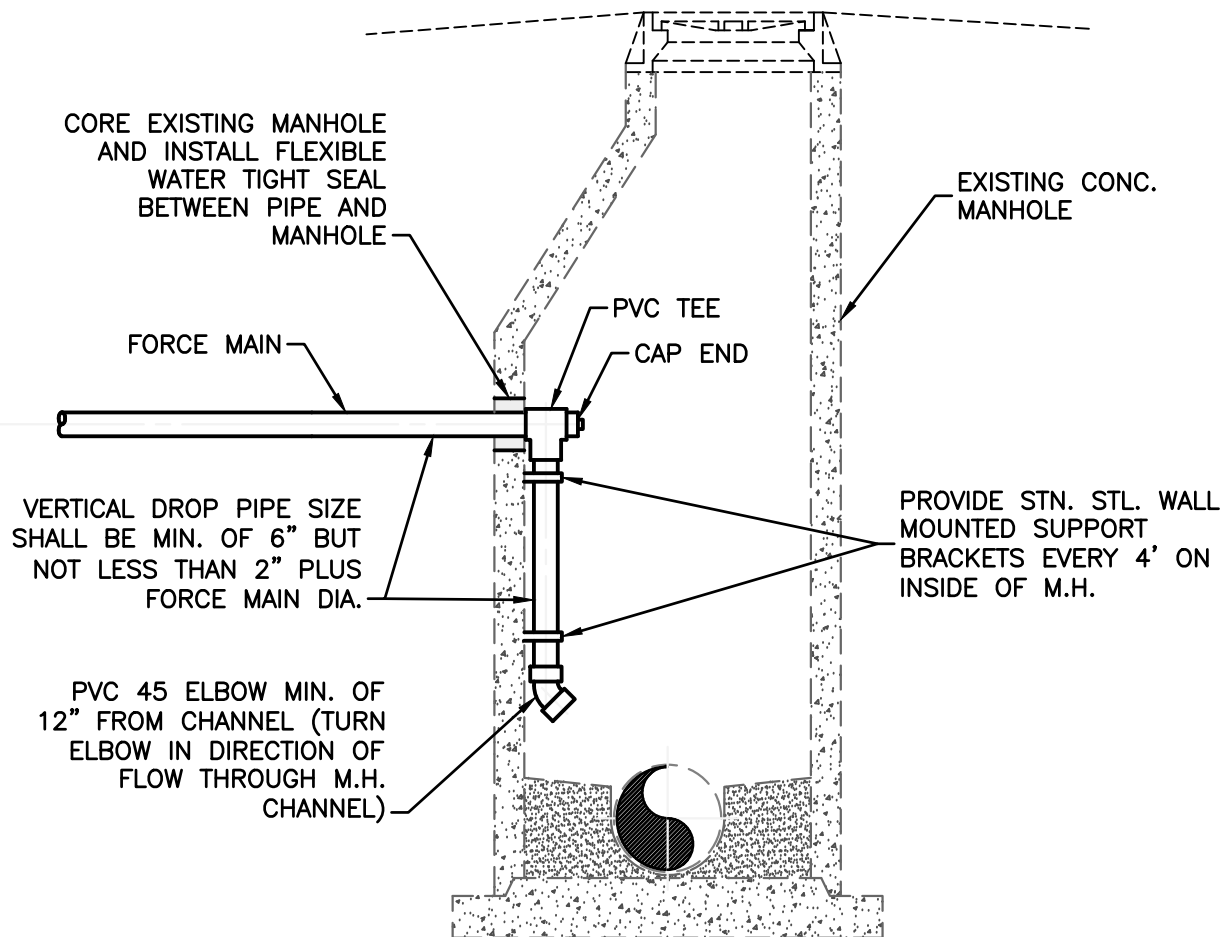
REVISION DATE

**CITY of MONTICELLO, INDIANA
STANDARD DETAILS
SANITARY SEWER**

DATE: AUGUST 2019

FIGURE

S-2



NOTE: MANHOLES WHICH HAVE FORCE MAIN DISCHARGE LINES SHALL HAVE AN INTERNAL EPOXY COATING

FORCE MAIN DROP INTO EXISTING MANHOLE

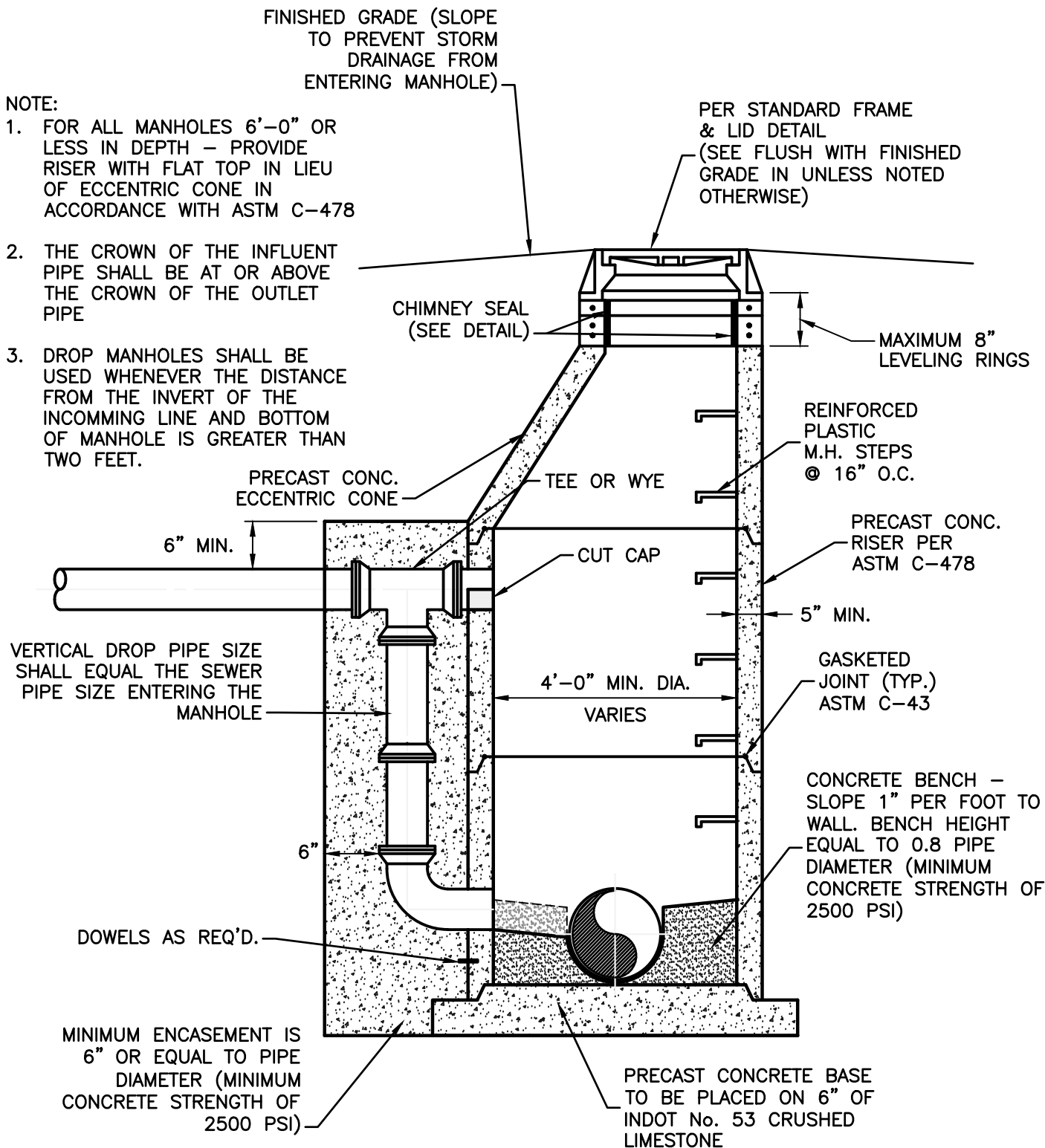
REVISION DATE

CITY of MONTICELLO, INDIANA STANDARD DETAILS SANITARY SEWER

FIGURE

S-3

DATE: AUGUST 2019



PRECAST DROP MANHOLE DETAIL

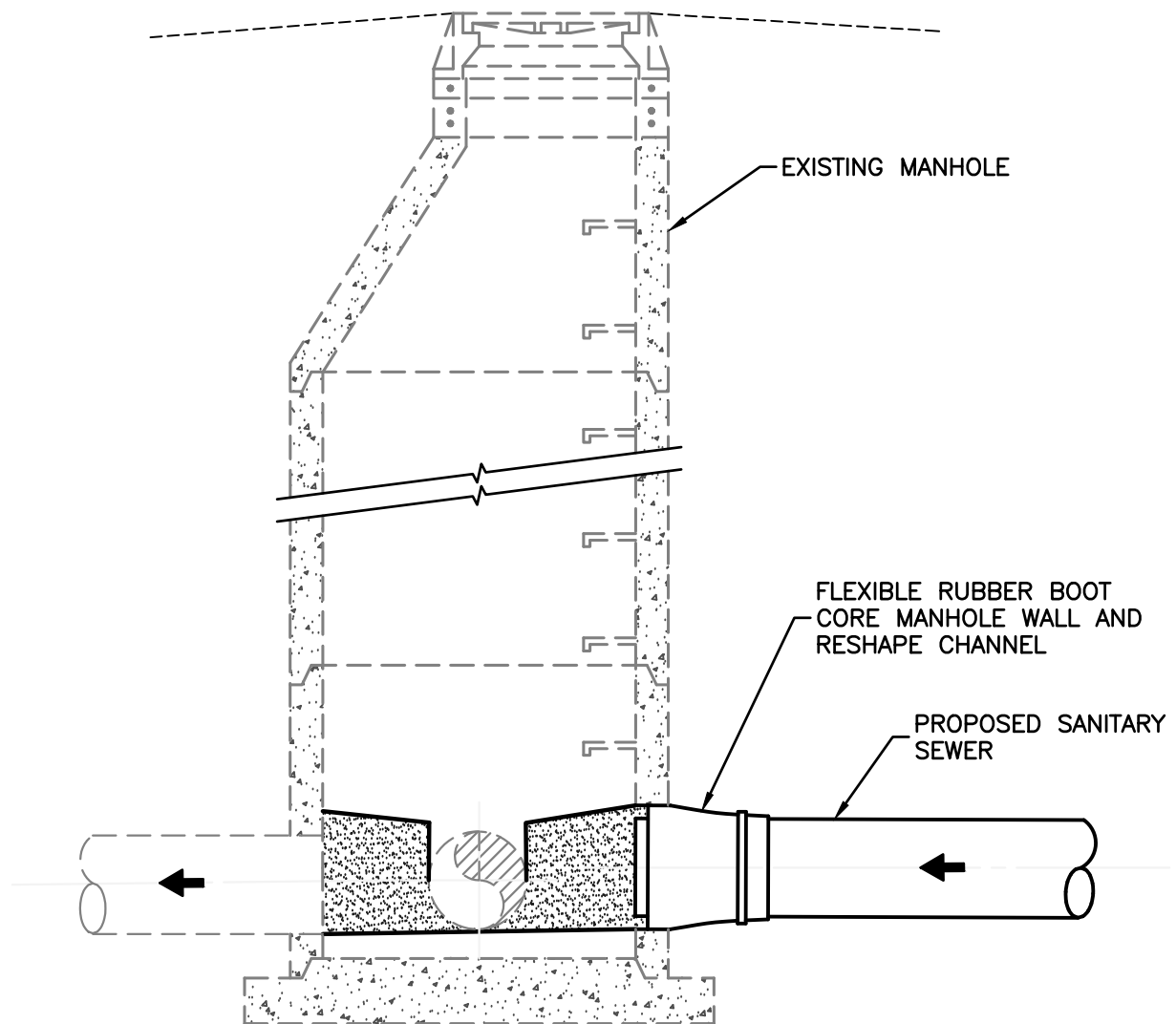
CITY of MONTICELLO, INDIANA
STANDARD DETAILS
SANITARY SEWER

FIGURE

S-4

REVISION DATE

DATE: AUGUST 2019



TYPICAL EXISTING MANHOLE ENTRY DETAIL

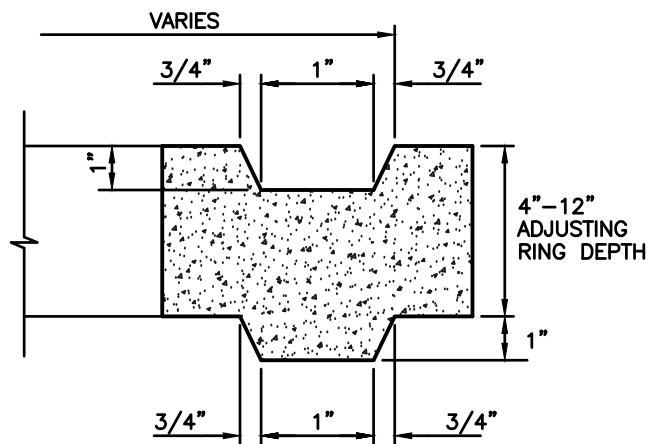
REVISION DATE

CITY of MONTICELLO, INDIANA
STANDARD DETAILS
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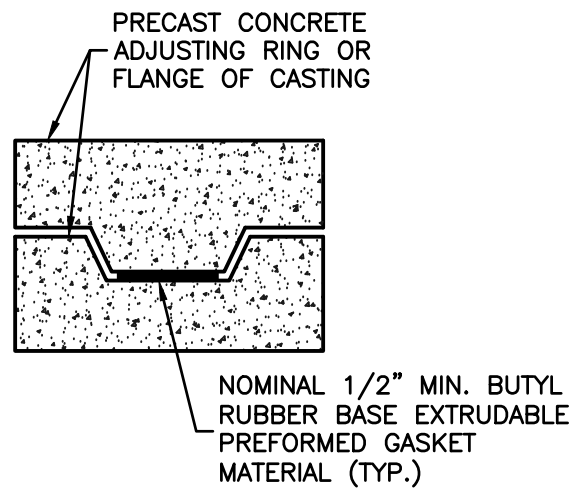
FIGURE

S-5

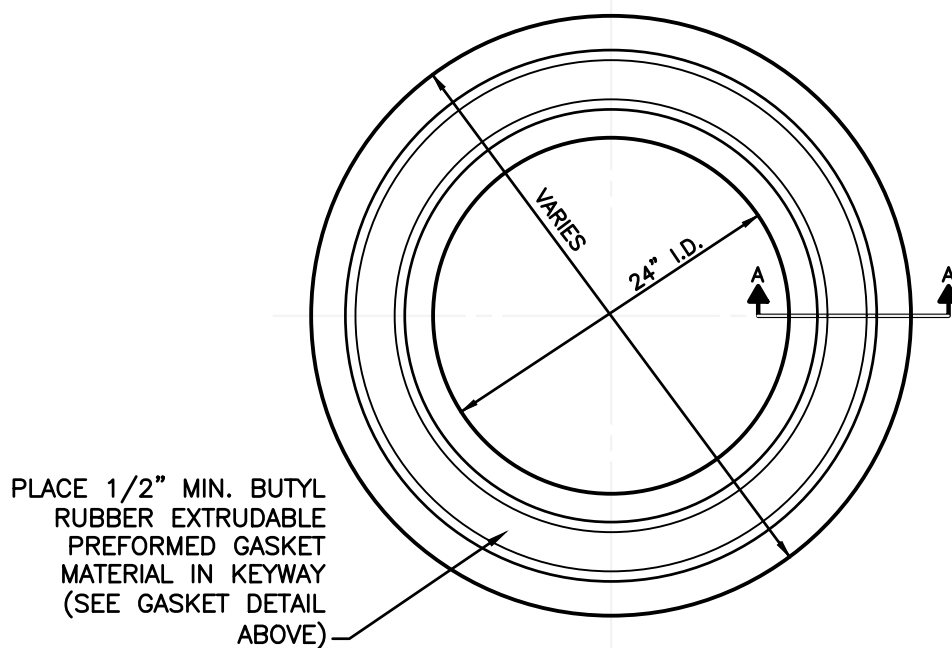
DATE: AUGUST 2019



SECTION "A-A"



GASKET DETAIL



PLAN VIEW

TYPICAL ADJUSTING RING

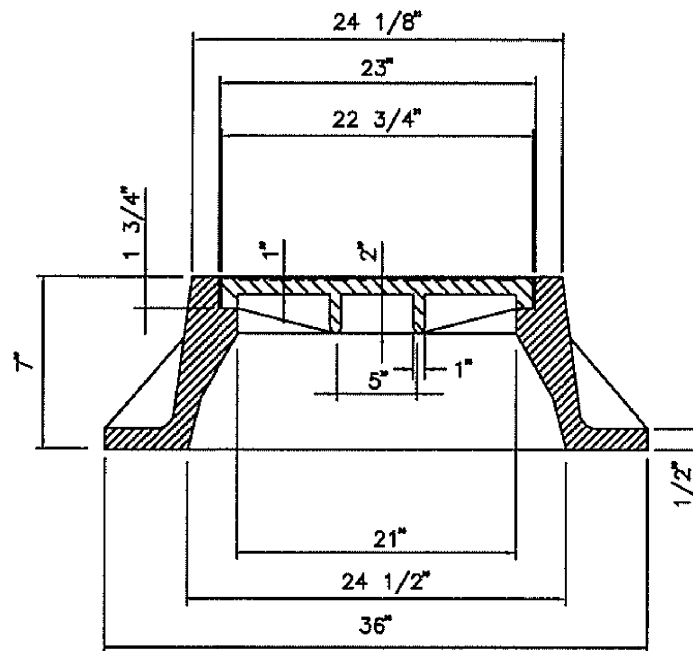
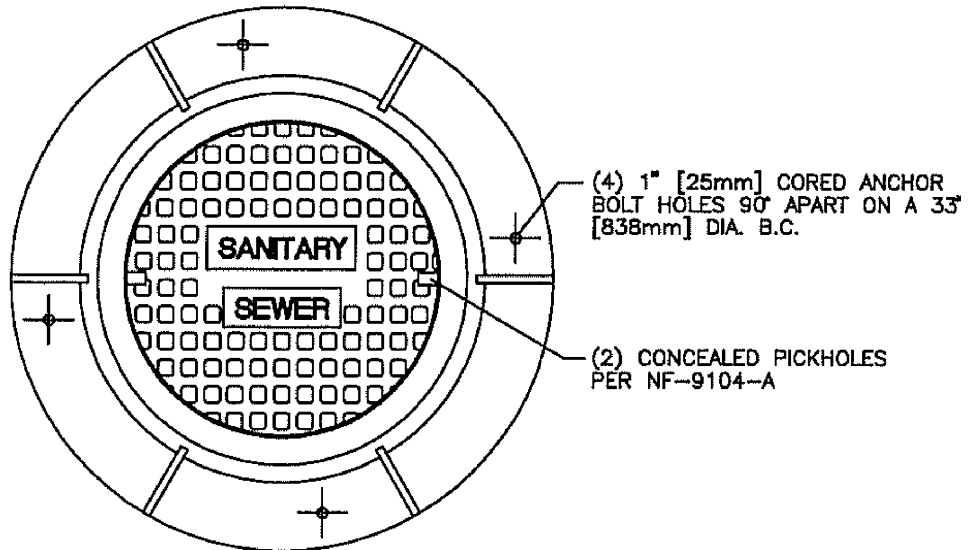
CITY of MONTICELLO, INDIANA STANDARD DETAILS SANITARY SEWER

FIGURE

S-6/7

REVISION DATE

DATE: AUGUST 2019



NOTE: METAL: CAST GRAY IRON ASTM A-48 CL.358
 FINISH: NOT PAINTED
 R-1772C BY NEENAH FOUNDRY OR
 1875-3 BY EAST JORDAN IRON WORKS

STANDARD FRAME AND LID

CITY of MONTICELLO, INDIANA STANDARD DETAILS SANITARY SEWER

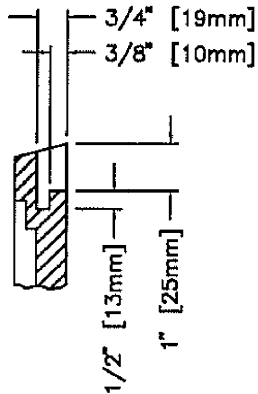
FIGURE

S-8

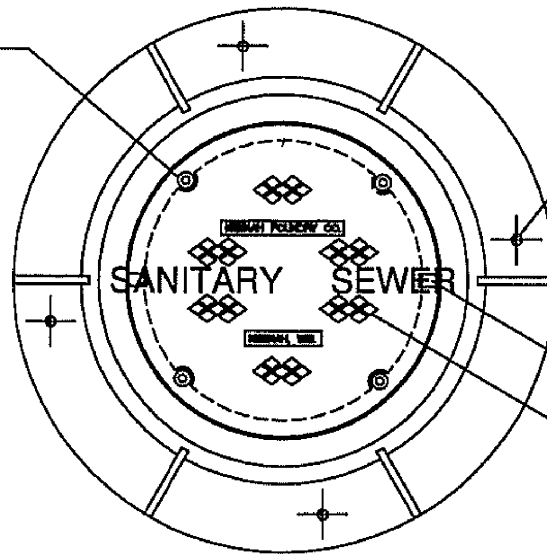
REVISION DATE

DATE: AUGUST 2019

(4) DRILL AND TAP FRAME FOR
 $\frac{1}{2}$ - 13x2 STN. STL.
 HEX. HD. CAP SCREWS ON A
 $23 \frac{3}{4}$ " [603mm] DIA. B.C.



PICKHOLE DETAIL
 QUARTER SCALE

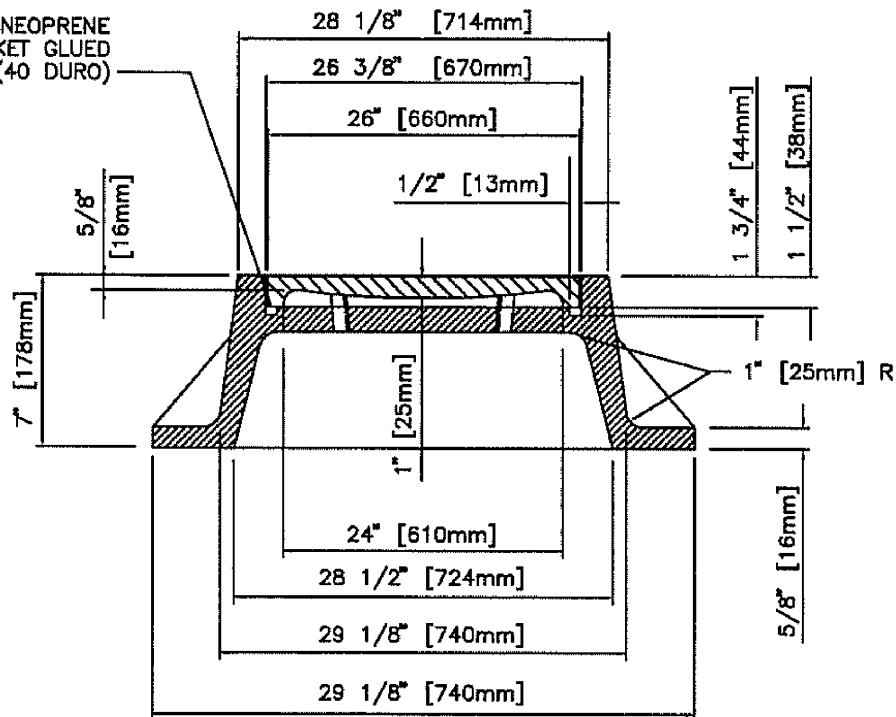


(4) 1" [25mm] CORED ANCHOR
 BOLT HOLES 90° APART ON A 33"
 [838mm] DIA. B.C.

(2) CONCEALED PICKHOLES
 PER NF-22642

TYPE "C" LID DESIGN

$\frac{1}{2}$ " [13mm] ϕ NEOPRENE
 CORD GASKET GLUED
 TO FRAME (40 DURO)



NOTE: ALL DIMENSIONS ARE SHOWN IN INCHES AND [MILLIMETERS].
 COMPONENT NO'S: FRAME 1916-0029, LID 1916-XXXX
 FINISH: NOT PAINTED
 WEIGHT: FRAME 216#; LID 130#

TYPICAL WATERTIGHT FRAME AND LID

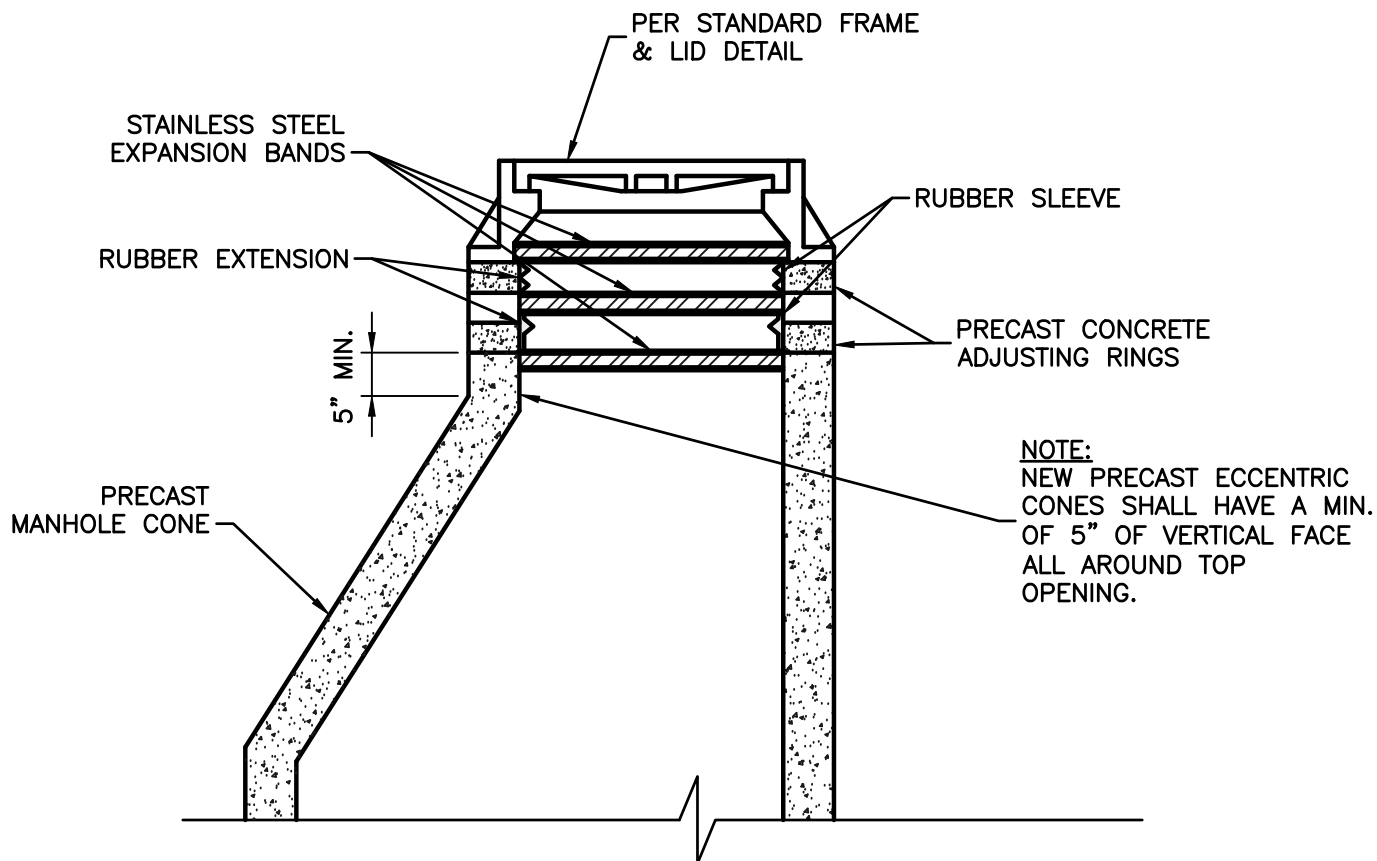
REVISION DATE

CITY of MONTICELLO, INDIANA STANDARD DETAILS SANITARY SEWER

FIGURE

S-9

DATE: AUGUST 2019



TO SPAN
CHIMNEY
HEIGHTS OF:

0-4 1/2"STD, CHIMNEY SEAL ONLY
2-7 1/2"WIDE CHIMNEY SEAL ONLY
OVER 4 1/2"-10 1/2"STD. SEAL + 7" EXTENSION
OVER 7 1/2"-13 1/2"WIDE SEAL + 7" EXTENSION

TYPICAL CHIMNEY SEAL DETAIL

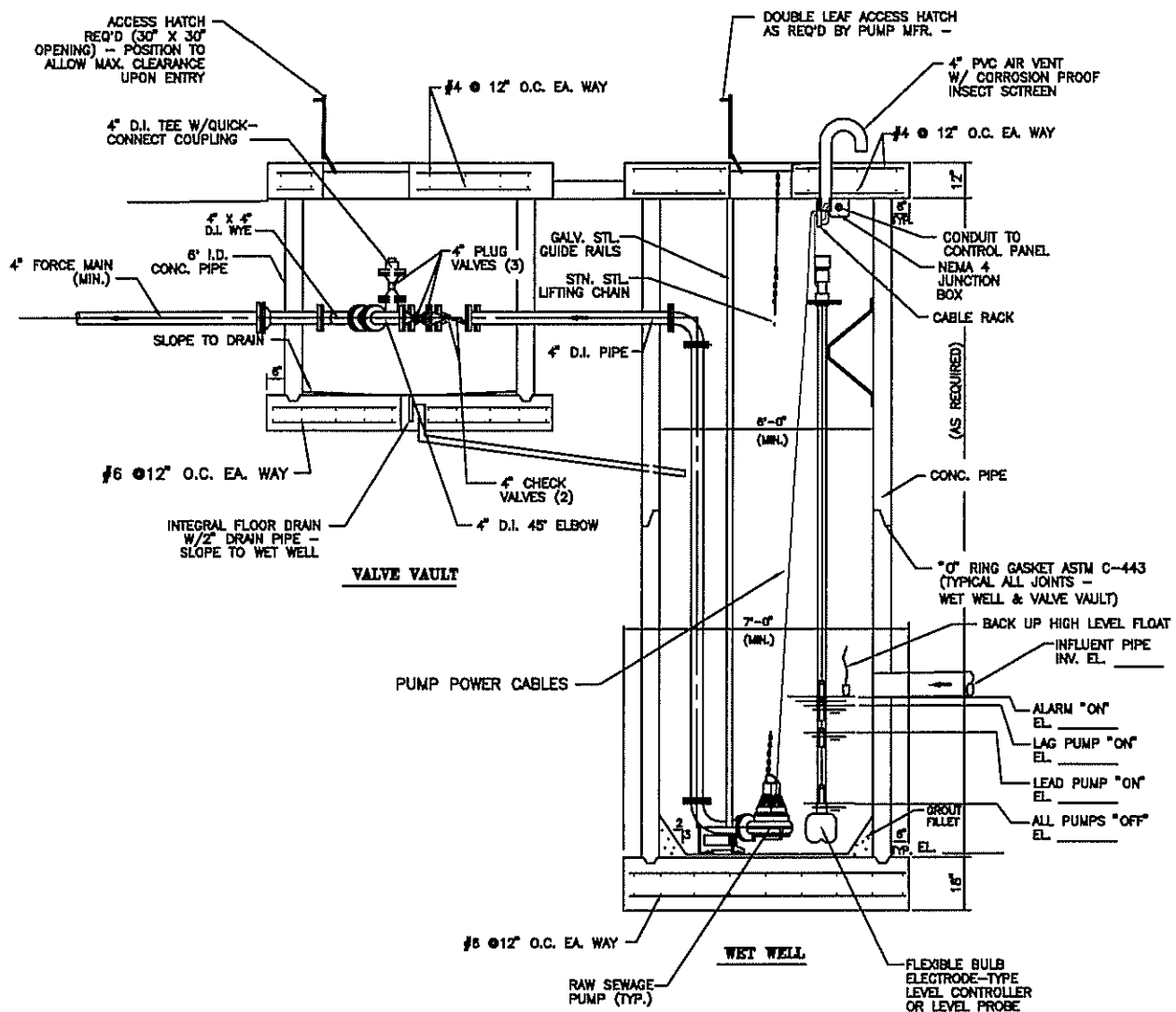
REVISION DATE

CITY of MONTICELLO, INDIANA STANDARD DETAILS SANITARY SEWER

FIGURE

S-10

DATE: AUGUST 2019



TYPICAL PUMP STATION SECTION

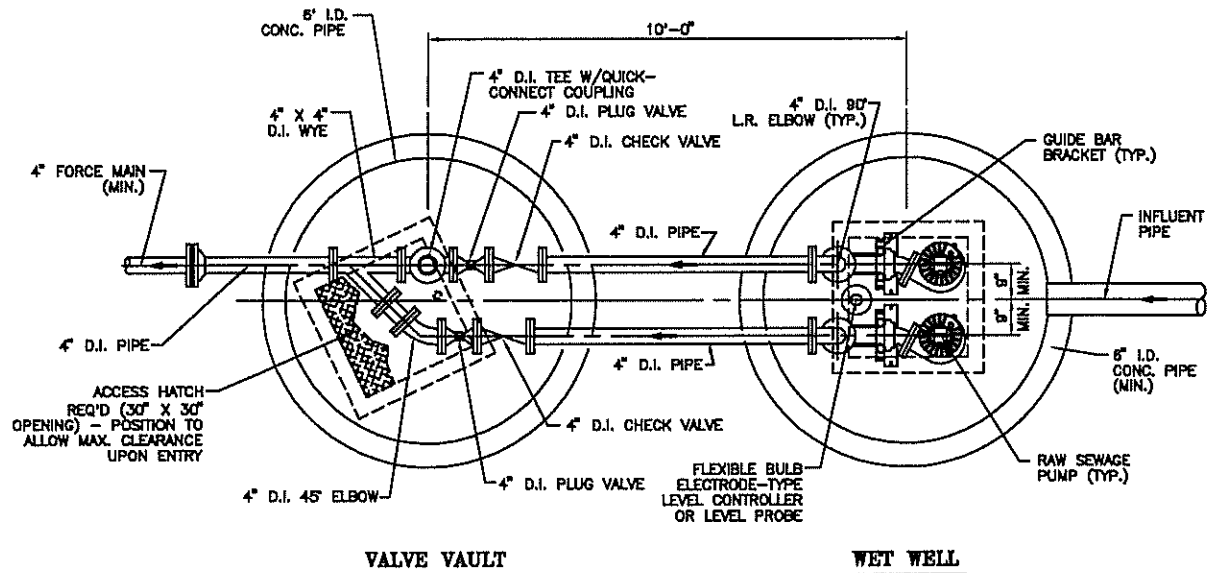
REVISION DATE

CITY of MONTICELLO, INDIANA STANDARD DETAILS SANITARY SEWER

FIGURE

S-11

DATE: MAY 21st, 2001



NOTE:

PIPING AND VALVES SHALL BE SIZED TO MATCH PUMP DISCHARGE, BUT NOT LESS THAN 4 INCHES.

TYPICAL PUMP STATION PLAN

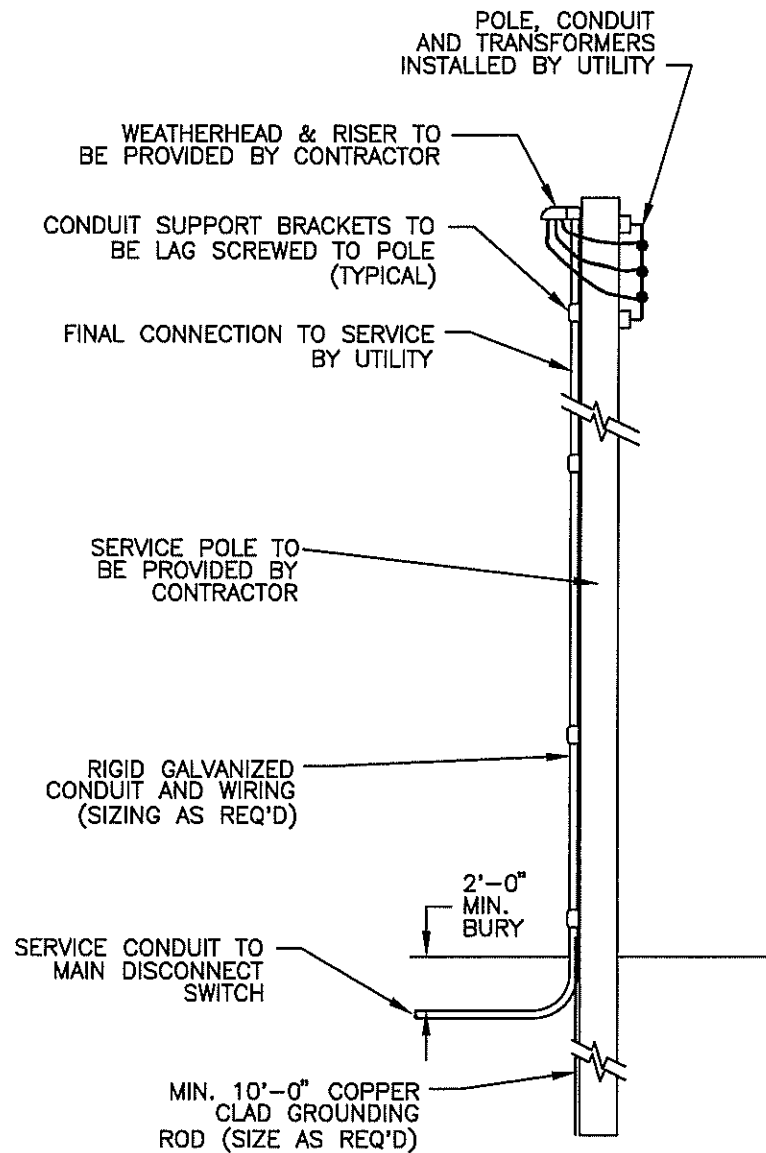
REVISION DATE

CITY of MONTICELLO, INDIANA STANDARD DETAILS SANITARY SEWER

FIGURE

S-12

DATE: MAY 21st, 2001



SERVICE POLE ELECTRIC DETAIL

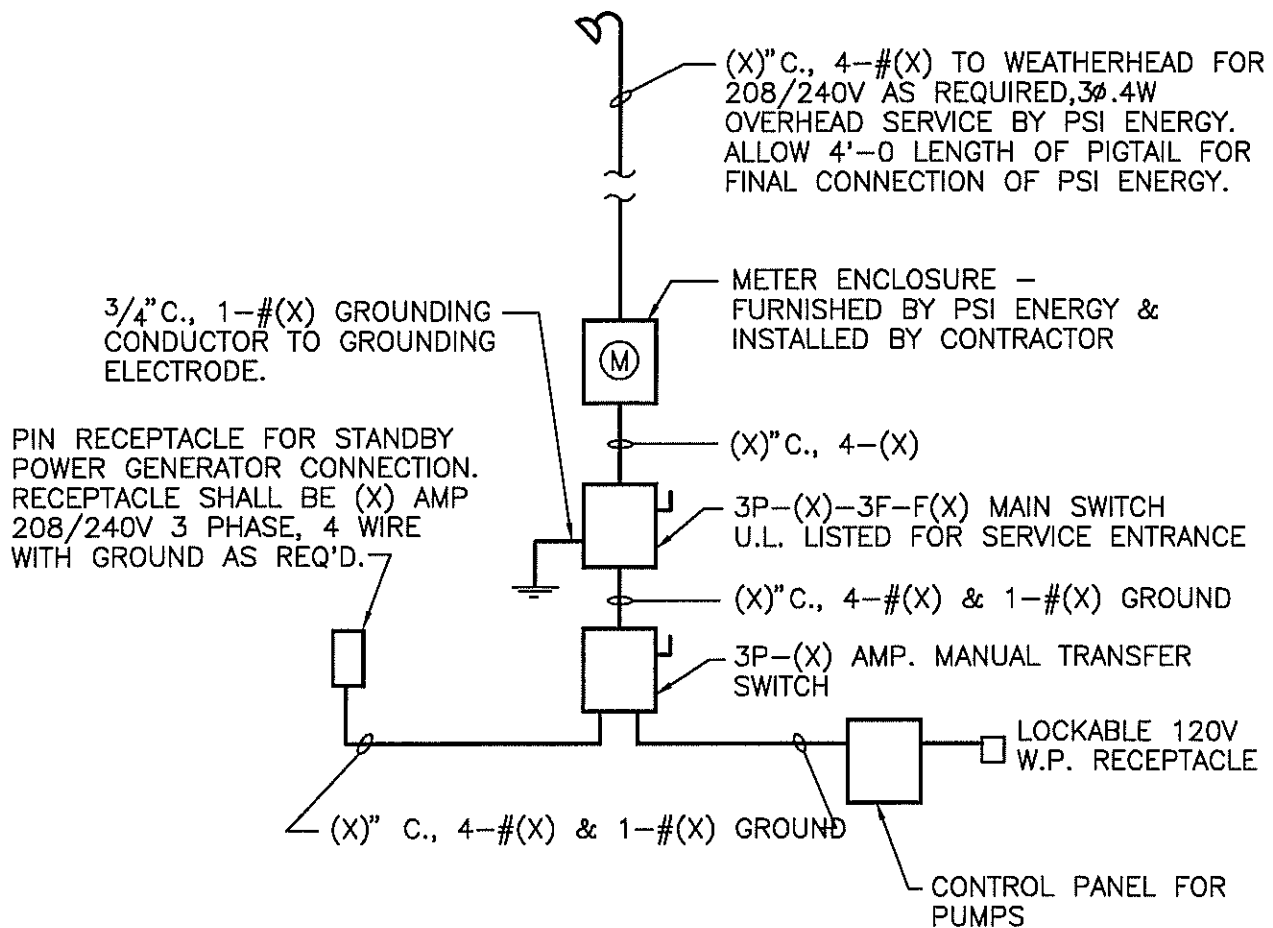
REVISION DATE

CITY of MONTICELLO, INDIANA STANDARD DETAILS SANITARY SEWER

FIGURE

S-13

DATE: MAY 21st, 2001



NOTES:

MAIN SWITCH, MANUAL TRANSFER SWITCH AND PUMP CONTROL PANEL SHALL BE MOUNTED IN NEMA 3R OR 4X STAINLESS STEEL ENCLOSURES.

(X) - INDICATES VARIABLE SIZING REQUIREMENTS.

**TYPICAL LIFT STATION
POWER DISTRIBUTION SCHEMATIC DETAIL**

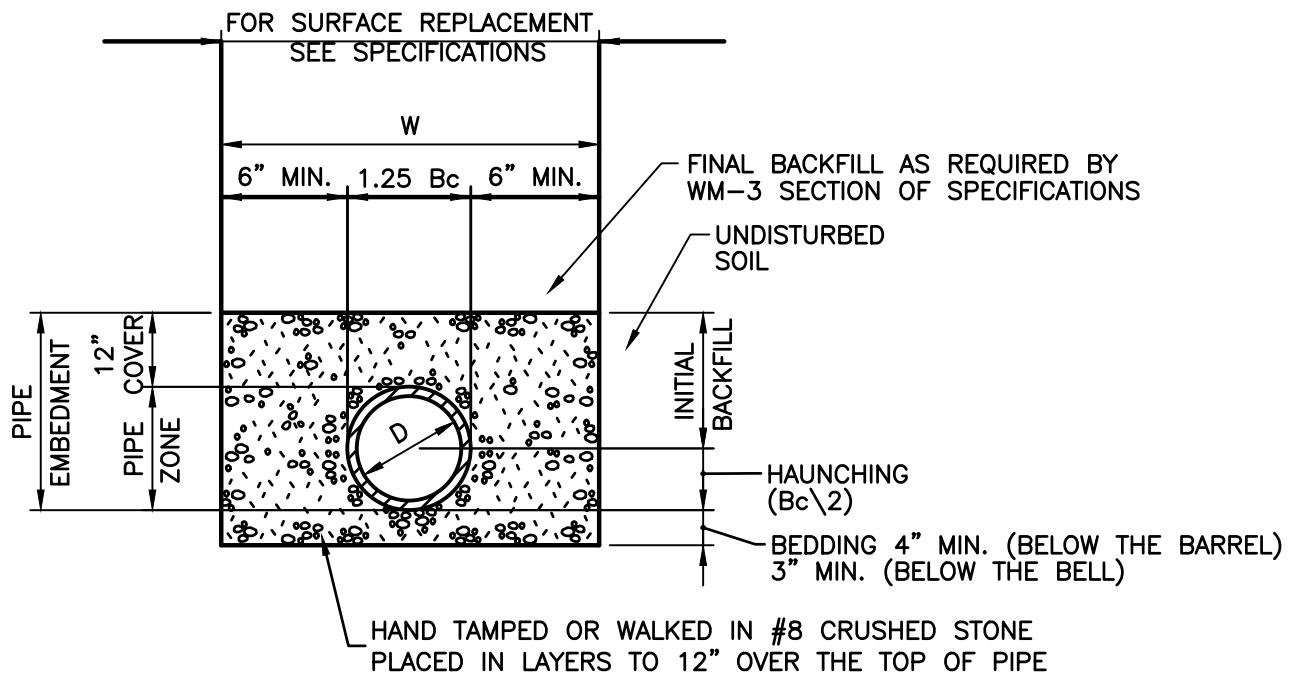
REVISION DATE

**CITY of MONTICELLO, INDIANA
STANDARD DETAILS
SANITARY SEWER**

FIGURE

S-14

DATE: MAY 21st, 2001



W = MAXIMUM ALLOWABLE TRENCH WIDTH FOR PIPE AS PER ASTM
NOT TO EXCEED FOUR (4) FEET FOR 6" THROUGH 24" PIPE
NOR SIX (6) FEET FOR 27" THROUGH 48" PIPE

D = PIPE DIAMETER (INTERNAL)

B_c = PIPE DIAMETER (EXTERNAL)

NOTES:

1. COMPACTED INITIAL BACKFILL SHALL EXTEND A MINIMUM OF 12" ABOVE THE TOP OF THE PIPE. FINAL BACKFILL ABOVE THIS POINT SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS AND AS REQUIRED HEREIN.
2. WORK FALLING UNDER THE JURISDICTION OF THE INDIANA DEPARTMENT OF TRANSPORTATION (INDOT) SHALL UTILIZE COMPACTED GRANULAR BACKFILL MATERIAL FOR INITIAL AND FINAL BACKFILL ANYWHERE WITHIN 12 FEET OF THE EDGE OF PAVEMENT. FOR ALL OTHER NON-INDOT PAVEMENT AREAS (INCLUDING BOTH HARD SURFACED AND COMPACTED AGGREGATE), COMPACTED GRANULAR BACKFILL MATERIAL SHALL BE USED WITHIN 5 FEET OF THE EDGE OF THE PAVEMENT.

TYPICAL TRENCH FOR FLEXIBLE PIPE

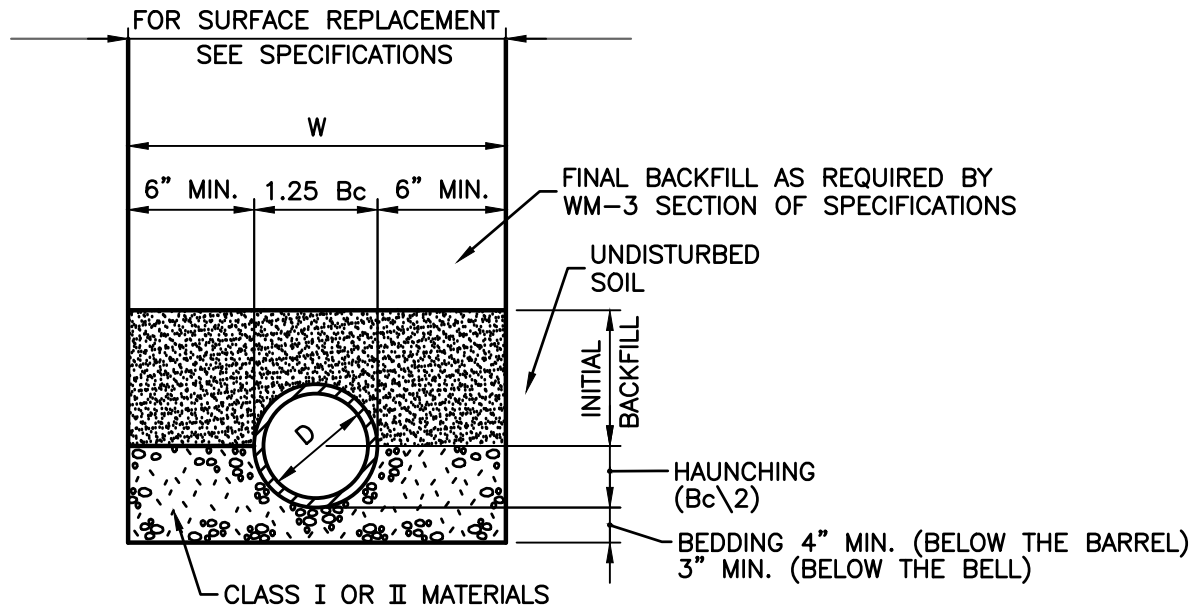
REVISION DATE

**CITY of MONTICELLO, INDIANA
STANDARD DETAILS
SANITARY SEWER**

FIGURE

S-15

DATE: AUGUST 2019



W = MAXIMUM ALLOWABLE TRENCH WIDTH FOR PIPE AS PER ASTM
NOT TO EXCEED FOUR (4) FEET FOR 6" THROUGH 24" PIPE
NOR SIX (6) FEET FOR 27" THROUGH 48" PIPE

D = PIPE DIAMETER (INTERNAL)

Bc = PIPE DIAMETER (EXTERNAL)

NOTES:

1. COMPACTED BEDDING STOPS AT SPRING-LINE OF THE PIPE. BACKFILLING ABOVE THIS POINT SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS AND AS REQUIRED HEREIN.
2. WHEN CLASS I MATERIAL IS USED FOR BEDDING, COMPACTION MAY BE ACCOMPLISHED BY HAND OR MECHANICAL TAMPING.
3. WHEN CLASS II MATERIAL IS USED FOR BEDDING, COMPACTION SHALL BE ACCOMPLISHED ONLY BY HAND OR MECHANICAL TAMPING TO A MINIMUM OF 95% STANDARD PROCTOR DENSITY.
4. WORK FALLING UNDER THE JURISDICTION OF THE INDIANA DEPARTMENT OF TRANSPORTATION (INDOT) SHALL UTILIZE COMPACTED GRANULAR BACKFILL MATERIAL FOR INITIAL AND FINAL BACKFILL ANYWHERE WITHIN 12 FEET OF THE EDGE OF PAVEMENT. FOR ALL OTHER NON-INDOT PAVEMENT AREAS (INCLUDING BOTH HARD SURFACED AND COMPACTED AGGREGATE), COMPACTED GRANULAR BACKFILL MATERIAL SHALL BE USED WITHIN 5 FEET OF THE EDGE OF THE PAVEMENT.

TYPICAL TRENCH FOR RIGID CONDUITS

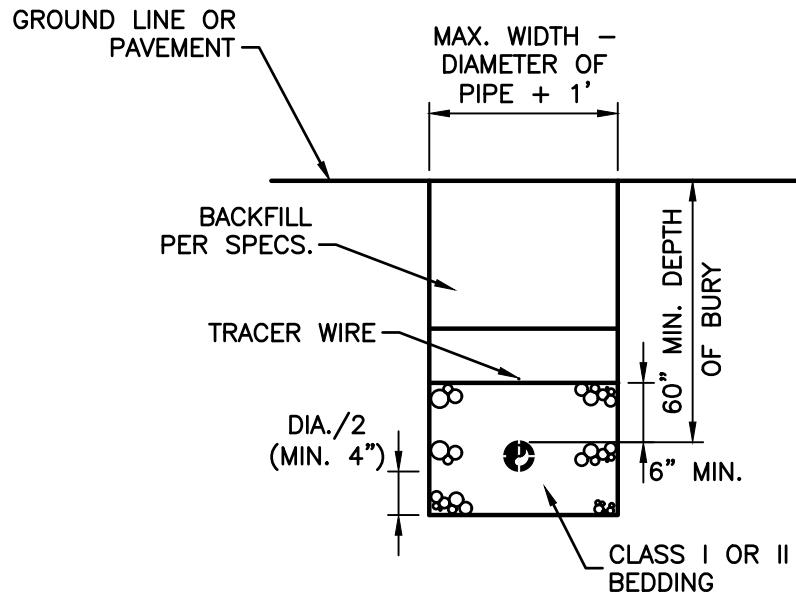
REVISION DATE

**CITY of MONTICELLO, INDIANA
STANDARD DETAILS
SANITARY SEWER**

FIGURE

S-16

DATE: AUGUST 2019



FORCE MAIN PIPE TRENCH DETAIL

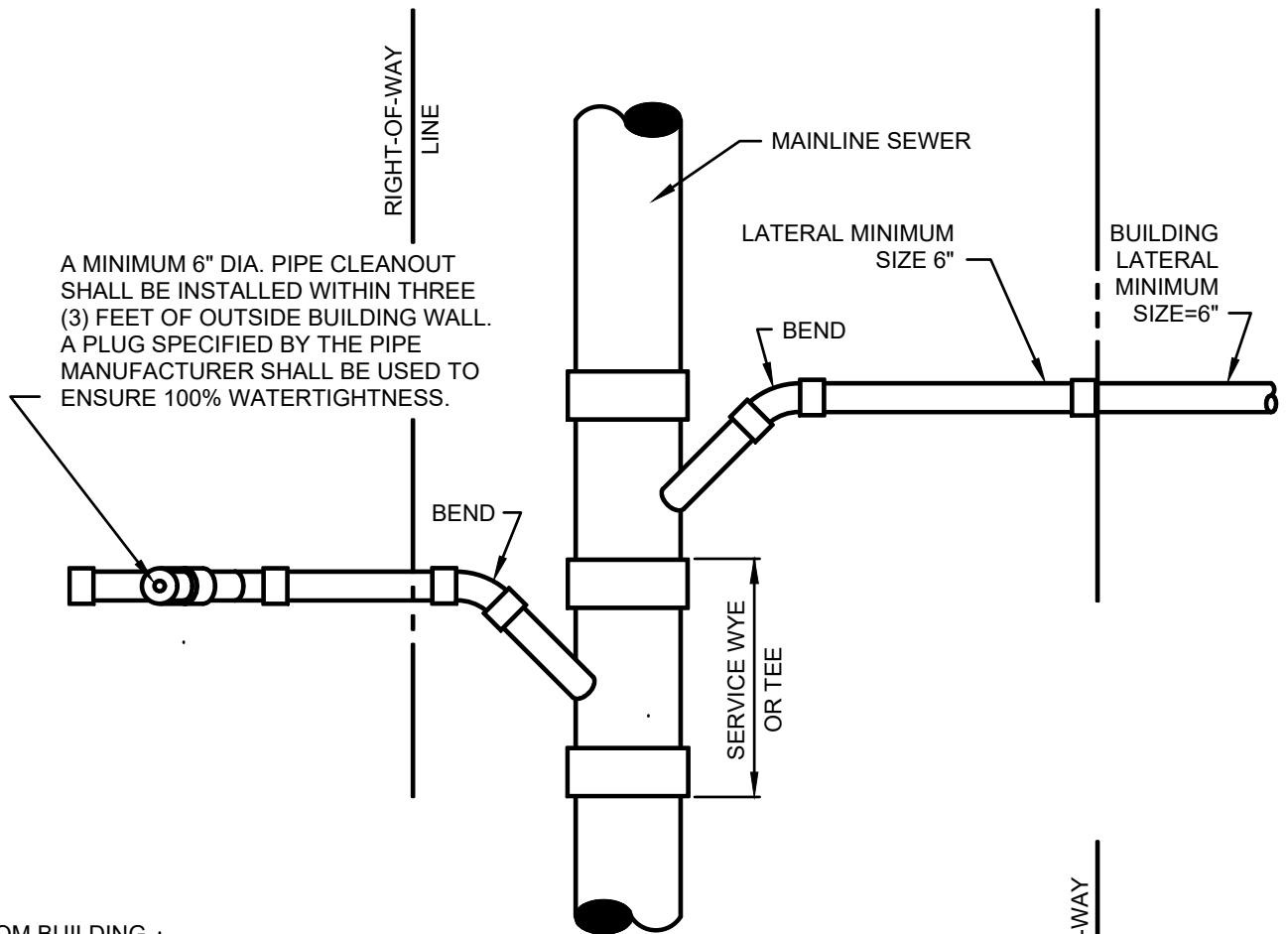
CITY of MONTICELLO, INDIANA STANDARD DETAILS SANITARY SEWER

REVISION DATE

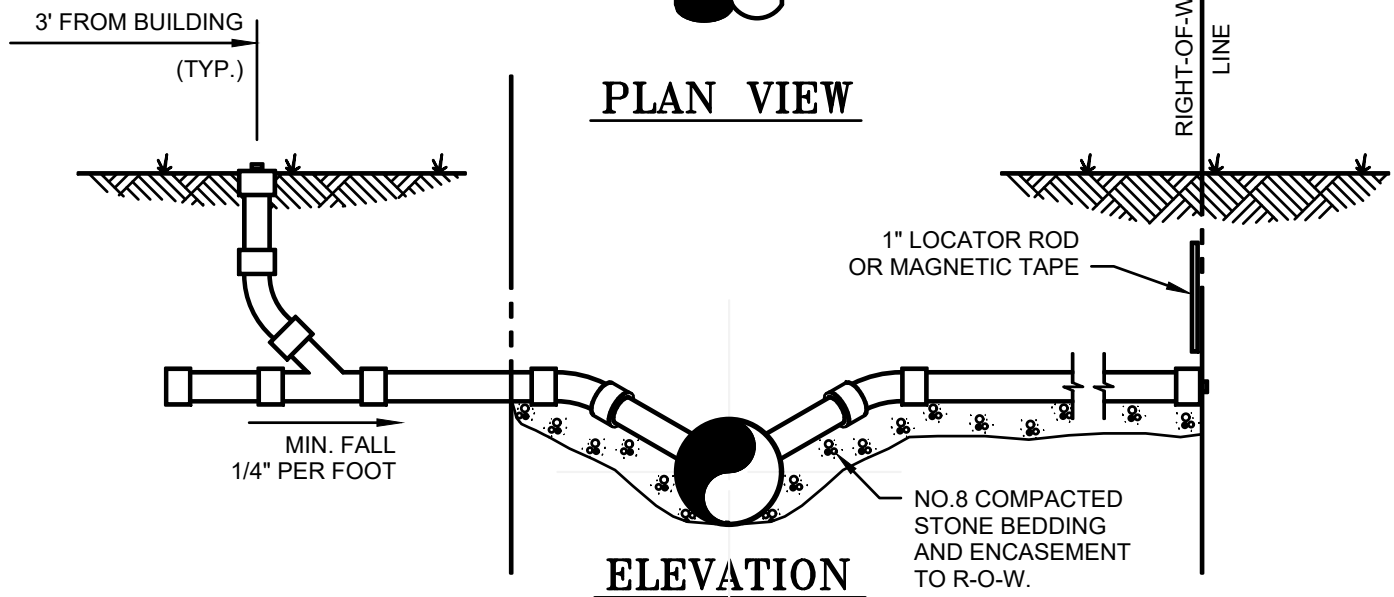
FIGURE

S-17

DATE: AUGUST 2019



PLAN VIEW



ELEVATION

**SERVICE CONNECTION FOR SHALLOW SEWERS
(LESS THAN 15' DEEP)**

REVISION DATE

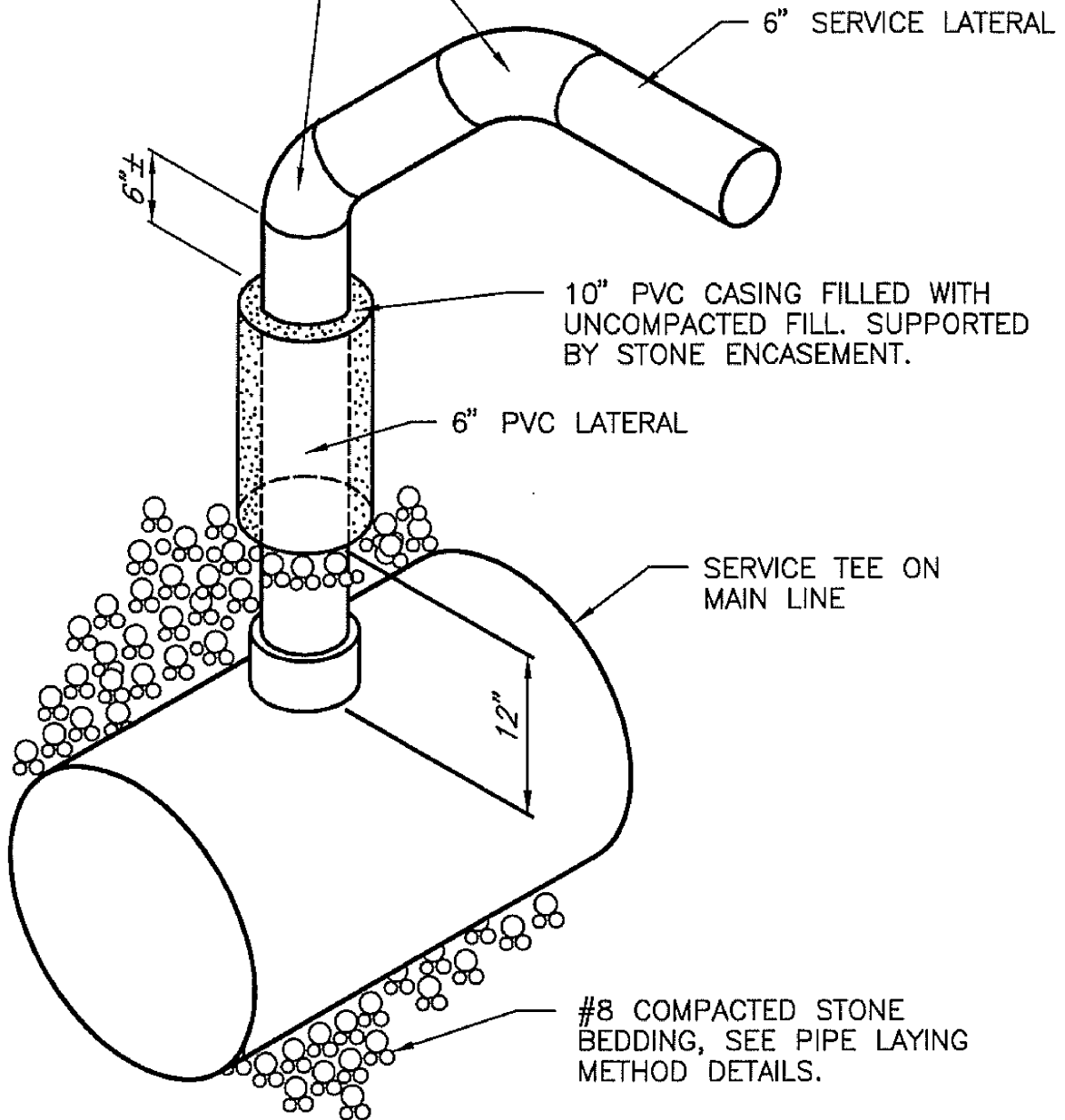
**CITY of MONTICELLO, INDIANA
STANDARD DETAILS
SANITARY SEWER**

FIGURE

S-18

DATE: AUGUST 2019

45° BEND REQUIRED



DEEP LATERAL INSTALLATION OVER 15' DEEP (ALT. #1)

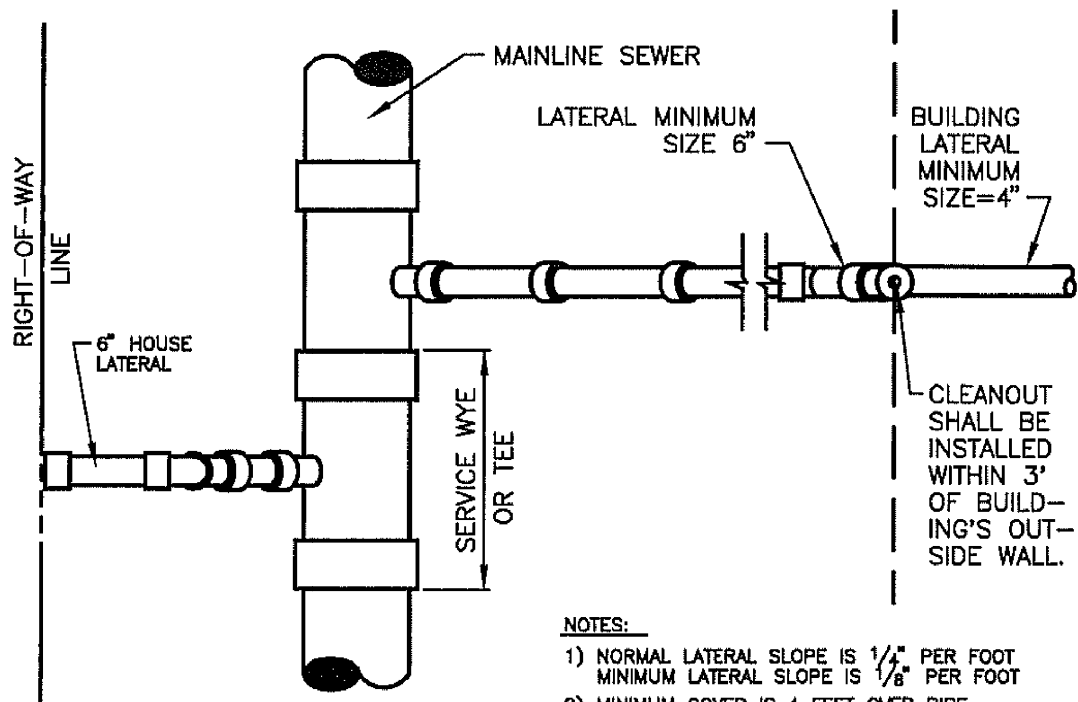
REVISION DATE

CITY of MONTICELLO, INDIANA
STANDARD DETAILS
SANITARY SEWER

FIGURE

S-19

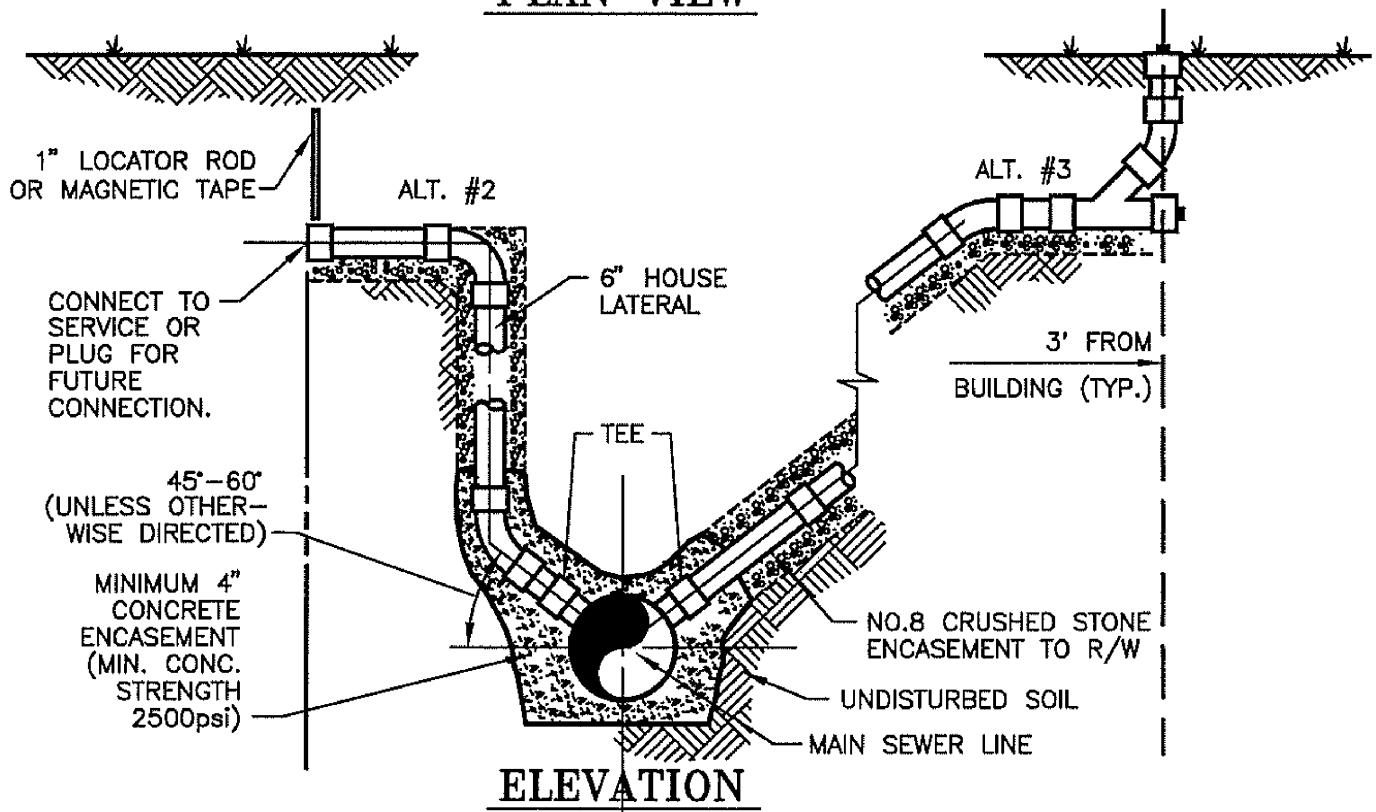
DATE: AUGUST 2019



NOTES:

- 1) NORMAL LATERAL SLOPE IS $\frac{1}{4}$ " PER FOOT
MINIMUM LATERAL SLOPE IS $\frac{1}{8}$ " PER FOOT
- 2) MINIMUM COVER IS 4 FEET OVER PIPE

PLAN VIEW



ELEVATION

**SERVICE CONNECTION FOR SHALLOW SEWERS
(ALT. #2 & ALT. #3)
(LESS THAN 15' DEEP)**

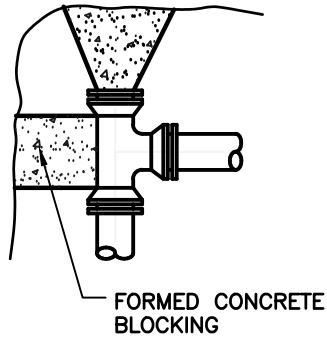
REVISION DATE

**CITY of MONTICELLO, INDIANA
STANDARD DETAILS
SANITARY SEWER**

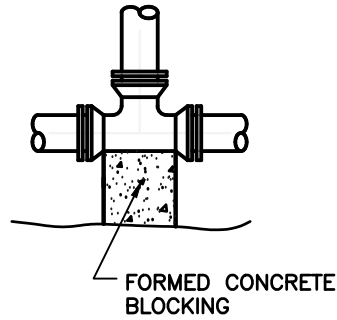
FIGURE

S-20

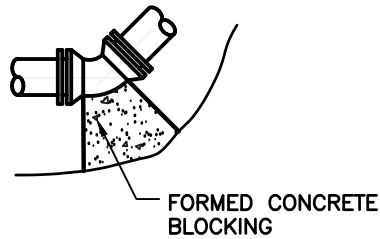
DATE: AUGUST 2019



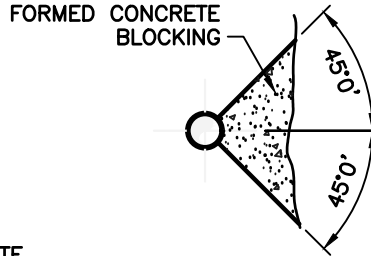
DETAIL A



DETAIL B



DETAIL C



TYP. PROFILE

TABLE OF DIMENSION FOR CONCRETE BLOCKING

SIZE	TEE				PLUG					90° BEND				45° BEND				22½° BEND				11½° BEND			
PIPE	L	T	W	D	L	T	W	D	s	L	T	W	D	L	T	W	D	L	T	W	D	L	T	W	D
4"	18"	12"	12"	8"	18"	12"	18"	18"	2"	24"	12"	24"	8"	18"	8"	12"	8"	18"	8"	12"	8"	15"	8"	12"	6"
6"	18"	12"	12"	8"	18"	12"	18"	18"	2"	24"	15"	24"	8"	18"	10"	12"	8"	18"	10"	12"	8"	18"	10"	18"	6"
8"	30"	12"	24"	8"	30"	18"	30"	24"	4"	36"	16"	30"	8"	24"	12"	18"	8"	24"	18"	18"	8"	24"	12"	18"	8"
10"	36"	18"	30"	10"	36"	18"	36"	24"	4"	48"	20"	36"	10"	30"	14"	24"	10"	30"	14"	24"	10"	24"	14"	18"	8"
12"	48"	18"	36"	10"	42"	18"	42"	24"	4"	54"	24"	48"	10"	36"	16"	30"	10"	36"	16"	30"	10"	30"	16"	24"	10"
14"	54"	24"	42"	12"	48"	18"	48"	30"	6"	60"	28"	60"	12"	42"	16"	42"	12"	42"	16"	42"	12"	33"	16"	27"	12"
16"	60"	24"	48"	12"	54"	18"	54"	30"	6"	66"	32"	63"	12"	48"	18"	48"	12"	48"	18"	48"	12"	36"	18"	30"	12"
18"	66"	30"	54"	14"	60"	24"	60"	36"	6"	66"	36"	66"	14"	54"	18"	54"	14"	54"	18"	54"	14"	39"	18"	33"	14"
20"	72"	30"	60"	14"	66"	24"	66"	36"	8"	72"	40"	69"	14"	60"	20"	60"	14"	60"	20"	60"	14"	42"	20"	36"	14"
24"	84"	36"	72"	18"	78"	30"	78"	42"	8"	84"	48"	75"	18"	72"	22"	72"	18"	72"	22"	72"	18"	48"	22"	42"	18"

NOTES:

1. FOR TEE WITH BRANCH UNEQUAL TO RUN USE TEE TYPE KICKER WITH D, L, AND W DIMENSIONS THE SAME AS THOSE FOR PLUG WITH SAME DIAMETER AS BRANCH OF TEE, SELECT "T" DIMENSIONS FROM TEE TABLE UNDER COLUMN HEADED BY THE SIZE OF THE BRANCH.
2. IF EXACT SIZE PIPE BLOCKING IS NOT SHOWN USE NEXT LARGER SIZE.
3. DEPTH "D" MAY BE GREATER THAN SPECIFIED TO ALLOW WORKING SPACE. BLOCKING MUST BE PLACED AGAINST UNDISTURBED EARTH OR ROCK.

THRUST BLOCKING DETAILS FOR FORCE MAIN

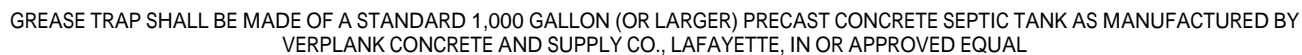
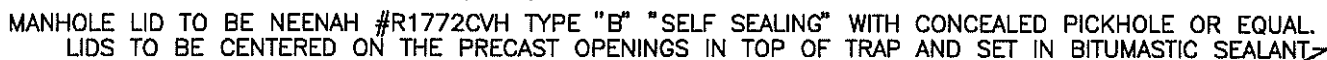
REVISION DATE

**CITY of MONTICELLO, INDIANA
STANDARD DETAILS
SANITARY SEWER**

FIGURE

S-21

DATE: AUGUST 2019



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SECTION 11

STORMWATER HYDROLOGY

SECTION 11

STORMWATER HYDROLOGY

11.1 General

The City and City Engineer shall issue final approval for the design of all storm sewer facilities.

11.2 Methodology for Determination of Runoff Rates

Runoff rates shall be computed for the area of the parcel under development plus the area of the watershed flowing into the parcel under development. The rate of runoff which is generated as the result of a given rainfall intensity may be calculated as follows:

A. Development Sites Less than or Equal to five (5) Acres in Size, With a Contributing Drainage Area Less than or Equal to fifty (50) Acres and No Depressional Storage

The Rational Method may be used. A computer model, such as TR-55 (NRCS), TR-20 (NRCS), HEC-HMS (COE), and HEC-1 (COE), that can generate hydrographs based on the NRCS TR-55 time of concentration and curve number calculation methodologies may also be used along with a twenty-four (24) hour duration NRCS Type 2 storm. In the Rational Method, the peak rate of runoff, Q, in cubic feet per second (cfs) is computed as:

$$Q = CIA$$

Where:

C = Runoff coefficient, representing the characteristics of the drainage area and defined as the ratio of runoff to rainfall.

I = Average intensity of rainfall in inches per hour for a duration equal to the time of concentration (tc) for a selected rainfall frequency.

A = Tributary drainage area in acres.

Values for the runoff coefficient "C" are provided in **Tables 11-1** and **11-2**, which show values for different types of surfaces and local soil characteristics. The composite "C" value used for a given drainage area with various surface types shall be the weighted average value for the total area calculated from a breakdown of individual areas having different surface types. **Table 11-3** provides runoff coefficients and inlet times for different land use classifications. Rainfall intensity shall be determined from the rainfall frequency data shown in **Table 11-4**.

In general, the time of concentration (tc) methodology to be used for all stormwater management projects within City of Monticello shall be as outlined in the U.S. Department of Agriculture (USDA) - NRCS TR-55 Manual. In urban or developed areas, the methodology to be used shall be the sum of the inlet time and flow time in the stormwater facility from the most remote part of the drainage area to the

point under consideration. The flow time in the storm sewers may be estimated by the distance in feet divided by velocity of flow in feet per second. The velocity shall be determined by the Manning's Equation (see **Section 15**). Inlet time is the combined time required for the runoff to reach the inlet of the storm sewer. It includes overland flow time and flow time through established surface drainage channels such as swales, ditches, and sheet flow across such areas as lawns, fields, and other graded surfaces.

Table 11-1
Urban Runoff Coefficients

Type of Surface	Runoff Coefficient "C"
Hard Surfaces	
Asphalt	0.82
Concrete	0.85
Roof	0.85
Lawns (Sandy)	
Flat (0-2% Slope)	0.07
Rolling (2-7% Slope)	0.12
Steep (> than 7% Slope)	0.17
Lawns (Clay)	
Flat (0-2% Slope)	0.16
Rolling (2-7% Slope)	0.21
Steep (> than 7% Slope)	0.30

Source: HERPICC Stormwater Drainage Manual, July 1995.

Table 11-2
Rural Runoff Coefficients

Type of Surface	Runoff Coefficient "C"
Woodland (Sandy)	
Flat (0-5% Slope)	0.10
Rolling (5-10% Slope)	0.25
Steep (Greater than 10% Slope)	0.30
Woodland (Clay)	
Flat (0-5% Slope)	0.30
Rolling (5-10% Slope)	0.35
Steep (Greater than 10% Slope)	0.50
Pasture (Sandy)	
Flat (0-5% Slope)	0.10
Rolling (5-10% Slope)	0.16
Steep (Greater than 10% Slope)	0.22
Pasture (Clay)	
Flat (0-5% Slope)	0.30
Rolling (5-10% Slope)	0.36
Steep (Greater than 10% Slope)	0.42
Cultivated (Sandy)	
Flat (0-5% Slope)	0.30
Rolling (5-10% Slope)	0.40
Steep (Greater than 10% Slope)	0.52
Cultivated (Clay)	
Flat (0-5% Slope)	0.50
Rolling (5-10% Slope)	0.60
Steep (Greater than 10% Slope)	0.72

Source: HERPICC Stormwater Drainage Manual, July 1995.

Table 11-3
Runoff Coefficients “C”
by Land Use and Typical Inlet Times

Land Use	Runoff Coefficients			Inlet Times (Minutes) ¹
	Flat ²	Rolling ³	Steep ⁴	
Commercial (CBD)	0.75	0.83	0.91	5
Commercial (Neighborhood)	0.54	0.60	0.66	5-10
Industrial	0.63	0.70	0.77	5-10
Garden Apartments	0.54	0.60	0.66	5-10
Churches	0.54	0.60	0.66	5-10
Schools	0.31	0.35	0.39	10-15
Semi Detached Residential	0.45	0.50	0.55	10-15
Detached Residential	0.40	0.45	0.50	10-15
Quarter Acre Lots	0.36	0.40	0.44	10-15
Half Acre Lots	0.31	0.35	0.39	10-15
Parkland	0.18	0.20	0.22	To be Computed

Source: *HERPICC Stormwater Drainage Manual, July 1995*

B. Development Sites Greater Than 5 Acres in Size or Contributing Drainage Area Greater than 50 Acres or With Significant Depressional Storage

The runoff rate for these development sites and contributing drainage areas shall be determined by a computer model that can generate hydrographs based on the NRCS TR-55 time of concentration and curve number calculation methodologies and the twenty-four (24) hour NRCS Type 2 Rainfall Distribution. Twenty-four (24) hour Rainfall depth for various frequencies shall be taken from **Table 11-5**. The NRCS Type 2 distribution ordinates are found in **Table 11-6**. Examples of computer models that can generate such hydrographs include TR-55 (NRCS), TR-20 (NRCS), HEC- HMS (COE), and HEC-1 (COE). These programs may be downloaded free of charge from the associated agencies' web sites. Other models may be acceptable and should be accepted by the City of Monticello City Engineer prior to their utilization.

¹ Interpolation, extrapolation and adjustment for local conditions shall be based on engineering experience and judgment.

² Flat terrain involves slopes of 0-2%.

³ Rolling terrain involves slopes of 2-7%.

⁴ Steep terrain involves slopes greater than 7%.

Table 11-4
Rainfall Intensities for Various Return Periods and Storm Durations

Duration	Intensity (Inches/Hour)					
	Return Period (Years)					
	2	5	10	25	50	100
5 Min.	5.04	8.24	7.08	8.16	9.00	9.84
10 Min.	3.84	4.74	5.46	6.24	6.90	7.50
15 Min.	3.20	3.96	4.52	5.16	5.72	6.20
20 Min.	2.85	3.51	4.02	4.59	5.10	5.55
30 Min.	2.22	2.74	3.12	3.58	3.96	4.32
40 Min.	1.85	2.28	2.61	2.99	3.30	3.60
50 Min.	1.60	1.97	2.24	2.57	2.83	3.10
1 Hr.	1.40	1.73	1.97	2.25	2.49	2.72
1.5 Hrs.	1.13	1.39	1.59	1.82	2.02	2.20
2 Hrs.	0.86	1.06	1.21	1.38	1.53	1.67
3 Hrs.	0.61	0.76	0.87	0.99	1.10	1.20
4 Hrs.	0.52	0.64	0.73	0.83	0.92	1.00
5 Hrs.	0.43	0.53	0.61	0.70	0.77	0.84
6 Hrs.	0.37	0.46	0.52	0.60	0.66	0.72
7 Hrs.	0.33	0.41	0.47	0.53	0.59	0.64
8 Hrs.	0.29	0.36	0.42	0.47	0.53	0.57
9 Hrs.	0.27	0.33	0.38	0.43	0.48	0.52
10 Hrs.	0.25	0.31	0.35	0.40	0.44	0.48
12 Hrs.	0.22	0.27	0.30	0.35	0.38	0.42
14 Hrs.	0.19	0.24	0.27	0.31	0.34	0.37
16 Hrs.	0.17	0.21	0.24	0.28	0.31	0.34
18 Hrs.	0.16	0.19	0.22	0.25	0.28	0.31
20 Hrs.	0.14	0.18	0.20	0.23	0.26	0.28
24 Hrs.	0.13	0.15	0.18	0.20	0.22	0.24

**Table 11-5
Rainfall Depths for Various Return Periods**

Depth (Inches)						
Duration	Return Period (Years)					
	2	5	10	25	50	100
24 Hrs.	3.00	3.70	4.23	4.83	5.35	5.83

**Table 11-6
NRCS Type II Rainfall Distribution Ordinates**

Cumulative Percent of Storm Time	Cumulative Percent of Storm Depth
0	0
5	1
10	3
15	4
20	6
25	8
30	10
35	13
40	17
45	22
50	64
55	78
60	84
65	87
70	90
75	92
80	94
85	96
90	98
95	99
100	100

SECTION 12

STORM SEWER DESIGN

SECTION 12

STORM SEWER DESIGN

12.1 General

All storm sewers, whether private or public, and whether constructed on private or public property, shall conform to the design standards and other requirements contained herein.

12.2 Design Storm Frequencies

- A. All storm sewers, inlets, catch basins, and street gutters shall accommodate (subject to the “allowable spread” provisions discussed later in this Section), as a minimum, peak runoff from a twenty-four (24) hour, ten (10) year return frequency storm calculated based on methodology described in **Section 11**. Additional discharges to storm sewer systems allowed must be considered in all design calculations. For Rational Method analysis, the duration shall be equal to the time of concentration for the drainage area. In computer-based analysis, the duration is as noted in the applicable methodology associated with the computer program.
- B. Culverts shall be capable of accommodating peak runoff from a twenty-four (24) hour, fifty (50) year frequency storm when crossing under a road which is part of the INDOT Rural Functional Classification System or is classified as freeway, arterial, and/or collectors by the City or City Engineer or provides the only access to and from any portion of any commercial or residential developments.
- C. For portions of the system considered minor drainage systems, the allowable spread of water on Collector Streets is limited to maintaining two (2) clear ten (10) foot moving lanes of traffic. One lane is to be maintained on Local Roads, while other access lanes (such as a subdivision cul-de-sac) can have a water spread equal to one-half of their total width. An overflow channel/swale between sag inlets and overflow paths or basin shall be provided at sag inlets so that the maximum depth of water that might be ponded in the street sag shall not exceed seven (7) inches measured from elevation of gutter.

12.3 Manning’s Equation

Determination of hydraulic capacity for storm sewers sized by the Rational Method analysis must be done using Manning’s Equation.

Where:

$$V = (1.486/n)(R^{2/3})(S^{1/2})$$

Then:

$$Q = (V)(A)$$

Where: Q = capacity in cubic feet per second

V = mean velocity of flow in feet per second

A = cross sectional area in square feet

R = hydraulic radius in feet

S = slope of the energy grade line in feet per foot

N = Manning's "n" or roughness coefficient

The hydraulic radius, R, is defined as the cross-sectional area of flow divided by the wetted flow surface or wetted perimeter. Allowable "n" values and maximum permissible velocities for storm sewer materials are listed in **Table 12-1**.

Table 12-1
Typical Values of Manning's "n"

Material	Manning's "n"	Maximum Velocities (feet/second)
Closed Conduits		
Concrete	0.013	10
Vitrified Clay	0.013	10
HDPE	0.012	10
PVC	0.011	10
Circular CMP, Annular Corrugations, 2 2/3 x 1/2 inch		
Unpaved	0.024	7
25% Paved	0.021	7
50% Paved	0.018	7
100% Paved	0.013	7
Concrete Culverts	0.013	10
HDPE or PVC	0.012	10
Open Channels		
Concrete	0.013	10
Concrete	0.015	10
Granite	0.018	10
Riprap Placed	0.030	10
Riprap Dumped	0.035	10
Gabion	0.028	10
New Earth ¹	0.025	4
Existing Earth ²	0.030	4
Dense Growth of Weeds	0.040	4
Dense Weeds and Brush	0.040	4
Swale with Grass	0.035	4

Source of manning "n" values: *HERPACC Stormwater Drainage Manual, July 1995.*

¹ New earth (uniform, sodded, clay soil)

² Existing earth (fairly uniform, with some weeds). Various computer modeling programs such as HYDRA, ILLUDRAIN, and STORMCAD are available for analysis of storm drains under these conditions. Computer models to be utilized, other than those listed, must be accepted by the City and City Engineer.

12.4 **Backwater Method for Pipe System Analysis**

For hydraulic analysis of existing or proposed storm drains which possess submerged outfalls, a more sophisticated design/analysis methodology than Manning's equation will be required. The backwater analysis method provides a more accurate estimate of pipe flow by calculating individual head losses in pipe systems that are surcharged and/or have submerged outlets. These head losses are added to a known downstream water surface elevation to give a design water surface elevation for a given flow at the desired upstream location. Total head losses may be determined as follows:

Total head loss = frictional loss + manhole loss + velocity head loss + junction loss

12.5 **Minimum Size for Storm Sewers**

The minimum diameter of all storm sewers shall be twelve (12) inches. When the minimum twelve (12) inch diameter pipe will not limit the rate of release to the required amount, the rate of release for detention storage shall be controlled by an orifice plate or other device, subject to acceptance of the City and City Engineer.

12.6 **Pipe Cover, Grade, and Separation from Sanitary Sewers and Water Mains**

Pipe grade shall be such that, in general, a minimum of two (2) feet of cover is maintained over the top of the pipe. If the pipe is to be placed under pavement, then the minimum pipe cover shall be two and one half (2.5) feet from top of pavement to top of pipe. Pipe cover less than the minimum may be allowed per manufacturer's specifications or recommendation and used only upon written acceptance from the City and City Engineer. Uniform slopes shall be maintained between inlets, manholes and inlets to manholes. Final grade shall be set with full consideration of the capacity required, sedimentation problems, and other design parameters. Minimum and maximum allowable slopes shall be those capable of producing velocities of between two and one half (2.5) feet and ten (10) feet per second, respectively, when the sewer is flowing full. Maximum permissible velocities for various storm sewer materials are listed in **Table 12-1**. Based on Kutter's formula using an "n" value of 0.013, the following are the minimum slopes should be provided. Slopes greater than these are desirable:

Sewer Size (inch)	Minimum Slope in Feet Per 100 Feet
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
27	0.067
30	0.058
36	0.046

A minimum of two (2) feet of vertical separation between storm sewers and sanitary sewers shall be required. When this is not possible, the sanitary sewer must be encased in concrete or ductile steel within five (5) feet, each side, of the crossing centerline. Storm sewers shall be laid at least ten (10) feet horizontally from any existing or proposed water main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten-foot separation, the appropriate, the reviewing agency may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the storm sewer closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the storm sewer and at the elevation so the bottom of the water main is at least eighteen (18) inches above the top of the storm sewer.

12.7 **Alignment**

Storm sewers shall be straight between manholes and/or inlets.

12.8 **Manholes/Inlets**

All Inlets must be pre-stamped with an appropriate "clean water" message. Manholes and/or inlets shall be installed to provide human access to continuous underground storm sewers for the purpose of inspection and maintenance. The casting access minimum inside diameter shall be no less than thirty-six (36) inches or a rectangular opening of no less than twenty-two (22) inches by twenty-two (22) inches. Manholes shall be provided at the following locations:

- A. Where two (2) or more storm sewers converge.
- B. Where pipe size or the pipe material changes.
- C. Where a change in horizontal alignment occurs.
- D. Where a change in pipe slope occurs.
- E. At intervals in straight sections of sewer, not to exceed the maximum allowed. The maximum distance between storm sewer manholes shall be as shown in **Table 12-2**.

Table 12-2
Maximum Distance Between Manholes

Size of Pipe (Inches)	Maximum Distance (Feet)
12 through 42	400
48 and larger	600

In addition to the above requirements, a minimum drop of 0.1 foot through manholes and inlet structures should be provided. When changing pipe size, match crowns of pipes, unless detailed modeling of hydraulic grade line shows that another arrangement would be as effective. Pipe slope should not be so steep that inlets surcharge (i.e. hydraulic grade line should remain below rim elevation).

- F. Manhole/inlet inside sizing shall be as shown in **Table 12-3**.

Table 12-3
Manhole/Inlet Inside Sizing

Depth of Structure	Minimum Diameter	Minimum Square Opening
Less than 5 feet	36 inches	36" x 36"
5 feet or more	48 inches	48" x 48"

12.9 Inlet Sizing and Spacing

Inlets or drainage structures shall be utilized to collect surface water through grated openings and convey it to storm sewers, channels, or culverts. The inlet grate opening provided shall be adequate to pass the design ten (10) year flow with fifty (50) percent of the sag inlet areas clogged. An overload channel from sag inlets to the overflow channel or basin shall be provided at sag inlets. Inlet design and spacing may be done using the hydraulic equations by manufacturers or orifice/weir equations. Use of the U.S. Army Corps of Engineers HEC-12 computer program is also an acceptable method. Gutter spread on continuous grades may be determined using the Manning's equation, or by using **Figure 12-1**. Further guidance regarding gutter spread calculation may be found in the latest edition of HERPICC Stormwater Drainage Manual, available from the Local Technical Assistance Program (LTAP). At the time of printing of this document, contact information for LTAP was:

Indiana LTAP
Purdue University
Toll-Free: (800) 428-7369 (Indiana only)
Phone: (765) 494-2164
Fax: (765) 496-1176
Email: inltap@ecn.purdue.edu
Website: www.purdue.edu/INLTAP/

12.10 Special Hydraulic Structures

Special hydraulic structures required to control the flow of water in storm runoff drainage systems include junction chambers, drop manholes, stilling basins, and other special structures. The use of these structures shall be limited to those locations justified by prudent planning and by careful and thorough hydraulic engineering analysis. Certification of special structures by a certified Structural Engineer may also be required.

12.11 Connections to Storm Sewer System

To allow any connections to the storm sewer system, provisions for the connections shall be shown in the drainage calculations for the system. Specific language shall be provided in the protective covenants, on the record plat, or with the parcel deed of record, noting the ability or inability of the system to accommodate any permitted connections, for example, sump pumps and footing drains.

- A. **Sump pumps** installed to receive and discharge groundwater or other stormwater shall be connected to the storm sewer where possible or discharged into a designated storm drainage channel/swale. Sump pumps installed to receive, and discharge floor drain flow or other sanitary sewage shall be connected to the sanitary sewers. A sump pump shall be used for one function only, either the discharge of stormwater or the discharge of sanitary sewage.
- B. **Footing drains and perimeter drains** shall be connected to Manholes or Curb inlets, where possible, or to designated storm sewers or discharged into designated storm drainage channels/swales.
- C. All **roof downspouts**, roof drains, or roof drainage piping shall discharge onto the ground and shall not be directly connected to the storm drainage system. Variation from this requirement may be requested and granted by the City or City Engineer in special circumstances. No downspouts or roof drains shall be connected to the sanitary sewers.
- D. **Swimming Pool drains** shall not be connected to the storm sewers.

In addition, none of the above-mentioned devices shall be connected to any street underdrains, unless specifically authorized by the City or City Engineer.

Table 12-4
Building Pad Elevations with Respect to Overflow Path Invert Elevations

Drainage Area (Acres)	Building Pad Above Overflow Path Invert (Feet)	Building Pad Above Overflow Path Invert [if overflow is in the street] (Feet)
Up to 5	2.5	1.5
6-10	3.0	1.5
11-15	3.25	1.75
16-20	3.5	1.75
21-30	4.0	2.0
30-50	4.25	2.0

If **Table 12-4** is used, the City or City Engineer reserves the right to require independent

calculations to verify that the proposed building pads provide approximately one (1) foot of freeboard above the anticipated overflow path/ponding elevations.

In the case of existing upstream detention, an allowance equivalent to the reduction in flow rate provided may be made for upstream detention only when:

- (1) such detention and release rate have previously been accepted by the City or City Engineer official charged with the approval authority at the time of the acceptance, and
- (2) evidence of its construction and maintenance can be shown.

Figure 12-1
Street and Gutter Capacities (continuous grade)

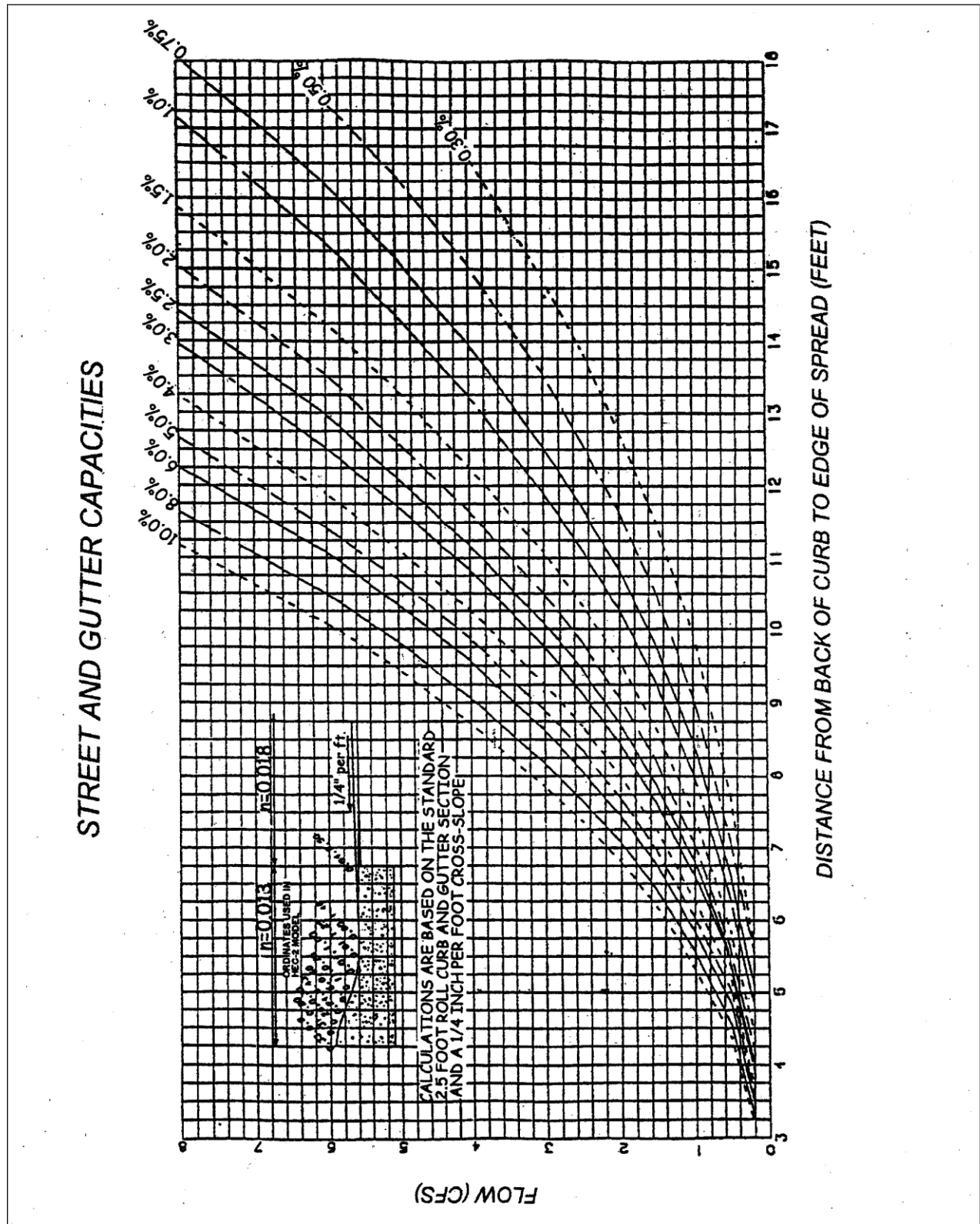


Figure 12-2
Bedding and Backfill Standards for Storm Sewers

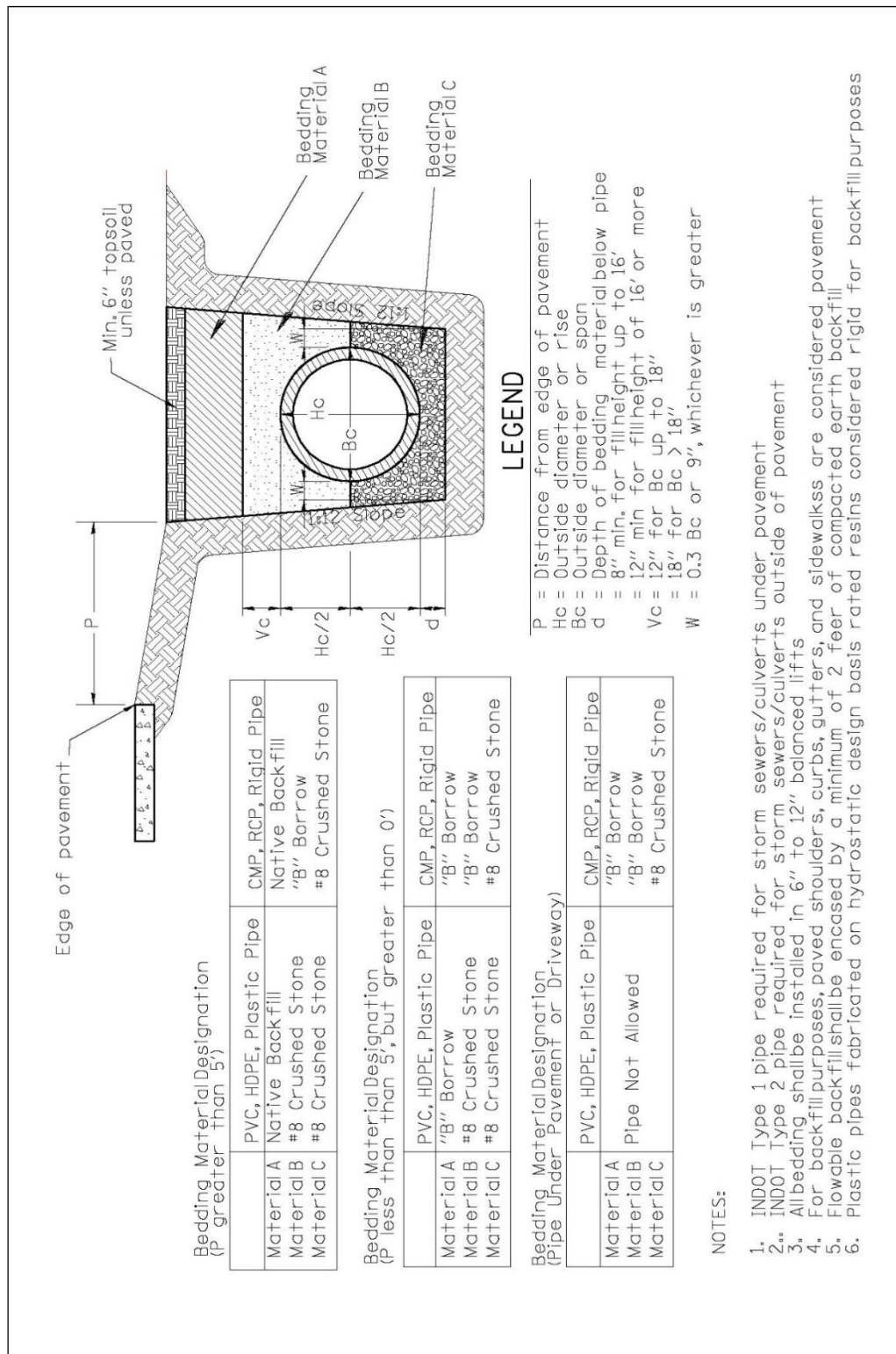
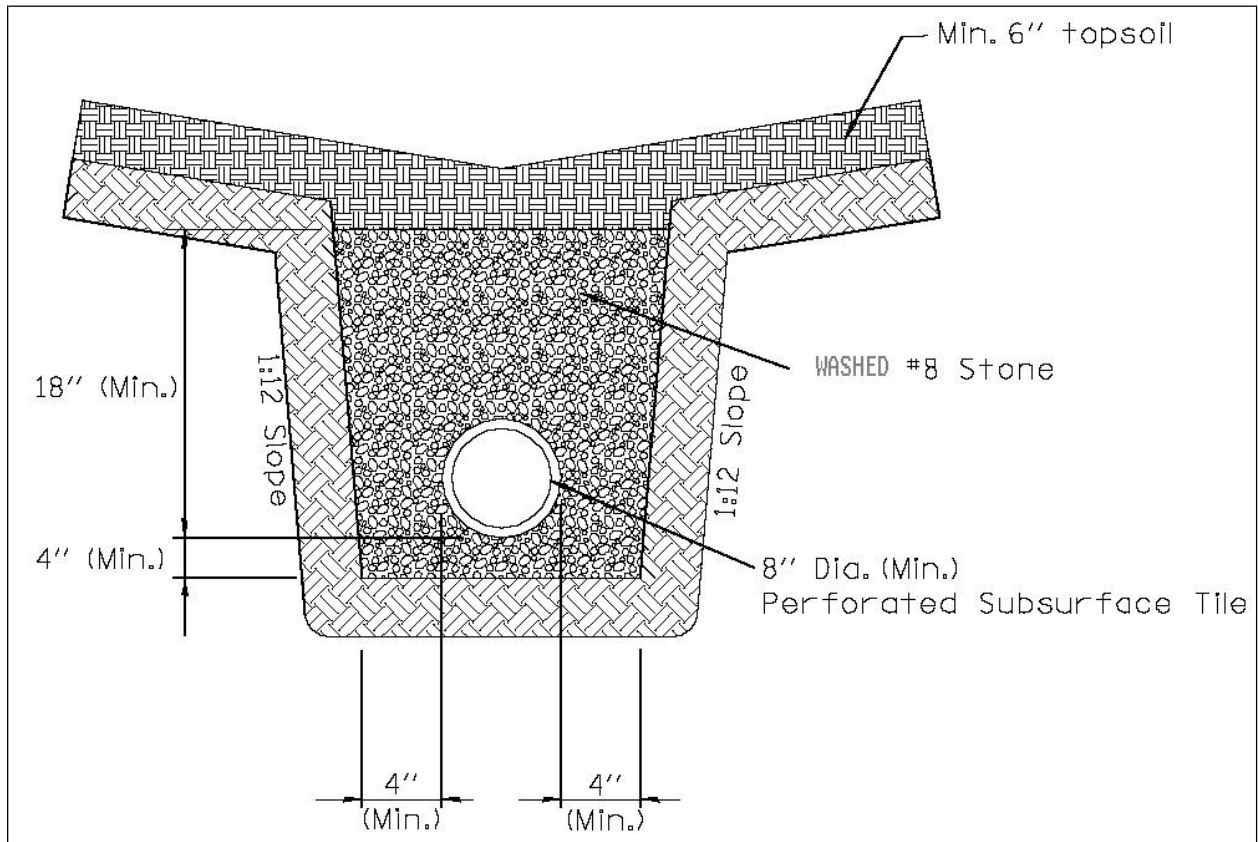


Figure 12-3
Bedding and Backfill Standards for Sub-drains under Swales



SECTION 13

STORM SEWER MATERIALS

SECTION 13

STORM SEWER MATERIALS

13.1 General

This section provides a description of the materials acceptable for the construction of storm sewer facilities. Use of other materials which are not specified herein shall only be permitted with the written approval by the City and City Engineer.

13.2 Storm Sewer Pipe

The City currently allows the use of the following pipe material:

- Reinforced Concrete Pipe (RCP)
- Ductile Iron (DI)
- Polyvinyl Chloride (PVC)
- High Density Polyethylene (HDPE)

A. Reinforced Concrete Pipe (RCP)

Reinforced concrete pipe shall be Reinforced Concrete Culvert, Storm Drain and Sewer Pipe conforming to ASTM Designation C 76. Pipe shall be wall thickness "B" or "C" as required by site conditions. Class shall be as required by loading conditions but shall not be less than Class III.

Reinforced concrete pipe shall be tested in accordance with ASTM Designation C 497.

Joints for sewer pipe manufactured of reinforced concrete shall be flexible watertight joints conforming to "Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible, Watertight, Rubber Gaskets" (ASTM Designation C443). Joints shall be made using rubber or rubber-like materials manufactured to fit tongue and groove or bell-and spigot type concrete pipe. The joint shall be installed in accordance with the manufacturer's recommendations.

Lateral connections to the RCP sewer shall be subject to City approval. Where lateral connections must be made to the RCP sewer, a rubber connector with stainless steel clamp shall be used. The connector shall be the sole element relied on to assure a flexible watertight seal of the pipe.

The rubber for the connector shall comply with ASTM C 923 and shall be resistant to ozone, weather elements, chemicals including acids and alkalis and oils.

The stainless-steel elements of the connector shall be totally non-magnetic Series 305 stainless-steel. The stainless-steel clamp shall be capable of sustaining applied torque in excess of eighty (80) inch-pounds. It shall be the responsibility of the Contractor to submit details of the proposed connection to the City for approval. Connections not approved by the City shall be subject to removal and replacement

with an approved adaptor.

B. Ductile Iron Pipe (DIP)

All ductile iron pipe shall conform to the ANSI A21.51 and AWWA C151, latest revisions. Ductile iron pipe shall be Class 350, 300, 250, 200, or 150 for eight (8) inch through eighteen (18) inch. Pipe shall be standard cement lined and seal coated with an approved bituminous seal coat in accordance with AWWA Specification C 104 (ANSI A21.4).

Fittings shall be standardized for the type of pipe and joint specified and shall comply with AWWA C 110 (ANSI A-21.10) or AWWA C 153 (ANSI A-21.53). Pipe joints shall use O-ring gaskets in accordance with ANSI 21.11 and AWWA C 111.

The class designations for the various classes of pipe and fittings, manufacturer's name, and year of manufacture shall be cast onto fittings in raised numerals and cast or stamped on the outside of each joint of pipe.

The Contractor shall furnish, upon request by the Engineer, certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable Standards.

C. Polyvinyl Chloride Pipe (PVC)

All PVC pipe shall be considered "flexible" and shall be installed as such. PVC pipe shall not be installed where exposed to sunlight unless current material certifications guarantee that it will not be subject to ultraviolet degradation.

1. Material

- a. Poly (Vinyl Chloride) (PVC) gravity storm sewer pipe shall be the integral wall bell and spigot type with elastomeric seal joints and smooth inner walls meeting or exceeding all of the requirements set forth in ASTM D-3034 for pipe diameters fifteen (15) inches or less and meeting or exceeding all of the requirements set forth in ASTM F-679 for pipe diameters greater than fifteen (15) inches.
- b. For diameters fifteen (15) inches or less, the pipe shall have a minimum cell classification of 12454-B and for diameters greater than fifteen (15) inches the pipe shall have a minimum cell classification of 12454-C; with all pipe having a minimum tensile strength of 34.50 psi as defined in ASTM D-1784.
- c. PVC storm sewer pipe shall have a minimum pipe stiffness of forty-six (46) psi for each diameter when measured at five (5) percent vertical ring deflection and tested in accordance with ASTM D-2412.
- d. NOTE: Poly (Vinyl Chloride) (PVC) Ribbed Sewer Pipe meeting or exceeding all of the requirements set forth in ASTM F 949-86a or ASTM F 794 is acceptable. The minimum cell classification

acceptable shall be 12454-B as defined in ASTM D-1784. PVC Ribbed Sewer Pipe shall have a minimum pipe stiffness of fifty (50) psi when measured in accordance with ASTM D-2412 for eight (8) inch through eighteen (18) inch pipe and forty-six (46) psi for twenty-one (21) inch and greater.

2. Joints

- a. Flexible gasket joints shall be compression type so that when assembled, the gasket inside the bell will be compressed radially on the pipe spigot to form a watertight seal. The assembly of joints shall be in accordance with the pipe manufacturer's recommendations and ASTM D-3212. The gaskets sealing the joint shall be made of rubber of special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five (5) years' experience in the manufacture of rubber gaskets for pipe joints. The gasket shall be a continuous ring of flexible joint rubber of a composition and texture which is resistant to common ingredients of sewage, industrial wastes and groundwater and which will endure permanently under the conditions imposed by this service. The gasket shall conform to the requirements of ASTM F-477.
- b. NO SOLVENT CEMENT JOINTS SHALL BE ALLOWED. Connections at manholes shall be watertight.
- c. All field-cutting of pipe shall be done in a neat manner as per manufacturer's recommendations and the cut end shall be beveled using a file or wheel to produce a smooth bevel of approximately 15° and be a minimum depth of one-third the pipe wall thickness. Field cut pipe is only allowed at manholes, at prefabricated fittings, and at the connection of new storm sewer and other structures to existing storm sewer pipe.

3. Fittings

- a. Only manufactured fittings made of PVC plastic having a cell classification of 12454-B as defined in ASTM D-1784 shall be used.
- b. Tee/Wye service connections for storm sewers where existing or proposed grade (to sewer invert), exceeds fifteen (15) feet shall be heavy wall.
- c. **SADDLE CONNECTIONS SHALL NOT BE ALLOWED FOR NEW CONSTRUCTION.**

4. Design

- a. The minimum wall thickness for PVC sewer pipe and lateral sewer pipe fifteen (15) inches or less in diameter shall conform to SDR-35 Type PSM as specified in ASTM D-3034. The minimum wall thickness for PVC sewer pipe greater than fifteen (15) inches in

diameter shall conform to T-1 as specified in ASTM F-679.

5. Markings

- a. The date of manufacture, class of pipe, specification designation, size of pipe, name or trademark of manufacturer, and identification of plant/location shall be legibly marked on the outside of each pipe section in accordance with the ASTM D-3034.

6. Certification

- a. The Contractor shall furnish, upon request, certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable Standards.

D. High Density Polyethylene Pipe (HDPE)

All HDPE pipe shall be considered “flexible” and shall be installed as such. HDPE pipe shall not be installed where exposed to sunlight unless current material certifications guarantee that it will not be subject to ultraviolet degradation.

The drainpipe for the various pipe diameters may be “Sure-Lok” High Density Polyethylene (HDPE) pipe as manufactured by Hancor of Findlay, Ohio, N-12 High Density Polyethylene Pipe (HDPE) as manufactured by ADS, Inc. of Columbus, Ohio, or approved equal. Bedding shall be Class I or II only as described in ASTM D-2321.

1. Production and Material Standards for HDPE

- a. Corrugated High Density Polyethylene (HDPE) pipe shall be manufactured in accordance with AASHTO M 294 Type S. Pipe manufactured under this specification shall have a minimum cell class of 335420C in accordance with ASTM D-3350.
- b. Ribbed Polyethylene pipe shall be in accordance with ASTM F-894 for the specified sizes, meeting the requirements for RSC 160. Pipe manufactured under this specification shall have a minimum cell class of 335420C in accordance with ASTM D-3350.
- c. Smooth wall Polyethylene pipe shall be in accordance with ASTM F-714 for the specified sizes. Pipe manufactured under this specification shall have a minimum cell class of 335420C in accordance with ASTM D-3350.
- d. All polyethylene pipe and fittings shall be made from high molecular weight high density polyethylene material meeting the application cell class requirements. All polyethylene material used in drainpipe manufacture shall be virgin resin.

2. HDPE Joints

- a. High-density polyethylene pipe shall possess male and female pipe ends or molded HDPE or PVC couplers that allow the construction of overlapping, gasketed pipe joints in accordance with the requirements of ASTM D-3212 for a gasketed joint. The gasket material shall conform to all requirements of ASTM F-477.

3. Rejection of Damaged HDPE Pipe and Fittings

- a. High density polyethylene pipe and fittings possessing the following defects may be rejected for installation: variations from straight centerline; elliptical shape in pipe intended to be round; illegible or improper markings as required herein; deep or excessive gouges or scratches on the pipe wall; fractures, punctures, or cracks; damaged or cracked ends where such damage would prevent making a satisfactory joint.

4. HDPE Pipe Markings

- a. For high density polyethylene pipe products, each length of pipe shall be clearly marked with the following information as a minimum: manufacturer's name or identification symbol; nominal pipe size; and production/extrusion code.

E. High Density Polyethylene Tubing (Perforated Pipe)

1. Six (6) inch HDPE tubing shall be manufactured by Hancor of Findlay, Ohio, ADS, Inc., of Columbus, Ohio, or approved equal, and shall meet all applicable standards of ASTM F405.
2. The perforated pipe for subsurface drains shall be installed within the bedding of the pipe trench as indicated on the plans. All manufacturer's recommended installation procedures shall be followed. Due to the nature of the soils, a geotextile fabric sock shall be provided with the pipe when recommended by the manufacturer for the given soil.

F. End Sections

1. End sections shall be precast concrete or galvanized steel as indicated by the Detail Specifications or Drawings unless otherwise approved by the Engineer. Where differing materials are used, an appropriate water-tight connection shall be made to join the pipe to the end section.

13.3 Storm Sewer Manholes

Location of manholes shall be as required in **Section 12**.

Manholes shall be either monolithic (cast-in-place) or precast. If monolithic manholes are to be used, the Contractor shall submit drawings showing all reinforcement, dimensions, and connections for City approval. All drawings shall be certified by a registered

Professional Engineer.

A. Precast Manholes

Manholes shall be constructed in accordance with the ASTM Specifications for "Precast Reinforced Concrete Manhole Risers and Tops", Designation C 478. The minimum wall thickness shall be five (5) inches for manholes four (4) feet in diameter. When the depth of the manhole exceeds twelve (12) feet, then the depth in excess of twelve (12) feet shall be reinforced with two cages of reinforcement the same as required for reinforced concrete sewer pipe of same diameter as the riser of the manhole per ASTM Specification Designation C 76 for Class III Pipe. The precast tops shall be of the eccentric cone type. Precast flat covers shall be not less than eight (8) inches thick and reinforced with two layers of steel with a minimum area of 0.39 square inches per linear foot in both directions in each layer. Precast flat bottoms of manholes shall also be reinforced the same as specified herein for precast flat top. Hoisting lugs or hooks shall be cast in place for handling and setting of the rings. Openings of proper sizes and suitable design shall be cast in place for receiving the sewer and/or drop pipes and connections. Adjusting riser rings shall be provided as approved by the City.

All manhole joints shall be tongue and groove and they shall be sealed with an O-ring and joint sealer conforming to Federal Specifications SS-S-00210 and similar to "Kent-Seal No. 2" as manufactured by the Hamilton Kent Manufacturing Co., of Kent, Ohio; "RAM-NEK" as manufactured by the K.T. Snyder Co. of Houston, Texas, or equal. Cracked or damaged barrel joints shall be rejected.

B. Manhole Steps

The steps provided shall be manufactured of reinforced plastic and shall be twelve (12) inches wide and one (1) inch square.

C. Manhole Bases

Manhole bases shall be of cast-in-place monolithic concrete or precast concrete. Where sewer lines pass through or enter manholes, the invert channels shall be smooth and semi-circular in cross section and may be formed directly in the concrete of the manhole base, may be half tile laid in the concrete, or may be constructed by laying the sewer lines continuously through the manhole and break-hardened and neatly trimming the edges. Changes of direction of flow within the manholes shall be made with a smooth curve with as long as a radius as possible. The floor of the manhole outside the channels shall be smooth and slope toward the channel not less than one (1) inch per foot.

No mortar or concrete shall be placed in water, and no water shall be allowed to flow over or against the concrete before it has set for a period of time deemed sufficient by the City to prevent damage to the structure. The invert channel through manholes should be made to conform in shape and slope to that of the sewer. All invert channels are to have a properly mortared apron on either side, sloped to prevent solids deposition.

D. Adjusting Rings

Where one (1) solid riser or barrel section cannot be used, final adjustments in elevation of the frame and cover shall only be accomplished by the use of precast concrete adjusting rings conforming to ASTM C 478.

Rings shall be of a nominal thickness of not less than four (4) inches. Not more than twelve (12) inches total of adjusting rings shall be allowed for adjustment of the manhole frame and cover to required elevation. Adjustment rings are required in situations with round, solid steel sized for casting. Expandable rings are not a suitable alternative.

E. Sewer Pipe to Manhole Connections

To connect a storm sewer to a manhole, either a flexible boot KOR-N-SEAL 1 or 2, flexible connector, cast-in-place Dura-Seal gasket, "A"-lock gasket or an approved equal shall be used. Connections to an existing manhole shall be a flexible boot KOR-N-SEAL or approved equal.

If the flexible boot connection is used, it shall be placed in the reinforced concrete manhole base and secured to the pipe by a stainless-steel clamp. Flexible connectors shall conform to ASTM C 923.

The cast-in-place inflatable gasket shall conform to ASTM C 923.

All connections shall provide for a watertight seal between the pipe and manhole. The connector shall be the sole element relied upon to assure a flexible watertight seal of the pipe to the manhole.

The rubber for the connector shall comply with ASTM C 923 and shall be resistant to ozone, weather elements, chemicals, including acids and alkalis, animal and vegetable fats, oils and petroleum products.

The stainless-steel elements of the connector shall be totally non-magnetic Series 305 stainless steel. The stainless-steel clamp shall be capable of sustaining applied torque in excess of eighty (80) inch-pounds. It shall be the responsibility of the Contractor to submit details of the proposed connection to the City for approval. Connections not approved by the City shall be subject to removal and replacement with an approved adapter.

F. Castings

Standard manholes shall have a R-1772 C frame and lid by Neenah Foundry, 1875-3 by East Jordan Iron Works, or approved equal. Material shall be in compliance with ASTM A 48, CL 35B. Each lid shall have two (2) inch high letters indicating "Storm Sewer".

Where watertight castings are required, the manholes shall have a R-1916F frame and lid by Neenah Foundry, 1045 HD by East Jordan Iron Works, or approved equal. The frame shall be anchored to through the riser rings (if provided) to the

cone section with four (4) galvanized rods.

G. Frame Chimney Seal

The joint between the manhole frame and chimney or cone shall be 3/4" thick and made using cement mortar. Any sealant used between the adjustment or grade rings of the chimney shall not be used in this joint. Installation of these rubber seals shall be in accordance with the manufacturer's recommendation.

13.4 Storm Sewer Catch Basins

Location of catch basins shall be as required in **Section 12**.

Catch basins shall be either monolithic (cast-in-place) or precast. If monolithic structures are to be used, the Contractor shall submit drawings showing all reinforcement, dimensions, and connections for City approval. All drawings shall be certified by a registered Professional Engineer.

All inlets shall be constructed of reinforced pre-cast concrete sections with plain joints and 2" extrudable gasket to produce soil tightness (minimum). Inlets shall have tops as shown on the plans. Joints between sewer pipe and inlet walls shall be sealed with grout.

Precast concrete inlets shall be constructed in accordance with ASTM Standard C-478. Adjustment to final grade of inlet casting shall be accomplished by utilizing pre-cast concrete adjusting rings. Adjusting rings when required should be sized to adjust to Final Grade by using a maximum of three (3) adjusting rings. Adjusting rings shall be limited to less than one (1) foot of inlet depth. All inlet joints, along with the adjusting rings and top casting are to be sealed with 2-inch extrudable gasket (Kent Seal, Rub'R Nek LTM by Henry Co., or approved equal) to produce soil-tight joint (minimum).

A. Sewer Pipe to Catch Basin Connections

To connect a storm sewer to a catch basin, either a flexible boot KOR-N-SEAL 1 or 2, flexible connector, cast-in-place Dura-Seal gasket, "A"-lock gasket or an approved equal shall be used. Connections to an existing catch basin shall be a flexible boot KOR-N-SEAL or approved equal.

If the flexible boot connection is used, it shall be placed in the reinforced concrete catch basin base and secured to the pipe by a stainless-steel clamp. Flexible connectors shall conform to ASTM C 923.

The cast-in-place inflatable gasket shall conform to ASTM C 923.

All connections shall provide for a watertight seal between the pipe and structure. The connector shall be the sole element relied upon to assure a flexible watertight seal of the pipe to the structure.

The rubber for the connector shall comply with ASTM C 923 and shall be resistant to ozone, weather elements, chemicals, including acids and alkalis, animal and vegetable fats, oils and petroleum products.

The stainless-steel elements of the connector shall be totally non-magnetic Series 305 stainless steel. The stainless-steel clamp shall be capable of sustaining applied torque in excess of eighty (80) inch-pounds. It shall be the responsibility of the Contractor to submit details of the proposed connection to the City for approval. Connections not approved by the City shall be subject to removal and replacement with an approved adapter.

B. Castings

The castings shall be as indicated on the plans. Both the frame and cover shall be heavy duty as manufactured by Neenah, East Jordan, or approved equal. The inlet and castings shall be capable of supporting H-20 traffic loadings.

13.5 PVC Surface Drainage Inlets

- A. PVC surface drainage inlets, if approved by the Owner for use in writing, shall include inline drains or drain basins as indicated on the contract drawings and referenced within the contract specifications. The ductile iron grates for each of these fittings are to be considered an integral part of the surface drainage inlet. The surface drainage inlets shall be as manufactured by Nyloplast, Harco Fittings, Inc., or approved equal.
- B. The inline drains and drain basins shall be manufactured from PVC pipe stock, utilizing a thermomoulding process to reform the pipe stock to the furnished configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the piping system specified. This joint tightness shall conform to ASTM D3212.
- C. Surface drainage products shall meet the mechanical property requirements for fabricated fittings as described in ASTM F794, F949 and F1336.
- D. The grates furnished for all surface drainage inlets shall be ductile iron and shall be made specifically for each fitting. Grates for 12" and larger drain basins and inline drains shall be capable of supporting H-20 wheel loading for standard grates and solid covers. Grates for drain basins and inline drain inlets smaller than 12" shall be capable of supporting light wheel load traffic. Metal used in the manufacture of the castings shall conform to ASTM A-48-83 Class 30B for cast iron or A536 grade 70-50-05. The castings shall be furnished with a black paint.

13.6 Other Structures

- A. Other structures provided for a project shall generally conform to the requirements of the above manhole and inlet specifications. Structures such as cleanouts, end sections, grated box end sections, pipe anchors, headwalls, slotted drains and other similar drainage structures are generally covered in the latest edition of the Indiana Department of Transportation (INDOT) Standard Details and Specifications. These are readily available through INDOT by purchasing a hard copy or CD from INDOT or by accessing their web page. Therefore, INDOT information is not repeated herein and is the responsibility of the Contractor/Bidder.

- B. If a structure is not completely detailed in the specifications or the plans, the INDOT standard details for that item shall be used. If no such details are available, the Contractor shall be required to detail out a structure and submit it to the Engineer for approval as part of the shop drawing process. In such latter cases, the Contractor shall submit shop drawings certified by an Indiana Registered Professional Engineer.

13.7 Pipe Connections

- A. Joints between a manhole or inlet and a sewer pipe may be sealed with high strength, non-shrink grout or a flexible boot KOR-N-SEAL 1 or 2, flexible connector, cast-in-place Dura-Seal gasket, "A"-lock gasket or an approved equal. All connections shall provide for a watertight seal between the pipe and manhole or inlet.

SECTION 14

**STORM SEWER INSTALLATION
&
CONSTRUCTION**

SECTION 14

STORM SEWER INSTALLATION AND CONSTRUCTION

14.1 General

This section provides general, minimum requirements for the installation and construction for storm sewer pipe and structures for the City service area.

14.2 Dewatering and Control of Surface Water

Where groundwater is encountered, the Contractor shall make every effort necessary to secure a dry trench bottom before laying pipe. The Contractor shall provide, install and operate sufficient trenches, sumps, pumps, hose, piping, well points, etc. necessary to depress and maintain the groundwater level below the base of the excavation. If the Contractor is unable to remove the standing water in the trench, the Contractor shall over-excavate the proposed bottom grade of the sewer bedding, and place not less than three (3) inches of Class No. 2 crushed stone (Indiana Department of Transportation aggregate classification) in the over-excavated area.

The Contractor shall keep the site free of surface water at all times and shall install drainage ditches, dikes, pumps and perform other work necessary to divert or remove rainfall and other accumulation of surface water from excavations. The diversion and removal of surface and/or groundwater shall be performed in a manner which will prevent the accumulation of water within the construction area.

UNDER NO CIRCUMSTANCES SHALL SURFACE WATER AND/OR GROUNDWATER BE DISCHARGED TO, DISPOSED OF, OR ALLOWED TO FLOW INTO THE CITY'S SANITARY SEWER SYSTEM.

A. Clearing

Preparatory to excavation, the site of all open cut excavations, embankments, and fills shall be first cleared of obstructions and existing facilities (except those which must remain temporarily or permanently in service). On all public or private property where grants or easements have been obtained, and on the property of the City, the Contractor shall remove and keep separate the topsoil, and shall carefully replace it after the backfilling is completed.

B. Pavement Cutting

Prior to excavating paved areas all excavation edges falling within the pavement shall be saw cut in a neat, straight manner. Cutting shall be performed with a saw designed specifically for this purpose. The cut shall penetrate the entire pavement thickness where possible. If the existing pavement is more than 6 inches thick, then a cut of not less than six (6) inch depth shall be made. If pavement cuts are made in streets which are opened to traffic prior to excavation, then the cuts shall be thoroughly filled with sand and maintained full until the excavation is performed. Contractor shall be required to obtain pavement cut permit prior to any excavation.

C. Protection of Existing Improvements

Before any excavation is started, adequate protection shall be provided for all existing utilities and City structures.

D. Protection of Trees and Shrubs

No existing trees or shrubs in street right-of-way's and easements shall be damaged or destroyed. Where branches of trees or shrubs interfere with the Contractor's operations, they shall be protected by tying back wherever possible. No limbs or branches shall be cut. If his operations will not permit saving certain trees, the Contractor shall be wholly responsible for satisfying all claims for restoration or restitution resulting from their damage or removal.

If small trees and shrubs are moved or pruned to permit more working space, pruning shall be done in accordance with Home and Garden Bulletin No. 83, U.S. Department of Agriculture, "Pruning Shade Trees and Repairing Their Injuries". However, the Contractor shall obtain, in writing, the City's permission to move or prune trees or shrubs.

E. Maintenance of Public Travel

The Contractor shall carry on the WORK in a manner which will cause a minimum of interruption to traffic and may close to through travel not more than two (2) consecutive blocks, including the cross street intersected. Where traffic must cross open trenches, the Contractor shall provide suitable bridges to street intersections and driveways. The Contractor shall post suitable signs indicating that a street is closed and necessary detour signs for the proper maintenance of traffic. Prior to closing of any streets, the Contractor shall notify responsible municipal authorities.

F. Utility Interruption

The Contractor shall proceed with caution in the excavation and preparation of the trench or pit so that the exact location of underground structures may be determined. Prior to proceeding with trench excavation, the Contractor shall contact all utility companies in the area to aid in locating their underground services.

The Contractor shall take all reasonable precautions against damage to existing utilities. However, in the event of a break in an existing water main, gas main, sewer or underground cable, he shall immediately notify the responsible official of the organization operating the utility interrupted. The Contractor shall lend all possible assistance in restoring services and shall assume all costs, charges, or claims connected with the interruption and repair of such services.

G. Open Cut Excavation

Open cut excavation shall be safely supported and of sufficient width and depth (and only to such width and depth) to provide adequate room for the construction or installation of the work to the lines, grades and dimensions.

1. Trench Dimensions

The bottom width of the trench at and below the top of the pipe and inside the sheeting and bracing, if used, shall not exceed the recommendations as contained in the applicable ASTM Standard for the pipe being used.

Trench sheeting and bracing or a trench shield or box shall be used as required by the rules and regulations of OSHA. The bottom of the trench shall still meet the above standards.

If the trench widths are exceeded without the written permission of the City Engineer and the City, the pipe shall be installed with a concrete cradle or with concrete encasement or other ASTM approved methods as approved by the City Engineer and the City.

2. Excavations with Sloping Sides, Limited

The Contractor may, at his option, where working conditions and right of way permit (as determined by the City Engineer and the City), excavate pipeline trenches and pits for structures with sloping sides, but with the following limitations:

- a. In general, only braces and vertical trenches will be permitted in traveled streets, alleys, narrow easements and for pit excavations more than ten (10) feet deep.
- b. Where pipeline trenches with sloping sides are permitted, the slopes shall not extend below the top of the pipe, and trench excavations below this point shall be made with near-vertical sides with widths not exceeding those specified herein before.
- c. Slopes shall conform to all OSHA regulations.

H. Earth Excavation

Earth materials shall be excavated so that the open cuts conform with the required lines, grades and dimensions.

1. Unsuitable Foundation

When the bottom of the excavation is unsuitable as a foundation, it shall be excavated below grade and then refilled with concrete or crushed stone to the grade as the City or its representative may direct. The crushed stone refill shall be mechanically compacted in six (6) inch layers or as directed by the City.

2. Unauthorized Excavation

Unauthorized excavation below grade shall be filled with crushed stone or concrete and compacted as ordered and directed by the City or its representative.

3. Excavated Earth for Backfill

Excavated earth materials may be used for Backfill subject to the approval of the City Engineer and the City. Such material may be used only where its class is allowed. For example: Excavated material conforming to "Class II" description may be used where "Class II" material is required.

I. Boring and Jacking

Construction of the pipeline by boring and jacking methods will be permitted unless otherwise specified on the plans.

1. Backstop

The backstop shall be of sufficient strength and positioned to support the thrust of the boring equipment without incurring any vertical or horizontal displacement during such boring operations.

2. Guide Rails

The guide rails for the boring equipment may be of either timber or steel. They shall be laid accurately to line and grade and maintained in this position until completion of the boring operations.

3. Casing Pipe

Steel casing pipe shall be new, conform to ASTM A 139 and shall be of the size (diameter) shown on the plans. The lengths of pipe shall be welded as they are installed. Where lengths of casing pipe are joined during the boring operations, care shall be taken to ensure that the proper line and grade is maintained.

The minimum wall thickness for casing pipes under highways, railroads and streams shall be 0.375 inches. Steel shall be Grade B under railroads and Grade A at all other locations.

14.3 Bedding and Backfill

A. General

All trenches or excavations shall be backfilled to the original surface of the ground or such other grades as required or directed. In general, the backfilling shall be carried along as speedily as possible.

B. Backfill Materials

The following materials shall be used for Backfill in accordance with and in the manner indicated by the requirements specified herein.

Class I - Angular, six (6) to forty (40) mm (1/4 to 1½ inch), graded stone such as crushed stone.

Class II - Coarse sands and gravel with maximum particle size of forty (40) mm (1½ inch), including various grades of sands and gravel containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class.

Class III - Fine sand and clayey gravel including fine sands, sand-clay mixtures and gravel-clay mixtures. Soil types GM, GC, SM and SC are included in this class.

Class IV - Silt, silty clays and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH and CL are included in this class. These materials are not recommended for bedding. This class shall also include any excavated material free from rock (three (3) inches and larger), concrete, roots, stumps, rubbish, frozen material and other similar articles whose presence in the backfill would cause excessive settlement.

C. Backfill of Trench Excavations for Pipes and Conduits

Bedding and Backfill materials samples shall be submitted to the City Engineer and the City prior to start of construction.

D. Bedding

1. Rigid Pipe and Conduit Bedding

For purposes of this specification, rigid pipe and conduits shall include those made of steel, ductile iron, concrete, RCP, PVC/ABS Truss and other materials as determined by the City Engineer and the City.

All rigid conduit and pipe shall be laid to the lines and grades unless otherwise directed by the City. All rigid conduit and pipe shall be bedded in compacted Class I or II material, placed on a flat trench bottom. The bedding shall have a minimum thickness of four (4) inch or one-fourth (1/4) the outside pipe diameter below the pipe and shall extend halfway up the pipe barrel at the sides. All material shall be placed in the trench in approximately six (6) inch layers. Each layer, shall be leveled and evenly distributed on both sides of the pipe so as not to disturb, displace or damage the pipe and shall be thoroughly compacted. When Class I or II materials is used compaction may be accomplished by hand or mechanical tamping or by "walking" the material in. Bedding from the halfway point on the pipe to a point twelve (12) inches above the top of the pipe shall be a Class I, II, III, or IV material placed in six (6) inch layers and thoroughly

compacted to prevent settlement. Class III and IV material shall not be used when the trench is located in an area subject to vehicular traffic.

2. Flexible and Semirigid Conduit Bedding

For purposes of this specification, flexible and semirigid conduits and pipes shall include those made of PVC, HDPE, and other materials as determined by the City Engineer and the City.

All flexible and semirigid pipe shall be laid to the lines and grades unless otherwise directed by the City. All flexible and semirigid conduit shall be bedded in compacted Class I or Class II material, placed on a flat trench bottom. The bedding shall have a minimum four (4) inch thickness or one-fourth (1/4) the outside pipe diameter below the pipe and shall extend to twelve (12) inches above the top of the pipe level the full width of the trench. All material shall be placed in the trench in a maximum of six (6) inch layers (before compaction). Each layer, shall be leveled and evenly distributed on both sides of the pipe so as not to disturb, displace or damage the pipe and shall be adequately compacted. When Class I materials are used compaction may be accomplished by hand or mechanical tamping or by "walking" the material in. When Class II materials are used compaction shall be accomplished only by hand or mechanical tamping to a minimum eighty-five percent (85%) Standard Proctor Density.

E. Backfill Above Pipe

1. Method A - Backfill in Areas Not Subject to Vehicular Traffic

For purposes of this specification, trenches shall be considered subject to vehicular traffic if all or any portion of the excavation is located within four (4) feet of a roadway or alley which is routinely traveled by powered vehicles. In the event of any question regarding the susceptibility of an area to traffic, the City Engineer's and the City's decision shall govern.

The trench between a level twelve (12) inches above the top of the pipe and the ground surface shall be backfilled with Class I, II, III or IV materials, as described above, deposited with mechanical equipment in such a manner that it will "flow" onto the bedding and not free fall. The Contractor shall consolidate the backfill by the back and forth travel of a suitable roller, wheeled device or other similar heavy equipment until no further settlement is obtained. Heavy equipment shall not be used until there is a cover of not less than three (3) feet over the pipes. To assist in promoting maximum settlement, the surface of the trench shall be left in a slightly rounded condition. Periodical dressing of the backfill in the trench to promote the drainage and safety conditions shall be made during the course of the work.

2. Method B - Backfill in Areas Subject to Vehicular Traffic (Mechanical Compaction)

The trench between a level of twelve (12) inches above the top of the pipe and the surface, which are located in areas subject to or possibly subject to vehicular traffic, shall be backfilled with Class I or II materials, deposited in uniform horizontal layers of two (2) feet +/- six (6) inches. Each layer shall be thoroughly compacted by mechanical tamping utilizing a crane mounted hydraulic vibratory compactors. Each layer shall be thoroughly compacted before the next succeeding layer is placed. This procedure shall be followed where trench walls remain stable during compaction. If in the opinion of the City Engineer and the City and/or their representative (inspector), the trench walls become unstable during compaction, then the City Engineer, City, and/or their representative (inspector) may authorize the Contractor to push from the back of the trench the Class I or II material into the trench the full depth, not to exceed twenty (20) lineal feet horizontally along the trench bottom and compact using the vibratory compactor in two (2) foot diagonal lifts.

The crane mounted vibratory compactors shall be capable of producing 1900 cycles per minute and have a compaction plate with the minimum dimensions of twenty-three by thirty-one (23 x 31) inches. The compactor shall be similar to those as manufactured by Allied, Ho-Pac, or equal.

When Class I or II materials do not contain sufficient moisture to obtain proper compaction, in the opinion of the City Engineer, the City and/or their representative, it shall be moistened or wetted as directed by the City Engineer, the City and/or their representative.

3. Method C - Backfill in Areas Subject to Vehicular Traffic (Jetting and Water-soaking)

In lieu of the Mechanical Compaction described in Method B above, the Contractor may compact the Class I or II materials by jetting and water-soaking in the manner described below. Except for compaction procedures of the Class I or II materials, all provisions of Method B described above shall apply to this Method C. The trench compaction shall be started at the point of lowest elevation of the trench and work up along the trench. Jetting and water-soaking shall not begin until the trench have been backfilled to within eight (8) inches of the finished surface. Jetting and water soaking are not allowed when the groundwater table is above the spring line of the pipe.

The holes through which water is injected into the backfill shall be centered over the trench backfill and at longitudinal intervals of not more than six (6) feet. Additional holes shall be provided if deemed necessary by the City Engineer to secure adequate settlement. All holes shall be jetted and shall be carried to a point one (1) foot above the top of the pipe. Drilling the holes by means of augers or other mechanical means will not be permitted. Care shall be taken in jetting so as to prevent contact with, or any disturbance of

the pipe.

The water shall be injected at a pressure and rate just sufficient to sink the holes at a moderate rate. After a hole has been jetted to the required depth, the water shall continue to be injected until it begins to overflow the surface. An approved soil auger shall be used for boring test holes. As soon as the jetting and water-soaking has been completed, all holes shall be filled with soil and compacted. Surface depressions resulting from backfill subsidence caused by jetting and water-soaking shall be filled and recompacted by tamping or rolling to the satisfaction of the City Engineer.

The Contractor shall provide all piping, fittings, etc., necessary to deliver the water along the site of the work and shall arrange with the Water Company for making the necessary taps and metering.

F. Temporary Surfaces Subject to Traffic

The Contractor shall open streets to traffic immediately after completing the backfill operation. He shall accomplish this by installing the compacted aggregate base immediately after granular backfill. The use of class II backfill as a temporary surface is specifically prohibited. When using Method C backfilling, the Contractor may elect to delay the jetting operation until just prior to installing the permanent pavement. This shall not relieve the Contractor from the responsibility of maintaining the temporary surface in accordance with these specifications.

G. Maintaining Trench Surfaces

All surface settlement of the backfill along trenches located beneath streets, roads, alleys, driveways and parking lots which are subject to traffic shall be kept filled level with or slightly above the original paved surface at all times with compacted aggregate base material until the permanent pavement is satisfactorily restored. When temporary asphalt pavement is used, depressions and "potholes" shall be promptly filled with the temporary asphalt material. Special attention shall be given by the Contractor to the timely and proper maintenance, leveling and grading of the surface of all backfilled trenches, especially those subject to traffic and especially following rains. The surface of streets, roads and alleys shall be maintained smooth and free of ruts and water trapping depressions by periodic power blading, scarifying; and/or filling settled areas, ruts, pockets, or holes with compacted aggregate base material or temporary asphalt where used.

As a dust preventive, the Contractor shall apply, calcium chloride over the surface of the compacted aggregate base in such amounts and at such times as are necessary to avoid or eliminate dust complaints from nearby residents. In event of any question regarding the existence or nonexistence of a dust nuisance, the City Engineer's and the City's decision on the matter will govern. The material used shall be Regular Flake Calcium Chloride having a minimum chemical content of Calcium Chloride of seventy-seven percent (77%). Unless otherwise specified or ordered by the City Engineer and the City, the rate of application shall be one and one half (1½) pounds per square yard of surface covered.

Wherever surface settlement is not important, unless otherwise specified or directed, the backfill shall be neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation. Just prior to the completion of all work under the contract, any surface settlement below original ground surface shall be refilled in a satisfactory manner and reseeded as specified if required.

14.4 Laying of Sewers

A. General

This section on the Laying of Sewers shall be divided into two (2) classifications - rigid and nonrigid conduit. Pipe materials such as concrete, steel, PVC/ABS truss, and ductile iron pipe are considered rigid conduits. Thermoplastic (PVC) shall be considered nonrigid or flexible conduits.

B. Rigid Conduit Installation

All rigid conduit for sewer pipe shall be laid to the lines and grades, unless otherwise directed by the City Engineer and the City. All rigid pipe shall be laid in accordance with the details for the First-Class Pipe Laying Method. This First-Class Pipe Laying Method may be achieved by Class B bedding methods as shown in the ASCE Manual of Practice No. 37, latest edition. Under this Class B bedding Method, the pipe shall be bedded in compacted granular material (Class I or Class II) placed on a flat trench bottom. The bedding shall have a minimum thickness of one-fourth ($1/4$) the outside pipe diameter below the pipe and shall extend halfway up the pipe barrel at the sides. All granular bedding material shall be placed in the trench in approximately six (6) inch layers. Compaction shall be accomplished by hand or mechanical tamping or by "walking" the granular material in. From the halfway point on the pipe (Springline) to a point twelve (12) inches above the top of the pipe, backfilling methods A or B or C shall be used depending on the trench location. In addition, all rigid conduit shall be installed in accordance with "Standard Recommended Practice for Installing Vitrified Clay Sewer Pipe" (ASTM Designation C 12 and ASTM D2321).

The laying of pipe in finished trenches shall be commenced at the lowest point, proceeding upstream, with the spigot ends pointing the direction of flow.

No blocking under pipes will be permitted, except as approved by the City Engineer or the City for pipe to be encased in concrete or laid in concrete cradles.

The practice of blocking pipe up to grade with bedding material, then backfilling under is prohibited. The entire length of the bed section is to be at proper grade before installing pipe.

The supporting strength of the pipe is dependent upon its foundation and trench width. To develop normal strength, the pipe shall have a firm uniform foundation under the entire lower quadrant of the barrel. No weight should be supported by the bell. The maximum trench width as recommended by ASTM at the level of the top of the pipe shall be maintained as narrow as possible, taking into consideration the limitation of the excavation equipment except as may be permitted by the City Engineer upon investigation of the soil conditions, laying methods and earth

loadings.

All pipes and specials shall be carefully inspected before being laid, and no cracked, broken or defective pipe or special shall be used in the work. All pipe shall be carefully inserted in the bell in such a manner that there will be no unevenness of any kind along the bottom half of the pipes and so that there is a uniform joint space all around.

All pipe that is field cut shall have the homing-marks reestablished, insuring for proper seating depths. Pipes that are field cut shall have the cut ends retapered, by grinding or filing, as close to the original taper provided by the manufacturer as possible. When homing pipe with a spud-bar or other mechanical equipment, other than by hand, place a piece of wood between pipe and tool to prevent damage to bell end-section.

Pipe laid in open cut shall have all trench spaces and voids solidly and completely filled with suitable earth materials from the excavations which shall be thoroughly and solidly rammed into place, unless otherwise specified.

The ends of the pipes shall be protected to prevent the entrance of dirt or other foreign substances. Such protection shall be placed at night or whenever pipe laying is stopped for any reason. Suitable plugs designed for use with the pipe material shall be provided and properly secured and used to cap all slants and branches.

C. Flexible Conduit Installation

Plastic sewer pipe (PVC) and other flexible pipe shall be carefully installed in accordance with the above specification for Rigid Conduit Installation, except where the following paragraphs modify those specifications.

Flexible conduit for sewer pipe shall be installed in accordance with "Underground installation of Flexible Thermoplastic Sewer Pipe" ASTM Designation C 2321.

The Contractor shall take special precautions when homing PVC pipe not to over-seat past the home-marks. The pipe installation must include adequate bedding to hold its proper placement, prior to installing the next section.

The Contractor shall use caution when stringing thermoplastic pipe. Excessive spans, in sunlight, will cause bowing damage; and said damaged spans will be rejected.

In addition to the construction and testing procedures outlined in other sections of these specifications, the Contractor shall be required to install the flexible pipe in such a manner so that the diameter deflection of the pipe shall not exceed five percent (5%) when tested in accordance with the Final Acceptance Test. Bedding materials surrounding the pipe shall be compacted to the densities required to meet the five percent (5%) maximum deflection requirement. The area requiring compaction shall be included in the bed and side fill material and also the material placed above the pipe for a distance of twelve (12) inches over the top of the pipe.

The First-Class Pipe Laying Method for Flexible conduit may be achieved by Class B Bedding Methods as shown in the ASCE Manual of Practice No. 37, latest edition. Under this class B Bedding Method, the pipe shall be bedded in compacted granular material (Class I or II) placed on a flat trench bottom. The bedding shall have a minimum thickness of one-fourth (1/4) the outside pipe diameter below the pipe and shall extend twelve (12) inches above the top of the pipe level and full width of the trench. All granular bedding material shall be placed in the trench in approximately six (6) inch layers.

Compaction shall be accomplished by hand or Mechanical Tamping or by "Walking" the granular material in for Class I materials only. When Class II materials are used compaction shall be accomplished by hand or mechanical tamping only to a minimum eighty-five percent (85%) Standard Proctor Density. Backfill from a point twelve (12) inches above the top of the pipe to the trench surface shall be in accordance with "backfilling Methods A or B or C" depending on the trench location.

Plastic pipe shall not be blocked, except where the plans or specifications call for concrete encasement or concrete cradles for the pipe. Blocks shall be encased in concrete also or removed. Where plastic pipe is to be installed below maximum ground water table, adequate weights shall be provided to prevent flotation of the pipe.

Pipe and fittings shall be carefully inspected before being installed. Cracked, broken or otherwise defective pipe, shall not be used.

14.5 Structure Installation

All manholes, inlets and catch basins shall be installed on a minimum of a six (6) inch No. eight (8) stone base. This material shall be compacted. All manholes shall receive a bitumastic coating. This coating shall be applied in the field prior to backfilling. Contractor shall exercise caution to completely cover the entire manhole.

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SECTION 15

**OPEN CHANNEL DESIGN
STANDARD
&
SPECIFICATIONS**

SECTION 15

OPEN CHANNEL DESIGN STANDARD AND SPECIFICATIONS

15.1 General

All channels, whether private or public, and whether constructed on private or public land, shall conform to the design standards and other design requirements contained herein.

A. Design Storm Frequencies

1. All channels and swales shall accommodate, as a minimum, peak runoff from a twenty-four (24) hour, ten (10) year return frequency storm calculated based on methodology described in **Section 11**. For Rational Method analysis, the storm duration shall be equal to the time of concentration for the drainage area. In computer-based analysis, the duration is as noted in the applicable methodology associated with the computer program.
2. Channels with a carrying capacity of more than thirty (30) cfs at bank-full stage shall be capable of accommodating peak runoff for a twenty-four (24) hour, fifty (50) year return frequency storm within the drainage easement.
3. Channel facilities functioning as a major drainage system must also meet IDNR design standards.
4. The ten (10) year storm design flow for residential rear and side lot swales shall not exceed four (4) cfs. The maximum length of rear and side lot swales before reaching any inlet shall not exceed four hundred (400) feet.
5. Regardless of minimum design frequencies stated above, the performance of all parts of drainage system shall be checked for the one hundred (100) year flow conditions to ensure that all buildings are properly located outside the one hundred (100) year flood boundary and that flow paths are confined to designated areas with sufficient easement.

B. Manning's Equation

The waterway area for channels shall be determined using Manning's Equation, where:

$$A = Q/V$$

A = Waterway area of channel in square feet

Q = Discharge in cubic feet per second (cfs)

V = Steady-State channel velocity, as defined by Manning's Equation

C. Backwater Method for Drainage System Analysis

The determination of one hundred (100) year water surface elevation along channels and swales shall be based on accepted methodology and computer programs designed for this

purpose. Computer programs HEC-RAS, HEC-2, and ICPR are preferred programs for conducting such backwater analysis. The use of other computer models must be accepted in advance by the City or City Engineer.

D. Channel Cross-Section and Grade

1. The required channel cross-section and grade are determined by the design capacity, the material in which the channel is to be constructed, and the requirements for maintenance. A minimum depth may be required to provide adequate outlets for subsurface drains, tributary ditches, or streams. The channel grade shall be such that the velocity in the channel is high enough to prevent siltation but low enough to prevent erosion. Velocities less than two (2) feet per second are not acceptable, as siltation will take place and ultimately reduce the channel cross-section area. The maximum permissible velocities in vegetated-lined channels are shown in **Table 15-1**. In addition to existing runoff, the channel design should incorporate increased runoff due to the proposed development.
2. Where depth of design flow is slightly below critical depth, channels shall have freeboard adequate to cope with the effect of hydraulic jumps.
3. Along the streets and roads, the bottom of the ditch should be low enough to install adequately sized driveway culverts without creating "speed bumps". The driveway culvert inverts shall be designed to adequately consider upstream and downstream culvert elevations.
4. Flow of a channel into a closed system is prohibited, unless runoff rate and head loss computations demonstrate the closed conduit to be capable of carrying the 100-year channel flow for developed conditions, either entirely or in combination with a defined overflow channel, with no reduction of velocity.

**Table 15-1
Maximum Permissible Velocities in Vegetal-Lined Channels (1)**

Cover	Channel Slope Range (%) (3)	Permissible Velocity (2)	
		Erosion Resistant Soils (feet per sec.)(4)	Easily Eroded Soils (feet per sec.)(4)
Bermudagrass	0-5	8	6
	5-10	7	5
	Over 10	6	4
Buffalograss Kentucky Bluegrass Smooth Brome Blue Grama	0-5	7	5
	5-10	6	4
	Over 10	5	3
Grass Mixture	0-5 (3)	5	4
Reed Canary Grass	5-10	4	3
Lespedeza Sericea	(4)		
Weeping Lovegrass			
Yellow Bluestem	0-5	3.4	2.5
Redtop	5-10		
Alfalfa			
Red Fescue			
Common Lespedeza(5) Sudangrass(5)	0-5 (6)	3.5	2.5

- (1) From Soil Conservation Service, SCS-TP-61, "Handbook of Channel Design for Soil and Water Conservation".
- (2) Use velocities exceeding 5 feet per second only where good channel ground covers and proper maintenance can be obtained.
- (3) Do not use on slopes steeper than 10 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.
- (4) Do not use on slopes steeper than 5 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.
- (5) Annuals - use on mild slopes or as temporary protection until permanent covers are established.
- (6) Use on slopes steeper than 5 percent is not recommended

E. Side Slopes

1. Earthen channel and swale side slopes shall be no steeper than three (3) horizontal to one (1) vertical (3:1). Flatter slopes may be required to prevent erosion and for ease of maintenance.
2. Where channels will be lined with riprap, concrete, or other acceptable lining method, side slopes shall be no steeper than two (2) horizontal to one (1) vertical (2:1) with adequate provisions made for weep holes.
3. Side slopes steeper than two (2) horizontal to one (1) vertical (2:1) may be used for lined channels provided that the side lining is designed and constructed as a structural retaining wall with provisions for live and dead load surcharge.
4. When the design discharge produces a depth of greater than three (3) feet in the channel, appropriate safety precautions shall be added to the design criteria based on reasonably anticipated safety needs.

F. Channel Stability

1. Characteristics for a stable channel are:
 - a. It neither promotes sedimentation nor degrades the channel bottom and sides.
 - b. The channel banks do not erode to the extent that the channel cross-section is changed appreciably.
 - c. Excessive sediment bars do not develop.
 - d. Excessive erosion does not occur around culverts, bridges, outfalls, or elsewhere.
 - e. Gullies do not form or enlarge due to the entry of uncontrolled flow to the channel.
2. Channel stability shall be determined for an aged condition and the velocity shall be based on the design flow or the bankfull flow, whichever is greater, using an "n" value for various channel linings as shown in **Tables 12-1** and **15-1**. In no case is it necessary to check channel stability for discharges greater than that from a one hundred (100) year frequency storm.
3. Channel stability shall be checked for conditions representing the period immediately after construction. For this stability analysis, the velocity shall be calculated for the expected flow from a ten (10) year frequency storm on the watershed, or the bankfull flow, whichever is smaller, and the "n" value for the newly constructed channels in fine-grained soils and sands may be determined in accordance with the "National Engineering Handbook 5, Supplement B, Soil Conservation Service" and shall not exceed 0.025. This reference may be obtained by contacting the National Technical Information Service in Springfield. The allowable velocity in the

newly constructed channel may be increased by a maximum of twenty (20) percent to reflect the effects of vegetation to be established under the following conditions:

- a. The soil and site in which the channel is to be constructed are suitable for rapid establishment and support of erosion controlling vegetation.
- b. Species of erosion controlling vegetation adapted to the area, and proven methods of establishment are shown.
- c. The channel design includes detailed plans for establishment of vegetation on the channel side slopes.

G. Drainage of Swales

Minimum swale slopes are 0.5%. All flow shall be confined to the specific easements associated with each rear and side lot swale that are part of the minor drainage system. Unless designed to act as a stormwater quality BMP, vegetated swales with a slope less than one (1) percent shall have tile underdrains to dry the swales. (See Figure 4-3). Tile lines may be outletted through a drop structure at the ends of the swale or through a standard tile outlet. Further guidance regarding this subject may be found in the latest edition of the Indiana Drainage Handbook.

H. Appurtenant Structures

The design of channels will include provisions for operation and maintenance and the proper functioning of all channels, laterals, travel ways, and structures associated with the project. Recessed inlets and structures needed for entry of surface and subsurface flow into channels without significant erosion or degradation shall be included in the design of channel improvements. The design will also provide for necessary floodgates, water level control devices, and any other appurtenance structure affecting the functioning of the channels and the attainment of the purpose for which they are built. The effects of channel improvements on existing culverts, bridges, buried cables, pipelines, and inlet structures for surface and subsurface drainage on the channel being improved and laterals thereto shall be evaluated to determine the need for modification or replacement. Culverts and bridges which are modified or added as part of channel improvement projects shall meet reasonable standards for the type of structure and shall have a minimum capacity equal to the design discharge or governmental agency design requirements, whichever is greater.

I. Appurtenant Structures

Spoil material resulting from clearing, grubbing, and channel excavation shall be disposed of in a manner that will:

1. Minimize overbank wash.
2. Provide for the free flow of water between the channel and floodplain

boundary unless the valley routing and water surface profiles are based on continuous dikes being installed.

3. Not hinder the development of travel ways for maintenance.
4. Leave the right-of-way in the best condition feasible, consistent with the project purposes, for productive use by the owner.
5. Be accepted by the IDNR or COE, if applicable.

J. Materials

Materials acceptable for use as channel lining are:

1. Grass
2. Revetment Riprap
3. Concrete
4. Hand Laid Riprap
5. Precast Cement Concrete Riprap
6. Gabions
7. Straw or Coconut Mattings (only until grass is established)

Other lining materials must be accepted in writing by the City or City Engineer. Materials shall comply with the latest edition of the INDOT, "Standard Specifications".

SECTION 16

STORMWATER DETENTION DESIGN STANDARDS

SECTION 16

STORMWATER DETENTION DESIGN STANDARDS

16.1 General

The following shall govern the design of any improvement with respect to the detention of stormwater runoff. Basins shall be constructed to temporarily detain the stormwater runoff that exceeds the maximum peak release rate authorized by this Standard. The required volume of storage provided in these basins, together with such storage as may be authorized in other on-site facilities, shall be sufficient to control excess runoff from the ten (10) year or one hundred (100) year storm as explained below in **Section 16.3**. Also, basins shall be constructed to provide adequate capacity to allow for sediment accumulation resulting from development and to permit the pond to function for reasonable periods between cleanings.

16.2 Acceptable Detention Facilities

The increased stormwater runoff resulting from a proposed development should be detained on-site by the provisions of appropriate wet bottom or dry bottom detention facilities, parking lots, or other acceptable techniques. Measures that retard the rate of overland flow and the velocity in runoff channels shall also be used to partially control runoff rates.

16.3 Allowable Release Rates

A. General Release Rates

Control devices shall limit the discharge to a rate such that the post- developed release rate from the site is no greater than 0.2 cfs per acre of development for zero (0) to one hundred (100) year return interval storms. For sites where the pre-developed area has more than one (1) outlet, the release rate should be computed based on pre-developed discharge to each outlet point. The computed release rate for each outlet point shall not be exceeded at the respective outlet point even if the post developed conditions would involve a different arrangement of outlet points.

B. Site-Specific Release Rates for Sites with Depressional Storage

For sites where depressional storage exists, the general release rates provided above may have to be further reduced. If depressional storage exists at the site, site-specific release rates must be calculated according to methodology described in **Section 11**, accounting for the depressional storage by modeling it as a pond whose outlet is a weir at an elevation that stormwater can currently overflow the depressional storage area. Post developed release rate for sites with depressional storage shall be the two (2) year pre-developed peak runoff rate for the post-developed one hundred (100) year storm. In no case shall the calculated site-specific release rates be larger than general release rates provided above.

Note that by definition, the depressional storage does not have a direct gravity outlet but if in agricultural production, it is more than likely drained by a tile and should be modeled as “empty” at the beginning of a storm. The function of any existing depressional storage should be modeled using an event hydrograph model to determine the volume of storage that exists and its effect on the existing site release rate. To prepare such a model, certain information must be obtained, including delineating the tributary drainage area, the stage-storage relationship and discharge-rating curve, and identifying the capacity and elevation of the outlet(s).

The tributary area should be delineated on the best available topographic data. After determining the tributary area, a hydrologic analysis of the watershed should be performed, including, but not limited to a calculation of the appropriate composite runoff curve number and time of concentration. Stage-storage data for the depressional area should be obtained from the site topography. The outlet should be clearly marked, and any calculations performed to create a stage-discharge rating curve must be included with the stormwater submittal.

Also note that for determining the post-developed peak runoff rates, the depressional storage must be assumed to be filled unless the City and City Engineer can be assured, through dedicated easement, that the noted storage will be preserved in perpetuity.

C. Management of Off-site Runoff

Runoff from all upstream tributary areas (off-site land areas) may be bypassed around the detention/retention facility without attenuation. Such runoff may also be routed through the detention/retention facility, provided that a separate outlet system or channel is incorporated for the safe passage of such flows, i.e., not through the primary outlet of a detention facility. Unless the pond is being designed as a regional detention facility, the primary outlet structure shall be sized, and the invert elevation of the emergency overflow weir determined according to the on-site runoff only. Once the size and location of primary outlet structure and the invert elevation of the emergency overflow weir are determined by considering on-site runoff, the one hundred (100) year pond elevation is determined by routing the entire inflow, on-site and off-site, through the pond.

Note that the efficiency of the detention/retention facility in controlling the on-site runoff may be severely affected if the off-site area is considerably larger than the on-site area. As a general guidance, on-line detention may not be effective in controlling on-site runoff where the ratio of off-site area to on-site area is larger than 5:1. Additional detention (above and beyond that required for on-site area) may be required by the City or City Engineer when the ratio of off-site area to on-site area is larger than 5:1.

D. Downstream Restrictions

In the event the downstream receiving channel or storm sewer system is inadequate to accommodate the post-developed release rate provided above,

then the allowable release rate shall be reduced to that rate permitted by the capacity of the receiving downstream channel or storm sewer system. Additional detention, as determined by the City or City Engineer, shall be required to store that portion of the runoff exceeding the capacity of the receiving sewers or waterways. When such downstream restrictions are suspected, the City or City Engineer may require additional analysis to determine the receiving system's limiting downstream capacity.

If the proposed development makes up only a portion of the undeveloped watershed upstream of the limiting restriction, the allowable release rate for the development shall be in direct proportion to the ratio of its drainage area to the drainage area of the entire watershed upstream of the restriction.

16.4 General Detention Basin Design Requirements

- A. The detention facility shall be designed in such a manner that a minimum of 90% of the maximum volume of water stored and subsequently released at the design release rate shall not result in a storage duration in excess of forty-eight (48) hours from the start of the storm unless additional storms occur within the period. In other words, the design shall ensure that a minimum ninety (90) percent of the original detention capacity is restored within forty-eight (48) hours from the start of the design one hundred (100) year storm.
- B. The one hundred (100) year elevation of stormwater detention facilities shall be separated by not less than twenty-five (25) feet from any building or structure to be occupied. The Lowest Adjacent Grade (including walkout basement floor elevation) for all residential, commercial, or industrial buildings shall be set a minimum of two (2) feet above the one hundred (100) year pond elevation or two (2) feet above the emergency overflow weir elevation, whichever is higher. In addition to the Lowest Adjacent Grade requirements, any basement floor must be at least a foot above the normal water level of any wet-bottom pond.
- C. No detention facility or other water storage area, permanent or temporary, shall be constructed under or within twenty (20) feet of any pole or high voltage electric line. Likewise, poles or high voltage electric lines shall not be placed within twenty (20) feet of any detention facility or other water storage area.
- D. All stormwater detention facilities shall be separated from any road right-of-way by no less than one right-of-way width, measured from the top of bank or the 100-year pool if no defined top of bank is present, using the most restrictive right-of-way possible. If the width of the right-of-way is less than 50 feet, then the minimum distance between top of bank and road right-of-way shall be increased to 50 feet. Use of guard rails, berms, or other structural measures may be considered in lieu of the above-noted setbacks.
- E. Slopes no steeper than three (3) horizontal to one (1) vertical (3:1) for safety, erosion control, stability, and ease of maintenance shall be permitted.
- F. Safety screens having a maximum opening of four (4) inches shall be provided for

any pipe or opening to prevent children or large animals from crawling into the structures.

- G. Prior to final acceptance, danger signs shall be mounted at appropriate locations to warn of deep water, possible flood conditions during storm periods, and other dangers that exist. The locations of the noted danger signs shall be shown on the plans.
- H. Use of fences around all detention ponds is strongly encouraged to assure safety. Unless specifically required by the City or City Engineer, the decision to use fencing around detention ponds are left to the owner or the developer. Recommendations contained within this document do not relieve the applicant and owner/developer from the responsibility of taking all necessary steps to ensure public safety with regards to such facilities.
- I. Outlet control structures shall be designed to operate as simply as possible and shall require little or no maintenance and/or attention for proper operation. For maintenance purposes, the outlet shall be a minimum of 0.5 foot above the normal water level of the receiving water body. They shall limit discharges into existing or planned downstream channels or conduits so as not to exceed the predetermined maximum authorized peak flow rate.
- J. Emergency overflow facilities such as a weir or spillway shall be provided for the release of exceptional storm runoff or in emergency conditions should the normal discharge devices become totally or partially inoperative. The overflow facility shall be of such design that its operation is automatic and does not require manual attention.
 - 1. Off-site flows greater than the allowable release rate for the pond shall be conveyed through the emergency spillway, not through the primary outlet structure. Unless the pond is being designed as a regional detention facility, the primary outlet structure shall be sized and the invert elevation of the emergency overflow weir determined according to the on-site runoff only and all other flows shall be either retained or safely bypassed through the emergency overflow weir.
 - 2. Emergency overflow facilities shall be designed to handle one and one-quarter (1.25) times the peak inflow discharge and peak flow velocity resulting from the one hundred (100) year design storm event runoff from the entire contributing watershed draining to the detention/retention facility, assuming post-development condition on-site and existing condition off-site.
- K. Grass or other suitable vegetative cover shall be provided along the banks of the detention storage basin. Vegetative cover around detention facilities should be maintained as appropriate.
- L. Debris and trash removal and other necessary maintenance shall be performed on a regular basis to assure continued operation in conformance to design.

- M. No residential lots or any part thereof, shall be used for any part of a detention basin or for the storage of water, either temporary or permanent.

16.5 Additional Requirements for Wet-Bottom Facility Design

Where part of a detention facility will contain a permanent pool of water, all the items required for detention storage shall apply. Also, a controlled positive outlet will be required to maintain the design water level in the wet bottom facility and provide required detention storage above the design water level. However, the following additional conditions shall apply:

- A. Facilities designed with permanent pools or containing permanent lakes shall have a water area of at least one-half (0.5) acre. If fish are to be used to keep the pond clean, a minimum depth of approximately ten (10) feet shall be maintained over at least twenty-five (25) percent of the pond area. The remaining pond area shall have no extensive shallow areas, except as required to install the safety ramp, safety ledge, and BMPs as required below. Construction trash or debris shall not be placed within the permanent pool.
- B. A safety ledge six (6) to ten (10) feet in width, depending on the presence of a security fence, is required and shall be installed in all lakes approximately 18 inches below the permanent water level (normal pool elevation). In addition, a similar maintenance ledge twelve (12) inches above the permanent water line shall be provided. The slope between the two ledges shall be stable and of a material such as stone or riprap which will prevent erosion due to wave action. The slopes below the safety ledge shall be 3:1 (horizontal to vertical) or flatter. The slopes above the safety ledge shall be 6:1 or flatter, unless a safety fence is used, in which case the side slopes above the safety ledge (except for the safety ramp area) shall be 3:1 or flatter.

As illustrated in **Standard Detail ST-7** and **ST-8**, the safety ledge is currently required to be 18 inches below the normal pool and six (6) to ten (10) feet wide, depending on the presence of a security fence. As an alternative to providing a security fence, the depth of safety ledge could be changed to be anywhere from zero (0) to six (6) inches below normal pool to encourage vegetation growth. Wetland plants can be installed as container grown plants or as seed at the time of construction, or the area can be left to be naturally colonized. When a vegetated ledge is used in lieu of a security fence, the safety ledge width shall be increased to fifteen (15) feet to allow more room to stop in the event of accidental entry into the pond. The vegetated ledge might discourage play near the edge of the pond and help stop a wayward bike or sled. Additional benefits to the vegetated ledge are stormwater quality improvement and goose deterrence. In lieu of a vegetated safety ledge, a zone of dense shrubs could be installed around the perimeter of the pond to discourage access. Shrubs and vines with briars and thorns or dense growth patterns make good deterrents.

Special Regulatory Note:

Detention ponds that include wetland features will not fall within the jurisdiction of IDEM or COE as long as:

- The pond is clearly identified on plans and in accompanying documentation as a stormwater treatment Best Management Practice (BMP).
The pond has not been abandoned and is maintained as originally designed.
The pond is not part of required wetland mitigation.
Construction of the pond does not impact existing jurisdictional wetlands or waterways.

Therefore, detention pond maintenance would not require a permit just because wetland features have been included in their construction.

In lieu of a vegetated safety ledge, a zone of dense shrubs could be installed around the perimeter of the pond to discourage access. Shrubs and vines with briars and thorns or dense growth patterns make good deterrents.

- C. A safety ramp exit from the lake shall be required in all cases and shall have a minimum width of twenty (20) feet and exit slope of 6 horizontal to 1 vertical (6:1). The safety ramp shall be constructed of suitable material to prevent structural instability due to vehicles or wave action.
- D. Periodic maintenance is required in lakes to control weed and larval growth. The facility shall also be designed to provide for the easy removal of sediment that will accumulate during periods of reservoir operation. A means of maintaining the designed water level of the lake during prolonged periods of dry weather may also be required.
- E. Methods to prevent pond stagnation, including but not limited to aeration facilities, shall be included on all wet-bottom ponds. Design calculations to substantiate the effectiveness of proposed aeration facilities shall be submitted with final engineering plans. Agreements for the perpetual operation and maintenance of aeration facilities shall be prepared to the satisfaction of the City or City Engineer.
- F. For visual clarification, refer to **Standard Detail ST-7** and **ST-8**.

16.6 Additional Requirements for Dry-Bottom Facility Design

In addition to general design requirements, detention facilities that will not contain a permanent pool of water shall comply with the following requirements:

- A. Provisions shall be incorporated into facilities for complete interior drainage of dry bottom facilities, including the provisions of natural grades to outlet structures, longitudinal and transverse grades to perimeter drainage facility, paved gutters, or the installation of subsurface drains.

- B. For residential developments, the maximum planned depth of stormwater stored shall not exceed four (4) feet.
- C. In excavated detention facilities, a minimum side slope of 3:1 shall be provided for stability. In the case of valley storage, natural slopes may be considered to be stable.

16.7 Parking Lot Storage

Paved parking lots may be designed to provide temporary detention storage of stormwater on all or a portion of their surfaces. Outlets for parking lot storage of stormwater will be designed so as to empty the stored waters slowly. Depths of storage shall be limited to a maximum depth of seven (7) inches so as to prevent damage to parked vehicles and so that access to parked vehicles is not impaired. Ponding should in general, be confined to those positions of the parking lots farthest from the area served.

16.8 Detention Facilities in Floodplains

If detention storage is provided within a 100-year floodplain, only the net increase in storage volume above that which naturally existed on the floodplain shall be credited to the development. In order to be hydraulically effective, the rim elevation of such detention pond, including any open spillways, should be at or above the 100-year floodplain elevation and, unless the detention pond storage is provided entirely above the 100-year flood elevation, any pipe outlets must be equipped with a backflow prevention device. A detention pond constructed within the 100-year floodplain and utilizing a backflow prevention device will eliminate the floodplain storage that existed on the detention pond site and will therefore require compensatory floodplain storage. The detention analysis for a detention pond in the floodplain must consider appropriate tailwater impacts and the effect of any backflow prevention device.

16.9 Joint Development of Control Systems

Stormwater control systems may be planned and constructed jointly by two or more developers as long as compliance with this Standard is maintained.

16.10 Diffused Outlets

When the allowable runoff is released in an area that is susceptible to flooding or erosion, the developer may be required to construct appropriate storm drains through such area to avert increased flood hazard caused by the concentration of allowable runoff at one point instead of the natural overland distribution. The requirement of diffused outlet drains shall be at the discretion of the City or City Engineer.

16.11 IDNR Requirements

All designs for basins to be constructed in the floodway of a stream with a drainage area of one square mile or more must also satisfy IDNR permit requirements.

16.12 Allowance for Sedimentation

Detention basins shall be designed with an additional ten (10) percent of available capacity to allow for sediment accumulation resulting from development and to permit the pond to function for reasonable periods between cleanings. Basins should be designed to collect sediment and debris in specific locations, such as a forebay, so that removal costs are kept to a minimum. For wet-bottom ponds, the sediment allowance may be provided below the permanent pool elevation. No construction trash or debris shall be allowed to be placed within the permanent pool. If the pond is used as a sediment control measure during active construction, the performance sureties will not be released until sediment has been cleaned out of the pond and elevations and grades have been reestablished as noted in the accepted plans.

SECTION 17

STORM SEWER INSPECTION, TESTING, & ACCEPTANCE

SECTION 17

STORM SEWER INSPECTION, TESTING AND ACCEPTANCE

17.1 General

This section describes the minimum requirement and general procedures for the inspection, testing and acceptance of systems dedicated to the City.

Connection Permits for storm service will not be issued until all the requirements of this section are fulfilled.

17.2 Inspection

Inspection of the construction shall occur for the duration of the project. The Owner shall execute the Agreement with the City for such services. Inspection fees shall be as set forth in **Section 3**.

A. General Requirements

1. Contractor and/or Owner shall provide notice to the City and his representative of the planned commencement of construction forty-eight (48) hours prior to such commencement.
2. Once the construction starts, the Contractor shall be responsible for informing and/or notifying the inspection representative assigned of the following:
 - a. Daily work schedule, including any changes in schedule;
 - b. Prior notification if work is to be performed on weekends and/or holidays;
 - c. Date tests are to be performed; and
 - d. Date as-built verification is to be performed.
3. The City, upon request of the Contractor and/or Owner, will schedule the Final Inspection.

All testing required shall be performed under the observation of the City or the City's representative. It shall be the Contractor's responsibility to schedule the testing with the City representative and/or City. Test results obtained in the absence of the presence of the City will not be accepted.

17.3 Testing Gravity Storm Sewers

- A. All gravity storm sewers constructed of flexible pipe shall be deflection tested no sooner than thirty (30) days after installation.
- B. The Contractor shall bear the complete cost and supply all equipment necessary

to perform the tests required.

All tests shall be conducted under the observation of the Engineer. It shall be the Contractor's responsibility to schedule testing.

1. Deflection Test for Select Pipe

A five percent (5%) vertical Mandrel Deflection Test shall be performed on all PVC Pipe gravity storm sewer pipe.

These pipes shall be mandrelled with a rigid device sized to pass five (5) percent or less vertical deflection (or deformation) of the base inside diameter of the pipe. The mandrel test shall be conducted no earlier than thirty (30) days after reaching final trench backfill grade.

Each pipe material/type required to be Mandrel tested shall be tested with a mandrel approved by the pipe manufacturer and meeting the requirements of this Section.

The mandrel shall be pulled through all sewer lines in a manner acceptable to the Engineer and any section of sewer not passing the mandrel shall be uncovered, replaced or repaired to the Engineer's satisfaction and retested.

The Contractor shall provide proving rings to check the mandrel. Drawings of mandrels with complete dimensions shall be furnished to the Engineer upon request for each diameter and specification type.

17.4 **Storm Structure Testing**

The structures will be given a field visual inspection. The inspection shall be performed at the discretion of the City during the warranty period following a rainfall sufficient enough to raise the groundwater table above the potential problem areas. All leakage problems determined by this inspection shall be corrected by the Contractor within an agreed upon time to the satisfaction of the City. Where necessary to complete the work, the Contractor shall be responsible for the bypassing and/or blocking of the flow in the manholes and must have prior approval by the City Engineer or City. It will be the Contractor's responsibility to supply his own traffic control as required by the particular location and/or jurisdiction.

17.5 **Acceptance**

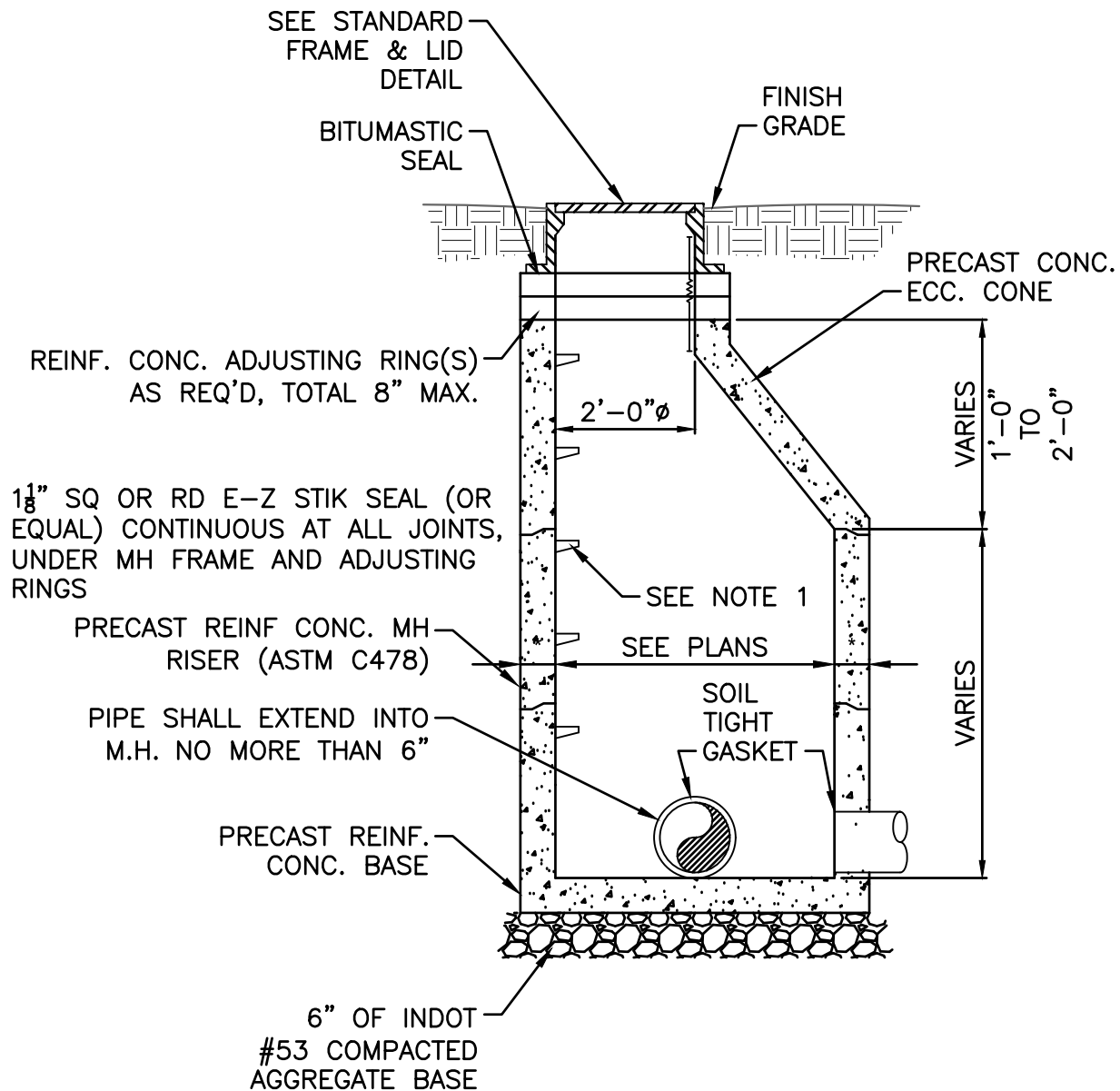
In order for the City to issue final acceptance, the following items shall be submitted, completed or on file:

- A. Copies of all testing reports and data;
- E. Final payment for inspection services;
- G. As-Built drawings;
- I. Daily inspection reports.

STORM SEWER STANDARD DETAILS

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Typical Trench for Rigid Pipe	Refer to S-16



NOTES:

1. COPOLYMER/STEEL MH STEPS AS MANUFACTURED BY M.A. INDUSTRIES, INC., OR EQUAL, AT 16" O.C. (MAX.)

STANDARD MANHOLE DETAIL

REVISION DATE

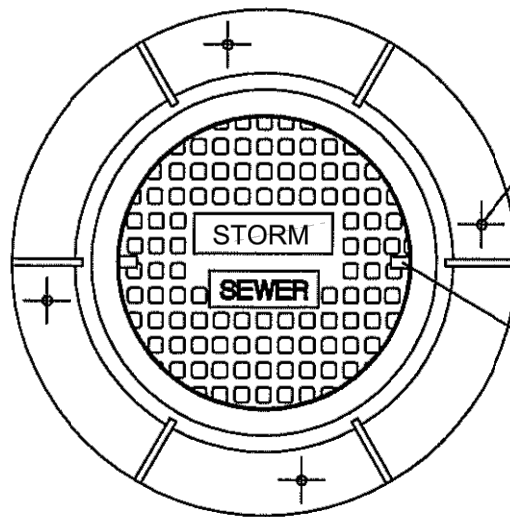
**CITY of MONTICELLO, INDIANA
STANDARD DETAILS
STORM SEWER**

FIGURE

ST-1

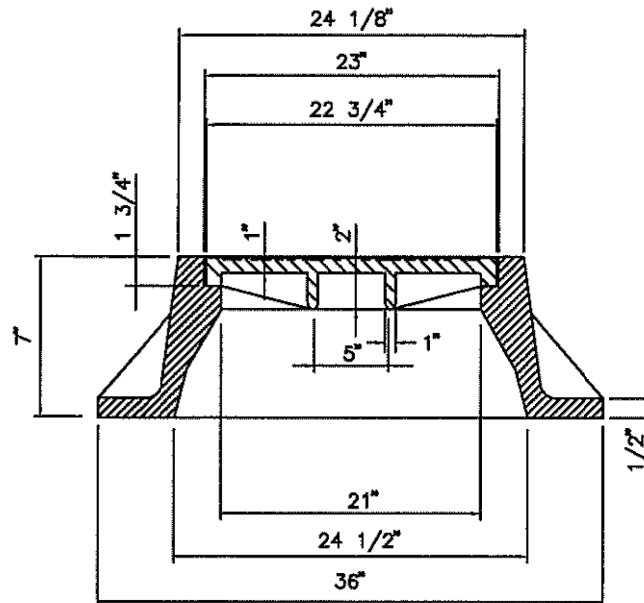
DATE: AUGUST 2019

ST-2



(4) 1" [25mm] CORED ANCHOR
BOLT HOLES 90° APART ON A 33"
[838mm] DIA. B.C.

(2) CONCEALED PICKHOLES
PER NF-9104-A



NOTE: METAL: CAST GRAY IRON ASTM A-48 CL358
FINISH: NOT PAINTED
R-1772C BY NEENAH FOUNDRY OR
1875-3 BY EAST JORDAN IRON WORKS

STANDARD FRAME & LID

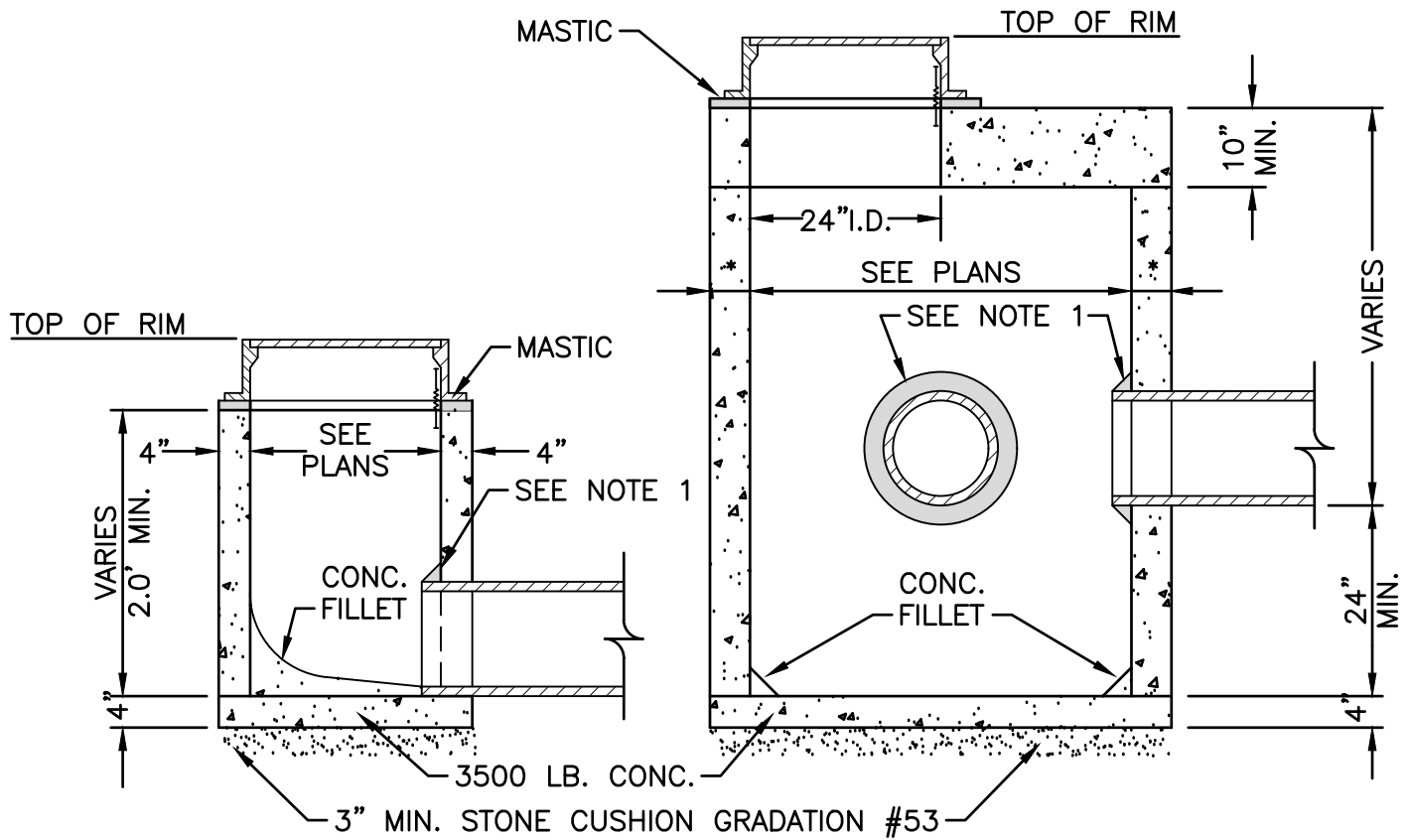
CITY of MONTICELLO, INDIANA STANDARD DETAILS STORM SEWER

FIGURE

ST-3

REVISION DATE

DATE: AUGUST 2019

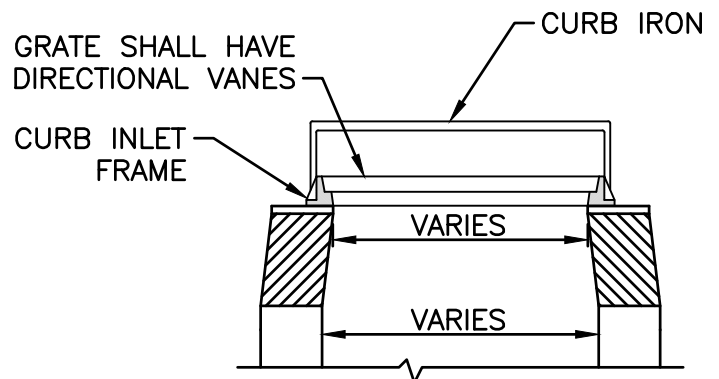


INLET

CATCH BASIN

NOTES:

1. USE SOIL TIGHT GASKET OR EQUAL.
2. WHERE DEPTH FROM TOP OF CASTING TO INVERT IS LESS THAN 5'-0", USE FLAT TOP MANHOLE TYPE "C" IN LIEU OF ECCENTRIC CONE
3. WATERTIGHT SEAL IS REQ'D BETWEEN PRECAST RISER AND STORM SEWER PIPE.
4. COPOLYMER/STEEL MH STEPS AS MANUFACTURED BY M.A. INDUSTRIES, INC., OR EQUAL, AT 16" O.C. (MAX.)



CURB INLET CASTING

STANDARD CATCH BASIN & INLET DETAIL

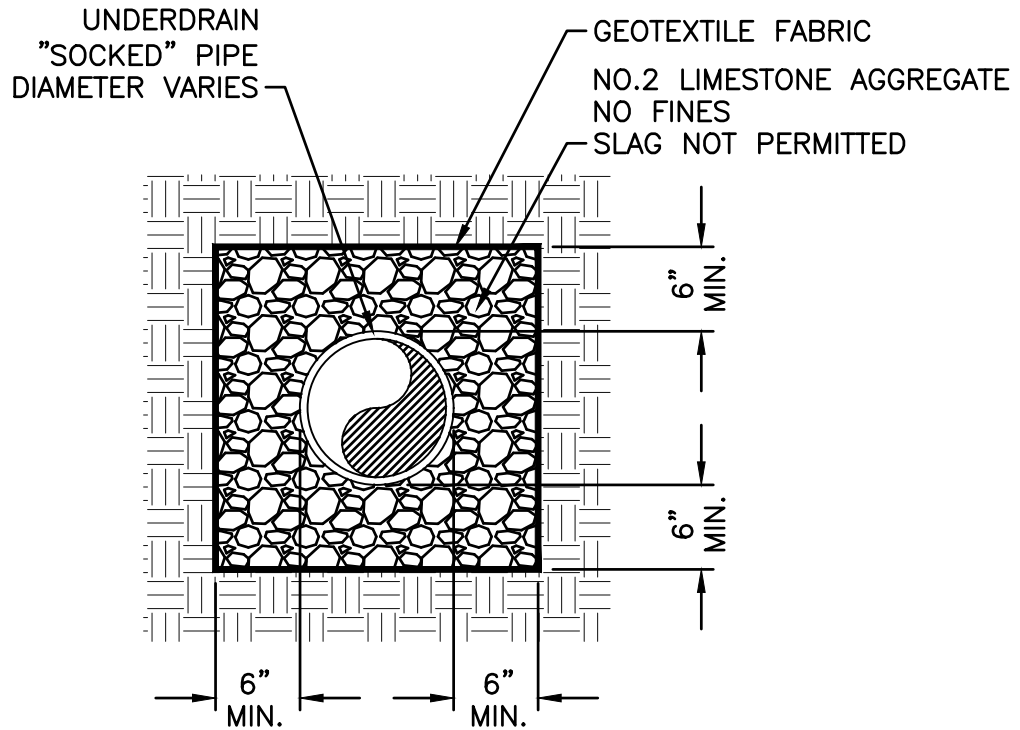
REVISION DATE

CITY of MONTICELLO, INDIANA
STANDARD DETAILS
STORM SEWER

FIGURE

ST-4

DATE: AUGUST 2019



STANDARD UNDERDRAIN DETAIL

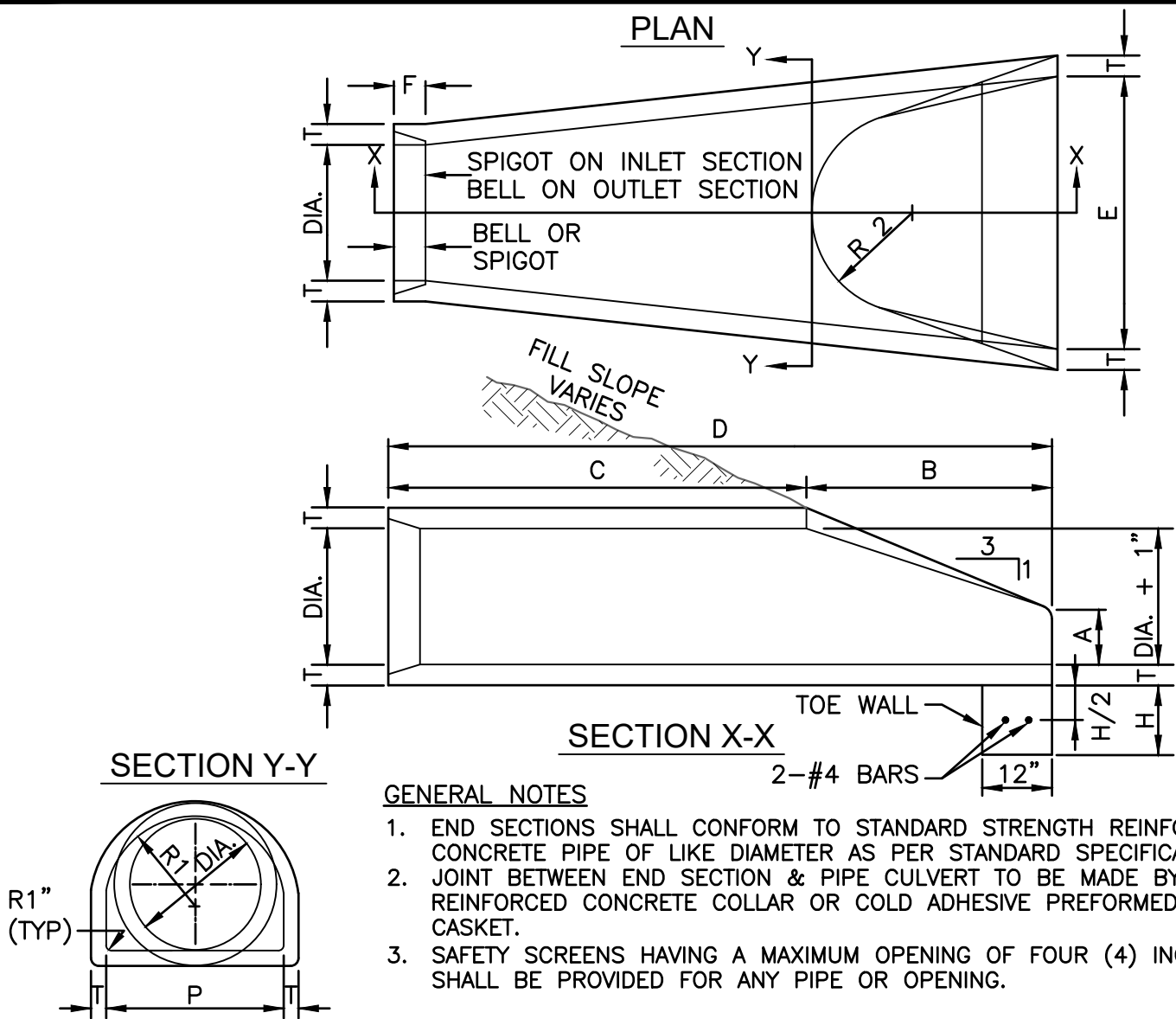
REVISION DATE

CITY of MONTICELLO, INDIANA STANDARD DETAILS STORM SEWER

FIGURE

ST-5

DATE: AUGUST 2019



GENERAL NOTES

1. END SECTIONS SHALL CONFORM TO STANDARD STRENGTH REINFORCED CONCRETE PIPE OF LIKE DIAMETER AS PER STANDARD SPECIFICATIONS.
2. JOINT BETWEEN END SECTION & PIPE CULVERT TO BE MADE BY REINFORCED CONCRETE COLLAR OR COLD ADHESIVE PREFORMED PLASTIC CASKET.
3. SAFETY SCREENS HAVING A MAXIMUM OPENING OF FOUR (4) INCHES SHALL BE PROVIDED FOR ANY PIPE OR OPENING.

DIA.	T	BELL OR SPIGOT	A	B	C	D	E	P	R 1	R 2	F	H	WEIGHT (LBS.)
15"	2"	2"	6"	2'-3"	3'-10"	6'-1"	2'-6"	24"	12"	11"	3"	12"	740
18"	2"	2"	9"	2'-3"	3'-10"	6'-1"	3'-0"	29"	15"	12"	4"	15"	990
24"	3"	2"	9"	3'-7"	2'-6"	6'-1"	4'-0"	33"	16"	14"	4"	18"	1520
30"	3"	3"	1'-0"	4'-6"	1'-7"	6'-1"	5'-0"	37"	18"	15"	5"	21"	2190
36"	4"	3"	1'-3"	5'-3"	2'-10"	8'-1"	6'-0"	47"	24"	20"	5"	21"	4100
42"	4"	3"	1'-9"	5'-3"	2'-11"	8'-2"	6'-6"	53"	27"	22"	5"	24"	5380
48"	5"	4"	2'-0"	6'-0"	2'-2"	8'-2"	7'-0"	56"	28"	22"	5"	24"	6550
54"	5"	4"	2'-3"	5'-5"	2'-11"	8'-4"	7'-6"	65"	33"	24"	6"	24"	8040
60"	6"	5"	2'-6"	5'-0"	3'-3"	8'-3"	8'-0"	72"	36"	24"	6"	24"	8750
66"	6"	5"	2'-0"	6'-6"	1'-9"	8'-3"	8'-6"	72"	36"	24"	7"	24"	10630
72"	7"	6"	2'-0"	6'-6"	1'-9"	8'-3"	9'-0"	77"	38"	24"	7"	24"	12520

FLARED END SECTION DETAIL

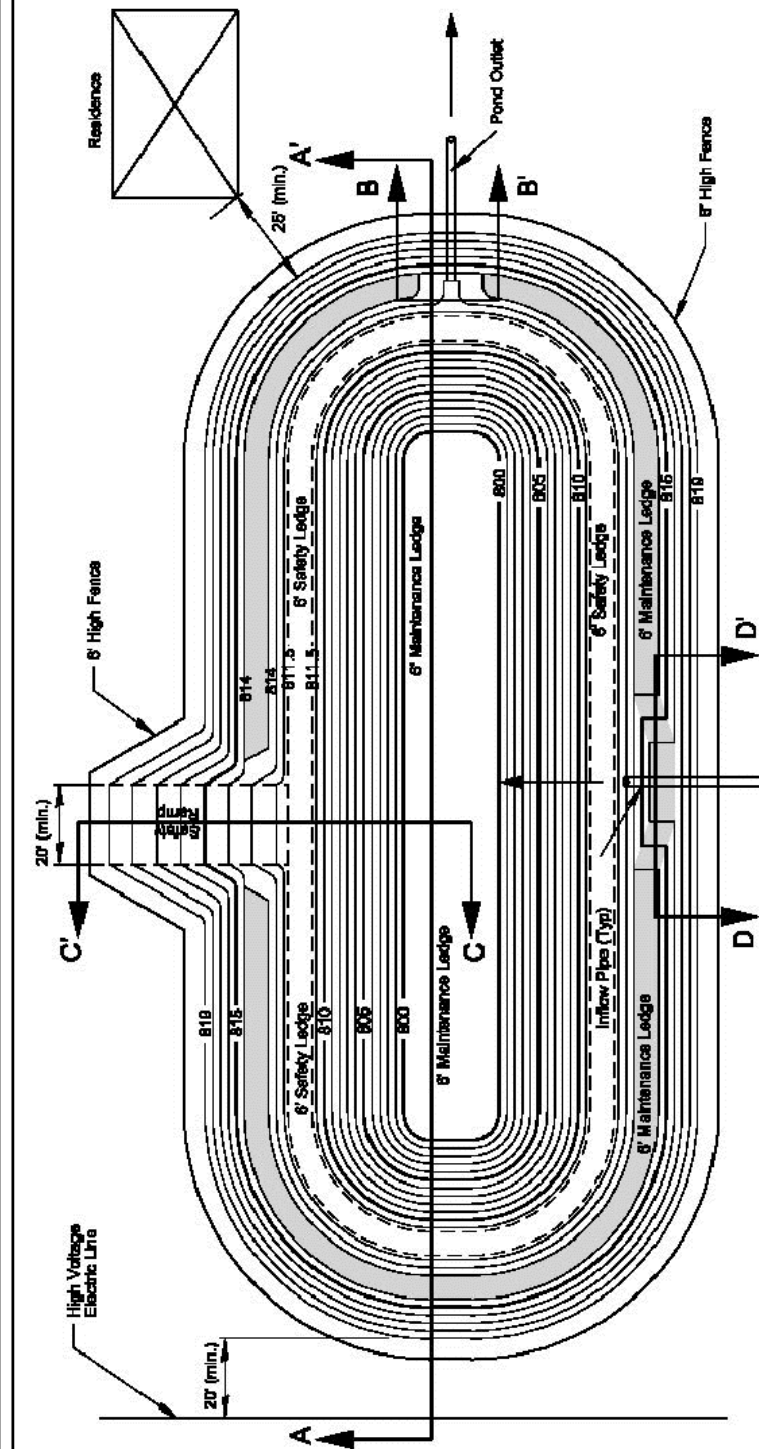
REVISION DATE

CITY of MONTICELLO, INDIANA STANDARD DETAILS STORM SEWER

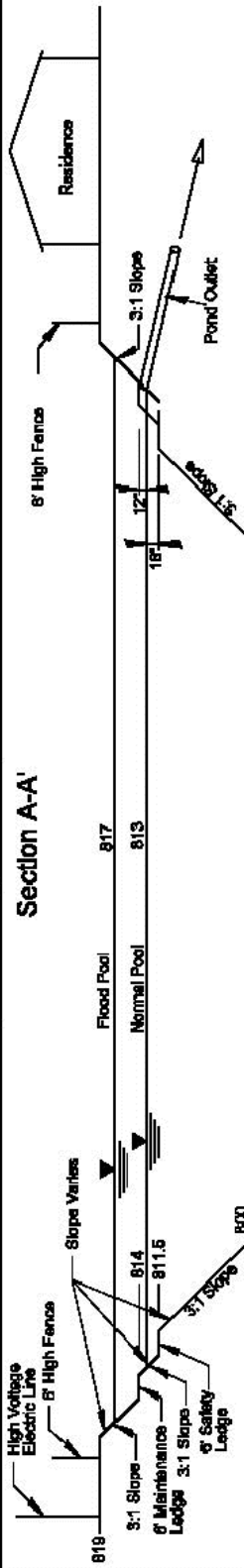
FIGURE

ST-6

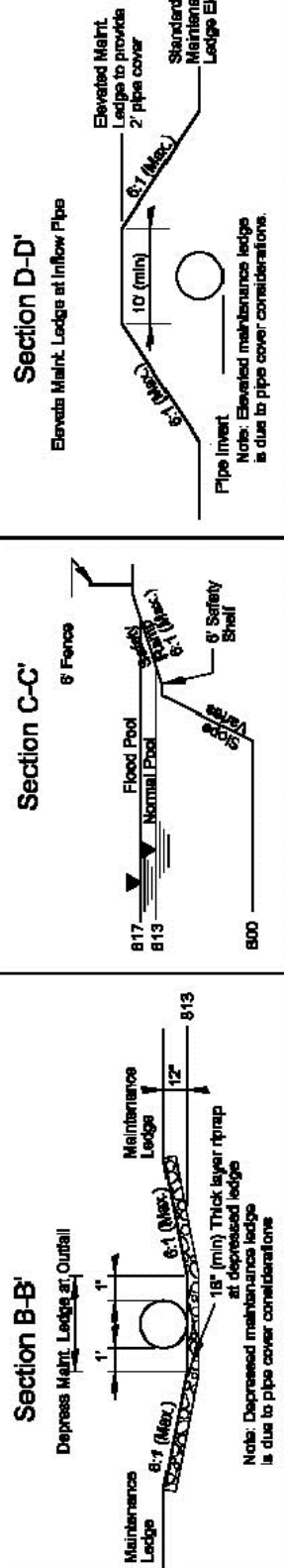
DATE: AUGUST 2019



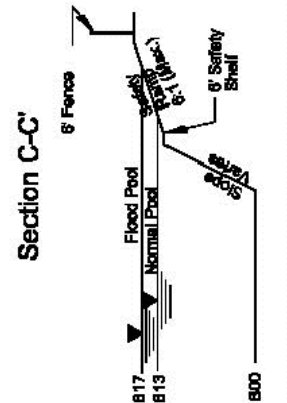
Section A-A'



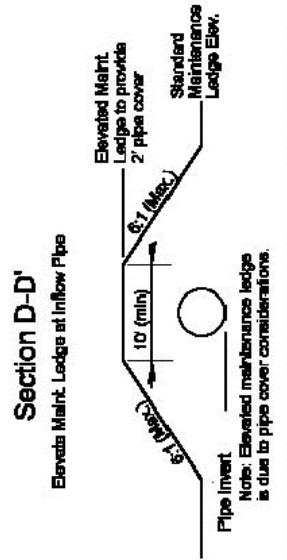
Section B-B'



Section C-C'



Section D-D'



WET-BOTTOM DETENTION FACILITY - WITH FENCE

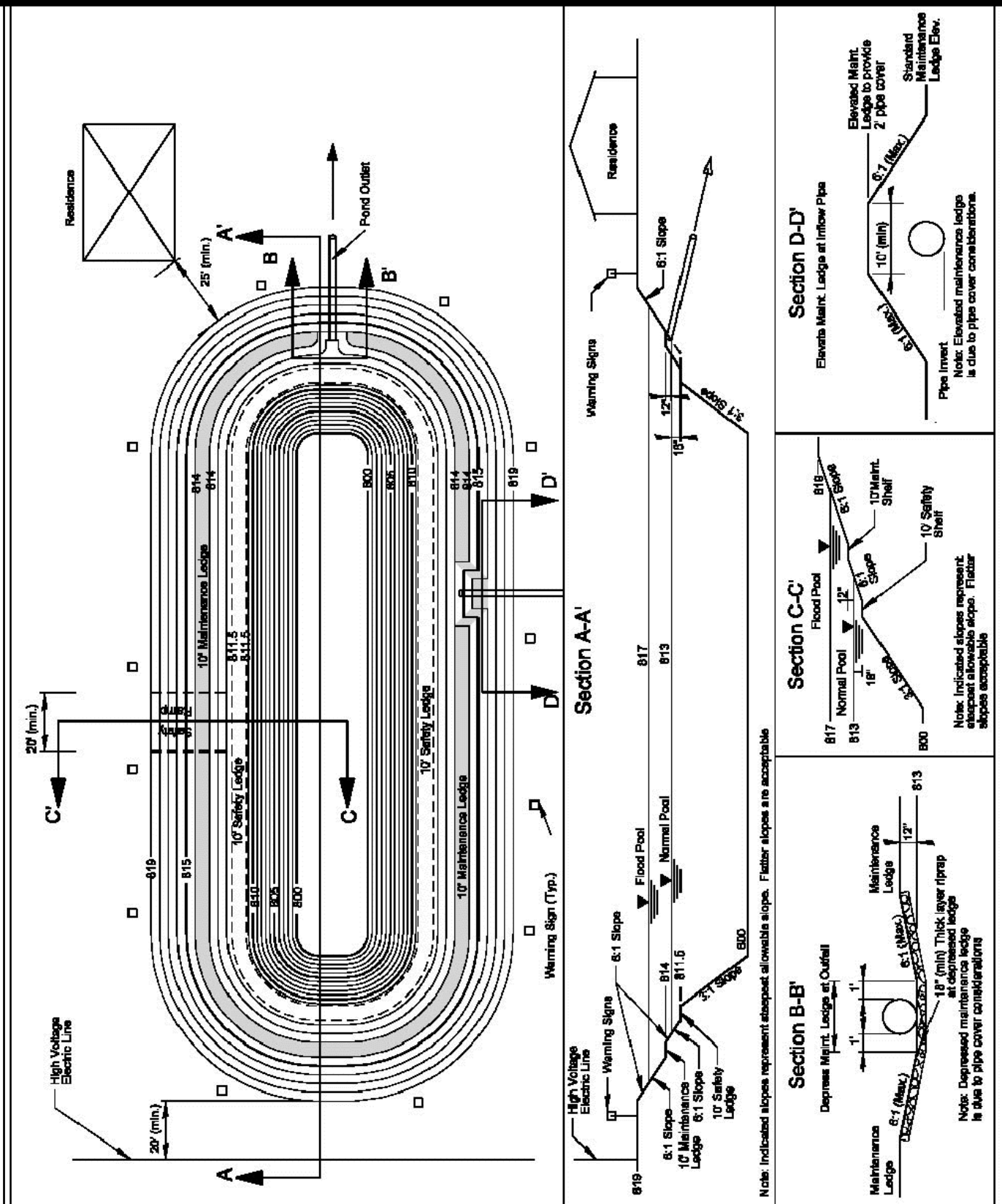
CITY of MONTICELLO, INDIANA STANDARD DETAILS STORM SEWER

FIGURE

ST-7

REVISION DATE

DATE: AUGUST 2019



WET-BOTTOM DETENTION FACILITY - WITHOUT FENCE

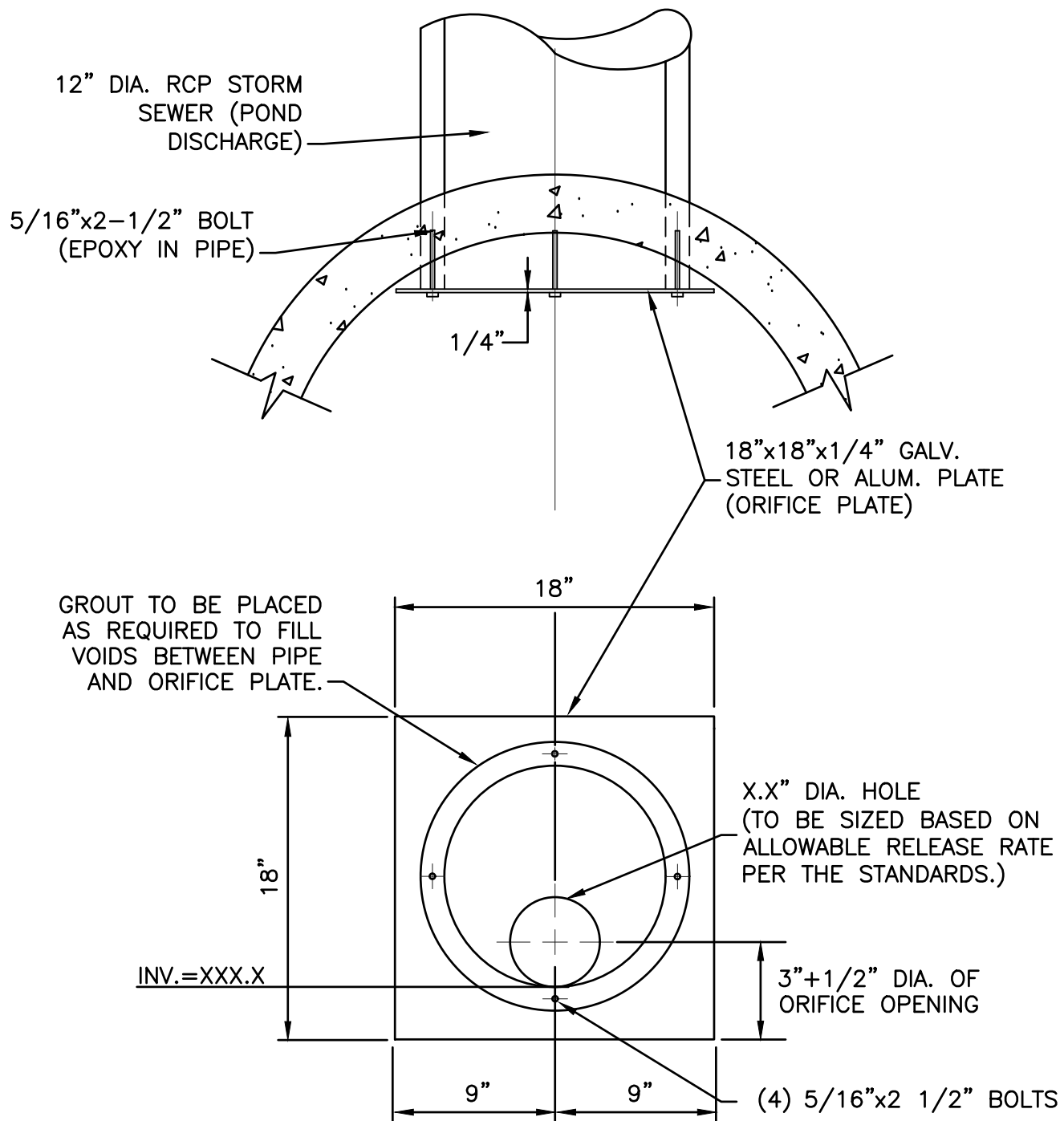
CITY of MONTICELLO, INDIANA STANDARD DETAILS STORM SEWER

FIGURE

ST-8

REVISION DATE

DATE: AUGUST 2019



ORIFICE PLATE DETAIL

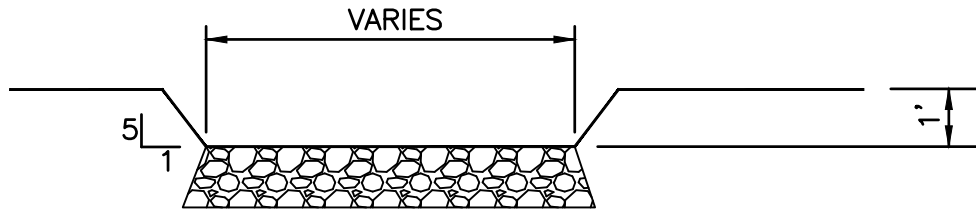
REVISION DATE

CITY of MONTICELLO, INDIANA
STANDARD DETAILS
STORM SEWER

FIGURE

ST-9

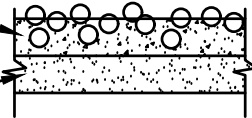
DATE: AUGUST 2019



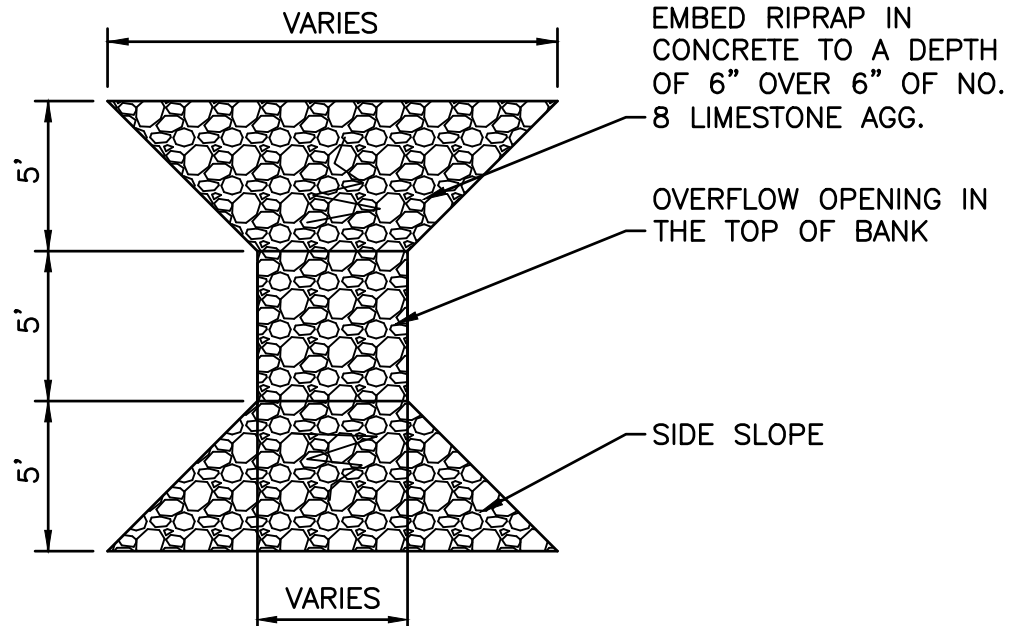
WEIR CROSS SECTION

EMBED RIPRAP (4"–8")
IN CONC. TO A DEPTH
OF 6"

6" OF NO.8
LIMESTONE AGGREGATE



EMBEDDED RIPRAP CROSS SECTION



OVERFLOW WIER DETAIL

REVISION DATE

CITY of MONTICELLO, INDIANA
STANDARD DETAILS
STORM SEWER

FIGURE

ST-10

DATE: AUGUST 2019

SECTION 18

WATER PROJECTS DESIGN STANDARDS & DETAILS

SECTION 18

WATER PROJECTS DESIGN STANDARDS AND DETAILS

18.1 General

The City and Town Engineer shall issue final approval for the installation of all public works facilities. All facilities shall be designed and installed in accordance with these Standards as well as applicable State and Federal regulations.

18.2 Water Distribution System Design Criteria

A. General

All water mains shall be designed and constructed in accordance with IDEM and Ten States Standards for Water Works requirements.

All water mains shall be designed to provide fire protection and sized by hydraulic analysis based on flow demands and pressure requirements. The system shall be designed to maintain a minimum pressure of twenty (20) psi at ground level at all points in the distribution system under all conditions of flow. The normal working pressure in the distribution system shall be approximately sixty (60) psi and not less than thirty-five (35) psi. System design shall be such that fire flows and facilities are in accordance with the requirements of the State Insurance Services Office.

All designs shall assume a peak hourly flow of no less than one (1.0) gpm per residential customer and no less than ten (10.0) gpm for a minimum dead-end flow analysis unless conditions warrant otherwise.

B. Mains

1. Pipe Capacities and Size

The minimum size of water main for providing fire protection and serving fire hydrants shall be six (6) inch diameter. Larger size mains will be required, if necessary, to allow the withdrawal of the required fire flow while maintaining the minimum residual pressure specified in **Section 5.2(A)**. Hydraulic calculations shall be prepared by the Developer/Contractor's Engineer and submitted to the City and City Engineer for review and approval. Any departure from minimum requirements shall be justified by hydraulic analysis and future water use and will only be considered in special circumstances. If necessary, booster pump systems shall be supplied to maintain minimum pressures at the Developer/Contractor's expense.

2. Minimum Depth

The minimum depth for all water lines shall be five (5) feet (60 inches) to the top of the pipe.

3. Dead Ends

In order to provide for additional reliability of service and reduce pressure loss, dead end mains shall be minimized by making appropriate tie-ins (looping) whenever possible. Where dead end mains occur, they shall be provided with a fire hydrant if flow and pressure are sufficient, or with an approved flushing hydrant or blow-off for flushing purposes as approved by the City and City Engineer. Flushing devices should be sized to provide flows with a minimum velocity of 2.5 feet per second in the water mains being flushed. No flushing device shall be directly connected to any sewer.

C. Hydrants

1. Location and Spacing

Hydrants shall be provided at each street intersection and at intermediate points between intersections as recommended by the State ISO. In general, hydrant spacing shall range from three hundred fifty (350) to six hundred (600) feet depending on the area being served.

2. Valves and Nozzles

The fire hydrants shall be 5¼ inch (main valve opening) with 6-inch auxiliary valve and connection pipe with breakoff flange and coupling assembly. The fire hydrants shall have two (2) 2½" hose nozzles and one (1) 4½" pumper nozzle threaded to meet the requirements of the local Fire Department. Nozzle caps shall be equipped with chains. All fire hydrants shall be arranged for operation with operating nut of size and shape which is the same as that of the existing fire hydrants, or as specified by the local Fire Department. Pumper nozzle shall have a nominal setting of between eighteen (18) and twenty-four (24) inches above the curb or centerline of road and if necessary, the Developer/Contractor shall furnish extensions. Hydrant color shall be per the Owner's request.

3. Hydrant Connection

The hydrant connection to the water main shall be a minimum of 6 inches in diameter. Auxiliary valves for hydrant isolation shall be installed in all hydrant connection lines.

4. Drainage

Hydrants shall be provided with a suitable drain. Hydrant drains shall not be connected to or located within ten (10) feet of sanitary sewers or storm drains.

D. Valves

Sufficient valves shall be provided on water mains so that mains can be isolated for repairs without inconvenience to water users or creating a sanitary hazard. Valves and tee fittings shall be provided at all locations where future mains will be installed to serve future development. Valves should be located at not more than five hundred (500) foot intervals in commercial districts and at not more than one block or eight hundred (800) foot intervals in other districts.

E. Air Relief Valves

1. Air Relief Valves

At high points in water mains, where air can accumulate, provisions shall be made to remove the air by means of hydrants or air relief valves. Automatic air relief valves shall not be used in situations where flooding of the manhole or chamber may occur. Manual air relief valves or hydrants are to be used as approved by the City or City Engineer.

2. Air Relief Valve Piping

The open end of an air relief pipe from automatic valves shall be extended to at least one foot above grade and provided with a screened, downward-facing elbow. The pipe from a manually operated valve should be extended to the top of the pit.

3. Chamber Drainage

Chambers, pits or manholes containing valves, blow-offs, etc. in a distribution system shall not be connected directly to any storm drain or sanitary sewer, nor shall blow-offs or air relief valves be connected directly to any sewer. Such chambers or pits shall be drained to the surface of the ground where they are not subject to flooding by surface water, or to absorption pits underground.

F. Water Services and Plumbing

Water services shall conform to the latest edition of the Uniform Plumbing Code and to these Standards.

The water service for individual users shall be connected to the water main with a service saddle or tee and a corporation stop.

All water services shall be sized for the anticipated water usage at the service, but in no case shall be less than 3/4 inch. All water services one (1) inch or larger shall have backflow preventers installed as approved by the City.

Provisions shall be made for metering of water usage to each service connection either by use of a meter pit or by a meter at the water service entrance to the building. If a service is metered at the building, a key curb stop shall be installed

at the edge of the right-of-way or easement line.

Water services installed for future connections shall be terminated at the right-of-way or easement line and valved and capped to insure one hundred (100) percent water tightness.

Individual booster pumps shall not be allowed for any individual service connection from the water main.

18.3 Easements

A. General

Whenever possible water mains shall be constructed within the public right-of-way. Should the construction be outside the limits of the public right-of-way, recorded easements shall be acquired, dedicated and recorded solely for the benefit of the City of Monticello.

The minimum permanent easement width to be dedicated to the City for the water main is fifteen (15) feet.

All water mains shall be centered in the easement unless sewer line is present. In that case, maintain minimum ten (10) foot separation between water and sewer lines.

The easements shall be exclusively under the discretion and control of the City. Ingress and egress shall be available to the City's crew at all times. No utility companies are allowed to use the easements for installation of their utility lines without the expressed written permission of the City. All plan sheets shall clearly identify the easement and the location of all other proposed utilities. The horizontal and vertical plans shall identify all utilities proposed to cross the easement.

B. Right-of-Way Plan Sheet

1. Geographic location map showing the extent of the project and including where applicable:
 - a. Directional North Arrow and Scale;
 - b. County;
 - c. Civil Township;
 - d. Section, Township and Range Identification;
 - e. Subdivision Names, Recording Information and Lot Numbers;
 - f. Highway, Road and Street Identification;
 - g. Rivers, Creeks and Named Ditches;
 - h. Assigned Parcel Numbers Arranged in Ascending, Numerical Order from the Project Beginning to End; and

- i. List of Apparent Owners (last deed of record) by Assigned Parcel Numbers.
2. In addition to the above, there should be sufficient information on the design drawings to properly correlate with the right-of-way plan sheet; i.e., property lines, subdivision information, parcel number or name, width of right-of-way, permanent or temporary and special conditions; for example, structures, trees, shrubs to be removed or replaced, sodding, riprap, etc.

C. Description Sheets

The following shall be provided:

1. Parcel Number;
2. Project Number;
3. Project Name;
4. Identification as to permanent or temporary easement;
5. Separate descriptions on separate sheets are required where both permanent and temporary easements are to be taken;
6. Meets and bounds descriptions shall be clear, concise and complete with sufficient detail to positively establish from known and referenced points, monuments, lines, etc. Total area should be stated at end of description, in acres;
7. Descriptions of easements from platted subdivision lots, including strips off sides of lots should include name of subdivision and recording information for the subdivision as well as affected lot number(s). NOTE: These are usually small areas; therefore, area should be stated in square feet; and
8. Registered land surveyor's licensed in the State of Indiana, seal and signature.

D. Property Plats

1. Parcel Number;
2. Project Number;
3. Project Name;
4. County;
5. Civil Township;
6. Section;
7. Township;
8. Range;
9. Owner;
10. Permanent or Temporary Legends;

11. Permanent or Temporary Easement Areas;
12. Total area of property out of which easement is to be taken;
13. Drawn By;
14. Directional North Arrow;
15. Scale;
16. Unplatted properties: complete boundaries of property description out of which easements are to be taken, including properly identified referenced corners, P.O.B.'s, monuments, roads, bearings, distances, etc.;
17. Platted subdivisions: dimensions of lot(s) as well as the lot number(s) and including the subdivision name and recording information;
18. Easement boundaries, including regulated drain boundaries, as described in Item A. of this subsection, including referenced bearings, distances, etc., and identified as in legend; and
19. Registered land surveyor seal and signature.

18.4 Drafting Standards for Project Plans

A. General

These Standards have been established for the purpose of ensuring uniformity in the design and drafting techniques of projects to be submitted for review and acceptance.

1. All projects submitted, having more than two (2) sheets, shall have a title sheet which will include:
 - a. General Overall Area Map;
 - b. Vicinity Location Map;
 - c. A Site Plan Map Detailing the Project;
 - d. Name/Title of Project, including Section Number if applicable;
 - e. Owner and Engineer's Name; and
 - f. Professional Engineer's Seal and Signature.
2. All plan and profile sheets are to be certified and dated by a professional engineer of the State of Indiana.
3. All sheets are to be numbered, with total number of sheets included.
4. Include detail sheet(s)/specification sheet(s), as applicable.
5. Design drawings shall be twenty-four (24) inch by thirty-six (36) inch.

B. Scales

The following scales for drawings are required:

1. Plan and Profile: Variable; Not to Exceed 1"=50' Horizontal and 1"=5'

Vertical.

2. Cross Sections: 1"=5' Horizontal and Vertical

C. Materials

Mylar type drafting film shall be used for all reproduction "originals" to be submitted as record drawings. They shall be of a quality suitable for blueline printing.

D. Plan and Profile Sheets

1. General

- a. A North Arrow;
- b. The Scales Used;
- c. Project Name and Number, Sheet Number, Date Drawn, Date and Nature of Revisions;
- d. All topography in the area affected by construction;
- e. Right-of-Way lines; property lines and easements;
- f. Locations of benchmarks and their descriptions;
- g. Locations of all existing and proposed utilities in the project area; and
- h. Match lines shall be easily identifiable.

2. Water Main Profile Drawings

All water main profile drawings shall include the following, as a minimum:

- a. Existing and finished grade lines;
- b. Depth of burial to top of pipe;
- c. Elevations to USGS datum;
- d. Types of materials used;
- e. Profile of existing and proposed utilities; and
- f. Special construction required due to unfavorable soil conditions, jacked and bored casing pipe, etc.

E. Record Drawings

All plans submitted as record ("as-built") drawings shall have all pertinent items shown on the plan view and properly scaled. This includes pipes, manholes, valves, hydrants, casing, etc. All sheets shall have the phrase "as-built" or "record drawing" boldly printed on them with the date and shall be stamped and signed by a professional engineer registered in the State of Indiana.

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SECTION 19

WATER PROJECT MATERIALS

SECTION 19

WATER PROJECT MATERIALS

19.1 General

This section provides a description of the materials acceptable for the construction of water systems additions and improvements for the City of Monticello. Use of other materials which are not specified herein shall only be permitted with the written approval by the City and City Engineer.

19.2 Water Mains

A. General

The following materials are acceptable for water mains:

Ductile Iron Pipe (DIP)

B. Water Main Materials

1. Ductile Iron Pipe PR350/PR250

Water main piping shall be ductile iron. DI pipe shall conform to ANSI/AWWA C150/A21.50, Thickness Design of Ductile Iron Pipe and the National Sanitation Foundation Standard No. 61. The material and properties used shall conform to ANSI/AWWA C151/A21.51, Ductile Iron Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids. The joints, unless otherwise specified, shall be of the push-on type conforming to ANSI/AWWA C111/A21.11. The pipe shall be cement mortar lined, conforming to ANSI/AWWA C104/A21.4 and shall be coated outside with a bituminous coating. The gasketed joint system shall conform to ASTM D 3139. The rubber gaskets shall conform to ASTM F 477.

The pipe shall be pressure rated in accordance with recommendations of the ANSI/AWWA standards. Pressure Class shall be as follows:

**Pressure Class 350 (12" or smaller) and
Pressure Class 250 (14" or greater)**

2. Fabricator Qualifications

Firms regularly engaged in manufacture of water system products of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years. Fabricator must have sufficient production capacity to produce required units without causing delay in work.

3. Lubricant

Lubricant shall be non-toxic and shall not support the growth of bacteria and shall have no deteriorating effects on the gasket or the pipe. It shall not impart a taste or odor to the water in a pipe that has been flushed in accordance with AWWA standard D 601. The lubricant containers shall be labeled with manufacturer's name.

4. Joints

- a. Push-on and Mechanical - Push-on and mechanical joints including all accessories shall conform to AWWA/ANSI Standard C151/A21.51. Bolts shall be high strength cast iron with tee head and hex nuts.
- b. Flanged - Flanged joints shall not be used for underground installations except within structures. Flange joints shall meet the requirements of AWWA/ANSI Standard C151/A21.51 or ANSI B.16. All flanged joints shall be rated for two hundred fifty (250) psi pressure and have ASA 125 lb. bolt pattern. Gaskets for flanged joints shall be cloth impregnated rubber one sixteenth (1/16) inch thick for sizes three (3) inches through eight (8) inches, and one eighth (1/8) inch thick for sizes ten (10) inches and larger. Bolt circle and bolt holes of flanges shall match those of Class 125 flanges per ANSI B16.1.
- c. Bell and Spigot - Bell and spigot joints shall conform to AWWA/ANSI Standard C151/A21.51.

Gasket dimensions shall be in accordance with ASTM F 477 and the manufacturers standard design dimensions and tolerances. The gasket shall be made of such size and shape as to provide an adequate compressive force against the spigot and socket after assembly to affect a positive seal under all combinations of joint and gasket tolerances. The trade name or trademark, size, mold number, gasket manufacturer's mark, and year of manufacture shall be molded in the rubber on the back of the gaskets.

Gaskets shall be vulcanized natural or vulcanized synthetic rubber. No reclaimed rubber shall be used. When too hardness's of rubber are included in a gasket, the soft and hard portions shall be integrally molded and joined in a strong vulcanized bond. They shall be free of porous areas, foreign material and visible defects.

5. Fittings

Fittings shall be ductile iron with mechanical joints, glands and gaskets to properly fit the DI pipe.

The radius of curvature of all bends, tees and other ductile iron fittings shall comply with ANSI/AWWA C110/A21.10 (standard) or ANSI/AWWA C153/A21.53 (compact). Iron fittings shall be as manufactured by DICOA,

Clow, U.S. Pipe or approved equal. Fittings shall have distinctly cast upon them the pressure rating and letters "DI" or "DUCTILE".

6. Tracer Wire

The Contractor shall provide a continuous wire buried in the pipeline trench directly above the water main to facilitate main location. Tracer wire shall be a 12 or 10 AWG Solid extra-high-strength copper-clad steel conductor (EHS-CCS) insulated with a 45 mil minimum, high-density, high molecular weight polyethylene (HDPE) insulation, and rated for direct burial use at 30 volts. EHS-CCS conductor must be a 21% conductivity for locating purposes. HDPE insulation shall be RoHS compliant and utilize virgin grade material. Insulation color shall meet the APWA color code standard for identification of buried utilities. Tracer wire materials shall comply with ASTM B-3, B170, D1248, D1238, and B869. The tracer wire shall also include 2 pound anodes soldered to the tracer wire every 500 feet.

7. Polyethylene Encasement

- a. In some cases, due to soil conditions or as required by the City, polyethylene encasement may be necessary. In such cases, Cross-Laminated Polyethylene encasement materials shall be used for ductile iron pipe, fittings, valves, and fire hydrants. Cross-Laminated Polyethylene tube material shall conform to AWWA C105 with a thickness of 6.5 mils.
- b. The minimum tube size for each pipe diameter shall be as follows:

Nominal Pipe Diameter (Inches)	Polyethylene Flat Tube Width (Inches)	
	Bell & Spigot Joints	Mechanical Joints
6	17	20
8	21	24
10	25	27
12	29	30
16	37	37
20	45	45
24	53	53

- c. Adhesive tape for repairs and circumferential joints shall be a general-purpose adhesive tape two (2) inches wide and approximately twelve (12) mils thick and shall conform to AWWA C209 with a polyethylene backing and a butyl rubber adhesive.

19.3 Gate Valves and Appurtenances

A. Gate Valves (3" - 16")

All gate valves shall be of the resilient wedge type by Waterous Company, St.

Paul, Minnesota. In addition, all buried gate valves shall have non-rising stems with a two (2) inch nut for operating with a tee handle wrench and shall be provided with valve boxes for the proper depth of bury.

All gate valves shall conform to the latest revision of AWWA Standard C-509 covering resilient seated gate valves.

All gate valves shall be non-rising stem, opening counterclockwise by turning the stem, and provided with a two (2) inch square operating nut or handwheel (dependent upon application) with the word "OPEN" and an arrow cast in the metal to indicate direction to open.

The wedge shall be of ductile iron completely encapsulated with urethane rubber. The urethane sealing rubber shall permanently bond to the cast iron wedge to meet ASTM tests for rubber metal bond ASTM D429.

Stems for non-rising stem assemblies shall be cast bronze with integral collars in full compliance with AWWA. OS & Y stems shall be on bronze stock. The non-rising stem stuffing box shall be on the O-Ring seal type with two (2) rings located above the thrust collar; the two (2) rings shall be replaceable with the valve fully open and subjected to full rated working pressure.

There shall be two (2) low torque thrust bearings located above and below the stem collar. The stem nut shall be independent of the wedge and shall be made of solid bronze. There shall be a smooth unobstructed waterway free of all pockets, cavities, and depressions in the seat area.

The body and bonnet shall be coated with fusion bonded epoxy both interior and exterior. Each valve shall have maker's name, pressure rating and year in which manufactured cast on the body. Prior to shipment from factory, each valve shall be tested by hydrostatic pressure equal to requirement of both AWWA and 500 PSI ULFM requirements.

B. Valve Boxes

Valve boxes shall be of cast iron, complete with pavement rings, as applicable, and covers. Cast iron boxes shall be of extension type with screw adjustment and with flared base. The minimum thickness of metal shall be 3/16". The word WATER shall be cast in the cover. Boxes shall be installed over each outside gate valve unless otherwise shown on the drawings. The boxes shall be of such length as will be adapted, without full extension, to the depth of cover required over the pipe at the valve location. A keynut extension shall be installed if the valve nut is greater than four (4) feet in depth.

C. Valve Stem Extensions

Extension rods less than six (6) feet in length shall be made of at least Schedule 80 steel pipe. Extension rods six (6) feet in length or more shall be made of solid steel pipe. All steel shall be of the highest quality capable of operating the valve under severe conditions without permanent distortion. The operating nut connector shall fit the operating nut closely, shall provide four (4) faces to the

operating nut, shall be made of the same type of steel as the extension rod, shall be of welded manufacture, and shall be welded to the extension rod. An extension centering disc shall be located on the stem extension close to the top. An operating nut of the same steel as the extension rod and of the same size and shape as the valve's operating nut shall be placed on the end of the stem extension. The operating nut on the stem extension shall be of welded manufacture and welded to the extension rod. The entire unit shall be painted immediately after manufacture and shall be free of rust or other defects.

19.4 Fire Hydrants and Flushing Hydrants

A. Fire Hydrants

1. The fire hydrants shall be five and one quarter (5¼) inch (main valve opening) with six (6) inch auxiliary valve and connection pipe with break-off flange and coupling assembly. The fire hydrants shall have two (2) 2½" hose nozzles and one (1) 4½" pumper nozzle threaded to meet the requirements of the local Fire Department. Nozzle caps shall be equipped with chains.

All fire hydrants shall be arranged for operation with operating nut of size and shape which is the same as that of the existing fire hydrants, or as specified by the local Fire Department. Pumper nozzle shall have a nominal setting of between eighteen (18) and twenty-four (24) inches above the curb or centerline of road and if necessary, the Contractor shall furnish extensions. Hydrant color shall be per the Owner's request.

2. Hydrants shall have six (6) inch mechanical joint inlets and auxiliary gate valves shall be mechanical joint. The valve should be a minimum of two (2) feet from the hydrant. In no case shall the valve be directly bolted the hydrant flange.
3. The hydrants shall be a "Super-Centurion" by Mueller.
4. All pipe, fittings, and valves shall conform to the applicable specifications included in these Standard Specifications. Connecting pipe and gate valves shall be six (6) inch size.

19.5 Service Connections

A. Service Saddles

Shall be single strap type of all stainless construction with confined "O" ring seal and AWWA thread outlet. Service saddles shall be of a design which will accurately fit pipe (O.D.) to provide a positive seal between main and saddle at the rated working pressure of the main.

The service saddle shall be marked to indicate size of main (O.D.) and outlet size on body and strap. Service saddle shall be Ford Style 101B for service lines up to one (1) inch in size, and 202B for service lines over one (1) inch in size; or

approved equal.

B. Corporation Stops

Shall be brass, designed and manufactured in accordance with AWWA standard specifications C-800 and shall be individually inspected and tested for the leaks at the factory prior to shipment. Corporation stops shall be of a design which will permit use with drilling machines of current design.

Corporation stops shall be ball type furnished with AWWA inlet thread and pack joint outlet for ETS pipe as manufactured by Ford Meter Box Co., Mueller Co. or approved equal.

C. Copper Service Pipe

All copper pipe ("K") service line for water distribution shall conform to all applicable requirements in the latest revision of ASTM and AWWA standards for Copper Tube Size (SDR-9). Per City Ordinance 167, only copper pipe may be used for service lines.

D. Metered Service Installations

1. Metered Connections

a. Meter Setters

Meter setters shall be used for services which are one and one half (1½) inches or larger.

Meter setters shall be copper tube with integral inlet and outlet pack joints for service line. Meter inlet valve shall be brass of the inverted key, angle ball valve type, with "O" ring seal, smooth contour and unobstructed waterway on inlet. It shall have padlock wings, lock cap and seal wire hole. Setter shall be braced between inlet and outlet risers with a structural brass member which shall have a hole at the bottom to accept a one half (½) inch steel, brace pipe. Saddle nuts shall be provided for supporting meter. All setters shall be set and maintained in a vertical position.

Setters for meters shall be manufactured by A.Y. McDonald Mfg. Company or as approved by the City and City Engineer.

b. Meter Yokes

Yokes shall be used when the service line is less than one and one half (1½) inches. For one (1) inch yokes, a Ford Model Y501 yoke shall be used. For three quarter (¾) inch yokes, a Ford Model Y-502 yoke shall be used.

2. Service Meter Enclosures

a. Enclosures for Meters

Meter enclosures for meter yokes shall be a minimum of twenty (20) inches in inner diameter. Enclosures shall be manufactured from PVC or PE and shall be of a ribbed type construction. Nominal wall thickness shall be not less than two (2) inches. Enclosures shall include two (2) 2½" wide slots at the bottom to accommodate service tubing.

b. Covers for Enclosures

Covers shall be cast iron, Wabash Double Lid Covers, four (4) inches deep with an eleven and one half (11½) inches diameter lid opening. Lid to have lifter worm lock with standard pentagon bolt. The words "WATER METER" shall be cast in the top of the lid. Covers shall be similar to Ford Meter Box Company, Model No. W3.

19.6 Tapping Sleeve

The tapping sleeve body shall be fabricated from 18-8 type 304 premium grade stainless steel to minimize corrosion. The body shall be of the full circumference band configuration. The tapping sleeves shall be designed for a water working pressure of one hundred fifty (150) pounds and shall be provided with the necessary test plugs for pressure testing. Dimensions shall be such that the tapping sleeves are installed so as to properly fit the O.D. of the existing pipes. All material shall be in accordance with AWWA Specifications.

Flanges shall be standard AWWA C207 Class D ANSI 150 lb. drilling with epoxy coated finish. Flange shall be recessed to accept tapping valve.

Bolts and nuts shall be 18-8 type 304 stainless steel with heavy hex nuts and 18-8 type 304 L stainless steel stud bolts. Nuts shall be Teflon coated to prevent galling. Washers shall be plastic lubricating type.

Bridge plate shall be 18-8 type 304 and bonded to the gasket to assure even distribution of gasket pressure.

Tapping sleeves shall be as manufactured by Rockwell International, or approved equal.

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SECTION 20

WATER PROJECT INSTALLATION AND CONSTRUCTION

SECTION 20

WATER PROJECT INSTALLATION AND CONSTRUCTION

20.1 General

This section shall provide general, minimum requirements for the installation and construction for City of Monticello. These standards shall apply to all areas of the construction. Where the construction passes through previously developed areas, special attention shall be given to the applicable portions of this section.

20.2 General Construction

A. Clearing

Preparatory to excavation, the site of all open cut excavations, embankments, and fills shall be first cleared of obstructions and existing facilities (except those which must remain temporarily or permanently in service). On all public or private property where grants or easements have been obtained, and on the property of the City, the Developer/Contractor shall remove and keep separate the topsoil and shall carefully replace it after the backfilling is completed.

B. Pavement Cutting

Prior to excavating paved areas all excavation edges falling within the pavement shall be saw cut in a neat, straight manner. Cutting shall be performed with a saw designed specifically for this purpose. The cut shall penetrate the entire pavement thickness where possible. If the existing pavement is more than six (6) inches thick, then a cut of not less than six (6) inch depth shall be made. If pavement cuts are made in streets which are opened to traffic prior to excavation, then the cuts shall be thoroughly filled with sand and maintained full until the excavation is performed.

C. Protection of Existing Improvements

Before any excavation is started, adequate protection shall be provided for all existing utilities and Town structures.

D. Protection of Trees and Shrubs

No existing trees or shrubs in street right-of-way and easements shall be damaged or destroyed. Where branches of trees or shrubs interfere with the Contractor's operations, they shall be protected by tying back wherever possible. No limbs or branches shall be cut. If his operations will not permit saving certain trees, the Contractor shall be wholly responsible for satisfying all claims for restoration or restitution resulting from their damage or removal.

If small trees and shrubs are moved or pruned to permit more working space, pruning shall be done in accordance with Home and Garden Bulletin No. 83, U.S. Department of Agriculture, "Pruning Shade Trees and Repairing Their Injuries". However, the Contractor shall obtain, in writing, the City's permission to move or prune trees or shrubs.

E. Maintenance of Public Travel

Works shall be carried out in a manner which will cause a minimum of interruption to traffic and may close to through travel not more than two (2) consecutive blocks, including the cross street intersected. Where traffic must cross open trenches, the Contractor shall provide suitable bridges to street intersections and driveways. The Contractor shall post suitable signs indicating that a street is closed and necessary detour signs for the proper maintenance of traffic. Prior to closing of any streets, the Contractor shall notify responsible municipal authorities.

All traffic control shall be in accordance with the latest edition of the Indiana Manual on Uniform Traffic Control Devices and Sections 104.04, 107 and 801 of the Indiana Department of Highways Standard Specifications.

F. Utility Interruption

The Contractor shall proceed with caution in the excavation and preparation of the trench or pit so that the exact location of underground structures may be determined. Prior to proceeding with trench excavation, the Contractor shall contact all utility companies in the area to aid in locating their underground services.

The Contractor shall take all reasonable precautions against damage to existing utilities. However, in the event of a break in an existing water main, gas main, sewer or underground cable, he shall immediately notify the responsible official of the organization operating the utility interrupted. The Contractor shall lend all possible assistance in restoring services and shall assume all costs, charges, or claims connected with the interruption and repair of such services.

G. Boring and Jacking

Construction of the pipeline by boring and jacking methods under highways, railroads, and streams will be permitted unless otherwise specified on the plans. Plans and details describing the materials and methods of construction proposed for use shall be submitted to the City and the City Engineer for approval.

1. Backstop: The backstop shall be of sufficient strength and positioned to support the thrust of the boring equipment without incurring any vertical or horizontal displacement during such boring operations.

2. Guide Rails: The guide rails for the boring equipment may be of either timber or steel. They shall be laid accurately to line and grade and maintained in this position until completion of the boring operations.
3. Casing Pipe: The casing pipe and joints shall be steel construction capable of withstanding the traffic load and constructed to prevent leakage from the casing or conduit throughout its entire length excepting the open ends.

- a. The casing pipe shall be welded steel pipe, new and unused. The pipe shall have a minimum yield of thirty-five thousand (35,000) psi and meet the requirements for Class B pipe under ASTM specification A-139 "Electric Fusion (Arc) - Welded Steel Pipe".
- b. The minimum wall thickness for the casing pipe shall be as follows:

Diameter of Casing	Minimum Wall Thickness (inches)
Under 14"	0.375
14"	0.375
16"	0.375
18"	0.375
20"	0.500
22"	0.500
24"	0.500
26"	0.500
28"	0.500
30"	0.500

- c. Where lengths of casing pipe are joined during the boring operations, care shall be taken to ensure that the proper line and grade is maintained. After welding of each joint, the casing pipe exterior wall shall be coated with coal tar, or bitumastic material.
- d. The casing ends shall be suitably protected against the entrance of foreign material which would interfere with the conduit removal. Brick and mortar bulkhead walls shall be used to seal the casing ends.
- e. Stream crossings shall be a minimum of three (3) feet from the stream bottom (as defined by the regulating agency) and the top of the casing pipe.
4. Casing Spacers: The carrier pipe shall be centered within the casing by use of stainless-steel casing spacers as manufactured by Cascade Waterworks Manufacturing Company, Yorkville, IL; or approved equal.

Casing spacers shall be bolt on style with a two (2) piece shell made from T-304 stainless steel of a minimum fourteen (14) gauge thickness. Each shell section shall have bolt flanges formed with ribs for added strength. Each connecting flange shall have a minimum of three 5/16" T-304 bolts. The shell shall be lined with a ribbed PVC extrusion with a retaining section that overlaps the edge of the shell and prevents slippage. Bearing surfaces (runners) made from UHMW polymer with a static coefficient of friction of .11-.13 shall be attached to support risers at appropriate positions to properly support the carrier within the casing and to ease installation. All metal surfaces shall be fully passivated.

Casing spacers shall be installed per the recommendations of the manufacturer, and at intervals of not more than five (5) inches.

5. Seal Ends: After the water main is fully installed within the entire length of the casing, the Contractor shall, to the satisfaction of the Engineer, seal both ends of the casing pipe with brick and mortar bulkhead walls.

20.3 Bedding and Backfill

A. General

All trenches or excavations shall be backfilled to the original surface of the ground or such other grades as required or directed. In general, the backfilling shall be carried along as speedily as possible in order to avoid open excavations.

B. Backfill Materials

The following materials shall be used for Backfill in accordance with and in the manner indicated by the requirements specified herein.

- | | |
|-------------|--|
| Class I - | Angular, six (6) to forty (40) millimeters (1/4 to 1½ inch), graded stone such as crushed stone. |
| Class II - | Coarse sands and gravel with maximum particle size of forty (40) millimeters (1½ inch), including various grades of sands and gravel containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class. |
| Class III - | Fine sand and clayey gravel including fine sands, sand-clay mixtures and gravel-clay mixtures. Soil types GM, GC, SM and SC are included in this class. |
| Class IV - | Silt, silty clays and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH and CL are included in this class. These materials are not recommended for bedding. This class shall also include any excavated material free from rock (3 inches and larger), concrete, roots, stumps, rubbish, frozen material and other similar articles |

whose presence in the backfill would cause excessive settlement.

C. Backfill of Trench Excavations for Pipes and Structures

Bedding and Backfill materials samples shall be submitted to the City or City Engineer prior to start of construction.

D. Rigid Pipe Bedding

For purposes of this specification, rigid pipe shall include those made of ductile iron and other materials as determined by the City and City Engineer.

All rigid pipe shall be laid to the lines and grades unless otherwise directed by the City. All rigid conduit and pipe shall be bedded in compacted Class I, II, or III material, placed on a flat trench bottom. The bedding shall have a minimum thickness of four inches (4") or one-fourth (1/4) the outside pipe diameter below the pipe and shall extend halfway up the pipe barrel at the sides. All material shall be placed in the trench in approximately six (6) inch layers. Each layer, shall be leveled and evenly distributed on both sides of the pipe so as not to disturb, displace or damage the pipe and shall be thoroughly compacted. When Class I or II materials are used compaction may be accomplished by hand or mechanical tamping or by "walking" the material in. Bedding from the halfway point on the pipe to a point twelve (12) inches above the top of the pipe shall be a Class I, II, III, or IV material placed in six (6) inch layers and thoroughly compacted to prevent settlement. Class III and IV material shall not be used when the trench is located in an area subject to vehicular traffic.

E. Backfill Above Pipe

For purposes of this specification, trenches shall be considered subject to vehicular traffic if all or any portion of the excavation is located within five (5) feet of a roadway or alley which is routinely traveled by powered vehicles. In the event of any question regarding the susceptibility of an area to traffic, the City and the City Engineer's decision shall govern.

1. Method A - Backfill in Areas Not Subject to Vehicular Traffic

The trench between a level twelve (12) inches above the top of the pipe and the ground surface shall be backfilled with Class I, II, III or IV materials, as described above, deposited with mechanical equipment in such a manner that it will "flow" onto the bedding and not free fall. The Contractor shall consolidate the backfill by the back and forth travel of a suitable roller, wheeled device or other similar heavy equipment until no further settlement is obtained. Heavy equipment shall not be used until there is a cover of not less than three (3) feet over the pipes. To assist in promoting maximum settlement, the surface of the trench shall be left in a slightly rounded condition. Periodical dressing of the backfill in the trench to promote the drainage and safety conditions shall be made during the course of the work.

2. Method B - Backfill in Areas Subject to Vehicular Traffic (Mechanical Compaction)

The trench between a level of twelve (12) inches above the top of the pipe and the surface, which are located in areas subject to or possibly subject to vehicular traffic, shall be backfilled with Class I or II materials, deposited in uniform horizontal layers of two (2) feet +/- six (6) inches. Each layer shall be thoroughly compacted by mechanical tamping utilizing a crane mounted hydraulic vibratory compactors. Each layer shall be thoroughly compacted before the next succeeding layer is placed. This procedure shall be followed where trench walls remain stable during compaction. If in the opinion of the City Engineer and City, and/or their representative (inspector), the trench walls become unstable during compaction, then the City Engineer, City, and/or their representative (inspector) may authorize the Contractor to push from the back of the trench the Class I or II material into the trench the full depth, not to exceed twenty (20) lineal feet horizontally along the trench bottom and compact using the vibratory compactor in two (2) foot diagonal lifts.

The crane mounted vibratory compactors shall be capable of producing 1900 cycles per minute and have a compaction plate with the minimum dimensions of twenty-three by thirty-one (23 x 31) inches. The compactor shall be similar to those as manufactured by Allied, Ho-Pac, or equal.

When Class I or II materials do not contain sufficient moisture to obtain proper compaction, in the opinion of the City Engineer, City and/or their representative, it shall be moistened or wetted as directed by the City Engineer, City and/or their representative.

F. Temporary Surfaces Subject to Traffic

All streets shall be open to traffic immediately after completing the backfill operation. This shall be accomplished by installing the compacted aggregate base immediately after granular backfill. The use of class II backfill as a temporary surface is specifically prohibited.

G. Maintaining Trench Surfaces

All surface settlement of the backfill along trenches located beneath streets, roads, alleys, driveways and parking lots which are subject to traffic shall be kept filled level with or slightly above the original paved surface at all times with compacted aggregate base material until the permanent pavement is satisfactorily restored. When temporary asphalt pavement is used, depressions and "potholes" shall be promptly filled with the temporary asphalt material. Special attention shall be given to the timely and proper maintenance, leveling and grading of the surface of all backfilled trenches, especially those subject to traffic and especially following rains. The surface of streets, roads and alleys shall be maintained smooth and free of ruts and water trapping depressions by periodic power blading, scarifying; and/or filling settled areas, ruts, pockets, or holes with compacted aggregate base material or temporary asphalt where used.

As a dust preventive, calcium chloride shall be applied over the surface of the compacted aggregate base in such amounts and at such times as are necessary to avoid or eliminate dust complaints from nearby residents. In event of any question regarding the existence or nonexistence of a dust nuisance, the City Engineer's and City's decision on the matter will govern. The material used shall be Regular Flake Calcium Chloride having a minimum chemical content of Calcium Chloride of seventy-seven percent (77%). Unless otherwise specified or ordered by the City Engineer and City, the rate of application shall be one and one half (1½) pounds per square yard of surface covered.

Wherever surface settlement is not important, unless otherwise specified or directed, the backfill shall be neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation. Just prior to the completion of all work under the contract, any surface settlement below original ground surface shall be refilled in a satisfactory manner and reseeded as specified if required.

20.4 Water Main Installation

A. General

In general, installation of buried water mains shall conform to the requirements of the manufacturer, the AWWA Standard for the type of pipe being installed, or as specifically indicated on the plans or specified herein.

Extreme care shall be taken in handling pipe to prevent damage. Pipe, fittings and valves shall not be dropped to ground or into trench; they shall be carefully lowered, piece by piece, using crane, backhoe, or other approved lifting device. During cold weather, valves and hydrants shall not be stored where trapped moisture can freeze and damage fittings.

Where water is encountered in trench, Contractor shall furnish and operate suitable pumping equipment of capacity adequate to dewater trench, dispose of such water, and maintain drainage conditions, as approved by the City and City Engineer. It is essential that discharge of trench dewatering pumps be conducted to natural drainage channels, drains or storm sewers. No pipe shall be laid in any water without the City's and City Engineer's approval.

Mains shall be laid and maintained to the indicated lines with fittings, valves and hydrants at required locations. All valve and hydrant stems shall be set plumb.

Wherever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration in the plan is required, the City or the City Engineer shall have the authority to change the location from the shown line and grade.

The excavations for construction of pipelines shall be of sufficient width, and only of sufficient width to permit the work to be constructed in a workmanlike manner. Working space shall be provided in all pipe trenches to allow room all around for the proper making of joints and the drainage of water, if necessary. Sheet piling

shall be used where necessary to protect curb, walk, trees, and other utility lines. Except as otherwise specified, the excavation work for the pipes, valves and hydrants shall be performed in accordance with these Standards.

Bell holes shall be provided at each joint to permit the jointing to be made properly. The trench shall be excavated to the depth required so as to provide a uniform and continuous bearing and support for the pipe on solid and undisturbed ground at every point between bell holes, except that it will be permissible to disturb and otherwise damage the finished surface over a maximum length of eighteen (18) inches near the middle of each length of pipe by the withdrawal of pipe slings or other lifting tackle. Any part of the bottom of the trench excavated below the specified grade shall be corrected by filling with approved material, thoroughly compacted in three (3) inch layers. The finished subgrade shall be prepared accurately by means of hand tools. No blocking under pipes will be permitted except as approved by the City Engineer under special conditions.

Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, all types of refuse, vegetable or other organic material, or large pieces or fragments of inorganic material which in the judgment of the City Engineer should be removed, the Contractor shall excavate, remove and satisfactorily dispose of such unsuitable material to the width and depth ordered by the Engineer. Before the pipe is laid, the subgrade shall then be made by backfilling with approved Class I or Class II material as defined in these Standards. The fill material shall then be thoroughly compacted by means of hand or mechanical tamping to a minimum 85% Standard Proctor Density.

In event of rock excavation or where ledge rock, boulders and large stones, or hard pan, shale or cemented gravel, are encountered in the bottom of the trench, then said materials shall be removed to provide a clearance of at least six (6) inches below and on each side of all pipe, valves and fittings. The space between the rock or other hard trench bottom and the pipe shall be filled with Class I or II material and hand or mechanically tamped as explained above.

Proper implements, tools and facilities shall be provided and used by the Contractor for the safe and convenient protection of the work. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece by derrick, ropes or other suitable tools or equipment, in such a manner as to prevent damage to pipe or pipe coating. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. Before lowering and while suspended, the pipe shall be inspected for defects and rung with a light hammer to detect cracks. Any defective, damaged or unsound pipe shall be rejected. All foreign matter or dirt shall be removed from the inside of the pipe before it is lowered into its position in the trench and shall be kept clean by approved means during and after laying.

The spigot shall be centered in the bell, and the pipe brought into the true alignment and secured there with earth carefully tamped on each side, excepting at the bell holes. Care should be taken to prevent dirt from entering the joint space. At times when pipe laying is not in progress, the open ends of pipe shall

be closed by approved means, and no trench water shall be permitted to enter the pipe.

Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise directed, pipe shall be laid with bell ends facing in the direction of laying and for lines on an appreciable slope, bells shall face upgrade. Wherever necessary to deflect pipe from a straight line, either in the vertical or horizontal plane to avoid obstructions, to plumb stems, or for other reasons, the degree of deflection shall be within permissible limitations as defined by the manufacturer.

All plugs, caps, tees and bends shall be provided with restrained joints and grip rings. The restrained joints shall be of adequate strength to prevent movement, as approved by the City of the City Engineer.

All bedding and backfill material shall be placed and compacted in accordance with the applicable portions of these Standards.

B. Depth of Cover for Water Mains

All water mains shall be constructed with a nominal earth cover of sixty (60) inches over the top of the pipe except as follows:

1. For purpose of avoiding direct interference with existing structures or utilities, the City or City Engineer may authorize decreased depth of cover.
2. For the purpose of making grade changes within tolerable limits, the depth may be increased.
3. Unless otherwise shown on the plans or permitted by the City or City Engineer, the new mains shall cross beneath the existing mains, except in cases where the specified cover can be maintained by crossing above the existing mains.
4. Where connections to existing mains dictates changes in the required depth of cover.

20.5 Gate Valve and Valve Box Installation

A. Installation

Gate valves and valve boxes shall be installed per the manufacturer's recommendations.

The stem extension shall sit solidly on the valve operating nut and shall turn freely. The extension shall be bolted to the valve operating nut in a manner such that the bolt prohibits the extension from being pulled off of the operating nut but does not transmit any force from the extension to the operating nut during operation of the valve, thus prohibiting the bolt from shearing.

The extension must of such a length that the nut on the extension shall be

between thirty (30) inches and thirty-six (36) inches below the finished grade.

B. Testing

Each valve stem extension shall be tested by closing the valve, reducing the pressure on one (1) side of the valve to zero (0), then opening the valve with the use of the extension. Any permanent distortion or damage to the valve stem extension is unacceptable.

20.6 Hydrant Installation

Hydrant barrels shall be constructed in such a manner that it is not necessary to cut off the water or to excavate to make repairs. The barrel of the hydrants shall be constructed in sections which are to be jointed in such a manner that the upper section of the barrel extending above the ground may be separated from the lower section by impact without injury to the stem or the barrel.

Hydrants shall be located in such a manner as to provide complete accessibility, and in such a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized. When set in the space between the curb or sidewalk or between the sidewalk and property line, no portion of the hydrant or nozzle cap shall be within six (6) inches of the sidewalk. All hydrants shall stand plumb and shall have their nozzles parallel or at right angles to the curb. They shall conform to the established grade, with nozzles at least twelve (12) inches above the ground.

Hydrants shall be thoroughly cleaned of dirt and other foreign matter before setting, and the hydrant shall be suitably anchored with a hydrant adapter. Said adapter shall be at least twenty-four (24) inches in length. All hydrants are to be properly supported and braced and surrounded with approximately five (5) cubic feet of washed gravel.

20.7 Service Meter Enclosure Installation

Enclosure shall be set vertically on a base of clean, washed gravel a minimum of one (1) foot deep and twelve (12) inches beyond outside of enclosure. Backfill shall be tamped in six (6) inch layers all around enclosures in excavated area to maintain stability and prevent settlement. Meter enclosure locations shall be as determined by the Developer/Contractor and approved by the City or City Engineer. Generally, meters shall be placed in lawns as near as possible to dedicated right-of-way lines.

SECTION 21

WATER PROJECT INSTALLATION, TESTING & ACCEPTANCE

SECTION 21

WATER PROJECT INSPECTION, TESTING AND ACCEPTANCE

21.1 General

This section describes the minimum requirement and general procedures for the inspection, testing and acceptance of systems dedicated to the City of Monticello.

Connection permits for utility service will not be issued until all the requirements of this section are fulfilled.

21.2 Inspection

Inspection of the construction shall occur for the duration of the project, including the installation of service connections. Inspection fees shall be as set forth in **Section 3**.

A. General Requirements

1. Contractor and/or Owner shall provide notice to the City and his representative of the planned commencement of construction thirty (30) days prior to such commencement.
2. Once the construction starts, the Contractor shall be responsible for informing and/or notifying the inspection representative assigned of the following [NOTE: The City may require as much as five (5) working days' notice to provide inspection services during construction.]:
 - a. Daily work schedule, including any changes in schedule;
 - b. Prior notification if work is to be performed on weekends and/or holidays;
 - c. Date tests are to be performed; and
 - d. Date as-built verification is to be performed.
3. The City, upon request of the Contractor and/or Owner, will schedule the Final Inspection.

All testing required shall be paid for by the Contractor and performed under the observation of the City or City's representative. It shall be the Contractor's responsibility to schedule the testing with the City representative and/or City. Test results obtained in the absence of the presence of the City will not be accepted.

21.3 Water Main Testing and Disinfection

A. General

After the pipe has been laid and backfilled, all newly laid pipe or any valved sections of it shall, unless otherwise expressly specified, be subjected to a hydrostatic pressure test. The duration of each pressure test shall be for a period of not less than two hours and not more than six hours. The basic provisions of AWWA C-600, **Section 4** shall be followed for all pressure testing.

The test pressure shall not exceed pipe and/or thrust resistant design pressures. The test pressure shall not vary by more than plus or minus five (5) psi for the duration of the test.

All newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing or fifty (50) psig whichever is greater.

B. Pressurization

Each valved section of pipe shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the City/City Engineer. The pump pipe connection and all necessary apparatus, including gauges and meters shall be furnished by the Contractor. Before applying the specified test pressure, air shall be expelled completely from the test section. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at all points so that the air can be expelled as the section is filled with water. After all the air has been expelled, the corporation cocks shall be closed, and the test pressure applied. At the conclusion of the pressure test the corporation cocks shall be removed and plugged or left in place at the direction of the City/City Engineer.

Any exposed pipe, fittings, valves, hydrants and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, hydrants or joints that are discovered following the pressure test shall be repaired or replaced with sound material approved by the City/City Engineer and the test shall be repeated until it is satisfactory to the City/City Engineer.

C. Leakage Test

After the completion of the pressure test a leakage test shall be conducted to determine the quantity of water lost by leakage under the specified test pressure. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled.

Leakage shall not be measured by a drop-in pressure in a test section over a

period of time.

No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = SD \sqrt{P/133,200}$$

Where:

L = allowable leakage, in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in pounds per square inch (gauge)

D. Acceptance

Acceptance shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than that specified, the Developer/Contractor shall at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance.

All visible leaks are to be repaired regardless of the amount of leakage. All flanged pipe shall be "bottle-tight".

If the section under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

E. Chlorination of Water Mains

1. Chlorination of New Water Mains

Before being placed in service, all new water distribution systems, or extensions to existing systems, or any valved section of such shall be chlorinated. Prior to chlorination, all dirt remaining in the pipe after completion shall be removed by a thorough flushing through the hydrants, where available, otherwise through other approved temporary connections to be provided by the Developer/Contractor for the purpose. This shall be done after the pressure test and may be done either before or after the trench has been backfilled. Each valved section of newly laid pipe shall be flushed independently. The flushing velocity shall be not less than 2.5 feet per second through the completed new main.

A chlorine gas-water mixture shall be applied by means of a solution feed chlorinating device or where approved by the City/City Engineer a solution of calcium hypochlorite (H.T.H.) or Perchloron may be injected under low pressure.

The preferable point of application of the chlorinating agent shall be at the beginning of the pipeline extension, or any valved section of pipe, and through a corporation stop inserted in the side of the newly laid pipe. The water injector for delivering the gas-water or calcium hypochlorite mixture

into the pipe shall be supplied from a tap on the upstream side of the valve controlling the flow into the pipeline extensions.

Water from the existing distribution system or any completed extension of the system, entering the newly laid pipeline, shall be controlled to flow very slowly during the application of chlorine. The rate of chlorine gas-water mixture or calcium hypochlorite solution flow shall be in such proportion to the rate of water entering the pipe that the treated water flowing from the far end of the main contains at least forty to fifty (40 - 50) parts per million of chlorine residual. Back pressure, causing a reversal of flow in the pipe being treated shall be prevented. The chlorine solution shall remain in the pipe for at least twenty-four (24) hours. After the chlorine treated water has been retained for the required time, the chlorine residual at pipe extremities and at representative points shall be at least ten (10) parts per million. In the process of chlorinating newly laid water pipe involving more than one (1) valved section, all valves or other appurtenances shall be operated while the pipeline is filled with the chlorinating agent.

Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipeline at the extremities until the replacement water throughout the length shall, upon test, be proved comparable in quality to the water served the public from the existing water supply system. Samples of the water for tests shall be taken by or under the direction of the City and in accordance with methods of sampling as recommended by the State Board of Health. The bacteriological tests shall be performed by the State Board of Health Laboratory or by a testing laboratory which is approved for bacteriological testing by the State Board of Health. The City's representative will send the samples to the State Laboratory, unless otherwise directed by the City.

At least two (2) sets of successive satisfactory bacteriological samples taken at twenty-four (24) hour intervals shall be obtained from the newly laid pipelines and equipment before water is discharged through them to the existing system. The new piping shall be lightly flushed a second time prior to taking the second sample. Should the test of the second or last taken sample prove ineffective, the chlorination procedure shall be repeated until confirmed tests show that water sampled from the newly laid pipe conforms to the requirement stated above.

When the bacteriological tests of the samples of water taken from the new mains prove to be satisfactory and before the new mains are placed in service, the City shall increase the chlorine dosage of the water being delivered to the entire distribution system as specified herein under the heading of "City's Responsibility for Temporary Step-up of System Chlorination".

2. Reconnection of Services

The reconnection of existing building services from existing water mains to new mains shall not be made until the water in the newly constructed mains has been disinfected and satisfactorily tested as specified herein under the heading of "Chlorination of New Water Mains".

3. Chlorination Procedure When Cutting into Existing Mains

Under ideal trench and installation conditions with full time inspection by the City, the Developer/Contractor may be permitted to make cuts into existing pipe lines for the insertion of valves, fittings, repairs or for other purposes by the following procedure of disinfection: Sprinkle the inside surfaces of the appurtenances to be installed with a dry hypochlorite (or apply a hypochlorite slurry) and place a small quantity of the hypochlorite powder into the ends of the existing pipe on either side of the opening before the new pipe and fittings are installed.

At the discretion of the City Engineer or the City and/or when the trench and installation conditions are not ideal for making the cuts into existing mains, the Developer/Contractor shall introduce the solution of chlorine or the suspension of hypochlorite into the isolated or valved-off sections of mains through a tap in the main to be made for this special purpose or through a fire hydrant when one is available in a suitable location.

In either of the two (2) above procedures, the chlorine introduced should be in sufficient amount to ensure a high concentration, forty to fifty (40 - 50) parts per million, reaching every part of the isolated section of mains. The maximum permissible contact period shall be used after which the water bearing strong chlorine solution shall be flushed out of the isolated section of mains before they are returned to service.

The Developer/Contractor shall schedule the making of all of the project cut-in connections to existing mains as close together, timewise, as is feasible. He shall notify the Water Works Superintendent at least seventy-two (72) hours in advance, so arrangements can be made for inspection of the work and so the City can step up the system chlorination and notify the affected water customers.

All water customers who will be affected by the isolated section of mains for the purpose of making the cut-in connections and disinfection are to be given advance notification by the Water Works Department through the local newspaper or by personal notice to each customer.

4. City's Responsibility for Temporary Step-Up of System Chlorination

At least eight (8) hours prior to the making of cuts into existing pipe lines for the insertion of valves, fittings, repairs and the connection of new mains to existing mains and prior to the placing of newly constructed

water mains into service, the City will increase the chlorine dosage of the water supply to the system to effect a free chlorine residual of at least 0.5 ppm, or a combined available chlorine residual of at least 1.0 ppm. The said chlorine residual shall be maintained by the City for a sufficient period of time to establish a record of satisfactory bacteriological quality of the water throughout the distribution system. After at least two (2) successive sets of satisfactory bacteriological samples of water have been taken from the system at approximate twenty-four (24) hour intervals, the stepped-up chlorination may be cut back to the normal dosage.

21.4 Fire Hydrant Testing

Hydrants shall be flushed, and flow/pressure tested after installation. Contractor shall submit test results to City utilizing City Fire Hydrant Data Sheet.

21.5 Documentation, Dedication and Acceptance Procedures

A. Documentation Requirements

In order for the City Council to accept dedicated facilities, the following items shall be completed and on file:

1. Copies of all testing reports and data;
2. Copies of all O&M Manuals (if applicable);
3. Pump manufacturer's certification letter (if applicable);
4. Final payment for inspection services;
5. Service line location forms;
6. As-built drawings;
7. Performance and/or maintenance bonds (if required);
8. Daily inspection reports;
9. Legal description of the land to be dedicated to the City; and
10. A written statement of facilities present on those lands. The written statement shall include:
 - a. Identification of the type and nature of facilities present
 - b. Dimensions of the facilities present
 - c. Totals for each type of facility present [example: one thousand (1,000) feet of water main, thirty-four (34) service connection, one (1) booster station, etc.]

B. Dedication

The City shall review the above-mentioned requirements and prepare a

document stating that the work has been completed, the requirements have been met, and all items are in proper form. The City shall include in the statement a recommendation on acceptance/denial of the facilities and may also include comments regarding the project. The City shall present to the City Council its findings in a public hearing for their consideration.

C. Acceptance

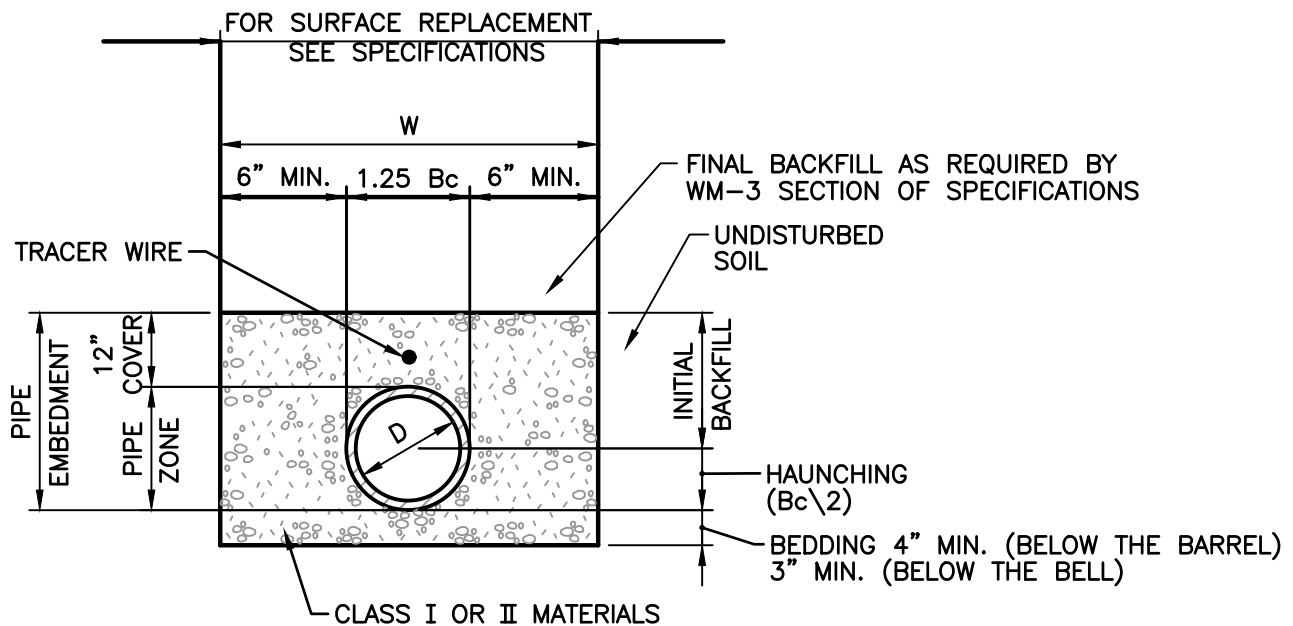
The City Council shall receive the recommendation from the City representative, and upon review by the City Attorney and Mayor, shall make a determination as to acceptance of the facilities. A majority approval of the Council members present at the meeting is required for acceptance. The City Council shall accept dedicated facilities by resolution.

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WATER PROJECT STANDARD DETAILS

WATER SYSTEM STANDARD DETAILS TABLE OF CONTENTS

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Water Service Line Jack and Bore Detail.....	W-9



W = MAXIMUM ALLOWABLE TRENCH WIDTH FOR PIPE AS PER ASTM
NOT TO EXCEED FOUR (4) FEET FOR 6" THROUGH 24" PIPE
NOR SIX (6) FEET FOR 27" THROUGH 48" PIPE

D = PIPE DIAMETER (INTERNAL)
B_c = PIPE DIAMETER (EXTERNAL)

NOTES:

1. COMPACTED BEDDING STOPS AT A POINT 12" ABOVE THE TOP OF PIPE. BACKFILLING ABOVE THIS POINT SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS AND AS REQUIRED BY NOTE 3 BELOW.
2. WHEN CLASS I MATERIAL IS USED FOR BEDDING, COMPACTION MAY BE ACCOMPLISHED BY HAND OR MECHANICAL TAMPING OR BY "WALKING" THE MATERIAL IN.
3. WHEN CLASS II MATERIAL IS USED FOR BEDDING, COMPACTION SHALL BE ACCOMPLISHED ONLY BY HAND OR MECHANICAL TAMPING TO A MINIMUM OF 85% STANDARD PROCTOR DENSITY.
4. WORK FALLING UNDER THE JURISDICTION OF THE INDIANA DEPARTMENT OF TRANSPORTATION (INDOT) SHALL UTILIZE COMPACTED GRANULAR BACKFILL MATERIAL FOR INITIAL AND FINAL BACKFILL ANYWHERE WITHIN 12 FEET OF THE EDGE OF PAVEMENT. FOR ALL OTHER NON-INDOT PAVEMENT AREAS (INCLUDING BOTH HARD SURFACED AND COMPACTED AGGREGATE), COMPACTED GRANULAR BACKFILL MATERIAL SHALL BE USED WITHIN 5 FEET OF THE EDGE OF THE PAVEMENT.

**FIRST CLASS PIPE LAYING METHOD, RIGID
CONDUITS (DUCTILE IRON) IN PAVEMENT AREAS**

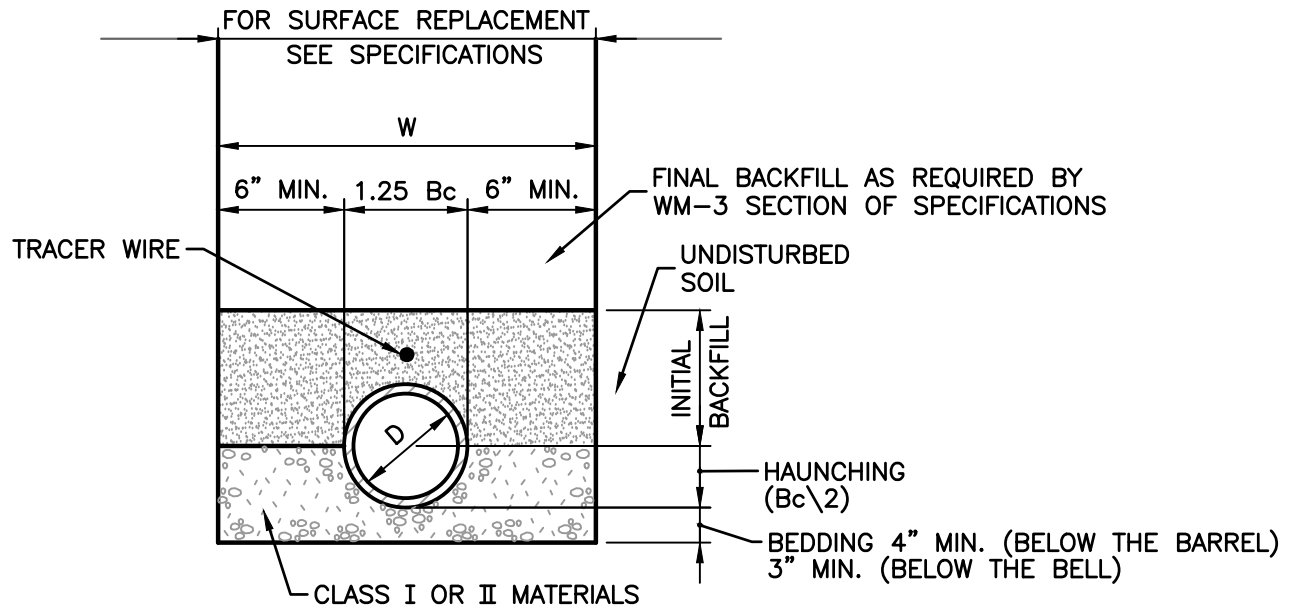
REVISION DATE

**CITY of MONTICELLO, INDIANA
STANDARD DETAILS
SANITARY SEWER**

FIGURE

W-1

DATE: AUGUST 2019



W = MAXIMUM ALLOWABLE TRENCH WIDTH FOR PIPE AS PER ASTM
NOT TO EXCEED FOUR (4) FEET FOR 6" THROUGH 24" PIPE
NOR SIX (6) FEET FOR 27" THROUGH 48" PIPE

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FIRST CLASS PIPE LAYING METHOD, RIGID CONDUITS (DUCTILE IRON) IN NON-PAVEMENT AREAS

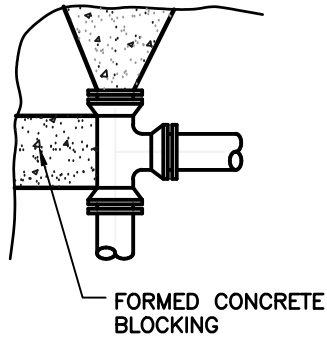
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CITY of MONTICELLO, INDIANA STANDARD DETAILS SANITARY SEWER

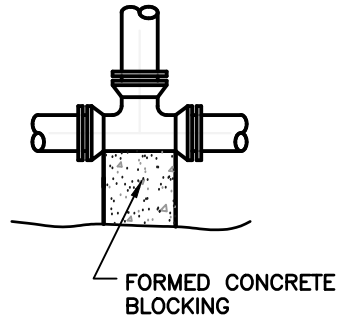
FIGURE

W-2

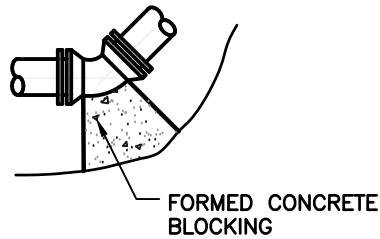
DATE: AUGUST 2019



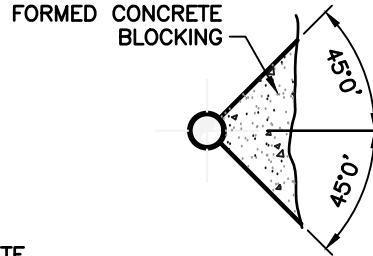
DETAIL A



DETAIL B



DETAIL C



TYP. PROFILE

TABLE OF DIMENSION FOR CONCRETE BLOCKING

SIZE	TEE				PLUG					90° BEND				45° BEND				22½° BEND				11½° BEND			
PIPE	L	T	W	D	L	T	W	D	s	L	T	W	D	L	T	W	D	L	T	W	D	L	T	W	D
4"	18"	12"	12"	8"	18"	12"	18"	18"	2"	24"	12"	24"	8"	18"	8"	12"	8"	18"	8"	12"	8"	15"	8"	12"	6"
6"	18"	12"	12"	8"	18"	12"	18"	18"	2"	24"	15"	24"	8"	18"	10"	12"	8"	18"	10"	12"	8"	18"	10"	18"	6"
8"	30"	12"	24"	8"	30"	18"	30"	24"	4"	36"	16"	30"	8"	24"	12"	18"	8"	24"	18"	18"	8"	24"	12"	18"	8"
10"	36"	18"	30"	10"	36"	18"	36"	24"	4"	48"	20"	36"	10"	30"	14"	24"	10"	30"	14"	24"	10"	24"	14"	18"	8"
12"	48"	18"	36"	10"	42"	18"	42"	24"	4"	54"	24"	48"	10"	36"	16"	30"	10"	36"	16"	30"	10"	30"	16"	24"	10"
14"	54"	24"	42"	12"	48"	18"	48"	30"	6"	60"	28"	60"	12"	42"	16"	42"	12"	42"	16"	42"	12"	33"	16"	27"	12"
16"	60"	24"	48"	12"	54"	18"	54"	30"	6"	66"	32"	63"	12"	48"	18"	48"	12"	48"	18"	48"	12"	36"	18"	30"	12"
18"	66"	30"	54"	14"	60"	24"	60"	36"	6"	66"	36"	66"	14"	54"	18"	54"	14"	54"	18"	54"	14"	39"	18"	33"	14"
20"	72"	30"	60"	14"	66"	24"	66"	36"	8"	72"	40"	69"	14"	60"	20"	60"	14"	60"	20"	60"	14"	42"	20"	36"	14"
24"	84"	36"	72"	18"	78"	30"	78"	42"	8"	84"	48"	75"	18"	72"	22"	72"	18"	72"	22"	72"	18"	48"	22"	42"	18"

NOTES:

1. FOR TEE WITH BRANCH UNEQUAL TO RUN USE TEE TYPE KICKER WITH D, L, AND W DIMENSIONS THE SAME AS THOSE FOR PLUG WITH SAME DIAMETER AS BRANCH OF TEE, SELECT "T" DIMENSIONS FROM TEE TABLE UNDER COLUMN HEADED BY THE SIZE OF THE BRANCH.
2. IF EXACT SIZE PIPE BLOCKING IS NOT SHOWN USE NEXT LARGER SIZE.
3. DEPTH "D" MAY BE GREATER THAN SPECIFIED TO ALLOW WORKING SPACE. BLOCKING MUST BE PLACED AGAINST UNDISTURBED EARTH OR ROCK.

THRUST BLOCKING DETAILS FOR WATER MAIN

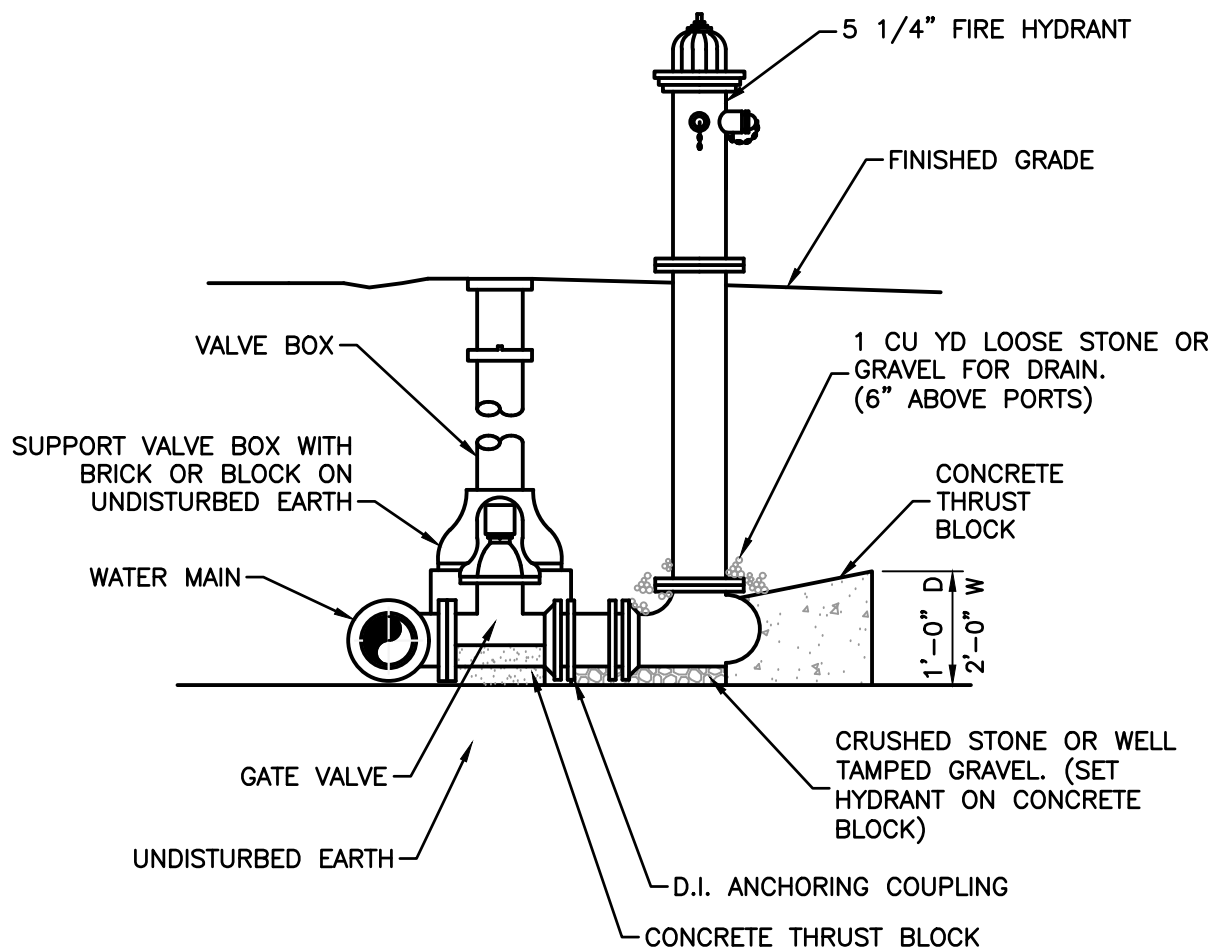
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**CITY of MONTICELLO, INDIANA
STANDARD DETAILS
SANITARY SEWER**

FIGURE

W-3

DATE: AUGUST 2019



HYDRANT DETAIL

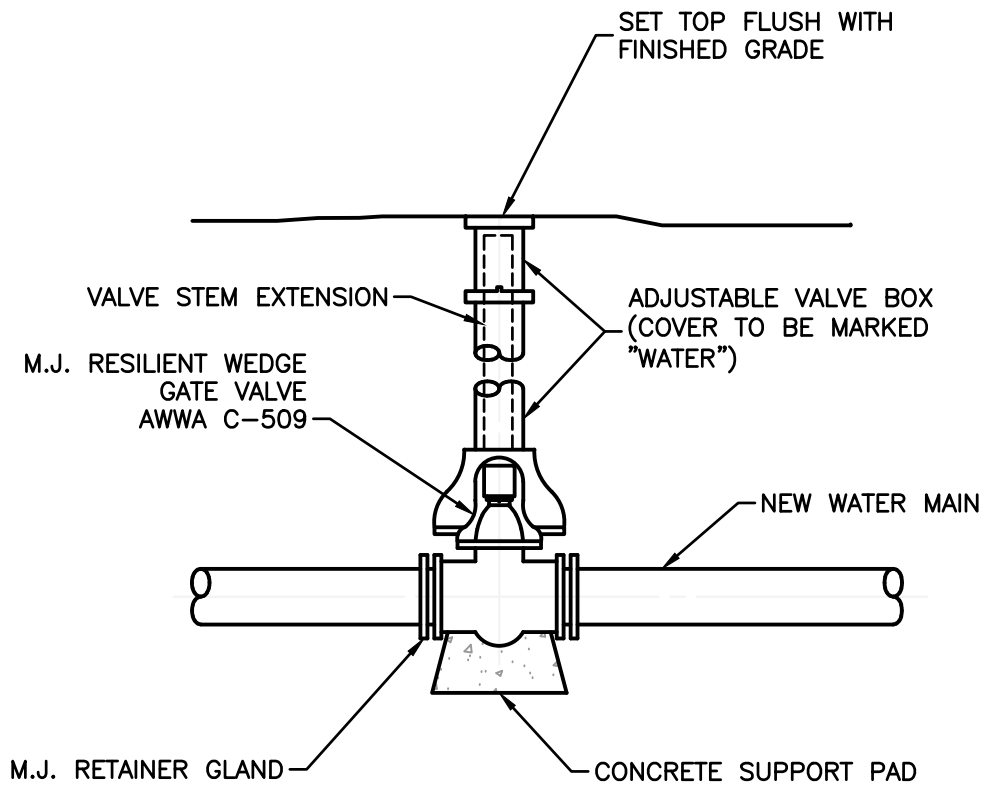
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CITY of MONTICELLO, INDIANA
STANDARD DETAILS
SANITARY SEWER

FIGURE

W-4

DATE: AUGUST 2019



THRUST BLOCKING DETAILS FOR WATER MAIN

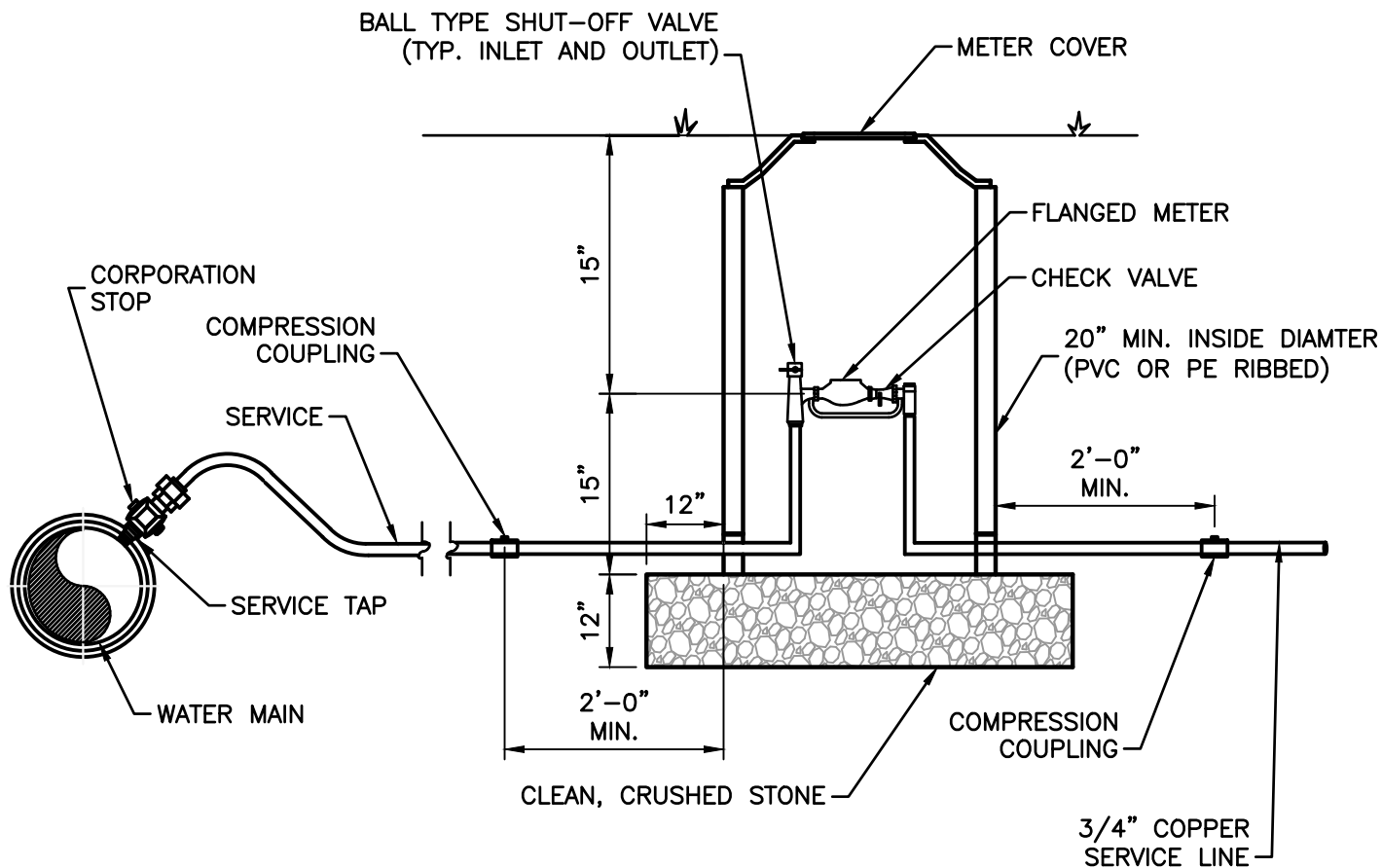
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CITY of MONTICELLO, INDIANA STANDARD DETAILS SANITARY SEWER

FIGURE

W-3

DATE: AUGUST 2019



RESIDENTIAL METER/SERVICE INSTALLATION

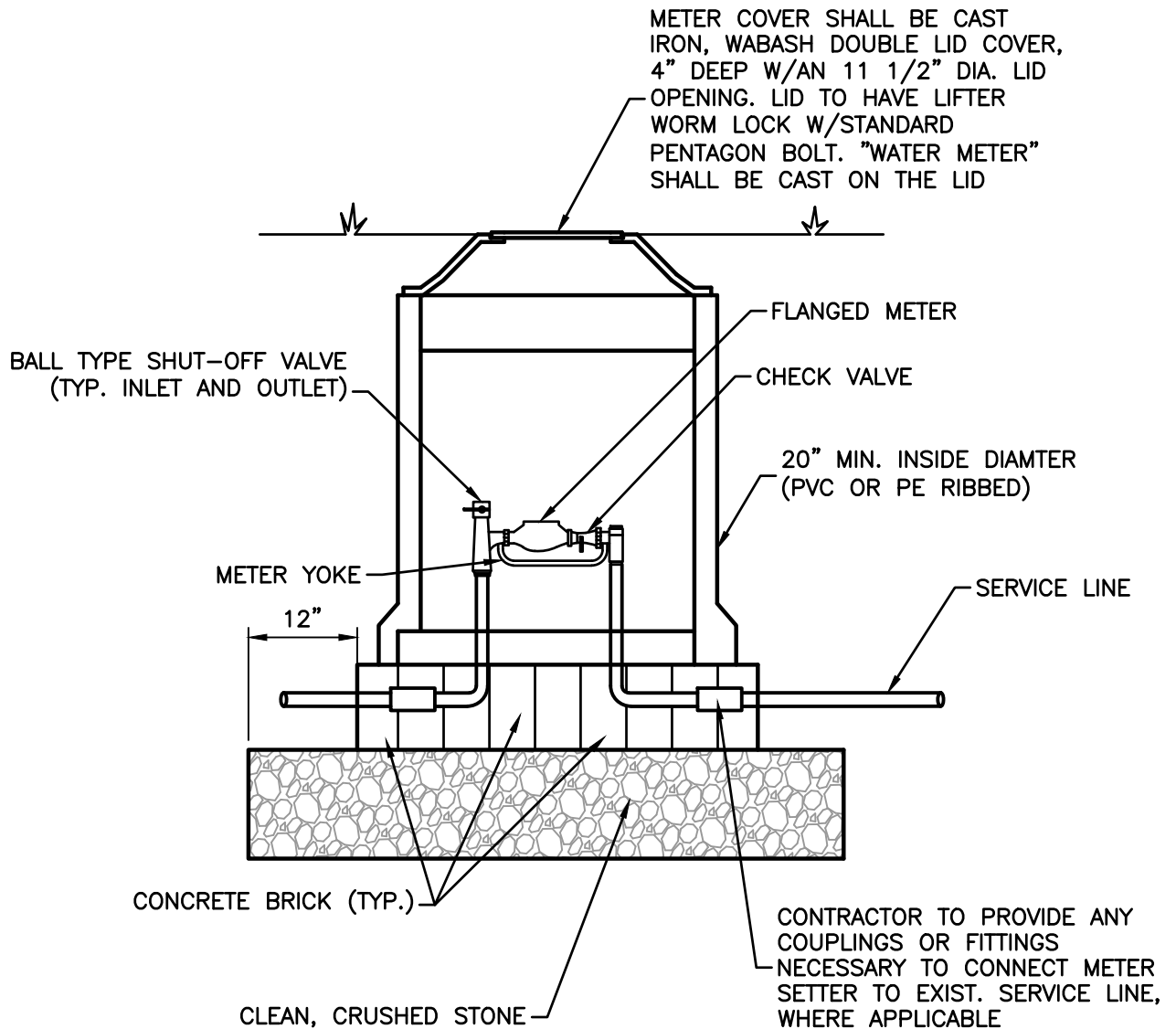
REVISION DATE

DATE: AUGUST 2019

CITY of MONTICELLO, INDIANA STANDARD DETAILS SANITARY SEWER

FIGURE

W-6



METER INSTALLATION 3/4" AND 1" SERVICE

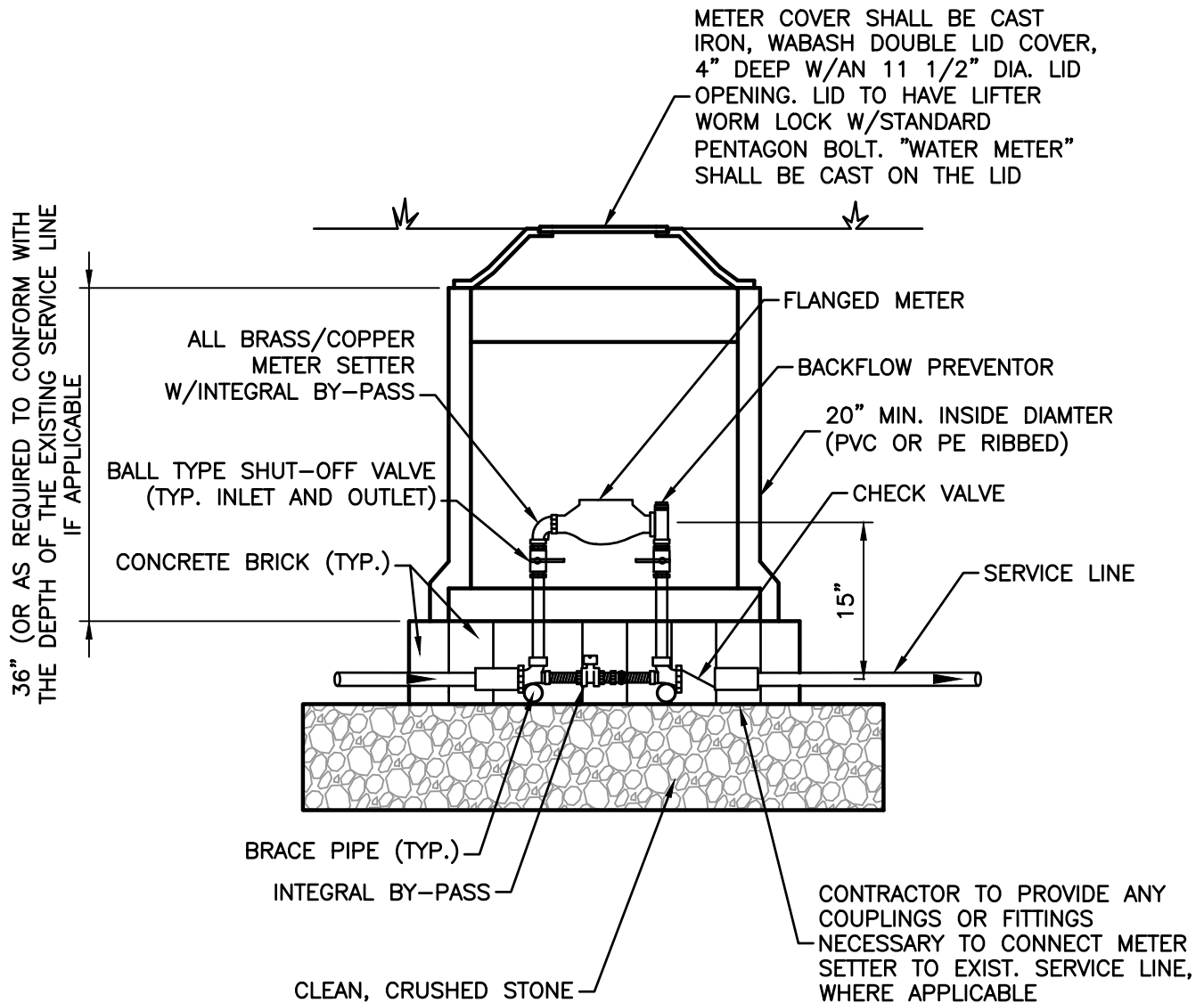
CITY of MONTICELLO, INDIANA STANDARD DETAILS SANITARY SEWER

FIGURE

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REVISION DATE

DATE: AUGUST 2019



COMMERCIAL METER INSTALLATION
1.5" SIZE OR GREATER

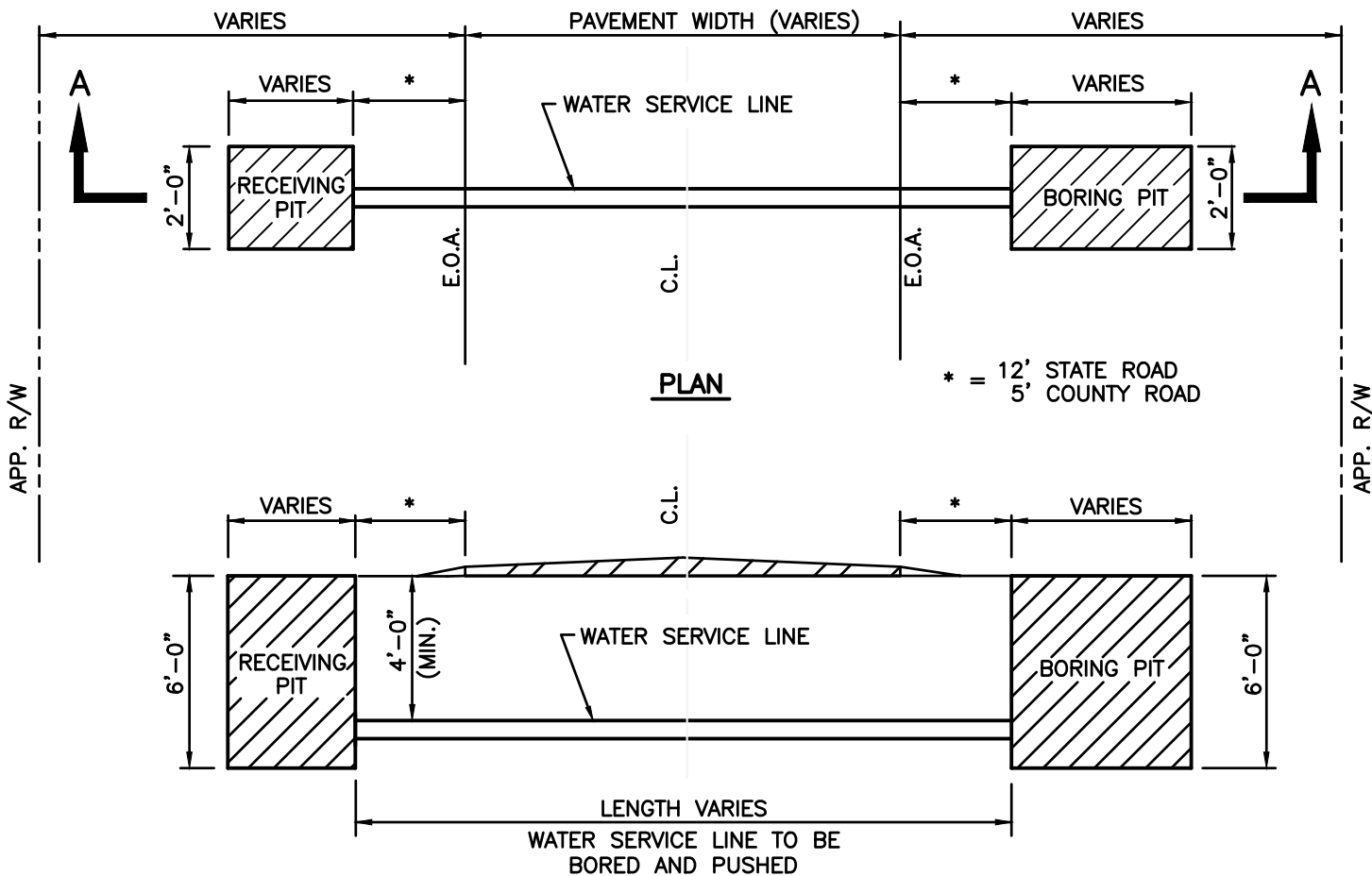
CITY of MONTICELLO, INDIANA
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FIGURE

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WATER SERVICE LINE JACK AND BORE DETAIL

REVISION DATE

CITY of MONTICELLO, INDIANA STANDARD DETAILS SANITARY SEWER

FIGURE

W-9

DATE: AUGUST 2019

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SECTION 22

PUBLIC STREETS & ALLEYS DESIGN STANDARDS & DETAILS

SECTION 22

PUBLIC STREETS AND ALLEYS DESIGN STANDARDS AND DETAILS

22.1 General

The City and City Engineer shall issue final approval for the installation of all public streets. All streets shall be designed and installed in accordance with these Standards as well as applicable State and Federal regulations.

22.2 Street and Alley Design Criteria

A. General

All streets, intersections, driveways, curbs and sidewalks shall be designed and constructed in accordance with these Standards and in accordance with local ordinances, County requirements, and State and Federal regulations.

Where no Standards exist for a particular item of work, the latest edition of the Indiana Department of Transportation Standards and Standard Specifications shall apply. All new construction and replacement work shall be constructed in compliance with the latest versions of the U.S. Architectural and Transportation Barriers Compliance Board's ADA Standards/Guidelines and the Dept. of Justice's ADA Standards for accessible design.

B. Street Standards

The City of Monticello shall not approve any plat unless all streets shown on it shall be of sufficient width and proper grade and shall be so located as to accommodate the probable volume of traffic thereon, provide access of firefighting equipment to buildings, and provide a coordinated system of streets.

1. All streets and alleys to be accepted by the City of Monticello into their street and alley system shall be placed in a dedicated right-of-way. Said rights-of-way shall be under the exclusive control of the City of Monticello.
2. Local streets shall be so planned as to discourage through traffic.
3. Wherever there exists a dedicated or platted portion of a street or alley along a boundary of the tract being subdivided, the remainder of that street or alley, to the prescribed width, shall be platted within the proposed subdivision.
4. Half streets shall not be provided, except where it is essential to the reasonable development of the subdivision in conformity the other requirements of these regulations, or where it becomes necessary to acquire the remaining half by condemnation so it may be approved in the public interest

5. Cul-de-sacs shall not be longer than five hundred (500) feet, including a turnaround which shall be provided at the closed end with an outside curb radius of at least thirty-eight (38) feet and a right-of-way radius of not less than fifty (50) feet. The maximum grade of the turnaround portion of the cul-de-sac shall be five (5) percent.
6. Alleys shall not be provided in residential districts but shall be included in commercial and industrial areas where needed for loading and unloading or access purposes.
7. The minimum distance between centerlines of parallel or approximately parallel streets intersecting a cross street from opposite directions shall be one hundred twenty-five (125) feet unless it is an in-line street intersection.
8. Intersections of more than two (2) streets at one point shall be avoided.
9. Temporary dead-end streets may be permitted where the approved preliminary plat shows that the street will be extended to conform to the provisions of these Standards, or to provide access to adjacent property where deemed necessary by the City of Monticello to provide for an adequate flow of future traffic, provided the length of that dead-end street shall not be greater than four hundred twenty (420) feet. A circular right-of-way in excess of the required street right-of-way at the terminus of the temporary dead-end street shall not be required.
10. City of Monticello may increase right-of-way requirements if it determines an increase to be required due to anticipated traffic flow or if drainage easements should reasonably parallel those thoroughfares.
11. Paving widths, and curb specifications, if curbs are required to be installed, shall be determined by the City of Monticello based upon factors, among others, of the overall design concept of the proposed subdivision, traffic patterns and densities, the availability of on or off-street parking, and those standards as adopted by the State and Local authorities. Minimum standards shall be in accordance with **Table 22-1**.
12. Subgrades may be stabilized by optional methods; however, the Developer/Contractor's Engineer shall first obtain the services of a licensed geotechnical engineer or geologist to recommend such a method. In any event, soil stabilization must be acceptable to the City prior to acceptance of the design.

**Table 22-1
Minimum Standards for Street Design**

Design Item	Street Classification			
	Alley	Minor/ Local	Secondary/ Collector	Primary/ Arterial
Horizontal Elements				
Pavement Width	18'	24'	30'	36'
Right-of-Way	30'	50'	60'	60'
Cul-de-Sac Curb Radius	N/A	38'	N/A	N/A
Cul-de-Sac Right-of-Way Radius	N/A	50'	N/A	N/A
Normal Crown	¼" per ft.	¼" per ft.	¼" per ft.	¼" per ft.
Maximum Longitudinal Grades	7%	7%	5%	5%
Minimum Longitudinal Grades	0.5%	0.5%	0.5%	0.5%
Design Speeds (Miles Per Hour)	20 MPH	20 MPH	30 MPH	35 MPH
Horizontal Curve Radius	150'	150'	200'	200'
Tangent Between Reversed Curves	150'	125'	125'	125'
Curb Return Radius	20'	25'	25'	30'
Minimum Angle of Intersection	75°	75°	75°	75°
Minimum Street Jog	150'	150'	150'	150'
Width of Sidewalks	5'	5'	5'	5'
Width of Drives		10'	N/A	N/A
Vertical Elements				
Stopping Sight Distance	125'	125'	200'	300'
Min. Length of Vertical Curve	[11]	[2]	[2]	[2]
Concrete Pavement ^[3]	6"	6"	7"	8"
a. Compacted Stone, #53	6"	6"	6"	6"
Bituminous Pavement ^[12]				
a. H.A.C. Surface, #11LV or #12LV	1.5"	1.5"	1.5"	1.5"
b. H.A.C. Binder, #9LV or #11LV	3"	3"	2½"	2½"
c. H.A.C. Base, #5LV	—	—	4"	6"
d. Compacted Stone, #53 ^[13]	10"	10"	8"	8"
Concrete Curb	N/A	Straight	Straight	Straight

[1] Use AASHTO Formula based upon algebraic difference and by design speed. Minimum 40' required.

[2] Engineer shall confirm pavement design using AASHTO Guide to Design of Pavement Structures, latest edition.

[3] May be reduced to 6" in trench construction limits where granular or better backfill is used.

C. Storm Drainage Standards

1. If the area proposed to be platted is located with regard to an adequate public storm sewer system so that storm sewers can be provided, then adequate lateral and connecting installations to it from all portions of that area proposed to be platted shall be constructed and installed in accordance with the plans and specifications submitted by the Developer/Contractor.
2. If the area proposed to be platted is not located with regard to an adequate public storm sewer system, then all open ditches within the area proposed to be platted shall be graded and all pipes, culverts, intersectional drains, drop inlets, bridges, headwalls, and similar or related installations necessary to provide adequate surface water drainage of that area proposed to be platted, shall be designed, constructed and installed in accordance with these Standards and the plans and specifications submitted by the applicant.
3. Drainage ditches or channels shall have a minimum gradient of 0.25 percent. This shall also apply to paved channels.
4. Streets not having curb and gutter, if approved by City, shall provide the following:
 - a. Side ditch swales measuring a minimum of eighteen (18) inches deep from the edge of the pavement with side slopes no steeper than 3:1 and at a point five (5) feet inside the right-of-way line.
 - b. A minimum twelve (12) inch diameter culvert pipe at all driveways. Culverts to be sized according to amount of storm water flow. All culverts shall be corrugated metal pipe. Any exceptions must be approved, in writing, by the City or City Engineer.
 - c. Culverts under the roadway as required and shown on the street improvement plans. Culverts to be sized by the Developer/Contractor through his Engineer and approved by the City according to amount of storm water flow (12-inch diameter minimum). All culverts shall extend at least five (5) feet beyond either edge of the paved roadway.
 - d. Relief of side ditches and swales along roadway through the use of off-street retention basins or existing County drainage channels. Storm water retention using the roadside ditches will not be accepted.
 - e. The Developer/Contractor shall provide an adequate storm water sewer system whenever the evidence available to the City indicates the natural surface drainage is inadequate. When the surface drainage is adequate, easement for such drainage shall be provided

D. Sidewalk Standards

Concrete sidewalks shall be installed along both sides of each newly constructed street unless a waiver is obtained from the City on a case-by-case basis. Generally, the sidewalks shall be constructed one (1) foot from the property line of lots and at intersections along that line as extended.

Concrete sidewalks shall be a minimum of five (5) feet wide and four (4) inches thick with a minimum of four (4) inches of compacted aggregate. At driveway crossings, the pavement shall be a minimum of six (6) inches thick with eight (8) inches of compacted aggregate. Sidewalks shall not have a cross slope of greater than two (2) percent (1/4":1') and driveways shall be adjusted to match the cross slope of the sidewalk. Concrete materials, aggregate base, and reinforcing wire fabric, along with installation requirements, shall conform to the latest INDOT Standards and Specifications.

Ramps for the handicapped shall be ADA compliant in that they will be constructed in the curb, gutter and sidewalk construction at all intersections and as required by and in conformance with all local, state, and federal laws.

E. Drive Entrance Standards

1. General

Drive entrances shall be classified as residential or commercial which shall meet the following minimum standards. All driveway entrances/approaches shall be constructed concrete from the edge of the existing street pavement to the right-of-way line. Care shall be taken to provide a smooth transition where the end of the drive abuts the edges of the existing road.

All drive entrances, whether classified as residential or commercial, shall have the concrete surface in place, from the edge of the existing street pavement to the right-of-way line and shall be equipped with wire reinforcement prior to the issuance of a Certificate of Occupancy for any structure constructed on the parcel of land.

2. Residential Drives

Residential drives shall be designed and constructed on minor (local) streets only and shall be a minimum of ten (10) feet in width. Drive shall be flared or radiused to the street. Minimum drive width at the street shall be eighteen (18) feet. Radius (if used) of the drive entrance shall be ten (10) feet. Drive entrance shall be a maximum of ten (10) percent slope at the streets. The slope at the sidewalk (if provided) shall be one quarter (1/4) inch per foot. Curbs, if provided, shall be depressed at the full width of the entrance.

3. Commercial Drives

Commercial drives shall be designed and constructed on secondary (collector) streets and primary (arterial) streets as approved by the City. Commercial drives shall be a minimum of twenty-four (24) feet in width with ten (10) foot minimum radius approach at the street. Drive entrance shall be a maximum of ten (10) percent slope at the street. Curbs shall be depressed at the full width of the entrance using a one (1) inch high "lip" curb and gutter section when straight curbs are used.

F. Curb Standards

Curb shall be either straight type or combined curb and gutter as stated herein or as approved by the City.

G. Street Identification

Street name signs as approved by the City shall be provided at each intersection by the Developer/Contractor. Signs shall be uniform of a design to match the current street signs in the City of Monticello.

H. Street Lighting

1. Streetlights are required in the City. The developer/designer shall submit a lighting plan which, as a minimum, shall include the following:

- a. A plan with typical cross sections showing buildings, landscaping, parking areas and the locations of all proposed exterior lighting fixtures, with designations of cutoff and/or shielded fixtures. The location of all service points(s), conduits, conduit types and depths, junction boxes, transformers, and conductor sizes and types shall also be shown.
- b. A description of the outdoor light fixtures which may include, but is not limited to manufacturer's catalog cuts, photometric report with light intensity distribution, drawings, and shielding information.
- c. Analysis and luminance level diagrams showing that the proposed installation conforms to the lighting level standards required by the City.

The lighting plan shall be approved by the City prior to ordering and/or installing any street lighting fixtures and/or equipment.

2. Unless streetlight fixtures of a particular period or architectural style are used, all new, repaired or replaced street lighting, whether public or private, shall utilize full cutoff, non-corrosive metal fixtures. If streetlight fixtures of a particular period or architectural style are use, then all such fixtures shall also be made of non-corrosive metal (unless a waiver is obtained from the City) and meet the Illuminating Engineering Society of North America (IESNA) criteria for cutoff fixtures.

3. There are two City approved options for lighting poles:
 - a. The larger shall be twenty-five (25) feet in length with a twenty (20) inch diameter. The pole shall be a taper fluted aluminum tube with 0.188" wall alloy 6063-T6 with sixteen (16) flutes, and 0.14/ft taper. There shall be a Duplex GFCI receptacle with in-use cover 2'-6" from the base. The larger pole option also requires a receptacle seven (7) feet from the top of the pole. See Figure PS-30 for reference.
 - b. The smaller pole option shall be fourteen (14) feet in length with a seventeen (17) inch diameter. The pole shall be a tapered fluted aluminum tube of 0.125" wall alloy, 6063-T6 with sixteen (16) fluted, 0.11"/ft taper. There shall be a Duplex GFCI receptacle with in-use cover two (2) feet from the base. See Figure PS-31 for reference.
 - c. At the base of either pole option, there shall be a cast aluminum decorative pedestal base, alloy 256-T6, with door and stainless-steel screws. The base of either pole option shall consist of a decorative pedestal with door and stainless-steel screws. The adaptor connecting either pole to the light shall have a cast alum adaptor with 2 1/2" diameter Sch. 40 Alum pipe tenon three (3) inch in length.
3. INDOT lighting specifications and standards shall be applied to all streets, alleys, rights-of-way, and thoroughfares in the City. Installations shall be made in full compliance and accord with all applicable local, state, and federal codes and standards including, but not limited to, the National Electric Code, the National Electrical Safety Code, IOSHA, and INDOT Standards and Specifications.

22.3 Easements

A. General

The easements shall be exclusively under the discretion and control of the City. Ingress and egress shall be available to the City's crew at all times. No utility companies are allowed to use the easements for installation of their utility lines without the expressed written permission of the City. All plan sheets shall clearly identify the easement and the location of all other proposed utilities. The horizontal and vertical plans shall identify all utilities proposed to cross the easement.

B. Easement Standards

Easements for utilities shall be platted. Those easements shall have a minimum width of fifteen (15) feet, unless water and sewer are located, or are to be located in the future, within the easement in which case it shall be a minimum of twenty (20) feet. See **Section 4.3** for further requirements. Where located along interior lines, one-half (1/2) the width should be taken from each lot.

If a subdivision is traversed by a watercourse, the sub divider shall provide a storm water easement or drainage right-of-way as required by I.C. 36-9-27.

Where paths and trails are proposed, they shall not exceed fifteen (15) feet in width and shall be so designed and constructed as to result in the least removal and disruption of trees and shrubs and the minimum impairment of natural beauty.

All utility easements as described on the face of the plat shall be kept free of all permanent structures and the removal of any obstructions such as structures, trees, shrubbery, fences, or other installations thereon, whether temporary or permanent, by the City, shall in no way obligate the City for damages, or to restore the obstruction in its original form.

C. Right-of-Way Plan Sheet

1. Geographic location map showing the extent of the project and including where applicable:
 - a. Directional North Arrow and Scale;
 - b. County;
 - c. Civil Township;
 - d. Section, Township and Range Identification;
 - e. Subdivision Names, Recording Information and Lot Numbers;
 - f. Highway, Road and Street Identification;
 - g. Rivers, Creeks and Named Ditches;
 - h. Assigned Parcel Numbers Arranged in Ascending, Numerical Order from the Project Beginning to End; and
 - i. List of Apparent Owners (last deed of record) by Assigned Parcel Numbers.
2. In addition to the above, there should be sufficient information on the design drawings to properly correlate with the right-of-way plan sheet; i.e., property lines, subdivision information, parcel number or name, width of right-of-way, permanent or temporary and special conditions; for example, structures, trees, shrubs to be removed or replaced, sodding, riprap, etc.

D. Legal Description Sheets

The following shall be provided:

1. Parcel Number;
2. Project Number;
3. Project Name;
4. Identification as to permanent or temporary easement;
5. Separate descriptions on separate sheets are required where both permanent and temporary easements are to be taken;
6. Meets and bounds descriptions shall be clear, concise and complete with sufficient detail to positively establish from known and referenced points, monuments, lines, etc. Total area should be stated at end of description, in acres;
7. Descriptions of easements from platted subdivision lots, including strips off sides of lots should include name of subdivision and recording information for the subdivision as well as affected lot number(s). NOTE: These are usually small areas; therefore, area should be stated in square feet; and
8. Registered land surveyor's licensed in the State of Indiana, seal and signature.

E. Property Plats

1. Parcel Number;
2. Project Number;
3. Project Name;
4. County;
5. Civil Township;
6. Section;
7. Township;
8. Range;
9. Owner;
10. Permanent or Temporary Legends;
11. Permanent or Temporary Easement Areas;
12. Total area of property out of which easement is to be taken;
13. Drawn By;
14. Directional North Arrow;
15. Scale;

16. Unplatted properties: complete boundaries of property description out of which easements are to be taken, including properly identified referenced corners, P.O.B.'s, monuments, roads, bearings, distances, etc.;
17. Platted subdivisions: dimensions of lot(s) as well as the lot number(s) and including the subdivision name and recording information;
18. Easement boundaries, including regulated drain boundaries, as described in Item A. of this subsection, including referenced bearings, distances, etc., and identified as in legend; and
19. Registered land surveyor seal and signature.

22.4 Drafting Standards

A. General

These Standards have been established for the purpose of ensuring uniformity in the design and drafting techniques of projects to be submitted for review and acceptance.

1. All projects submitted, having more than two (2) sheets, shall have a title sheet which will include:
 - a. General Overall Area Map;
 - b. Vicinity Location Map;
 - c. A Site Plan Map Detailing the Project;
 - d. Name/Title of Project, including Section Number if applicable;
 - e. Owner and Engineer's Name; and
 - f. Professional Engineer's Seal and Signature.
2. All plan and profile sheets are to be certified and dated by a professional engineer of the State of Indiana.
3. All sheets are to be numbered, with total number of sheets included.
4. Include detail sheet(s)/specification sheet(s), as applicable.
5. Design drawings shall be twenty-four (24) inch by thirty-six (36) inch.

B. Scales

The following scales for drawings are required:

1. Plan and Profile: Variable; Not to Exceed 1"=50' Horizontal and

1"=5' Vertical. A scale of 1"=30' is preferred for street and alley plans.

2. Cross Sections: 1"=5' Horizontal and Vertical

C. Materials

Mylar type drafting film shall be used for all reproduction "originals" to be submitted as record drawings. They shall be of a quality suitable for blue-line printing.

D. Plan and Profile Sheets

1. General

- a. A North Arrow;
- b. The Scales Used;
- c. Project Name and Number, Sheet Number, Date Drawn, Date and Nature of Revisions;
- d. All topography in the area affected by construction;
- e. Right-of-Way lines; property lines and easements;
- f. Locations of benchmarks and their descriptions;
- g. Locations of all existing and proposed utilities in the project area; and
- h. Match lines shall be easily identifiable.

2. Street and Alley Drawings

All street and alley drawings shall include the following, as a minimum:

- a. Location, width, and name of all streets;
- b. Turn angles and distances to nearest established street(s);
- c. Radius and angle of intersection, tangent length, length of curve, P.C.'s and P.T.'s radii, internal angles, points and curvatures, tangent bearings, and lengths of all arcs;
- d. Cross sections, at 50 feet intervals, showing road grade, pavement section, curbs, and gutters;
- e. Plan and profile of all drainage structures;
- f. Types of materials used;
- g. Traffic control details; and
- h. Special construction details.

E. Record Drawings

All plans submitted as record ("as-built") drawings shall have all pertinent items shown on the plan view and properly scaled. This includes drives, sidewalks, manholes, hydrants, inlets, etc. All sheets shall have the phrase "as-built" or "record drawing" boldly printed on them with the date and shall be stamped and signed by a professional engineer registered in the State of Indiana.

SECTION 23

PUBLIC STREETS & ALLEYS MATERIALS

SECTION 23

PUBLIC STREET AND ALLEY MATERIALS

23.1 General

This section provides a description of the materials acceptable for the construction of public streets. Use of other materials which are not specified herein shall only be permitted with the written approval by the City and City Engineer.

23.2 Pavement Materials

A. General

All materials shall be obtained from a source(s) which currently supplies similar approved materials for the Indiana Department of Transportation projects.

B. Concrete Pavement

All concrete pavement shall be composed of Portland cement concrete, with or without reinforcement as may be specified, constructed on a prepared and compacted base course in close conformance with the INDOT Standard Specifications, Section 500, latest edition. Concrete pavements shall contain air entrainment and be finished with a broom-type finish.

C. Bituminous Pavement

Bituminous material for wedge and leveling, approaches, base, binder and surface shall be furnished in accordance with INDOT Standard Specifications, Sections 300, 400 and 610, as applicable.

Bituminous surface and base courses shall be Hot Asphaltic Concrete. Unless otherwise directed or permitted by the City, the base mixture shall be No. 5LV with 4.3 percent asphalt or shall be Compacted Aggregate No. 53. Unless otherwise directed or permitted by the City, the surface mixture shall be size No. 11LV with 6.0 percent asphalt or No. 12 LV with 6.2 percent asphalt.

Bituminous binder shall be Hot Asphaltic Concrete, and unless otherwise directed or permitted by the City, the binder mixture shall be size No. 9 LV with 4.8 percent asphalt or No. 11 LV with 5.0 percent asphalt.

Bituminous material for wedge and leveling shall consist of bituminous binder as set out above. Such material shall meet all requirements of Bituminous Binder as set out in the Standard Specifications Section 400.

Cover aggregate for Type 2 or Type 5 seal coat shall be limestone chips.

Bituminous mixtures for approaches shall meet all the applicable requirements of Sections 400 and 600 of the Standard Specifications.

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SECTION 24

PUBLIC STREETS & ALLEYS INSTALLATION AND CONSTRUCTION

SECTION 24

PUBLIC STREET AND ALLEY INSTALLATION AND CONSTRUCTION

24.1 General

This section shall provide general, minimum requirements for the installation and construction for City of Monticello street and alley projects.

A. Protection of Existing Improvements

Before any excavation is started, adequate protection shall be provided for all existing utilities and Town structures.

B. Traffic Control

The Contractor shall plan construction activities to minimize impact to traffic. Local traffic access must be maintained at all times. The Contractor shall so schedule his work whenever possible and make suitable provisions for access by local residents, school buses, police, emergency, fire and mail delivery vehicles. The Contractor shall keep fire hydrants and other public utility valves accessible at all times. To maintain traffic movement, appropriate traffic control devices shall be used. Such traffic control devices shall comply with the latest edition of the Indiana Manual on Uniform Traffic Control Devices and Sections 104.04, 107, and 801 of the Standard Specifications.

C. Utility Interruption

The Contractor shall proceed with caution in the cut and fill of the subgrade preparation so that the exact location of underground structures may be determined. Prior to proceeding with any cut areas and/or excavation, the Contractor shall contact all utility companies in the area to aid in locating their underground services.

The Contractor shall take all reasonable precautions against damage to existing utilities. However, in the event of a break in an existing water main, gas main, sewer or underground cable, he shall immediately notify the responsible official of the organization operating the utility interrupted. The Contractor shall lend all possible assistance in restoring services and shall assume all costs, charges, or claims connected with the interruption and repair of such services.

D. Construction Staking

The Developer/Contractor shall provide for all construction staking of lines, grades and construction limits.

24.2 Pavement Installation

A. Subgrades

Subgrades for all pavements shall be compacted no less than ninety-five (95) percent of their maximum density at optimum moisture based on the modified Proctor compaction test (modified AASHTO [1978], Designation T-180, and ASTM [1980], Designation D 1557).

B. Concrete Pavement

Concrete pavement and base course shall be constructed in close conformance with the Indiana Department of Transportation Standard Specification, Section 500, latest edition. Pavement shall be broom finished.

C. Bituminous Pavement

Bituminous pavement, including base course, shall be placed and compacted in accordance with the INDOT Standard Specification Sections 300, 400, and 600 as applicable.

SECTION 25

PUBLIC STREETS & ALLEYS INSPECTION, TESTING & ACCEPTANCE

SECTION 25

PUBLIC STREET AND ALLEY INSPECTION, TESTING AND ACCEPTANCE

25.1 General

This section describes the minimum requirement and general procedures for the inspection, testing and acceptance of streets and alleys dedicated to the City of Monticello.

25.2 Inspection

Inspection of the construction shall occur for the duration of the project. The Developer/Contractor shall execute the Agreement with the City for such services if the City does not have staff available to perform such inspections. Inspection fees shall be as set forth in **Section 3**.

A. General Requirements

1. Contractor and/or Developer shall provide notice to the City and his representative of the planned commencement of construction thirty (30) days prior to such commencement.
2. Once the construction starts, the Contractor shall be responsible for informing and/or notifying the inspection representative assigned of the following. (NOTE: The City may require as much as five (5) working days to provide inspection services during construction.)
 - a. Daily work schedule, including any changes in schedule;
 - b. Prior notification if work is to be performed on weekends and/or holidays;
 - c. Date tests are to be performed; and
 - d. Date as-built verification is to be performed.
3. The City, upon request of the Contractor and/or Owner, will schedule the Final Inspection.

All testing required shall be paid for by the Contractor and performed under the observation of the City or City's representative. It shall be the Contractor's responsibility to schedule the testing with the City representative and/or City. Test results obtained in the absence of the presence of the City will not be accepted.

25.3 Testing of Pavement Materials

A. Subgrade Testing

The Contractor shall be responsible for providing soil Proctor analyses for all soils to be tested on the project. All test results shall be reviewed, and a recommendation given by a qualified and licensed geotechnical engineer. At least one copy of each geotechnical report shall be submitted to the City/City Engineer. The AASHTO Method T-99 (Standard Proctor Analysis) is to be the preferred test used.

Should subgrades not meet minimum compaction requirements (minimum 95%), other forms of soil modification shall be employed. This shall include but not be limited to scarifying and aerating, undercutting and aeration, total replacement of soils, or the installation of geotextiles such as woven or non-woven filter fabrics or geogrid soil reinforcing systems. A qualified and licensed geotechnical engineer or highway engineer shall be provided by the Contractor to give such recommendations.

B. Pavement Materials Testing

The Contractor shall furnish evidence to the City/City Engineer as necessary to show that the materials to be furnished for a project conform to the requirements specified.

In addition, the City may have any of the materials tested at any time to show compliance with the specifications. In connection with this requirement, the Contractor shall provide such facilities as the City may require for collecting and forwarding samples and shall hold the materials represented by the samples until tests have been made and such materials found to have qualities required by the specifications. All samples required shall be furnished and tested by the Contractor utilizing the services of a qualified and licensed geotechnical engineer without charge to the City of Monticello.

The frequency of sampling and testing shall be based on the number of tests required for each quantity of materials placed for a particular item of work as specified by the City/City Engineer. Where no criteria for sampling and testing is given for a particular item or items of work by the City, the Contractor shall adhere with the schedules and instructions specified in the Indiana Department of Transportation, Division of Materials and Tests Manual For Frequency of Sampling and Testing and Basis for Use of Materials, latest edition.

25.4 Documentation, Dedication and Acceptance Procedures

A. Documentation Requirements

In order for the City Council to accept dedicated facilities, the following items shall be completed and on file:

1. Copies of all testing reports and data;
2. Final payment for inspection services;
3. As-built drawings;
4. Performance and/or maintenance bonds (if required);
5. Daily inspection reports;
6. Legal description of the land to be dedicated to the City; and
7. A written statement of facilities present on those lands. The written statement shall include:
 - a. Identification of the type and nature of facilities present
 - b. Dimensions of the facilities present
 - c. Totals for each type of facility present (example: one thousand (1,000) feet of roadway, one thousand (1,000) feet of residential curbing, etc.)

B. Dedication

The City shall review the above-mentioned requirements and prepare a document stating that the work has been completed, the requirements have been met, and all items are in proper form. The City shall include in the statement a recommendation on acceptance/denial of the facilities and may also include comments regarding the project. The City shall present to the City Council its findings in a public hearing for their consideration.

C. Acceptance

The City Council shall receive the recommendation from the City representative, and upon review by the City Attorney and Mayor, shall make a determination as to acceptance of the facilities. A majority approval of the Council members present at the meeting is required for acceptance. The City Council shall accept dedicated facilities by resolution.

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SECTION 26

RESTORATION OF SURFACES

SECTION 26

RESTORATION OF SURFACES

26.1 General

Restoration of surfaces within the public right-of-way and easements shall include the removal of the existing surface, the disposal of the surplus material and the construction of new surfaces and adjusting all new and existing structures for proper grade prior to paving as indicated on the plans and/or as specified in these Standards.

26.2 Restoration of Paved Surfaces

Restoration of any paved surfaces damaged during the course of construction shall be restored to a condition as good as or better than existed prior to the beginning of the work, in accordance with the following specifications.

A. Paved Surfaces:

Streets, alleys, sidewalks, driveways, curbs and gutters, not constructed or maintained by the State Highway Department, but paved with asphalt, concrete, cinders, crushed stone, water-bound macadam, oil-bound macadam, or heterogenous paving materials, which are wholly or partially removed, damaged, or disturbed by the Contractor's operations, shall be restored with like or better materials, acceptable to the City and the City Engineer, to a condition as good as or better than existed prior to the beginning of the work, so that movement of traffic, both vehicular and pedestrian, through the restored way shall be as free, safe and unimpeded as before.

B. Temporary Pavement Replacement

Trench surfaces of highly traveled streets and roads may be, at the direction of /the City, required to receive a temporary pavement replacement of cold mixed bituminous pavement. This temporary pavement shall be surface mixture Class A or B prepared and placed in accordance with Section 406 - Cold Mixed Bituminous Pavement of the latest edition of the Indiana Department of Transportation Standard Specifications. Prime and tack coats shall not be required. All temporary pavement shall be maintained by the Contractor to proper grade so as not to impede the safe flow of traffic until the permanent pavement replacement is made.

C. Permanent Paving

Permanent paved surfaces shall be restored in accordance with the following requirements, unless otherwise set forth by the City and the City Engineer. In all cases, the methods and materials of restoration shall meet the requirements of the Indiana Department of Transportation, as applicable.

1. Class "B" Concrete Pavement

Existing local streets, roads, alleys, driveways and parking areas consisting of concrete pavement shall be restored according to the following requirements.

Areas subjected to excavation or damage by the Contractor are to be replaced as a whole. Sidewalks are to be replaced in complete sections, streets and driveways as complete sections or replaced with sections that coincide with the original pattern, and to the City's and/or City Engineer's satisfaction.

Prior to placing concrete, the existing edges are to be saw-cut in a neat straight manner, sub-base compacted, wetted down and edges swept clean. The use of flexible joint material is required as needed. All chunks of existing material larger than three by three (3 x 3) inches are to be removed.

Class B concrete pavement shall consist of a cast in place, layer of Class A concrete with one (1) layer of woven wire fabric (6 x 6 - W1.4 x W1.4) meeting ASTM Designation 497. The concrete layer shall be six (6) inches thick. All rigid concrete pavement work and materials shall meet the latest specifications of the Indiana Department of Transportation.

2. Class "C" Asphalt Pavement

Existing local streets and roads consisting of asphalt paving shall be restored with binder and surface of the thickness specified and as follows:

Areas subject to Class C asphalt pavement replacement shall have the existing edges cut in a neat straight manner as to remove irregularities and damaged areas. Manholes, existing valve areas, etc. are to be boxed out in a neat manner. All cuts shall be parallel or perpendicular to the trench. Curved or diagonal cuts shall not be allowed. All chunks of existing material larger than three by three (3 x 3) inches are to be removed.

Any previously placed temporary surface or pavement, shall be removed to allow placement of the binder and surface. After the base is cutback, it shall be re-compacted with a ten (10) ton roller or other suitable equipment if approved by the City and/or City Engineer. Care shall be taken to assure that not less than six (6) inches of compacted aggregate base remains below the permanent pavement.

A tack coat shall be applied to the cleaned and patched surface at a rate of 0.05 to 0.10 gallons per square yard immediately prior to placing of bituminous mixtures.

The binder course(s) shall consist of compacted Hot Asphaltic Concrete, Type A, Size No. 9LV or 11LV as defined by the latest edition of the Indiana Department of Transportation Standard Specifications. Compaction shall

be accomplished with suitable smooth wheel rollers. Generally, conventional self-propelled rollers of not less than ten (10) tons gross weight shall be used. The City and/or City Engineer shall consider alternate equipment only if Contractor requests same in writing and includes technical data on the specific equipment to be considered.

The quantity and thickness of binder courses required shall match the existing pavement but shall not be less than one (1) course, three (3) inches in thickness.

When the existing base is granular material, or a new granular base is placed, the surface shall be fine graded and compacted by rolling to produce a smooth uniform surface free of voids and depressions.

The surface course shall consist of compacted Hot Asphaltic Concrete Surface Type A (Size No. 11LV or 12LV), as defined by the latest edition of the Indiana Department of Transportation Specifications and placed in the same manner as described above for binder. The surface thickness shall match the existing pavement, but not be less than one (1) inch.

3. Adjustments of Shoulders Necessitated by Resurfacing

The shoulders of the road shall be adjusted to the elevation of the resurfacing with all materials (i.e. earth, sod, gravel, crushed stone, asphalt, etc.) necessary. The transition may be made within a distance of one (1) foot to one and one-half (1½) feet from the edge of paving except in unusual cases where a greater distance is required. Existing driveways shall be primed and wedged from a featheredge to the final height of the resurfaced street paving.

18.3 Restoration of Ground Surfaces

All ground surfaces in public Rights of Way and easements that have been damaged or destroyed by the Contractor's operations shall be restored in accordance with the following specifications. All surplus material, rock, trees, shrubs, concrete pipe, asphalt, crushed stone, etc., not to be used in the Contractor's restoration operations shall be removed from the site and disposed of in an acceptable manner.

A. Restoration of Grassed Areas with Sod

Where shown on the plans or required by the City or City Engineer, established grassed areas shall be restored with sod containing grasses of comparable quality. Sod shall be placed and rolled so that the final elevations of the area being restored are the same as existed prior to the beginning of construction. Sod shall be pegged where necessary and shall be watered and cared for to assure its survival.

B. Restoration of Grassed Areas with Seed and Mulch

The Contractor shall seed and mulch in one of the following manners:

1. Seed

The ground shall be loosened approximately three (3) inches deep with a disc or a harrow and fertilized with twenty-five (25) pounds of 10-10-10, or equivalent, and one hundred (100) pounds of agricultural lime per one thousand (1,000) square feet.

The mixture of seed applied shall be as follows:

35% Kentucky Bluegrass
30% Perennial Rye Grass (*Lolium Perenne*)
30% Kentucky 31 Fescue
5% Inert Matter

The seed shall be applied at a rate of four (4) pounds per one thousand (1,000) square feet and shall be well raked or boarded into the soil and mulched with straw of sufficient thickness to hold the seed until it has germinated.

2. Mulching Material

Materials for mulching shall be wheat, oats, barley or rye straw only. All materials shall be reasonably free from weed seeds, foreign material, and other grasses and chaff, and shall contain no Johnson Grass. The straw shall be reasonably bright in color and shall not be musty, moldy, caked, or of otherwise low quality. The straw shall be dry on delivery and spread evenly.

Mulch net may be required on special areas designated by the City to hold mulch in place until turf is established. The net shall be made of a tightly twisted craft paper yarn, leno woven with a wrap count of one (1) pair of yarns per two (2) inches and a filling count of two (2) per inch. Salvage edges and center shall be reinforced with polyethylene filament. The material shall have a minimum width of forty-five (45) inches.

SECTION 27

EROSION CONTROL

SECTION 27

EROSION CONTROL

27.1 **General**

This section provides the general guidelines for the control of erosion and sediment for construction sites. Control of sedimentation for construction site may be accomplished through utilization of a variety of control practices. The complexity of the erosion and sediment control plan will vary depending upon individual site conditions. The goal of such a plan is to limit the quantity of sediment leaving the construction site. The Contractor's plan must be approved by the City and City Engineer.

In addition, the Contractor must also comply with Rule 5 327 IAC 15-5 for land alteration which disturbs 5 acres or more.

27.2 **Permitting Requirements**

If the Developer/Contractor is required to submit a soil erosion control plan to the State under Rule 5 (327 IAC 15-5), such plan shall be deemed in compliance with the City requirements. In this case all applicable State and Federal permits or notices for land disturbing activities shall be obtained or filed prior to beginning land disturbing activities. Copies of all applications, letter of intent, submittals, plans and other erosion and sediment control related information shall be submitted to the City and City Engineer.

27.3 **Design Guidelines**

In order to fully achieve an acceptable level of erosion and sediment control on the construction site, the following design principles shall be fully adhered to during site analysis and development of the erosion and sediment control plan:

- A. Existing site contours should be followed as close as reasonably possible in order to minimize cut and fill.
- B. Existing natural vegetation should remain undisturbed for as long as possible during the construction activities. Naturally vegetated areas along property lines, jurisdictional wetlands, lakes, and watercourses, both natural and man-made, should be left undisturbed during all phases of the site construction. These vegetative filter strips will be required at the discretion of the City.
- C. A logical sequencing of site construction activities must be provided in order to minimize the size of exposed land areas, and the length of time land areas are left without some form of temporary or permanent soil protection.
- D. Soil stockpiles shall be stabilized utilizing either vegetative establishment, sediment trapping barriers, or erosion control measures such as tarping or mulching, singly or in combination.

- E. Storm sewer inlets which are made operable either before or during the construction phase of development shall be provided with protection from siltation.
- F. Stable, properly maintained construction traffic access routes and stream crossings shall be identified on the site erosion and sediment control plan as needed. These construction access routes shall be installed as part of the site perimeter sediment control barriers, prior to the initiation of on-site land alteration activities. Where sediment is transported onto public street or road surfaces, these streets or roads shall be cleaned thoroughly at the end of each day. Sediment shall be removed by either scraping, shoveling or sweeping and be transported to a controlled fill area. Street washing will be allowed only if wash water flows to a controlled sediment trapping area.
- G. Runoff velocities shall be kept as low as possible.
- H. A thorough maintenance and follow-up program, and identification of the person(s) responsible for its implementation will be required.

The latest edition of the Indiana Handbook for Erosion Control in Developing Areas (HECDA) shall be used for detailed technical guidance for all erosion and sediment control practices. The following general practice guidance applies to the development of all control plans:

- A. Perimeter Control - Perimeter control measures shall be installed as specified on the approved plan, including construction access drives, straw bale dams and fabric fencing, temporary sediment traps, sediment basins, and diversions.
- B. Vegetative Control - Disturbed areas which are at finish grade shall be permanent seeded within seven (7) days. At the discretion of the City; barren areas to be rough graded and left undisturbed for more than thirty (30) days shall be established with temporary vegetation; and dormant seeding will be required during seasonal periods (October through February) for those barren areas to be left undisturbed for one hundred and twenty (120) days or longer.
- C. Slope Protection - Slope protection shall be provided by use of temporary and permanent diversion levees, vegetative cover, and slope drains. Concentrated stormwater flows shall not be allowed to flow down cut or fill slopes without proper slope stabilization.
- D. Sediment Trapping - To achieve the goal of preventing sediment from leaving the construction site, the City will require the use of sediment barriers such as fabric fencing, straw bale dams, and sediment basins.
- E. Protection of Outlet Channel - Concentrated stormwater runoff leaving a development site shall be outlet to an open channel, storm sewer pipe or culvert which is capable of receiving this discharge. Runoff velocities shall be controlled during all storm events so that the peak runoff velocity during and after the completion of the land alteration approximates existing conditions.

The principles and practices provided by the State in Rule 5 are to be followed in the development of all control plans. Rule 5 does not give specific requirements for use of various practices leaving that to the localities. Individual practices can be modified or waived upon request to the City based on special site characteristics and conditions.

The designer should rely on the Indiana Handbook for Erosion Control in Developing Areas (HECDA) for detailed design, construction and maintenance criteria for all erosion control practices. Such criteria shall be required by the City unless waived in writing. The manual can be obtained from:

Urban Conservation Program
Division of Soil Conservation
Indiana Department of Natural Resources
402 West Washington Street, Rm. W-265
Indianapolis, Indiana 46204-2748

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PUBLIC STREET & ALLEY STANDARD DETAILS

PUBLIC STREETS AND ALLEYS STANDARD DETAILS

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Traffic Control Barricade Details	PS-23
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Traffic Control Concrete Barrier Detail	PS-27
Tree Planting Detail	PS-28
Shrub Planting Detail	PS-29
14-Foot Lighting Pole Detail	PS-30
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REVISION NO.

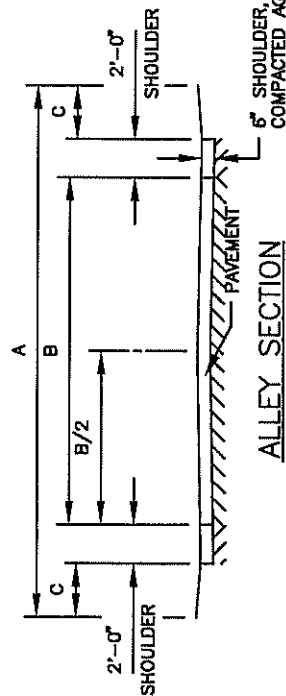
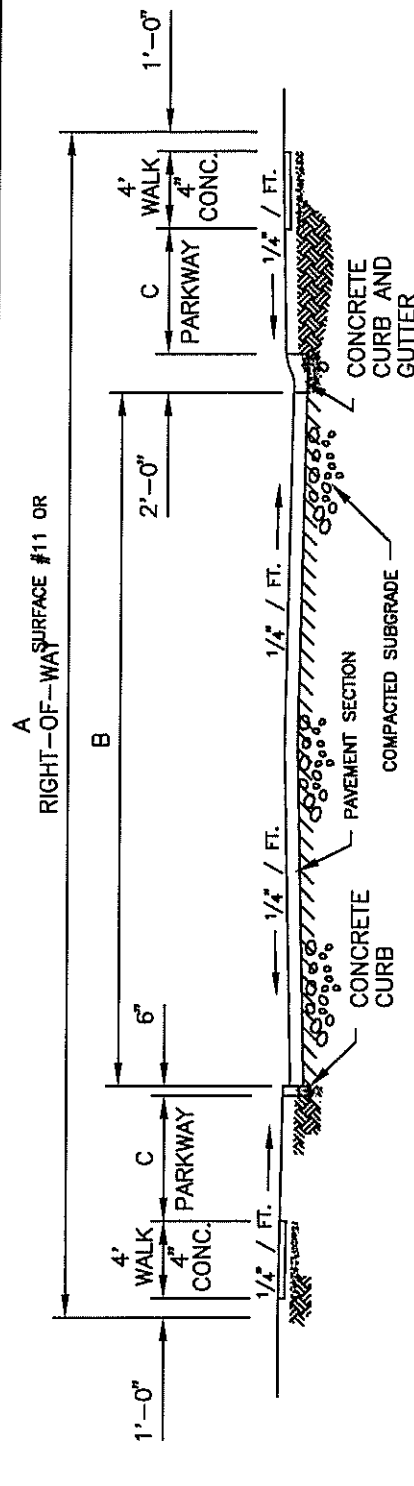
DATE: MAY 21st, 2001

CITY of MONTICELLO, INDIANA STANDARD DETAILS PUBLIC STREETS AND ALLEYS

FIGURE

PS-1

PAVEMENT DETAILS



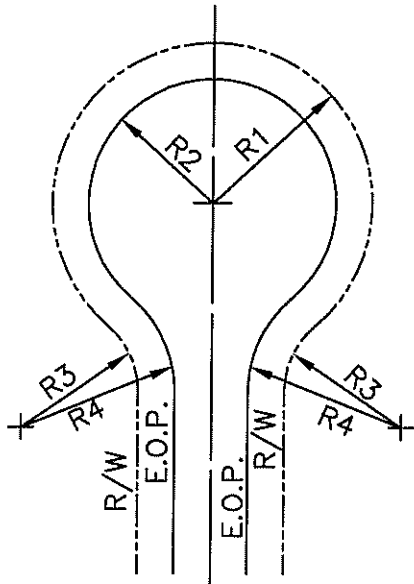
NOTE: OTHER PAVEMENT SECTIONS WILL BE CONSIDERED PROVIDING THEY ARE DESIGNED BY A REGISTERED PROFESSIONAL ENGINEER, AND ARE BASED ON TRAFFIC NEEDS AND EXISTING SOIL CONDITIONS.

ALL RIGHT-OF-WAY IMPROVEMENTS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE INDIANA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS, LATEST EDITION.

MINIMUM PAVEMENT THICKNESS									
CLASSIFICATION	BITUMINOUS					CONCRETE			
	H.A.C. SURFACE #11 OR #12 (INCHES)	H.A.C. BINDER #9 OR #11 (INCHES)	H.A.C. BASE #5 (INCHES)	COMPACTED AGG. BASE (INCHES)	C (FEET)	PCG (INCHES)	COMPACTED AGG. BASE (INCHES)	CURB TYPE	COMMENTS
PRIMARY, ARTERIAL	1	2.5	6	8	6.5	8	6	STRAIGHT	
SECONDARY, COLLECTOR	1	2.5	4	8	8	7	6	ROLL/STRAIGHT	
LOCAL, MINOR	1	3	N/A	10	8	6	6	ROLL/STRAIGHT	
SERVICE DRIVE	1	3	N/A	10	6	6	6	STRAIGHT	
ALLEY	1	3	N/A	10	4	6	6	N/A	
CLASSIFICATION	NO. OF LANES	A (FEET)	B (FEET)	C (FEET)					
PRIMARY, ARTERIAL	3	60	36	6.5					
SECONDARY, COLLECTOR	2	60	30	8					
LOCAL, MINOR	2	50	24	6					
SERVICE DRIVE	2	50	24	5					
ALLEY	1	30	18	4					

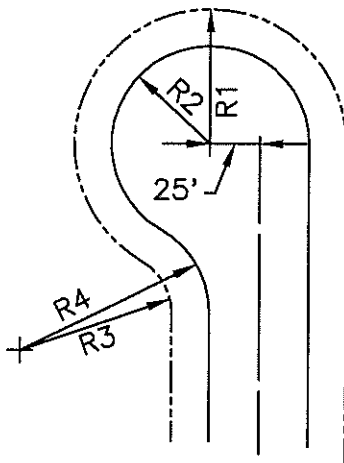
MIN. DIMENSIONS (IN FEET)

	R1	R2	R3	R4
RESIDENTIAL	50'	38'	48'	60'
COMMERICAL	60'	50'	88'	100'



NOTES:

1. PAVEMENT SECTIONS AND STREET WIDTHS (PAVEMENTS AND RIGHT OF WAY) SHALL BE IN ACCORDANCE W/ THE REQUIREMENTS OF TABLE 4-1.
2. MAX. CUL-DE-SAC STREET LENGTH ALLOWED IS 500 FT., DEFINED TO THE CENTER OF THE CUL-DE-SAC.
3. OFFSET TYPE CUL-DE-SAC ALLOWED, W/ SAME MIN. DIMENSIONS.
4. CUL-DE-SAC W/ MIN. DIMENSIONS WILL NOT BE ALLOWED TO CONTAIN ISLANDS, LANDSCAPED, CURBED OR OTHERWISE.
5. TRAFFIC CONTROL SIGNING, AS NECESSARY, WILL BE IN ACCORDANCE W/ THE INDIANA MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.
6. CUL-DE-SAC WILL NOT BE ALLOWED AT INTERSECTIONS (CIRCULAR TRAFFIC PATTERNS).
7. PAVEMENT MATERIALS (CONC. OR ASPH.) SHALL BE THE SAME AS THE REMAINDER OF THE STREET.



CUL-DE-SAC DETAIL

CALDSAC.DWG

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**CITY of MONTICELLO, INDIANA
STANDARD DETAILS
PUBLIC STREETS AND ALLEYS**

FIGURE

PS-2

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DATE: MAY 21st, 2001

**CITY of MONTICELLO, INDIANA
STANDARD DETAILS
PUBLIC STREETS AND ALLEYS**

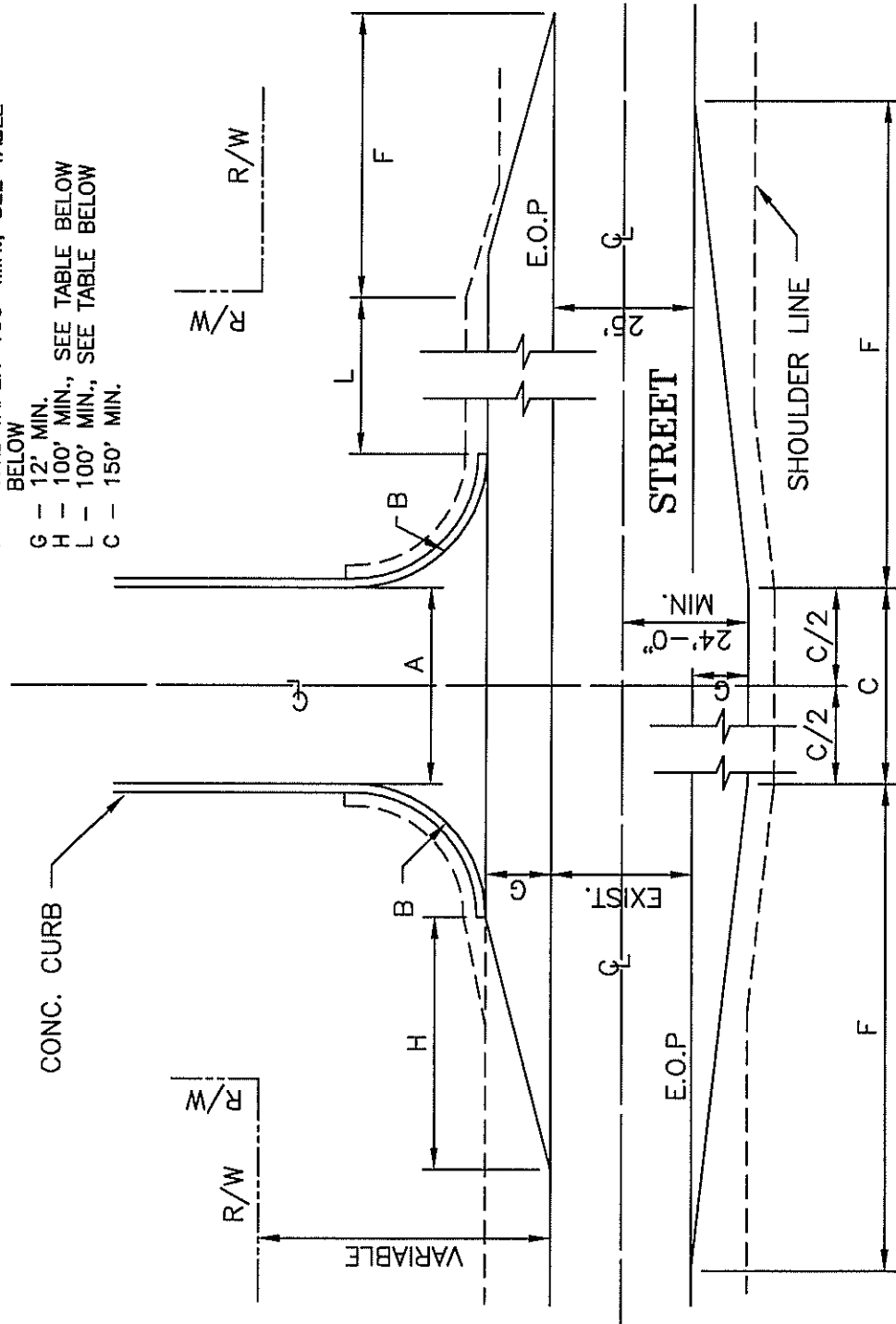
FIGURE

PS-3

PUBLIC STREET OR ROAD APPROACH DETAIL

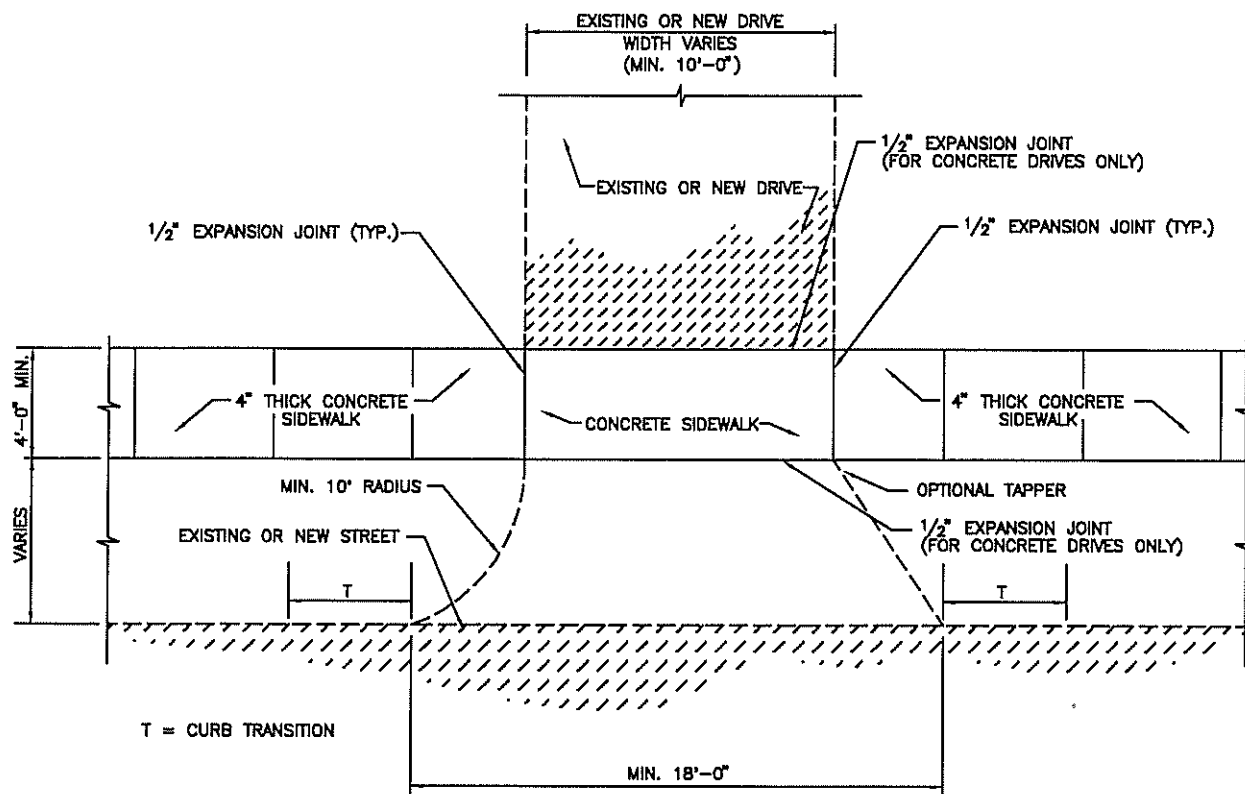
LEGEND

- A - TOWN PUBLIC WORKS STANDARDS, TABLE 4-1
 B - 25' STD., 10' MIN. RADIUS
 F - 1:12 TAPER-150' MIN., SEE TABLE BELOW
 G - 12' MIN.
 H - 100' MIN., SEE TABLE BELOW
 L - 100' MIN., SEE TABLE BELOW
 C - 150' MIN.

**NOTE:**

1. PROVIDE LARGER RADIUS, "B", IF DESIGN VEHICLE REQUIRES IT.
2. WHEN "F" IS OTHER THAN 90° "B" (EDGE RADI) IS TO BE BY APPROVAL OF TOWN ENGINEER.

DESIGN SPEED	F + L
30	250 FEET
40	370 FEET
50	500 FEET



NOTES FOR SIDEWALK RAMP:

1. CURB CUT RAMPS ARE TO BE LOCATED AS SHOWN ON THE PLANS OR AS DIRECTED.
2. SURFACE TEXTURE OF THE RAMP SHALL BE NO LESS THAN A BROOM FINISH, BUT SHALL MEET AMERICAN DISABILITIES ACT REQUIREMENTS
3. CARE SHALL BE TAKEN TO ASSURE A UNIFORM GRADE ON ALL RAMPS WITH NO BREAKS IN GRADE.
4. THE NORMAL GUTTER LINE PROFILE SHALL BE MAINTAINED THROUGH THE AREA OF THE RAMP.
5. EXPANSION JOINT FOR THE RAMP SHALL BE A MAXIMUM 1/2" WIDE. THE TOP OF THE JOINT FILLER FOR ALL RAMP TYPES SHALL BE FLUSH WITH ADJACENT CONCRETE.

TYPICAL RESIDENTIAL DRIVE APPROACH DETAIL

REVISION NO.

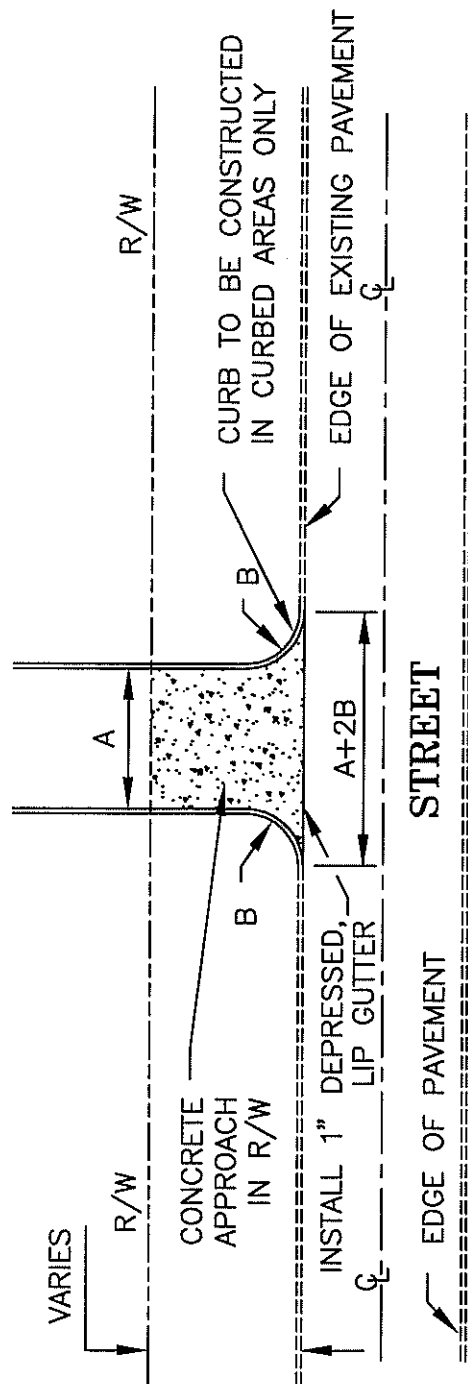
CITY of MONTICELLO, INDIANA
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FIGURE

PS-4

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SIDE4.DWG



LEGEND

A = 24'

B = 25' STANDARD, 10' MINIMUM RADIUS.

LARGER RADIUS IF DESIGN VEHICLE REQUIRES IT.

COMMERCIAL DRIVE APPROACH DETAIL TYPE I

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PUBLIC STREETS AND ALLEYS

FIGURE

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CITY of MONTICELLO, INDIANA
STANDARD DETAILS
PUBLIC STREETS AND ALLEYS

FIGURE

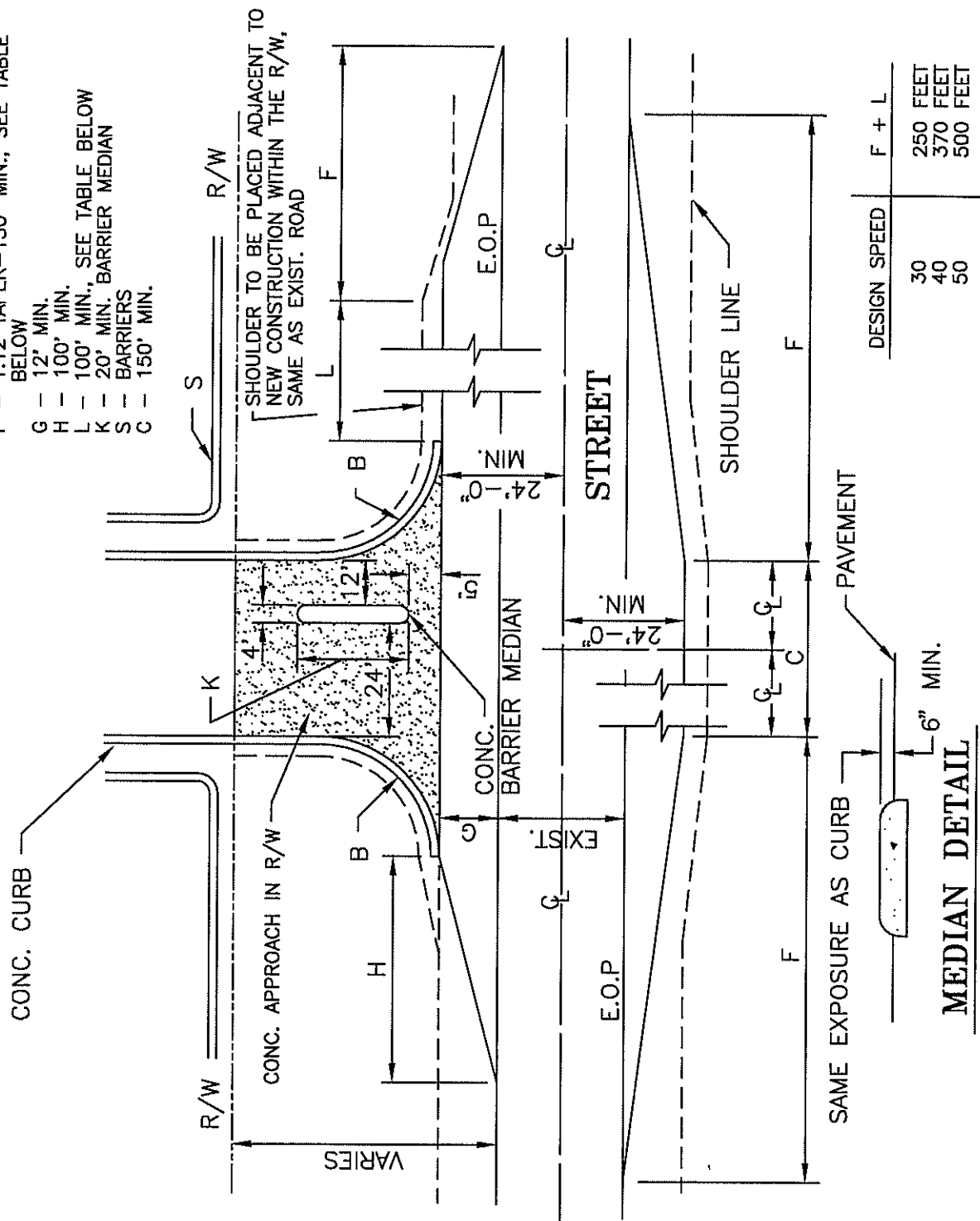
PS-6

COMMERCIAL DRIVE APPROACH DETAIL - TYPE II

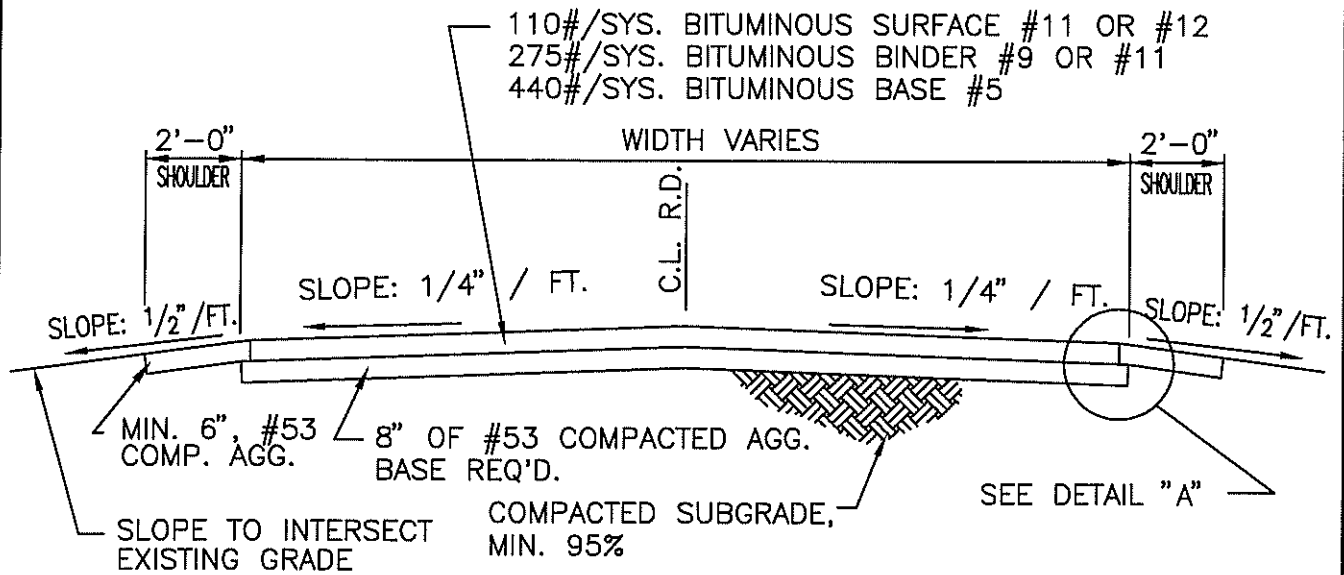
NOTE: PROVIDE LARGER RADIUS, "B" IF
DESIGN VEHICLE REQUIRES IT.

LEGEND

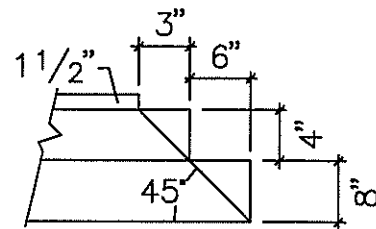
- A - 40'
- B - 25' MAX., 10' MIN. RADIUS
- F - 1:12 TAPER-150' MIN., SEE TABLE BELOW
- G - 12' MIN.
- H - 100' MIN.
- L - 100' MIN., SEE TABLE BELOW
- K - 20' MIN. BARRIER MEDIAN
- S - BARRIERS
- C - 150' MIN.







NOTE: ALL BITUMINOUS TO BE TYPE "LV" OR BETTER.



DETAIL "A"

TYPICAL SECONDARY ROAD REPLACEMENT- OPEN SECTION

ROAD2.DWG

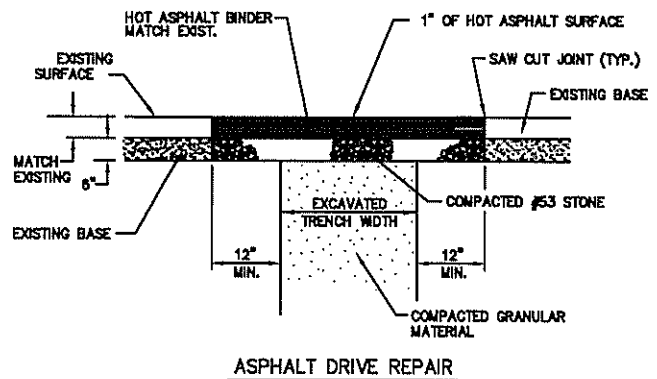
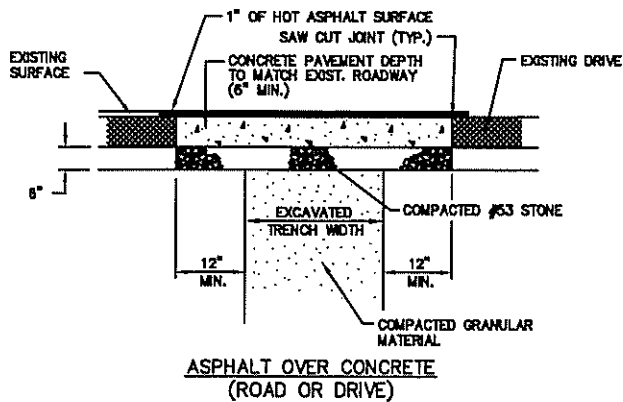
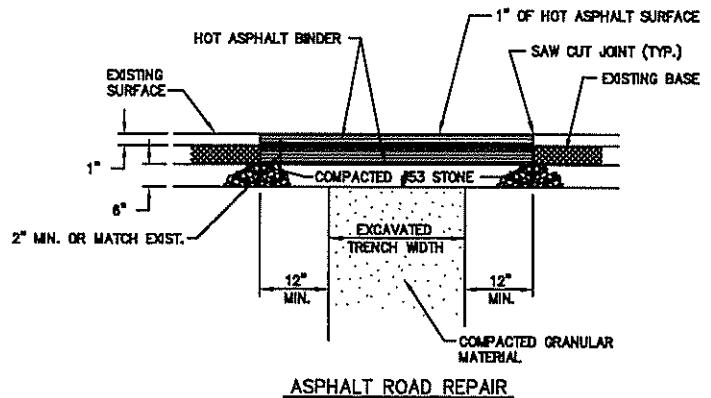
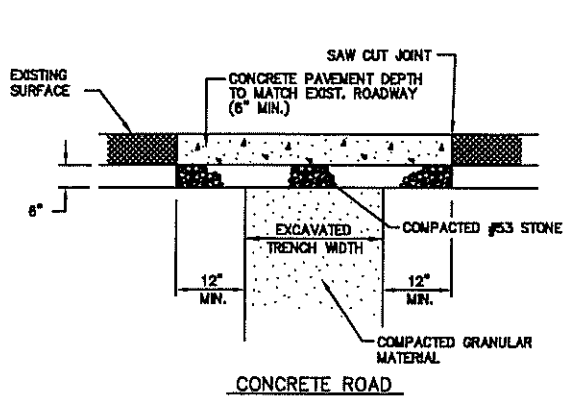
REVISION NO.

DATE: MAY 21st, 2001

CITY of MONTICELLO, INDIANA
 STANDARD DETAILS
 PUBLIC STREETS AND ALLEYS

FIGURE

PS-8



STREET AND DRIVE REPAIR DETAILS

CITY of MONTICELLO, INDIANA
STANDARD DETAILS
PUBLIC STREETS AND ALLEYS

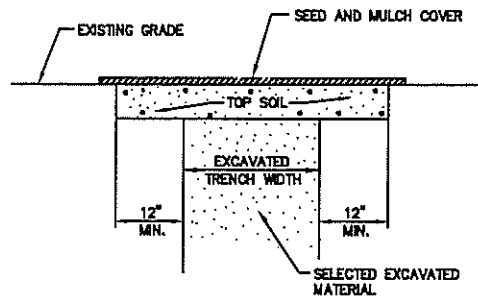
FIGURE

PS-9

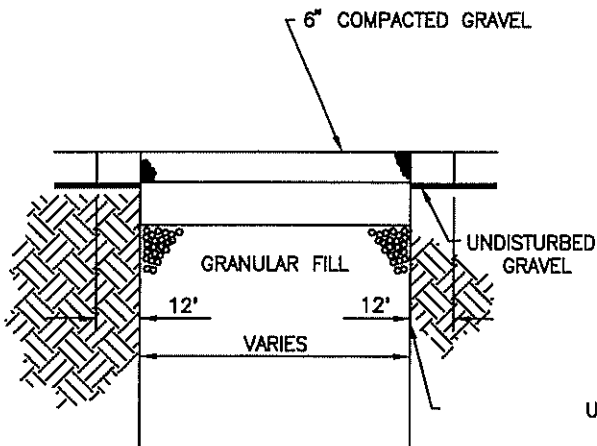
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DATE: MAY 21st, 2001

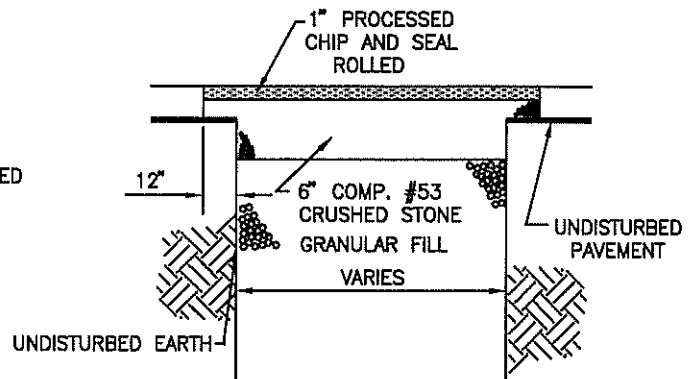
STDREP2.DWG



GRASSED AREA



GRAVEL STREET REPAIR



CHIP & SEAL REPAIR

NOTE:

ALL STREETS ROADS & PAVED DRIVE CROSSINGS ARE TO BE BACKFILLED WITH GRANULAR MATERIAL & TOPPED WITH 10" OF No. 53 STONE OR APPROVED MATERIAL DURING CONSTRUCTION PRIOR TO FINAL PAVEMENT REPAIR

STREET AND DRIVE REPAIR DETAILS

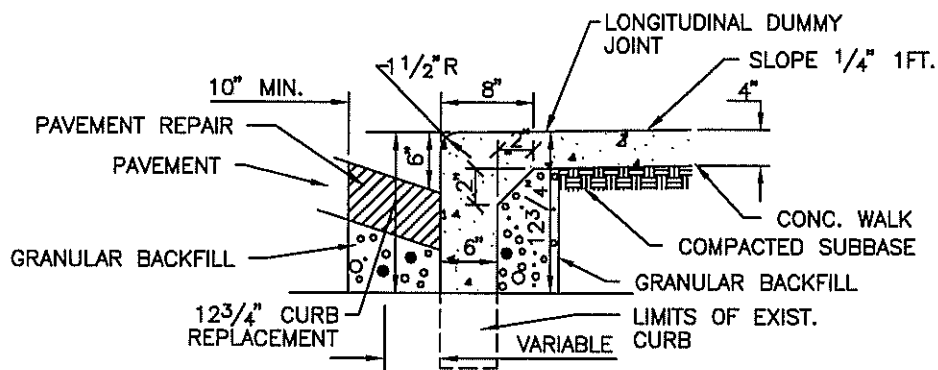
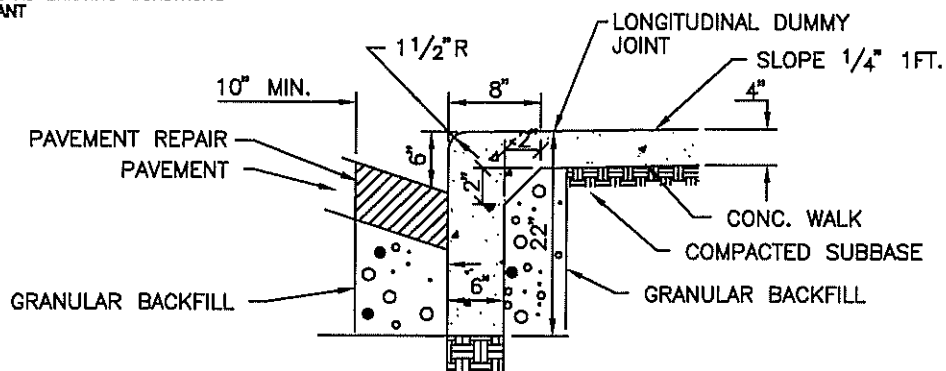
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DATE: MAY 21st, 2001

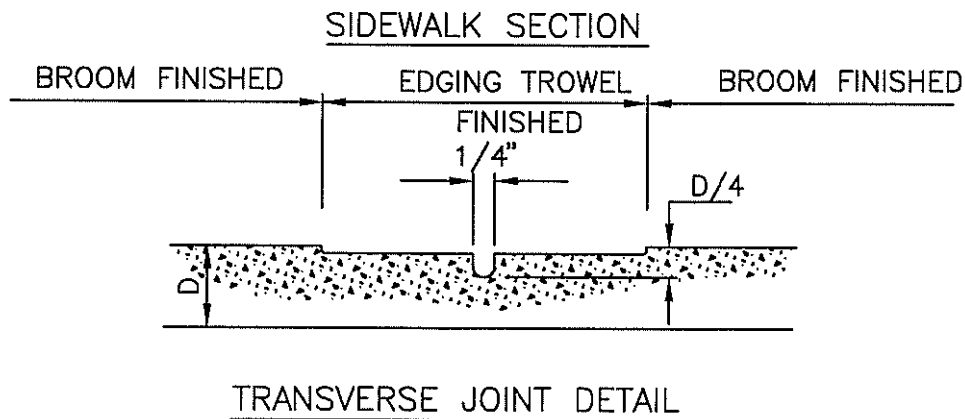
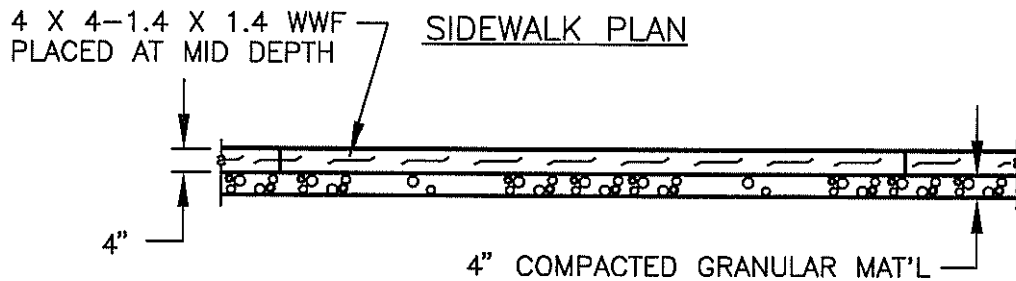
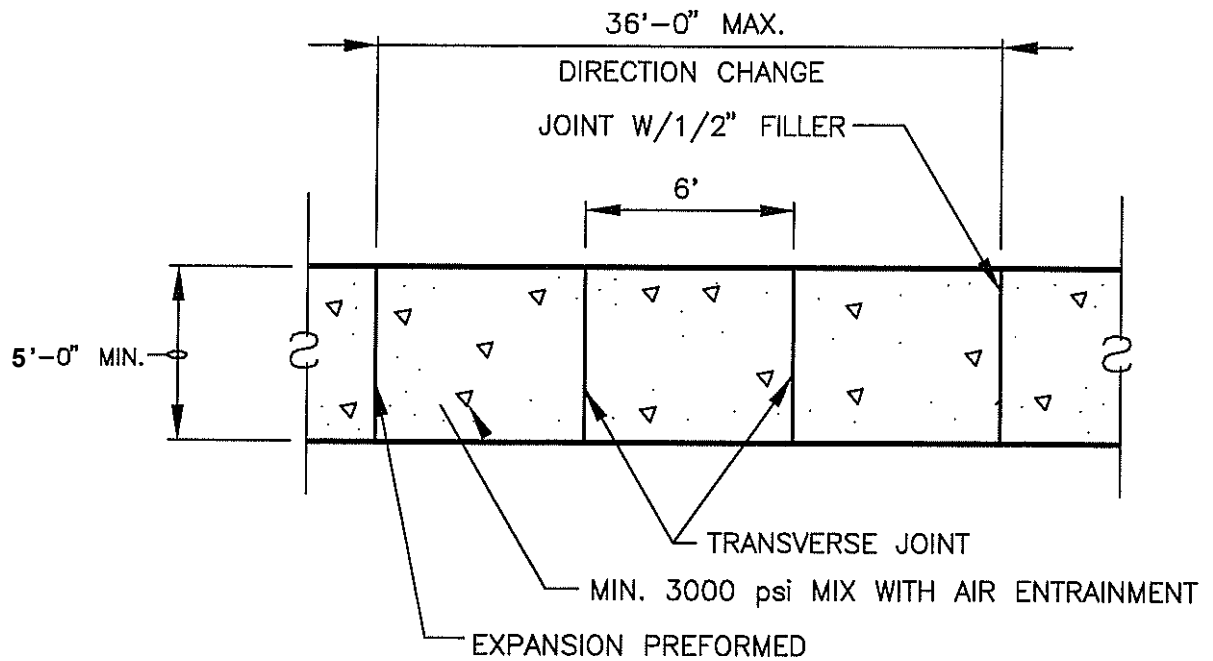


CONCRETE CURB AND GUTTER DETAIL

CURB DETAILS



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			PS-12
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TYPICAL SIDEWALK DETAIL

REVISION DATE

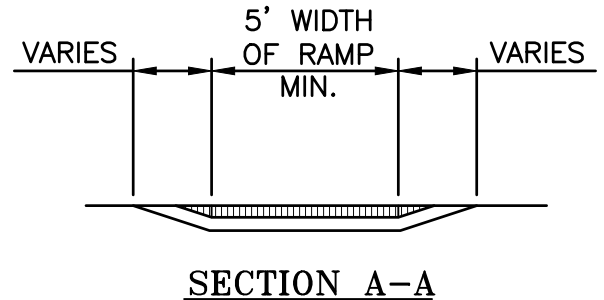
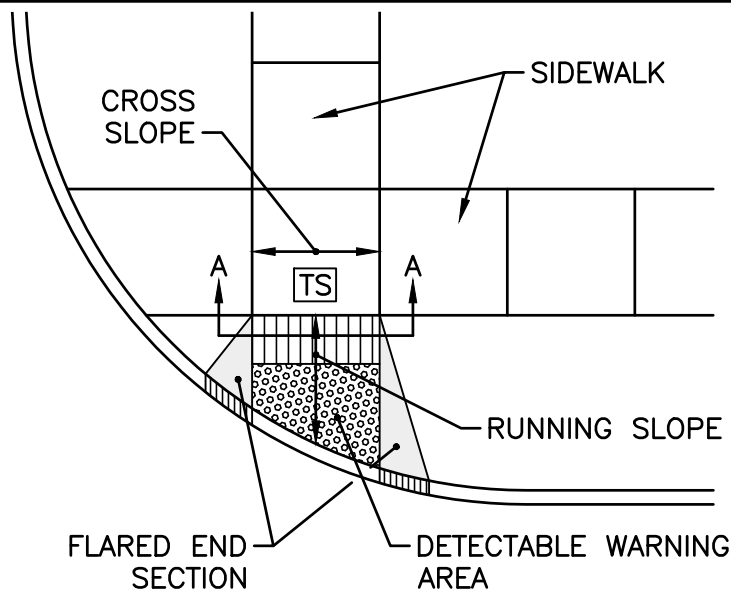
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CITY of MONTICELLO, INDIANA
STANDARD DETAILS
PUBLIC STREETS AND ALLEYS

DATE: MAY 21st 2001

FIGURE

PS-13



PLAN

TS = TURNING SPACE

GENERAL NOTES:

1. ALL SLOPES ARE ABSOLUTE RATHER THAN RELATIVE TO THE SIDEWALK OR ROADWAY GRADE. SLOPE AT LEAST 0.50% LESS THAN THE MAXIMUM ARE PREFERRED.
2. RAMP OR BLENDED TRANSITION. A RAMP OR BLENDED TRANSITION SHALL BE USED TO LOWER OR RAISE THE SIDEWALK TO CONNECT WITH THE STREET OR HIGHWAY.
3. TURNING SPACE. A TURNING SPACE SHALL BE PROVIDED AT THE TOP OF A PERPENDICULAR RAMP, BOTTOM OF A PARALLEL RAMP, OR WHERE THE PEDESTRIAN TRAVEL REQUIRES A CHANGE IN DIRECTION. A COMMON TURNING SPACE MAY BE SHARED BY ADJACENT RAMPS. THE TURNING SPACE SHALL HAVE A MINIMUM CLEAR DIMENSION OF 4FTX4FT. WHERE THE TURNING SPACE IS CONSTRAINED AT THE BACK OF THE SIDEWALK BY A CURB, RETAINING WALL, BUILDING, OR FEATURE COVER 2 INCHES IN HEIGHT, THE MINIMUM CLEAR DIMENSION SHALL BE 4FTX5FT, WITH THE 5-FT DIMENSION IN THE DIRECTION OF THE RUNNING SLOPE.
4. FLARED SIDE. A FLARED SIDE SHALL BE USED ADJACENT TO A WALKABLE SURFACE. A FLARED SIDE MAY BE USED ADJACENT TO A NON-WALKABLE SURFACE. A FLARED SIDE SHALL HAVE A MAXIMUM SLOPE OF 10.00% MEASURED PARALLEL TO THE BACK OF CURB.
5. CLEAR SPACE. A CLEAR SPACE SHALL BE PROVIDED BEYOND THE BOTTOM GRADE BREAK OF A CURB RAMP WHOLLY CONTAINED WITHIN THE CROSSWALK AND WHOLLY OUTSIDE THE PARALLEL VEHICLE TRAVEL PATH. THE CLEAR SPACE SHALL HAVE A MINIMUM CLEAR DIMENSION OF 4FT X 4FT.
6. DETECTABLE WARNING SURFACE. A DETECTABLE WARNING SURFACE SHALL CONSIST OF TRUNCATED DOMES AND BE PLACED AT EACH STREET, HIGHWAY OR RAILROAD CROSSING. THE DETECTABLE WARNING SURFACE SHALL EXTEND A MINIMUM OF 2 FT IN THE DIRECTION OF PEDESTRIAN TRAVEL AND BE PLACED THE ENTIRE WIDTH OF A RAMP, BLENDED TRANSITION, OR TURNING SPACE.
7. RUNNING SLOPE. THE RUNNING SLOPE OF A RAMP, BLENDED TRANSITION, OR TURNING SPACE SHALL BE MEASURED PARALLEL TO THE DIRECTION OF PEDESTRIAN TRAVEL.
 - A. A RUNNING SLOPE OF 2.00% OR LESS IS CONSIDERED LEVEL.
 - B. A RAMP SHALL HAVE A MAXIMUM RUNNING SLOPE OF 8.33% BUT SHALL NOT REQUIRE A RAMP LENGTH TO EXCEED 15 FT.
 - C. A BLENDED TRANSITION SHALL HAVE A MAXIMUM RUNNING SLOPE OF 5.00%.
 - D. A TURNING SPACE SHALL HAVE A MAXIMUM RUNNING SLOPE OF 2.00%.
8. WIDTH. UNLESS OTHERWISE NOTED, MINIMUM WIDTH OF A RAMP, BLENDED TRANSITION, OR TURNING SPACE, EXCLUDING FLARED SIDES OR OR RETURN CURB, SHALL BE 5FT.
9. CROSS SLOPE EXCEPTIONS. THE CROSS SLOPE OF A RAMP, BLENDED TRANSITION, OR TURNING SPACE SHALL BE MEASURED PERPENDICULAR TO THE DIRECTION OF PEDESTRIAN TRAVEL.
 - A. THE MAXIMUM CROSS SLOPE AT A PEDESTRIAN STREET CROSSING WITHOUT YIELD OR STOP CONTROL SHALL BE 5.00%
 - B. THE MAXIMUM CROSS SLOPE AT A PEDESTRIAN STREET CROSSING WITH YIELD OR STOP CONTROL SHALL BE 2.00%.
 - C. THE MAXIMUM CROSS SLOPE AT A MIDBLOCK CROSSING SHALL BE THE ESTABLISHED GRADE OF THE ADJACENT ROADWAY.
10. OBJECTS SUCH AS UTILITY COVER, VAULT FRAME, AND GRATING SHALL BE PLACED OUTSIDE THE CURB RAMP.
11. CURB RAMP SHALL BE PLACED WITHIN THE MARKED CROSSWALK AREA.
12. DRAINAGE INLETS SHOULD BE LOCATED UPHILL FROM A CURB RAMP TO PREVENT PONDING IN THE PATH OF PEDESTRIAN TRAVEL.

SIDEWALK RAMP DETAIL

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STANDARD DETAILS
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DATE: MAY 21st 2001

FIGURE

PS-14

GENERAL NOTES

1. ALL MATERIAL AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS.
2. BARRICADE TYPE III-A AND BARRICADE TYPE III-B WITH SIGNS SHALL INCLUDE CONSTRUCTION SIGNS, TYPICAL SIGN STANDARD, AND CONSTRUCTION WARNING LIGHTS AS SHOWN ON THE STANDARD DETOUR SIGN SHEETS.
3. CONSTRUCTION SIGN TYPE A AND TYPE B SHALL INCLUDED THE SUPPORT, ALL NECESSARY HARDWARE, AND REQUIRED CONSTRUCTION WARNING LIGHTS.
4. THE TEMPORARY BITUMINOUS DIVIDER SHALL INCLUDE THE STANDARD TUBULAR AND TRAFFIC PAINT AS SHOWN.
5. THE FOR BARRICADES TYPE III-A AND III-B. BARRICADES TYPE III-B WITH SIGNS, TYPE A AND B CONSTRUCTION SIGNS, AND CONCRETE BARRIER SHALL BE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS.
6. WOOD MATERIALS ARE TO BE DIMENSION LUMBER IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS.
7. STANDARD DRUMS, TYPE I AND TYPE II BARRICADES, SHALL BE USED ON CONVENTIONAL ROADS, URBAN STREETS AND ARTERIALS. ONLY STANDARD DRUMS AND TYPE I BARRICADES SHALL BE USED ON THE EXPRESSWAYS, FREEWAYS, AND OTHER HIGH SPEED ROADWAYS.
8. UNLESS OTHERWISE SPECIFIED, DRUMS, TYPE I AND TYPE II BARRICADES, CONES, AND TUBULAR MARKERS SHALL BE SPACED AS FOLLOWS:
 - A) NUMERICALLY EQUAL TO THE POSTED SPEED LIMIT, BUT NOT LESS THAN 20 FEET ON TAPERS.
 - B) 50 FEET FRO A POSTED SPEED OF LESS THAN 40 M.P.H. ON TANGENTS.
 - C) 100 FEET FOR A POSTED SPEED EQUAL TO OR GREATER THAN 40 M.P.H. ON TANGENTS.
9. STANDARD CONES AND TUBULAR MARKERS SHALL BE A MINIMUM OF 18 INCHES IN HEIGHT FOR POSTED SPEEDS UP THROUGH 40 M.P.H. AND A MINIMUM OF 28 INCHES FOR POSTED SPEEDS OVER 40 M.P.H.
10. REFLECTORIZED BANDS MAY BE OMITTED FROM CONES OR TUBULAR MARKERS FOR LANE CLOSURES DURING DAYLIGHT HOURS.
11. THE STRIPES ON BARRICADES TYPE I AND II SHALL SLOPE DOWNWARD TOWARD THAT SIDE OF WHICH THE APPROACHING VEHICLE MUST PASS. FOR TYPE II-A AND II-B BARRICADES, THE STRIPES SHALL SLOPE DOWNWARD IN THE DIRECTION TOWARD WHICH THE TRAFFIC MUST TURN IN DETOURING, AND WHERE BOTH RIGHT AND LEFT TURNS ARE PROVIDED. THE STRIPING SHALL SLOPE DOWNWARD IN BOTH DIRECTIONS FROM THE CENTER OF THE BARRICADE.
12. ALL BARRICADES SHALL HAVE REFLECTORIZED STRIPING ON THOSE SIDES WHICH ARE APPROACHABLE BY TRAFFIC. WHEN BARRICADES ARE APPROACHABLE BY TRAFFIC IN BOTH DIRECTIONS, SPECIFIED CONSTRUCTION WARNING LIGHTS SHALL HAVE BI-DIRECTIONAL LENSES.
13. FOR BARRICADES TYPE I AND II LESS THAN 3 FEET IN LENGTH, THE WIDTH OF THE STRIPES SHALL BE 4 INCHES.
14. ALL BARRICADES SHALL BE WEIGHTED WITH SANDBAGS FOR STABILITY AS SHOWN.
15. THE DETOUR ARROW SIGN SHALL BE USED ONLY WHEN A DETOUR ROUTE HAS BEEN SIGNED.
16. UNLESS OTHERWISE SPECIFIED, CONSTRUCTION SIGNS SHALL BE MOUNTED ON PORTABLE ON NON-PORTABLE SUPPORTS ONLY AS DESCRIBED HEREIN. A PORTABLE SUPPORT IS A TYPICAL SIGN STANDARD AS SHOWN ON THIS SHEET, OR SHALL LIGHT WEIGHT TRAILER IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS. NON-PORTABLE SUPPORTS ARE DRIVEN METAL OR WOODEN POSTS AS DESIGNATED ON STANDARD DETOUR SIGNS SHEET AND SIGN DESIGN DETAILS SHEETS. ALL SIGNS SHALL BE MOUNTED SUCH THAT THE MESSAGE ON THE SIGN IS LEVEL IN THE HORIZONTAL PLANE AFTER PLACEMENT.
17. THE MINIMUM VERTICAL CLEARANCE FOR CONSTRUCTION SIGNS SHALL BE AS FOLLOWS:
 - A) 7 FEET BETWEEN THE TOP AND THE CURB AND THE BOTTOM OF THE SIGN ON CURBED ROADWAY SECTIONS.
 - B) 5 FEET BETWEEN THE EDGE OF PAVEMENT AND THE BOTTOM OF THE SIGN ON NON-CURBED ROADWAY SECTIONS.
 - C) AN ADVISORY SPEED PLATE, REQUIRED TO BE PLACED WITH ANOTHER WARNING SIGN, SHALL BE MOUNTED ON THE POST CLOSEST TO THE ROADWAY AT A MINIMUM CLEARANCE OF 4 FEET ABOVE THE EDGE OF PAVEMENT. THE BOTTOM OF THE CONSTRUCTION WARNING SIGN SHALL NOT BE LOWER THAN THE TOP OF TE ADVISORY SPEED PLATE.
18. THE MINIMUM HORIZONTAL CLEARANCE FOR CONSTRUCTION ON NON-CURBED ROADWAY SECTIONS SHALL BE AS FOLLOWED:
 - A) THE GREATER OF 12 FEET FROM THE EDGE OF THE PAVEMENT OR 6 FEET FROM THE EDGE OF THE PAVED SHOULDER TO THE NEAR EDGE OF THE SIGN FOR NON-PORTABLE SUPPORT MOUNTED SIGNS AND FOR PORTABLE SUPPORT MOUNTED SIGNS DURING THE NIGHT-TIME HOURS.
 - B) 6 FEET FROM THE EDGE OF PAVEMENT TO THE NEAR EDGE OF THE SIGN FOR PORTABLE SUPPORT MOUNTED SIGNS DURING DAYLIGHT HOURS.
19. THE MINIMUM HORIZONTAL CLEARANCE FOR CONSTRUCTION SIGNS ON CURBED ROADWAY SECTIONS SHALL BE 2 FEET FROM THE FACE OF THE CURB TO THE NEAR EDGE OF THE SIGN.
20. LATERAL PLACEMENT OF CONSTRUCTION SIGNS MAY BE ADJUSTED BY THE ENGINEER ONLY IN R/W IS RESTRICTED.
21. A 1 FOOT SECTION OF THE CONCRETE BARRIER SHALL BE REMOVED OR OMITTED EVERY 25 FEET TO PROVIDE DRAINAGE ON TILT PAVEMENTS.

TRAFFIC CONTROL

REVISION DATE

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FIGURE

PS-15

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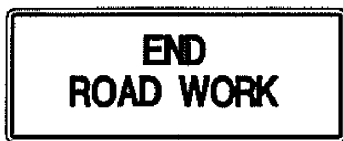
XG20-1
60"x36"

39



XG20-2
60"x24"

40



XG20-2a
60"x24"

41 42



XM4-9(R or L)
30"x24"

XM4-9-B(R or L)
60"x48"

43 44



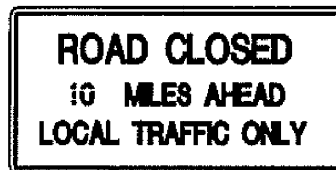
XW1-6
48"x24"
XW1-6-A
60"x30"

45



R11-2
48"x30"

46



R11-3
60"x30"

47



R11-4
60"x30"

TRAFFIC CONTROL SIGN DETAILS

REVISION DATE

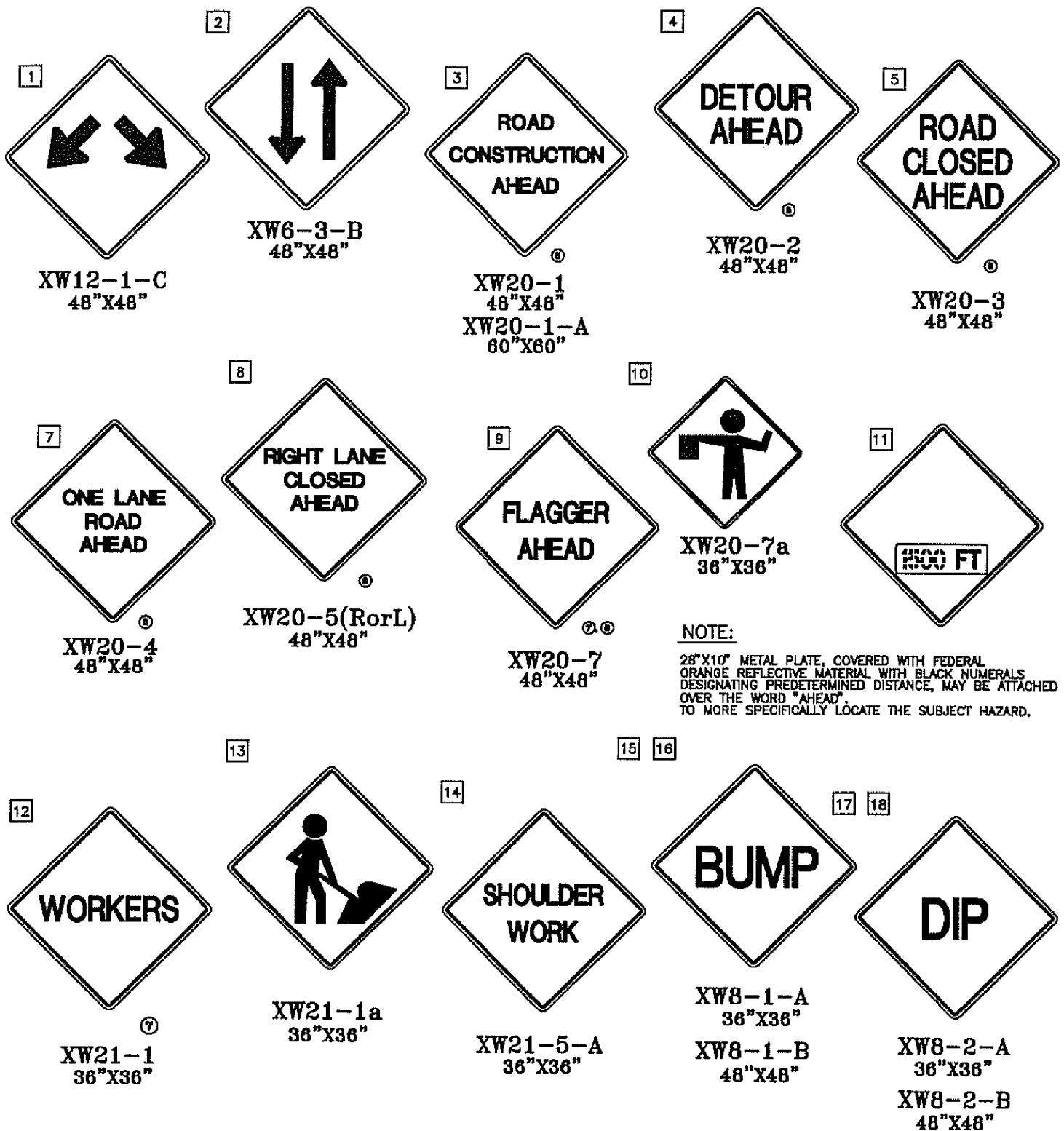
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FIGURE

PS-16



TRAFFIC CONTROL SIGN DETAILS

REVISION DATE

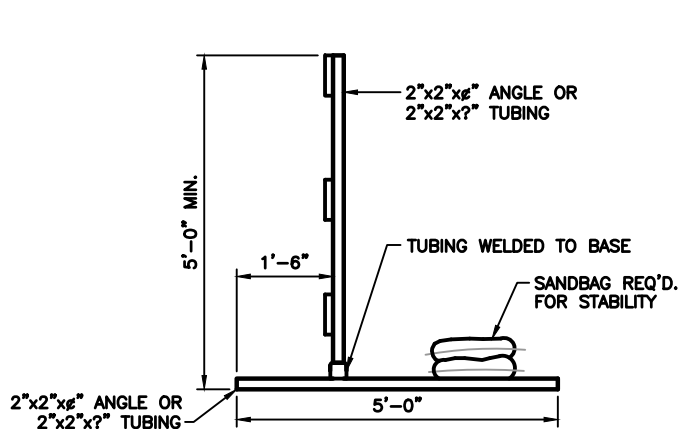
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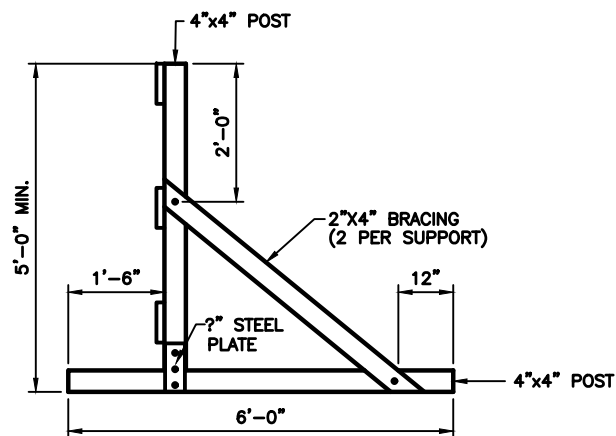
DATE: MAY 21st 2001

FIGURE

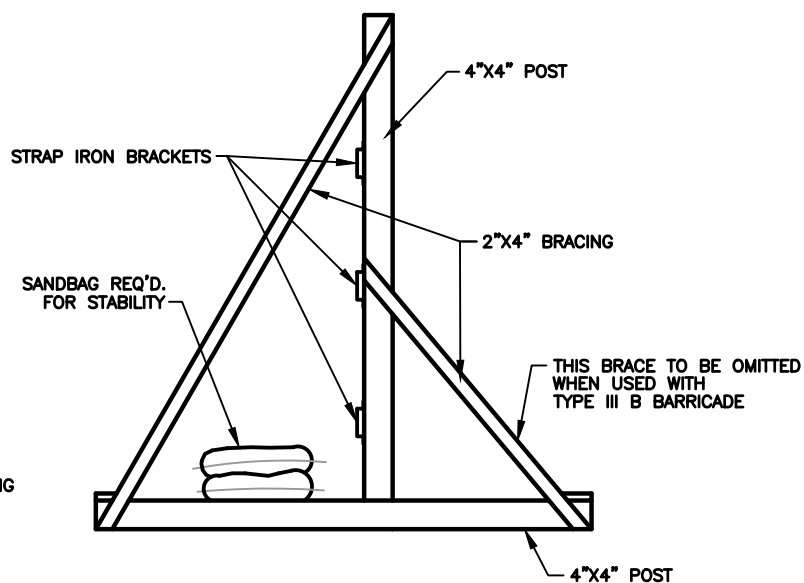
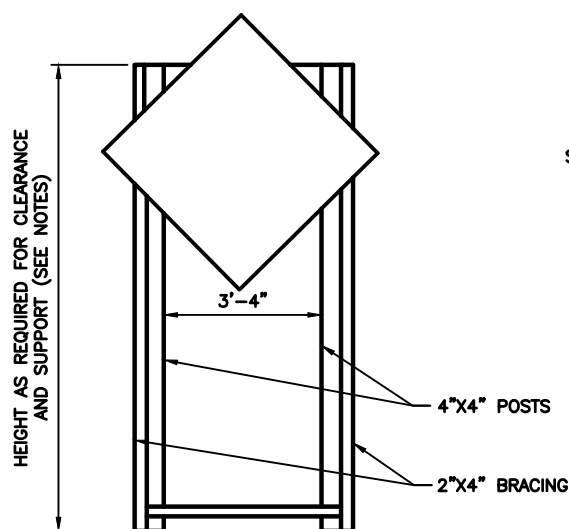
PS-17



STEEL SUPPORTS



WOOD SUPPORTS



DETAIL OF TYPICAL SIGN STANDARD (T.S.S.)

TRAFFIC CONTROL SIGN STANDARD DETAILS

REVISION DATE

09/2019

CITY of MONTICELLO, INDIANA STANDARD DETAILS PUBLIC STREETS AND ALLEYS

DATE: MAY 21st 2001













FIGURE

PS-18

GENERAL NOTES:

1. DISTANCES SHOWN ARE TYPICAL EXCEPT MINIMUM DISTANCES MAY BE VARIED BASED ON FIELD CONDITIONS.
2. THE SPACING OF DRUMS AND CONES ON TANGENTS SHALL BE AS FOLLOWS:
 - a. WHERE THE POSTED SPEED LIMIT IS 50 mph. OR GREATER, THE SPACING SHALL BE 100 ft.
 - b. WHERE THE POSTED SPEED LIMIT IS LESS THAN OR EQUAL TO 45 mph., THE SPACING SHALL BE 50 ft.
3. THE SPACING OF CHANNELIZING DEVICES ON TAPERS SHALL BE NUMERICALLY EQUAL IN FEET TO THE POSTED SPEED LIMIT IN mph.
4. THE FLASHING ARROW SIGN SHALL NOT BE PLACED ON A SIDEWALK. THE FLASHING ARROW SIGN SHALL BE PLACED AT A DISTANCE OF $L/3$ FROM THE BEGINNING OF THE TAPER.
5. FOR TEMPORARY LANE CLOSURES DURING DAYLIGHT HOURS, CONES OR TUBULAR MARKERS MAY BE USED IN LIEU OF DRUMS.
6. TEMPORARY PAVEMENT MARKINGS WILL NOT BE REQUIRED FOR TEMPORARY DAYLIGHT LANE CLOSURES.
7. MINIMUM PAVEMENT SECTION FOR 1000 TRUCKS PER DAY OR LESS SHALL CONSIST OF 165 #/syd OF HMA SURFACE, ON 330 #/syd OF HMA INTERMEDIATE, ON 935 #/syd OF HMA BASE, ON 8 IN SUBGRADE TREATMENT. IF THE TRUCK COUNT FOR THE CROSSOVER IS GREATER THAN 1000 TRUCKS PER DAY, THE REQUIRED PAVEMENT SECTION WILL BE PROVIDED ELSEWHERE IN THE PLANS.
8. TEMPORARY HIGHWAY ILLUMINATION, WHEN SPECIFIED, SHALL BE AS DETAILED ELSEWHERE IN THE PLANS.
9. ONCE THE CROSSOVERS HAVE BEEN REMOVED, THE LINE SHALL BE RESTRIPTED YELLOW, IF THE PAVEMENT IS TO AGAIN TO BE USED FOR ONE-WAY TRAFFIC.
10. FOR TEMPORARY CROSSOVER TYPE B, THIS LINE SHALL BE REMOVED WHEN THE TRAFFIC PATTERN IS SWITCHED.
11. THE ADVISORY SPEED PLATE WILL NOT BE REQUIRED WHEN THE EXISTING POSTED SPEED LIMIT IS LESS THAN 55 mph.
12. SPACING OF CHANNELIZING DEVICES AT THIS LOCATION SHALL BE 20 ft.
13. THE "TWO-WAY TRAFFIC" (XW6-3B) AND "DO NOT PASS" (R4-1-B) SIGNS SHALL ALTERNATE EVERY 2600 ft. THROUGHOUT THE TWO-LANE TWO-WAY OPERATION.
14. FOR A BRIDGE CONTRACT, THE DISTANCE MAY BE ADJUSTED BY THE ENGINEER AS REQUIRED. HOWEVER, IT SHALL BE AS CLOSE TO THE MINIMUM AS POSSIBLE.
15. ONCE THE CROSSOVERS HAVE BEEN REMOVED, THIS LINE SHALL BE RESTRIPTED BROKEN WHITE, IF THE PAVEMENT IS TO AGAIN BE USED FOR ONE WAY TRAFFIC.

LEGEND

	REMOVAL OF PAVEMENT MARKINGS AND PRISMATIC REFLECTORS
	TYPE III-A OR III-B BARRICADES AS SHOWN
	CHANNELIZING DEVICE
	FLAGGER
	WORK AREA
	FLASHING ARROW SIGN
	POLICE CAR (OPTIONAL)
	CONSTRUCTION SIGN AND SUPPORTS
	TEMPORARY PAVEMENT MARKING
	TYPICAL SIGN STANDARD (ROAD CLOSURE SIGN ASSEMBLY)
	DOUBLE HEADED FLASHING ARROW SIGN
	DIRECTION OF TRAFFIC
W= WIDTH OF OFFSET	

TRAFFIC CONTROL DEVICE LEGEND AND GENERAL NOTES

REVISION DATE

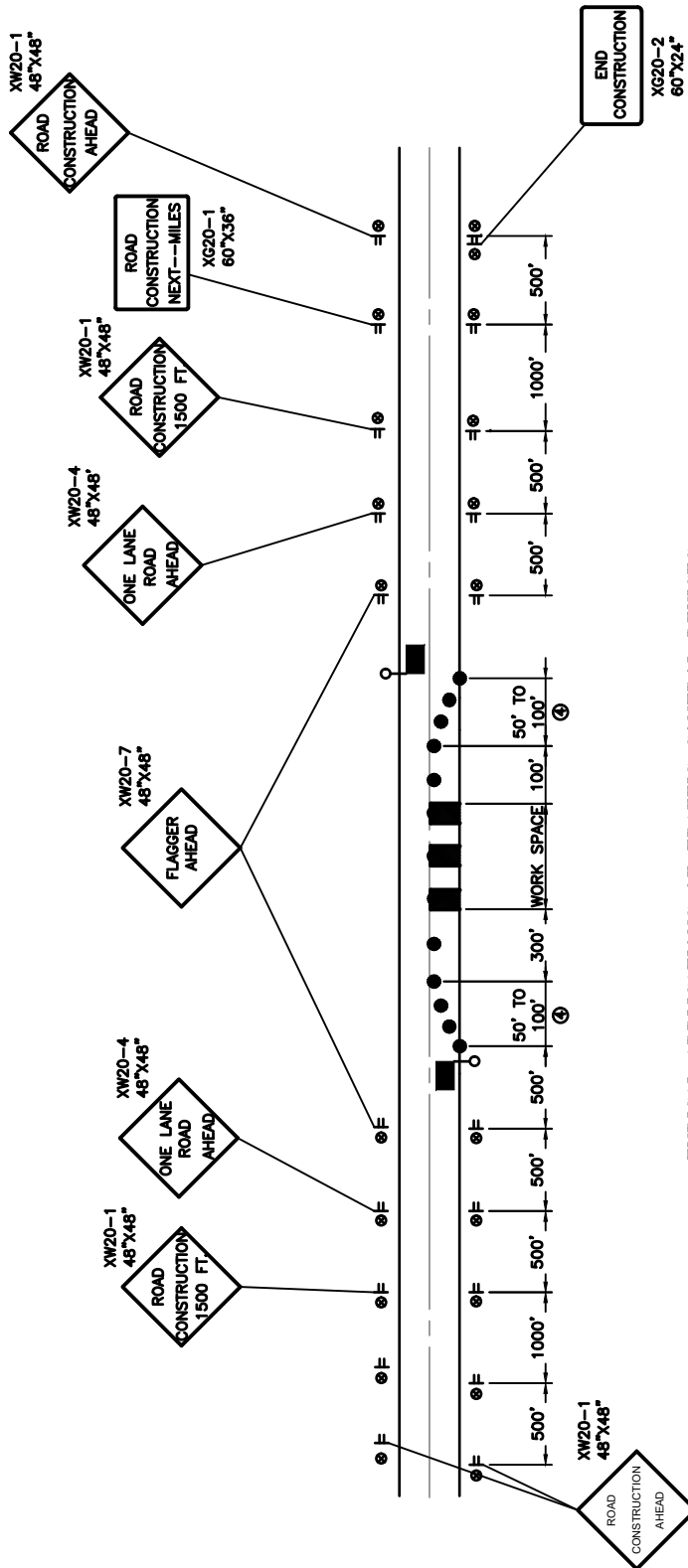
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DATE: MAY 21st 2001

FIGURE

PS-19



**TYPICAL APPLICATIONS OF TRAFFIC CONTROL DEVICES
FOR SINGLE LANE TWO-WAY TRAFFIC WITH
FLAGGER CONTROL**

DETAIL NO. 1
NO SCALE

TRAFFIC CONTROL DEVICE LOCATIONS

CITY of MONTICELLO, INDIANA STANDARD DETAILS PUBLIC STREETS AND ALLEYS

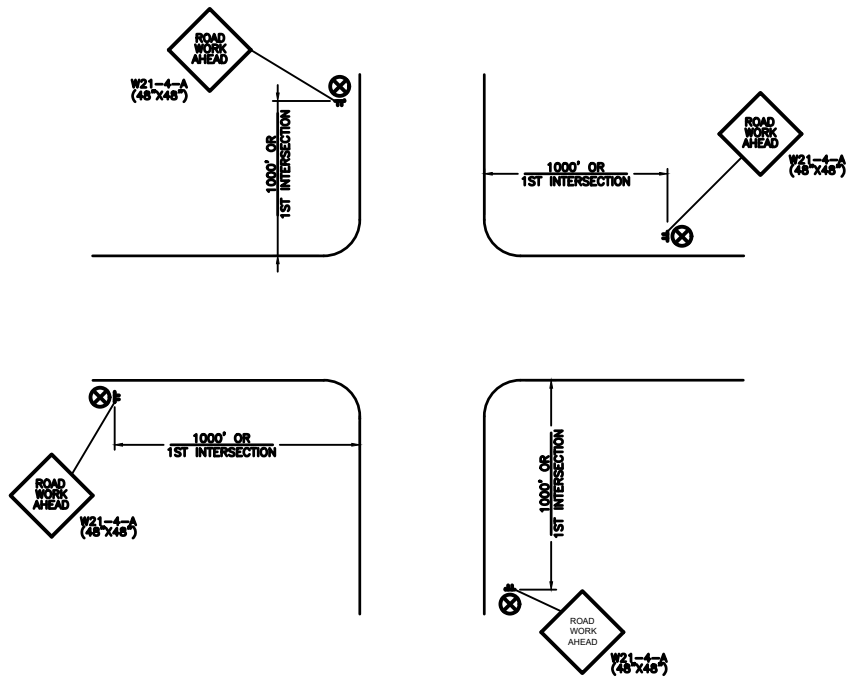
FIGURE

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REVISION DATE

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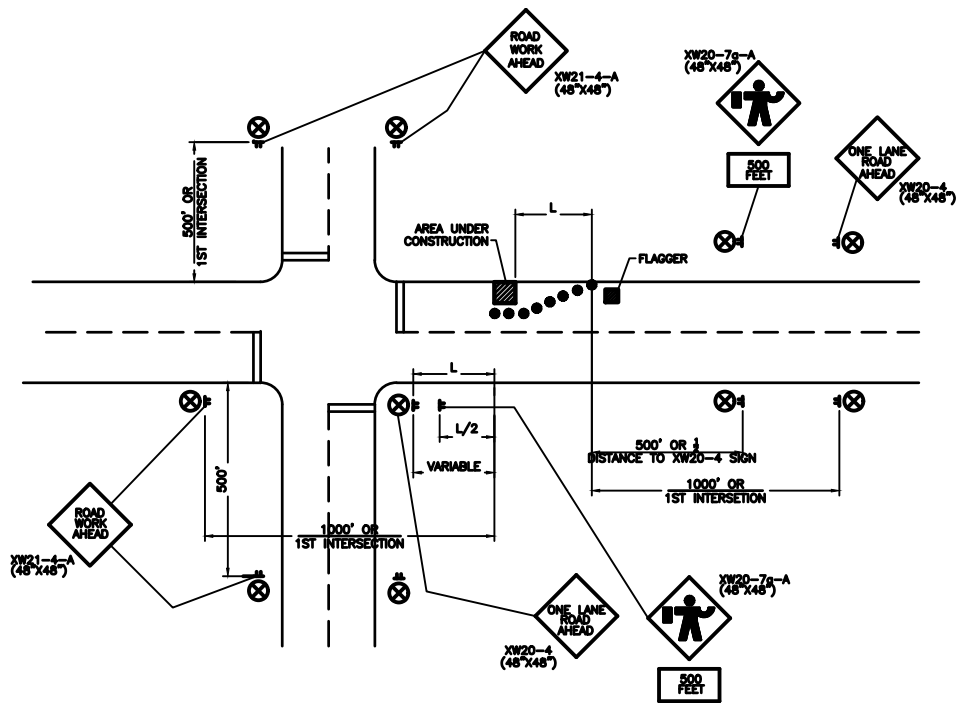
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CONSTRUCTION AT INTERSECTION

DETAIL NO. 2

NO SCALE



CONSTRUCTION ON PAVEMENT (2 LANES)

DETAIL NO. 3

NO SCALE

TRAFFIC CONTROL DEVICE LOCATIONS

REVISION DATE

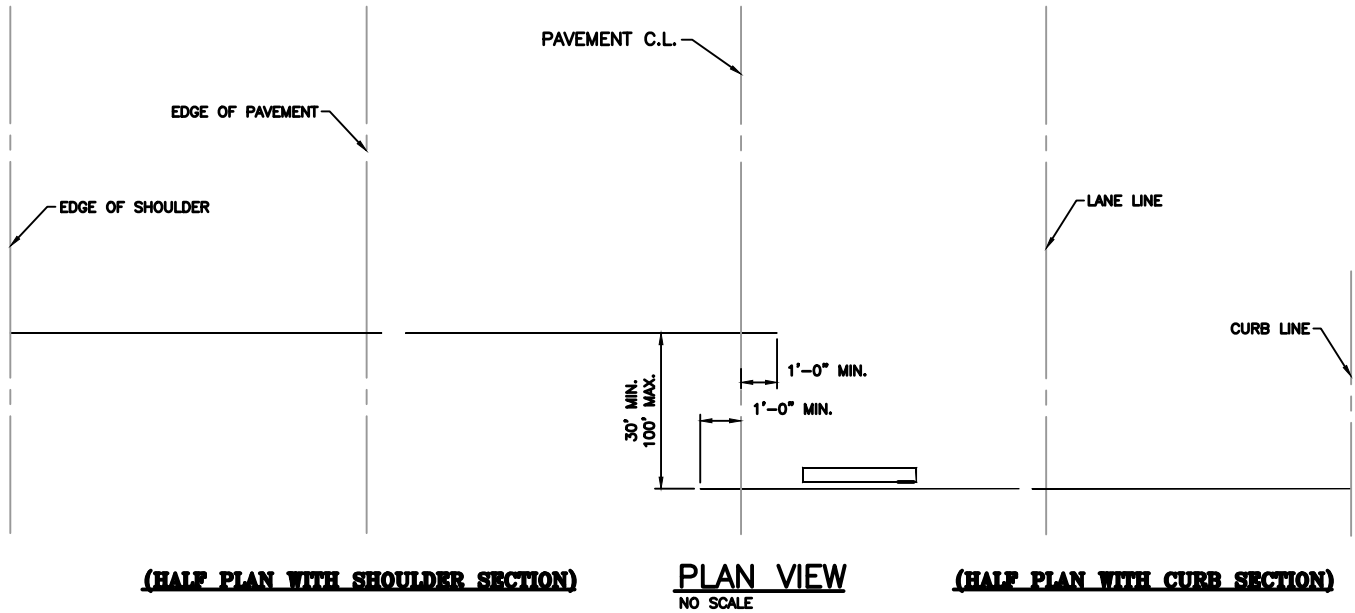
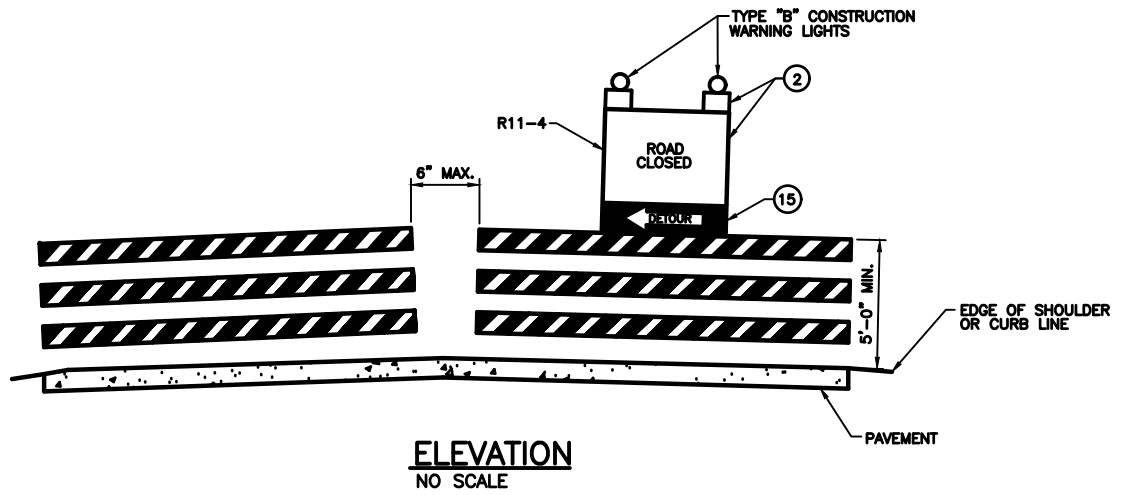
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FIGURE

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TRAFFIC CONTROL BARRICADE DETAILS

REVISION DATE

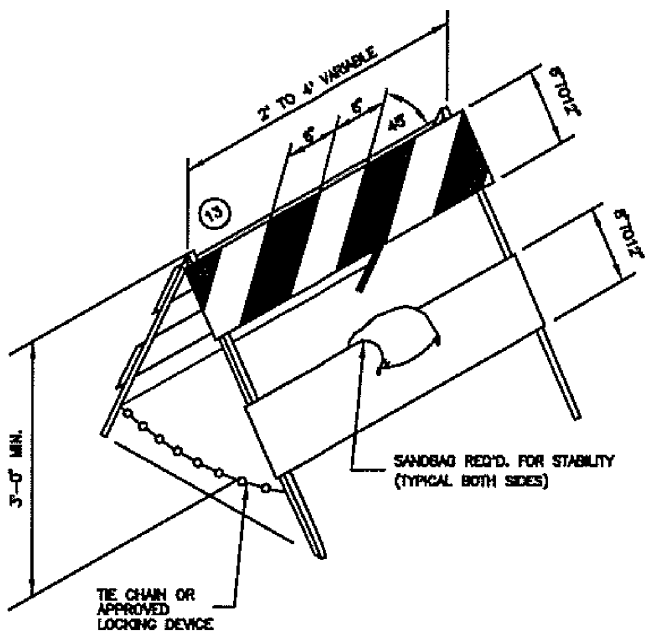
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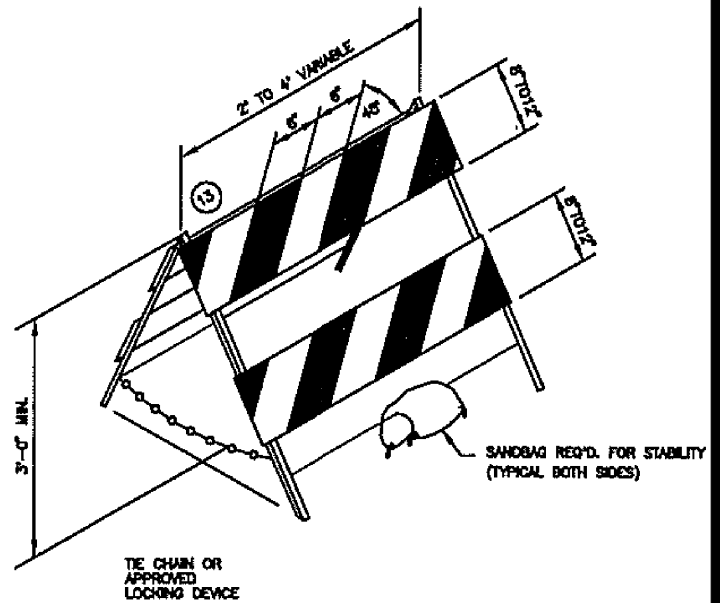
DATE: MAY 21st 2001

FIGURE

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BARRICADE TYPE I



BARRICADE TYPE II

TRAFFIC CONTROL BARRICADE DETAILS

REVISION DATE

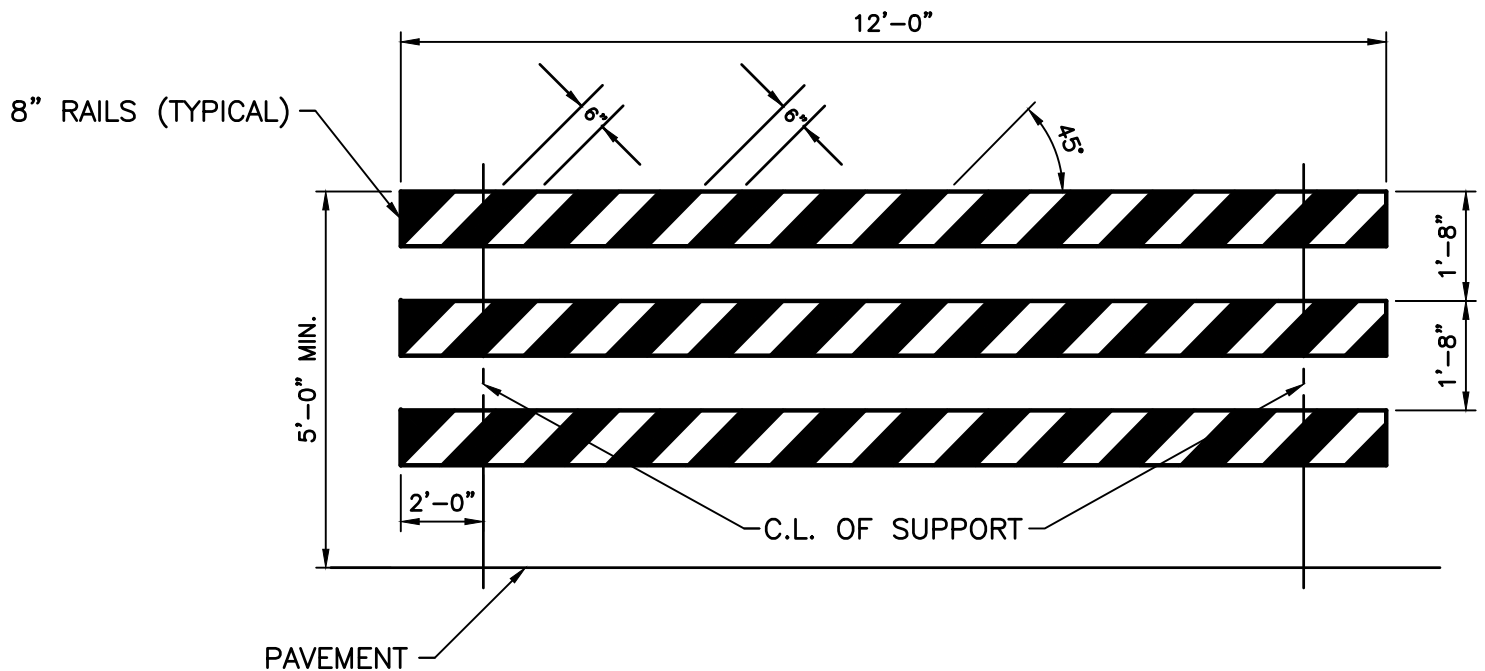
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DATE: MAY 21st 2001

FIGURE

PS-23



NOTE:
RAILS SHALL BE REFLECTORIZED ON BOTH SIDES

TRAFFIC CONTROL BARRICADE TYPE III-B DETAILS

REVISION DATE

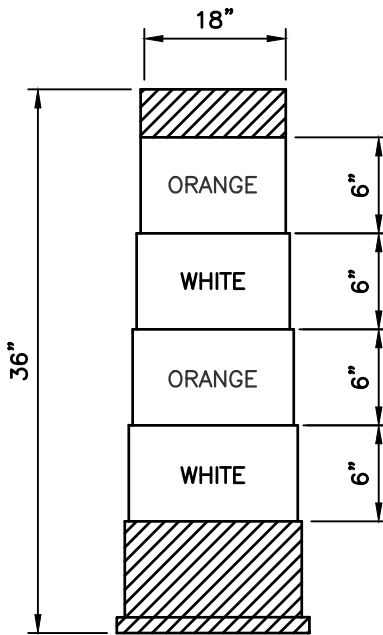
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DATE: MAY 21st 2001

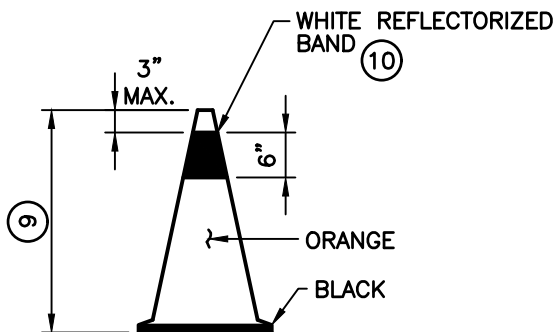
FIGURE

PS-24

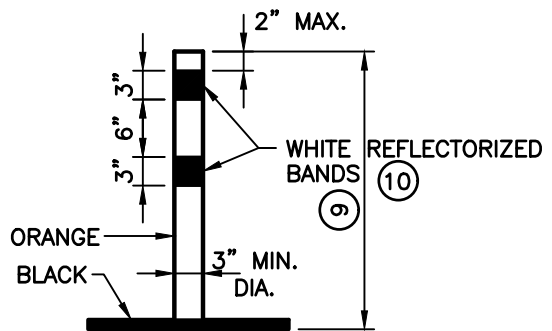


BLACK OR OTHER APPROVED COLOR

STANDARD DRUM



STANDARD CONE



STANDARD TUBULAR MARKER

TRAFFIC CONTROL CONE/DRUM/TUBULAR MARKER DETAILS

REVISION DATE

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CITY of MONTICELLO, INDIANA STANDARD DETAILS PUBLIC STREETS AND ALLEYS

DATE: MAY 21st 2001

FIGURE

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GENERAL NOTES

1. TEMPORARY CONCRETE SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS.
2. TEMPORARY CONCRETE BARRIER SHALL BE DELINEATED AS SHOWN. TYPE "C" CONSTRUCTION WARNING LIGHTS SHALL BE ATTACHED AS SHOWN AND SHALL BE SPACED NUMERICALLY EQUAL TO THE 85 PERCENTILE SPEED WITH A MINIMUM SPACING OF 20" C-C. WIDE ANGLE REFLECTORS SHALL BE MOUNTED AS SHOWN AND SHALL BE REQUIRED ON BOTH SIDES OF THE BARRIER WHEN THE BARRIER IS USED TO SEPARATE OPPOSING TRAFFIC.
3. THE DIMENSION OF THE LIFTING SLOTS ARE SUBJECT TO ADJUSTMENT AS NECESSARY TO ACCOMMODATE HANDLING EQUIPMENT.
4. HEX NUT MAY BE TACK WELDED TO BOTTOM SPACER TO FACILITATE INSTALLATION AND REMOVAL. BOLTS SHALL BE TORQUED ONLY TO TIGHT CONDITION. CLEARANCE BETWEEN SPACER S1 AND THE ENDS OF THE BARRIER SHOULD ALLOW ANGULAR DEFLECTION AT THE JOINTS TO PERMIT FLARE RATE OF 10:1.
5. WHEN ANCHORING AGAINST LATERAL MOVEMENT IS SPECIFIED FOR TEMPORARY CONCRETE BARRIER LOCATED ON CONCRETE OR BITUMINOUS PAVEMENT OF SHOULDER, THE METHOD OF ANCHORING SHALL BE AS SHOWN AND SHALL BE ACCORDANCE WITH THE STANDARD SPECIFICATIONS, INDOT, LATEST EDITION.

TRAFFIC CONTROL CONCRETE BARRIER GENERAL NOTES

REVISION DATE

09/2019

CITY of MONTICELLO, INDIANA STANDARD DETAILS PUBLIC STREETS AND ALLEYS

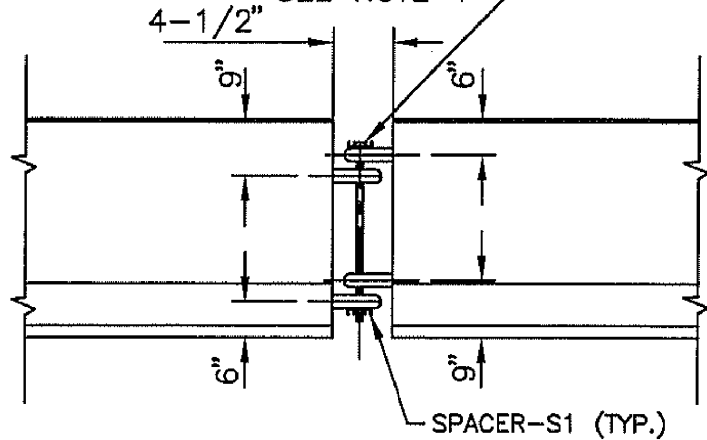
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FIGURE

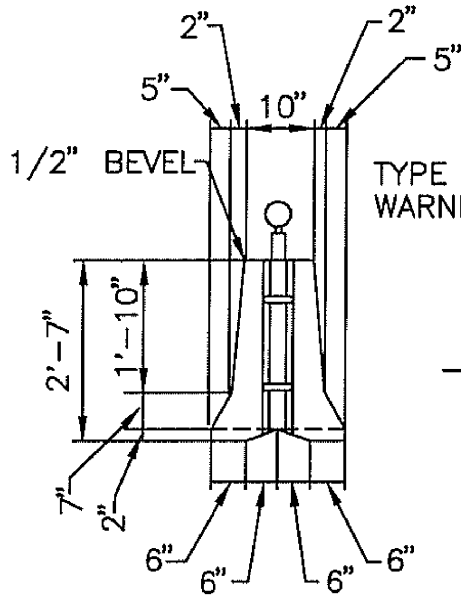
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1" DIA. BOLT X 1'-10 (4" MIN. THREAD, HEX HEAD AND HEX NUT)
SEE NOTE 4

TABLE NO. 1	
CONSTR. ZONE SPEED	TAPER FLARE RATE
20	10:1

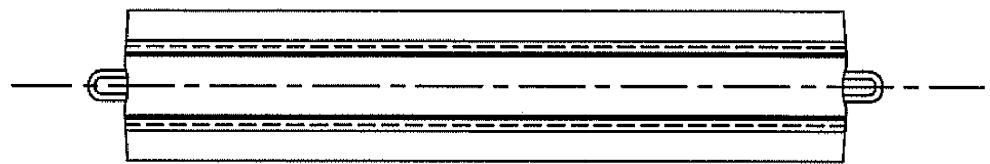


FRONT VIEW
NOT TO SCALE

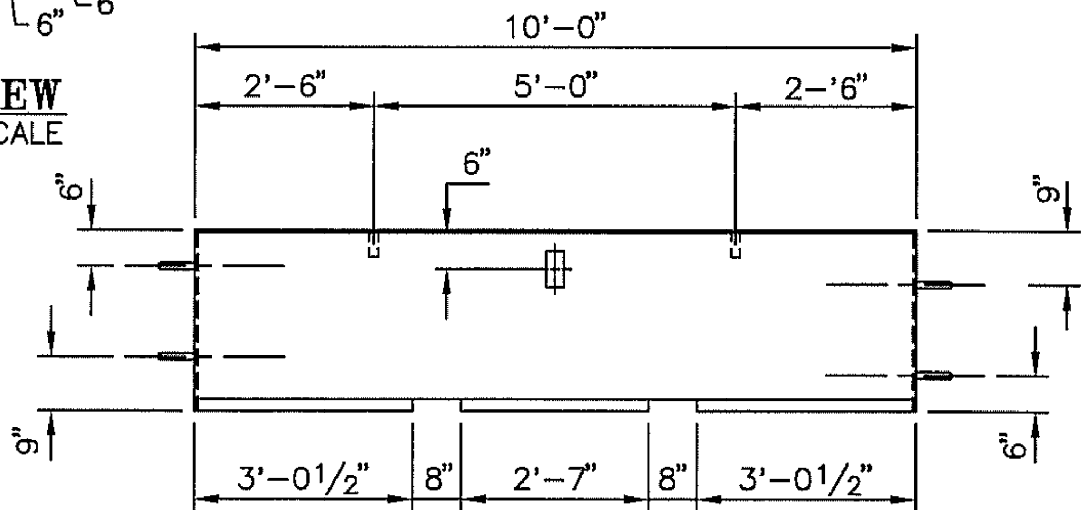


END VIEW
NOT TO SCALE

TYPE "C" CONSTRUCTION
WARNING LIGHT



TOP VIEW
NOT TO SCALE



FRONT VIEW
NOT TO SCALE

TRAFFIC CONTROL CONCRETE BARRIER DETAIL

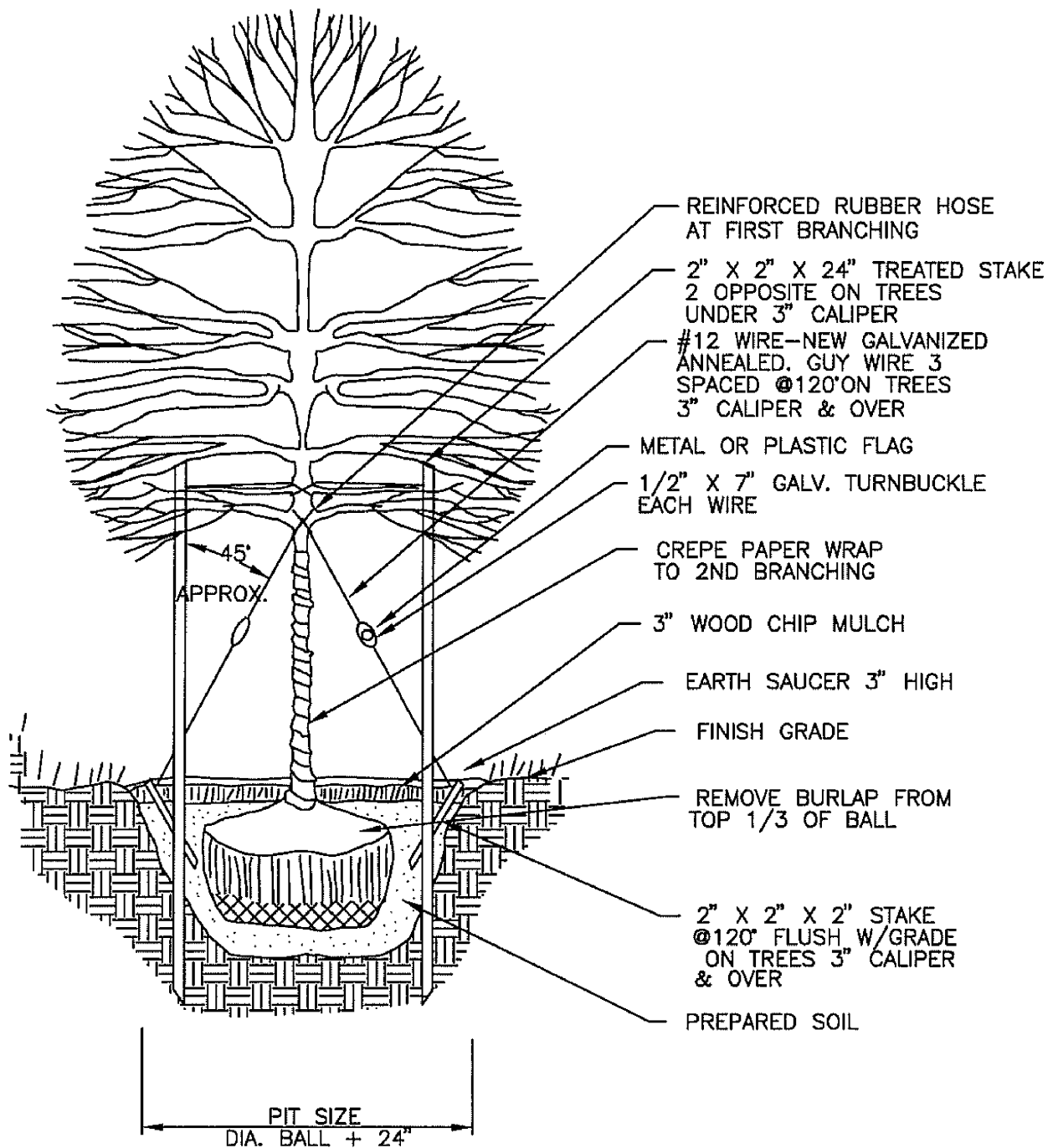
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CITY of MONTICELLO, INDIANA STANDARD DETAILS PUBLIC STREETS AND ALLEYS

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FIGURE

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TREE PLANTING DETAIL

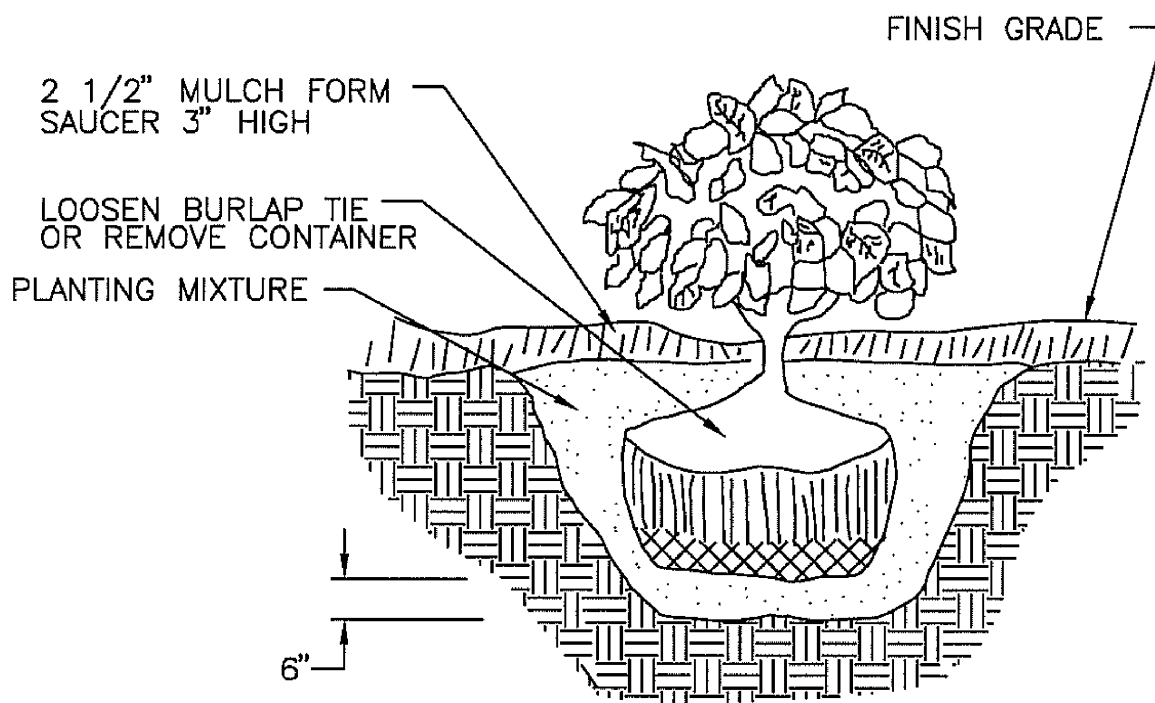
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CITY of MONTICELLO, INDIANA STANDARD DETAILS PUBLIC STREETS AND ALLEYS

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FIGURE

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SHRUB PLANTING DETAIL

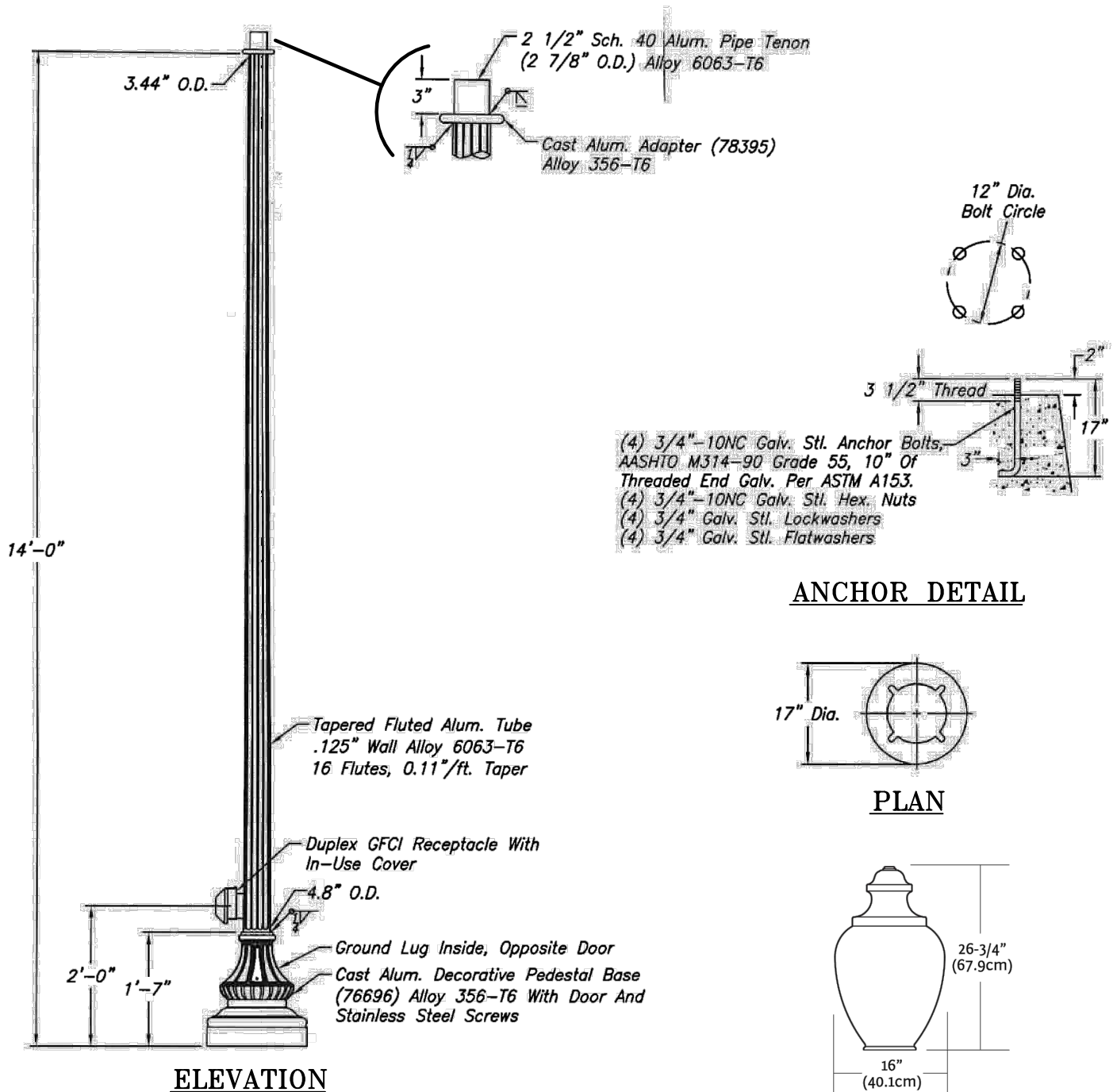
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CITY of MONTICELLO, INDIANA
STANDARD DETAILS
PUBLIC STREETS AND ALLEYS

FIGURE

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14-FOOT LIGHTING POLE DETAIL

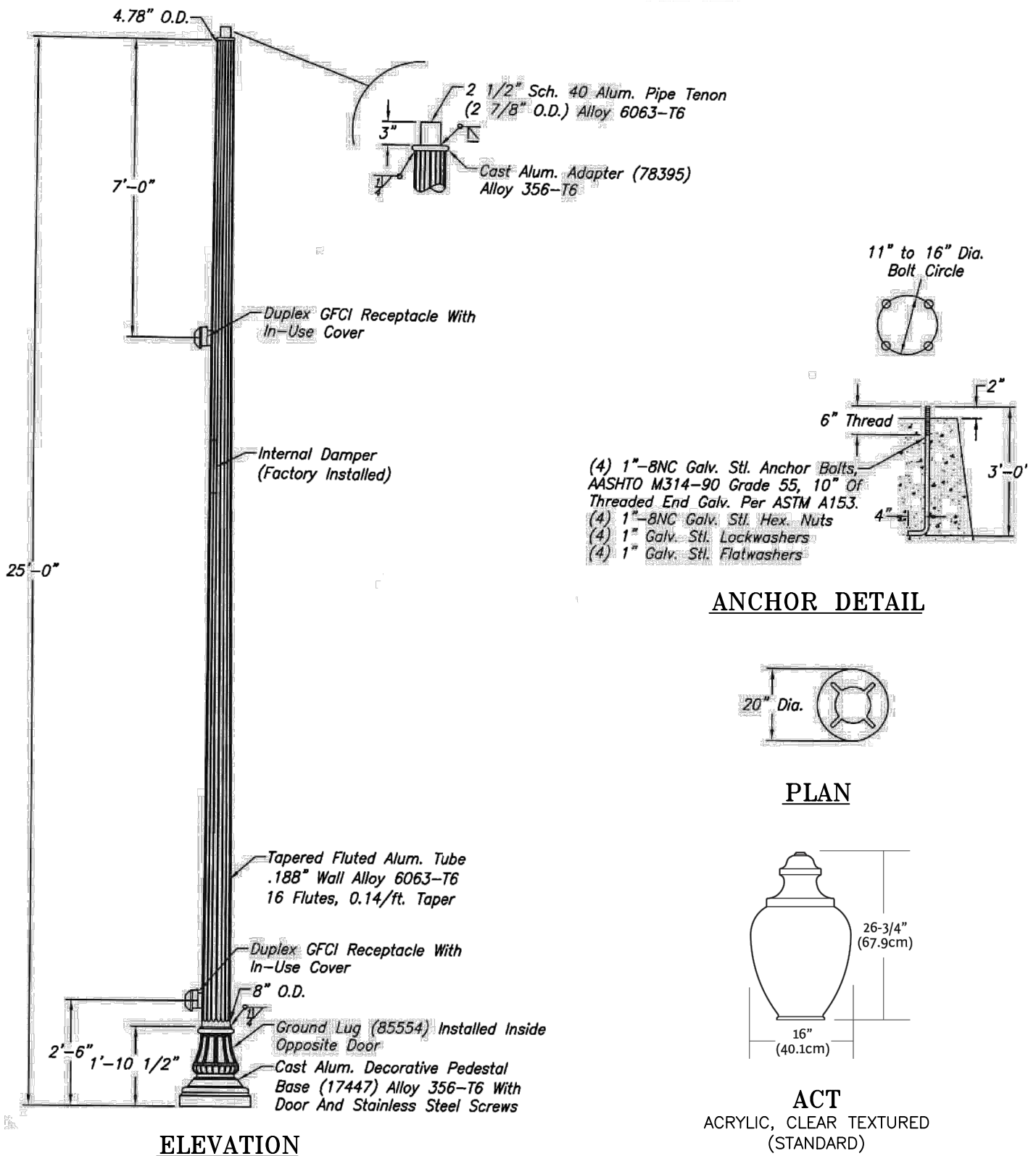
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CITY of MONTICELLO, INDIANA STANDARD DETAILS PUBLIC STREETS AND ALLEYS

FIGURE

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25-FEET LIGHTING POLE DETAIL

CITY of MONTICELLO, INDIANA STANDARD DETAILS PUBLIC STREETS AND ALLEYS

FIGURE

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