Engineering Standards Manual

Charter Township of Van Buren

April 2014

Prepared by

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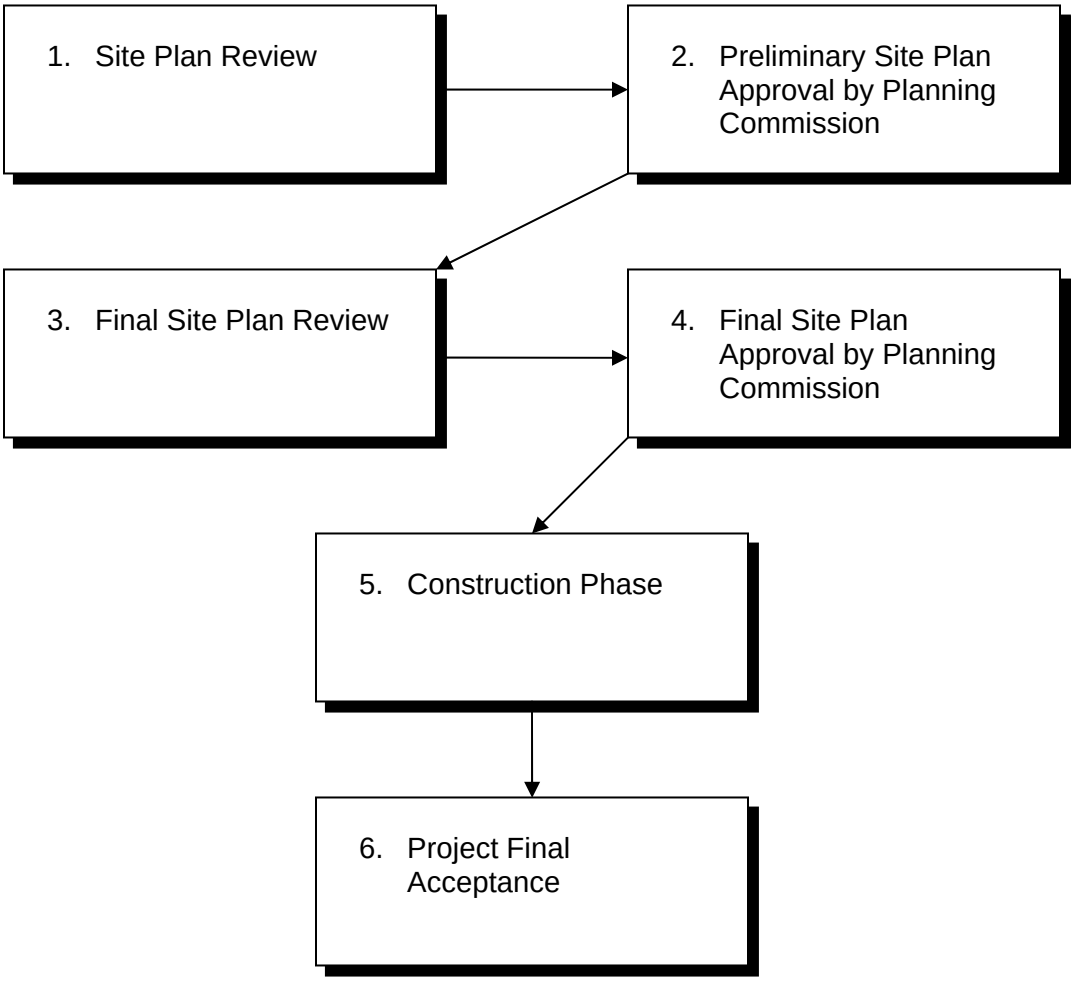
Van Buren
CHARTER TOWNSHIP

ENGINEERING STANDARDS MANUAL

Chapter I
Project Process Overview

The development process in the township consists of six general steps. These steps are shown on the Project Process Overview flowchart below.



Each of these steps is explained in more detail in the following chapters. The process is intended to provide the township with the regulatory controls necessary to ensure compliance with ordinances, policies, and adopted standards, with the least time and financial impacts on developers. This manual covers the engineering aspects of the process. Planning and zoning aspects are addressed in the Zoning Ordinance.

A. Site Plan Review

1. Site Plan Review

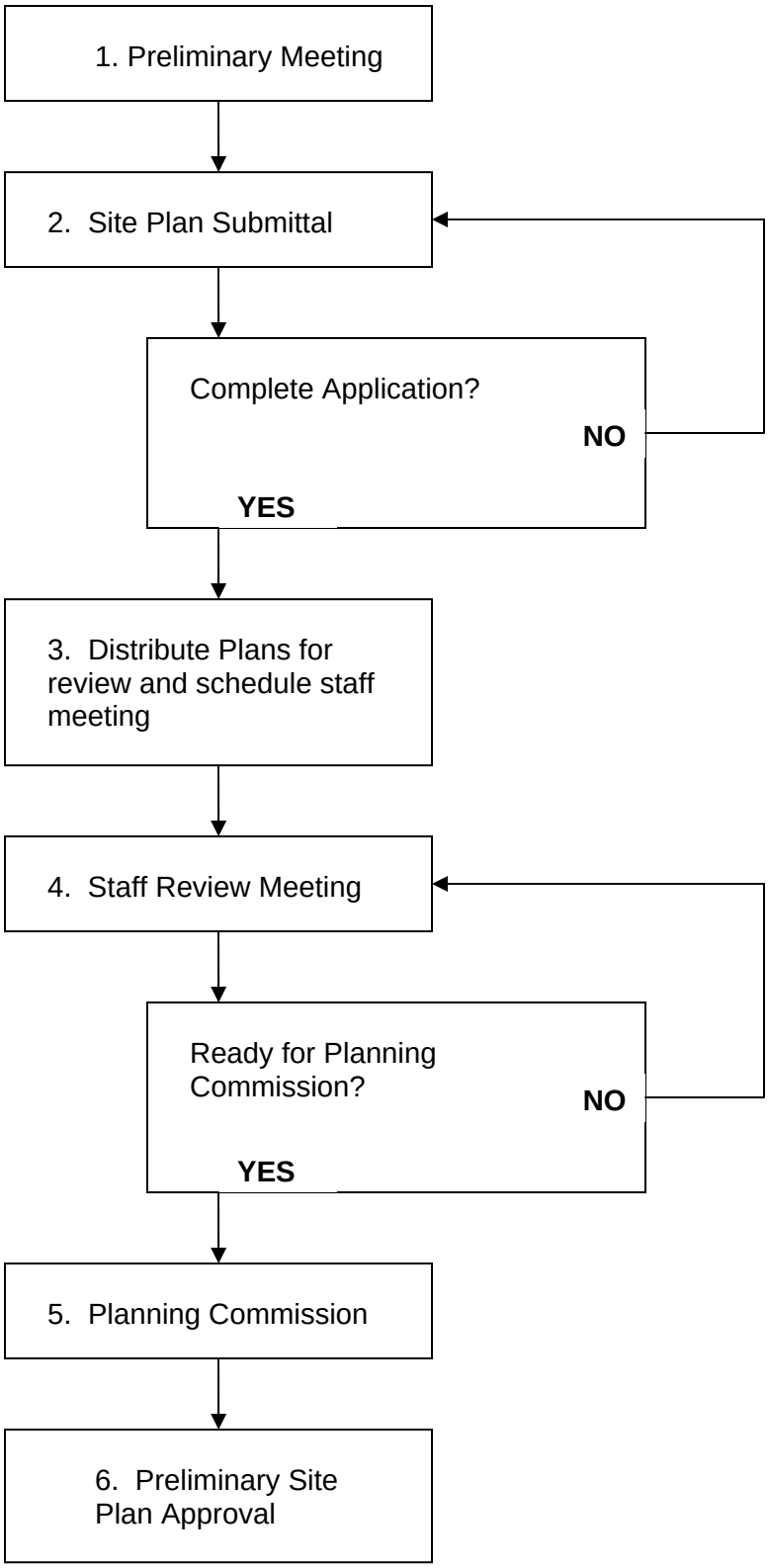
The purpose of the site plan review, from an engineering standpoint, is to determine if the proposed project can be constructed as presented by the Developer. Site access and municipal utilities such as water, sanitary sewer, and storm drainage are reviewed for general compliance with established Township, County, and State standards. The Developer must show these systems in adequate detail so that the township can determine the feasibility of the project.

The primary goal of the site plan review is to determine if the proposed project complies with zoning and development ordinances. The township planning department is primarily responsible for this review. Engineering concerns are also reviewed to establish locations and relative sizes of physical features on the site. This is important so that ponds, easements, roadways, and other features do not change significantly later on in the process. Such changes could affect location, size, and/or configuration of the lots and other property divisions that have received preliminary approval by the Planning Commission.

The site plan process is also intended to inform the Developer of the regulatory permits and processes that must be complied with in order to make the project move forward. It is important to the township that the Developer understands the entire process and has adequate resources at hand to complete the project.

The site plan process is shown in detail on the flow chart on the following page. The Planning Commission will review and grant approval for preliminary site plan. The process is slightly different for a plat than for other types of developments as the preliminary plat must be reviewed by the township Board of Trustees.

Preliminary Site Plan Review Process



1. Site Plan Review
- Preliminary Meeting
- Site Plan Submittal
- Distribute for Review
- Staff Review Meeting
- Planning Commission

Preliminary Meeting

The first step in the site plan review is to have a preliminary meeting with the township staff. This meeting may be a simple visit to the information counter, or a scheduled meeting with the staff. Applicants are encouraged to bring concept sketches and diagrams to this meeting showing the basic layout of the project.

At the preliminary meeting, the township Planning Department can verify that the proposed project has the correct zoning and that the proposed uses are allowed within that zone. The preliminary meeting can help to identify special use permits, variances, and other planning approvals that may be necessary for the project.

The Developer will also receive the application packet and other important information and instructions that are needed to assemble a complete site plan submittal.

1. Site Plan Review
- Preliminary Meeting
- Site Plan Submittal
- Distribute for Review
- Staff Review Meeting
- Planning Commission

Site Plan Submittal

The site plan submittal includes several important documents, including the following:

- Application for Site Plan Review
- Preliminary Site Plan Sheets (12 sets of drawings)
- Payment of Review Fees

The site plan sheets are required to follow a predetermined format, with specific information being shown on certain drawings. This format is designed to help the applicant to include all the information necessary for a complete application. The standard plan format also makes the plans easier to review.

The site plan submittal should be made directly to the township Planning Department. Once received, the submittal will be reviewed to ensure that all the required documents are included. Incomplete submittals will not be accepted.

1. Site Plan Review
- Preliminary Meeting
- Site Plan Submittal
- Distribute for Review
- Staff Review Meeting
- Planning Commission

Plan Review and Staff Review Meeting

Once the application is found to be complete, the preliminary site plans will be distributed to the following departments for review and comment:

- Planning/Economic Development Department
- Water and Sewer Department
- Environmental Department
- Assessing Department
- Police Department
- Fire Department
- Engineering Consultant
- Planning Consultant
- Township Board Liaison

When a proposed project has impacts on facilities owned by other jurisdictions, those agencies will be asked to review and provide comments on the preliminary site plan. Additional copies of the site plan will be requested from the applicant if outside agency review is necessary.

The township will set a date and time for the staff review meeting. Typically, staff review meetings are held on the first and third Wednesdays of the month. The applicant will be notified of the time, date, and location of the staff review meeting. Comments from each reviewer will be discussed at the meeting. These comments should be addressed by the Designer and this process will be repeated until all issues are resolved. At this time, the plans will be recommended for site plan review by the Planning Commission.

1. Site Plan Review
- Preliminary Meeting
- Site Plan Submittal
- Distribute for Review
- Staff Review Meeting
- Planning Commission

Planning Commission

Once a site plan has been recommended for site plan review, the plan will be sent to the Planning Commission. The Planning Commission usually meets the second and fourth Wednesdays of each month. The meeting schedule for the Planning Commission can be found at the township website at www.vanburen-mi.org.

At the Planning Commission meeting, the plans will be reviewed and public hearings will be held as necessary. The final outcome of the Planning Commission meeting(s) will be a preliminary approval, an approval with conditions, a rejection with reason(s), or the matter may be tabled until a future date.

Planning Commission approval must be obtained prior to proceeding.

B. Final Site Plan Review

3. Final Site Plan Review

The site plans submitted for preliminary review typically show the planning and zoning components of the plan in great detail, but tend to have less detail on the engineering aspects of the project. Many developers do not want to go to the time and expense of completing detailed engineering drawings prior to obtaining preliminary site plan approval. The infrastructure systems are typically shown schematically which is sufficient for preliminary plan review, however, detailed construction plans must be reviewed prior to granting final site plan approval.

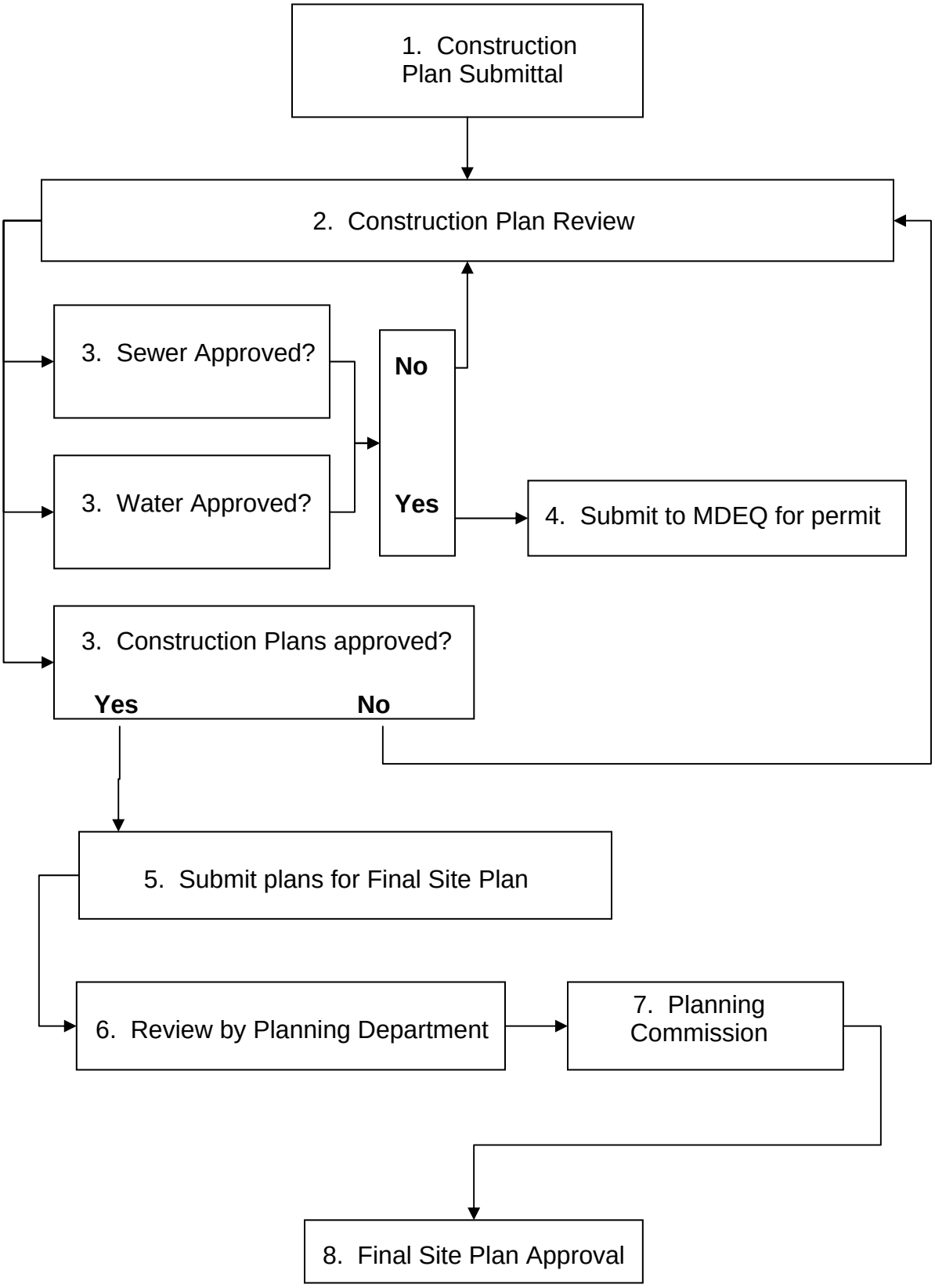
The purpose of the final site plan review is to review all the components of the project in preparation for construction. The plan requirements for design review are much more stringent than the requirements are for preliminary site plan review. Municipal utilities such as water, sanitary sewer, and storm drainage are reviewed, in detail, for compliance with established Township, County, and State standards. The design review also incorporates a review of the paving, grading drainage, and storm water detention for each site plan.

Included in the review process is the submittal of permits for municipal owned utilities such as sanitary sewer and water mains. When these portions of the plans are in compliance with township standards they will be submitted to the MDEQ for permit approval. The developer will be responsible for obtaining all other permits which may be required for the project.

Following approval of the construction plans, the township Planning Department will conduct a review of the plans to ensure that no modifications were made during engineering that may impact zoning or subdivision ordinance requirements and to ensure that any conditions of preliminary approval have been addressed.

The final site plan review process is shown, in detail, on the flow chart on the following page. The process ends with the Planning Commission review and approval of the final site plan. The process is slightly different for a plat as the preliminary plat must be approved by the township Board of Trustees rather than by the Planning Commission.

Final Site Plan Review Process



3. Final Site Plan Review

- Plan Submittal
- Plan Review
- Plan Approvals
- MDEQ Permits
- Final Site Plan Review

Construction Plan Submittal

Once preliminary approval has been granted by the Planning Commission, the developer may submit plans for final site plan approval. The final site plan submittal includes several important documents, including the following:

- Application for Review of Engineering Plans
- Complete Construction plans (one set of drawings)
- Payment of Review Fees

Construction Plan requirements can be found in Chapter II Plan Requirements. Specific details for utilities, paving, grading and pump stations can be found in Chapters III – VI. Each Chapter includes submittal requirements, design criteria, materials and construction requirements that are specific to the system discussed in that chapter.

The site plan submittal should be made directly to the township Planning Department. Once received, the submittal will be reviewed to ensure that all the required documents are included. Incomplete submittals will not be accepted. Complete packages will be sent to the Township Engineer for review.

3. Final Site Plan Review

- Plan Submittal
- Plan Review
- Plan Approvals
- MDEQ Permits
- Final Site Plan Review

Plan Review

Construction plans submitted to the township will be forwarded to the township engineer for review. The review will be based on the requirements contained in this Engineering Standards Manual and will include sanitary sewer, water main, storm sewer, storm water detention, paving, and grading. Improvements outside the jurisdiction of the township will not be reviewed except to the extent that they affect other township facilities.

The township engineer will generate a letter with review comments which will be sent to the municipality, the developer, and the design engineer. The review letter will detail changes that need to be made to the plans to be in conformance with the engineering standards. The developer and their design engineer should make the requested changes and resubmit one complete set of plans directly to the engineer for review and approval.

3. Final Site Plan Review

- Plan Submittal
- Plan Review
- **Plan Approvals**
- **MDEQ Permits**
- Final Site Plan Review

Plan Approvals and MDEQ Permits

Plan approvals can occur at two different points in the review process, when the sanitary sewer and/or water main portions of the plans are complete, and when the entire plan set is ready for approval.

When the sanitary sewer and/or water main portions of the plans are ready for approval, the developer may submit plans showing those utilities. These plans will be stamped approved and will be submitted for permit approval. Often plans must first be approved by a local permitting agency such as Detroit Water and Sewerage Department or a local sewer utility authority before they can be sent to the Michigan Department of Environmental Quality (MDEQ) for approval.

When the engineer determines that the entire plan set complies with the engineering standards, they will request the developer to submit four complete sets of plans for approval. These plans will be stamped approved and will be distributed as follows:

One copy to the township
One copy to the developer
One copy to the township engineer
One copy to the field engineer for construction

3. Final Site Plan Review

- Plan Submittal
- Plan Review
- Plan Approval
- MDEQ Permits
- **Final Site Plan Review**

Final Site Plan Review

After the construction plans have been approved by the township engineer, the developer may submit final site plan documents to the township for review. Twelve sets of final site plans should be submitted directly to the township planning department.

The purpose of the final site plan review is to check that any conditions of preliminary approval have been addressed, and to ensure that no changes occurred during engineering review and approval that might impact zoning or subdivision ordinance requirements. Once all conditions of approval have been checked, the plans can be forwarded to the Planning Commission for approval.

C. Construction and Project Final Acceptance

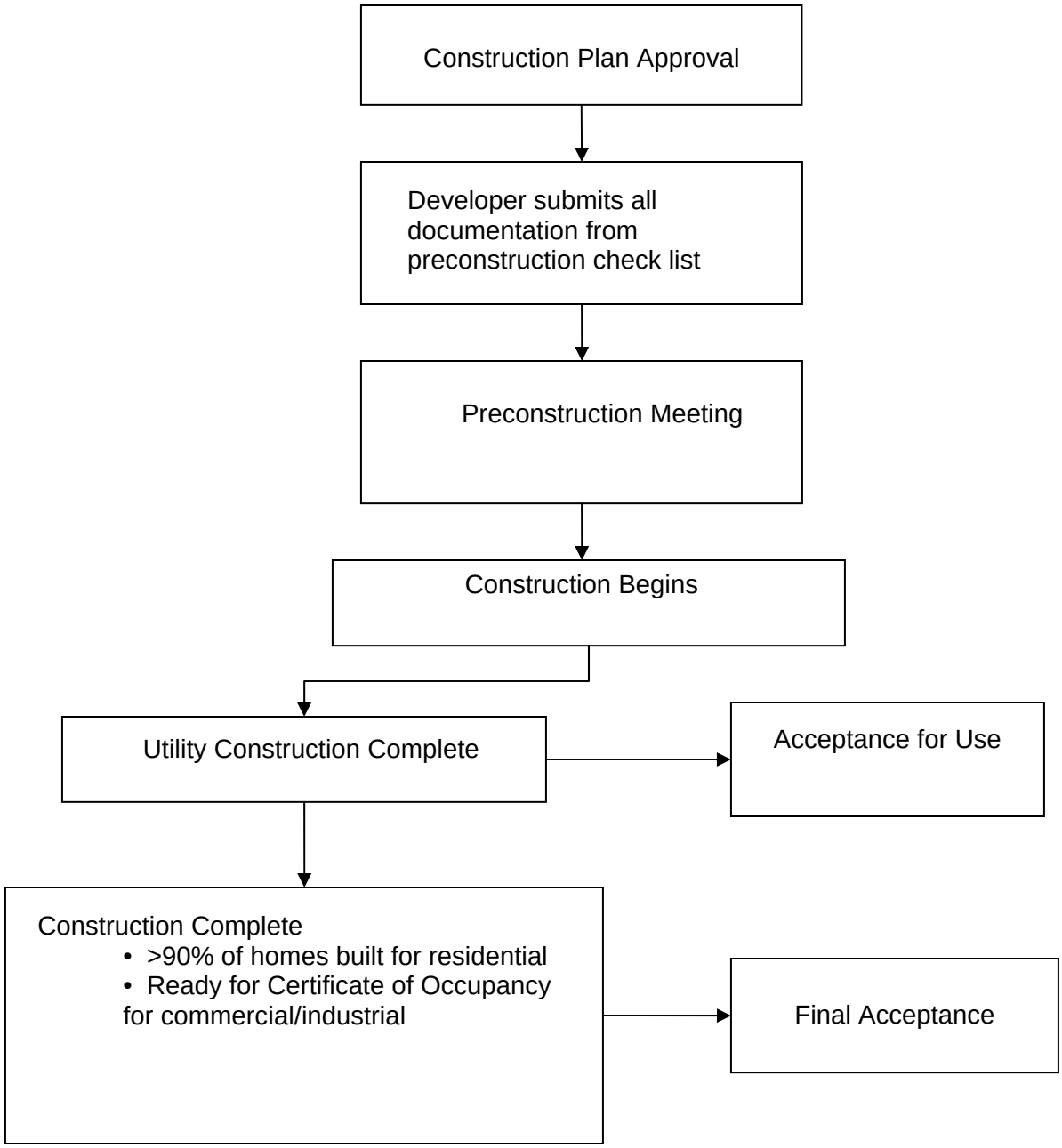
5. Construction Phase

6. Final Acceptance

Once the project has received final site plan approval from the Planning Commission, the construction phase can begin. The first step in the construction phase is submitting the documentation required to hold the preconstruction meeting.

During construction, the township engineer will provide inspection services on the project. When the construction of the public utilities is complete, the developer can request that acceptance for use is granted.

Construction Phase and Project Final Acceptance



5. Construction/Acceptance

- Precon Documentation
- Preconstruction Meeting
- Acceptance For Use
- Final Acceptance

Preconstruction Documentation

Once the project has received final site plan approval from the Planning Commission, the construction phase can begin. The first step in the construction phase is submitting the documentation required to hold the preconstruction meeting. The developer will be provided with a checklist and detailed instructions for completing all the forms needed for the preconstruction meeting.

A sample preconstruction checklist and instructions can be found in Chapter X.

5. Construction/Acceptance

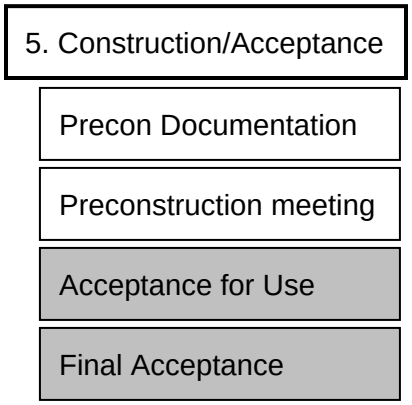
- Precon Documentation
- Preconstruction Meeting
- Acceptance for Use
- Final Acceptance

Preconstruction Meeting

Once all documentation required for the preconstruction meeting has been received, the engineer will set the time and location for the preconstruction meeting. A preconstruction meeting notice will be faxed to the developer, general contractor, utility companies, and the township. The developer is responsible for making sure that their contractor, subcontractors, and design engineer attend the preconstruction meeting.

The preconstruction meeting is a chance for the developer, contractor, township, engineers, and utility companies to discuss the details of the project and to set expectations for construction. Major aspects of the project such as materials, construction requirements, inspection, testing, staking, and community concerns will be discussed.

Detailed minutes of the preconstruction meeting will be distributed to all of the meeting attendees.



Acceptance for a project will be granted in two forms, acceptance for use and final acceptance. Acceptance for use occurs when the utility construction is complete and the utilities are ready to be turned over to the township. Final acceptance occurs when all construction is complete on the project. For commercial/industrial projects, acceptance for use and final acceptance both usually occur when construction is complete and prior to granting of a certificate of occupancy by the township.

Acceptance for use and final acceptance requirements can be found in Chapter XI.

D. Definitions

The following words, terms, phrases, and abbreviations, when used in this manual, shall have the meanings ascribed to them in this section and as set forth in the township Zoning Ordinance, except where the context clearly indicates a different meaning:

AASHTO means the American Association of State Highway and Transportation Officials.

ANSI means the American National Standards Institute.

ASTM means the ASTM International.

AWWA means the American Water Works Association.

Board shall mean the township Board, Van Buren Township, Wayne County, Michigan.

Township means Van Buren Township, Michigan, represented by the township Supervisor.

*Township E*ngineer means the consulting engineers employed by the township.

Township Supervisor means the person appointed by the township in charge of the township's administrative duties.

Contractor means the person, firm, or corporation responsible for the construction of the roads or utilities.

Department shall mean the township's Sewer and Water Department.

Developer means the person, association, partnership, firm, or corporation responsible for designing the project, obtaining all permits and approvals, and developing the land as approved.

Easement means the right of an easement holder to use the property of another

for purposes of ingress, egress, utilities, drainage and similar uses as specified in the easement.

GLUMRB means the Recommended Standards for Sewage Works (Ten States Standards) for use as a guide in the design and preparation of plans and specifications for sewage works, prepared by the Standards Committee of the Great Lakes-Upper Mississippi River Board of State Sanitary Engineers.

MDOT means the Michigan Department of Transportation.

MDPH means the Michigan Department of Public Health.

NCPI means the National Clay Pipe Institute.

WCRC means the Wayne County Road Commission.

Project shall mean a specifically designated site being developed (or proposed for development) by a Developer.

Project Sponsor, same as Developer

Standard Details Drawings (SDD) means the township Standard Details Drawings for water mains, storm sewers, sanitary sewers and road pavement adopted by township council resolution. They are considered a part of this manual.

Subdivision shall be equivalent to a subdivision as defined in the township subdivision regulations. A site condominium consisting entirely of single-family detached condominium units shall be equivalent to a subdivision as used in this manual.

E. Interpretation

The provisions of this manual shall be held to be the minimum requirements adopted for the promotion and preservation of public health, safety, and general welfare of the township. This manual is not intended to repeal, abrogate, annul, or in any manner interfere with existing regulations or laws of the township, nor conflict with any statutes of the state or the county, except that this manual shall prevail in cases where this manual imposes a greater restriction than is provided by existing statutes, laws, or regulations.

F. Variance

The township Board may authorize a variance from the terms of this manual when it determines that undue hardship may result from strict compliance. In granting any variance, the Board shall prescribe other conditions that it deems necessary or desirable for the public interest. No variance shall be granted unless the township Board finds at least one of the following conditions to be valid:

(1) There are special circumstances or conditions affecting the subdivision or project improvement such that a strict application of the provisions of this chapter would deprive the applicant of reasonable use of his property.

(2) The variance is necessary for the preservation and enjoyment of the substantial

property rights of the applicant.

(3) That an alternative proposed by the applicant shall be adequate for the intended use and shall not substantially deviate from the performance that would be obtained by strict enforcement of the standards.

(4) That the granting of the variance will not be detrimental to the public welfare or injurious to other property in the area in which such property is situated.

Application for a variance from the terms of this manual shall be submitted, in writing, by the Project Sponsor/Developer at the time the preliminary plans are submitted, stating fully and clearly all facts relied upon by the Project Sponsor/Developer, and shall be supplemented with maps, plans, or other additional data which may aid in the analysis of the proposed project. The plans for such development shall include such covenants, restrictions, or other legal provisions necessary to guarantee the full achievement of the plan.

Substitutions to the standards described in this manual may be allowed if, in the judgment of the township Engineer, the alternative design is equal to or better than the standards set forth in this manual.

CHAPTER II
PLAN REQUIREMENTS

All construction shall be in compliance with the procedural and substantive requirements of all township ordinances, the Subdivision Control Act of 1967, Act No. 288 of the Public Acts of Michigan of 1967 (MCL 560.101 et seq., MSA 26.430(101) et seq.); the Condominium Act, Act No. 59 of the Public Acts of Michigan of 1978 (MCL 559.101 et seq., MSA 26.50(101) et seq.), as amended; all county rules, regulations, and ordinances as applicable, and all other applicable statutes and ordinances, in addition to the requirements contained in this Engineering Standards Manual.

All plans for utility, paving, and grading construction shall be submitted to the township for approval. The plans shall be prepared under the supervision of a civil engineer licensed in the state. Plans shall contain the signature and seal of that engineer. The plans shall contain a note requiring that all construction shall conform to the current standards, specifications and general conditions of the township.

The plan requirements are divided into two sections. General plan requirements apply to all plan submittals and include basics such as north arrows, plan scales and title sheet information. Following the general plan requirements are the plan requirements that are specific to a site plan, engineering or soil erosion submittal. Each submittal type has specific information that must be shown on the plans.

These are the minimum requirements required for approval. Specific requirements for utilities can be found in Chapters III – IX. Other requirements such as township Zoning Ordinances requirements, Traffic Studies, Soil Borings, etc., as determined by the township may be required prior to any approvals.

A. General Requirements

Plans are reviewed to verify conformance with the established township standards. To ensure accurate and timely reviews, certain information needs to be presented. These general requirements apply to all plans submitted for review and include, but are not limited to, the following:

1. All elevations shall be on NGVD 29 datum.

2. Drawings must be submitted on 24-inch by 36-inch white paper using blue or black lines.

3. A north arrow and both the horizontal and vertical drawing scales must be indicated on each sheet.

4. Match lines should be used wherever plans continue to other sheets.

5. The line style and symbology used for each utility is at the discretion of the Design Engineer; however, they shall be distinguishable from one another, with different line styles and symbols for existing and proposed utilities. A legend shall be shown identifying the line styles and symbology used.

6. The signature and seal of the professional engineer, registered in the State of Michigan, who is responsible for the design of the project, must be included on the plans.

7. Each sheet shall have a title block which includes at least the following information:

    a. Name of the project.
    b. Revision history.
    c. Description of the information provided on the sheet.
    d. Sheet number

8. For larger developments, a key map should be provided on each sheet indicating the portion of the project the information on the sheet pertains to.

9. The square footage of proposed commercial/industrial buildings must be provided on the plan view.

10. The number of units per condominium or apartment building must be shown on the plans.

11. The property identification numbers should be included on the plans.

12. Road names, units, utilities, pavement, site dimensions, phase lines, lot lines, and lot numbers should be included in the plans.

13. When the proposed plan is part of a larger development being constructed in phases, a reference map of the entire development must be submitted with the portion of the development clearly indicated.

Title Sheet Requirements

1. Project title.

2. Location map showing the general location of the project, 1/4 Section number, major streets, with north indicator and graphic scale, drawn with appropriate scale (generally not greater than 1-inch equals 100 feet nor smaller than 1-inch equals 2,000 feet), and relationship of general project area to the surrounding area.

3. Overall layout of the complete pavement and utility system including manhole numbers and direction of flow arrows on storm and/or sanitary sewer systems.

4. Name, address, and telephone number of Project Sponsor and designer.

5. Legal description including the source the description was taken from (i.e., deed, survey, title company).

6. Plan completion date with most recent revision dates.

7. Listing of permits required.

8. An index of plan sheets must be provided.

B. Site Plan Review Requirements

The following requirements apply to all plans submitted to the township for preliminary site plan approval or for tentative preliminary plat approval. The Design Engineer is encouraged to reference Chapters III-IX for specific requirements and design criteria for utility systems and pavements.

1. All the General Plan Requirements apply to site plans.

2. Site plan submittals shall consist of a title sheet, plan sheets showing the proposed improvements, storm water detention volume calculations and a landscape plan.

3. Existing topography extending 100 feet past the site boundaries and in contiguous areas if pertinent to design and construction. Topography shall include existing elevation contours at a minimum of 2-foot intervals.

4. Existing utilities should be shown on the plans including water mains, sanitary sewers, storm sewers, and franchise utilities. Pipe diameters and materials should be indicated. Field measured rim and invert elevations of existing structures should be shown. These elevations should be noted as being field measured on the plans.

5. Preliminary location of proposed roadways and utilities should be shown. These include, but are not limited to, water mains, valves, fire hydrants, manholes, sanitary sewers, storm sewers, and storm water detention ponds.

6. Sanitary sewer and water service locations must be shown in plan view. For single-family developments, a typical lot detail indicating service locations may be substituted.

7. All existing and proposed easements should be shown.

8. 100-year flood elevation must be shown on the plans when within the site.

9. Basis of design flow computations for sanitary sewers and storm sewers shall be submitted for both phase and total development. Calculations for total development shall include all development phases, present and future, and existing and future off-site areas tributary to the system.

10. Preliminary storm water detention storage calculations should be provided to verify storm water storage facility sizing. Calculations for the composite C factor for the entire site should be provided.

11. Field measured top of bank and bottom elevations at 50-foot intervals, along with flow arrows and percent grades, should be shown for existing ditches and drains. These elevations should be marked as being field measured on the plans.

12. The permanent water elevation within existing ditches and drains should be field measured and indicated on the plans.

13. All existing County Drains, existing and proposed drains, drainage structures, culverts, bridges, and similar facilities should be clearly labeled and identified.

14. All existing wetlands should be shown.

15. Parking spaces, maneuvering lanes and driveway locations shall be shown on the site plan. Typical dimensions and angles of parking spaces, maneuvering lanes and driveways shall be noted.

16. Radii of driveway returns and all other points of curvature.

17. A landscape plan should be included. The underground utilities should be shown on the landscape plan.

18. Soil borings indicating the ground water elevation should be provided.

19. An overall drainage area map should be provided indicating all areas tributary to the proposed storm water system.

20. Typical sections for pavement, parking lots, bicycle path, driveways, and sidewalks

21. Existing and proposed right-of-way dimensions should be indicated. Proposed right of way widths should be in conformance with the County master plan.

22. Required notes:

    a. A statement that all construction shall conform to the current standards, specifications and general conditions of the township.

    b. The Developer is responsible for resolving any drainage problems on adjacent properties which are the result of the Developer's actions.

C. Engineering Plan Review Requirements

The following requirements apply to all plans submitted to the township for engineering plan approval. The Design Engineer is encouraged to reference Chapters III-IX for specific requirements and design criteria for utility systems and pavements.

1. All the General Plan Requirements apply to engineering plans.

2. All of the minimum requirements for the site plan submission are required for the engineering plan submission.

3. Engineering plan submittals shall include a title sheet, plan and profile sheets for all utility and roadway construction, typical sections, storm sewer and storm

water detention calculations, detailed grading plan, soil erosion plan, standard detail sheets and project specific details.

4. The township standard detail sheets must accompany the plans submitted for permitting and for final approval. Standard details are not required for plans submitted for review.

5. A quantity list itemizing all proposed public sanitary sewer, storm sewer and water main construction must appear on each sheet showing such construction. A quantity list showing the total quantities of construction for the entire project should also be provided.

6. A “MISS DIG” note needs to be provided on each sheet.

7. A quantity list itemizing all proposed road and street construction must appear on each sheet. A quantity list showing the total quantities of road and street construction for the entire project should also be provided.

8. Final location of sanitary sewers, storm sewers, water mains, manholes, valves, bends, fittings, and fire hydrants shall be shown in plan view. Length, type, class, size, slope of the pipes, and wye locations shall also be shown.

9. Profile views must be provided for all sanitary sewers, all storm sewers and for water mains 16 inches in diameter and larger. The profiles should indicate the pipe size, grade, invert elevations and rim elevations. All utility crossings shall be shown in the profile view and shall include top of pipe and bottom of pipe elevations.

10. Water and sewer service line location, diameter and shut-off valves shall be shown to all buildings.

11. The plans shall indicate the finish grades of all fire hydrants, valve-well rims and all other water structures.

12. Depth of bury shall be indicated. A note may be used to indicate this. When a water main crosses an underground utility, bottom of pipe and top of pipe elevations of both pipes shall be shown to verify compliance with the required vertical separation.

13. Two benchmarks should be indicated per sheet. These benchmarks should be shown in the plan view.

14. Basement grades shall be shown for existing and proposed houses where the sewer is less than ten feet deep. A note indicating that a proposed building will not have a basement should be provided for buildings without basements.

15. Sanitary Sewer profiles. Profile portion of sheet shall appear below companion plan portion, generally projected vertically, and shall show at least the following:

a. Size, slope, length, type and class of pipe, type of pipe joint and controlling invert elevations for each section of proposed sewer between manholes.

b. Limits of special backfill requirements shown graphically on profile.

c. Profile over centerline of proposed sewer, of existing and finished ground, and pavement surfaces. Existing profile obtained from actual field survey data. Profiles obtained from aerial photographs will not be permitted.

d. Location of existing or proposed installations crossing the line of the sewer, sewer leads, or otherwise affecting sewer construction with top and bottom of pipe elevations showing 18 inches of clearance.

e. Location, by station, of every proposed manhole, with manhole number, invert elevation of all inlet or outlet pipes, top of casting elevation, and manhole type and manhole diameter.

f. Location, by station, of all building leads, wye branches or tee inlets to be constructed or installed concurrently with proposed sewer construction.

g. Drop connections to manholes (interior drops are not allowed).

h. The elevation of the lowest floor and corresponding lot number to be served by the sanitary sewer if the depth of sewer is less than ten feet.

i. Cover elevations of all manhole covers shall be shown.

j. Required risers, with control elevations.

k. Invert elevation at property line for building lead to be included with sewer construction.

16. All existing sewer inverts must be field measured and so noted on the plans

17. A storm drainage area map should be provided showing the tributary area to each inlet to the system. Some of these areas may include off-site drainage. The map should be overlaid on a proposed grading plan. There should be one tributary area delineated for each entry point into the system, and each area should be labeled on the map with an identifier, the acreage of that area, and the composite C value for that area. Storm water storage shall be in accordance with all local (including county drain commission's) ordinances and regulations. All calculation must be clearly indicated on the plans.

18. Final proposed location of storm water storage, grades, bank slopes, easements, overflow and outlet devices must be shown. Grades, slopes, and elevations shall be shown in plan view.

19. Storm Sewer Calculations

Computations showing the calculation of the C value for each of the drainage areas should be provided. Assumptions for the base C values should be clearly indicated. Aggregate C values for more than one drainage area are not permitted.

Calculations for the design of the storm sewer system must be provided. This is generally given in a table format and at minimum, the following information should be provided for each section of system:

a. The design storm and the equations used in the calculations, including all assumptions.

b. Upstream and downstream structures.

c. Tributary area to the upstream structure.

d. C value for the tributary area to the upstream structure.

e. Total equivalent area, including upstream areas.

f. Total travel time from most upstream point in the system to upstream structure.

g. Rainfall intensity for the area tributary to the upstream structure.

h. Calculated runoff flow from area tributary to the upstream structure, as well as all areas upstream in the system.

i. Diameter, length, slope, and the upstream and downstream invert elevations for the proposed pipe.

j. Flow capacity of the proposed pipe.

k. Time of concentration through the proposed pipe.

l. Hydraulic grade line elevation at both upstream and downstream structures.

m. Rim elevations at upstream and downstream structures.

n. Depth of hydraulic grade line from rim elevation at both upstream and downstream structures.

20. Sump pump leads, wye branches, or tee inlets to be constructed or installed concurrently with sewer construction with locations at easement and/or property lines. Length, size and end-of-lead invert elevations shall be shown on the plan for each lead.

21. Storm sewer profiles: Profile portion of sheet shall appear below the companion plan portion, generally projected vertically, and shall show at least the following:

    a. Size, slope, length, type and class of pipe, and controlling invert elevations for each section of proposed sewer between manholes.

    b. All storm sewer invert elevations, including leads, and roof drains.

    c. Limits of special backfill requirements shown graphically on profile.

    d. Profile, over centerline of proposed sewer, of existing and finished ground and pavement surfaces. Existing profiles obtained from actual field survey data. Profiles obtained from aerial photographs will not be permitted.

    e. Location of existing or proposed utilities or other installations crossing the line of the sewer or otherwise affecting sewer construction with top and bottom pipe elevations showing clearances.

    f. Location, by station, of every proposed manhole, with manhole number, invert elevation of all inlet or outlet pipes, top of cover elevation, manhole diameter, and manhole type. Structures with sumps should be clearly identified.

    g. Hydraulic grade line for ten-year storms at each manhole and catch basin.

    h. Location, by station, of all building sewers, roof drains, wye branches or tee inlets to be constructed.

    i. A structure table is suggested which includes the following information:

        i. Structure number.
        ii. Diameter and type of structure.
        iii. Rim elevation.
        iv. Frame and cover model numbers.
        v. Size, direction, and invert of connecting pipes.
        vi. Cover above top-of-pipe of connecting sewers.
        vii. Any special notes, such as sumps or end treatments

22. A staking/layout plan should be included in the plan set. The staking plan must include coordinates for all sanitary sewer, sanitary leads, storm sewer and water main structures bends, tees, hydrants, and fittings. Coordinates are also required for private roads and parking lots (including at a minimum PC, PT, PRC, break points, angle points and radius points). These coordinates are required for staking purposes and for checking easement descriptions. The Designer may use a site specific local coordinate system if adequate information is provided to allow translation into State Plane coordinates. At a minimum, the Designer shall provide the following information:

    a. At least two section corners or two site specific control points (traverse points or property corners) must be shown labeled with both local and Michigan State Plane south coordinates. The line of sight between these control points must be unobstructed and these points must be permanent points that will remain undisturbed throughout the construction of the project.

    b. A site specific conversion equation must be provided on the plan set for converting all local coordinate points into Michigan State Plane south coordinates.

    c. Vertical Datum: NGVD 29

    d. Horizontal Datum: NAD 83

23. Stationing of centerline of pavements with elevations shown at 50-foot intervals and all high points and low points. Horizontal and vertical curves shall be at 25-foot intervals.

24. At all vertical curves, tangent elevation shall be shown for point of curvature, point of intersection and point of tangency only, and corrected elevation shown at every station and half station. Length of vertical curve and stationing of point of curvature and point of tangency shall also be indicated.

25. Elevation at spring points of all intersection radii.

26. Profile of existing ground along centerline of proposed street.

27. Stationing of plan and profile.

28. Proposed grade elevation of top of curb.

29. Proposed and existing parking lot and driveway grades and elevations.

30. Driveway culverts shall be shown in plan and profile view. Plans shall include diameter, length, grade and material of driveway culvert and culvert end treatments.

31. Proposed and existing elevations shall be shown on the plan at all radii points, finish grade at the corners of all buildings, at 50-foot intervals along the edge of the pavement, and at 50-foot intervals along the line of surface flow. Proposed elevation contours at 2-foot intervals shall be provided if requested by the township Engineer.

32. Top of curb or shoulder elevation opposite each front lot corner, and side lot corner for corner lots, to hundredths of a foot.

33. Proposed ground elevation at each lot corner, front and rear, and side lot elevations to tenths of a foot.

34. Finish house grades and first floor elevations for each lot, to hundredths of a foot, shown inside rectangular boxes drawn comparable to a typical house to be built in the subdivision and placed within each lot according to the front yard setback. Plans should also designate which housing units are proposed to be constructed with a full basement, a look out or a walk out. Walk out units must also show finish grade elevations at all exits.

35. Whenever swales for each lot drainage are called for on the plan, swale elevations at the high point adjacent to the house, the back of the house, and the front of the house shall be provided. General flow direction of swales shall be shown with arrows. Include a typical lot grading scheme.

36. Drainage flow arrows shall be shown to indicate the direction surface water flows on the lots and pavement.

37. Proposed elevations shall be provided for pavement, sidewalks, top of curbs, parking islands and additional locations as required by the township Engineer.

38. Pump station submittal requirements are shown in Chapter IX.

39. Cross section for all storm water ponds and sedimentation forebays should be provided. The cross section shall note side slopes, pond bottom elevation, permanent pool elevation, bank full flood elevation, 100-year flood elevation, and elevations of all inlets, outlets, and overflow structures.

40. Standard details shall include the applicable Standard Detail Drawings (SDD) as found in Appendix A.

41. Project specific special details should be provided as needed to show certain aspects of the project that are not covered by the township standard details. Special details shall include specific and complete details for the paving and utility appurtenances and structures to be included with the utility construction and special, unusual, or allied construction requirements. Scales utilized for special details shall be selected to clearly portray intended construction and component or equipment arrangement. Scales used shall be clearly identified.

42. Required notes:

a. When connecting to an existing water main, a note must be added that states:

"Connection to the existing water main shall not occur until all required hydrostatic and bacteriological testing has been successfully completed and accepted by the township Engineer."

b. Sanitary sewer notes:

1) "Sand backfill is required for sanitary sewer trench located under or within three feet of pavement."

2) "The required bedding for sanitary sewer is _____"

3) At all connections to an existing sanitary sewer system:

a) "A temporary brick bulkhead shall be placed in the first manhole upstream of the connection to the existing sewer. The bulkhead shall be removed after successful testing.

4) At all stubs for future connection:

a) "To facilitate future construction only. No house leads shall be constructed until terminus manhole is constructed."

D. Soil Erosion and Sedimentation Control Plan Requirements

The following requirements apply to all plans submitted to the township for Soil Erosion and Sediment Control (SESC) plan approval. The Design Engineer is encouraged to reference Chapter VI for specific requirements and design criteria for grading.

1. All the General Plan Requirements apply to SESC plans.

2. Three sets of earth change plans must be submitted. The plan must be sealed by a registered engineer or a registered landscape architect.

3. A plan or plans at a scale not more than 100 feet to the inch, including a legal description; a site location map which includes the proximity of any proposed earth change to lakes, streams or wetlands; existing structures; existing contour intervals which clearly show the character of the land; proposed contour intervals which clearly show the future character of the land; and a description of the existing vegetation on the site.

4. Details for the proposed earth changes, including:

    a. Location of the physical limits of each proposed earth change including the location of temporary soil stockpile areas. If soil is to be removed from the site, indicate the location of the offsite disposal area.

    b. A description and location of all existing and proposed on-site drainage facilities, including detailed storm sewer plans, drainage arrows for surface drainage, and the ultimate drainage outlet for the site.

    c. Time and sequence of each proposed earth change with approximate dates for major grading activities, including clearing, rough grading and cut and fill; construction of detention basin, roads and underground utilities; digging basements and backfilling lots; final grading, landscaping and paving.

        This sequence must include a description of erosion and sediment control measures to prevent sediment from leaving the project site during each step indicated above.

    d. A description and location of all proposed temporary and permanent soil erosion control measures.

    e. Approved standard details of all temporary and permanent soil erosion control measures must be shown on the plan.

    f. A perforated riser pipe with stone filter will be required on all detention and sediment basins on projects five acres or more in size.

    g. A temporary crushed rock tracking pad will be installed at the construction entrance and exit. This tracking pad will be maintained with fresh stone. Construction traffic will be limited to the designated entrance and exit.

    h. A street scraping and sweeping schedule. (Minimum - at least one sweeping a week, and a scraping at the end of each workday.)

i. Paved storm sewer inlets shall be protected by a single sheet of filter fabric conforming to Geotex III F as manufactured by Synthetic Industries, Inc. or equivalent woven monofilament filter fabric (ASTM flow rate =110 gallons per minute/per square foot).

j. Rear yard (beehive-type) storm sewer inlets shall be protected by a filter fabric fence conforming to Ecolofence CB as manufactured by Amoco Fabrics and Fibers Company or equivalent woven geotextile filter fence 24 inches in height securely fixed with lath and staples to hardwood stakes spaced no more than four feet on center. The silt fence shall be trenched in a minimum of eight inches into the ground.

k. All catch basins and inlets in areas that are determined to be susceptible to flooding will have high flow sack type catch basin filters.

l. All exposed earth shall be stabilized with seed and mulch or sod within five days of final grade. Sediment basins shall be stabilized with seed and straw mulch blankets. Straw mulch blankets shall be staked into the ground five days after the construction of the sediment basin.

m. An undisturbed, vegetative buffer strip of at least 25 feet shall be retained around rivers, creeks, streams, wetlands, drains, and other sensitive areas.

n. Straw mulch blankets shall be used on 3:1 slopes or greater (3-foot horizontal, 1-foot vertical).

o. Ditches, swales, and other areas that will channel concentrated runoff must be stabilized within 15 days of construction. Temporary rock check dams will be required to slow water to non-erosive velocities in areas of concentrated flow.

p. Road right-of-ways must be stabilized with seed and mulch within 5 days of completing utility work in the right of way.

q. Areas of earth change that are disturbed beyond the fall seeding deadline (Nov. 1) must be temporarily stabilized with a minimum of straw mulch securely crimped to the ground.

r. Riprap will be placed immediately following installation of pond outlets and culverts.

s. Single-family lots, during construction, must have a silt fence barrier installed across the front with a temporary crushed rock-tracking pad at each lot.

t. A single-family residence, prior to receiving a Certificate of Occupancy, must have a silt fence barrier, or ten feet of curlex blanket installed back of the curb across the entire front of the lot. The silt fence shall be trenched a minimum of six inches into the ground. Along with the general plan requirements, there are also requirements for Wayne County. (These design and maintenance features must be shown on the plan and included in the construction sequence.)

CHAPTER III
WATER MAIN STANDARDS

Chapter III covers water main design, materials, and construction. This chapter is meant to be used in conjunction with the plan submittal requirements presented in Chapter II.

A. Design Criteria

1. General

a. Water main systems shall incorporate minimum sizings as determined by the township water distribution system master plan and other requirements as determined by inclusion of the proposed project within the master plan computer network model, as well as minimum/maximum flows and pressures as determined by the township engineer. Water mains are required to be extended along all road frontages abutting the proposed development.

b. Feeder mains 12 inches or larger in diameter shall be provided on major streets, collector streets, and elsewhere as design dictates and/or as provided by the water distribution system master plan.

c. Main sizes within new developments shall be eight inches in diameter minimum, and larger as design dictates, for residential and commercial developments. Water mains of 12-inch diameter minimum size will be required for industrial developments.

d. Ten inch diameter mains are not allowed.

e. Water mains shall be placed on the west side or north side of the road to the extent possible. Mains shall be placed according to the typical cross sections shown in Appendix B. The following is a summary of the spacing requirements:

i.	60-foot wide right-of-way	8 feet inside right-of-way
ii.	86-foot wide right-of-way	10 feet inside right-of-way
iii.	120-foot wide right-of-way	22 feet inside right-of-way

f. Within nonplatted projects, water mains shall be installed parallel to the property lines or building lines, with clearance distances to allow for a 12-foot wide easement centered on the centerline of all water mains. All water mains on which fire hydrants are located shall be located within dedicated easements or rights-of-way and shall be dedicated to the township.

g. Water mains in new developments shall be installed from boundary to boundary in abutting roads and interior streets. Water main stubs shall be provided to property lines at locations designated by the township engineer for future extension. Water main stubs shall terminate with a hydrant, followed by a gate valve in well.

h. Wherever possible water main shall be constructed outside of paved parking areas, streets, and drives. Sand or other porous material approved by the township Engineer shall be required full depth of trenches that are within three feet of all streets, alleys, existing driveways and sidewalks, and all parking areas (public or private).

i. The maximum deflection for water main 8 to 12 inches in diameter is five degrees. The maximum deflection for water main 16 inches in diameter is four degrees. Bends and thrust blocks shall be shown as required.

j. Provide six feet of minimum cover below proposed ground surface at water main location. Provide seven feet of minimum cover below proposed ground surface when proposed water main is within 32 feet of centerline on section line roads, or within 19 feet of centerline on 1/4 line roads.

k. All water mains crossing paved public roadways shall be bored and jacked unless otherwise approved by the township or road authority. Water main jacking or boring shall extend a minimum of ten feet outside the edges of the pavement.

l. Hydrants and valves shall be located on extensions of lot lines.

m. Profile views are required for 16-inch and larger water mains, for water mains parallel to major and collector streets, at crossings with other utilities, and for other sizes when determined necessary by the township Engineer.

n. Private booster pumps are not allowed on public water mains.

o. Where required by the township Engineer, the Developer shall provide exploratory borings and laboratory tests. Boring locations shall be indicated on the plans. Areas which show unsatisfactory ground material for pipe bearing or possible chemical deterioration due to soils shall be avoided, or the pipe shall be suitably installed on adequately designed bedding and/or enclosed in protective wrap.

p. A minimum of 18 inches of vertical clearance shall be provided between either the water main or service and any other underground utility as measured from outside of pipe to outside of pipe. In general, water mains should cross over top of sanitary sewer utilities.

q. A minimum of ten feet of horizontal separation shall be provided between water mains and sanitary sewer lines, storm sewer lines, or other water mains. This is measured from outside of pipe to outside of pipe and should be shown on the plans.

r. The maximum length of dead-end mains are as follows:

   i. 450 feet for 8-inch mains.
   ii. 1,000 feet for 12-inch mains.

The minimum water pressure at the dead end of the main shall be 20 psi (residual) with a minimum flow of 1,500 gpm. Calculations must be provided to verify adequate pressure and flow.

s. Pipe size shall not be increased beyond that necessary to deliver adequate flow and pressure for the sole purpose of satisfying the dead-end length requirements.

t. No private services will be allowed from water mains 16 inches in diameter or greater.

u. All water main systems, excluding building service leads, which serve more than one parcel of land, shall be dedicated to the township for maintenance and operation. The dedication of the water system must be in accordance with the township policy for acceptance of Developer provided utilities.

v. All public water mains must be located in an easement or public right-of-way. The easement descriptions shall include hydrants and extend a minimum of six feet beyond the hydrant on any lead. Standard easement forms are in Appendix A. The minimum easement width shall be 12 feet for the permanent easement and 20 feet for the construction easement. The submittal of the easement will be required prior to township scheduling a preconstruction meeting.

2. Valves

a. Gate valve spacing is regulated by providing the following provisions:

i. in the event of a breakage:

a) No more than 24 single family units will lose service.
b) No more than 30 multiple family units will lose service.
c) No more than two hydrants will be out of service.

ii. No more than four valves shall have to be closed to isolate the break. Where possible, three valves should isolate the break.

iii. There shall be valves on tees feeding dead end mains.

iv. On line valve spacing shall be a maximum of 800 feet (500 feet in commercial and industrial zoned districts).

v. For major commercial and industrial developments (services larger than six inches), the building service must be maintained from a looped system with valves located on either side of the service.

vi. Gate valves shall generally be placed near tees to isolate sections of mains as noted above.

b. Gate valves shall be located so they will not be in the sidewalk or in driveways.

c. Valves shall generally be located far enough back from the intersection of street right-of-way lines for the gate well structure to clear crosswalks, typically five feet off intersecting right-of-way line.

d. All gate valves except those at hydrants shall be installed in wells. Gate valves at fire hydrants shall be installed with a three-piece adjustable valve box.

e. Valves in wells and hydrants shall be placed on all dead end mains for future extension.

f. Connection of new mains to existing mains shall generally be with a tapping sleeve, valve, and well. Connections to like-size pipes must be made with a standard tee and a cutting-in-sleeve. The method of connection (tapping sleeve or standard tee) must be noted on the plans.

3. Hydrants

a. All fire hydrants are the responsibility of the township and all water mains servicing fire hydrants are deemed to be public water mains.

b. In no case shall hydrants be placed on the same lead used for automatic sprinkler protection.

c. A separate fire protection line shall be provided in addition to a domestic service for each building in industrial and commercial zoned districts, sized to provide adequate fire flow. Individual shutoff valves should be provided within a public water main easement. Where a separate fire service line is required, a fire hydrant should be located within 100 feet of the siamese connection.

d. Generally, hydrants are to be placed five feet behind the curb on the north side or west side of the road.

e. Hydrants are to be located at least ten feet from driveways.

f. In all cases, hydrants shall be located and maintained as highly visible and accessible locations. Nozzles must face the road. Nozzles shall be located so that immediate access can be made by the firefighters to the fire apparatus.

g. Coverage

i. Detached single and two-family dwelling unit buildings and buildings less than 5,000 square feet that have moderate to light fire loading: Hydrants shall be placed so that no part of any buildings is more than 500 feet from a hydrant. This distance shall be measured along the shortest feasible exterior route for laying fire hose.

ii. All other developments, buildings, and structures: No part of any building or structure shall be more than 250 feet from a hydrant

unless the Fire Department approval is given to do otherwise. This distance shall be measured along the shortest feasible exterior route for laying fire hose.

h. Hydrants shall be accessible by a paved fire lane. Where hydrants are to be located across drainage ditches, a 20-foot culvert and 10-foot access drive shall be provided. Hydrants shall be located at least 40 feet from the exterior wall of the building unless a closer location is allowed by the Fire Department. Hydrants located in parking areas shall be placed at least five feet behind curb and gutter or protected by 6-inch diameter, concrete filled, steel pipe bollards – painted with high visibility protective paint.

i. All hydrant leads shall be not less than six inches in diameter. Where the length of the lead will exceed 40 feet, an 8-inch lead will be required. No hydrant leads may be connected to 6-inch dead-end mains. All hydrant leads shall be valved.

j. Hydrants placed within cul-de-sacs shall be placed in such a manner as to provide easy access for fire apparatus. Hydrants are not allowed to be placed in center islands in cul-de-sacs.

k. Determining water supplies for firefighting purposes shall be as determined by the Insurance Services Office formula:

$$F = 18C\sqrt{A}$$

where: F = Fire Flow, gallons per minute
C = Constant *(see table below)*
A = Effective Area (includes all floors, excluding the basement), square feet

Construction	Class	C Value
Wood Frame	Class 1	1.5
Ordinary Joisted Masonry	Class 2	1.0
Non-Combustible Masonry	Classes 3 and 4	0.8
Fire-Resistant	Classes 5 and 6	0.6

4. Water Services

a. Residential services for single-family or double units must be a minimum of 1-inch in diameter.

b. For multi-family units, water leads shall be less than 100 feet in length and the following minimum sizes shall apply:
   i. For 3 - 15 units per building, 1.5-inch minimum service lead.
   ii. For 16 - 31 units per building, 2-inch minimum service lead.
   iii. For 32 units per building and over, 4-inch minimum service lead.

c. A minimum size of two inches shall be required for commercial or industrial developments.

d. Water services shall not be installed under driveways or other obstacles.

e. Water services shall not be located in, under, above, or near septic tanks, cesspools, septic tank drainage fields, or seepage pits.

f. All lawn sprinkler and irrigation systems shall be equipped with a suitable backflow preventer in compliance with the Michigan Department of Environmental Quality.

5. Special crossings.

a. Railroad crossings. Water main shall be installed at railroad crossings within an approved steel casing as specified by the railroad. Details shall include casing pipe thickness and diameter, and complete pressure grouting with a flowable fill as approved by the township Engineer, of the encased water main.

b. Stream or river crossings. Water main shall be installed crossings within an approved steel casing as specified by the township Engineer or ball and socket type joint pipe shall be used. Details shall include type and class of pipe, type of joint, casing pipe thickness and diameter, and complete pressure grouting of casing with a flowable fill as approved by the township Engineer.

B. Materials

1. General

a. No secondhand or salvaged materials or equipment will be permitted.

b. All fittings shall be ductile iron, pressure rating 350 psi, conforming to ANSI A21.53 (AWWA C153).

c. All precast products shall conform to the requirements of ASTM C-478.

d. Domestic service two inches in diameter or smaller shall be seamless copper tubing designated as Type “K” and shall conform to ASTM B-88. Fittings and threads shall be in compliance with ASTM B62 and AWWA C800.

e. All necessary fittings for the installation of the water main are to meet the City of Detroit Water and Sewerage Department standards.

f. Bolts, nuts and studs shall be high strength, low alloy steel conforming to ANSI/AWWA C111/A21.11.

2. Ductile Iron Water Mains

a. Open Cut and/or Bored in Steel Casing Construction

i. Piping. The materials approved for use in water main to pipe shall be ductile iron conforming to ANSI A21.51 (AWWA C151), PC 350 minimum. Ductile iron pipe shall be marked as required by ANSI A21.51 (AWWA C151).

a. Cement-mortar lining. Ductile iron pipe and fittings shall be lined with cement mortar, twice the standard thickness, conforming to ANSI A21.4 (AWWA C104).

b. The outside of all pipes and fittings shall be covered with a uniform asphaltic coating approximately one mil thick. The coating materials shall be applied uniformly and shall be of a quality necessary to provide a firm, tenacious, and tough coating which will not sag or flow when exposed to pipe temperatures of 140 degrees Fahrenheit, nor crack, peel or check when pipe temperatures attain 20 degrees Fahrenheit.

c. These coatings, after drying 48 hours, shall have no deleterious effect upon the quality, color, taste, or odor of potable water.

ii. Fittings shall conform to ANSI A21.53 (AWWA C153), 350 psi, with mechanical joints, double thickness cement mortar lining, and asphaltic coating.

iii. Ductile iron joints and fittings. Push-on type pipe joints, shall be in conformity with the current ANSI A21.11 and shall be Tyton, Super Bell-Tite, or approved equal. The bulb or main body portion of the gasket shall have a maximum compression set of 20 percent after 22 hours at 158 degrees Fahrenheit as determined in accordance with ASTM designation D-395, method B.

iv. Mechanical type joints, when specified, shall be in conformity to the current ANSI A21.11, Rubber Gasket Joints for Cast Iron Pressure Pipe and Pipe and Fittings. The bolts shall be of the high strength, low alloy steel type.

v. Flanged joints shall conform to ANSI B16.1. Flanged joints shall not be used in buried construction.

vi. Bell and socket joints shall be Clow Bell Joint River Crossing Pipe, Uniflex, or equivalent, as approved by the township Engineer.

vii. Water Service Taps. Brass corporation stop.

3. PVC Water Mains

a. Open Cut Construction

i. Piping. AWWA C900, pressure class 235, DR 18 with push on joints.

ii. Fittings and plugs shall be ductile iron compact fittings, mechanical joint, pressure rating of 350 psi, conforming to ANSI/AWWA C153/A21.53, and rubber gasket joints conforming to ANSI/AWWA C111/A21.11, with double thickness cement mortar lining and coal tar enamel coating on the outside of fittings.

a) Fittings on PVC water main shall be restrained joint type for PVC pipe designed for a working pressure of 200 psi. Restraint shall be provided by a clamping ring with serration to provide positive restraint around the full circumference of the pipe. Acceptable manufacturers for PVC restrained fittings include EBAA Iron – Megalug Series 2000PV, 2000SV, 2100, or Series 2200 or approved equal.

iii. Water Service Taps. Bronze, single strap, full circle saddles with 1-inch brass outlet threads, and brass corporation stop.

b. Directional Drill Construction

i. Piping. AWWA C900, restrained joint, PVC plastic, Class 200 (DR 14) for 8-inch and Class 150 (DR 18) for 10-inch and 12-inch diameters. Pipe shall be Certa-lok C900/RJ or approved equal.

a) Joints. Non-Metallic, restrained joint couplings with high strength, flexible, thermoplastic spline retainers. Retainers shall be inserted into the mating precision machined grooves in the pipe and coupling to provide full 360-degree restraint. Couplings shall be designed for use at the rated pressures of the pipe and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477.

ii. Piping. Fusible PVC, ductile iron pipe size, DR 18 (235 psi), cell classification 12454 conforming to AWWA C905.

a) Joints. Butt fusion welded.

iii. Fittings and plugs shall be ductile iron compact fittings, mechanical joint, pressure rating of 350 psi, conforming to ANSI/AWWA C153/A21.53, and rubber gasket joints conforming to ANSI/AWWA C111/A21.11, with double thickness cement mortar lining and coal tar enamel coating on the outside of fittings.

a) Fittings on PVC water main shall be restrained joint type for PVC pipe designed for a working pressure of 200 psi. Restraint shall be provided by a clamping ring with serration to provide positive restraint around the full circumference of the pipe. Acceptable manufacturers for PVC restrained fittings include EBAA Iron – Megalug Series 2000PV, 2000SV, 2100, or Series 2200 or approved equal.

iv. Water Service Taps. Bronze, single strap, full circle saddles with 1-inch

brass outlet threads, and brass corporation stop.

b) Water services connections greater than 1 inch installed on fusible PVC pipe shall be:

1. a tee cut into the pipe as noted above, or,

2. a service saddle inside of a restraining harness to relieve the axial stress and keep the pipe from splitting when tapped. CONTRACTOR shall verify dimensions of service saddle and restraining harness prior to construction. Restraining harness shall be as recommended by the manufacturer of the pipe.

4. HDPE Water Main - Directional Drill

a. HDPE Piping Systems. AWWA C906, Pressure Class 160 (SDR 11), Ductile Iron Pipe size.

a) Material. PE 3408.

b) Cell Classification. 335434C per ASTM D3350.

c) Fittings. Fittings (tees, crosses, bends, etc.) and plugs shall be Butt Heat Fusion Type, SDR 11, per ASTM D3261 or Electrofusion Type, per ASTM F1055. Fittings for joining HDPE pipe to Ductile Iron pipe or PVC C900 pipe shall be fully restrained, Mechanical Joint Adapters.

d) Pipe Joints. Butt Fusion Welded or Electrofusion Saddles.

e) Water Service Taps. Electrofusion corporation saddles with 1-inch brass outlet threads and brass corporation stop.

5. Valves

a. Gate valves, for sizes 4-inch through 16-inch diameters, shall be East Jordan Iron Works Flow Master, resilient wedge type, conforming to AWWA C509 or C515 specification. Valves shall be designed for a working pressure of 200 psi and a test pressure of 400 psi and to open in a clockwise direction and shall have a 2-inch square operation nut and a double operating stem O-rings. Valves shall be ordered with mechanical joint inlet and outlet connections. Butterfly valves shall be used for sizes 16 inches and larger.

b. All gate wells shall be constructed of pre-cast reinforced concrete sections in accordance with township standard details.

c. Gate well bottoms shall be of 3,500 psi reinforced concrete with at least six inches in diameter larger than the outside diameter of the riser sections. The minimum bottom thickness shall be eight inches.

d. Gate well covers and frames shall be East Jordan Iron Works #1040 with Type "A" cover, or approved equal. Covers shall have the words "WATER SUPPLY SYSTEM" in raised letters spaced in the periphery of the cover.

e. Valves in gate wells shall be at least six inches above floor of gate well, supported with either brick or formed concrete.

6. Hydrants

Fire hydrants shall be East Jordan Iron Works model 5BR-250 conforming to AWWA C-502 improved hydrant specifications. Hydrants shall be designed to open in a counter-clockwise direction with an opening arrow cast into the bonnet and shall have seat valve and double operating stem O-ring seals, 6-inch diameter valve openings, 6-inch diameter mechanical joint hubs and two, 4-inch pumper nozzles. Hydrants shall be equipped with City of Detroit Fire Department standard nozzle threads and operating nut and shall be ordered for 6.5-foot bury. Hydrants must be painted red and have a breakaway flange.

a. There must be 21 inches from the center of the nozzle to the ground surface.

b. Self draining hydrants must be plugged - No weep or drain holes will be allowed.

7. Valve well

a. All gate valves except those at hydrants shall be installed in wells.

b. In no case shall a sewer be connected to a valve well for any purpose.

c. Valve wells shall be constructed of brick or block with three to five courses of brick at the top for future adjustment.

d. Extension stems and stem guides shall be provided in each valve well wherein the valve operating nut is further than five feet below the top of the valve well cover. Extension stems shall extend to within five feet of the top-of-cover elevation. Extension stems and stem guides shall be as manufactured by East Jordan Iron Works, or approved equivalent.

e. Brick shall, as a minimum, conform to ASTM C32, grade MS, or ASTM C55, grade U-L.

f. Mortar for laying brick or pointing of joints and for plastering outside of structures shall be composed of one part type II masonry cement and 2.5 parts masonry sand.

g. Water for concrete and mortar shall be clean and fresh, free from oil, acids and organic matter.

h. Radial concrete block shall conform to ASTM C139.

i. See SDD for additional information.

8. Curb boxes in non-paved areas shall be Mueller Company, extension type with Minneapolis pattern base, model H-10312, 1-inch inside diameter (one-piece lid). Curb boxes in paved areas shall be Mueller Company, extension type with Minneapolis pattern base, model H-10332, 1-inch inside diameter (combination

lid with pentagon plug).

9. Curb stops shall be Mueller Company, Mark II Oriseal, model H-15164, 1-inch minimum size, copper flare inlet and outlet, Minneapolis thread top.

10. Corporation stops shall be Mueller Company, model H-15000, 1-inch minimum size, AWWA taper thread inlet and copper flare outlet.

C. Construction

1. General

   a. All water system construction shall conform to the current standards and general specification of the agency or agencies having jurisdiction of the water supply system and construction area. All work within the Wayne County road right-of-way shall conform to the Wayne County General Notes (GN-1).

   b. All surface structures, such as hydrants, gate wells, and valve boxes shall be set to grade or as indicated on the plans.

   c. All water mains are to be kept in service during construction operations unless arrangements with the Water Department are made. The township Water Department will be the only authorized personnel to operate the valves on the main line.

   d. When jacking or boring all voids shall be filled by means of pressure grouting with 1:3 cement mortar. This work must be accomplished within 24 hours after the water main crossing has been completed.

   e. The location of any angle points or bends are to be marked at grade level with a 2” x 2” board. This board is to be painted blue.

   f. Place sand backfill within three feet of all structures, including valve wells and hydrants.

   g. Pipe bedding for the water main will be four inches of compacted sand with 12 inches of compacted sand over the top of the pipe (Class III bedding as shown on Detail Sheet MD-1).

2. Valves

   a. Wherever possible, water main is to be placed level through all gate wells.

3. Valve well

   a. Bricks shall be thoroughly wetted and laid in a full bed of mortar. Plastering shall be performed in conjunction with the laying of brick and block shall never be more than six and two courses ahead of the exterior plaster, respectively.

b. All brick, block, mortar and concrete work shall be properly cured and protected from freezing for a minimum of 48 hours. When the temperature is 40 degrees Fahrenheit and below, brick, mortar and concrete shall be heated to a minimum temperature of 60 degrees Fahrenheit.

4. Hydrants

a. Fire hydrants are to be installed plumb and have their nozzles facing the road.

b. Contractor shall bag all new fire hydrants until the water main is accepted for service.

c. When the fire hydrant is being installed, the fire hydrant valves shall be installed in the full open position.

d. The township Water Department will be the only authorized personnel to operate the valves or hydrants. The township's normal working hours are 7:00 a.m. - 3:30 p.m., Monday through Friday. The Contractor may obtain a permit to operate a single, specified hydrant from the township.

5. Thrust Block

a. Concrete thrust blocks shall be provided at all bends of 11¼° or greater, behind tee outlets, at hydrant shoes, at plugs or caps, and at any crosses where necessary to prevent lateral movement of the pipe. Thrust blocks shall bear against undisturbed earth in all instances and shall have sufficient bearing area to develop the full resultant axial thrust of the pipe at test pressure. Thrust block specifics can be found in the Standard Detail Sheets.

b. Thrust blocks shall be made of 3500 psi concrete and of adequate size and shape to resist all design working and surge pressures to which the main will be subjected.

D. Testing

1. Testing and Sterilization

a. The township Engineer is to have an inspector present when the pressure test is performed.

b. A testing lab approved by DWSD must be used for bacteriological testing. The township Engineer is to be present during the bacteriological testing; chain of custody will be tracked throughout the process from picking up the sample containers to delivery of the samples at the lab. Written results of the bacteriological testing are required before connection to the water system.

c. The township Engineer and the township are to be notified 24 hours in

advance of the final hook-up and flushing of the water main. The Contractor will be responsible for flushing of the new main.

2. Pressure tests.

   a. No permanent connection to existing water mains shall be made before the newly constructed water mains have undergone a satisfactory pressure test as witnessed by the township Engineer or the township Water and Sewer Department staff. Temporary connections (jumpers) between existing water mains and the newly constructed system, which connections may be made for chlorinating and flushing purposes, shall include a back check valve to prevent backflow and possible contamination of the public water supply.

   b. Pressure testing shall be made in lengths of 2,000 feet or less unless otherwise authorized by the township Engineer. Before applying the specified test pressure, all air shall be expelled from the pipe.

   c. Pressure testing shall be accomplished by filling the main with clean water under a minimum hydrostatic pressure of 150 pounds per square inch. In no case shall the leakage in any stretch of pipe being tested exceed 11 U.S. gallons per inch diameter of main per mile of pipe per day (0.0001736 multiplied by diameter (inches) multiplied by pipe length (feet) in a two-hour period).

3. Disinfection of water mains.

   a. No permanent connection to an existing water main shall be allowed until the new water main pressure test and bacteriological test have been successfully completed and approved by the township Engineer or township Water and sewer Department.

   b. All new water mains shall be disinfected in a manner acceptable to the state department of public health.

   c. Water samples for bacteriological testing shall be taken from the end of each main and at any other locations selected by the township Engineer. Samples shall be taken from corporation stops only, unless authorized by the township engineer.

   d. Bacteriological water samples shall be collected by the township Water and Sewer Department. One sample shall be taken for each section of main disinfected. Analysis of each sample must be made by a laboratory approved by the state department of public health.

   e. If analysis of any sample indicates that the water is unsafe for human consumption, the disinfection, sampling and analysis procedures shall be repeated until samples obtained on two successive days are found to be safe.

   f. The method of disinfection will be as follows:

      i. After satisfactory hydrostatic test results are obtained, the system

shall be flushed until the water runs clear. Chlorine solution will be added through a corporation stop at the beginning of the main. A slow flow of water shall be let into the main approximately at the point of injection of the chlorine solution at a rate such that the chlorine dosage of the entering water shall be at least 80 parts per million (ppm). An open discharge shall be maintained at all extremities of the system, and the introduction of chlorine solution and water shall be continued until the full dosage of chlorine reaches each outlet. The chlorine concentration within the system shall be not less than 80 ppm and will be verified by township Water Department personnel.

ii. Upon reaching the required concentration, the chlorinated water shall remain in the system for a period of not less than 12 hours, after which time the water main will be flushed until the chlorine residual is 0.5 ppm. Township Water and Sewer Department personnel will then collect and transport samples for bacteriological testing. Written confirmation of the results will be provided to the contractor.

iii. Two consecutive samples with acceptable test results are required before the water main is placed into service.

iv. The township may charge a fee for services provided.

g. All water main systems shall be subject to a final inspection prior to acceptance of the system by the township.

CHAPTER IV
SANITARY SEWER STANDARDS

Chapter III covers sanitary sewer design, materials, and construction. This chapter is meant to be used in conjunction with the plan submittal requirements presented in Chapter II.

A. Design Criteria

1. Definitions

The following words, terms, and phrases, when used in this article, shall have the meanings ascribed to them in this section, except where the context clearly indicates a different meaning:

Branch sewer means a sewer that receives, via lateral sewers, wastewater from a relatively small area and discharges into a main sewer serving more than one branch sewer area.

Building drain means that part of the lowest piping of the wastewater drainage system of a building which receives the sanitary sewage from soil pipes, waste pipes, and other drainage pipes inside the perimeter walls of the building and conveys it to the building sewer, which begins approximately five feet outside the building wall.

Building sewer, building lead, and house connection means that part of the exterior sewer piping of a drainage system which continues from a building drain approximately five feet outside the building wall and carries the flow emanating from the building drain to the public sanitary sewer.

Lateral sewer means a sewer that discharges into a branch or other sewer and has no other sewer tributary to it.

Main or trunk sewer means a sewer to which one or more branch sewers are tributary.

Public sanitary sewer means a pipe or conduit with appurtenances, which services more than one building or more than one parcel of land, within township rights-of-way or easements and formally dedicated to the township, that carries liquid and/or water-carried wastes from residences, commercial buildings, industrial plants and institutions, together with minor quantities of stormwaters, surface waters, and groundwaters that are not admitted intentionally.

Sanitary sewage means wastewater discharged from homes, commercial establishments, and other structures, designated as sanitary flow because it is composed of used or spent water resulting from human use in so-called sanitary conveniences.

2. General

a. The extension of the sanitary sewers will generally be required across the entire frontage or depth of the site to provide service to adjacent properties.

b. Only one building shall be serviced from one service lead.

c. Downspouts, weep tile, footing drains, or any conduit that carries storm or ground water shall not be allowed to discharge into the sanitary sewer system.

d. Sanitary sewers shall be located so unrestricted access for maintenance and inspection is provided. A paved access road is required.

e. A minimum horizontal separation of ten feet (measured outside of pipe to outside of pipe) must be maintained between the sewer and all other utilities. The water main and sanitary sewer shall be located on opposite sides of the street wherever possible.

f. Sanitary sewers shall be placed on the east side or south side of the road to the extent possible. Sewers shall be placed according to the typical cross sections shown in Appendix B. The following is a summary of the spacing requirements:

i.	60-foot wide right-of-way	2 feet outside right-of-way
ii.	86-foot wide right-of-way	9 feet inside right-of-way
iii.	120-foot wide right-of-way	12 feet inside right-of-way

g. All public sewers must be located in a public right-of-way or an easement. The easement size will vary individually as required for maintenance and access. The minimum sanitary sewer easement shall be 20 feet.

h. Sewers shall be constructed outside of paved parking areas, streets, and drives wherever possible.

i. Stubs for future extensions shall be provided to the property lines at locations designated by the township Engineer.

j. Within unplatted projects, sewers shall be installed parallel to the property lines, or building lines, with clearance distances to accommodate the full width of the proposed easement.

3. Sewer Capacity

a. Sanitary sewers shall be designed to serve all natural tributary areas, anticipating full development of such areas, with due consideration given to topography, established zoning, and the township's adopted master land use plan.

b. For single-family homes, the design population shall be at least 3.2 persons per unit. For multi-family units, the design population shall be at least 2.1 persons per unit.

c. Wastewater collection systems shall be based on an average daily flow of 100 gallons per capita per day for single and multi-family areas.

d. Commercial and industrial areas shall be designed based on an average daily flow of 940 gallons per day per acre. The area to be used shall be based on the total area of the property, excluding right-of-ways.

e. The peaking factor to be used shall be calculated using the following formula.

$$PF = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}$$

Where: PF = Peaking Factor
P = Population, in thousands

f. Minimum size for public sanitary sewer shall be ten inches in diameter.

g. Minimum design velocity for sanitary sewers shall be two feet per second with pipe flowing full, based on Kutter's formula using an "n" value of 0.013.

h. Maximum design velocity for sanitary sewers shall be 12 feet per second with pipe flowing full.

i. The following table represents the minimum and maximum grade for public sanitary sewers.

Size	Minimum Grade	Maximum Grade
10-inch	0.30%	6.2%
12-inch	0.22%	6.0%
15-inch	0.16%	3.6%
18-inch	0.12%	2.8%
21-inch	0.10%	2.2%

j. Sewers shall not be oversized in order to lower pipe slopes unless it can be shown that they will flow at least one-half full during peak flows.

k. All upstream dead-end sewers shall have a minimum last run grade of 0.6%.

l. Sewers shall be matched at the eight-tenths diameter depth above invert in manholes when changing the internal diameter sizes of sewers or connecting to an existing system.

m. Unless otherwise approved, no sanitary sewer shall have less than six feet of cover. In general, sanitary sewers shall have a minimum of eight feet of cover below finished road surface grade.

n. Unless otherwise approved, the top of any sanitary sewer shall be at least ten feet below finished grade elevation at the building setback line of each fronting property which the sewer is designed to serve.

o. The maximum depth to invert of any sanitary sewer shall not exceed the depth recommended by the manufacturer for each size and class of pipe.

p. Sanitary sewers and services should cross other utilities, including storm sewer, water, gas, and electric, with a minimum of 18 inches of clearance measured from outside of pipe to outside of pipe.

4. Manholes

a. Manholes shall generally be placed at maximum intervals of 400 feet and at every change of grade, alignment, pipe size, and at each junction of sewers. Manholes must be placed in locations accessible by sewer cleaning equipment.

b. External drop connections are required where the invert of the outlet pipe is two feet or more below the invert of the inlet pipe. Internal drop connections will not be allowed.

c. Manholes shall not be located in drives or approaches.

d. Generally, manholes shall be located on lot lines.

e. Provide a drop of one-tenth foot in the downstream sewer invert for direction changes in excess of 30 degrees to compensate for velocity head loss of the incoming flow.

5. Services

a. Service connections and sanitary leads shall be provided for each proposed building. Building leads shall extend a minimum of ten feet beyond the property line.

b. Cleanouts shall be provided within five feet of foundation walls, at all bends, and at intervals no greater than 100 feet. A minimum of one cleanout external to the building shall be required on all sanitary leads.

c. Connection of house leads to manholes is prohibited.

d. Service leads shall be a minimum of six inches in diameter with a minimum slope of one percent. Maximum length of building sewers shall be 200 feet unless otherwise approved by the township engineer. Cleanouts are required for every 100 feet of building lead and at all horizontal and vertical bends.

e. Unless otherwise approved, construction of house leads from the public sewer to the easement and/or property line for each fronting parcel which the sewer is designed to serve shall be included with the construction of each sanitary sewer.

f. Where the construction of building sewers to the property line is not required concurrently with the sanitary sewer construction, a wye branch or tee inlet with riser is required. Such tee, wye, or riser shall be provided with a watertight stopper or plug with type of joint used for the sewer pipe

and shall be installed for every lot or building site which the sewer is designed to serve. Such tee, wye or riser and end of building sewer shall be marked with a 2" x 2" (nominal dimension) hardwood marker to six inches below the ground surface.

g. Building sewer risers shall be installed to a depth of ten feet below finished ground elevation, unless otherwise authorized by the township. All risers that are installed without building leads shall include an approved stopper.

h. All connection branches in the sewer pipe shall be securely and completely fastened to or formed in the wall of the pipe during manufacture. All pipes containing such connection branches shall be installed with the main sewer. Wyes for vacant property shall be installed opposite the center of the frontage unless otherwise indicated. All wyes that are installed with building sewers shall include an approved stopper.

i. The ends of building sewers shall terminate with an approved stopper at the property line or easement line, whichever is farther. The ends shall be marked with a 2" x 2" hardwood stake placed vertically from the pipe invert to two feet above the ground surface. The portion above ground shall be painted with an approved phosphorescent paint.

j. Sanitary services should cross other utilities, including storm sewer, water, gas, and electric, with a minimum of 18 inches of clearance measured from outside of pipe to outside of pipe.

6. Septic Tanks

a. Septic tanks are not permitted unless shown on the Master Plan.

b. Where permitted, septic tanks must conform to Wayne County standards.

7. Inverted Siphons

a. In general, sanitary sewer siphons shall be avoided and will only be accepted where no other feasible alternative exists where there will be sufficient flow in the sewer so that maintenance will be held to a minimum.

b. The minimum pipe size for inverted siphons shall be six inches in diameter.

c. The minimum number of pipes for each inverted siphon shall be two. The pipes should be sized such that, in the event that one pipe had to be shut down for repair, the remaining pipes would be able to transport the design flow.

d. The minimum velocity shall be three feet per second through the siphon.

8. Sanitary Pump Stations

a. Sanitary pump stations are not allowed unless identified in the township Sanitary Sewer Master Plan, or when approved by the township Board.

b. See Section IX for standards for pump stations.

B. Materials

1. Sewer Pipe. Sanitary sewer pipe shall conform to the following current American Society for Testing and Materials Specifications (ASTM):

   a. Reinforced Concrete Sewer Pipe. Reinforced concrete sewer pipe shall conform to the requirements of ASTM C76, Class IV. Joints shall conform to the requirements of ASTM C443, Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets, with the exception that gasket material shall be synthetic rubber only and shall conform to the requirements of ASTM C361. Joints in concrete pipe having a diameter of 30 inches or larger shall be pointed on the inside with mortar after backfilling has been completed.

   b. ABS Composite Sewer Pipe. ABS composite pipe and fittings shall be as described under ASTM designation D 2680, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Composite Sewer Pipeline.

      i. Solid wall ABS pipe for 6-inch house connection sewers shall conform to ASTM designation D 2751 SDR 23.5, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings. Solid wall pipe shall be installed in accordance with the requirements outlined below.

      ii. Pipe shall have a home mark. Pipe with an absence of filler material at the ends greater than one-fourth-inch deep shall be subject to rejection or acceptable repair.

      iii. Joints shall be chemically welded in accordance with the manufacturer's recommendation. Additionally, all exposed ends of the pipe shall be fully and thoroughly coated with plastic jointing cement prior to making joint to seal ends to eliminate the possibility of false low pressure air tests. Care shall be taken to ensure all joints being pushed to the full home position and held tightly in the home position during any grade or line adjustments. Pipe shall be rotated during joint insertion to ensure a complete spread of jointing cement. ABS plastic cement primer and ABS plastic pipe cement shall arrive at the job site in sealed and labeled containers. Johnny mops or similar swab type applicators shall be used to apply primer and cement. Opened containers in the trench shall be protected from dirt, water and other contaminants.

      iv. Wyes and tees shall be manufactured to the same standard as the pipe. Spurs shall be of the same size and type as the house lead/riser pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe.

c. Polyvinyl Chloride (PVC) Solid Wall Pipe.

i. PVC solid wall pipe and fittings for 6-inch through 15-inch diameter shall be as described under ASTM designation D 3034 SDR 35, Standard Specification for Polyvinyl Chloride Sewer Pipe and Fittings. PVC pipe and fittings for 18-inch through 27-inch diameter shall be ASTM F 679 SDR 23.5.

ii. Joints for pipe and fittings shall be of the elastomeric gasket push-on type. Such joints shall conform to ASTM designation D 3212 and the pipe manufacturer shall file with the township a copy of certified test results of its jointing system prior to use. Gasket joints shall be installed in accordance with procedures specified by the pipe manufacturer. Care should be taken to ensure all joints being pushed to the full home position and held tightly in the home position during any grade or line adjustments.

iii. Wyes or tees shall be a molded wye or tee fitting per ASTM D2680, with gasketed joints on each end suitable for directly inserting in the mainline pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe. Branch connection fitting shall be a gasketed joint suitable for the house lead pipe specified. Saddle connections are not allowed.

d. Polyvinyl Chloride (PVC) Truss Pipe

i. Polyvinyl Chloride (PVC) truss pipe shall be ASTM D2680. The pipe shall be of a double wall construction, braced with a truss-type structure with all three (3) formed in one (1) extrusion. The truss voids are filled with lightweight concrete to provide additional compressive strength and bracing.

ii. Joints for Polyvinyl Chloride (PVC) pipe shall be elastomeric gasketed conforming to ASTM D3212, push on type joint.

iii. Wyes or tees shall be a molded wye or tee fitting per ASTM D2680, with gasketed joints on each end suitable for directly inserting in the mainline pipe. Branch connection fitting shall be a gasketed joint suitable for the house lead pipe specified. Saddle connections are not allowed.

2. Manholes. Manholes shall be constructed of precast reinforced concrete sections in accordance with the township Standard Details.

a. Precast reinforced concrete manhole sections shall conform to requirements of the American Society for Testing and Materials "Tentative Specifications for Precast Reinforced Concrete Manhole Risers and Tops" - ASTM Designation: C-478, latest revision.

b. Precast manhole joints shall be Modified Grooved Tongue, (MGT) having a rubber gasket snapped into a groove cast into the tongue. The modified

groove or bell end of the section shall be made smooth and shall not have more than two degrees slope, tapered to fit the rubber gasket to tolerances as determined by the gasket manufacturer. MGT joints shall be lubricated and coupled in accordance with the manufacturer's printed instructions.

c. All manholes shall use eccentric cones placed with steps away from the road unless directed otherwise.

d. Manhole steps shall be EJIW #8502 or approved equal.

e. Where manholes are located in paved areas, final grade adjustment shall be made with precast concrete grade adjustment rings; brick construction will not be allowed. Grade rings, frame and cover shall be per External Frame Seal detail on SDD’s.

f. Where manholes are located outside of pavements and sidewalks, final grade adjustments shall be made with precast concrete grade adjustment rings; brick construction will not be allowed. Grade rings shall be a minimum of 3-inch thick and reinforced with two full circles of 3/16" diameter steel reinforcing wire. Manhole casting frame and concrete adjustments rings shall be secured to precast cone section with a minimum of four 5/8" diameter cadmium coated threaded studs or bolts.

g. All manholes shall be provided with water tight manhole covers.

h. Manhole frame and covers shall be East Jordan Iron Works #1040-1 ZPT with 1040 AGS (narrow skirt) cover or approved equal. Covers shall be cast with the words "SANITARY SEWER SYSTEM" in raised letters spaced in from the periphery of the cover.

i. Special approved wet area manholes with precast rubber gasket type pipe fittings and lockdown rubber gasket type manhole covers such as EJIW #1040 ZPT, or equal, shall be required in areas of high ground water table and where manholes are to be located in or adjacent to drainage ditches, low areas and flood plains. Details of this type of manhole are included in the standard plan sheets.

j. The base of the manhole must be channeled in the direction of flow. Channels shall be installed such that flow is allowed to travel downstream unrestricted. Formed shelves should be tapered so as to direct flow and debris into the channel.

3. Special Structures and Appurtenances

a. Preliminary plans. Preliminary plans for special structures and appurtenances required for sanitary sewer systems shall be submitted to the township for review and comment prior to their inclusion in the construction drawings.

b. Inverted siphons. Inverted siphon design shall provide at least two independent parallel pipes, with a minimum diameter of six inches each, sized to secure an average velocity of flow of at least three feet per second for average flows.

c. Pumping stations. Sewage pumping stations shall have at least two pumps or ejectors, each sized to handle maximum design flow. For three or more pumps or ejectors, sizing of units shall be such that design flows can be handled with the largest unit out of service. Design features shall conform to the ten states standards of GLUMRB. Pump station design shall also conform to other requirements as determined by the township Engineer. When all pumps are operating, the pumping station shall not discharge flows which exceed the capacity of any downstream sewers. Force mains shall be provided with automatic air release valves in wells at all main high points of the type approved by the township Engineer. Cleanouts shall be placed at locations designated by the township Engineer. The Developer will supply a portable emergency power source which will become the property of the township if the township maintains the pumping station.

4. Service Leads

a. Ordinary house leads shall be constructed of ABS plastic solid wall pipe ASTM D-2751, latest revisions, or PVC SDR 23.5 solid wall. Larger building sewers may be constructed of materials permitted for sanitary sewers under the same conditions of depth.

C. Construction

1. All sanitary sewer construction shall conform to the current township Sanitary Sewer Standards and Specifications.

2. Construction shall not commence without a representative of the Owner present.

3. Manholes shall be constructed of precast reinforced concrete sections. Further details can be found on the Standard Detail Sheet. The following conditions must also be adhered to:

    a. Manhole rims shall be set to grade or as indicated on the plans.

    b. Pipe shall not be extended into a manhole beyond the inside face of the wall. Field cutting of the pipe should be done in a neat, workmanlike manner, using methods approved by the township Engineer.

    c. Concrete placed inside manholes to form the channel through the manhole shall not be placed between the pipe and the precast flexible joint opening in the manhole base section so as to interfere in any way with the flexible joint connection.

    d. Manhole assembly shall be in strict accordance with the manufacturer's recommendations. Particular care shall be taken to keep foreign materials from interfering with proper joint assembly.

    e. All manholes shall be supported on a firm, stable foundation. The foundation shall remain stable during backfill and subsequent operations.

    f. Adjustments to manhole castings in non-paved areas shall be accomplished prior to final acceptance by using precast concrete adjustment rings bolted to the cone section of the manhole with synthetic rubber O-ring gaskets compressed between each adjacent ring.

    g. Manhole castings located within pavement areas shall be adjusted a maximum of 15 inches using precast concrete grade rings and mortar plaster coat. A butyl rubber sealant and polyethylene wrap for watertightness shall be applied to the exterior of the adjustment after the concrete has taken its initial set and is resistant to damage.

4. Drop connections. A drop connection shall be constructed whenever an inlet sewer pipe enters a manhole at an invert elevation 24 inches or more above the invert elevation of the outlet sewer pipe. Drops less than 24 inches will not be permitted.

5. Stubs. Where future connections to a manhole are anticipated, stubs or blind drop connections with watertight plugs shall be provided.

6. Bulkheads. Where sanitary sewers tap into existing manholes, a 6-inch temporary masonry bulkhead shall be constructed in the sewer to prevent flow into the existing system from the new system. Temporary bulkheads shall be removed only after approval from the township Engineer.

7. All rigid sanitary sewer pipe shall have Class B bedding and all flexible sanitary sewer pipe shall have Class I bedding (See SDD's) unless otherwise approved.

8. Trench B (See SDD's) sand backfill shall be placed within three feet of all structures.

9. No connection receiving storm water, surface water, or ground water shall be made to sanitary sewers.

10. No footing drains shall be connected to the buildings sanitary sewer.

11. When house leads are to be cut into an existing sanitary sewer, tap shall be made with the use of a tapping saddle and sleeve.

12. Private sanitary sewer leads of excessive length, although not a public sewer, may require inspection and testing. Each site will be considered individually by the township Water and Sewer Department.

13. Differential of excavation around existing manholes shall not exceed six feet.

14. Risers on sanitary sewers shall be installed to a depth of ten feet where the sewer is over 12 feet deep.

15. Prior to the backfilling of a service lead, the ends of building lead shall terminate with an approved stopper at the property line or easement line, whichever is farther. The ends shall be marked with a 2" x 2" hardwood stake placed vertically from the pipe invert to two feet above the ground surface. The portion above ground shall be painted with an approved phosphorescent paint.

16. All stubs shall have a water tight bulkhead.

D. Testing

1. All sewers shall be subjected to air, infiltration or exfiltration tests, or a combination of same, prior to acceptance. All sewers over 24 inches in diameter shall be subjected to infiltration tests. All sewer 24 inches in diameter or smaller, where the ground water level above the top of the sewer is over seven feet, shall be subjected to infiltration tests. All sewers of 24 inches in diameter or less, where the ground water level above the top of the sewer is seven feet or less, shall be subjected to air tests or exfiltration tests. All tests shall be witnessed by the township Engineer.

2. The procedure for air testing of sewers shall be in accordance with ASTM C828 for Vitrified Clay pipe, ASTM C924 for Concrete pipe, and ASTM F1417 for Plastic pipe.

    a. The sewer line shall be tested in increments between manholes. The line shall be cleaned and plugged at each manhole. Such plugs shall be

designed to hold against the test pressure and shall provide an airtight seal. One of the plugs shall have an orifice through which air can be introduced into the sewer.

b. An air supply line shall be connected to the orifice. The air supply line shall be fitted with suitable control valves and a pressure gauge for continually measuring the air pressure in the sewer. The pressure gauge shall have a minimum diameter of 3.5 inches and a range of zero to ten pounds per square inch gauge. The gauge shall have minimum divisions of one-tenth pound per square inch gauge and an accuracy of plus or minus 0.04 pound per square inch gauge.

c. The sewer shall be pressurized for four pounds per square inch greater than the greatest back pressure caused by groundwater over the top of the sewer pipe. At least two minutes shall be allowed for the air pressure to stabilize between 3.5 and four pounds per square inch gauge. If necessary, air shall be added to the sewer to maintain a pressure of 3.5 pounds per square inch gauge or greater.

d. After the stabilization period, the air supply control valve shall be closed so that no more air will enter the sewer. The sewer air pressure shall be noted and timing for the test begun. The test shall not begin if the air pressure is less than 3.5 pounds per square inch, or such other pressure as is necessary to compensate for groundwater level.

e. The time required for the air pressure to decrease one pound per square inch gauge during the test shall not be less than the time shown in air test tables as developed by the ASTM.

f. Manholes on sewers to be subjected to air tests shall be provided with a one-half-inch diameter galvanized, capped test pipe installed through the manhole wall and extending three inches into the manhole at an elevation equal to the top of the sewer pipe. Prior to the air test, the groundwater elevation shall be determined as follows:

   i. The test pipe in the downstream manhole shall be cleared by blowing air through it.

   ii. A length of clear plastic tubing shall then be attached to the end of the test pipe and extended vertically upward to or near the top of the manhole.

   iii. Groundwater will enter and rise in the tubing to the elevation of the groundwater level at the manhole and will be readily visible.

g. The air test pressure shall be adjusted (1-foot water equals to 0.433 psi) to compensate for the maximum groundwater level above the top of the sewer pipe to be tested. After all tests are performed and the sewer is ready for final acceptance, the test pipe shall be capped with a watertight cap.

3. Infiltration for any section of sewers between manholes shall not exceed 200 gallons per inch diameter per mile of sewer per 24 hours and shall include the infiltration from all manholes and other appurtenances.

4. Exfiltration Test

a. For the purpose of exfiltration testing, the internal water level shall be equal to the external water level plus seven feet as measured from the top of the highest pipe in the system being tested. This could be either a house lead or a lateral. However, the maximum total height of water above the invert of the pipe at the lower end shall not exceed 20 feet. A prospective test that would exceed this 20-foot limit should not be taken. The line under construction can be broken down into smaller sections so that the maximum head of 20 feet will not be exceeded.

b. The actual exfiltration of leakage from the sewer line can be measured by recording the volume of water lost over a given period of time in a standpipe or pipes connected in the upstream and/or downstream manhole, or the upstream manhole can be used provided the test water level is below the bottom on the tapered section. It may be necessary to add a measured amount of water during the testing time interval to maintain water in the standpipe at the specified level so that the total volume of water lost would be based upon the amount of water added and the difference in elevation of water at the end of the testing converted to gallons. When the standpipe method is used, the time interval to record the difference in elevation of the water surface shall be a minimum of 15 minutes. When the upstream manhole method is used, the time interval shall be a minimum of two hours.

c. A minimum of four hours should elapse after the test section is filled with water to permit the escape of trapped air and to allow for maximum absorption. After such absorption and escape of air has taken place, water should be added to the specified test level, and the test begun.

d. The maximum exfiltration rate shall be 200 gallons per inch diameter of pipe per mile of pipe per 24 hours.

5. A nine point mandrel test is required for all flexible pipes not less than 30 days after installation.

6. All sewers shall be televised, with results approved by the township prior to placing the sewer in service. Copies of the television recording need to go to the township and the Engineer. The television inspection must be witnessed by the Owners representative.

7. If a sewer fails to pass any of the previously described tests, the Contractor shall determine the location of the leaks, repair them, and retest the sewer. The test

shall be repeated until satisfactory results are obtained. Television inspection shall be considered completed when the necessary construction repairs have been made and the installation re-televised and the system is acceptable for the testing phase.

CHAPTER V
STORM SEWER STANDARDS

Chapter V covers storm sewer design, materials, and construction. This chapter is meant to be used in conjunction with the plan submittal requirements presented in Chapter II

A. Design Criteria

1. General

a. An underground drainage system will be required. All run-off generated on-site, and all run-off from off-site, must be accommodated for and discharged in a controlled manner.

b. *In streets.* Storm sewers shall be placed on the east side or south side of the road to the extent possible. Sewers shall be placed according to the typical cross sections shown in Appendix B. The following is a summary of the spacing requirements:

i.	60-foot wide right-of-way	8 feet inside right-of-way
ii.	86-foot wide right-of-way	16 feet inside right-of-way
iii.	120-foot wide right-of-way	22 feet inside right-of-way

c. *In easements.* Easements for sewers shall have a minimum width of 20 feet. The utility shall be centered in the easement unless otherwise permitted by the township Engineer. Such easements shall be deeded or dedicated to the township with restrictions against use or occupation of easements by the property owners and/or by other utilities in any manner which would restrict sewer maintenance or repair operations.

i. Easements for possible extensions shall be provided to the property lines at locations designated by the township Engineer.

ii. Sewers shall, whenever feasible, be constructed outside of paved parking areas, streets and drives, and not closer than ten feet to any building.

iii. Easements shall be provided for all drainage ditches and storm sewers located within a subdivision.

iv. Drainage and storm sewer easements shall be provided where off-site drainage enters onto the lot or parcel to be developed.

v. Easements shall be provided in size and location in accordance with the township storm water management plan.

vi. Drainage easements shall be provided at the location of and of the design width required for the 100-year overflow drainageway outside of public rights-of-way.

d. *Tributary area.* Sewers shall be designed to serve all natural tributary areas and areas designated in the township storm water management plan with due consideration given to the topography, established zoning and the adopted township master land use plan and the capacity of the storm water outlet proposed to be used. Discharge must not be diverted onto abutting properties without necessary easements. The outlet must be in accordance with the existing natural drainage courses in the area. Provision for detention/retention of stormwaters where required must be included in the storm drainage system as described in Chapter 6 this manual.

2. Storm System

a. Storm sewers are to be designed for the 10-year storm flows.

b. Peak design flows for each drainage area shall be calculated with the Rational Formula.

$Q = CIA$

where: Q = Peak Flow Rate, cfs
C = Composite Runoff Coefficient
I = Rainfall Intensity, in/hr
A = Drainage Area, acres

c. The composite runoff coefficient, C, must be calculated for each area based on the percentage of surface types in the drainage area tributary to that location. The minimum C values to be used for each surface type are as follows:

Type of Surface			**Runoff Coeff. C**
Water Surfaces			1.00
Roofs			0.95
Asphalt or Concrete Pavements			0.95
Gravel, Brick, or Macadam Surfaces			0.85
Semi-pervious: Lawns, Parks, Playgrounds			
	Slope < 4%	Slope 4% - 8%	Slope > 8%
Hydrologic Soil Group A	0.15	0.20	0.25
Hydrologic Soil Group B	0.25	0.30	0.35
Hydrologic Soil Group C	0.30	0.35	0.40
Hydrologic Soil Group D	0.45	0.50	0.55

d. Rainfall intensity for a 10-year design storm with a time of concentration less than 60 minutes shall be:

$$I = \frac{151.8}{(T + 19.9)}$$

where: I = Rainfall Intensity, in/hr
T = Time of concentration, min

For time of concentrations greater than 60 minutes, please refer to the Wayne County Storm Water Management Standards Manual.

e. Time of concentration shall be determined as follows:

i. For the most upstream end of the storm water management system, the time of concentration is referred to as the initial time of concentration.

a) For multiple and commercial/industrial land use, initial time of concentration shall be 15 minutes.

b) For single-family residential land use, initial time of concentration shall be 20 minutes.

c) For unimproved lands, initial time of concentration shall be given as:

$$T = 0.48S^{1/2}$$

where: T = Time of concentration, min
S = slope of the overland flow route, ft/ft

ii. For all other downstream locations in the storm water management system, the time of concentration shall be the sum of the initial time of concentration plus the travel time from the upstream end to the location being analyzed. A velocity of 2.5 ft/s should be assumed when calculating the travel time through the upstream pipes.

f. The storm sewer should be designed using the Manning Equation for pipes flowing full.

$$Q = \frac{1.486AR^{2/3}S^{1/2}}{n}$$

where: Q = Peak Flow Rate, cfs
A = Cross Sectional Flow Area, ft^2
R = Hydraulic Radius, ft
S = Pipe or Energy Slope, ft/ft

(The energy slope is only to be used under surcharged conditions)

n = Manning's Coefficient of Roughness

g. The minimum size for storm sewer is 12 inches in diameter.

h. The minimum cover for storm sewer shall be 2.5 feet. Cover should be at least four feet wherever possible.

i. The minimum and maximum allowable closed conduit velocities are 2.5 and 8.0 feet per second, respectively. The corresponding minimum and maximum percent slopes based on pipe size for concrete pipe (n = 0.013) shall be as follows:

Pipe Diameter (inches)	Minimum Percent Slope	Maximum Percent Slope
12	0.31	3.10
15	0.23	2.30
18	0.17	1.80
21	0.14	1.50
24	0.12	1.20
27	0.10	1.10
30	0.09	0.90
36	0.07	0.70
42	0.06	0.60
48	0.05	0.50

j. Storm sewer of different sizes should be set such that the 0.8 depth point for each pipe shall be at the same elevation.

k. A drop of 0.10 feet shall be provided in the downstream sewer invert elevation for directional changes in excess of 30 degrees to compensate for the hydraulic head losses.

l. The hydraulic grade line must be calculated based on 10-year storm flows, starting with the crown elevation at the outlet or the 10-year event water elevation at the detention basin, whichever is higher. The hydraulic grade line must not be higher than 1.0 feet below the rim elevation at any upstream manhole location along the closed conduit. Wherever possible, flow should be maintained within the pipe without surcharging.

m. Storm sewer systems that are designed with invert elevations below the permanent pool elevation of the downstream detention pond are not allowed.

n. The rim elevation at any manhole location along the closed conduit system upstream of a detention basin must be at least 1-foot above the design water level of the detention basin.

3. Structures

a. The maximum distance between manholes must not exceed 300 feet for 36-inch diameter conduits and smaller, and 100 additional feet for every 1-foot of diameter for closed conduits over 36 inches in diameter. Maximum distance shall not exceed 500 feet.

b. All structures must be a minimum of four feet deep.

c. The first structure upstream of an existing system shall be at least 48 inches in diameter with a 24-inch sump.

d. Manholes are to be located at:

i. All changes in alignment.

ii. Points where the size of the sewer changes.

iii. Points where the grade of the sewer changes.

iv. Junctions of sewer lines.

v. Street intersections or other points where catch basins or inlets are to be connected.

e. All manholes shall be a minimum of 48 inches in diameter.

f. Catch basins are to be located as follows:

i. All low points in gutters and swales.

ii. Upstream of street intersections (at or ahead of the spring point of street returns where possible). When drainage is required to go around a corner, a maximum distance of 150 feet between the high point and the corner catch basin is allowed.

iii. Maximum intervals of 400 feet along a continuous slope.

iv. Upstream of driveways where possible.

v. Generally, the flows to be accommodated shall not exceed the intake capacity of the cover. Catch basin cover capacities shall be determined by assuming a value of 0.011 cfs per square inch of opening.

g. Catch basins with an inlet pipe shall have a minimum diameter of 48 inches.

h. Inlets at the upstream end of the system shall be a minimum of 24 inches in diameter.

i. Inlets shall only be allowed in pavement areas, and then only as a high end structure and when followed by a catch basin within 50 feet of the inlet.

j. End sections may be used as a ditch inflow device when followed within 50 feet by a catch basin. Field catch basins shall be provided at the low point of all swales and ditches so as to prevent a concentrated flow of storm water onto a paved surface such as streets, driveways, parking lots, etc.

k. In rear yard drainage systems (subdivision) structures shall be located on every other lot line to provide positive drainage for the lot and to provide a collection point for the sump pump discharge lines.

l. *Stubs.* Where future connections to a manhole are anticipated, stubs with watertight bulkheads shall be provided.

4. Roadside Ditches

a. Ditch design shall include maximum side slopes of one on four. Side slopes of one on three may be utilized where sufficient hardship can be demonstrated, subject to approval of the township Engineer. In general, the minimum ditch slope shall be one percent. Underdrain shall be provided for all ditches with slope of less than one percent but in no case shall a ditch slope be less than 0.4%. All ditches to a maximum of three percent slope shall be provided with topsoil, seed and mulch. Slopes greater than three percent shall be sodded. Ditch slopes over five percent shall be paved or shall incorporate other permanent erosion control measures as approved by the township Engineer. The above erosion measures must be installed to the hydraulic grade line for a five-year storm.

b. Maximum ditch depths in subdivisions shall not exceed two feet.

c. Improved open drains may only be permitted upon special circumstances, with the approval of the township Engineer.

d. Open drains shall have an approved slope protection or energy dissipater grouted at areas subject to possible erosion and at other locations as required by the township Engineer.

5. Rear Yard/Side Yard Swales

a. Slopes for swales shall be between one percent and three percent. Swales shall be directed to inlets and shall not carry water across more than one other lot, or 500 feet whichever is less.

6. Pipe End Treatment

   a. The inlet end of culverts and storm drains shall have a properly designed inlet structure, i.e., headwall or flared end section, approved by the township Engineer.

   b. Culverts and storm drain outlets shall have headwalls or flared end sections with necessary erosion control, i.e., grouted concrete riprap or energy dissipater, as required by the township Engineer.

   c. Grouted concrete riprap or interlocking concrete pavers is required at all pipe outlet points other than structures. The minimum width of the riprap shall be twice the outside diameter of the pipe. The minimum length of the riprap shall be three times the outside diameter of the pipe, plus one additional foot under the end of the pipe outlet. Where the discharge point is on a slope, the riprap shall extend from the bottom of slope to the pipe invert as determined by the township engineer. Two types of riprap may be used:

      i. Field stone or broken concrete of 4-inch minimum thickness and one square foot minimum area; broken concrete or stone shall be mortared to form a monolithic slab with a minimum thickness of six inches; or

      ii. Poured MDOT 30P or 30M concrete of 4-inch minimum thickness scored at a maximum of 2-foot intervals. A 2-foot-deep poured concrete header shall be installed at the outer edges.

7. Special Structures and Appurtenances

   Preliminary plans for special structures and appurtenances required for sewer systems shall be submitted to the township for review and comment prior to their inclusion in the construction drawings.

8. Storm Drainage House Leads

   All lots shall be provided with an individual storm drainage house lead so that footing drain discharge from sump pumps can outlet directly into the enclosed storm drainage system. Invert elevations of the proposed house lead shall be shown on the grading and storm drainage plans.

   a. House lead pipe requirements. Service leads provided for footing drain discharge shall consist of schedule 40 polyvinyl chloride (PVC) or cast iron pipe. Minimum pipe diameter shall be four inches. Minimum pipe slope shall be one percent.

b. Collector pipe requirements. Storm sewer piping which only collects waters discharged from footing drains and does not cross any roads or paved areas, may consist of ADS N-12 dual-wall, HDPE meeting AASHTO M252, Type S or AASHTO M294 type S or solid wall PVC pipe meeting ASTM D 3034 SDR 35 as well as the sewer pipe types as listed below. Minimum earthcover over pipe shall be two feet. Minimum pipe slope shall be one-half of one percent. Pipe diameter shall not be less than eight inches.

B. Materials

1. Sewer Pipe

a. Concrete Pipe

i. Storm sewer pipe shall conform to the current ASTM C-76 for circular pipe, or C-507 for horizontal elliptical pipe, latest revision.

ii. All pipe shall be class IV and shall have the class, lot number and date of manufacture conspicuously marked on each length by the manufacturer.

iii. Pipe shall have a rubber gasket snapped into a groove cast into the tongue. The modified groove or bell end of the pipe shall be made smooth and shall have not over a 3 degree slope for sizes 12" - 24", or a 2 degree slope for sizes 27" - 108", tapered to fit the rubber gasket to tolerances as determined by the gasket manufacturer. Joints shall be lubricated and coupled in accordance with the pipe manufacturer's printed instructions.

iv. Rubber gasket joints shall be in accordance with ASTM Designation: C-443, latest revision. Rubber gasket joints shall be lubricated and coupled in accordance with pipe manufacturer's printed instructions. Gaskets shall conform to the requirements of ASTM C361

v. Joints on pipes 36 inches in diameter or larger shall be inside cement pointed.

vi. Elliptical and non-circular pipe the exterior of the joints shall conform to ASTM C877, external sealing bands for non-circular concrete pipe. The width of the sealing bands shall be at least equal to twice the depth of the groove. For modified bell tongue and groove pipe, use the next larger gasket. The length of the sealing bands shall be equal to the outside circumference of the pipe at its largest diameter plus an amount equal to the width of the gasket to be used. The tongue and groove portion of the joint shall be sealed with a butyl rubber based gasket sealant meeting the requirements of AASHTO M-198 and having a nominal size of 1-inch.

b. Dual Wall Corrugated PVC Pipe – Smooth Interior

i. Pipe shall be a single extrusion of PVC with smooth interior and corrugated outer walls. Corrugated outer profile shall be annular and seamless. Pipe and fittings shall be in accordance with ASTM F949. Joints shall be bell and spigot type with a elastomeric gasket meeting the requirements of ASTM F477 and be suitable for storm sewer service.

ii. Wyes or tees shall be a molded wye or tee fitting per ASTM F949, with gasketed joints on each end suitable for directly inserting in the mainline pipe. Branch connection fitting shall be a gasketed joint suitable for the house lead pipe specified. Saddle connections are not allowed.

iii. Acceptable manufacturers of Dual wall corrugated pipe include Contech A2000, Uponor ETI Ultra-Corr or ENGINEER approved equal.

c. Smooth-Lined Corrugated Polyethylene Pipe

i. Smooth lined corrugated polyethylene pipe shall meet the requirements of MDOT section 909.06 and AASHTO M252, Type S for sizes 4” to 10” diameter, and AASHTO M294 Type S for 12” to 48” diameter.

ii. Fittings shall conform to the corresponding pipe specification and be constructed of the same material classification as the pipe. Fittings shall be welded on the interior and exterior at all junctions.

iii. Joints shall be bell and spigot type with rubber gaskets on both sides of the joint conforming to MDOT section 909.03 and ASTM F477. Split collar couplers are not allowed. Joints shall be watertight meeting the performance requirements of ASTM D3212.

d. Plastic pipe will be allowed only in residential private sewers outside the influence of paved surfaces. Plastic pipe is not allowed in commercial or industrial properties.

2. Manholes

a. Manholes shall be constructed of concrete block or precast reinforced concrete sections in accordance with the township standard details.

b. Precast reinforced concrete manhole sections shall conform to the requirements of the ASTM C-478, latest revision. Wall thickness shall depend on depth and shall be subject to the approval of the township's Engineer.

c. Brick for casting adjustment, or concrete block for manhole, inlet, and catch basin construction shall be concrete brick and conform to the requirements of ASTM C55, Grade S-II, solid units of nominal 3-inch (75 mm) thickness.

d. A minimum of three or a maximum of five courses of brick shall be placed above the top of the cone section on all precast or block manholes.

e. Manhole covers and frames shall be East Jordan Iron Works No. 1010, No. 1000, or approved equal, (see standard detail sheets in Appendix E).

f. Plastic structures may be used in rear yard drainage systems subject to approval by the township's Engineer.

3. Catch Basins

a. Catch basins shall be constructed of brick, precast manhole blocks, or precast reinforced concrete manhole sections, in accordance with the township standard details.

b. Catch basin and inlet frame and covers shall be EJIW No. 5080 or equivalent when located in pavement edge or gutter line.

c. Catch basin and inlet frame and covers shall be EJIW No. 1010 Type M cover or equivalent when located in paved areas other than edge gutter line.

d. Catch basin and inlet frame and covers shall be EJIW No. 1000 with Type N or Type M cover or equivalent when located in yard areas.

e. Plastic structures may be used in rear yard drainage systems subject to approval by the township's Engineer.

4. Leaching Basins

Leaching basins may be utilized only when the following conditions exist:

a. No adequate storm sewer, open ditch or road drain is available for storm water disposal.

b. Soil composition and groundwater table is suitable for percolation.

c. Total area of site shall be one acre or less. Consideration will be given for the utilization of leaching basins for sites larger than one acre, provided that soil conditions are optimum. Optimum soil condition is defined as soil composed entirely of coarse sand, gravel or a coarse sand and gravel mixture.

d. Generally, the drainage area to each leaching basin shall be one-fifth acre or less. However, for sites larger than one acre, consideration will be given to larger drainage areas.

e. The leaching basin shall be at least 1,000 gallons in volume with openings in the bottom and sides. The basin shall be bedded in 10-A washed stone with a minimum thickness of 12 inches at the bottom and along all sides.

f. Leaching basins which incorporate a sump with 6-inch open joint finger drain tile or perforated pipe may be considered acceptable in pavement areas.

C. Construction

1. Manholes, Catch Basins, and Inlets

a. Manhole, catch basins, and inlets, see SDD.

b. Precast reinforced concrete sections shall conform to ASTM C478. All precast sections shall be set in a full bed of mortar.

c. Pipe shall not extend into a manhole beyond the inside face of the manhole wall. Field cutting of pipe to be used at manholes shall be done in a neat, workmanlike manner. Exposed ends of reinforcing steel shall be cut flush with the pipe end.

d. The joint between a precast riser section and the base of the structure or the top of a brick or concrete radial block riser section shall be set in a full bed of mortar. Similarly, the joint between a precast eccentric cone section and the top of a brick or concrete radial block riser section shall be set in a full bed of mortar.

e. Brick and radial block used shall be laid in a full bed of mortar and shall be plastered on the outside with at least one-half inch of mortar in a manner that will completely seal the structure. Plastering shall be performed in conjunction with the laying of brick or block. The laying of block shall never be more than two courses ahead of the exterior plaster. The laying of brick shall never be more than six courses ahead of the exterior plaster.

f. Mortar for laying brick and block, pointing of joints, and plastering outside of structures shall be composed of one part type II masonry cement and 2.5 parts masonry sand. No lime shall be used in the mortar.

g. Water for concrete and mortar shall be clean and fresh, free from oil, acids and organic matter.

h. All brick, block, mortar and concrete work shall be properly cured and protected from freezing for a minimum of 48 hours. When the temperature is 40 degrees Fahrenheit and below, brick, block, mortar and concrete shall be heated to a minimum temperature of 60 degrees Fahrenheit.

i. After the concrete and/or plaster has set up sufficiently to avoid damage, backfilling shall be done in a manner that will not cause unequal pressure on the structure.

2. Connections

a. A proper channel shall be constructed within any existing manhole or other structure to which a connection is to be made to direct the flow to the existing outlet in a manner which will tend to create the least amount of turbulence. Any portion of the existing structure which would interfere with such construction shall be removed.

b. When connections are made with sewers or drains carrying water, special care must be taken that no part of the work is built under water. A flume or dam must be installed and pumping maintained, if necessary, and the new work kept dry until completed and any concrete or mortar has set.

3. Pipe Bedding

a. All rigid storm sewer pipe bedding shall be class B, all flexible storm sewer pipe bedding shall be class I.

All storm sewer systems shall be subjected to a final inspection prior to acceptance of the system by the township.

CHAPTER VI
STORM WATER STORAGE STANDARDS

Chapter VIII covers storm water storage design, materials, and construction. This chapter is meant to be used in conjunction with the plan submittal requirements presented in Chapter II.

All storm sewer designs shall conform to the township storm water management plan. Prior to the approval of a storm water master plan, storm sewer and on-site storm water holding facilities shall be in accordance with the requirements of the township Engineer. The master plan describes the township storm water system. Storm drainage facilities will generally be required for storm water disposal, sized for a ten-year storm event. Design consideration shall also be given to storm events in excess of the ten-year storm event and shall be reviewed and approved by the township Engineer.

Hydraulic design calculations and a copy of the drainage area layout used for the hydraulic design of the storm sewer shall be included in the construction plans submitted for review.

A. Design Criteria

Definitions

The following words, terms and phrases, when used in this article, shall have the meanings ascribed to them in this section, except where the context clearly indicates a different meaning:

Detention facility means a facility designed for holding or detaining storm water runoff for a short period of time and then releasing it at a controlled rate to the natural watercourse. The objective of a detention facility is to regulate the runoff from a given rainfall event and to reduce the impact on downstream drainage systems, natural or manmade.

Retention facility means a facility which does not have positive dewatering capabilities whereby water is held for a considerable length of time. The water may be dissipated by plants, evaporation or percolation into the ground.

1. Detention - Runoff that would cause the discharge rate to be exceeded must be detained onsite until it can be released without surpassing the allowable discharge. Acceptable means of detention can be achieved by a detention basin or by oversized underground pipes. Retention basins are generally not allowed, however exceptions may be made on a case by case basis. Storage of water in parking lots and on rooftops is not permitted under any circumstances.

    a. Storage Requirements

        Sites with drainage areas greater than five acres should have a detention system designed for the 100-year storm event. Sites with drainage areas of five acres or less should have a detention system designed for the 10-year storm event. The following formulas will apply:

10-year design equations:

$$Q_a = 0.10A$$

$$Q_o = \frac{Q_a}{AC}$$

$$T_{10} = -19.9 + \sqrt{\frac{4{,}530}{Q_o}}$$

$$V_{s,10} = \frac{9{,}108\,T_{10}}{(T_{10} + 19.9)} - 40Q_oT_{10}$$

$$V_{t,10} = V_{s,10}AC$$

100-year design equations:

$$Q_a = 0.10A$$

$$Q_o = \frac{Q_a}{AC}$$

$$T_{100} = -45 + \sqrt{\frac{19{,}845}{Q_o}}$$

$$V_{s,100} = \frac{17{,}649T_{100}}{(T_{100} + 45)} - 40Q_oT_{100}$$

$$V_{t,100} = V_{s,100}AC$$

where:

Q_a = Allowable release rate from the flood control storage volume (cfs).

Q_o = Maximum outflow per acre imperviousness (cfs/acre imperviousness).

T = Storage time defined as the instant storage begins until peak storage is attained (minutes).

V_s = Maximum volume of water stored per acre imperviousness (ft^3/acre imperviousness).

V_t = Maximum volume of water stored (ft^3).

A = Drainage area (acres).

C = Composite runoff coefficient.

The composite runoff coefficient, C, must be calculated for the entire site based on the percentage of surface types in the drainage area tributary to that location. The minimum C values to be used for each surface type are as follows:

Type of Surface			**Runoff Coeff. C**
Water Surfaces			1.00
Roofs			0.95
Asphalt or Concrete Pavements			0.95
Gravel, Brick, or Macadam Surfaces			0.85
Semi-pervious: Lawns, Parks, Playgrounds			
	Slope < 4%	Slope 4% - 8%	Slope > 8%
Hydrologic Soil Group A	0.15	0.20	0.25
Hydrologic Soil Group B	0.25	0.30	0.35
Hydrologic Soil Group C	0.30	0.35	0.40
Hydrologic Soil Group D	0.45	0.50	0.55

b. Detention Basins

i. Detention basins must be designed to have a permanent pool with a minimum depth of four feet.

ii. The volume of water associated with the permanent pool may count towards the detention volume requirement.

iii. Water stored below the ground water table in the detention basin does not count towards the detention volume requirement.

iv. Side slopes for a detention basin shall not be steeper than 1:6.

v. A 25-foot buffer strip shall be maintained from the top of bank around the detention basin.

vi. The depth of water designed to be stored in the detention basin should not exceed five feet above the permanent pool water level.

vii. A minimum of 1-foot of freeboard is required above the design water level.

viii. The design water level of the detention basin must be at least 1-foot below the rim elevation of any storm water structure upstream of the detention basin.

ix. All detention basins must have a provision for overflow set at the high water level capable of passing a 100-year storm. A spillway is an acceptable overflow provision with an outlet located so as not to cause potential hardships to adjacent property. If possible any spillway overflow must flow into a recognized natural drainage course. All spillways shall have a hard surface consisting of concrete, asphalt or grouted riprap, unless otherwise approved by the township Engineer.

x. The allowable discharge shall be 0.10 cfs/acre.

xi. A water quality system in the form of either a fore bay or a mechanical device is required to protect the detention system from sediments.

c. Underground Storage

i. Only pipe storage downstream of the water quality system is counted towards the detention volume requirement.

ii. The design of the underground storage system must incorporate an emergency overflow in the event that the storage within the system is exhausted.

iii. Buoyancy calculations shall be provided for any underground storage systems using either corrugated metal or plastic piping.

d. Water Quality

A water quality system in the form of either a fore bay or a mechanical device is required to protect the detention system from sediments.

i. Fore Bay

a) Fore bays shall be designed to capture and treat the first flush of runoff over the entire site. The first flush volume can be calculated by the following formula:

$$V_{t,ff} = 1{,}806AC$$

b) The first flush volume shall be discharged over a period no less than 24 hours.

ii. Manufactured System

a) The proposed water quality device must be approved by township Engineer for use.

b) Each manufactured storm water system shall be sized to treat, without a need for an internal bypass, the 10 year design flow rate.

c) Each treatment system shall be capable of removing 80% of the net annual Total Suspended Solids (TSS) at an average particle size of 100 microns.

d) Trapped sediments and/or floating contaminants shall not be resuspended or re-entrained at flow rates up to and including the specified design flow rate.

e) Direct access shall be provided to the sediment and floatable contaminant storage areas to facilitate maintenance.

f) The system shall be designed to not allow surcharge of the upstream system during dry weather conditions.

g) A bypass must be provided and sized to carry flow in excess of the 10-year design storm.

B. Outlets

i. The outlet structure should be placed at least ten feet from the top of bank to allow water to enter from all sides.

ii. A 2-foot sump shall be placed at the bottom of the outlet structure.

iii. The first flush volume must be released from storage in no less than 24 hours without exceeding the allowable discharge rate. The first flush volume can be calculated by the following formula:

iv. The bank full flood storage volume should be released in no more than 40 hours without exceeding the allowable discharge rate. The bank full flood storage volume can be calculated by the following formula:

v. The outlet structure or drainage path downstream of the outlet structure must be designed to carry a 10-year storm.

2. Retention Facilities

a. Retention ponds which are not to be used for aesthetic, agricultural or consumptive reasons but serve the sole purpose of collecting storm runoff will be permitted only if no drains or natural drainage course for discharging of a detention pond are reasonably available to the developer. Such use of retention ponds shall be considered a temporary measure or last resort to be discontinued as soon as a drain becomes available to the development.

b. The volume of retention ponds shall be adequate to hold runoff from back-to-back 100-year frequency storms over the entire tributary area. The computed volume in cubic feet of water shall be no more than five feet deep plus 1-foot of freeboard below the top of the basin unless otherwise approved by the township Engineer.

c. Retention basin volume shall not include volume below the average or existing groundwater table. A comprehensive soil investigation including determination of groundwater levels shall be furnished for all retention basins.

d. All requirements governing detention ponds, unless specifically revised or waived by the township Engineer, shall be applicable to retention ponds.

e. Maximum side slopes of retention ponds shall be one vertical to six horizontal. Anything greater shall require approval of the township Engineer and shall be fenced. When fencing is required by this article the proposed materials, gates and access shall be approved by the township Engineer. A 4-foot minimum height is required.

B. Construction

Detention/retention basins shall be constructed prior to any other construction for all projects in the township. Immediately following construction of the basin, suitable ground cover shall be established, weather conditions permitting. Such ground cover shall be established on the basin bottoms, side slopes, a 10-foot-wide maintenance strip, and an additional 10-foot width around the entire perimeter of the basin.

All subdivision storm water holding facilities shall be located in parks or outlots and not on a subdivision lot. During the approval process, the township Board may, at its discretion, allow the use of a lot for holding facilities when the lot has been oversized for this use. Holding facilities within proposed septic field areas will not be permitted.

In contaminated soil areas, i.e., landfills, dump sites, etc., where open ditches are proposed, the storm water holding facility shall be provided with a bentonite or vinyl liner to prevent the seepage of leachate into a watercourse.

A method of facility maintenance acceptable to the township shall be submitted and approved prior to final plan approval. This method shall provide for private maintenance. If maintenance is not subsequently provided, a special assessment district shall be established prior to final approval of the facility. This would allow the township to provide proper maintenance and assess the cost to the benefited property owners.

CHAPTER VII
PAVING STANDARDS

Chapter VII covers design, materials, and construction for roadway pavements, sidewalks, and bike trails. This chapter is meant to be used in conjunction with the plan submittal requirements presented in Chapter II.

A. Design Criteria

Definitions

The following words, terms and phrases, when used in this article, shall have the meanings ascribed to them in this section, except where the context clearly indicates a different meaning:

Alley means any dedicated public right-of-way affording a secondary means of access to abutting property, and not intended for general traffic circulation.

Bicycle Path means a permanent easement located outside of street rights-of-way for the construction, operation, maintenance, repair and/or replacement of a pedestrian and non-motorized pathway, which will allow access to adjacent properties.

Boulevard Street means a street of two one-way pavements of two or more lanes each, separated by a grassed or paved island (can be collector or local street).

Collector Street means a street which carries traffic from local streets to major streets.

Cul-de-sac Street means a short local street having one end permanently terminated by a vehicular turnaround.

Driveway means any area or portion of a premises, lot, parcel or yard used or proposed to be used to provide a means of ingress, egress, access and circulation of vehicles and traffic to, from and between any public or private street, principal or accessory building, use or structure, loading spaces, or parking lots or spaces.

Driveway approach means that portion of a driveway located between the street right-of-way line and the travel portion of the roadway.

Industrial or Commercial street means a street intended to serve primarily as a means of access from within nonresidential subdivisions or nonresidential districts to major streets and not intended to serve residential properties or carry residential traffic.

Loading space means an off-street facility or space on the same lot with a building or group of buildings for temporary parking of a commercial vehicle while loading and unloading merchandise or materials.

Local Street means a street which is of limited continuity used primarily for access to the abutting residential properties.

Maneuvering lane or aisle means a permanently surfaced area of land located between the driveway and all parking spaces and loading spaces, including lanes at the end of parking space tiers and areas provided for adequate ingress and egress from all parking spaces.

Major Street means a street which is intended to serve as a large volume thoroughfare for both the immediate township area and the region beyond, and is designated as such on the township's Master Land Use Plan.

Marginal Access Street means a local street utilized to provide access to multifamily and attached condominium dwellings of four or more units. This type street may also be parallel to and adjacent to a major street that provides access to abutting properties and protection from through traffic.

Parking Lot means that area of land which includes loading spaces, parking spaces and maneuvering lanes.

Parking Space means a permanently surfaced area of land adequate to carry out the off-street parking regulations of the township zoning ordinance, and an area for each motor vehicle exclusive of drives, aisles and entrances giving access thereto, and fully accessible for the storage and parking of permitted vehicles.

Parkway Street means a street intended to serve as the primary access to various uses and facilities within parkland.

Private Road means an area of land used for ingress and egress, including vehicular traffic, emergency response and public safety vehicles, and for private and public utilities to serve more than one parcel of land, which is under private ownership and not maintained at public expense.

Right-of-Way Line means the boundary between private property and the public lands under the legal control of the township.

Street Right-of-Way means an area dedicated to public use or about to become dedicated for public use, which provides emergency or other vehicular and pedestrian access to adjacent properties, and may be further designated as a local street, major street, service drive, collector street, boulevard, marginal access road, cul-de-sac, road, avenue, alley, lane or however otherwise designated, and shall include the land between the right-of-way lines, whether improved or unimproved, and may comprise pavement, curbs and gutters, shoulders, sidewalks, parking areas, lawn areas, ditches, utilities, signage and other items within the right-of-way lines.

U-Street means a short boulevard street permanently terminated by a half-circle turnaround.

Street Design Criteria

1. Residential and industrial subdivision streets shall be surfaced with bituminous pavement or Portland cement concrete pavement, curbed with Portland cement concrete curb and gutter sections, and provided with enclosed storm drainage systems and shall be approved by the township Engineer.

2. The following table sets forth minimum requirements for street right-of-way widths, pavement widths and pavement thicknesses.

Table 1
Street Right-of-Way Width, Pavement Width, and Pavement Thicknesses

Street Type	R.O.W. Width (Feet)	Pavement Width, Back of Curb to Back of Curb (Feet)	Minimum Pavement Thickness		
			Concrete Pavement (Inches)	Bituminous Pavement Full Depth (Inches)	Bituminous Pavement Full Depth (Inches) on Aggregate Base (Inches)
Major	Per Twp. Master Plan	-Special Design Considerations-			
Collector	86	36	9	11	6/8
Local residential (A)	60	27	7	9	4.5/8
Boulevard collector	100	27(B)	9	11	6/8
Boulevard local	86	24 (B)	7	9	4.5/8
Local non-residential	60	22 (C)	7	9	4.5/8
	70	36	9	11	6/8
Marginal access non-residential	34	24	9	11	6/8
Marginal access residential	30	22	7	9	4.5/6
Cul-de-sac, residential	60 (radius)	48 (radius)	7	9	4.5/6
Cul-de-sac, non-residential	70 (radius)	56 (radius)	9	11	6/8
Parkway	45	24	7	9	4.5/8
Parkway, cul-de-sac	45	44	7	9	4.5/8

Notes:

A. Includes subdivisions, site condominiums, detached cluster housing, attached condominiums or cluster housing of three or less units.

B. Two lanes of traffic in each direction with parking prohibited.

C. One lane of traffic and one parking lane permitted in each direction.

3. The requirements of this section may be modified for residential lot developments (subdivisions, lot splits and detached condominiums) to permit open roadside ditches if the following conditions are met:

a. Each lot must have a gross area not less than one-half acre.

b. Each lot must have a frontage of not less than 120 feet.

c. Each lot must have a depth not less than the lot width, nor greater than three times the lot width.

d. No lot shall be partitioned or divided if such partitioning or dividing would produce lots having less than the minimum width and area stipulated in this section.

e. No water, other than natural surface storm water, shall be allowed to enter such open roadside ditches. Basement sump water, for example, shall not be discharged into open roadside ditches. Footing drain discharge shall be in accordance with section V, pertaining to storm drainage house leads.

f. Discharge of storm drainage into an open roadside ditch shall be in accordance with storm drainage design standards as set forth in this manual.

g. The natural groundwater table must be below the bottom of all ditches.

h. Designs for subdivision streets with open roadside ditches shall conform to the requirements of the WCDPS standards and specifications; see SDD.

4. The right-of-way widths set forth in Table 1 shall generally govern; however, if the township determines that additional right-of-way is required for proper construction because of special circumstances, which shall include but not be limited to requirements for horizontal sight distances, grading operations, location of open channels, permanent structures occupying portions of the right-of-way, or for a street that is not now so designated but which may in the future function as a collector or major street, such facts will be made known to the Project Sponsor/Developer after a review of the plans by the planning commission, the township Council, or the township Engineer.

5. Industrial, commercial, and office street RIGHT-OF-WAY widths may be reduced to 60 feet with two, 5-foot easements, subject to the review and approval of the township Engineer.

6. Marginal access street shall be either dedicated as public street RIGHT-OF-WAY or shall be an easement which will permit the use of the marginal access street for traffic circulation from one property to another. A marginal access street shall be used to access multifamily residential sites and attached condominium projects where the preponderance of buildings have four or more units per building. Such easement shall be in a form acceptable to the township Engineer and township Attorney.

7. Soil borings shall be made at maximum intervals of every 250 feet along the centerline of the proposed road. The borings shall be made by an approved drilling company, and shall be to a minimum depth of five feet below the proposed centerline elevation. The log of these borings shall be submitted, in duplicate, with the paving plans and specifications. The Project Sponsor's/Developer’s engineer shall submit acceptable soil investigation analysis along with the boring logs so that the township Engineer may determine the additional need for undergrading, base material, subbase material,

subgrade treatment, and any other special design requirements that the township Engineer may deem necessary to ensure the integrity and design life of the street pavement.

8. The pavement thicknesses shown in Table 1 are minimum standards. Alternate designs for pavement cross sections that provide equal or greater structural capacity and longevity will be considered by the township Engineer if adequate engineering data is furnished for analysis. Thickness shown is based on clay subsoil.

9. Regardless of design, six inch edge drain will be required along all roadways. Design requirements may be increased due to existing conditions encountered in the field as determined by the township Engineer.

10. Refer to sections V, VI and VIII of this manual for standards for storm sewers, storm water storage and grading requirements.

11. Roadway Design

    a. All roadways shall be shown in plan and profile views. Profiles shall include at a minimum the following vertical curve information:

        i. Point of curvature (PC), point of intersection (PI) and point of tangency (PT) shall be shown graphically and labeled with stationing.

        ii. Vertical curve length shall be labeled for all curves. Minimum vertical curve length is 100 feet. Grade changes of less than one percent do not require a vertical curve and may be made with a point grade break.

        iii. Vertical curves shall be labeled with the “K” value which is defined as the length of the curve in feet divided by the absolute value of the grade difference. Minimum “K” values are 30 and 36 for crest and sag curves respectively.

    b. Roadways shown in plan view shall include at a minimum the following horizontal curve data:

        i. Horizontal curve radius shall be labeled for all roadway curves. Minimum horizontal radius is 300 feet.

        ii. Minimum curb radius is 25 feet for all residential streets and 30 feet for collector streets.

        iii. Residential driveways shall have a 25-foot radius. Commercial driveways shall have a 30-foot radius.

        iv. A minimum sight distance triangle shall be maintained at all street intersections. The sight distance triangle is defined as an area 30 feet from the end of radius on each leg of the approach. The sight distance triangle must be kept clear of all obstructions other than regulatory signs.

v. Driveways and street intersections should align with existing streets and/or drives whenever possible. Intersections offset less than 150 feet from centerline to centerline are not allowed.

vi. Cul-de-sacs shall be designed to the radii shown in Table 1. Cul-de-sacs are to be designed with a landscape island 32 feet in diameter.

vii. Eye brow cul-de-sacs are permitted. Eye brows require a 27-foot wide travel lane is maintained and a minimum 13-foot wide landscape island.

Parking Lot and Driveway Design Criteria

1. Drive widths shall be as shown in Table 2.

Table 2
Drive Widths and Pavement Thickness

	Maximum Width (Feet)	Minimum Width (Feet)	Minimum Thickness (Inches, Concrete)	Minimum Thickness (Inches, Bituminous)
Residential	18	12	6	6
Office	24	12 (one-way)	8	n/a (a)
Commercial	24	12 (one-way)	8	n/a (a)
Industrial	36	15 (one-way)	8	n/a (a)

Notes:

a. Asphalt drives for other than single-family residential must be approved by the township Engineer.

2. Driveway and parking lot surfacing including parking spaces and maneuvering lanes are required to be hard surfaced. The minimum standard for a light duty parking lot is three inches of bituminous on six inches of aggregate base.

3. All driveways and all sides of parking lots (including islands) shall have concrete curb and gutter to delineate the drive aisles and to direct storm runoff to the storm water management system. The use of bumper blocks is not allowed.

4. Pavement layout and schematics. Parking spaces, maneuvering lanes and driveways shall conform in size and configuration to the requirements of the township Zoning Ordinance. No parking areas shall be permitted in the future road right-of-way as designated in the township Master Land Use Plan. All parking spaces shall be double striped.

5. Generally, the minimum pavement slopes shall be one percent. Lesser slopes may be used if existing topography prohibits a one percent slope and only upon approval by the township Engineer.

6. Maximum driveway slopes shall be eight percent.

7. Maximum parking lot slopes shall be three percent unless otherwise approved by the township Engineer.

8. All driveway approaches to a roadway shall not exceed five percent for a distance of 25 feet (minimum) from the edge of the roadway.

9. All paved areas shall be drained to dispose of all surface waters accumulated in the parking area in a manner that will preclude unrestricted drainage of water onto adjacent property unless otherwise approved by the township Engineer.

10. The disposal of storm water from all paved surfaces shall conform to the requirements of sections V, VI and VIII of this manual for the design and construction standards for storm sewers and grading.

11. The discharge of storm water onto private property is not permitted unless an easement to do so is received from the affected property owners.

Sidewalk Design Criteria

1. Sidewalk grades shall be set to match the general profile on the traveled road, and elevations shall blend in with the general grading plan of the abutting property and shall not impede drainage to presently established storm structures, ditch drainage or site drainage swales.

2. At street intersections where open ditch drainage prevails, a 12-inch minimum size or larger 16-gauge corrugated metal culvert pipe shall be installed and backfilled with granular material Class II (MDOT specification) prior to the sidewalk construction. The culvert pipe shall have sufficient length to provide a sidewalk five feet wide with a grass area 2.5 feet wide each side at top, and a maximum slope of 1-foot vertical on three feet horizontal to the ditch flow line. The entire area of the filled ditch section, from the ditch bottom to the edges of the new sidewalk, shall be protected with sod. The sidewalk shall terminate at the shoulder point, eight feet from the edge of the traveled roadway, or at the back of curb.

3. At drive or street crossings, residential, commercial or otherwise, the sidewalk shall be sloped to meet the drive or street entrance grade. If existing curb is involved, the curb shall be removed and the sidewalk sloped to meet existing pavement. Curb return transition shall be installed and carried back along the edges of the sidewalk to maintain existing grade each side of the walk. Expansion joints shall be provided at all abutting edges of the sidewalk and the sidewalk header shall include an expansion joint at its junction with the pavement. A typical enlarged detail shall be submitted, indicating the construction features as necessary.

4. Barrier free, detectable ramps in a contrasting color, shall be constructed at curbs in accordance with the standard details and specifications shown on the SDD as provided by the township and shall be in accordance with current ADA requirements.

5. All concrete sidewalks shall be a minimum four inches thick, except that sidewalks which extend through a residential driveway shall be a minimum six inches in thickness. Sidewalks extending through office, commercial, or industrial drives shall be not less than eight inches in thickness.

Bicycle Path Design Criteria

1. Bicycle paths are to be constructed of three inches of bituminous pavement on six inches of aggregate base, or four inches of Portland cement concrete pavement where pathways will extend existing concrete walks. They shall be constructed in accordance with AASHTO guidelines and the standard details and specifications shown on the SDD as provided by the township.

2. Minimum bicycle path widths shall be eight feet, and a 3-foot clear zone on each side shall be provided. Sharp grade transitions, trees, signs and other fixed objects in the clear zone shall not be permitted.

3. Bicycle paths are to be generally located with a minimum offset from the road surface of 12 feet. Lesser distances may be allowed along curbed streets or when approaching intersections of streets to provide a safe alignment for crossing at the intersection.

4. Bicycle paths will generally follow the longitudinal slope of the existing ground, with adjustments in grade provided for intersecting drives and streets.

5. Grade on the bicycle path shall generally not exceed five percent. The maximum grade of a bicycle path shall be eight percent for 300 feet.

6. Bicycle paths will be sloped one-fourth inch per foot toward the street, unless existing surface drainage requires reversal of the pathway slope.

7. For minimum required horizontal and vertical clearances, see SDD.

8. Barrier-free ramps shall be constructed at curbs in accordance with standard details and specifications shown on the SDD as provided by the township and shall be in accordance with current ADA requirements.

9. Bicycle paths shall be constructed across the frontage or throughout a project as determined by the township Engineer, unless specifically waived by the Planning Commission and/or Township Board.

B. Materials

Concrete for pavement, driveways, sidewalks and bike paths must be a maximum seven sack mix, air-entrained and reach a minimum of 3,500 psi in 28 days.

The materials used in concrete pavement, driveways, sidewalk, and bike path construction shall meet the requirements specified in the sections of MDOT 2012 Standard Specifications for Construction designated as follows:

Section 601 Portland Cement Concrete for Pavements

Section 902 Aggregates

Section 903 Admixtures and Curing Materials for Concrete

Section 905 Steel Reinforcement

The concrete mixture shall conform to the requirements listed for grade of concrete P1 with 6AA coarse aggregate.

Bituminous mixtures for pavement, driveways and bike paths must be a minimum 1200 psi Marshall stability and meeting the requirements of MDOT 2003 Standard Specifications for Construction.

C. Construction

Street, Driveway and Parking Lot Construction

1. All construction methods, materials and equipment shall be in accordance with the WCDPS and MDOT standards and specifications, as supplemented by this section. In the case of conflict between these standards and the township, the township standards shall govern. Copies of the WCDPS and MDOT standards and specifications can be reviewed at the township Engineer‘s office.

2. Concrete and bituminous paving will not be allowed between November 1 and the following May 1 without written special permission from the township Engineer.

3. It is required that all proposed public and private underground utilities adjacent to or in the street right-of-way be installed prior to the paving of the roadway.

4. It is recommended that a systematic procedure of construction be followed in order to better coordinate the efforts of the township Engineer and the Project Sponsor/Developer or his agents. A progress schedule must be approved by the township Engineer before beginning construction.

5. All pavement surfaces must be supported upon a prepared subgrade that has been compacted to at least 95 percent of maximum unit weight in accordance with MDOT standards. When unstable subgrade materials, i.e., peat, muck, marl, wet clays, etc., are encountered, excavation and removal of such unstable materials and replacement to plan subgrade with approved materials compacted in place shall be required. Approved materials shall include blast furnace slag, crushed stone, gravel, coarse sand, or other materials approved by the township Engineer.

6. Should it be found that the excavation, removal and replacement of unstable subgrade material is impractical due to excessive depths, alternate pavement structure designs must be submitted to and approved by the township Engineer prior to pavement installation.

7. Deferment for placement of bituminous aggregate surface courses for a period of one year from the time of construction of the base course is permitted subject to terms, conditions and approval by the township. Deferment for placement of bituminous aggregate surface course for a period longer than one year may be granted by the township upon approval and recommendation by the Department of Public Services or the township Engineer. However, the time period beyond one year will only be extended until 90 percent of the lots have been developed. Any extension of

placement of bituminous aggregate surface course will require placement of a security deposit by the Developer acceptable to the township.

8. All sidewalks shall be concrete. Sidewalks shall be flush with abutting curbs and paved surfaces, and shall be constructed in accordance with the following standards:

   a. All unstable subgrade material shall be removed and replaced with class II granular material per MDOT specifications. Subgrade material other than such class II material may be used with prior approval of the Department of Public Services. Tree roots shall be trimmed and cut to allow for proper construction of a sidewalk.

   b. Forms shall be clean and straight, composed of wood or metal. The forms shall be staked to line and grade in a manner that will prevent deflection or settlement. Forms shall be oiled before placing concrete.

   c. The base shall be thoroughly wetted and the concrete deposited thereon to the proper depth. Concrete shall be spaded along the forms, compressed and struck-off flush with the top of the forms. The surface shall be floated with a steel float, edges and joints properly tooled, and then finished with a wood float or brush, transverse to the centerline of the sidewalk to provide a nonslip surface.

   d. One-half-inch transverse expansion joint, the full depth of the sidewalk, shall be placed at uniform intervals not exceeding 50 feet, at driveways, and where the new sidewalk abuts existing concrete structures. Contraction joints shall be formed every five feet. All joints shall be constructed at right angles to the centerline of the sidewalk.

   e. The concrete shall be cured with white membrane curing compound, wet burlap, or by other methods approved by the township Engineer, as soon as surface moisture has disappeared. Concrete shall not be placed on frozen ground. When the temperature is below 40 degrees Fahrenheit, or when freezing temperatures within the next 24-hour period are forecast, concrete shall not be placed unless protection against freezing of the concrete, as required by the township Engineer or building official, is provided.

CHAPTER VIII
GRADING STANDARDS

Chapter VI covers grading design, materials, and construction. This chapter is meant to be used in conjunction with the plan submittal requirements presented in Chapter II.

A. Design Criteria

1. Drainage Pattern

    a. In general, each residential lot shall drain from the front of the house to the road and from the rear of the house to the rear of the lot.

    b. Whenever a lot is graded toward the rear, a drainage structure must be provided on the lot or immediately across the rear lot line on the adjacent lot to receive surface runoff. Standard catch basins or special rear yard inlets may be used for this purpose.

    c. Drainage within a subdivision which crosses adjacent lots due to topography is permitted.

    d. Drainage for subdivisions and individual site developments must be self contained so that drainage across adjacent subdivisions and adjacent site developments is avoided, unless easements are provided for that purpose.

    e. Drainage for lots must be directed to a swale located on the side lot lines, the rear lot line, or out to the street.

    f. Parking lot and/or site drainage from commercial and industrial sites will not be permitted onto the right-of-way without approval of the township Engineer. An on-site storm drainage system or storm drainage facility must be provided.

2. Minimum Slopes

    a. Minimum ground slope for any part of the site, except for the protective slope around the building, shall be one percent (1/8-inch per foot).

    b. Minimum swale slopes along the side property lines, the rear property line and the swale located eight feet behind the building shall be one percent (1/8-inch per foot).

    c. The finish building grade, defined as the ground surface elevation at the building exterior, shall be established and maintained at an elevation that will provide a minimum 1-inch per 12 inches (1.25 percent) slope away from the building for a minimum distance of eight feet, with the balance of the site graded to provide positive drainage from that point.

3. Maximum Slope

Generally, the maximum ground slope for any part of the site shall be 25 percent (one vertical to four horizontal). For paved areas, the maximum grade shall be three percent (3/8-inch per foot).

4. Landscape Berms

The maximum side slope of landscape berms shall be 33 percent (one vertical to three horizontal). If a berm is used for all or part of a buffer zone, all required plant material shall be placed on the top and side slope facing the exterior of the site. Landscape berms five feet and greater in height shall have a minimum 10-foot wide flat top for access and maintenance.

5. Additional Requirements

a. The high point of the swale located on a side lot line shall be a minimum of one-half of 1-foot below the proposed finished ground elevation of the house.

b. Generally, a building shall not be set below the crown of the road on which it fronts.

c. A minimum of six-tenths of 1-foot of vertical drop shall be provided from the front (and side on corner lots) property line to the top of curb.

6. Grading Plans shall show at a minimum elevations and proposed grades for the following locations.

a. All lot corners

b. High points, low points and all storm water structures including catch basins, manholes, inlets and end sections.

c. Permanent pool elevation, high water elevation and freeboard elevation for all ponds and water features.

d. Grades of swales, ditches and roads. Break points and grade change locations shall be called out on the plans.

e. Finish floor elevations shall be provided for all buildings. Lots that are designed for walk out basements shall be labeled with “WO”, look out basements labeled with “LO” and full basement lots with “FB”.

f. Arrows showing the direction of drainage shall be placed on the grading plan in sufficient locations to make the drainage patterns apparent.

B. Materials

1. Topsoil: Topsoil shall be fertile, friable, sandy clay loam without admixture of subsoil. Topsoil is to be free of glass, stones greater than 1-inch (25 mm) in any dimension, weeds, undesirable grasses and other extraneous materials. Topsoil shall have the following range of values:

pH	5.0 to 7.5
soluble salts	500 ppm max
organic content	5% to 30%
silt content	35% to 50%
clay content	5% to 10%
deleterious mat'l*	5% max

*rock, gravel, stone, sticks, roots, sod, etc.

Compost may be mixed with topsoil to obtain the desired content. Topsoil is to be final screened thru a 5/8-inch (15 mm) maximum mesh screen prior to delivery to the Project site. ENGINEER shall review source and final screen results prior to release of topsoil. Contractor shall submit a certified analysis of the topsoil from each source to the township Engineer. Topsoil shall be placed in 3-inch minimum thickness throughout.

C. Construction

1. At all times the grading shall be conducted in a timely and orderly fashion acceptable to the township Engineer. Grading shall be accomplished in accordance with soil erosion and sedimentation control requirements and sequences and shall not alter or in any way affect off-site and adjacent natural drainage. Natural drainage flow passing through any construction site shall be accommodated at all times.

2. Any earth excavations and/or embankment construction shall be in strict accordance with the approved engineering drawings and the current state department of transportation standards and specifications for construction.

3. Special care shall be taken by the Contractor to ensure that trees, stumps, topsoil, or any other surplus or unsuitable materials shall not be placed in future building sites, roadways, or other areas which may support structures. On-site fill or wasting site locations for these unsuitable materials shall be as approved by the township Engineer.

4. Ground slopes shown between proposed elevations shall be considered constant unless noted to the contrary.

5. Finish grades shall be completed to an accuracy of one-tenths of 1-foot of the elevations shown in the subdivision's approved overall grading plan.

6. Temporary stockpiling of excavated materials and topsoil within 100 feet of adjacent property lines and/or rights-of-way shall not exceed a height of 20 feet with side slopes not to exceed an angle greater than 45 degrees. The toe of the slope shall be a minimum of 25 feet from adjacent properties and rights-of-way.

SECTION IX
PUMP STATION STANDARDS

The use of a sanitary sewer pump station is governed by the sewer use ordinances of the township. In general a pump station is not an option unless it can be shown that the project cannot be served by any other means. A project sponsor considering the use of a sanitary pump station should discuss the project with the township before proceeding with plans.

Storm water pump stations are typically owned and maintained by the development, be that a home owner's association or landlord. Storm water pump stations that are not to be turned over to the township may be used at the developer's discretion.

A. Design Criteria

When developing any extensions to an existing system or creating a new system, the overall service area for each pump station within the system must be considered. This must take into account future development that may occur within the area the pump station will eventually serve.

When establishing the pumping capacity for a new station, the hydraulics of the outlet sewer needs to be analyzed to assure that it can handle the flows from a new or upgraded pumping station. The impact that the flow may have on any downstream pump stations or treatment plant processes also needs to be reviewed.

H_2S generation from septic sewage, which will decay concrete pipe, has been a problem in the past at the discharge point of long force mains. In these instances the consideration of hydrogen sulfide resistant piping materials may be warranted. Such considerations may include:

1. Plastic (PVC or ABS) pipe
2. A lined concrete pipe
3. Chemical injection to neutralize the H_2S generation

Prior to the initiation of the design the Engineer and Owner should be consulted regarding the type of pump station to be specified. Although many types of stations exist, the two most predominant types constructed are either a submersible station or a flooded suction (wet well/dry well) type. Reviewing this information with operational personnel, and taking into account what other types of pump stations, pumps, and equipment the Owner is set up to maintain, needs to be considered.

Capacity – Sanitary Pump Stations

1. Service Area

   The service area needs to be determined based on both the existing and future potential area to be served by the pump station being designed. This may include other areas adjacent to the pump station being designed that may also require pumping.

2. Tributary Population

The population tributary to the station should be developed based on the service area and the projected type of land use for the area (residential, commercial, industrial, etc.). Factors contained in Chapter IV can be used to calculate the population tributary to the station.

3. Present Average Flow

The present average flow should be determined using the factors contained in Chapter IV. If this is an existing station upgrade, information regarding the system should be obtained to see if a value higher than those in chapter IV should be used due to infiltration/inflow that may exist in the system.

4. Design Peak Flow and Future Peak Flow

The design peak flow and the future peak flow in many cases is the same value; however, where future land use plans identify a higher population density in the future, the future peak flow may exceed the design peak flow. The design period should be for a minimum of 20 years, for the service area. The design peak flow should be derived using the factors in Chapter IV.

5. Firm Pump Capacity

Firm pump capacity is the pumping capacity with the largest pump out of service. This, at a minimum, should meet the design peak flow.

Capacity – Storm Water Pump Stations

1. Service Area

The service area needs to be determined based on both the existing and future potential area to be served by the pump station being designed. This may include other areas adjacent to the pump station being designed that may also require pumping.

2. Design Peak Flow and Future Peak Flow

The design peak flow and the future peak flow will be determined on one of two factors. For storm water pump stations that are discharging from a detention pond the design peak flow will be equal to the allowable outflow from the pond.

For pump stations that are upstream of the storm water outlet from a project (i.e., internal to the project site) the design peak flow is determined based on the tributary area and the storm water runoff factors contained in Chapter V.

3. Firm Pump Capacity

Firm pump capacity is the pumping capacity with the largest pump out of service. This, at a minimum, should meet the design peak flow.

Pump Selection

1. General

The approach to the proper selection of a pump, or system of pumps for a pump station, is the simultaneous solution of two equations and two unknowns. The system curve represents the first equation and the pump curve represents the second equation. The unknowns are rate of flow and total discharge head, and the two equations are solved graphically.

2. Number of Pumps

The number of pumps to be installed will depend on the station capacity and range of flow. Both present and future flows must be considered. Ten State Standards, WEF MOP #8 and other regulatory agencies or design documents require that there be a standby pumping unit equal to the capacity of the largest pump in the facility. Normally, a duplex pump station is required. Both pumps are identical and one serves as a back up to the other unit. If a third pump is required for the future, then space is set aside in the structure for the future unit. There may be occasions where three or more pumps may be required, or the pumps may not be of equal capacity. Two equal capacity pumps may be provided for the average daily flows and two large capacity pumps may be required for storm flows. There may also be occasions where variable speed pumping is required. Each situation is unique and depends on the specific requirements of the project and/or the township.

3. System Curve

The system curve is developed by selecting or assigning a range of flow rates for the pump station and calculating the corresponding total discharge head (TDH) associated with that flow. The total discharge head is plotted on the “Y’ axis, and the flow on the “X” axis. The Total Discharge Head (TDH) is the sum of the static head and the dynamic head. The system curve will resemble an increasing polynomial. The system curve consists of two head conditions. They are the static and dynamic heads.

a. Static Head

The static head is the difference between the water level in the wet well and the level of the free water surface (atmosphere) at the point of discharge. Normally for pump stations the discharge level or elevation is the centerline of the horizontal force main at the point of discharge. It is not the centerline of the force main at its highest point in the route of the force main. The difference between the highest point (if there is an elevation higher than the discharge) and the discharge elevation is negative static head, and is deducted from the total static head. The static head elevation for vertical discharge pipes is usually the elevation at the opening of the outlet.

Static head is not a constant. Since the water level in the wet well can vary from the low “stop” level to the high “alarm” level, the static head will depend on the level of water in the wet well at any point during the pump cycle. The static head must be computed for both the low water and high water levels in the wet well. There are many occasions when the operational level in the wet well can be very

large compared to the dynamic head, and has a significant bearing on the proper selection of the pump curve for the situation.

b. Dynamic Head

The dynamic head is the total of all the friction losses due to conveyance of the water in the piping and appurtenances. The dynamic head is also a variable and depends on the pumping rate. The calculation of dynamic head is dependant on the force main size (or sizes if there are two or more pipe sizes), length of force main, type of pipe, the friction factor for the pipe, valves, and fittings, the entrance condition and the flow discharge condition.

The Hazen and Williams formula is the most widely used empirical formula for calculating the head loss due to pipe friction. The head is calculated for the flow based on pipe diameter, pipe length and friction coefficient “C”. The friction coefficient, or C factor is specific for the type and age of pipe used.

In Michigan, the MDEQ requires that a C factor of 120 be used for lined ductile iron, PVC and polyethylene pipe. Newer pipe has a higher C factor (as much as 140) and old, worn pipe can have a C factor of 80 or less. The 120 value is the mid range that represents the useful life of the material. During the design of new pump stations, a system curve should be prepared for the new pipe condition to make certain the proper pump has been selected for the present as well as future hydraulic conditions. Nomographs are available for calculating the pipe friction losses based on all the variables.

Head losses due to pipe fittings, valves, pipe geometry, entrance and exit conditions, etc. can be calculated using two methods. The first method is to covert the fittings, valves, etc. to an equivalent length of pipe, and add this equivalent length of pipe to the actual pipe length to determine the total dynamic head. The second method is to calculate the head losses for each of the valves, fittings, etc. in terms of the velocity head using the applicable resistance coefficient or "K factor". The velocity head is (V2/2g), and is a variable depending on the rate of flow and pipe size. The “K” factors can be found in hydraulic handbooks. Factors for specific types of valves or other unusual appurtenances should be obtained from the manufacturer of the equipment.

The sum of the static head, pipe friction losses and minor losses for any flow rate is the total discharge head (TDH) for that rate of flow.

4. Multiple Pumps—Common Force Main

If the pump station design is for two or more pumps to discharge into a common force main, (parallel operation) then the system curve requires special consideration. The static head is calculated as previously outlined. However, the total dynamic head is only calculated for the “common force main” from the point of juncture of the individual pump legs to the pipe outlet. The system curve is to be plotted for the lowest anticipated flow for one pump to the maximum anticipated flow for all pumps operating at the same time. The dynamic losses for the individual pump leg (from the pump discharge to the point of juncture) are to be calculated separately and applied later during the modification of the pump curve.

5. Pump Curve

The pump curve or capacity-head curve is supplied by the manufacturer and indicates the rate of flow that the pump will supply at the head condition for the pump. The pump curve for a centrifugal pump generally resembles a decreasing rate polynomial, and is the second curve used in the graphical solution for the design of the pump station.

The pump curve is plotted on the system curve. The intersection of the pump curve with the system curve is the point where the pump will operate. Since there are two system curves, one for the high water level and one for the low water level, the actual range of pumping will follow the pump curve from the head condition at the high water level, to the head condition at the low water level. Since the TDH will be increasing, the rate of pumping will be decreasing. If the selected pump curve does not adequately fit the desired flow and head conditions, then select another pump curve.

For parallel pump operation, plot the selected pump curve on the system curve. Refer to the dynamic head losses that were calculated separately for the pump leg (see above). At each rate of flow, subtract the dynamic head loss from the pump curve head value at the flow rate selected, and plot the resultant head value below the original pump curve. Repeat this for several rates of flow. This generates a “modified” pump curve. The modified pump curve accounts for the losses in the pump leg that are only associated with the single pump. If all the pumps for the parallel operation are the same and the pump legs are generally the same (same pipe size, pipe length, geometry, etc.) then only one modified curve has to be generated for the situation. The pump leg losses for any of the pumps is the same regardless of the number of pumps that may be operating.

The intersection of the modified curve with the system curve is the point where the pump will operate. The modified curve must cross both of the system curves, and the pumping rate will follow the system curve. To determine the TDH at the pumping rate, vertically move up to the original pump curve and then read across to determine the TDH at the flow in question.

The modified curve is for one pump operating. To generate the curve for two pumps operating, select a “TDH and Q” point on the modified curve and double the flow (2*Q) at the same head, and plot the point to the right of the original modified curve. For example, if the TDH at 150 GPM is 12 FT, then plot a point for the two-pump curve at 300 GPM and 12 FT. Continue with other points using the same procedure to generate the two-pump operating curve. For three operating pumps, use the same procedure except triple the flow (3*Q) shown at the modified curve at the same TDH. For four operating pumps, it is four times, etc. Make certain that the generated curves cross both system curves.

Pumps operating in parallel will both function at the same head. If the pumps are the same capacity and if the discharge legs are the same, then both pumps will pump the same flow. To determine the head for two parallel operating pumps at any rate of flow, start at the TDH-Q point on the two-pump curve and move horizontally to the left to the modified curve. Then move vertically up to the original pump curve and then again move horizontally to the left to the TDH axis. The intersection at the TDH axis is the head for each pump. Figure 4 shows an example of this procedure.

For sanitary sewage the pump must be a solids handling type of pump. A pump curve should be selected so that the normal operating range for the pump is near or at the optimum efficiency point on the pump curve. Normally, the pump should pass a 3-inch diameter solid. The maximum speed of the pump should be 1180 RPM if possible to avoid additional wear on the pump. The motor horsepower and pump volute should have the ability to increase the impeller a minimum of 1-inch without increasing the motor size that is provided for the installation.

6. Motor Selection

On most manufacturer's pump curves, the motor horsepower recommended for the pump is shown. Make certain that the horsepower selected covers the full range of the pump curve. It is acceptable to always round up to the next highest motor horsepower.

The following formula can be used to calculate the power requirement:

$$Hp = (GPM \times TDH\ [FT] \times 8.34) / (550 \times 60 \times EFF\ [80\%=0.8])$$

Both the present and future conditions should be calculated and the horsepower to match the future condition could be specified for the project. However, a larger motor could be added to the pump at a future date.

Wet Well Sizing

It is recommended that the pump be selected first because the pump capacity is then used to determine the size of the wet well. The main parameter for wet well sizing is pump cycle time that relates directly to the pumping capacity.

1. Cycle Time

The pump cycle time is the sum of the pump running time and rest time, or from pump "on" to the next pump "on". There is always a minimum or critical cycle time for a pumping situation. The critical cycle time occurs when the inflow to the wet well is half of the capacity of the pump. The volume of a wet well between start and stop elevations for a single pump is:

$$V = (Tc * Qp)/4$$

Where:

V = Wet well volume between the start and stop elevations (gal)
Tc = Critical cycle time (min)
Qp = Rated pump capacity (gpm)

The above equation was derived based on the critical cycle time occurring when the inflow was half of the pump capacity.

The cycle time has no effect on the pump, but does impact the motor. Pump motors need to cool down prior to the next start. If not, they can prematurely burn out. For large pump motors, the cycle time should not be less than 20 minutes. For smaller pump motors, the cycle time can range between 5 and 15 minutes. Submersible pumps can operate over smaller cycle times because the motor is submerged and is cooled by the

water. It is always recommended to contact the pump manufacturer and obtain specific recommendations for their equipment.

Once the wet well volume is obtained, determine the start and stop elevations. That determines the draw down depth. The draw down depth can range from about 1-foot for a single small pump to up to ten or more feet for multiple pumps. Add additional depth for the high and low water alarms. Divide the wet well volume by the depth to obtain the surface area of the wet well. Determine an adequate spacing for the pumps based on their size, hydraulic approach conditions for the wet well, spacing required between the pumps and/or motors for maintenance, and other geometry considerations/limitations and determine the surface dimensions for the wet well. Also, make certain that adequate height is provided for in any superstructure to allow for removal of the pumps or motors.

2. Net Positive Suction Head (NPSH)

NPSH is the total suction head in feet of liquid (absolute) less the absolute vapor pressure (in feet) of the liquid being pumped. NPSH must always be a positive value. In other words, if the suction condition for the pumps is restrictive because of the suction piping or pump submergence, then the pump can be starved of flow, cause cavitation and ruin the pump. Proper design of the wet well will eliminate NPSH deficiencies.

There are two formulas used to calculate NPSH.

For positive (flooded) suction, for most pumping situations, except self priming pumps:

$$NPSH = Ha - Hvpa + Hst - Hfs$$

For suction lift, self priming pumps:

$$NPSH = Ha - Hvpa - Hst - Hfs$$

Where:

Ha = Absolute pressure (in feet of liquid) on the surface of the liquid supply level. This is barometric pressure and will depend on elevation. At 500 feet, barometric pressure is 33.4 feet. At 1,000 feet, barometric pressure is 32.8 feet.

Hvpa = Vapor pressure of the liquid at the temperature being pumped. Use 0.78 FT for water at ambient temperatures.

Hst = Static height in feet that the liquid supply level is above or below the pump centerline. For flooded suction pumps, this is the pump submergence.

Hfs = All suction line losses including entrance losses and friction losses through the pipe, valves and fittings.

There are two values for NPSH—NPSH required and NPSH available. The available NPSH is calculated per above. The required NPSH is determined by the pump manufacturer, and is usually plotted on the pump curve supplied by the manufacturer. The available NPSH MUST ALWAYS be equal to or greater than the required NPSH.

If a certain pump submergence depth is required, this elevation must be below the low water stop elevation. Therefore the overall wet well depth must include the submergence in the design of the pump station. Also, the dimensions of the wet well must accommodate the layout of the suction piping and other appurtenances.

3. Air Locking

If air gets trapped at a high point in the suction piping, the pump will not pump water. The pump is air locked. Air can enter and get trapped in the suction piping if there is inlet turbulence. The wet well must be designed to eliminate inlet turbulence. Inlet baffles can be used for this purpose.

4. Solids Collection

The wet well must be sized and dimensioned to minimize any areas in the wet well that could collect debris, grit, floatables, or other matter. The accumulation of these solids could damage the pump and excess floatables can adversely hinder or damage pump control elements. Individual wells or sumps for the pumps in the wet well can help eliminate excess solids accumulation. Divided wet wells can also be constructed to allow cleaning of the wet well without totally shutting down the pump station.

5. Confined Space Entry

Any underground dry well or valve pit associated with a pump station may be a confined space. In the design of a dry well or valve pit, the design should minimize or eliminate confined space considerations. Easy stairway access and permanent ventilation equipment may, therefore, have to be included in the design of the structure.

Special Considerations –Sanitary Pump Stations

1. Hydrogen Sulfide

H_2S generation from septic sewage, which will decay concrete pipe, has been a problem in the past at the discharge point of long force mains. In these instances the consideration of hydrogen sulfide resistant piping materials may be warranted. Such considerations may include:

a. Plastic (PVC or ABS) pipe
b. A lined concrete pipe
c. Chemical injection to neutralize the H_2S generation

Prior to the initiation of the design the Engineer and Owner should be consulted regarding the type of pump station to be specified. Although many types of stations exist, the two most predominant types constructed are either a submersible station or a flooded suction (wet well/dry well) type. Reviewing this information with operational personnel, and taking into account what other types of pump stations, pumps, and equipment the Owner is set up to maintain, needs to be considered.

2. Odors

Sanitary wet wells can generate odors. Usually these odors are hydrogen sulfide related. The proper sizing of the wet well with regard to cycle time will minimize the generation of odors. Eliminating dead zones that can accumulate solids will also minimize the potential for odors.

If a wet well requires ventilation, then it must receive 12 air changes per hour if the ventilation system runs continuously and 30 air changes per hour if run intermittently. In certain situations, the exhaust air may require odor control. Filters, wet scrubbers, deodorizers, etc. are available for odor control. The sizing of the wet well together with the superstructure must accommodate any odor control equipment.

B. Pump Controls

Pump control is considered the heart of any pump station design because the control equipment starts and stops the pumps, sequences the operation of the pumps, varies their speed (for variable speed drive pumps), alarms for abnormal conditions, and transmits the alarms to remote locations. Other instrumentation and control elements automatically monitor flow, level, temperature, pressure, etc., and saves the data for subsequent retrieval.

1. Start/Stop

   Several different alternatives are available for controlling the start and stop operation of pumps. Primary elements shall be electronic elements including sensed pressure trapped air elements, sonic level elements, and pressure transducer elements. The method used will depend on township preference, costs, and compatibility with existing control elements and similar factors. Electronic elements shall be backed up with float switches for emergency start and stop. The controls should alternate all pumps, including the backup unit. That is, the lead and lag sequence for the pumps should alternate. If a pump should fail for any reason, then the next pump must automatically be brought on line and an alarm condition must be transmitted for operator response. Pump station control shall utilize Programmable Logic Controllers (PLC's).

   All pump stations shall incorporate a Supervisory Control and Data Acquisition (SCADA) system compatible with the township system.

   Consult with the township engineer to determine requirements for pump station control and SCADA systems.

2. Variable Speed Control

   There are occasions when pumps require variable speed drives. A variable speed drive may be used to match the influent rate of flow into a wet well with the pumping rate. The speed of the pump can be paced to the level of water in the wet well. As the level increases, the pump would run faster and pump a larger volume of flow and vice versa. Commercial pump controllers are available and/or the control circuitry may be included with the drive equipment. Variable speed pump drives are more expensive than constant speed drives, however, the cost may be offset because smaller volume wet wells will usually be required.

3. Water Hammer

Pump station designs or situations where the pumps discharge into a long force main, especially if there is a high static head on the pumps, will require special analysis. Water hammer may occur during pump shut down, especially if the shut down is a result of a power failure. Special controls may then be required. An automatic shut down valve is placed on the discharge line from the pump. On pump shut down, the valve closes slowly while the pump is still operating. When the valve is fully closed, the controls will stop the pump. On pump activation, the pump controls will first start the pump, and then slowly open the valve.

These valves should be 90 degree actuated plug, ball or cone valves. These provide the best control. Do not use gate valves, even for clear water service. The valve operators must also be 90 degree actuators and it is preferred that they be specified for modulating service.

4. Flow Metering

There may be situations where the rate of pumping must be controlled based on another variable other than wet well level. One way to accomplish this is to install an automatic control valve and flow meter downstream of the pump being controlled. These two elements are then tied into flow controller instrumentation. The flow meter, such as a magnetic flow element, must always be downstream of the flow control valve. The flow rate will be set or determined by the flow controller, the meter will measure the actual rate of flow and compare it to the set point flow, and the flow control valve will regulate the valve to achieve the desired rate of flow. Be certain that the necessary upstream and downstream straight lengths of pipe are provided for the flow meter. For magnetic flow meters, at least 5 to 7 pipe diameters are required for the upstream pipe and 3 to 5 pipe diameters are needed downstream. Closed conduit flow meters must always be submerged.

5. Second Source of Power

Pump stations must have a second source of power. For smaller pump stations, the township may use a portable standby generator that can be used to power the station in the event of a power failure. If a portable standby generator is proposed, the Developer may be required to furnish the generator to the township. A permanent standby generator is usually required as the secondary power system on pump stations. The generator should have an automatic transfer switch. The Power Company could also bring an independent second source of power to the site. Recent experience has been that the second independent source of power is not always dependable and can also be knocked out during the same storm event. Therefore, permanent on-site standby generators are recommended for any large or critical pump stations.

6. Explosion Proof Design

All electrical elements, control elements and wire in the pump station wet well must be explosion proof or intrinsically safe. This is even true for storm water pump stations due to the chance of gasoline or other volatile substances getting to the storm water pump station.

Superstructures must also be explosion proof if there is any possibility of gasses from the wet well getting into the superstructure.

Controls and Operation

Consult with township and Engineer to determine needs for automatic controls, monitoring alarm conditions, telemetering, remote signals, alarm condition transmission, emergency operation guidelines, and preferences in equipment. Programmable Logic Controllers, and Supervisory Control and Data Acquisition (SCADA) are required for all pump stations.

Sanitary Pump Controls

The lead pump shall start a minimum of two feet below the invert of the influent sewer, to prevent surcharging the sewer. The lag pump shall start upon continuing rising level, no higher than 1-foot below the influent sewer elevation. Redundant start and high water alarm shall occur when the water level reaches a critical level, typically the invert sewer elevation. Pump(s) shall stop a minimum of 1-foot above the minimum submergence level for submersible pumps, and 1-foot above the centerline of the impeller for dry pit pumps to prevent cavitation and re-priming problems. Redundant stop and alarm shall be provided at minimum submergence elevation and/or pump impeller elevation.

Storm Water Pump Controls

The elevations in the pump station should be set as such – the pump off elevation is set at or below the permanent pool elevations. The pump on elevation should then be set such that the minimum cycle time of the pump is equal to or greater than five minutes. The emergency/backup float elevation should be set at the 100-year design elevation and the high water alarm elevations between the 100-year design elevation and the freeboard elevation. Redundant stop float elevation shall be below the pump on elevation but above the minimum submergence level of the pump to prevent pump cavitation. Calculations should be provided on the plan set indicating how the cycle time was calculated.

C. Force Mains

Force Mains

The minimum depth of force mains shall be six feet.

Force mains shall be provided with automatic air release valves in wells at all main high points of the type approved by the township Engineer. Cleanouts shall be placed at locations designated by the township Engineer.

D. Materials

1. Force Main. Force mains shall be ductile iron, polyvinyl chloride (PVC), or high density polyethylene (HDPE) piping systems. All joints will be subjected to leakage testing.

    a. Ductile iron pipe

i. Ductile iron pipe shall conform to the current requirements of ANSI A21.51, class 54 minimum, Ductile Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water and Other Liquids.

ii. Mechanical type joints, when specified, shall conform to the current ANSI A21.11, Rubber Gasket Joints for Cast-iron Pressure Pipe and Pipe and Fittings. The bolts shall be of the high strength, low alloy steel type.

iii. Push-on type joints, when specified, shall conform to the current ANSI A21.11, and shall be Tyton, Super Bell-Tite, or approved equal. The bulb or main body portion of the gasket shall have a maximum compression set of 20 percent after 22 hours at 158 degrees Fahrenheit as determined in accordance with ASTM D395, method B.

b. Polyvinyl Chloride (PVC)

i. Rigid polyvinyl chloride bell and spigot type pressure pipe and couplings conforming to AWWA C 900, for four inches and larger pipe, or ASTM D 2241 for pipe smaller than four inches, of the types and pressure class indicated on the plans. Spigot end of pipe shall be marked to visually determine when the spigot is fully sealed in the bell of the adjoining pipe.

ii. Joints shall be push or mechanical elastomeric gasket type, conforming to ASTM D 3139.

c. High Density Polyethylene (HDPE)

i. Pipe: Polyethylene, Nominal IPS OD, SDR-11, Pressure Rating 160 psi, pipe less then 3-inch diameter shall be in accordance with ASTM D 3035, pipe three inches and larger shall be per ASTM F714.

ii. Polyethylene Resin: PE 3408, minimum Cell Classification PE 345464C per ASTM D3350.

iii. Joints: Butt Fusion Welded or Electrofusion Welded per ASTM D 2657.

iv. Fittings in accordance with ASTM D3261 with a pressure rating equal to the pipe with an included 2:1 safety factor.

v. Flange Adapters - Stub Ends: Butt Fusion Welded.

2. Sanitary Pumps

Pumps shall be specifically designed for sanitary sewage service, capable of passing a 3-inch solid, cast iron construction, squirrel cage induction inverter duty motor, bearings with a L-10 life of 100,000 hours minimum, mechanical seals with tungsten carbide/ceramic seats. Impeller shall be bronze or cast iron or stainless steel as required by the township. Provide a warranty for a minimum of 1 year after acceptance.

3. Storm Water Pumps

Pumps shall be specifically designed for storm water service, and shall be capable of passing a 3-inch solid, have induction motors, bearings with an L-10 life of 50,000 hours minimum, and seals as recommended by the manufacturer. Provide a warranty for a minimum of 1-year after acceptance.

4. Back-up Emergency Generators

Emergency generator shall be natural gas fired, liquid cooled, 4-cycle, electric start, water jacket heater, with a critical grade exhaust silencer, lighted-sound attenuating enclosure, automatic dual rate battery charger, automatic transfer switch, sensing elements to monitor engine and generator performance and malfunction, alarm panel interfaced to SCADA system, rated to accept the pump stations full load.

5. Pump Station Controls

Control cabinets and related equipment shall be of a make and model as specified by the township for conformity and ease of maintenance.

E. Testing and Start up

1. Force Main Testing

a. No sanitary sewer pumping system shall be put into service until all pressure piping (force main) has undergone a satisfactory hydrostatic pressure test witnessed by the township Engineer.

b. Before applying the specified test pressure, all air shall be expelled from the pipe. The contractor shall furnish proper appliances and facilities for testing and draining the main without injury to the work and surrounding territory.

c. The Contractor shall be responsible for furnishing, and for the cost of, all water required for pressure testing. He shall test by filling the main with clean water under a minimum hydrostatic pressure of 100 pounds per square inch. In no case shall the leakage in any stretch of pipe being tested exceed the 11 U.S. gallons per inch diameter of main per mile of pipe per day (0.0001736 multiplied by diameter (inches) multiplied by pipe length (feet) in a two-hour period).

d. The Contractor shall pressure test sections of force main as directed by the township Engineer. Pressure testing shall be made in increments of 2,000 feet or

less unless otherwise authorized by the township Engineer and then only the allowable leakage for 2,000 feet will be permitted.

2. Pump Station start up sanitary sewer and storm water pump stations shall undergo an initial start-up process. Township Engineer and township personnel must be present for the start-up. The Contractor will demonstrate the operation and maintenance of the equipment to the township, as well as test the controls and operation of the station. The Contractor shall supply the township with two (2) copies of the Operations and Maintenance Manuals for all equipment at the pump station and replacement parts for all wear items.

CHAPTER X
PERMIT SUBMITTALS

Plans are sent to various permit agencies for approval prior to construction of a project. Each agency has different requirements. Permits must be obtained before construction may begin.

Unless otherwise provided, the township will obtain and is responsible only for submitting Sanitary Sewer and Water Main Construction Permits to the appropriate permitting agencies for review. Required fees for these permits are to be paid by the developer.

All other permits and approvals shall be obtained by the contractor, developer, or project designer and a copy provided to the township engineer prior to construction. If, for some reason, an agency does not require or agrees to waive a permit when one is usually needed, this shall be stated in writing by a responsible person-in-charge from that agency with a copy furnished to township engineer.

A1. Sanitary Sewers on Wayne County System

Construction of sanitary sewers that are tributary to the Detroit Waste Water Treatment Plant or the Downriver WWTP located in Wyandotte will require a permit from the MDEQ and from Wayne County. The plans along with the MDEQ permit form are submitted to the County first, and when approved are forwarded to the state for review.

The following requirements apply to sanitary sewer permits within the Wayne County sewer systems.

1. A permit application form is required for all public sanitary sewer construction. The standard Michigan Department of Environmental Quality (MDEQ) form is available on the MDEQ website at: www.michigan.gov/deq. From the home page select “Water” (left side), then select “Surface Water” (left side), then select “Part 41 Sewerage System Construction Permit” (under Quick Links on the right side), scroll down to the “Part 41” heading and either click on the link to the permit application.

2. A copy of the Wayne County Sewer Use Ordinance, permit application form and permit fees can be found at: www.waynecounty.com/doe/1029.htm

3. The plans and permit application form are submitted to township Engineer for review and approval first. The township Engineer will forward the plans to the County for approval. Once approved, the plans are forwarded to the state for final review and issuance of a permit.

4. Four sets of plans are required. Plans must be signed and sealed by a registered professional engineer and stamped as approved by the township Engineer.

5. A listing of all sewer lengths and diameters, by street (or appropriate segment if not along a street), for the proposed sewer must accompany the plans.

6. A completed copy of the latest revision of the “Wayne County Dept. of Environment, Sanitary Sewer Approval Checklist” must accompany the plan submittal. All of the requirements of the checklist should be completed.

7. A plan review fee is required; see “Wayne County Dept. of Environment, Sanitary Sewer Approval Checklist” for amount. Check is made payable to Wayne County Dept. of Environment.

8. Plans are approved by Wayne County Dept. of Environment and forwarded to MDEQ for approval. MDEQ issues the permit.

A2. Sanitary Sewers on South Huron Valley Utility Authority System

Construction of sanitary sewers that are tributary to the SHVUA Waste Water Treatment Plant located in Brownstown will require a permit from the MDEQ and from the Utility Authority. The plans along with the MDEQ permit form are submitted to the Utility Authority first, and when approved are forwarded to the state for review.

The following requirements apply to sanitary sewer permits within the South Huron Valley Utility Authority system.

1. A permit application form is required for all public sanitary sewer construction. The standard Michigan Department of Environmental Quality (MDEQ) form is available on the MDEQ website at: www.michigan.gov/deq. From the home page select “Water” (left side), then select “Surface Water” (left side), then select “Part 41 Sewerage System Construction Permit” (under Quick Links on the right side), scroll down to the “Part 41” heading and either click on “Hard Copy” or “Template”.

2. Refer to the South Huron Valley Utility Authority (SHVUA) Sewer Use Ordinance for fees, requirements, etc.

3. Four sets of plans are required. Plans must be signed and sealed by a registered professional engineer and stamped as approved by the township Engineer.

4. A plan review fee is required; the amount is as required by SHVUA Sewer Use Ordinance. The Check is made payable to South Huron Valley Utility Authority (SHVUA).

5. Plans and signed permit application form are sent to the township Engineer.

6. Plans are approved by township Engineer for sent to the (SHVUA) Engineer for approval, then sent to MDEQ for approval. MDEQ issues the permit.

B. Submittal for Water Main Construction Permit

Construction of water mains that are connected to the Township water supply will require a permit from the MDEQ. The plans along with the MDEQ permit form are submitted to the township engineer first, and when approved are forwarded to the state for review.

The following requirements apply to water main permits.

1. A permit application form is required for all public water main construction. The form is available on the MDEQ website at: www.michigan.gov/deq, then select “Water” (left side), then select “Drinking Water” (left side), then select “Community Water Supply” (left side), scroll down to the “Manuals, Forms and Brochures” and click on “Water Supply Permit Application”, choose either the Microsoft Word or the Adobe Acrobat version.

2. Four sets of plans are required. Plans must be signed and sealed by a registered professional engineer and stamped as approved by the township Engineer.

3. Plans should include a water main listing all water main lengths, by size and by location (street, or appropriate segment).

4. Plans are approved by the township engineer and sent to Michigan Department of Environmental Quality (MDEQ). MDEQ issues permit.

C. Work in Road Right-of-Way

Construction activities that occur within existing rights of way will require a permit from that owning jurisdiction. Permit requirements and processes vary from agency to agency. The applicant is encouraged to verify the permit requirements with the appropriate agencies.

1. Work in Wayne County Right of Way (includes Drains, Parks, and any other Wayne Co. Owned Property)

    a. Three sets of plans are required

    b. Plans are sent to:

    Wayne County Department of Public Services
    Engineering Division-Permits Office
    Attention: Division Permit Engineer

2. Work in Washtenaw County Road Right-of-Way

    a. The most current information can be obtained at: http://www.wcroads.org/permits

    b. Three sets of plans are required

    c. Permit application form is required

    d. Plans and permit application form are sent to:

    Washtenaw County Road Commission
    Permit Engineering Section
    555 N. Zeeb Road
    Ann Arbor, MI 48103
    (734) 761-1500 Phone
    (734) 761-3737 Fax

3. Work in MDOT Right-of-Way

   a. Five sets of plans are required

   b. Permit application form is required

   c. Plans and permit application form are sent by transmittal to the appropriate TSC (Transportation Service Center), for information see: www.michigan.gov/mdot/1,1607,7-151-9623_10695---,00.html

D. Soil Erosion and Sedimentation Control Permit

Construction activities which disturb land area may be subject to a Soil Erosion and sedimentation permit. Permit requirements vary from one jurisdiction to another, and the applicant is encouraged to verify the requirements with the Authorized Public Agency (APA).

1. General

   a. The applicant must first determine who the Authorized Public Agency (APA) is. The APA can be determined in Wayne County, by going to: www.waynecounty.com/doe/1029.htm

   b. Submittals must be in accordance with the APA.

2. For Projects where Wayne County Department of Environment is the Authorized Public Agency (APA).

   a. Three sets of plans are required; plans must be signed and sealed by a registered professional engineer.

   b. A permit application form is required.

   c. A check payable to Wayne County Department of Environment, for the plan review fee is required. The plan review fee can be determined from Page 6 of the permit application form.

   d. The three sets of plans, the permit application form, and the check for the review fee are sent to the appropriate Inspector at:

      Wayne County Department of Environment
      Land Resource Management Division

3. For Projects where Washtenaw County is the Authorized Public Agency (APA).

   a. Two sets of plans are required; plans must be signed and sealed by a registered professional engineer.

   b. A permit application form is required and fees are required. See their website at http://www.ewashtenaw.org/government/drain_commissioner/dc_websoilerosion for additional information.

E. NPDES – Construction Site Storm Water Permit

Construction activities which disturb more than five acres of land area are subject to an NPDES Storm Water Permit.

1. Sites of one to five acres do not require the issuance of a permit but the program requirements still apply.

2. Sites of five acres or more require a permit.

3. Must first have the Soil Erosion and Sedimentation Control Permit from the Authorized Public Agency (APA) for the Project.

4. Or, the Project Owner must have APA status.

5. A "Notice of Coverage" application form is required.

    a. The permit application form is available at: www.michigan.gov/deq/, then click on "Water" (left side), then click on "Surface Water" (left side), then click on "Storm Water" (left side), then go to the section in the middle entitled "Information" and click on "Construction Site Program". The permit application form is the "Notice of Coverage" pdf file.

6. A check for the application fee is required.

7. Send the Application form and the check for the application fee to:

    Michigan Department of Environmental Quality
    Water Division
    Lansing, MI

F. Work in County Drain

Construction activities within or impacting a County Drain will require a permit from that maintaining agency. Work in County Drains may also require a permit from the MDEQ for impacts to wetlands, floodplains or inland lakes and streams. Applicants should verify with the County and the MDEQ which permits will be required.

1. Projects in Wayne County

    a. Work in Drains is covered by the Permit Office. All Wayne County reviews (road right-of-way, drains, parks, etc.) are done from one submittal. See "Submittal for Work in Road Right-of-Way".

G. MDEQ – Land and Water Management Division Permit

The Land and Water Division of the Michigan Department of Environmental Quality (MDEQ) governs a variety of construction activities as they may impact water features and environmentally sensitive areas. Applicants should contact the MDEQ to determine which permits may apply to their project.

Submittal for MDEQ Land/Water Management Permits (Act 451)
Part 301 Inland Lakes and Streams
Part 303 Wetlands
Part 31 Floodplain
Etc.

1. The MDEQ land/water management permit forms, fee schedules, rules etc., are all available at:

    a. www.michigan.gov/deq/ , then click on "Water" (left side), then click on either "Inland Lakes and Streams" or "Wetlands Protection" (left side).

        i. If you chose "Inland Lakes and Streams" then click on "Lakes and Streams Protection" (left side), then look under "Permits" in the center column, the application form is "MDEQ/USACE Joint Permit Application".

        ii. If you chose "Wetlands Protection", then look under "Permits" in the center column, the application form is "MDEQ/USACE Joint Permit Application".

        iii. To determine when a permit is required, the permit fees, etc. then look under "Laws and Rules" in the center column.

2. The Permit Application Form and permit fees are required.

3. Five sets of plans are required.

4. One set of reduced size plans (11" x 17") are also required.

5. A listing of adjacent property owners is required.

    a. This list can usually be obtained from the City Clerk's Office

6. Submit plans, reduced size plans, property owner listing, permit application form, and check for the review fee to:

    Michigan Department of Environmental Quality
    Geological and Land Management Division
    525 West Allegan
    P.O. Box 30204
    Lansing, MI 48909

    Attn: Permit Consolidation Unit

H. Other Permits

1. When working within a railroad company right-of-way, a permit from the railroad company will be required. Contact the railroad company involved to determine the permit procedures.

2. In addition, Water utilities, Oil and Gas pipeline utilities, Electric and Telephone company utilities, etc. may be in utility easements. When doing any work within a utility easement, a permit or approval from the utility company may be involved. Contact the utility company involved to determine the permit and/or approval procedures.

CHAPTER XI
CONSTRUCTION STANDARDS

Standards and specifications contained in this article shall apply to the design and construction of all water mains, storm sewers, sanitary sewers and related appurtenances constructed within the legal limits of the township.

Whenever reference is made to generally recognized specifications, such as those promulgated by AASHTO, ANSI, MDOT, etc., such specifications shall apply and be binding as if fully set forth in this chapter.

Prior to construction of subdivisions and project improvements, a pre-construction meeting will be scheduled by the township Engineer to discuss the various project requirements with the Developer, Contractor and the township. Prior to scheduling a pre-construction meeting, items such as insurance binders, permits and other items as required by law must be submitted for review and approved by the township Engineer.

A. Preconstruction Requirements

PRECONSTRUCTION REQUIREMENTS

The following is a summary of preconstruction requirements, which shall be fulfilled (where applicable), and evidence supplied to the township Engineer prior to the scheduling of the preconstruction meeting. A checklist of Preconstruction Meeting Requirements is provided in Appendix A. Improvements refer to installations such as sanitary sewers, water mains, roads and storm sewers (other than those under the jurisdiction of Wayne County), parking lots, and site grading where applicable, that will be turned over to the township or a home owners association for use and maintenance.

PERMITS AND APPROVALS

Unless otherwise provided, the township will obtain and is responsible only for submitting Sanitary Sewer and Water Main Construction Permits to the appropriate permitting agencies for review. Required fees for these permits are to be paid by the developer.

All other permits and approvals shall be obtained by the contractor, developer, or project designer and a copy provided to the township engineer prior to the scheduling of the Preconstruction Meeting. If, for some reason, an agency does not require or agrees to waive a permit when one is usually needed, this shall be stated in writing by a responsible person-in-charge from that agency with a copy furnished to township engineer.

More information on permits can be found in Chapter X.

CONTRACTS

Bona fide copies of the Construction Contract(s) for the proposed improvements shall be provided.

FEES

Appropriate fees and/or deposits for fees shall be deposited with the township for administration, construction engineering, staking and inspection. If geotechnical or material testing is required, sufficient funds shall also be deposited for such testing. Project fees and deposit amounts can be found in the fee schedule in Appendix A.

CONSTRUCTION SECURITIES

Where applicable, the construction security as approved by the township (i.e., bank letter of credit, cash or escrow agreement) shall be in an amount equal to 100 percent of the total cost of construction and shall be maintained until final acceptance of the Project by the township. The construction security amount should include the cost to construct sanitary sewer, water main, storm sewer, paving including roads and parking lots and curb and gutter. Construction security is not required for mass grading, landscaping, and improvements for which other agencies require a bond such as County road work. Original documents should be submitted directly to the township with a photocopy being supplied to the engineer. This amount is in addition to the fees referenced above.

BONDS

A Maintenance and Guarantee Bond shall be drawn in an amount equal to 100 percent of the construction cost of improvements payable to the township and running for a period of one year, or such period as may be required if longer than one year, from the date of final acceptance of the installation. The Maintenance and Guarantee bond amount shall be sufficient to cover the construction costs for all public utilities. A standard bond form is provided in Appendix A.

INSURANCE REQUIREMENTS

The Contractor will be required to submit to the township engineer evidence of insurance meeting the requirements stated in "Municipal Insurance Requirements" which can be found in Appendix A.

ACCEPTANCE OF GENERAL CONSTRUCTION REQUIREMENTS

The General Construction Requirements found in Appendix A outline the relationships and responsibilities of the Project Sponsor, Contractor, Township, and Engineer. Evidence of acceptance of General Construction Requirements shall be supplied to the township engineer by completing the Acceptance of General Construction Requirements form found in Appendix A.

MYLARS

Prior to scheduling a Preconstruction Meeting, it will be necessary for the Project Designer to forward to the township engineer one complete set of high quality mylar originals showing the proposed improvements. The mylars shall carry a certification signed by the Design Professional stating that the mylars are identical with the approved plans, which shall be worded as follows:

"I hereby certify that this plan dated _____ is a true and accurate copy of the plan approved by township on _____(date)_____ for ____(type of improvement)____ for the ___(name of establishment___ located at ___(location)___, and this is the only plan approved for construction."

It is not necessary to provide mylars of the township's Standard Detail Sheets.

EASEMENTS

Easements must be granted to the township for improvements that traverse private property. Easement requirements can be found in Chapters III, IV and V for each type of improvement. Standard easement forms are provided in Appendix A. Executed easements shall be furnished to the township and a copy furnished to the township engineer.

When work is performed on, or requires the use of, adjacent property, permission to do so must be obtained from that property owner in appropriate written form and filed with the township, with a copy furnished to the township engineer.

CONSTRUCTION SURVEY (STAKING)

The Project Sponsor is responsible to retain a qualified surveyor to stake out township utilities. The township engineer can provide Construction Surveying for improvements at the request of the Project sponsor. Unless specifically waived, the Project Designer shall furnish the township engineer, with three copies of the plat, or stringer plan and control print indicating the type and location of monuments or survey points required to field stake the proposed utilities. This plan must also locate all the utility lines, manholes, valves, and hydrants in relation to these survey points by tie dimensions or coordinates.

PRECONSTRUCTION MEETING

Prior to construction, but after all of the above items have been complied with, the Contractor shall contact the township engineer to schedule a preconstruction meeting to discuss the various Municipal standards, specifications, staking, grading, and inspection of the improvements. At this meeting the Contractor shall be prepared to submit a construction schedule of his proposed order of work and to indicate dates for the completion of the work.

B. General Construction Requirements

Full-time or part-time inspection as determined by the township Water and Sewer Director shall be required during the construction of subdivisions, site plan improvements and utility systems and roads located within the township. Such construction and improvements shall include, but not be limited to, water mains, sanitary sewers, storm sewers, storm water holding facilities, street paving, driveway pavements and pumping stations. Inspection personnel shall be provided by the township Engineer or the township. All estimated costs to be incurred for inspection review services must be paid prior to the start of construction by the Project Sponsor of the project to be constructed. All costs incurred by the township for inspection shall be paid by Project Sponsor prior to final acceptance of the project by the township and the issuance of a Certificate of Occupancy.

1. Three working days prior to beginning any work, the Project Sponsor or his Contractor must notify the township or the township Engineer.

2. It shall be the Project Sponsor's responsibility to provide soil and material testing to ensure that all construction methods and materials meet the requirements of this chapter. Such testing will be performed by a qualified testing laboratory or registered professional engineer acceptable to the township Engineer. All testing shall be subject to the direction and review of the township Engineer

3. Failure by the Project Sponsor or his Contractors or Agents to strictly adhere to these requirements, to use good engineering judgment during any phase of the work, or to conduct the work in accordance with the approved plans may cause the township Engineer to consider the work unacceptable.

4. *Site Grading.* In new developments, the entire site shall be positively graded to within six inches of proposed finished grade prior to construction of any permanent improvements other than permanent soil erosion and sedimentation control facilities.

5. *Cleanup.* General cleanup, including completion of rough grading of backfilled trench areas, shall continuously progress along with, and shall lag no further than 100 feet behind, the pipe installation operations. Fine grading and restoration work not dependent on weather or subject to seasonal limitations shall also progress concurrently with, and shall lag no further than 500 feet behind, the pipe installation operations.

6. *Pavement Replacement, Temporary.* All pavement removed in crossing and/or paralleling paved streets, alleys, drives and parking areas shall be temporarily replaced by the Contractor immediately following completion of backfilling operations. Temporary pavements for driveways, including approaches and parking areas, shall consist of a minimum of three inches of compacted cold patch asphalt over a minimum of seven inches of compacted MDOT 22A aggregate base. All temporary pavements, including those constructed for streets, alleys, drives and parking areas, shall be maintained in good condition by the Contractor until the final pavement replacement is made.

7. *Trench Enclosures.* All trenches shall normally be backfilled at the end of the working day. Only under special conditions and with the approval of the township Engineer shall trenches be left open overnight. Trenches which are allowed to be left open overnight shall be completely enclosed with suitable fencing and lighted barricades. When the trench contains water or when required by the township Engineer, the exposed end of the pipe shall be securely closed with a watertight plug. The end of the pipe shall be properly staked with a 2-inch x 2-inch marker extending to within six inches of the ground surface.

8. *Prohibition of Salvaged Materials.* All sewer pipes, water mains, precast structures, castings and appurtenances shall meet or exceed the specifications required in this Engineering Manual. No secondhand or salvaged materials will be permitted.

9. *Abandoned Utilities.* All castings, hydrants, valves and similar items to be abandoned shall become the property of the township Water and Sewer Department and returned to the township maintenance building.

10. *Staking Requirements.* All proposed utilities, appurtenances and roads shall be properly staked for location and elevation prior to construction under the supervision of a land surveyor or engineer licensed in the state. This information shall be provided to the township Engineer prior to the start of construction.

11. All construction within a road or railroad right-of-way or a waterway shall be performed in accordance with the requirements of the governmental body having jurisdiction over the right-of-way involved. Advanced notice of intent to start work shall be given to the township before such work commences.

12. Trench excavation shall not approach nearer than four feet to any tree that is not designated on the plans to be removed. Trees two inches or less in diameter may be removed, heeled in, and subsequently replanted in their original locations if proper precautions are taken to prevent permanent injury to the tree. Trenches approaching trees having a diameter greater than eight inches shall begin and end at points located no nearer to such trees than the radius of the tree, expressed in inches, multiplied by 1-foot per inch. As an example, the trench shall not approach closer than six feet to a 12-inch diameter tree. Tunneling operations adjacent to or under trees shall begin and end at points which fall outside a radius, measured from the center of the tree, equal to:

    a. Four feet around trees eight inches or less in diameter.

    b. The radius of the tree in inches multiplied by 1-foot per inch.

C. Soil Erosion and Sedimentation Control

1. All soil erosion and sediment control measures, including tree protection fencing, must be installed prior to earthwork operations.

2. Tree protection fencing must be field inspected and approved by the township prior to construction starting.

3. A certified storm water operator must be identified for each construction site. This individual will ensure that the soil erosion measures are in place and operational throughout the construction.

4. The soil erosion permitting agency is Wayne County. Periodic inspection of the site will be performed by the soil erosion authority. Inspections of the site may also be done by the township and/or the township Engineer. Any deficiencies noted during inspection must be corrected within 24 hours.

D. Trenching

1. The trench shall be excavated so that the pipe can be laid to the alignment and grade shown on the plan, taking into consideration the bedding specified. Excavation shall include removal of all materials encountered and disposal off the site of those materials not suitable or needed for backfilling of the trench. All adjacent structures encountered above and below the ground surface shall be properly protected and supported.

2. If the maximum trench widths noted on the Standard Detail Drawings (SDD) are exceeded, unless otherwise authorized by the township Engineer, the Contractor shall construct a concrete cradle or other type of bedding as approved by the township Engineer to provide support for the additional load.

    a. When sand bedding is used, the maximum trench widths shall be used to permit compaction of the bedding around the pipe.

b. If stone bedding is used, a minimum 6-inch clearance shall be provided on each side of the pipe without exceeding the maximum trench width as tabulated.

3. Metal trench boxes used for trench construction and safety, where possible, should ride above the top of the pipe on the bottom of a wider step-trench. Using this method will usually permit the trench box to be dragged forward without interfering with pipe bedding or pulling the pipe joints apart. If the trench box rides below the top of the pipe, then care must be taken to protect the integrity of the pipe bedding, particularly when movement of the trench box leaves a void in the pipe bedding. Care must also be taken to ensure that movement of the trench box does not pull the pipe joints apart and, if necessary, the pipelines should be secured with a wood crossblock, cable and winch at the downstream manhole.

E. Bedding

Pipe bedding is defined as that material placed from a minimum of four inches below the pipe to 12 inches above the top of the pipe. It shall consist of stone or sand, as noted on the SDD. The bedding shall be removed under each bell so that the pipe barrel will be uniformly supported for its full length. The bedding material shall be placed and compacted uniformly on both sides of the pipe to prevent lateral movement. Mechanical methods of tamping shall be used when it is possible to do so without damaging the pipe. Bedding shall be placed in layers of six inches or less as necessary to obtain thorough compaction around the pipe. In addition:

a. If density tests become necessary to resolve a question of the sufficiency of compaction of bedding material, the minimum acceptable density shall be considered to be 95 percent of maximum density as determined by the AASHTO T180, method D, modified proctor method.

b. Bedding of pipe shall be in accordance with SDD.

c. Where unstable bottoms are encountered, the Contractor shall provide a foundation consisting of an approved graded and processed angular stone or gravel to act as an impervious mat to prevent migration or vertical movement of unstable soils or bedding materials. Where trench sheeting, plates or a trench box are used due to severe ground conditions, all voids to the side and below the top of the pipe caused by the sheeting, plates or box withdrawal shall be completely filled or the supports left in place below the top of the pipe.

d. Where allowable trench widths are exceeded, concrete cradle bedding or crushed, angular stone pipe bedding, as approved by the township Engineer (see SDD), shall be provided to the full width between undisturbed trench walls or at least 2.5 pipe diameters, whichever is less, on both sides of the pipe.

e. Due to potential damage to exterior walls of PVC or composite pipe, particularly under cold weather conditions if rocks, frozen material, or large objects strike the pipe, the Contractor shall carefully avoid dumping any materials other than approved bedding stone on the pipe until 12 inches of cover is placed on it. Pipe walls and ends shall also be protected from abrasion and damage during handling and shall be fully inspected just prior to placing in the trench.

f. Care shall be taken during bedding compaction to avoid distorting the shape of the pipe or damaging its exterior wall. Mobile equipment shall not be used over the pipe trench until 48 inches of cover has been placed and properly compacted.

g. House connections shall be made to wye or tee fittings. Bedding for house connection sewers shall be equal to that of the main sewer bedding. Risers in deep and unstable trenches should be bedded in crushed, angular stone to avoid settlement. Concrete shall not be used for bedding. End caps or plugs as recommended by pipe manufacturer shall be braced or anchored to withstand air test pressures. Caps or plugs shall not be chemically welded in place.

Concrete cradles shall be constructed using MDOT grade 30P concrete. Cradles shall extend up the sides of the pipe to a horizontal plane located a minimum of one-fourth the outside diameter of the pipe above the bottom of the pipe as noted on the SDD.

F. Laying Pipe

Laying of pipe shall conform to the following specifications:

1. All pipe shall be certified by the manufacturer to meet the applicable specification requirements. Certification forms together with a report of the test results shall be provided to the township Engineer with pipe deliveries. Certification forms shall include project name, location, Contractor and test lot number. Lot sizes shall be acceptable to the township Engineer.

2. All pipe and fittings shall be suitably marked to provide manufacturer's name or trademark, lot or production number, specification designation, PVC cell classification, SDR number and nominal diameter. Fittings, however, need not contain lot number, cell classification or SDR number.

3. Handling Material

   a. Proper and suitable tools and equipment for the safe and careful handling, conveying and laying of the pipe shall be used. Care shall be taken to prevent the coating of cast or ductile iron pipe from being damaged. Pipe, valves, hydrants and fittings strung along the route shall be placed in such a manner that they will not be submerged or collect water. Dropping of material directly from a truck or platform is prohibited.

   b. All pipe and castings shall be carefully examined for defects. Materials that are found to be defective shall not be used and shall immediately be removed from the site.

4. Cleaning Pipe and Fittings

   a. All lumps, blisters and excess coal tar coating shall be removed from both the bell and spigot ends of each length of pipe and each fitting. The outside of each spigot and the inside of each bell shall be wire-brushed and wiped clean, dry and free from oil or grease immediately prior to installation. The inside of the pipe shall be free of dirt and debris.

   b. Any damage to the exterior pipe coating shall be repaired with an approved coating before the pipe is laid.

5. Laying Pipe

   a. Each pipe shall be inspected for possible defects and compliance with the plans before being placed in the trench. Joint surfaces shall be free of foreign matter.

   b. Pipe laying operations shall follow immediately behind the excavation.

   c. Pipe shall be laid upstream from the lower end of the sewer, with bell ends up grade. The use of brick, lumps of clay, wood, etc., to level the pipe will not be permitted. Pipe shall be pushed home and, if joints do not remain tightly closed or construction is in saturated sand, a cable and winch, or other approved means, shall be used to maintain a tight joint. Under no circumstances shall pipe be dropped directly into the trench.

   d. All pipe shall be laid to line and grade as called for on the plans. Each pipe as laid shall be checked by the Contractor. The trench shall be excavated to provide equal clearance on both sides of the pipe. After the pipe is set, care shall be taken in backfilling so as not to disturb its line or grade. As work progresses, the interior of the pipe shall be thoroughly cleaned. At all times, the open ends of the pipe shall be covered to prevent foreign matter from entering.

   e. When the trench contains water, the exposed end of the pipe shall be closed with a watertight plug. This provision shall apply during the noon hour as well as overnight. If water is in the trench, the seal shall remain in place until the trench

6. Cutting and Handling of PVC Pipe

   a. Cutting of pipe lengths, where required, shall be performed by the use of tools or equipment that will provide a neat, perpendicular cut without damage to the plastic. All burrs shall be removed by the use of a file, knife, or abrasive paper. Spigot ends on cut pipe shall be beveled similar to factory beveling to prevent gasket damage.

   b. Bowing or warping of plastic pipe can occur with temperature fluctuations.

   c. The Contractor shall store and protect the pipe to minimize bowing. Nominal pipe lengths of ten feet, 12 feet six inches, or 20 feet having deviations from straight greater than 1-inch shall not be used.

7. Cutting and Handling of Composite Pipe

   a. Cutting of pipe lengths, where required, shall be performed by the use of tools or equipment that will provide a neat, perpendicular cut without damage to the plastic or the filler material.

   b. Bowing or warping of ABS pipe can occur with temperature fluctuations. The Contractor shall store and protect the pipe to minimize bowing. Nominal pipe lengths of 12 feet six inches having deviations from straight greater than 1-inch shall not be used.

8. Flexible Pipe

   The completed installation of flexible pipes shall at no point have out-of-round pipe deflections greater than five percent. The township Engineer shall have the option of requiring deflectometer or go/no-go gauging tests run prior to acceptance on pipelines where high deflections are suspected.

G. Backfilling

Definitions. The following words, terms and phrases, when used in this section, shall have the meanings ascribed to them in this subsection, except where the context clearly indicates a different meaning:

Backfilling means the placement in the trench of approved material by an acceptable method from the top of the bedding to proposed ground surface grade.

Unsuitable material. All backfill material shall be free from cinders, ashes, refuse, vegetation or organic matter, boulders, rocks or stones, blue or gray clay or other material which, in the opinion of the township Engineer, is unsuitable.

1. Backfilling immediately after installation. Unless otherwise authorized by the township Engineer, all excavations shall be backfilled at least to a point 1-foot above the pipe immediately after installation.

2. Backfilling from 1-foot above top of pipe to grade.

   a. Backfilling to grade shall not fall more than 100 feet behind pipe laying unless otherwise permitted by the township Engineer. Excavated material, other than blue or gray clay, shall be compacted by a small dozer in lifts of not over 12 inches loose measure or in layers appropriate to the compaction technique used as approved by the township Engineer. Machine compaction of backfill is mandatory where large volumes of backfill are involved.

   b. Settlement occurring in trenches within one year after completion of the work shall be filled, regraded and restored with sod or topsoil, seed and mulch by the Contractor as determined by the township Engineer.

   c. Settlement occurring in trenches under pavement within one year after completion of the work shall be filled and pavement replaced by the Contractor as determined by the township Engineer.

3. Backfill under streets, alleys, sidewalks, drives and parking areas. The trench backfill under existing and proposed streets, alleys, sidewalks, drives and parking areas shall be of granular material MDOT class II placed in layers and thoroughly compacted. If density tests become necessary to resolve the question concerning the compacting of backfill material, the minimum acceptable density shall be considered to be 95 percent of maximum density as determined by the AASHTO T180, method D, modified proctor method. The maximum thickness of each layer shall generally be no greater than 15 inches and in all cases shall be of such thickness that the equipment used will provide the required density for the full depth of the backfill. This backfill shall include the area to the outside of shoulders in ditch sections and three feet back of curb in curb sections, and thence down on a ratio of one-to-one slope, unless otherwise required by the governing agency having jurisdiction over the area affected. In all cases, this fill shall be constructed to elevations determined by the proposed grade of the surfacing. The top 14 inches of backfill under streets, alleys, drives and parking areas shall consist of compacted MDOT 21AA aggregate upon which a temporary pavement is to be constructed. For sidewalks, the sand backfill shall be constructed to the original sidewalk grade and maintained until the sidewalk is replaced. Streets, alleys, sidewalks, drives and parking areas which are disturbed during the course of construction shall be backfilled and restored to a usable condition as soon as such crossing is made.

4. Backfilling in freezing weather. At no time shall frozen materials be permitted for use as backfill.

5. Backfilling around structures. All backfill placed within three feet of manholes, catch basins, gate wells and other underground structures shall be approved sand, placed in 1-foot layers, and compacted. After the structure and/or exterior masonry plaster has set up sufficiently to resist damage, backfilling shall be performed in a manner that will not cause unequal pressure on the structure.

6. Backfilling around fire hydrants. Backfill around fire hydrants shall be carefully tamped in 6-inch layers from the centerline of the lead main to a height 1-foot below the finished grade. Care shall be taken to ensure that the hydrant remains plumb during backfilling. Excavated material shall then be used to backfill to grade.

7. Rocks, boulders and stones over two inches in diameter shall be removed to provide a clearance of at least six inches from any part of the pipe or appurtenances.

H. Unstable Soil

1. Pipe and pipe appurtenances must be supported on a firm foundation. The trench bottom shall remain stable during backfilling and all subsequent pipe laying operations.

2. When unstable trench bottoms, such as wet clays, sands, etc., are encountered, it will be necessary to excavate below design depth to stable, non-compressible ground and backfill to grade with materials as approved by the township Engineer, 1/4-inch to 3/4-inch in size.

3. Where organic materials, such as peat, marl, muck, etc., exist at the trench bottom, it shall be necessary to remove these to stable soils and backfill to grade with the aforementioned select materials. Where the material below plan grade is unstable to such a degree that it cannot be removed and replaced with an approved material, the Contractor shall construct supports as directed by the township Engineer.

4. Where necessary to lay pipe in a fill area, unstable or unsuitable material shall be removed and slopes steeper than one vertical on two horizontal shall be stepped before fill material is placed. The embankment shall be of suitable material, one vertical on two horizontal fill slopes, and shall be placed in layers not exceeding 1-foot in thickness compacted to 95 percent of maximum density as determined by the AASHTO T180, method D, modified proctor method, to the proposed top of the pipe. The embankment shall be not less than four pipe diameters plus 12 feet wide at the invert of the pipe and shall be continued up to provide no less than three feet of cover over the pipe.

I. Bored and Jacked Casing

Steel casings shall be bored and jacked in any areas considered to be detrimentally affected by open cut construction in the opinion of the township Engineer. The open cutting of public paved roadways will not be permitted, except under extremely unusual situations and with approval from the township Engineer.

1. Materials. See SDD for required materials.

2. Installation.

    a. Casing pipe. Casing pipe shall be installed in a continuous auguring or mining and jacking operation with the casing pipe installation following directly behind the face of the excavation. Water shall not be introduced during the boring-jacking operation.

    b. Bulkheads. The ends of the casing pipe shall be closed with a masonry bulkhead at least eight inches thick.

    c. Minimum boring distances. All work shall be performed from boring and jacking pits adequately sheeted to prevent damage to the roadway, railway, etc. The minimum distance from the edge of the pavement to the trench or boring and jacking pit for curb or guardrail sections, railway tracks, or two-lane highways will vary from shoulder point to the toe of slope as shown on the plans or as directed by the township Engineer.

J. Acceptance

Acceptance of improvements will be done in two stages, Acceptance for Use (or substantial completion) and Final Acceptance. Acceptance for Use is an administrative process that will enable the improvements to be turned over to, delivered to and accepted by the township for Operation and Maintenance. Final Acceptance of a Project requires action by the township Board. Improvements refer to installations such as sanitary sewers, water mains, roads and storm sewers (other than those under the jurisdiction of Wayne County), parking lots, and site grading where applicable, that will be turned over to the township or a home owners association for use and maintenance.

The following is a summary of the requirements for Acceptance for Use, which shall be fulfilled (where applicable) and appropriate documentation supplied to township Engineer before an Acceptance for Use letter can be issued.

1. Testing

Sanitary sewer mains shall pass a pressure test (exfiltration test or infiltration test depending on the depth of the main relative to the water table). Sanitary sewer mains shall also pass a deflection (mandrill) test. Once pressure and deflection testing is complete, a videotaped inspection of the entire sanitary sewer system must be done. Two copies of the video inspection must be submitted to township Engineer, township Engineer field personnel must be present on-site to witness these tests.

Water Mains shall pass a pressure and bacteriological testing prior to acceptance. township Engineer field personnel must be present during the pressure test, but do not need to be present during bacteriological testing. Written test results and acceptance of the water main from Detroit Water and Sewerage Department must be submitted to township Engineer.

2. Pump Station Initial Start-Up

Sanitary sewer and storm water pump stations shall undergo an initial start-up process. Township Engineer and township personnel must be present for the start-up. The Contractor will demonstrate the operation and maintenance of the equipment to the township, as well as test the controls and operation of the station. The Contractor shall supply the township with two copies of the Operations and Maintenance Manuals for all equipment at the pump station and replacement parts for all wear items.

3. Final Measure Drawings

Final Measure Drawings will be prepared by township Engineer based upon inspector daily reports and other information, which shall be obtained from the Contractor and/or Design Engineer.

As-built drawings shall contain all the information shown on the approved construction drawings with the addition of, but not limited to, the following information:

a. Sanitary sewers and storm sewers.

1) Plan location of all sewers with respect to property and right-of-way lines.

2) A minimum of three witnesses (dimensions) to all force main bends.

3) Length of sewer as measured from center of manhole to center of manhole; this information should be shown on both plan and profile.

4) Length of stubs and manholes.

5) The following as-built elevations on USC&GS datum:

a) Manhole, inlet and catch basin covers;

b) Invert elevations of pipes within each manhole;

c) Changes in percents between manholes.

6) List of material used for construction. Example: Manholes: Precast,

concrete specialties, press wedge flexjoint. Pipe: 8-inch V.C.P. Clow No Bel 6-inch V.C.P. Logan O-Ring.

7) Any changes in pipe and manhole locations of more than ten feet shall be redrawn on the plan and profile. The original plan locations of these facilities should be crossed out on the plans.

8) Any changes to the total quantities shall be lined out and the correct as-built quantity indicated.

9) The following as-built information for all sanitary service leads:

a) Station of wye;

b) Length of lead;

c) Length of riser;

d) Tie from nearest manhole to end of lead.

b. Retention and detention ponds.

1) As-built drawing of pond.

2) The following as-built elevations on USCGS datum:

a) Overflow spillway;

b) Inlet and outlet pipe inverts;

c) Outlet structure cover;

d) Outlet and inlet ditch elevations;

e) Bottom and top of bank slopes.

3) A statement of final computed volume of the pond as measured from high water elevation to the invert of the outlet pipe.

c. Roadways.

1) Top of curb elevations on USCGS datum, at high and low points. Edge of pavement elevations shall be provided in the case of open ditch road designs.

2) As-built profiles for any changes in road design.

d. Water mains.

1) Plan location of all water mains with respect to property lines.

2) Rim (cover) elevations on gatewells, USC&GS datum.

3) Fire hydrant bury line elevations, USC&GS datum.

4) Distances between gatewells, fittings and fire hydrants.

5) Type of materials used in construction.

6) Any changes in pipe and structure locations exceeding five feet shall be redrawn on the plan. The original plan locations of these facilities shall be crossed out on the plan.

7) Any changes to the total quantities shall be lined out and the correct as-built quantity indicated.

e. Floodways. As-built ground elevations of all areas located within a floodway.

f. Proposed information is to be crossed out, and installed information is added, even if they are the same, so it is known that it wasn't missed.

4. Easements

Executed easement documents that were submitted prior to the Preconstruction Meeting will be checked against field notes and as-built conditions. Any changes in the horizontal alignment of the easement will require that a new easement document be prepared. Once approved, the easement documents must be submitted by the Project Sponsor for recordation at Wayne County. An original recorded easement must be submitted to the township, with a copy to township Engineer.

5. Project Walk Through

Township Engineer, township personnel, the Contractor and the Project Sponsor shall conduct a project walk through inspection of all aspects of the project. Following the walk through a punch list of required corrections will be prepared. The Acceptance for Use may be made contingent upon the correction of minor punch list items. Any items that are considered to be significant shall be corrected and a follow-up walk through performed prior to Acceptance for Use.

6. Recommendation for Acceptance for Use

Once the above requirements have been satisfied township Engineer will issue a letter recommending that the township accept the improvements for use. The Acceptance for Use letter will state which portions of the project are being accepted, and may contain a punch list of minor items remaining to be completed prior to final acceptance.

Appendix A

General Construction Requirements

Appendix A
Fee Schedule

The following schedule can be used to determine fees for various services provided by the township Engineer. Fee schedules are adopted by the township each year and posted to their website.

1. *Site Plan Review*. At the time of submittal of plans the project sponsor shall deposit with the Planning and Economic Department a fee for review as specified in the township fee schedule.

2. *Engineering Plan Review.* Submittals for Engineering Plan Review shall include plans, specifications and a detailed cost estimate of the proposed improvements. The Project Sponsor shall deposit with the Public Works Department a fee for review as specified in the township fee schedule. If costs exceed the deposit amount then the Project Sponsor shall deposit additional funds. At the completion of review, any surplus funds will be returned to the Project Sponsor. The township will also collect a 1 percent administration fee at the time of engineering plan submittal. This fee is to cover township expenses and is non-refundable.

3. *Construction.* Prior to scheduling the pre-construction meeting for the project improvements, the Project Sponsor shall deposit with the Public Works Department the following:

    a. Construction securities equal to 100% of the value of the public improvements in the form of a Bank Letter of Credit or cash escrow.

    b. Construction Engineering fees in the form of a cash escrow account in an amount as specified in the township fee schedule. Actual construction costs incurred by the township will be deducted from the deposit. If costs exceed the deposit amount then the Project Sponsor shall deposit additional funds. At the completion of construction, any surplus funds will be returned to the Project Sponsor.

    At the completion of the project, if the deposit made toward the cost of a total inspection fee, as provided in this section, is not sufficient, then the Project Sponsor shall pay such additional amount as may be required to pay to the township for the total inspection costs at the time when funds are depleted. If, at the completion of the project, it is ascertained that the total inspection cost to the township was less than the amount deposited, then the surplus shall be returned to the Project Sponsor upon the final acceptance of the project. However, the township Administration charges are non-refundable. The fees and charges contained in this section shall be in addition to those charged for debt services, service charges, connection charges and other charges or fees imposed for sanitary sewer, water supply and other public improvements.

MUNICIPAL INSURANCE REQUIREMENTS

The Contractor shall purchase and maintain during the term of the Project such insurance as will protect him, the Municipality, the township Engineer and the Project Designer from claims arising out of the work described in this Contract and performed by the Contractor, Subcontractor(s) or Sub-subcontractor(s) consisting of:

1. Workers' Compensation Insurance including Employer's Liability to cover employee injuries or disease compensable under the Workers' Compensation Statutes of the states in which work is conducted under this Contract; disability benefit laws, if any; or Federal compensation acts such as U.S. Longshoremen or Harbor Workers', Maritime Employment, or Railroad Compensation Act(s), if applicable. Self-insurance plans approved by the regulatory authorities in the state in which work on this Project is performed are acceptable.

2. A Comprehensive General Liability policy to cover bodily injury to persons other than employees and for damage to tangible property, including loss of use thereof, including the following exposures:

    a. All premises and operations.

    b. Explosion, collapse and underground damage.

    c. Contractor's Protective coverage for independent contractors or subcontractors employed by him.

    d. Contractual Liability for the obligation assumed in the Indemnification clause found in the General Construction requirements.

    e. The usual Personal Injury Liability endorsement with no exclusions pertaining to employment.

    f. Products and Completed Operations coverage. This coverage shall extend through the Maintenance and Guarantee Bond period.

3. A Comprehensive Automobile Liability policy to cover bodily injury and property damage arising out of the ownership, maintenance or use of any motor vehicle, including owned, non-owned and hired vehicles. The Comprehensive General Liability and the Comprehensive Auto Liability shall be written by the same insurance carrier, though not necessarily in one policy.

4. An Umbrella or Excess Liability policy shall be provided that shall apply both to the Contractor's General Liability and to his Automobile Liability Insurance with wording at least as broad as the primary or underlying policy(ies). The Contractor is granted the option of arranging coverage under a single policy for the full limit required or by a combination of underlying policies with the balance provided by an Excess or Umbrella Liability policy equal to the total limit(s) requested.

5. The required limits of liability for the insurance coverages requested shall be not less than those specified in the Limits of Liability.

INSURANCE - OTHER REQUIREMENTS

1. Cancellation - Notice of Cancellation or Intent Not to Renew. Policies will be endorsed to provide that at least 30 days written notice shall be given to the Municipality and to township Engineer of cancellation or of intent not to renew. The cancellation clause shall be modified as follows:

> Should any of the above described policies be canceled before the expiration date thereof, the issuing company will ~~endeavor to~~ mail 30 days written notice to the certificate holder named to the left, ~~but failure to mail such notice shall impose no obligation or liability of any kind upon the insurer, its agents or representatives.~~

All work on the project by the contractor and/or subcontractors, shall cease until new insurance coverage acceptable to the Municipality is in place.

2. Additional Insured - The contractor is to submit a Certificate of Liability Insurance naming township Engineer as an additional insured, and adding the following language for the Township: township including its elected and appointed officials, employees, officers, agents, servants and members of boards and commissions shall be named as additional insured on the general liability policy.

3. Evidence of Coverage - Prior to preconstruction meeting, the Contractor shall furnish to the Municipality two (2) original Certificates of Insurance in force for the amounts and types of insurance required. These certificates shall include all the items prescribed by this section including the agreement to cancellation provisions. All copies of Certificates of Insurance and Insurance Policies shall include the specific project name and location of work.

4. Qualification of Insurers - In order to determine financial strength and reputation of insurance carriers, all companies providing the coverage required shall be licensed or approved by the Insurance Bureau of the State of Michigan and shall have a financial rating not lower than XI and a policyholder's service rating no lower than B+ as listed in A.M. Best's Key Rating Guide, current edition. Companies with ratings lower than B+:XI will be acceptable only upon written consent of the Municipality.

INSURANCE - LIMITS OF LIABILITY

The required limits of liability for insurance coverage requested in the Municipal Insurance Requirements shall be not less than the following:

Worker's Compensation

Coverage A - Compensation	Statutory
Coverage B - Employer's Liability	
Each Accident	$500,000
Disease - Policy Limit	$500,000
Disease - Each Employee	$500,000

Comprehensive General Liability* - Coverage Shall be Occurrence Form

General Aggregate	$1,000,000
Products - Com/Ops Aggregate	$1,000,000
Personal and Advertising Injury	$ 500,000
Each Occurrence	$ 500,000
Fire Damage (any one fire)	$ 50,000
Medical Expense (any one person)	$ 5,000

Comprehensive Automobile Liability – Coverage Shall Include Owned, Non-owned, and Hired Autos

Bodily Injury - Per person	$ 500,000
Bodily Injury - Per Accident	$1,000,000
Property Damage	$1,000,000
Combined Single Limit	$1,000,000

Umbrella or Excess Liability

Each Occurrence	$2,000,000
Aggregate	$2,000,000

*Certificates shall show that X, C, and U coverage is included.

MAINTENANCE BOND

Bond No. _____

KNOW ALL MEN BY THESE PRESENTS, That we, _____
_____
_____ as Principal, and the_____
_____
_____
_____ as Surety, are held and firmly bound unto the Charter Township of Van Buren, 46425 Tyler Road, Van Buren Twp., MI 48111 as Obligee, in the full and just sum of _____
_____ ($_____) Dollars, to be paid to the said Obligee or its certain attorney, heirs, executors, administrators or assigns, to which payment well and truly to be made, we bind ourselves and each of us, our and each of our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

Signed with our seals and dated this _____ day of _____, 20___.

The condition of this obligation is such that whereas the above bounden Principal has entered into a Contract with _____
dated _____ for _____
_____
_____
_____
_____

Now, therefore, if the Principal shall at its own expense, properly repair and remedy any defective workmanship or materials that may appear within _____ year(s) from the date of final acceptance of work by the said Obligee, then this obligation to be null and void; otherwise to remain in full force and effect.

Witness:

_____
Principal

_____ By:_____

_____
Surety

_____ By:_____
Attorney-In-Fact

PRIVATE SPONSORED PROJECT
EASEMENT FOR SANITARY SEWER

PARCEL/LOT & SUBN _____
SIDWELL NO. _____

THIS INDENTURE made the _____ day of _____ A.D. 20___ between

_____

_____

party of the first part, and the _____ of _____, a Municipal Corporation, of the County of Wayne, State of Michigan, party of the second part.

WITNESSETH: That the said parties of the first part, for and in consideration of the sum of One Dollar and other valuable consideration to them in hand paid by the said party of the second part, the receipt whereof is hereby confessed and acknowledged, do, by these presents, grant unto the said party of the second part, its successors, and assigns, an easement for the purpose of access to install and maintain sanitary sewer lines and connections and equipment therefor, in, unto, and upon that certain piece of land situated in the _____of _____, County of Wayne, and State of Michigan, to-wit:

PROVIDED: That the granting of the above easement does not vest in the party of the second part authority to use any portion of the said property for purposes other than herein designated: Provided also, that this easement shall obligate the party of the first part to pay all costs associated with restoration work, performing maintenance and replacement operations. Provided, also, that this easement shall continue for such period of time as the said party of the second part, their successors, and assigns, shall maintain said sewer lines to provide service to the local community.

IN WITNESS WHEREOF, the said parties of the first part have hereunto set their hands and seals the day and year first above written.

OWNER:

_____

_____

STATE OF MICHIGAN) SS
COUNTY OF WAYNE)

On this _____ day of _____, 20___, before me, the subscriber, a Notary Public in and for said County, personally appeared:

_____ and_____
to me known to be the same persons described in and who executed the within instrument, and who have acknowledged the same to be their free act and deed.

INSTRUMENT DRAFTED BY:

Notary Public, _____ County, Michigan

My commission expires_____

_____

WHEN RECORDED RETURN TO:

PRIVATE SPONSORED PROJECT
EASEMENT FOR WATER MAIN

PARCEL/LOT & SUBN._____
SIDWELL NO._____

THIS INDENTURE made the _____ day of _____ A.D. 20_____ between

_____party of the first part, and the _____ of _____, a Municipal Corporation, of the County of Wayne, State of Michigan, party of the second part.

WITNESSETH: That the said parties of the first part, for and in consideration of the sum of One Dollar and other valuable consideration to them in hand paid by the said party of the second part, the receipt whereof is hereby confessed and acknowledged, do, by these presents, grant unto the said party of the second part, its successors, and assigns, an easement for the purpose of access to install and maintain water lines and connections and equipment therefor, in, unto, and upon that certain piece of land situated in the _____of _____, County of Wayne, and State of Michigan, to-wit:

PROVIDED: That the granting of the above easement does not vest in the party of the second part authority to use any portion of the said property for purposes other than herein designated: Provided also, that this easement shall obligate the party of the first part to pay all costs associated with restoration work, performing maintenance and replacement operations. Provided, also, that this easement shall continue for such period of time as the said party of the second part, their successors, and assigns, shall maintain said water lines to provide service to the local community.

IN WITNESS WHEREOF, the said parties of the first part have hereunto set their hands and seals the day and year first above written.

OWNER:

_____

_____

STATE OF MICHIGAN) SS
COUNTY OF WAYNE)

On this _____ day of _____, 20___, before me, the subscriber, a Notary Public in and for said County, personally appeared:

_____ and _____
to me known to be the same persons described in and who executed the within instrument, and who have acknowledged the same to be their free act and deed.

INSTRUMENT DRAFTED BY:

Notary Public, _____ County, Michigan

My commission expires _____

_____

WHEN RECORDED RETURN TO:

GENERAL CONSTRUCTION REQUIREMENTS
TABLE OF CONTENTS

1.0 GENERAL

The Project, Municipality, Project Sponsor, Contractor, Engineer, and Designer referred to in the Preconstruction Requirements, Insurance requirements, and these General Construction Requirements are described and named on Attachment II titled "Acceptance of General Construction Requirements and Municipal Insurance Requirements."

2.0 SUPERVISION

2.1 Contractor shall supervise and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences and procedures of construction. Contractor shall be responsible to see that the finished Work complies accurately with the Contract Documents.

2.2 Contractor shall keep on the Work, at all times during its progress, a competent superintendent who shall not be replaced without written notice to Municipality and Engineer except under extraordinary circumstances. Any superintendent or foreman who neglects to have Work done in accordance with the Plans and Specifications shall be removed from the Project. The superintendent will be Contractor's representative at the site and shall have authority to act on behalf of Contractor. All communications given to the superintendent shall be as binding as if given to Contractor.

2.3 Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to persons, property, material and equipment.

3.0 LABOR AND EQUIPMENT

3.1 The Contractor shall employ only workmen skilled in their various duties.

3.2 All Work at the site shall be performed during regular working hours (7:00 a.m. to 7:00 p.m.), and Contractor will not permit the performance of Work on Sunday or any legal holiday without the permission of the Municipality, except for the purpose of making emergency repairs and for the proper protection of the Work, such as the curing of concrete.

3.3 The Contractor shall furnish and use such adequate and proper machinery and equipment as will insure the Work being done in a satisfactory manner.

4.0 PATENTED DEVICES, MATERIALS, AND PROCESSES

Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify, hold harmless and defend Municipality including its elected and appointed officials, officers, agents, servants and members of the boards and commissions and Engineer and anyone directly or indirectly employed by either of them from and against all claims, costs, losses, and damages arising out of or resulting from any infringement of patent rights or copyrights incident to the use in the performance of the Work of any invention, design, process, product or device, and shall indemnify the Municipality including its elected and appointed officials, officers, agents, servants and members of the boards and commissions for any costs, expense and damages which it may be obliged to pay by reason of any such infringement at any time during the prosecution or after the completion of the Work.

5.0 LAWS TO BE OBSERVED

Contractor shall give all notices and comply with all laws, ordinances, rules, and regulations applicable to furnishing and performance of the Work.

6.0 SANITARY PROVISIONS

The Contractor shall be responsible for installation, maintenance and removal of temporary sanitary facilities for use of construction personnel. All rules and regulations of the state and local health officials shall be observed, with precautions taken to avoid creating unsanitary conditions.

7.0 CLEANLINESS OF THE WORK

7.1 During the progress of the Work, Contractor shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. This requirement shall also apply to any areas in the vicinity of the Work which are affected by the Contractor's construction or hauling operations.

7.2 If the Contractor shall fail to keep the above noted areas cleaned of dust or debris resulting from his operations, and thereby shall create any public nuisance, he shall be so notified in writing by the Engineer. If within 24 hours after receipt of such notice the Contractor shall fail to clean such areas satisfactorily, the Engineer shall have such other agency as he shall designate, perform the Work and all costs of such cleaning shall be paid for by the Contractor.

8.0 PUBLIC CONVENIENCE AND SAFETY

In accordance with generally accepted construction practices the Contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons and property affected directly or indirectly by the Contractor's operations during the performance of the Work. The Contractor shall comply with all federal and state laws, including the rules and regulations of the State Safety Commission, MIOSHA, Michigan Manual of Uniform Traffic Control Devices, local ordinances, laws, by-laws, and regulations governing the

furnishing and use of all safety procedures, safeguards, safety devices, and protective equipment, and take any and all needed action necessary to protect the life and health of employees on the job and the safety of the public and to protect property for the duration of the Project. This requirement will apply continuously 24 hours per day until final acceptance of the Work by the Municipality and shall not be limited to normal working hours. Where sufficient lights and safety devices have not been provided by the Contractor and when, in the opinion of the Municipality or its agents, immediate corrective measures are considered to be necessary, the Municipality shall have the authority at its option and without any obligation to do so, to provide for any additional protective equipment or devices necessary and the cost thereof shall be the obligation of the Contractor. The Municipality shall also have the right to order the cessation of all work on the project until corrective measures are taken.

9.0 PROTECTION AND RESTORATION OF PROPERTY

9.1 The Contractor shall restore, at his own expense, any public or private property damaged or injured in consequence of any act or omission on his part, or on the part of his employees or agents, to a condition equal or better than that existing before such injury or damage was done. If the Contractor neglects to restore or make good such damage or injury, the Municipality may upon 48 hour notice, at its option and without any obligations to do so, proceed to restore or make good such damage or injury and to charge the Contractor or Project Sponsor for all costs incurred.

9.2 When it is possible for construction operations to endanger any public or private utility, conduit, or structure, the Contractor shall notify the utility owner of this possibility, and the Contractor shall take such steps as may be required to safeguard and support such utilities, conduits, or structures.

9.3 Where it is the policy of any utility owner to make its own repairs to damaged conduit or other structures, the Contractor shall cooperate to the fullest extent with the utility, and he shall see that his operations interfere as little as possible with these operations, and the Contractor shall assume the cost of any charge against the Municipality therefore.

9.4 In cases where existing sewers, drains, water service connections or other utilities are encountered, the Contractor shall perform his operations in such a manner that service will be uninterrupted, and the cost thereof shall be at the Project Sponsor's expense, unless otherwise provided.

9.5 All trees and shrubs, which are not designated to be removed, shall be protected from injury by the Contractor. When excavating adjacent to trees or shrubs, the Contractor shall exercise due care and caution so not to unnecessarily disturb or damage the roots of trees or shrubs. Roots that are exposed and injured during excavation shall be cut clean and smooth with an approved root-pruning tool prior to backfilling. Other physical damage to the trunk or branches of trees and shrubs shall be satisfactorily repaired at the Contractor's expense.

9.6 Trees or shrubs which die subsequent to construction, are damaged beyond repair, or are removed without authorization shall be replaced in kind or paid for by the Contractor prior to final acceptance of the Project.

10.0 INDEMNIFICATION

10.1 The Contractor agrees that he is thoroughly familiar with the Work to be done under this project and is familiar with all safety regulations of the local, state and federal governments applicable to the Work and will provide experienced and qualified full time superintendence, supervision and direction of all Work done on the project previously described; and further

10.2 The Contractor agrees to indemnify, defend, and save harmless the Municipality and its Engineer, their consultants, agents, elected and appointed officials, officers, servants, members of boards and commissions, and employees, from and against all loss or expense (including, but not limited to fees and charges of engineers, architects, attorneys, and other professionals and court and arbitration costs, if applicable) by reason of liability imposed by law upon the Municipality and its Engineer, their consultants, agents, elected and appointed officials, officers, servants, members of boards and commissions, and employees for damages because of bodily injury, including death at any time resulting there from, sustained by any person or persons or on account of damage to property, including loss of use thereof, arising out of or in consequence of the performance of this Work, whether such injuries to person or damage to property is due, or claimed to be due, to the negligence of the Contractor, his Sub-contractors, the Municipality and its Engineer, their consultants, agents and employees, except only such injury or damage as shall have been occasioned by the sole negligence of the Municipality or its Engineer, and their consultants and further excepting such injury or damage due to any professional negligent act, error and omission of the Municipality and his Engineer, their consultants, agents, elected and appointed officials, officers, servants, members of boards and commissions, and employees.

11.0 PROJECT SPONSOR'S RESPONSIBILITY FOR WORK

Until the final acceptance by the Municipality, the Work shall be under the charge and care of the Project Sponsor. He shall take every necessary precaution against injury or damage to any part of the Work by the action of the elements or by any other cause whatsoever. The Project Sponsor shall rebuild, repair, restore and make good, at his own expense, all injuries and damage to any portion of the Work occasioned by any cause before its completion and final acceptance.

12.0 COOPERATION OF CONTRACTOR

The Contractor shall conduct his operations so as to interfere as little as possible with those of other Contractors, utilities or any public or private entity working on or near the Work previously described. The Municipality reserves the right to perform other Work by contract or otherwise, and to permit public utility companies and others to do Work on or near the Project during progress of the Work. The Contractor shall conduct his Work and cooperate with such other parties so as to cause as little interference as possible with their operations and as the Engineer may direct. Claims for delay or inconveniences due to operations of such other parties, or Work indicated or shown on the plans or in the proposal, will not be considered.

13.0 CONSTRUCTION STAKES

13.1 The Engineer or such other competent surveyor as designated by the Municipality will provide a construction survey and will furnish suitable stakes and marks showing the locations on the surface of various parts of the Work. The Contractor shall furnish such labor and assistance as may be required in setting stakes and markers. It will be the responsibility of the Contractor to transfer surface line and grade for any tunnel or other than normal surface open-cut operations, which he may conduct, and also for any operations where ordinary surface line and grade is not feasible.

13.2 The Contractor shall provide such masts, scaffolds, batterboards, straightedges, templates or other devices as may be necessary to facilitate laying out, inspecting and constructing the Work.

13.3 The Contractor shall submit a staking schedule and order location, line and grade stakes in quantities that he can reasonably protect and preserve. At the pre-construction meeting, the Contractor, Engineer, and designated surveyor shall mutually agree upon the amount of advance notice required for such line and grade stakes, normally a minimum of 72 hours. When the Contractor fails to preserve the construction survey stakes or requests relocation of stakes he previously ordered, he shall be responsible for the cost of such restaking.

13.4 The Contractor shall bear all expense involved in re-establishing and/or resetting any survey control point, land survey point or monument disturbed by his operation.

14.0 AUTHORITY OF THE ENGINEER AND DESIGNER

14.1 On all Work related to public improvements, the Engineer shall decide all questions which may arise relating to the quality and acceptability of materials furnished and Work performed.

14.2 Questions related to design will be referred to the Designer for resolution with approval required by the Engineer.

15.0 ADJUSTMENTS OF LINE AND PROFILE

15.1 Minor adjustments of alignment and profile may be allowed by the Engineer to avoid obstructions or underground facilities whose presence or exact locations are not known, or to compensate for differences between preliminary measurements and actual construction layout measurement, or on account of variations between record documents and actual locations of existing utilities to which the Work under this Project will be connected or will be encountered during the construction operation.

15.2 Adjustments that may affect design or the complexity of the Work will be referred to the Designer for resolution and require the approval of the Engineer.

16.0 AUTHORITY AND DUTIES OF RESIDENT PROJECT REPRESENTATIVE

16.1 The Resident Project Representative may be appointed by the Engineer and directed to observe all materials used and all Work done. The observation may extend to all or any part of the Work and to the preparation or manufacture of the materials for use in the Work. The Resident Project Representative is not authorized to revoke, alter, enlarge, or relax any of the provisions of these General Construction Requirements or the specifications nor to change the plans in any particular, nor are they authorized to approve or accept any portion of the completed Work. The Resident Project Representative on the Work will inform the Engineer as to the progress of the Work, the manner in which it is being done, and the quality of the materials being used. He will also call to the attention of the Contractor any failure to follow the plans and specifications that he may observe. In no instance, shall any action or omission on the part of the Resident Project Representative relieve the Contractor of the responsibility of completing the Work in accordance with the plans, specifications or local requirements.

16.2 The Resident Project Representative shall in no case act as foreman or perform any duties for the Contractor, nor interfere with the management of the Work by the latter. Any advice which the Resident Project Representative may give the Contractor shall in no case be construed as binding upon the Engineer in any way, or releasing the Contractor from fulfilling all of the terms of the contract or local requirements.

17.0 SAMPLING OF MATERIALS

Sampling of materials will be made by the Engineer in accordance with the methods designated by the specifications or local requirements. The Contractor shall furnish such facilities as the Engineer may require for collecting, storing, and forwarding samples to the laboratory. The Contractor in all cases shall furnish the required samples to the Engineer without charge.

18.0 TESTS OF MATERIALS

18.1 All materials in the Work shall meet the requirements of their respective specifications.

18.2 Tests of materials will be made as specified herein. The Engineer shall, at all times, have access to all materials intended for use in the Work as well as to the plants where such materials are produced. Plant inspection may be made if the quantities are sufficient to warrant such inspection and if it is to the best interest of the Municipality. In any case, materials may be either inspected or tested when received on the Project. Materials shall not be used until approval has been received from the Engineer. Approval of materials at the producing plant does not constitute a waiver of the Engineer's right for re-examination at the Project site.

18.3 The standards for testing materials unless otherwise specified herein, shall be as established by the American Society for Testing and Materials. All tests of materials will be made in accordance with the methods described or designated in the Specifications.

18.4 The sampling and testing of all materials not specifically mentioned shall be done by generally accepted methods, unless otherwise specified by the Engineer.

19.0 STORAGE OF MATERIALS

19.1 Materials, the qualities of which have been approved, if stored for future use, shall be stored so as to ensure the preservation of their quality and fitness for the Work. The storage area shall be located so as to cause minimum interference with traffic (pedestrian and/or vehicular). No material shall be stored closer than seven feet to the edge of a pavement or traveled way open to the public.

19.2 Materials that have been stored shall be subject to retest and shall meet the requirements of their respective specifications at the time they are to be used in the Work.

20.0 CERTIFICATION OF MATERIALS

At the request of the Engineer, the Contractor shall provide the Engineer with certification that the various materials to be used conform to the standards referred to on the plans or in the specifications.

21.0 DEFECTIVE MATERIALS

All materials which do not meet the requirements of the specifications at the time they are to be used will be rejected and, unless otherwise permitted by the Engineer, shall be removed immediately from the Work.

22.0 WARRANTY AND GUARANTEE

Contractor warrants and guarantees to Municipality and Engineer that all Work will be in accordance with the approved plans and specifications and will not be defective. All defective Work, whether or not in place, may be rejected or corrected as provided by Section 26.0 "Correction or Removal of Defective Work".

23.0 ACCESS TO WORK

Engineer and Engineer's representatives, Municipality, Testing Agencies, and Governmental Agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide proper and safe conditions for such access.

24.0 TESTS AND INSPECTIONS

24.1 Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests or approvals.

24.2 If any law, ordinance, regulation, code, or order of any public body having jurisdiction requires any Work or part thereof to specifically be inspected, tested or approved, Contractor shall assume full responsibility therefore, pay all costs in connection therewith and furnish Engineer the required certificates of inspection, testing or approval. Contractor shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with Municipalities acceptance of a manufacturer, fabricator, supplier or distributor of materials or equipment proposed to be incorporated in the Work, or of materials or equipment submitted for approval prior to Contractor's purchase thereof for

incorporation in the Work.

24.3 All inspections, tests or approvals other than those required by law, ordinance, rule, regulation, code or order of any Public body having jurisdiction shall be performed by organizations acceptable to Municipality and Contractor or by Engineer if so specified.

24.4 Cost of materials to be used in inspection and transportation costs shall be paid for by the Contractor.

24.5 Neither observations by Engineer nor inspections, tests or approvals by others shall relieve Contractor from his obligations to perform the Work in accordance with the General Construction Requirements.

25.0 UNCOVERING WORK

25.1 If any Work that is to be tested, inspected or approved is covered without concurrence of Engineer, or contrary to the request of Engineer, it shall, if requested by Engineer, be uncovered for Engineer's observation. Such uncovering shall be at Contractor's expense unless Contractor has given Engineer timely written notice of his intention to cover such Work and Engineer has not acted with reasonable promptness in response to such notice.

25.2 If Municipality considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Municipality request, shall uncover, expose or otherwise make available for observation, inspection or testing as Municipality may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.

26.0 CORRECTION OR REMOVAL OF DEFECTIVE WORK

If required by Engineer, Contractor shall promptly, as directed, either correct all defective Work, whether or not fabricated, installed or completed, or if the Work has been rejected by Engineer, remove it from the site and replace it with nondefective Work. Contractor shall bear all direct, indirect, and consequential costs of such correction or removal (including, but not limited to, fees and charges of engineers, architects, attorneys, and other professionals) made necessary thereby.

27.0 REMOVAL AND DISPOSAL OF STRUCTURES AND OBSTRUCTIONS

The Contractor shall remove any existing structure or part of a structure which is to be replaced or rendered useless by new construction. Salvage material derived there from shall become the property of the Contractor and shall be disposed of by him except as otherwise provided in the specifications, or the plans.

28.0 FINAL CLEANING UP

Upon completion and before final acceptance of the Work, the Contractor shall remove all false work, excavated, excess, or useless material, rubbish, temporary buildings, bridges and approaches, replace or renew any fences damaged, and restore in an acceptable manner all property, both public and private, which may have been used or damaged during the prosecution of the Work. The Contractor shall replace signs, mail boxes, or other appurtenances which have been temporarily removed. All excavated material and false

work placed in stream channels during construction shall be removed. The Contractor shall thoroughly clean all pavements, sewers, manholes, catch basins, and other structures affected by his operations whether within or outside of the limits of his Work. The Contractor shall remove from the right-of-way all machinery and equipment and all surplus materials and leave the right-of-way in a neat and presentable condition, satisfactory to the Engineer.

29.0 ACCEPTANCE FOR USE

When Contractor considers any portion of the Work ready for its intended use Contractor shall, in writing to Municipality and Engineer, certify that that portion of the Work is substantially complete and request that Engineer issue a certificate of Acceptance for Use. Within a reasonable time thereafter, Municipality, Contractor, and Engineer shall make an inspection of that portion of the Work to determine the status of completion. If Engineer does not consider the Work sufficiently complete to be acceptable to use, Engineer will notify Contractor in writing giving his reasons therefore. If Engineer considers the Work sufficiently complete, Engineer will prepare and deliver to Municipality an Acceptance for Use which shall fix the date of acceptance. There shall be attached to the acceptance, a list of items to be completed or corrected.

30.0 FINAL INSPECTION

The Engineer shall make final inspection of all Work included in the Project as soon as possible after notification in writing by the Contractor that the Work is completed or after the Engineer's records show that the Work is completed. If the Work is not acceptable to the Engineer at the time of such inspection, he shall advise the Contractor in writing as to the particular defects to be remedied before final acceptance. The Contractor shall make written request for review of Work considered corrected. The Engineer shall notify the Contractor and Project Sponsor in writing when the Project is acceptable.

Charter Township of Van Buren
Acceptance of General Construction Requirements
And Municipal Insurance Requirements

Project: _____

Job No. VBN _____-__T

Project Sponsor: _____

Contractor: _____

Designer: _____

Date: _____

We, hereby, fully and unconditionally accept the General Construction Requirements (GCR-1 through GCR-9) and Municipal Insurance Requirements (MIR-1 through MIR-3) which are attached hereto and made a part of this acceptance, and agree to construct, or cause to be constructed, the project in strict accordance therewith.

Witness for the Project Sponsor: Project Sponsor

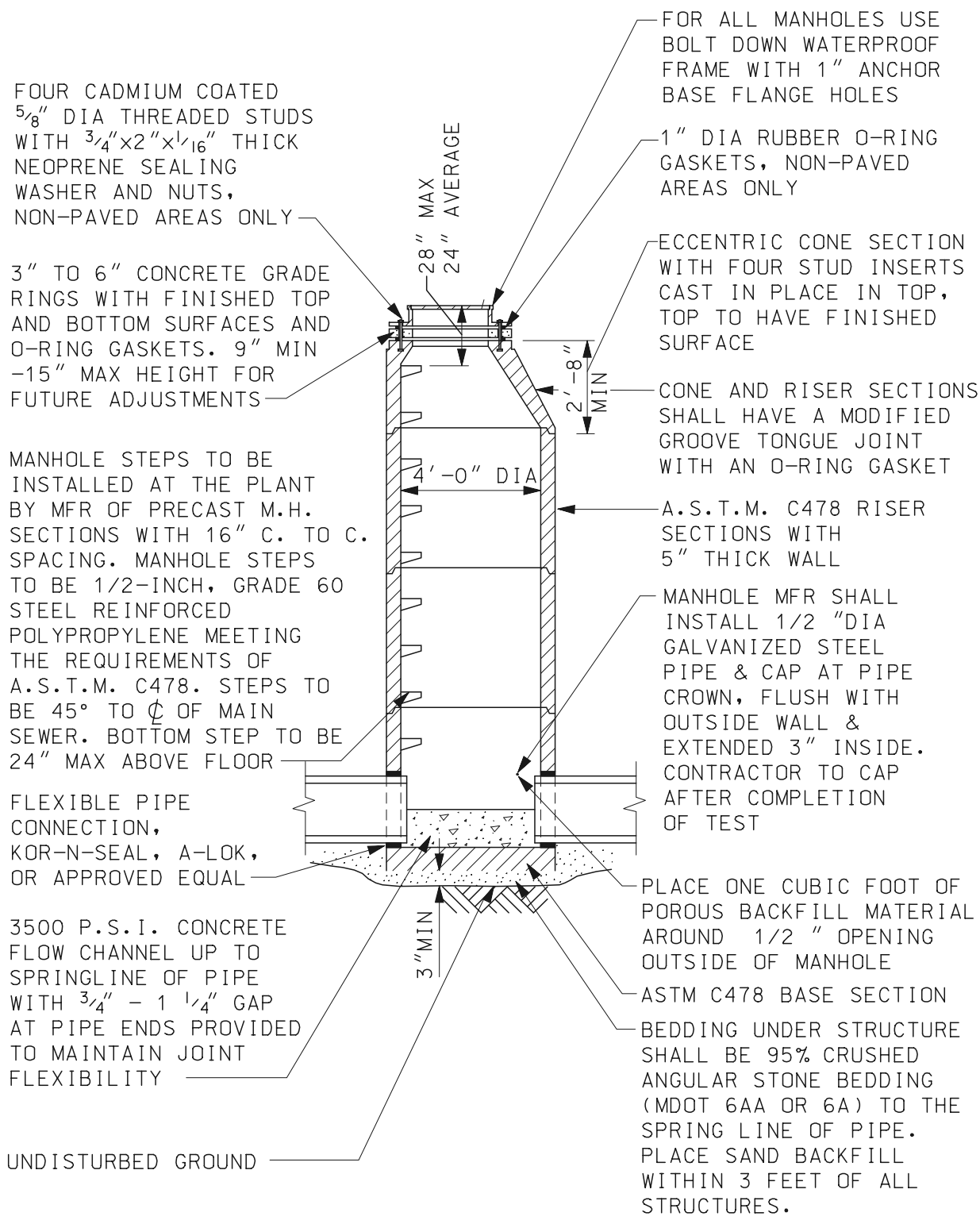
_____ _____

Witness for the Contractor: Underground Contractor

_____ _____

Appendix A

Standard Details



STANDARD SANITARY MANHOLE
FOR SEWERS 8" THROUGH 18"

DATE	REVISION

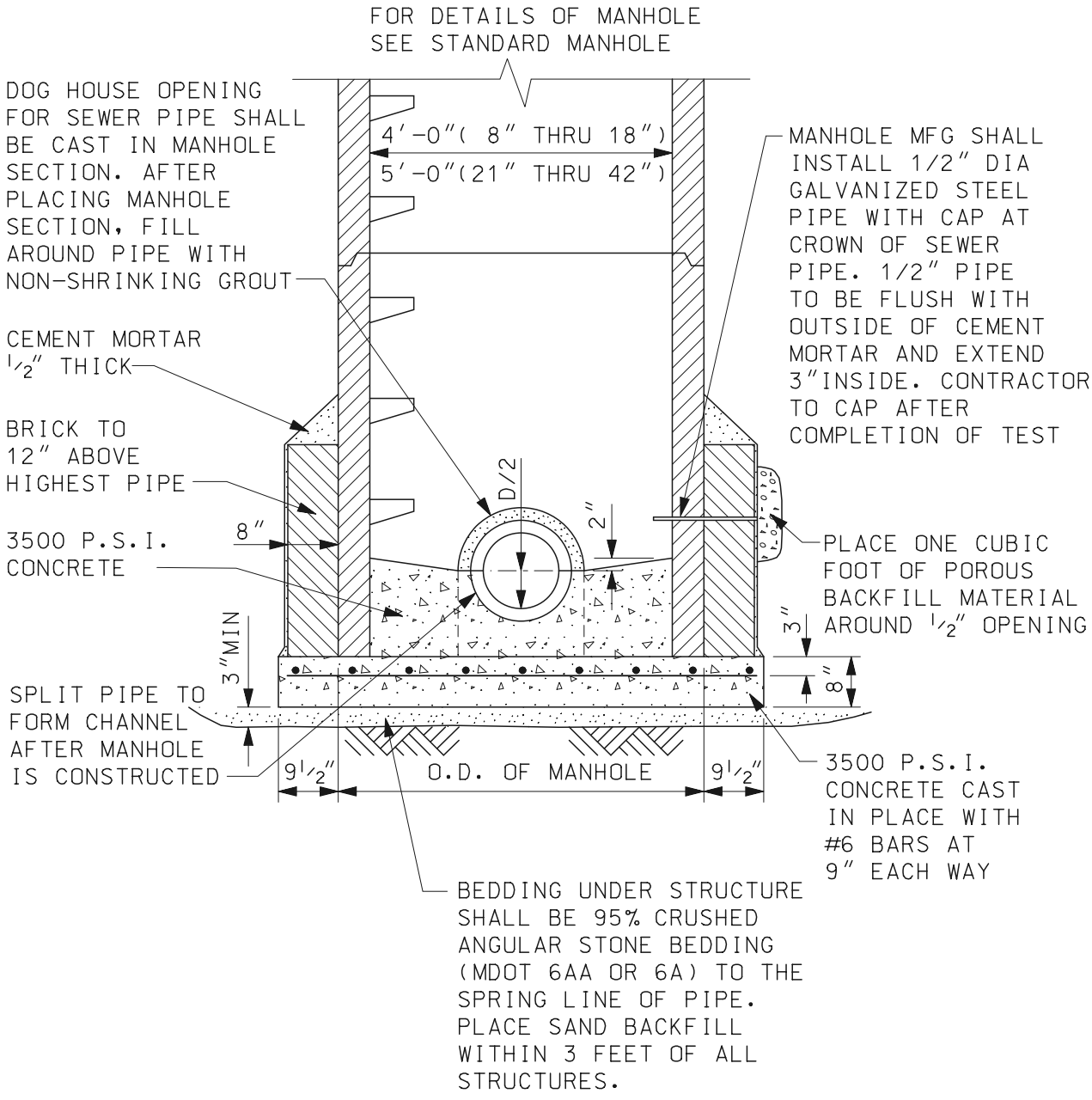
WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. SS-1

DOG HOUSE CUT OUT SIZES	
SEWER SIZE	MAX CUT OUT SIZE
8" THRU 10"	17 1/2"
12" THRU 15"	20"



STANDARD SANITARY MANHOLE OVER EXISTING SEWERS 8" THROUGH 42"

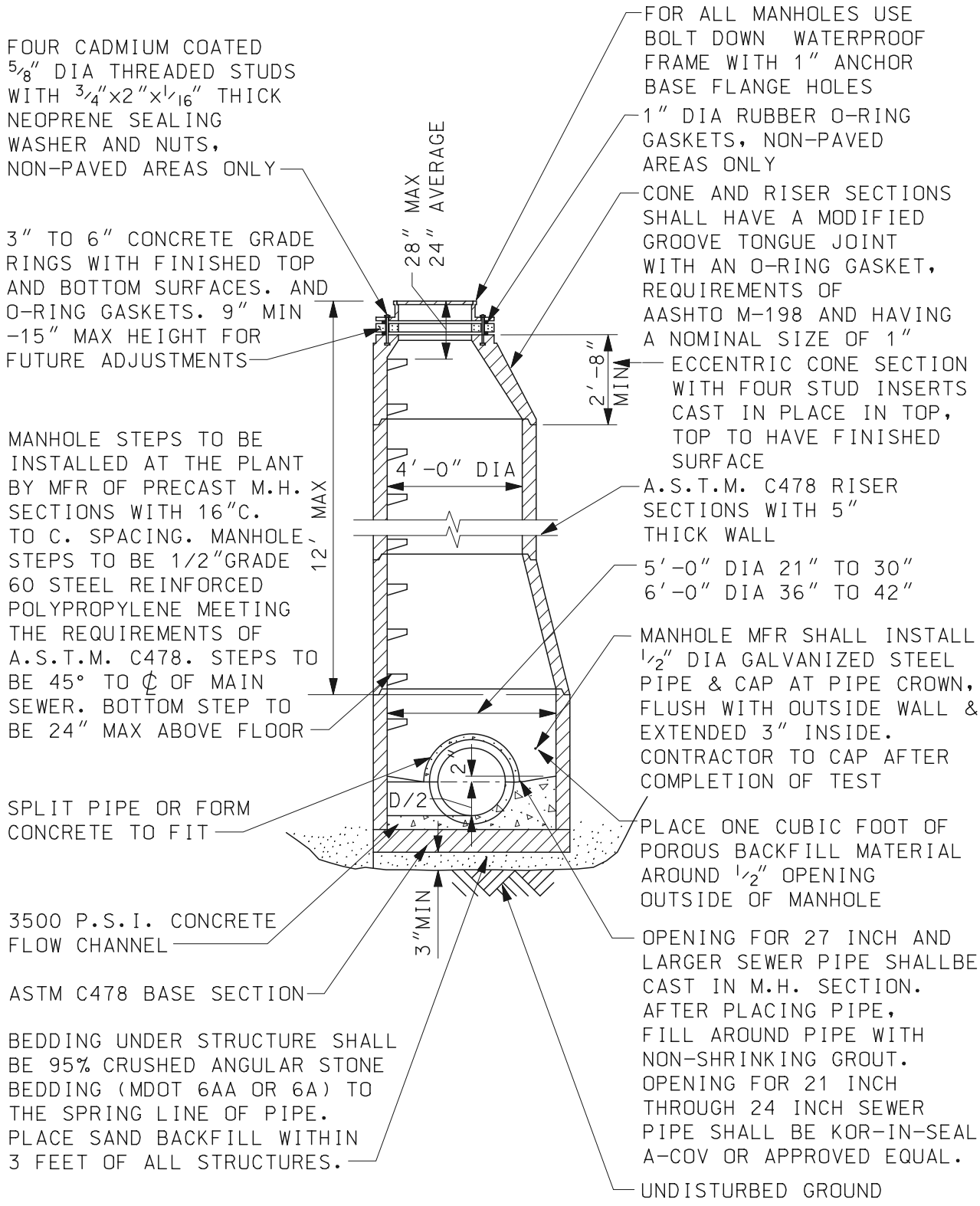
DATE	REVISION

WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. SS-2



STANDARD SANITARY MANHOLE
FOR SEWERS 21" THROUGH 42"

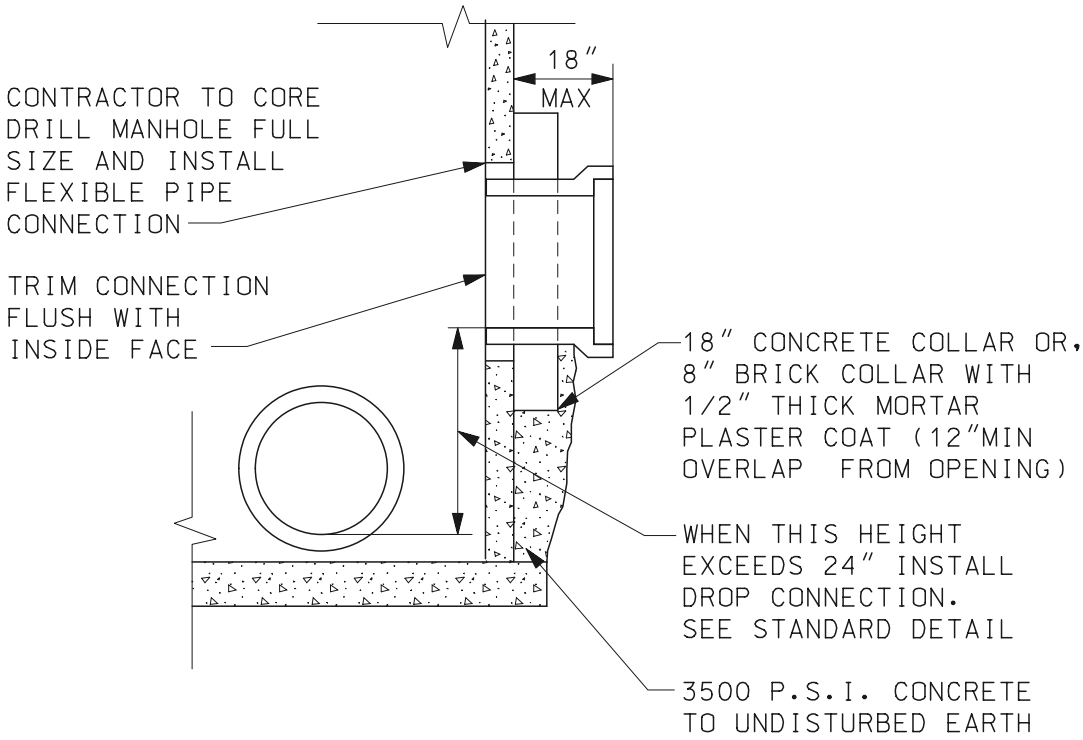
DATE	REVISION

WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. SS-3



STANDARD CONNECTION TO EXISTING MANHOLE (WCD-7)

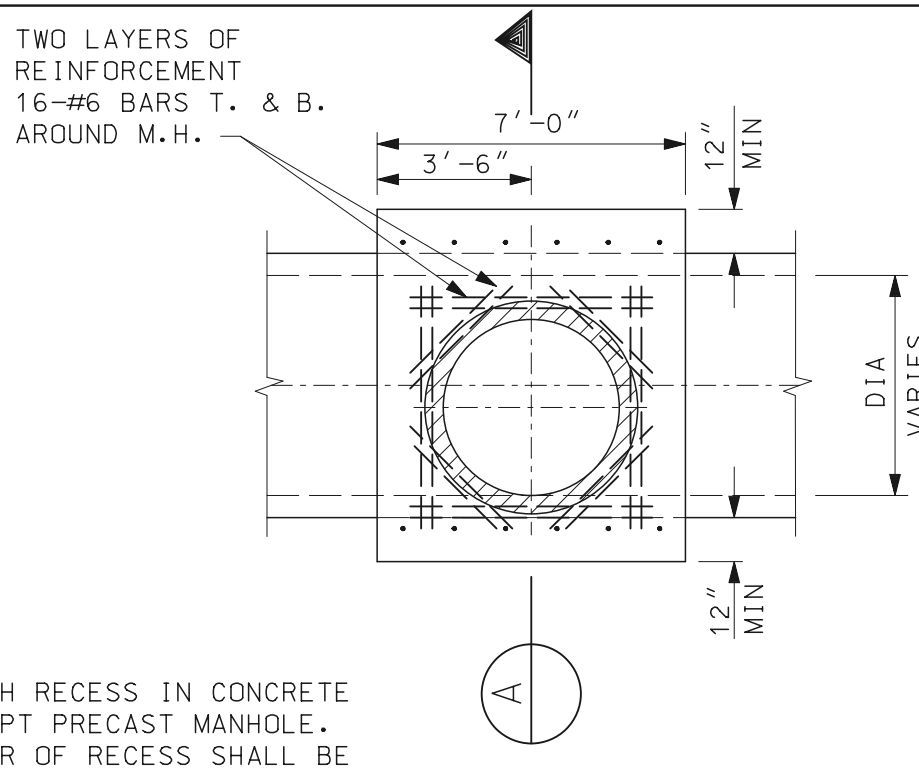
DATE	REVISION

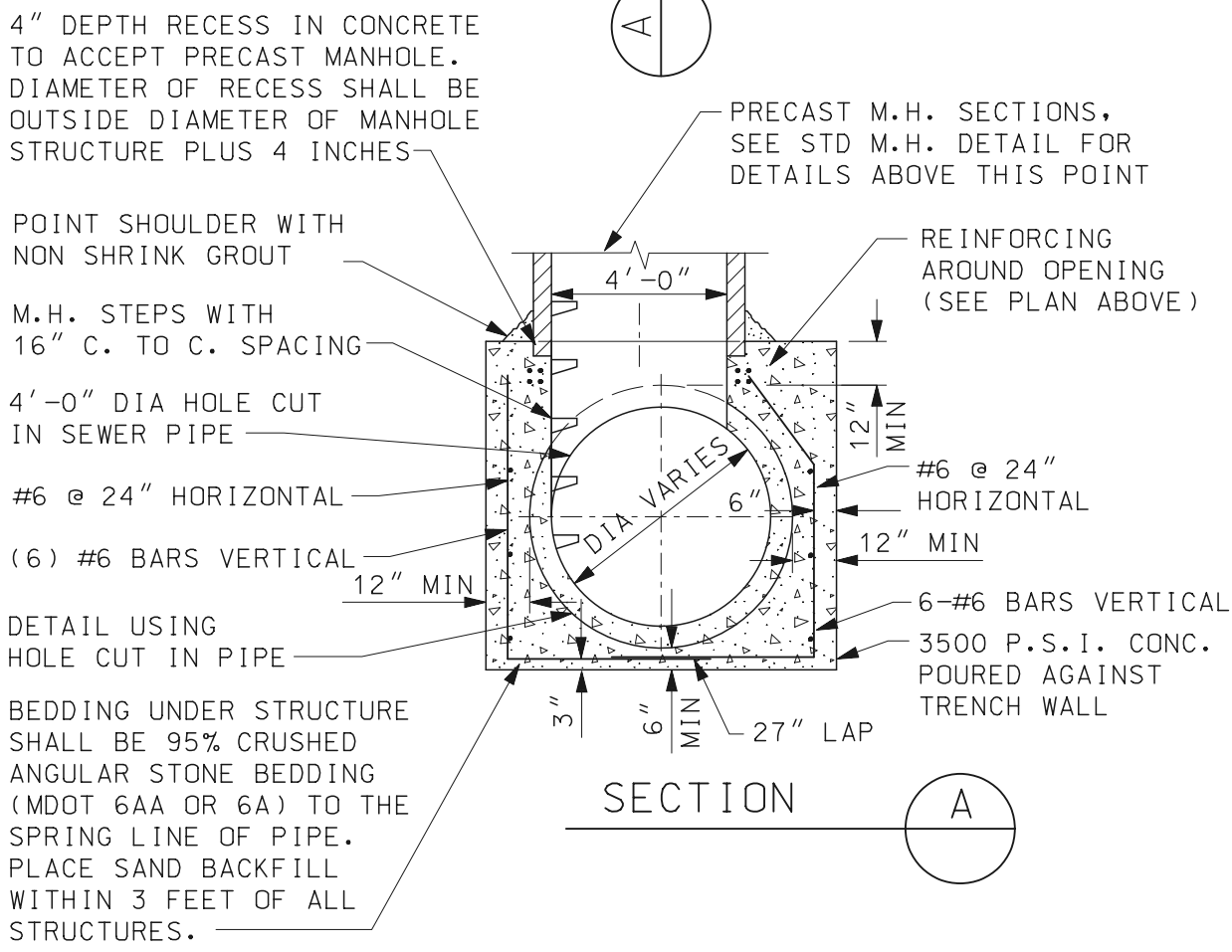
WADETRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. SS-4





STANDARD SANITARY MANHOLE
FOR 48" & LARGER SEWERS

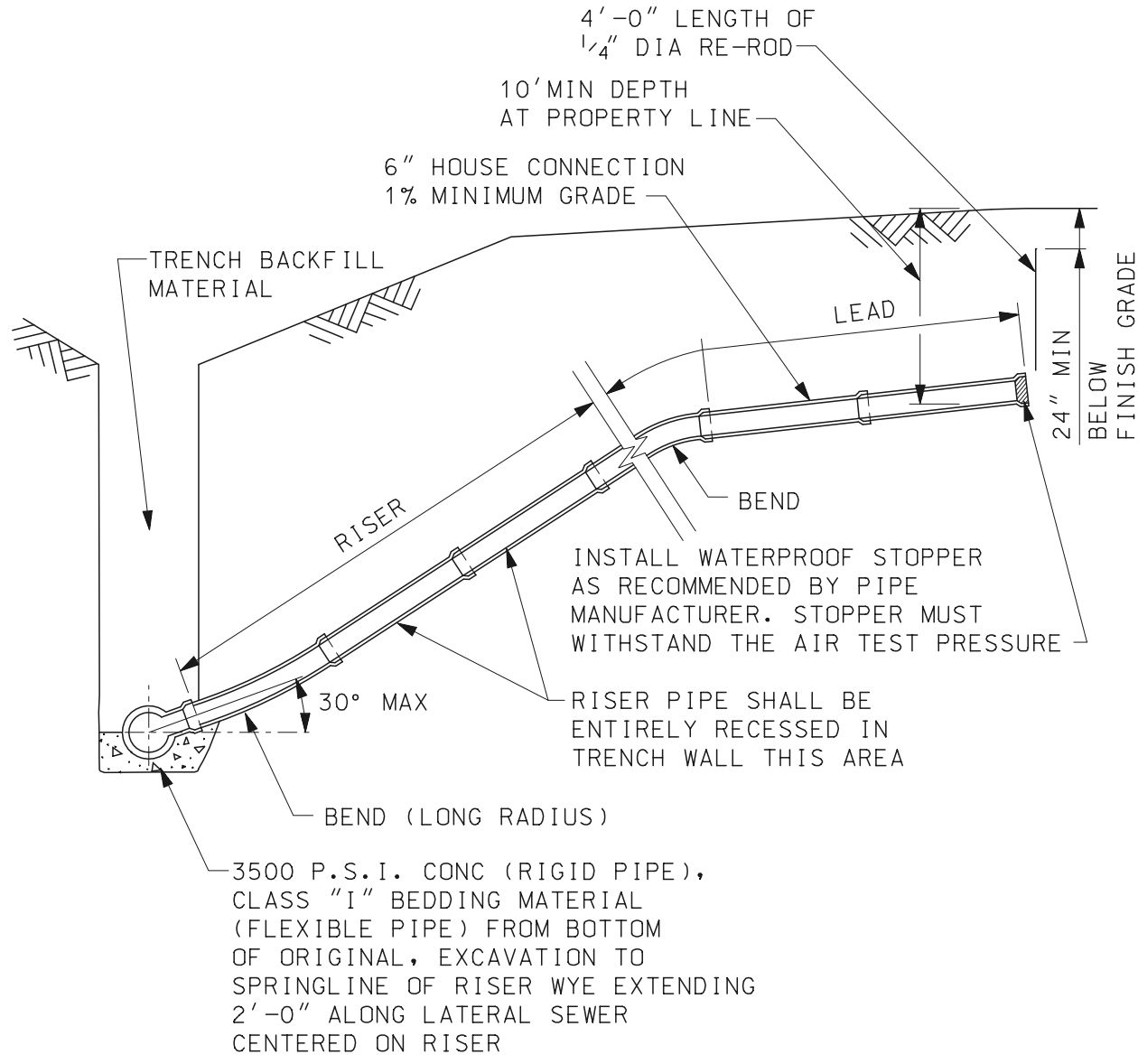
DATE	REVISION

WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. SS-5



RISER/LEAD DETAIL

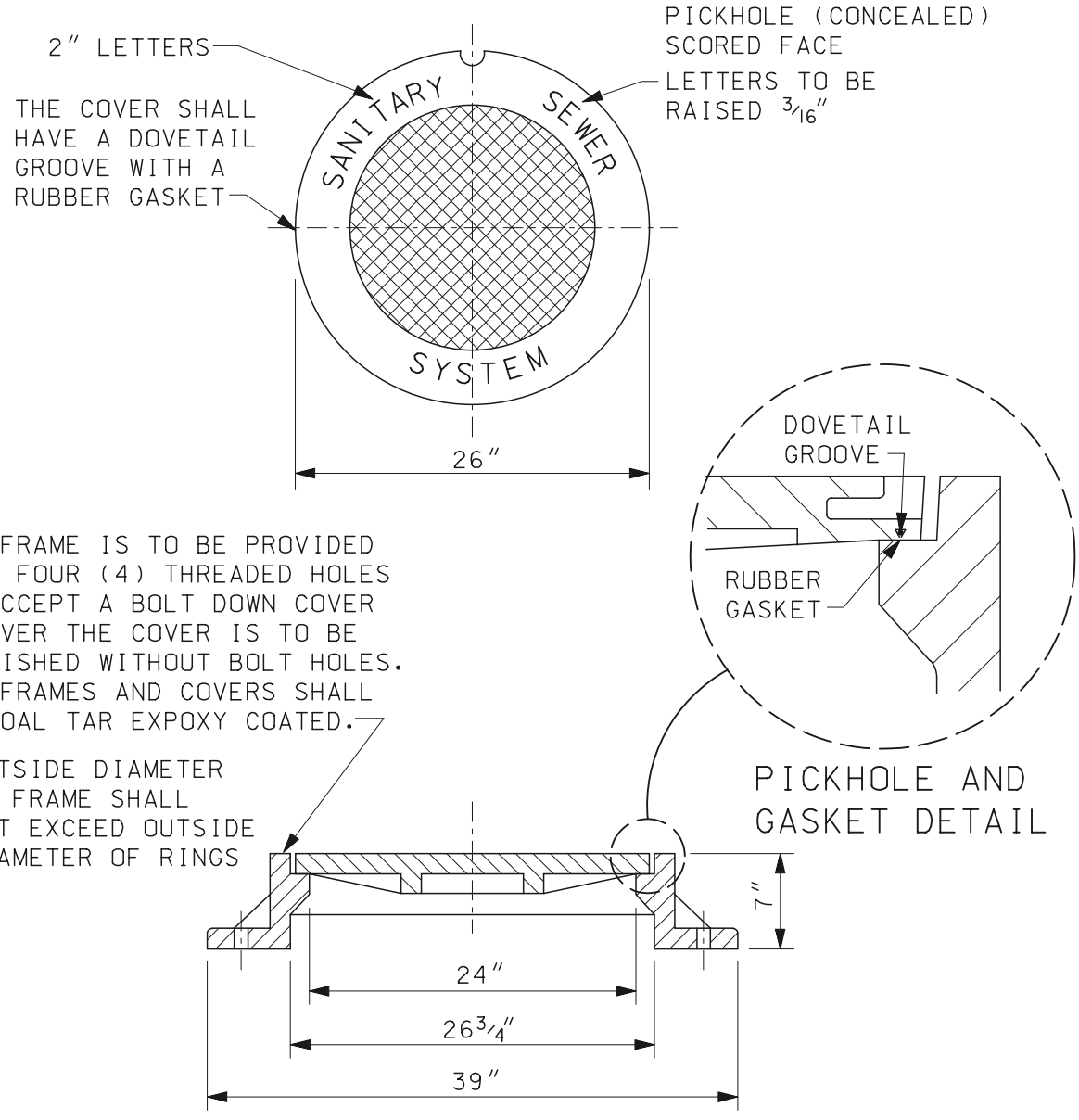
DATE	REVISION

WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. SS-6



NOTE:
THERE SHALL NOT BE A GROOVE NOR A RUBBER GASKET IN THE FRAME, THE GROOVE AND GASKET SHALL BE IN THE COVER.

E.J.I.W. #1040-1 ZPT FRAME WITH 1040 AGS (NARROW SKIRT) LID (SPECIAL ORDER), NEENAH R-1916-F FRAME WITH R-1642 T57 LID OR EQUAL

STANDARD FRAME AND COVER

DATE	REVISION

WADE TRIM

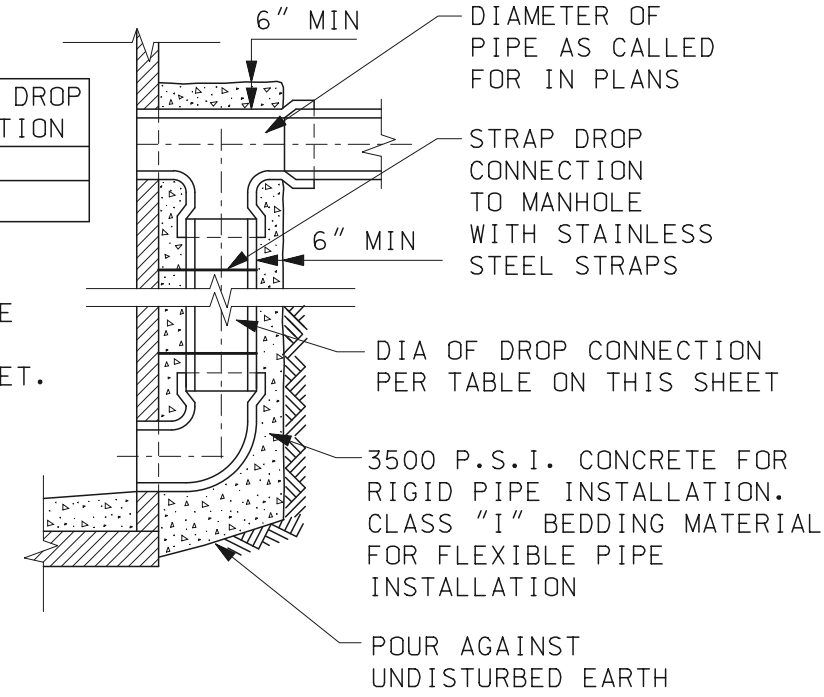
CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. SS-7

DIA OF SEWER	DIA OF DROP CONNECTION
8" & 10"	6"
12", 15" & 18"	10"

PLACE HOOK BOLTS INTO MANHOLE TO BOND CONCRETE ENCASEMENT WHEN DROP CONNECTION EXCEEDS 2 FEET.



EXTERIOR DROP CONNECTION

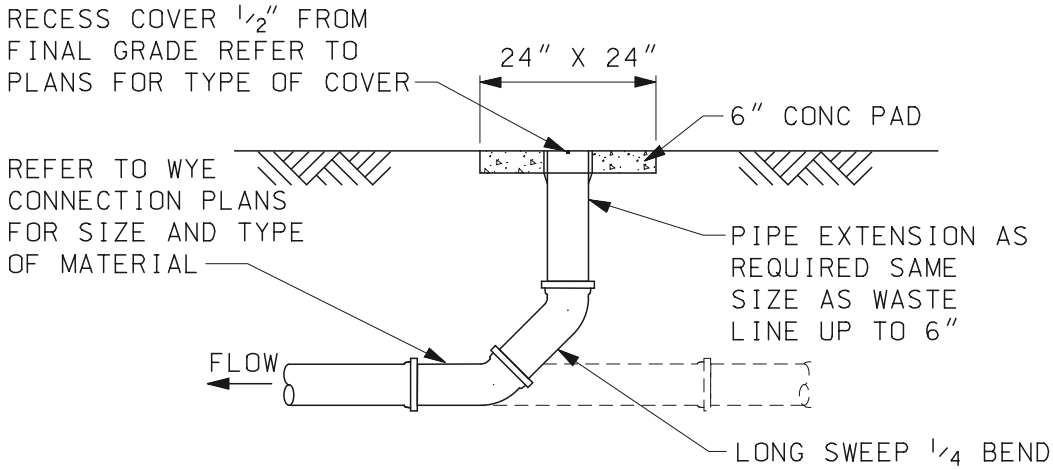
DATE	REVISION

WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

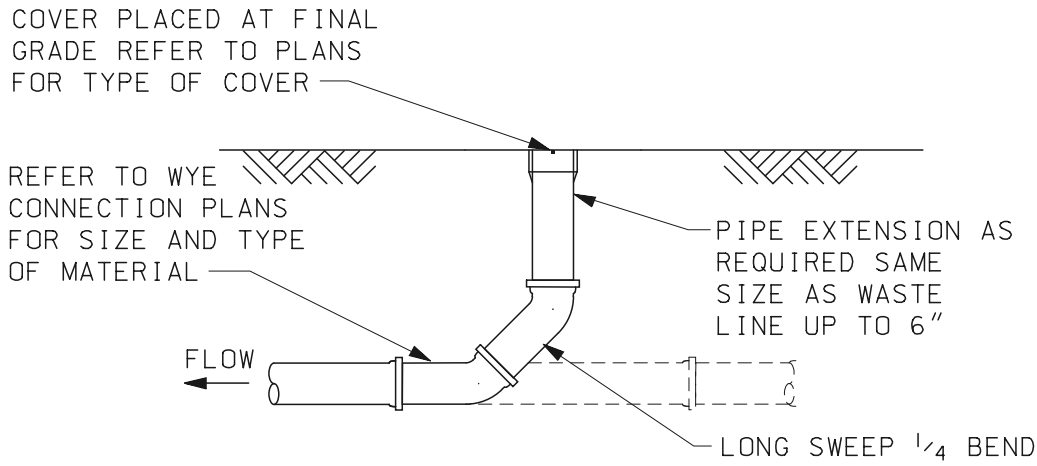
ORIGINAL ISSUE: Ø4-22-14

SHEET No. SS-8



CLEAN - OUT

(LOCATED IN PAVED AREA)



CLEAN - OUT

(LOCATED IN GREENBELT AREA)

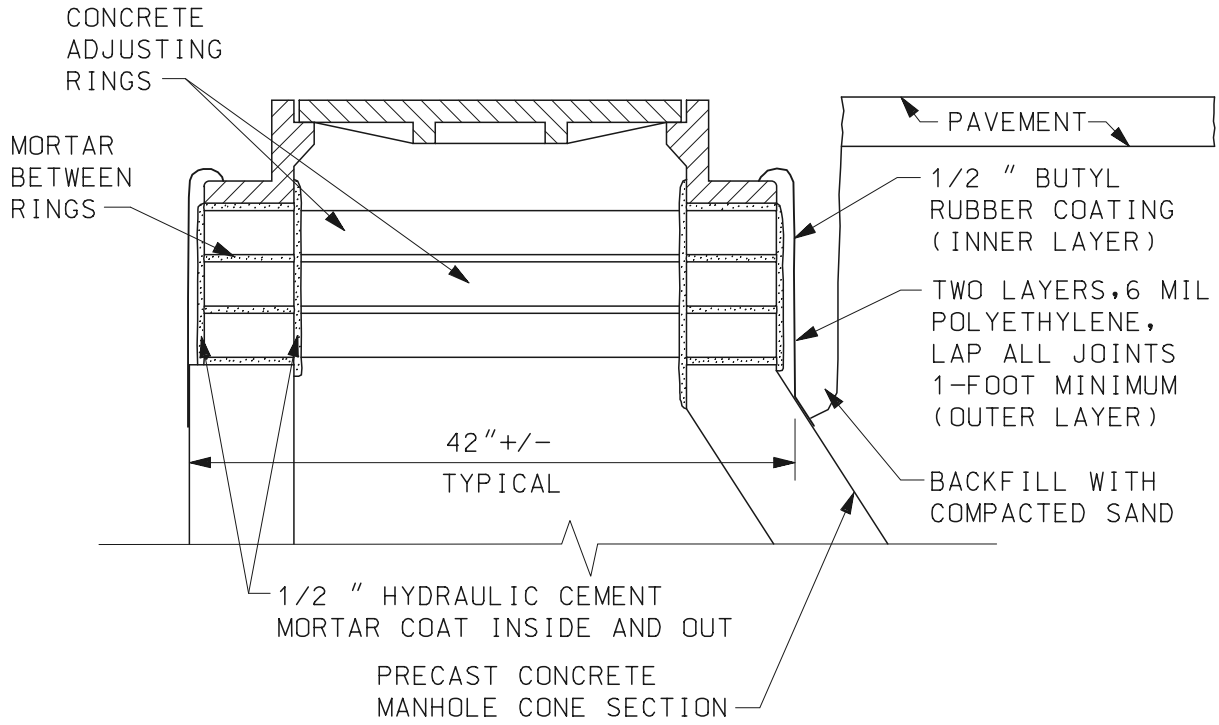
DATE	REVISION

WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. SS-9



* OUTSIDE DIAMETER OF FRAME SHALL NOT EXCEED OUTSIDE DIAMETER OF RINGS

NOTE:
THIS DETAIL TO BE USED IN CONCRETE OR BITUMINOUS PAVED AREAS. ALL OTHER AREAS SHALL USE BOLT DOWN FRAMES WITH RUBBER O-RINGS AS SHOWN ON MANHOLE DETAILS.

EXTERNAL FRAME SEAL DETAIL

FOR PAVED AREAS ONLY

DATE	REVISION

WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. SS-10

SANITARY SEWER NOTES

1. ALL SEWER SYSTEM CONSTRUCTION SHALL CONFORM TO THE CURRENT STANDARDS AND GENERAL SPECIFICATION OF THE COMMUNITY SEWER DEPARTMENT AND ANY OTHER AGENCY HAVING JURISDICTION OF THE CONSTRUCTION AREA.

2. DETAILS ARE FOR STRUCTURES WITH NO MORE THAN TWO PIPES ENTERING, 180° APART. LARGER DIAMETER STRUCTURES MAY BE REQUIRED FOR DIFFERENT CONFIGURATIONS.

3. THE MANHOLE STRUCTURE REQUIRES A MINIMUM OF 8 INCHES OFCONCRETE WALL BETWEEN PIPE OPENINGS. LARGER DIAMETER STRUCTURES MAY BE REQUIRED WHERE PIPE ENTERING THE STRUCTURE ARE LESS THAN 90° APART IN ANY DIRECTION.

4. CONSTRUCTION SHALL NOT COMMENCE WITHOUT A REPRESENTATIVE OF THE OWNER PRESENT.

5. ALL MANHOLES SHALL USE ECCENTRIC CONES PLACED WITH STEPS AWAY FROM THE ROAD UNLESS DIRECTED OTHERWISE.

6. ALL MANHOLES SHALL BE PROVIDED WITH WATER TIGHT MANHOLE COVERS AND RIMS SHALL BE SET TO GRADE OR AS INDICATED ON THE PLANS.

7. ALL PRECAST PRODUCTS SHALL CONFORM TO THE REQUIRMENTS OF ASTM C-478.

8. DIFFERENTIAL OF EXCAVATION AROUND EXISTING MANHOLES SHALL NOT EXCEED SIX FEET.

9. EXTERIOR DROP CONNECTIONS ARE REQUIRED WHENEVER A SEWER INVERT IS 2.0 FEET OR GREATER ABOVE THE MANHOLE FLOW CHANNEL INVERT. INTERIOR DROP CONNECTIONS ARE NOT ALLOWED.

10. NO SEWERS SHALL BE CONSTRUCTED LESS THAN 10-INCH DIAMETER WITHOUT SPECIFIC APPROVAL OF THE COMMUNITY SEWER DEPARTMENT.

11. ALL RIGID SANITARY SEWER PIPE SHALL BE CLASS "R-B" BEDDING, ALL FLEXIBLE PIPE SHALL BE CLASS "F-I" BEDDING, UNLESS OTHERWISE NOTED ON THE PLANS. SEE SHEET MD1.

12. PLACE ONE 6-INCH WYE FOR EACH LOT OR PARCEL 100 FEET OR LESS IN WIDTH OR EVERY 100 FEET FOR LOTS OR PARCELS IN EXCESS OF 100 FEET ON SANITARY SEWERS UNLESS OTHERWISE NOTED.

13. NO CONNECTION RECEIVING STORM WATER, SURFACE WATER, OR GROUND WATER SHALL BE MADE TO SANITARY SEWERS.

14. NO FOOTING DRAINS SHALL BE CONNECTED TO THE BUILDINGS SANITARY SEWER.

15. RISERS ON SANITARY SEWERS SHALL BE INSTALLED TO A DEPTH OF 10 FEET WHERE SEWER IS OVER 12 FEET.

DATE	REVISION

WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. SS-11

SANITARY SEWER NOTES

CONTINUED

16. PRIOR TO THE BACKFILLING OF A SERVICE LEAD, A 2" BY 2" PIECE OF WOOD SHALL BE PLACED FROM A POINT IMMEDIATELY IN FRONT OF THE SERVICE CONNECTION TO 2-FOOT BELOW THE FINISH GROUND SURFACE. DO NOT REST THE MARKER ON ANY PORTION OF THE SERVICE CONNECTION OR STOPPER.

17. ALL STUBS SHALL HAVE A WATER TIGHT BULKHEAD.

18. INFILTRATION FOR ANY SECTION OF SEWERS BETWEEN MANHOLES SHALL NOT EXCEED 100 GALLONS PER INCH DIAMETER PER MILE OF SEWER PER 24 HOURS AND SHALL INCLUDE THE INFILTRATION FROM ALL MANHOLES AND OTHER APPURTENANCES.

19. ALL SEWERS SHALL BE SUBJECTED TO AIR, INFILTRATION OR EXFILTRATION TESTS, OR A COMBINATON OF SAME, PRIOR TO ACCEPTANCE. ALL SEWERS OVER 24-INCH DIAMETER SHALL BE SUBJECTED TO INFILTRATION TESTS. ALL SEWERS OF 24-INCH DIAMETER OR SMALLER, WHERE THE GROUND WATER LEVEL ABOVE THE TOP OF THE SEWER IS OVER SEVEN FEET, SHALL BE SUBJECTED TO INFILTRATION TESTS. ALL SEWERS OF 24-INCH DIAMETER OR LESS, WHERE THE GROUND WATER LEVEL ABOVE THE TOP OF THE SEWER IS SEVEN FEET OR LESS, SHALL BE SUBJECTED TO AIR TESTS OR EXFILTRATION TESTS.

20. THE PROCEDURE FOR AIR TESTING OF SEWERS SHALL BE IN ACCORDANCE WITH ASTM C828, ASTM C924, OR ASTM F1417 AS APPLICABLE.

21. NINE POINT MANDREL TEST IS REQUIRED FOR ALL FLEXIBLE PIPES AND MAY NOT BE PERFORMED UNTIL 30 DAYS AFTER INSTALLATION.

22. IF A SEWER FAILS TO PASS ANY OF THE PREVIOUSLY DESCRIBED TESTS, THE CONTRACTOR SHALL DETERMINE THE LOCATION OF THE LEAKS, REPAIR THEM, AND RETEST THE SEWER. THE TEST SHALL BE REPEATED UNTIL SATISFACTORY RESULTS ARE OBTAINED. TELEVISION INSPECTION SHALL BE CONSIDERED COMPLETED WHEN THE NECESSARY CONSTRUCTION REPAIRS HAVE BEEN MADE AND THE INSTALLATION RETELEVISED AND THE SYSTEM IS ACCEPTABLE FOR THE TESTING PHASE.

23. THE CONTRACTOR SHALL PROVIDE FOR TELEVISION INSPECTION OF THE SANITARY SEWER LINES. ALL SANITARY LEADS FOR COMMERCIAL AND INDUSTRIAL SITES OVER 100 FEET IN LENGTH MUST BE AIR TESTED AND TELEVISION INSPECTION COMPLETED.

24. ALL SEWER SHALL BE TELEVISED, WITH RESULTS APPROVED BY THE COMMUNITY PRIOR TO PLACING THE SEWER IN SERVICE. COPIES OF THE TELEVISION RECORDING (DVD FORMAT) NEED TO GO TO THE COMMUNITY AND THE ENGINEER PRIOR TO THE CONTRACTOR LEAVING THE SITE. THE TELEVISION INSPECTION MUST BE WITNESSED BY THE OWNERS REPRESENTATIVE.

25. THE CONTRACTOR SHOULD ARRANGE FOR, ENGAGE, AND PLAY ALL EXPENSES INVOLVED FOR THE SERVICES OF A COMPETENT COMPANY TO PERFORM THIS TELEVISION INSPECTION.

DATE	REVISION

WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. SS-12

SANITARY SEWER NOTES

CONTINUED

26. THE TELEVISION INSPECTION SHALL BE OBERVED BY REPRESENTATIVES OF THE OWNER, ENGINEER, AND THE CONTRACTOR. ANY TELEVISION VIEWING PERFORMED IN THE ABSENCE OF THE ENGINEER WILL NOT BE CONSIDERED AS A PART OF THE FINAL INSPECTION.

27. THE INSPECTION SHALL INVOLVE THE VISUAL OBSERVATION BY CLOSED CIRCUIT TELEVISION OF ALL SANITARY SEWER INSTALLED AS PART OF THIS CONTRACT. THE INSPECTION SHALL BE PERFORMED AT A RATE OF SPEED WHICH WILL ALLOW EXAMINATION OF ALL POINTS OF INFILTRATION, CRACKED OR CRUSHED PIPE, DEFECTIVE JOINTS, MISALIGNMENT IN LINE OR GRADE, LOCATION OF ALL WYE OPENINGS AND ANY DEFECTS OR ITEMS OF POOR WORKMANSHIP WHICH MAY APPEAR. ANY ITEMS WHICH, IN THE OPINION OF THE ENGINEER, REQUIRE REPAIR SHALL BE PRECISELY LOCATED AND PHOTOGRAPHED ALONG WITH A DETAILED STATEMENT OF THE CONDITION. THE CONTRACTOR SHALL TAKE IMMEDIATE ACTION TO REPAIR ALL SUCH DEFECTS INCLUDING EXCESSIVE INFILTRATION AT ANY SPECIFIC LOCATION. EVEN THOUGH THE INFILTRATION LIMITS AS HEREIN SPECIFIED HAVE NOT BEEN EXCEEDED FOR THE ENTIRE LENGTH OF SEWER BEING INSPECTED. FOLLOWING COMPLETION OF THE REPAIR, THE ENGINEER AT THEIR DISCRETION, MAY REQUIRE A SECOND TELEVISION INSPECTION OF ANY REPAIRED AREAS. THE CONTRACTOR SHALL ARRANGE FOR AND PAY ALL COSTS INVOLVED IN PERFORMING THIS RE-INSPECTION.

28. THERE SHALL BE NO DISCHARGE OF UNTREATED SANITARY SEWAGE TO THE SURFACE WATERS OF THE STATE DUE TO CONSTRUCTION ACTIVITIES ASSOCIATED WITH THIS PROJECT.

29. CONTRACTOR SHALL NOTIFY WAYNE COUNTY DEPARTMENT OF PUBLIC SERVICES, ENGINEERING DIVISION PERMIT OFFICE, 48 HOURS PRIOR TO START OF CONSTRUCTION. MR. PAUL POLKOWSKI AT (734) 595-6507, EXTENSION 2009.

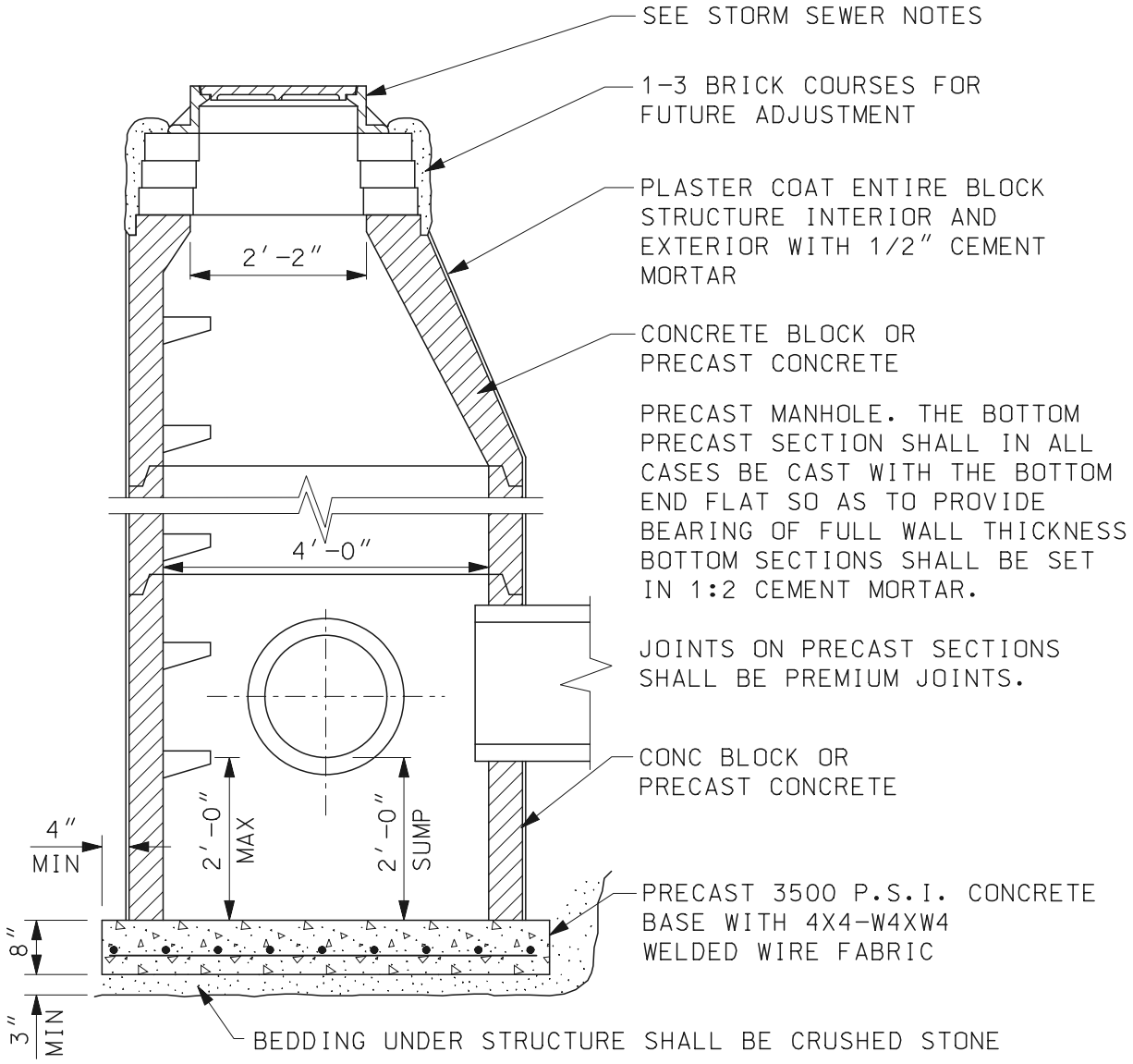
DATE	REVISION

WADETRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. SS-13



M.H. STEPS SHALL BE SPACED AS FOLLOWS:
- CONC BLK. M.H.....18" CENTERS
- PRECAST M.H. .....16" CENTERS

TOP STEP TO BE 24" MAX BELOW TOP OF FRAME

MIN CONE HEIGHTS AS FOLLOWS:

BLOCK	CONCENTRIC 3'-0"
PRECAST	ECCENTRIC 2'-8" OR 3'-4"

CONC BLOCK MANHOLE:
APPROVED CONC BLODK
USE 6" OR 8" MIN THICK BLOCK TO 16' DEPTH USE 12" MIN THICK BLOCK TO 24' DEPTH 16" MIN BLOCK WALL BELOW 24' DEPTH

PRECAST MANHOLE:
ASTM C-478 UP TO 32' DEEP WITH 5" MIN THICK WALL

STANDARD STORM MANHOLE FOR SEWERS WITH OUTLETS OF 18" & UNDER

N.T.S.

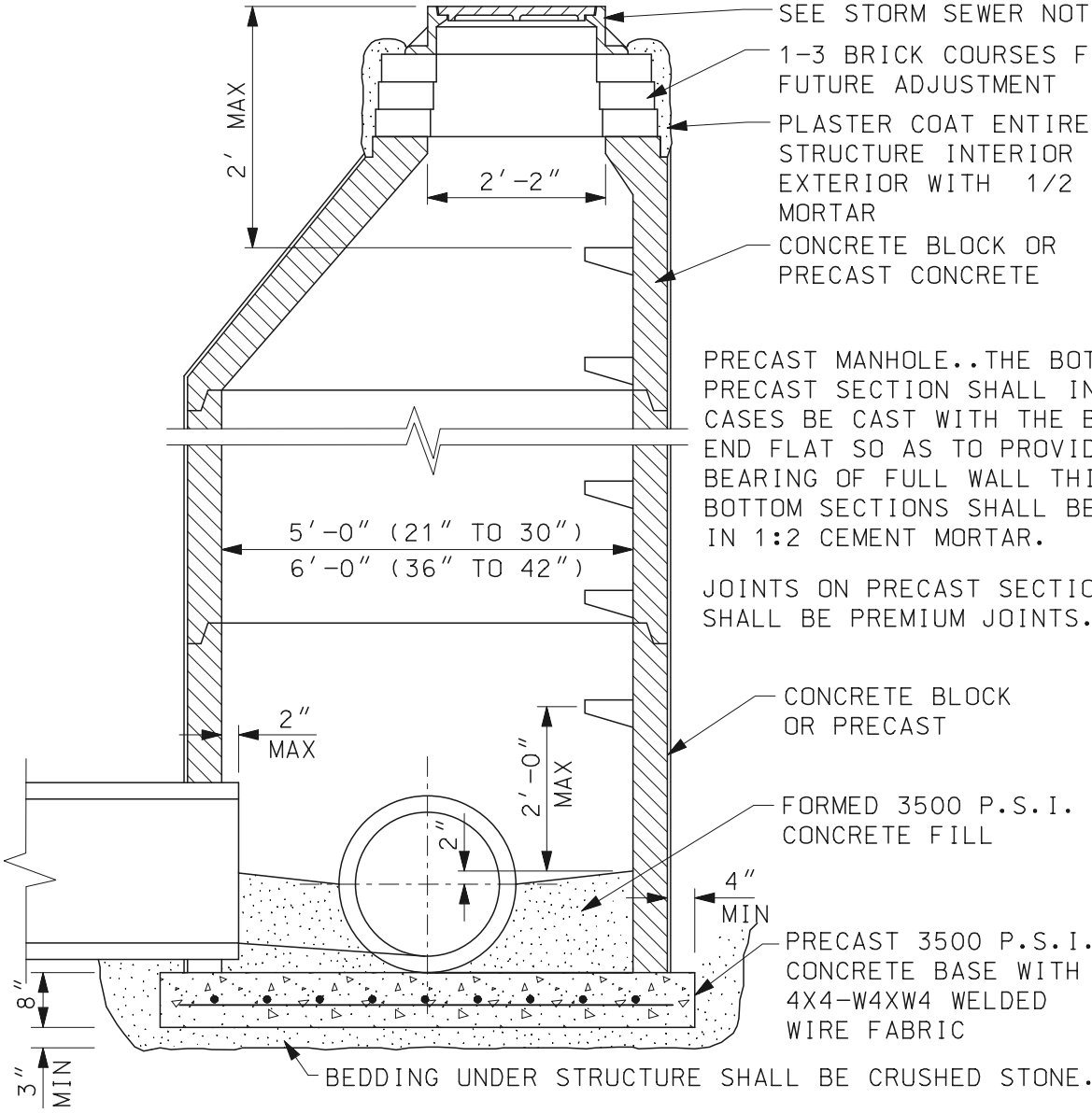
DATE	REVISION

WADETRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. ST-1



PRECAST MANHOLE..THE BOTTOM PRECAST SECTION SHALL IN ALL CASES BE CAST WITH THE BOTTOM END FLAT SO AS TO PROVIDE BEARING OF FULL WALL THICKNESS. BOTTOM SECTIONS SHALL BE SET IN 1:2 CEMENT MORTAR.

JOINTS ON PRECAST SECTIONS SHALL BE PREMIUM JOINTS.

M.H. STEPS SHALL BE SPACED AS FOLLOWS:
- CONC BLK. M.H.....18" CENTERS
- PRECAST M.H. .....16" CENTERS

TOP STEP TO BE 24" MAX BELOW TOP OF FRAME

MIN CONE HEIGHTS AS FOLLOWS:

BLOCK	CONCENTRIC 3'-0"
PRECAST	ECCENTRIC 2'-8" OR 3'-4"

CONC BLOCK MANHOLE:
APPROVED CONC BLOCK
USE 6" OR 8" MIN THICK BLOCK TO 16' DEPTH USE 12" MIN THICK BLOCK TO 24' DEPTH 16" MIN BLOCK WALL BELOW 24' DEPTH

PRECAST MANHOLE:
ASTM C-478 UP TO 32' DEEP WITH 5" MIN THICK WALL

STANDARD STORM MANHOLE FOR SEWERS 21" TO 42"

N.T.S.

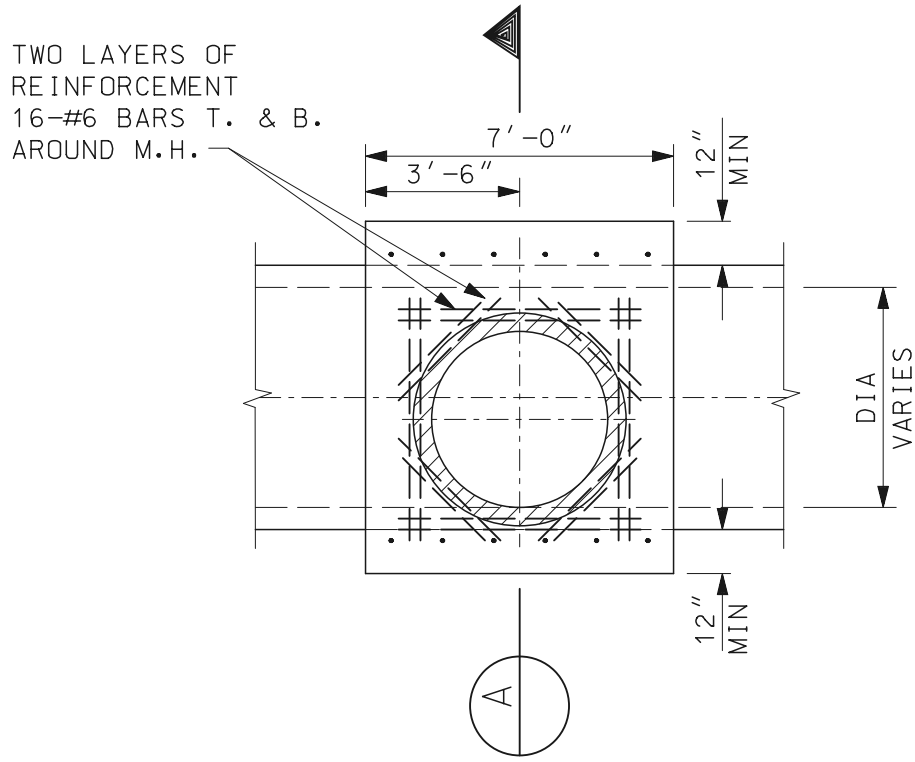
DATE	REVISION

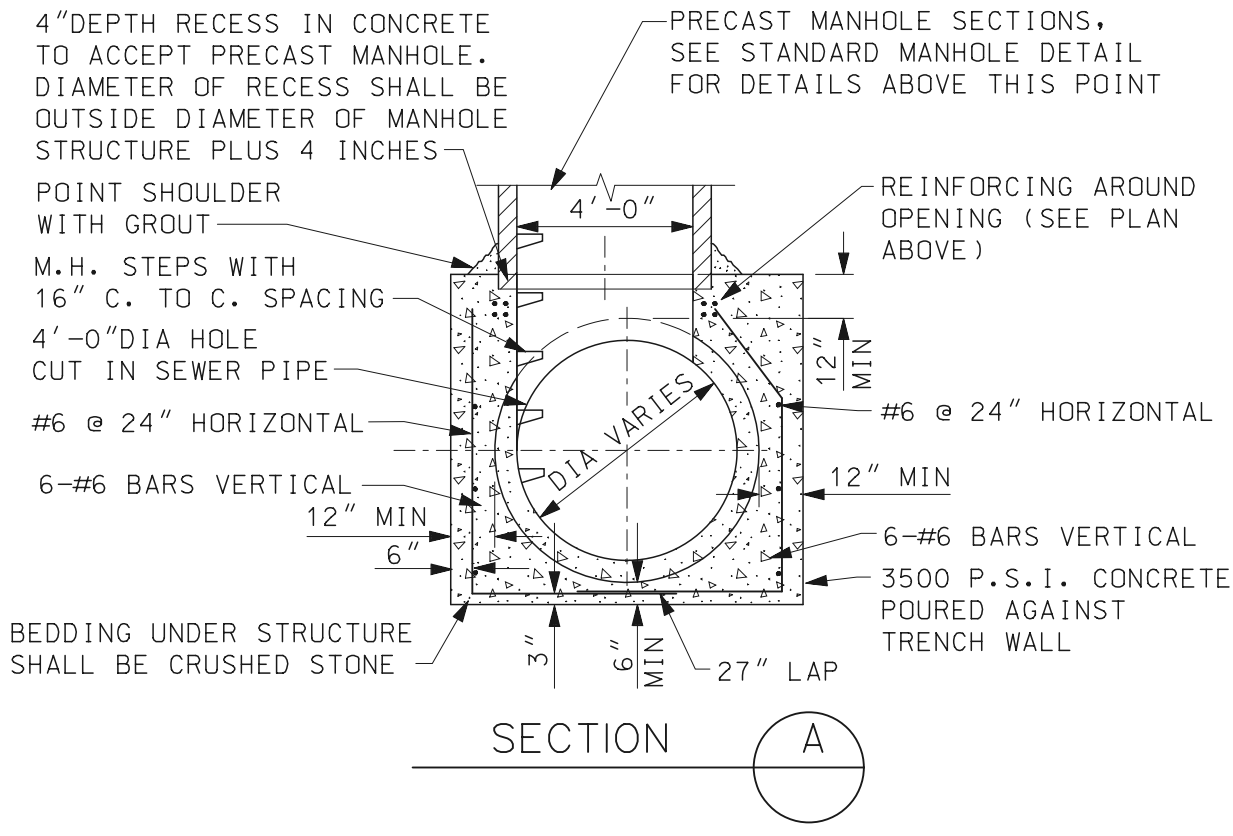
WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: Ø4-22-14

SHEET No. ST-2





SECTION A

STANDARD STORM MANHOLE FOR 48" & LARGER SEWERS

N.T.S.

DATE	REVISION

WADE TRIM

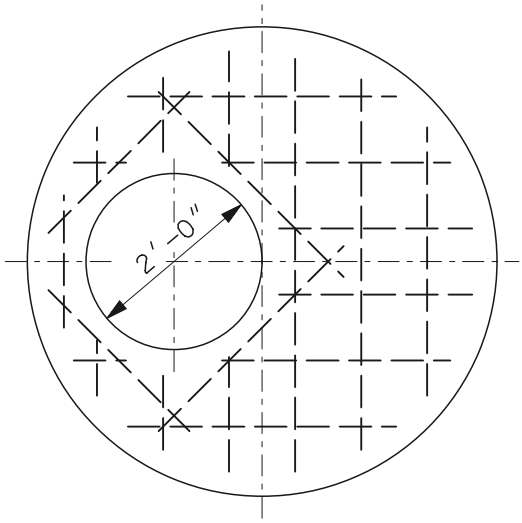
CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

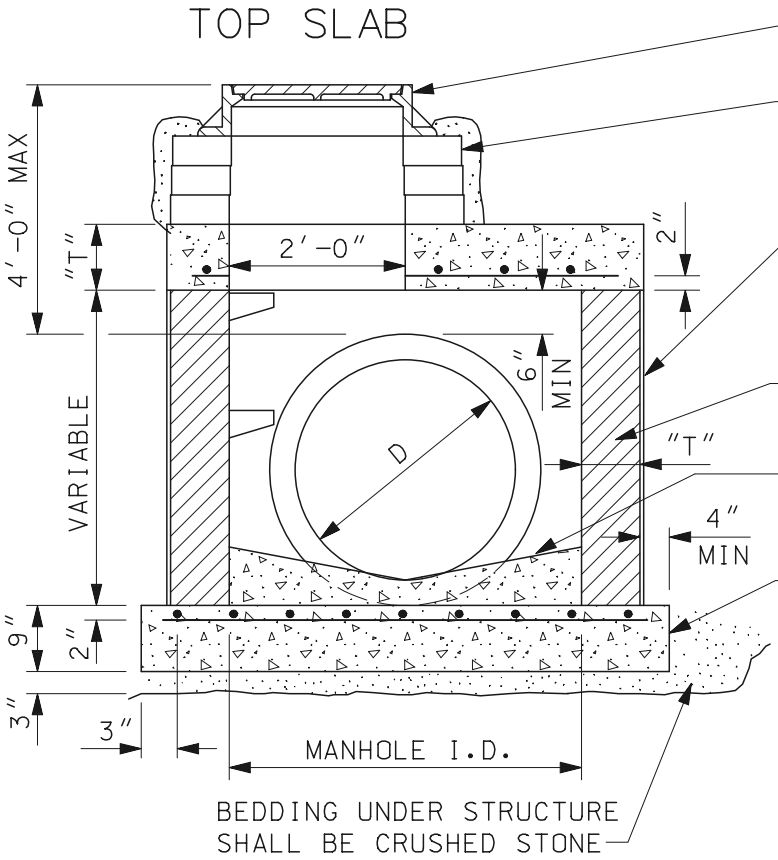
SHEET No. ST-3

OUTLET "D"	M.H. I.D.	TOP SLAB "T"	WALLS "T"	REINF STEEL
**24" OR LESS	4'-0"	9"	8"	#6@9"* E.W.
30"	4'-0"	9"	8"	#6@9" E.W.
36"	4'-0"	9"	12"	#6@9" E.W.
42"	5'-0"	10"	12"	#6@9" E.W.
48" 54"	6'-0"	11"	12"	#7@9" E.W.

* TOP SLAB
** 2' SUMP REQ'D FOR MANHOLE WITH OUTLET OF 18" & UNDER



TOP SLAB



SEE STORM SEWER NOTE

1-3 COURSES BRICK UNLESS OTHERWISE SPECIFIED

PLASTER COAT ENTIRE BLOCK STRUCTURE, INTERIOR AND EXTERIOR WITH 1/2" CEMENT MORTAR

CONC BLOCK OR PRECAST CONCRETE

3500 P.S.I. CONCRETE FLOW CHANNEL

3500 P.S.I. CONC BASE WITH 4x4-W4xW4 WELDED WIRE FABRIC

BEDDING UNDER STRUCTURE SHALL BE CRUSHED STONE

TYPICAL SECTION

TYPICAL MANHOLE/ CATCH BASIN "D"

N.T.S.

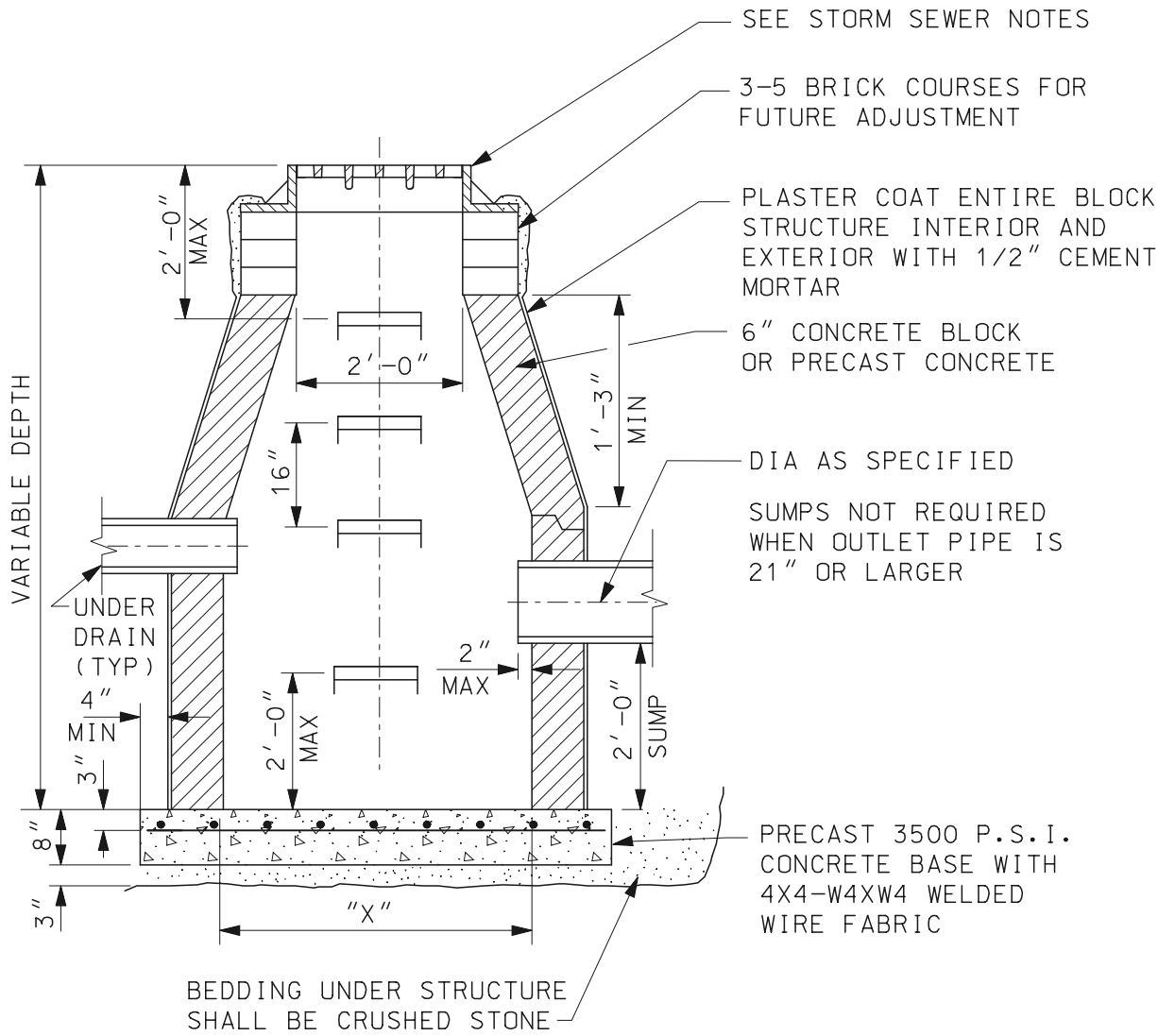
DATE	REVISION

WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. ST-4



DIAMETER OF OUTLET PIPE	"X" INSIDE DIA.
12"-18"	4'-0" MIN
21"-30"	5'-0" MIN

NOTE:
MINIMUM OF TWO-10' LONG 6"DIA. PERFORATED UNDERDRAIN PIPE WITH GEOTEXTILE MATERIAL WRAP TO BE INSTALLED WITH EACH CATCH BASIN SEE UNDERDRAIN DETAIL FOR INSTALLATION AND MATERIAL REQUIREMENTS.

STANDARD CATCH BASIN

N.T.S.

DATE	REVISION

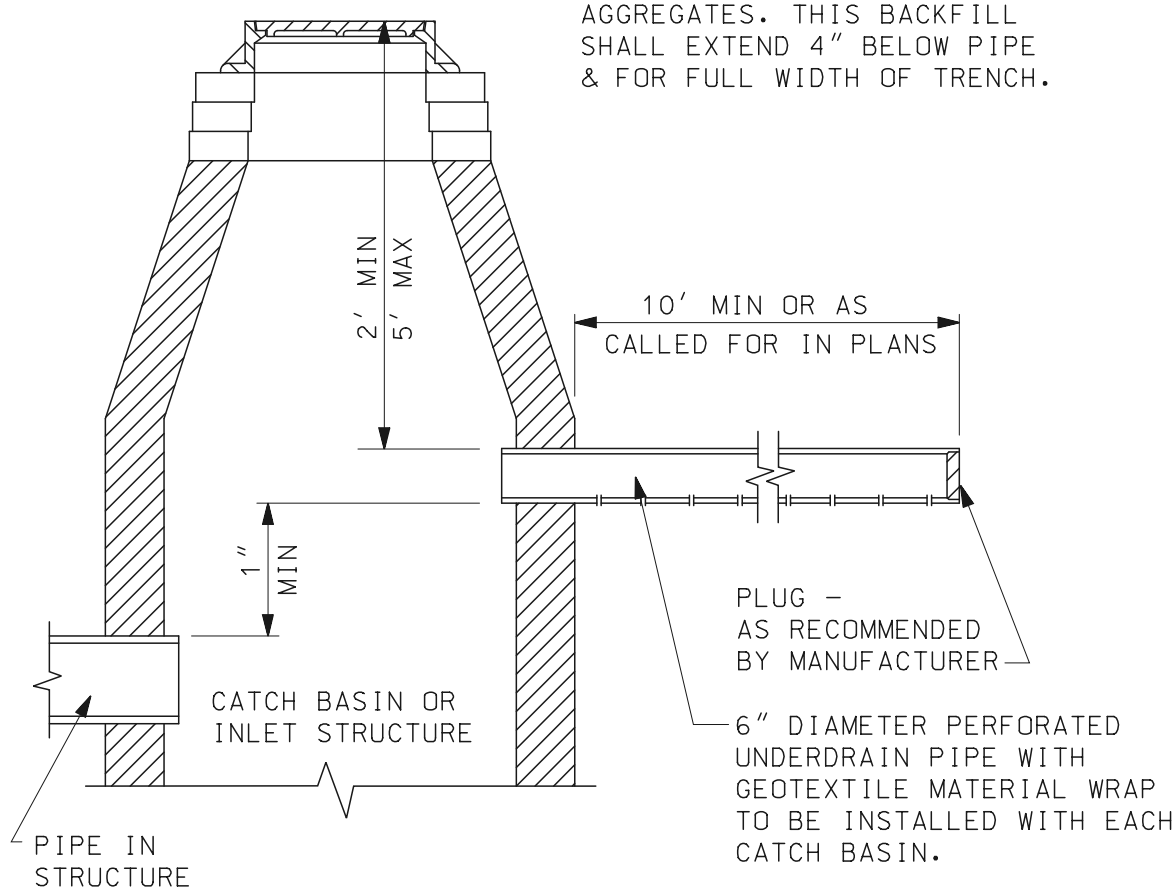
WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

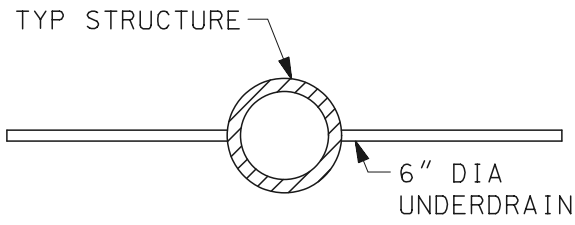
ORIGINAL ISSUE: 04-22-14

SHEET No. ST-5

BACKFILL SHALL MEET M.D.O.T. REQUIREMENTS FOR 34R OR 34G OPEN GRADED DRAINAGE COURSE AGGREGATES. THIS BACKFILL SHALL EXTEND 4" BELOW PIPE & FOR FULL WIDTH OF TRENCH.

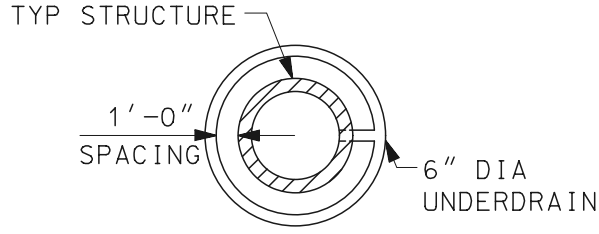


STANDARD UNDERDRAIN



TYPICAL UNDERDRAIN PARALLEL W/CURB

N.T.S.



TYPICAL UNDERDRAIN IN PARKING LOT

N.T.S.

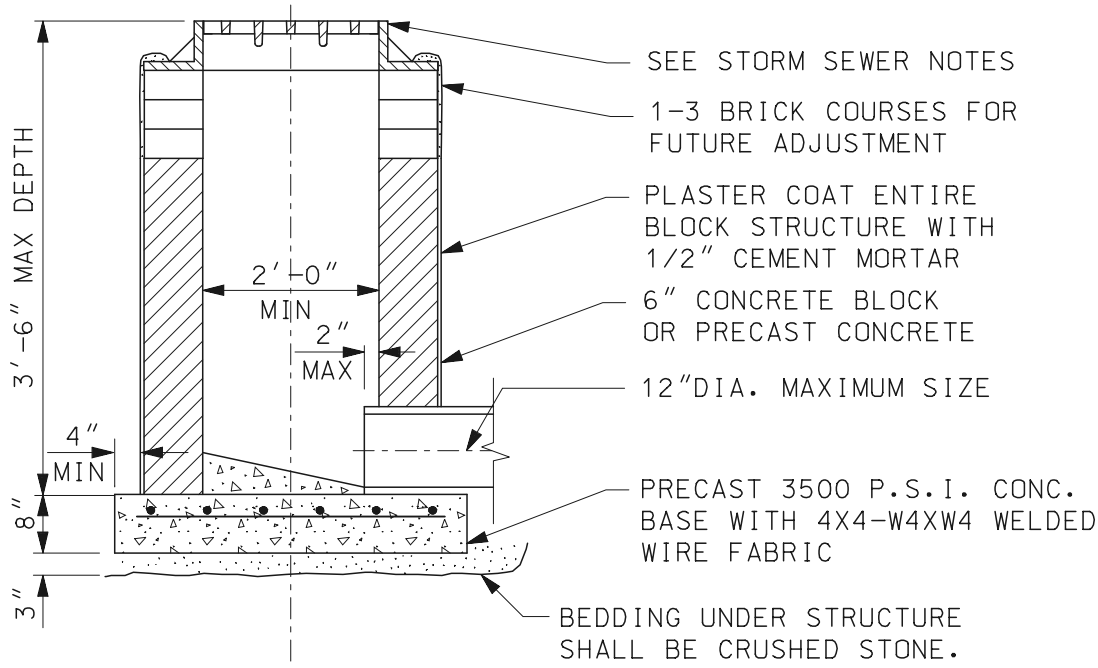
DATE	REVISION

WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: Ø4-22-14

SHEET No. ST-6



STANDARD INLET

N.T.S.

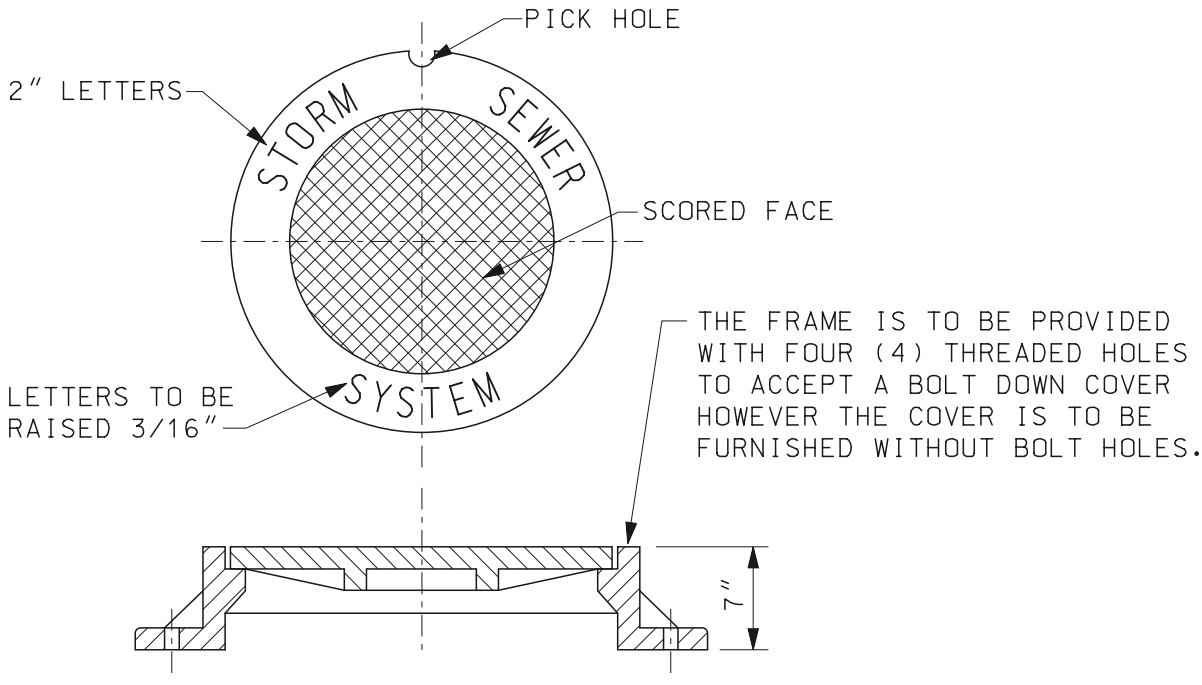
DATE	REVISION

WADETRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. ST-7



STANDARD MANHOLE FRAME AND COVER

N.T.S.

DATE	REVISION

WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. ST-8

STORM SEWER NOTES

1. ALL STORM SEWER CONSTRUCTION SHALL CONFORM TO THE CURRENT STANDARDS AND GENERAL SPECIFICATION OF THE AGENCY OR AGENCIES HAVING JURISDICTION OF THE STORM SEWER AND CONSTRUCTION AREA.

2. DETAILS ARE FOR STRUCTURES WITH NO MORE THAN TWO PIPES, 180° APART. LARGER DIAMETER STRUCTURES MAY BE REQUIRED FOR DIFFERENT CONFIGURATIONS.

3. ALL STRUCTURES REQUIRE A MINIMUM OF 8-INCHES OF WALL BETWEEN PIPE OPENINGS. LARGER DIAMETER STRUCTURES MAY BE REQUIRED WHERE PIPE ENTERING THE STRUCTURE ARE LESS THAN 90° APART IN ANY DIRECTION.

4. ALL CASTING RIMS SHALL BE SET TO GRADE OR AS SHOWN ON THE PLANS.

5. NO MANHOLES OR OTHER STRUCTURES MAY BE INSTALLED WITHIN DRIVEWAYS, DRIVE APPROACHES, OR SIDEWALKS.

6. ALL CATCH BASIN STORM PIPE SHALL BE 12-INCH DIAMETER C76, CL-IV CONCRETE UNLESS OTHERWISE NOTED.

7. MANHOLE STEPS TO BE GRAY IRON OR STEEL REINFORCED POLYPROPYLENE ASTM 2146, TYPE II, GRADE 49108.

8. CATCH BASIN AND INLET FRAME AND COVERS SHALL BE SPECIFIED AS FOLLOWS:

   A. WHEN LOCATED IN PAVEMENT GUTTER LINE, FRAME AND COVER SHALL BE E.J.I.W. NO. 5080, NEENAH R-3448-C TYPE "A" (RECTANGULAR), OR EQUIV.

   B. WHEN LOCATED IN PAVED AREAS OTHER THAN GUTTER LINE, FRAME SHALL BE E.J.I.W. NO. 1040 WITH TYPE "M1" COVER, NEENAH R-2370 TYPE "G" COVER, OR EQUIV.

   C. WHEN LOCATED IN YARD AREAS, FRAMES SHALL BE E.J.I.W. NO. 1000 WITH TYPE "N" OR "M" COVER, NEENAH R-2370 TYPE "D" OR "B" COVER, OR EQUIV.

9. MANHOLE FRAME AND COVER SHALL BE E.J.I.W. NO. 1040 OR NEENAH R-1642 WITH SOLID COVER OR EQUAL.

10. DIFFERENTIAL OF EXCAVATION AROUND EXISTING MANHOLES SHALL NOT EXCEED SIX FEET.

11. PLACE SAND BACKFILL WITHIN THREE FEET OF ALL STRUCTURES.

12. ALL STORM SEWER PIPE SHALL HAVE CLASS "R-B" BEDDING UNLESS OTHERWISE NOTED ON THE PLANS. SEE SHEET MD1 FOR BEDDING DETAILS.

13. ALL PRECAST PRODUCTS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-478.

14. ALL DRAINAGE STRUCTURES LOCATED WITHIN PAVEMENT MUST HAVE UNDER DRAIN AS SHOWN.

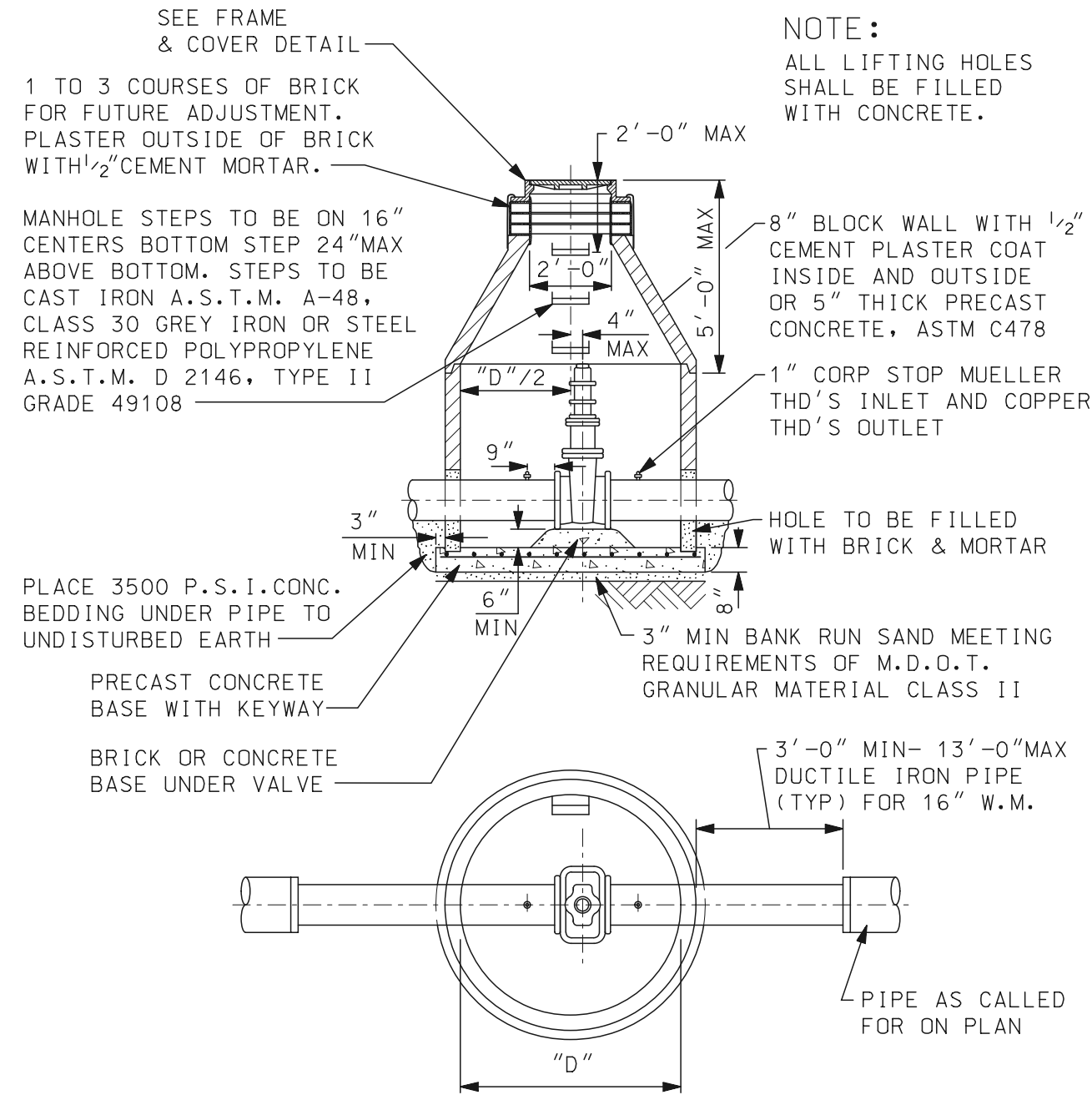
DATE	REVISION

WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. ST-9



NOTE:
ALL LIFTING HOLES
SHALL BE FILLED
WITH CONCRETE.

PRECAST CONCRETE WELL SECTIONS
SHALL BE MANUFACTURED IN
ACCORDANCE WITH A.S.T.M. C478
UNLESS OTHERWISE SPECIFIED

"D"= 6'-0" FOR 8"-12" W.M.
"D"= 7'-0" FOR 16" W.M.

STANDARD GATE WELL

N.T.S.

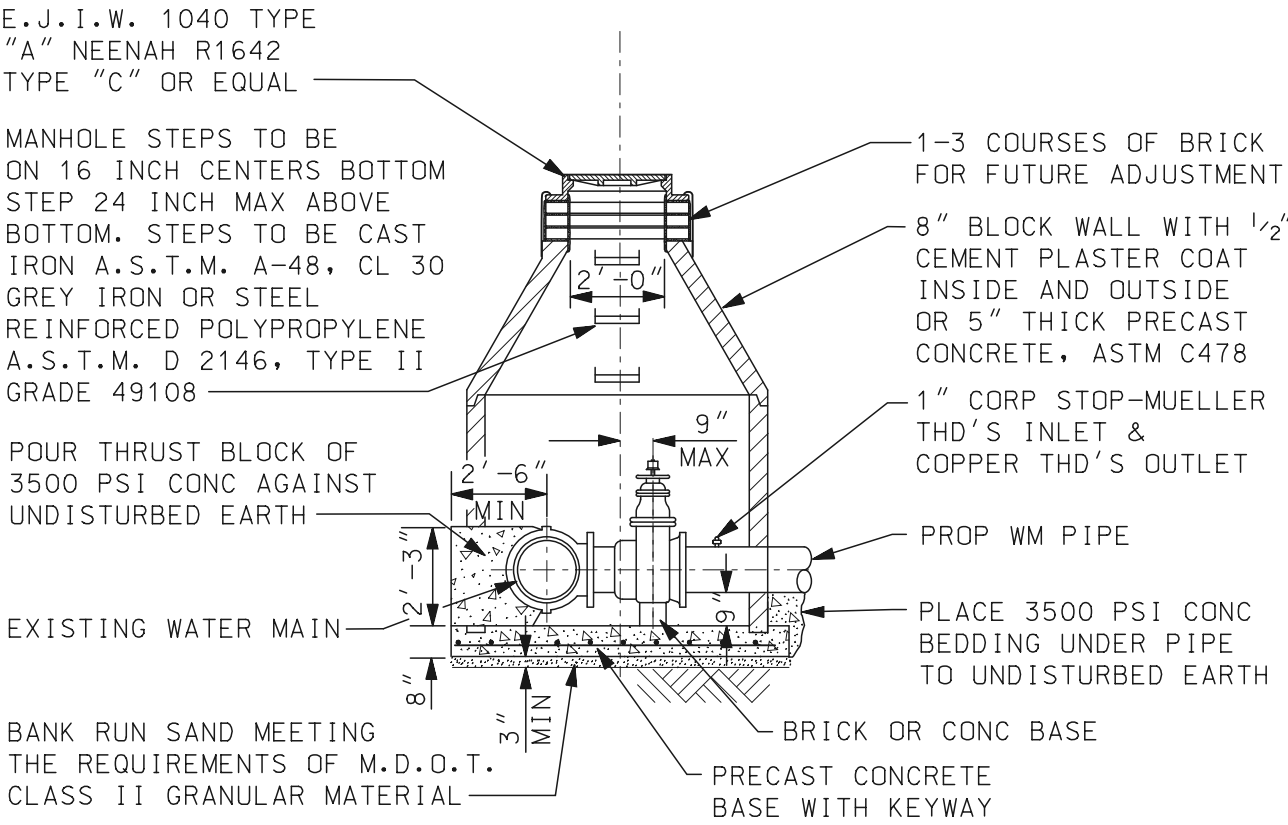
DATE	REVISION

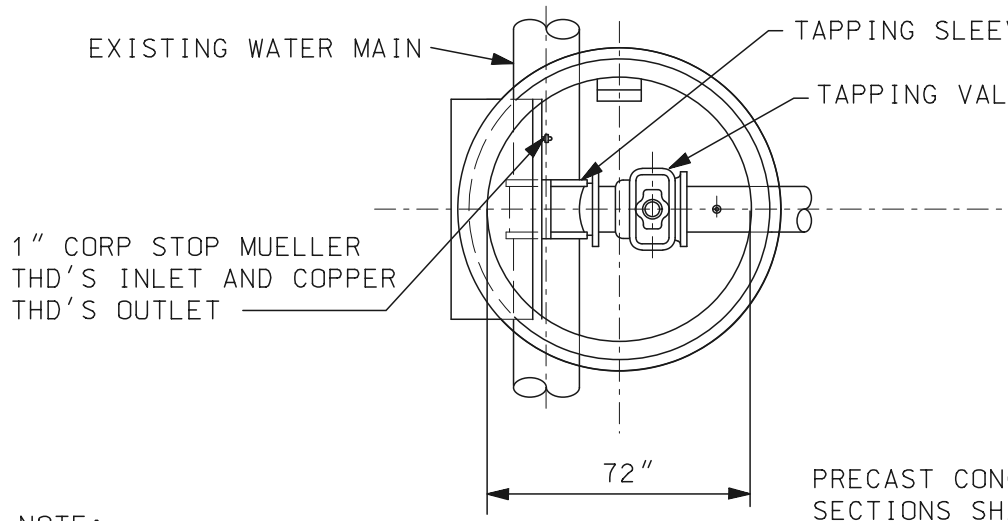
WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. WM-1





NOTE:
ALL LIFT HOLES SHALL BE FILLED WITH CONCRETE

PRECAST CONCRETE WELL SECTIONS SHALL BE MANUFACTURED IN ACCORDANCE WITH ASTM C478 UNLESS OTHERWISE SPECIFIED.

STANDARD TAPPING SLEEVE, VALVE & WELL

N.T.S.

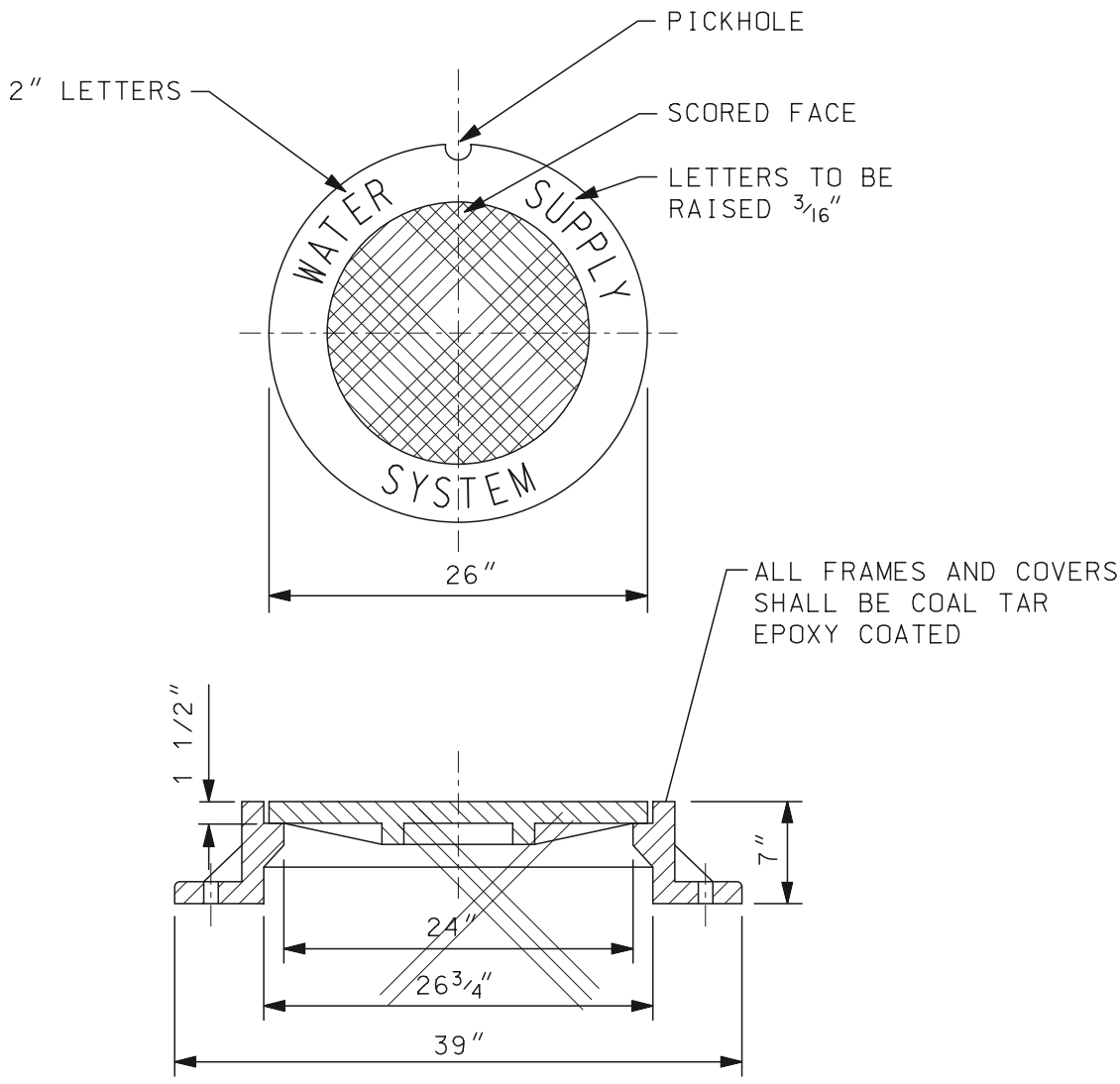
DATE	REVISION

WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: Ø4-22-14

SHEET No. WM-2



E.J.I.W. #1040, TYPE "A"
NEENAH #R1642, TYPE "C"
OR EQUAL

STANDARD FRAME AND COVER

N.T.S.

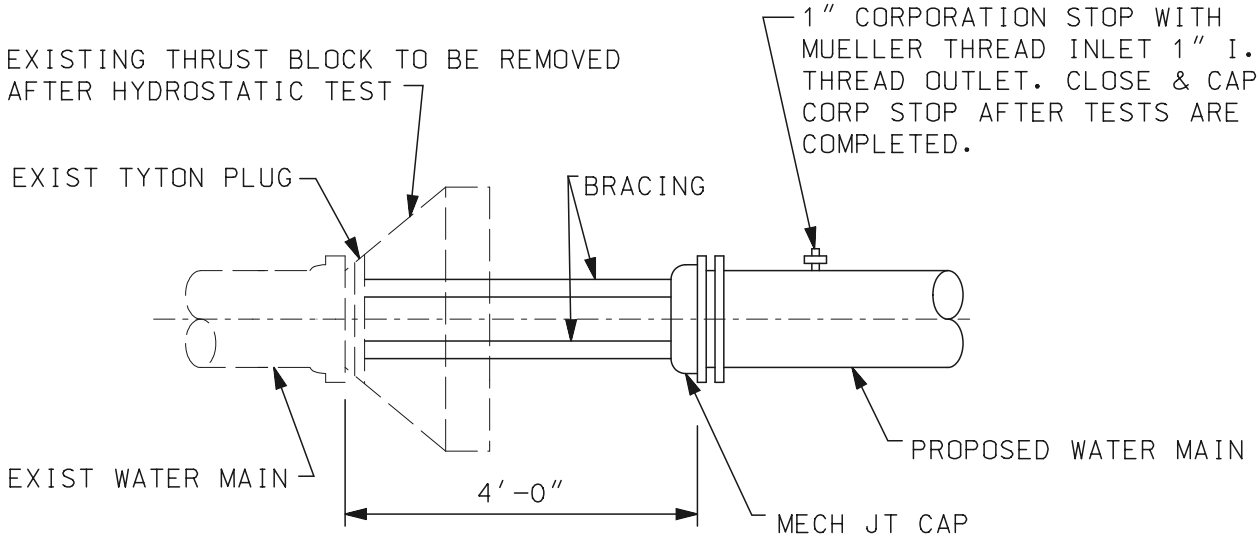
DATE	REVISION

WADE TRIM

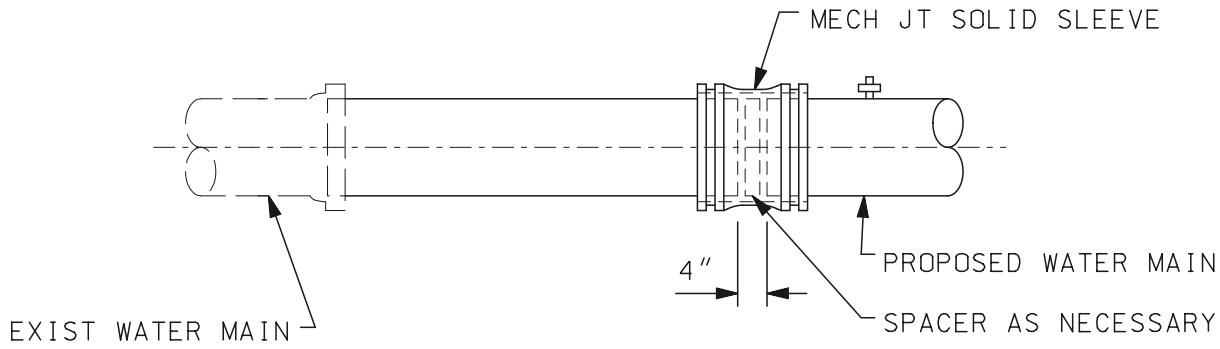
CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: Ø4-22-14

SHEET No. WM-3



TEMPORARY ARRANGEMENT FOR HYDROSTATIC TEST



NOTE:
ALL JOINTS NOT SUBJECTED TO HYDROSTATIC TEST SHALL BE OBSERVED UNDER LINE PRESSURE TO ASSURE WATER TIGHTNESS.

COMPLETED CONNECTION TO EXIST WATER MAIN

N.T.S.

DATE	REVISION

WADE TRIM

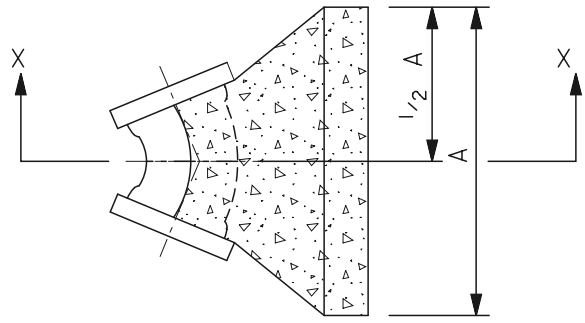
CHARTER TOWNSHIP OF VAN BUREN

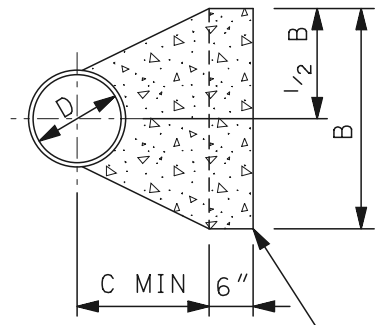
ORIGINAL ISSUE: Ø4-22-14

SHEET No. WM-4

DIA OF WATER MAIN	THRUST BLOCK		
D	A	B	C
6"	2'-0"	1'-6"	1'-0"
8"	2'-0"	2'-0"	1'-3"
10" & 12"	3'-6"	2'-6"	1'-6"
14" & 16"	5'-6"	3'-0"	1'-9"
18" & 20"	6'-6"	4'-0"	1'-9"
24"	7'-0"	5'-0"	2'-0"

NOTE:
WHEN "A" DIMENSION IS 6'-0" OR GREATER, USE #4 BARS AT 12" CENTERS EACH WAY.



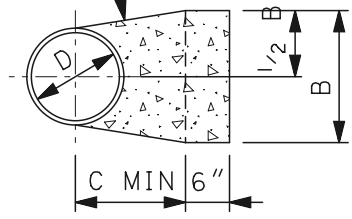


THRUST BLOCK AT 30° & 45° BEND

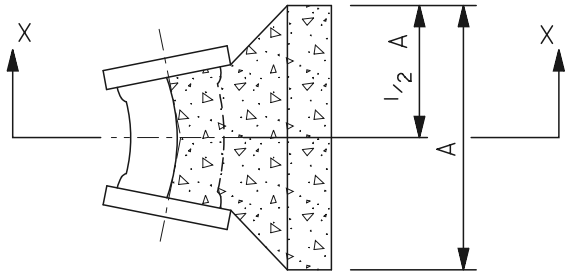
SEC X-X

3500 P.S.I. CONC POURED AGAINST UNDISTURBED EARTH

DIA OF WATER MAIN	THRUST BLOCK		
D	A	B	C
6"	1'-6"	1'-0"	1'-0"
8"	1'-9"	1'-3"	1'-0"
10" & 12"	3'-0"	1'-6"	1'-3"
14" & 16"	4'-0"	2'-0"	1'-6"
18" & 20"	4'-0"	3'-0"	1'-9"
24"	4'-0"	4'-6"	2'-0"



SEC X-X



THRUST BLOCK AT 22 1/2° BEND

N.T.S.

DATE	REVISION

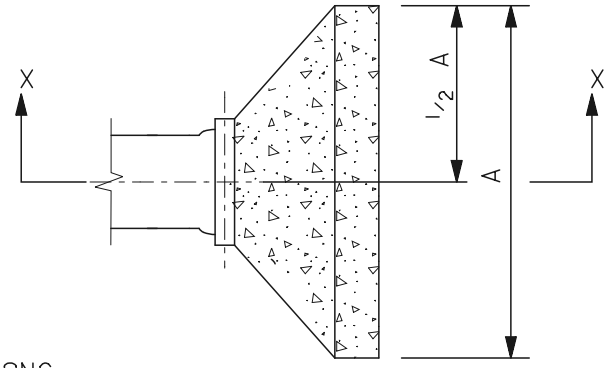
WADE TRIM

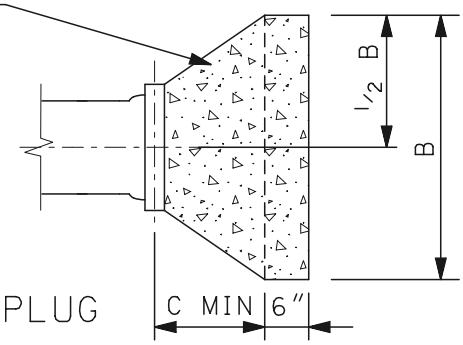
CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. WM-5

DIA OF WATER MAIN	THRUST BLOCK		
D	A	B	C
6″	2′-0″	1′-6″	9″
8″	2′-6″	2′-0″	1′-0″
10″ & 12″	4′-0″	3′-0″	1′-3″
14″ & 16″	5′-0″	4′-0″	1′-6″
18″ & 20″	8′-0″	4′-0″	1′-9″
24″	9′-0″	5′-0″	2′-0″

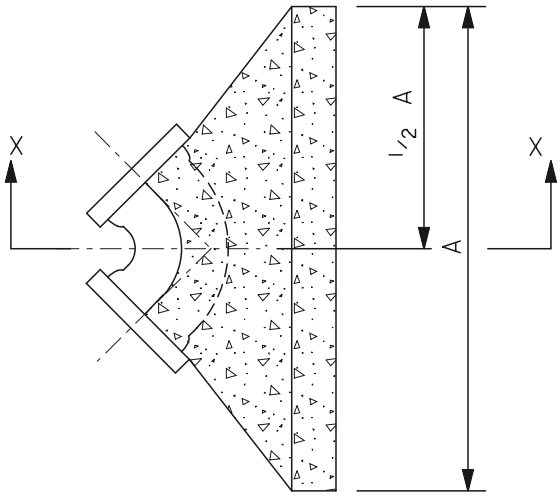




NOTE:
WHEN "A" DIMENSION IS 6′-0″ OR GREATER, USE #4 BARS AT 12″ CENTERS EACH WAY.

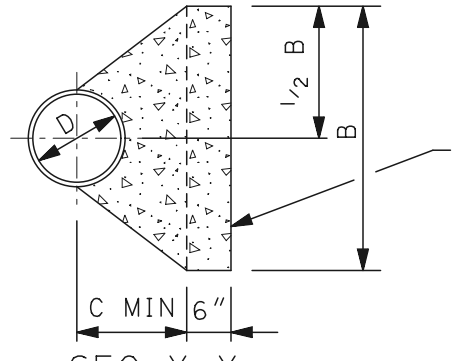
THRUST BLOCK AT PLUG

SEC X-X



DIA OF WATER MAIN	THRUST BLOCK		
D	A	B	C
6″	2′-9″	1′-6″	9″
8″	3′-0″	2′-6″	1′-0″
10″ & 12″	5′-6″	3′-0″	1′-3″
14″ & 16″	6′-0″	5′-0″	1′-6″
18″ & 20″	9′-0″	5′-0″	1′-9″
24″	11′-0″	6′-0″	2′-0″

NOTE:
WHEN "A" DIMENSION IS 6′-0″ OR GREATER, USE #4 BARS AT 12″ CENTERS EACH WAY.



SEC X-X

THRUST BLOCK AT 60° & 90° BEND

N.T.S.

DATE	REVISION

WADE TRIM

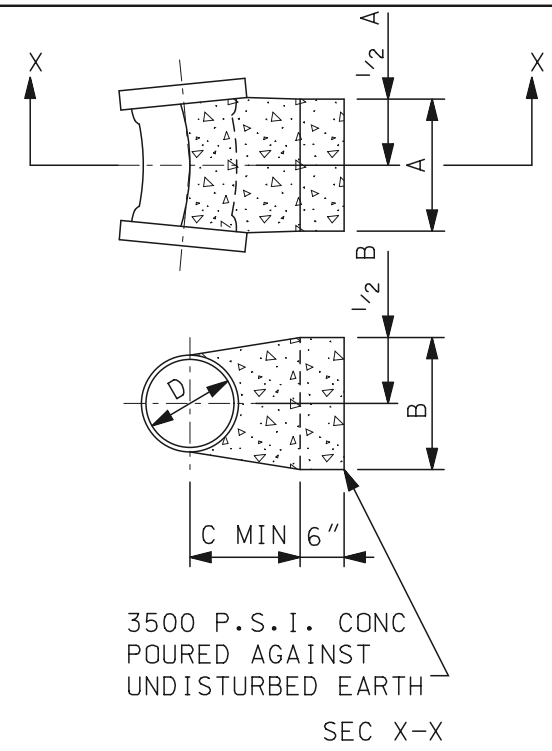
CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. WM-6

DIA OF WATER MAIN	THRUST BLOCK		
D	A	B	C
6″	1′-0″	1′-0″	1′-0″
8″	1′-3″	1′-3″	1′-0″
10″ & 12″	1′-6″	1′-6″	1′-3″
14″ & 16″	2′-0″	2′-0″	1′-6″
18″ & 20″	3′-1″	2′-0″	1′-9″
24″	3′-0″	3′-0″	2′-0″

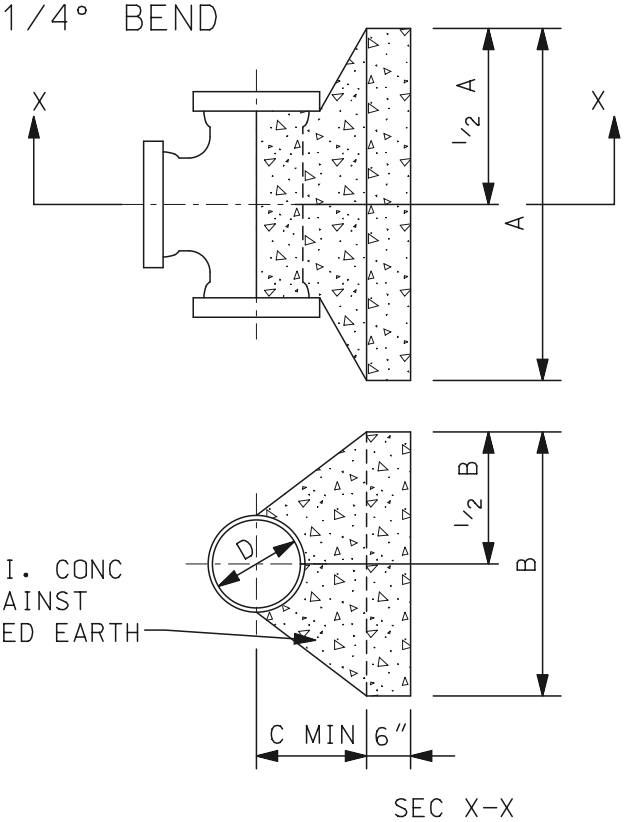
NOTE:
THESE TABLES ARE BASED ON SOIL BEARING OF 1500 P.S.F. IN MUCK, PEET OR OTHER UNSUITABLE SOILS HAVING A SOIL BEARING LESS THAN 1500 P.S.F., THE CONTRACTOR SHALL PROVIDE SUITABLE ADDITIONAL BLOCKING, ENCASEMENTS OR RESTRAINTS, BLOCKING IN BORE PIT EXCAVATIONS SHALL BE AGAINST UNDISTURBED SOIL OR SHALL BE PROVIDED WITH RESTRAINTS AS REQUIRED.



SEC X–X

THRUST BLOCK AT 11 1/4° BEND

DIA OF WATER MAIN	THRUST BLOCK		
D	A	B	C
6″	2′-0″	1′-6″	9″
8″	2′-6″	2′-0″	1′-0″
10″ & 12″	4′-0″	3′-0″	1′-3″
14″ & 16″	5′-0″	4′-0″	1′-6″
18″ & 20″	8′-0″	4′-0″	1′-9″
24″	9′-0″	5′-0″	2′-0″



SEC X–X

NOTE:
WHEN "A" DIMENSION IS 6′-0″ OR GREATER, USE #4 BARS AT 12″ CENTERS EACH WAY.

THRUST BLOCK AT TEE

N.T.S.

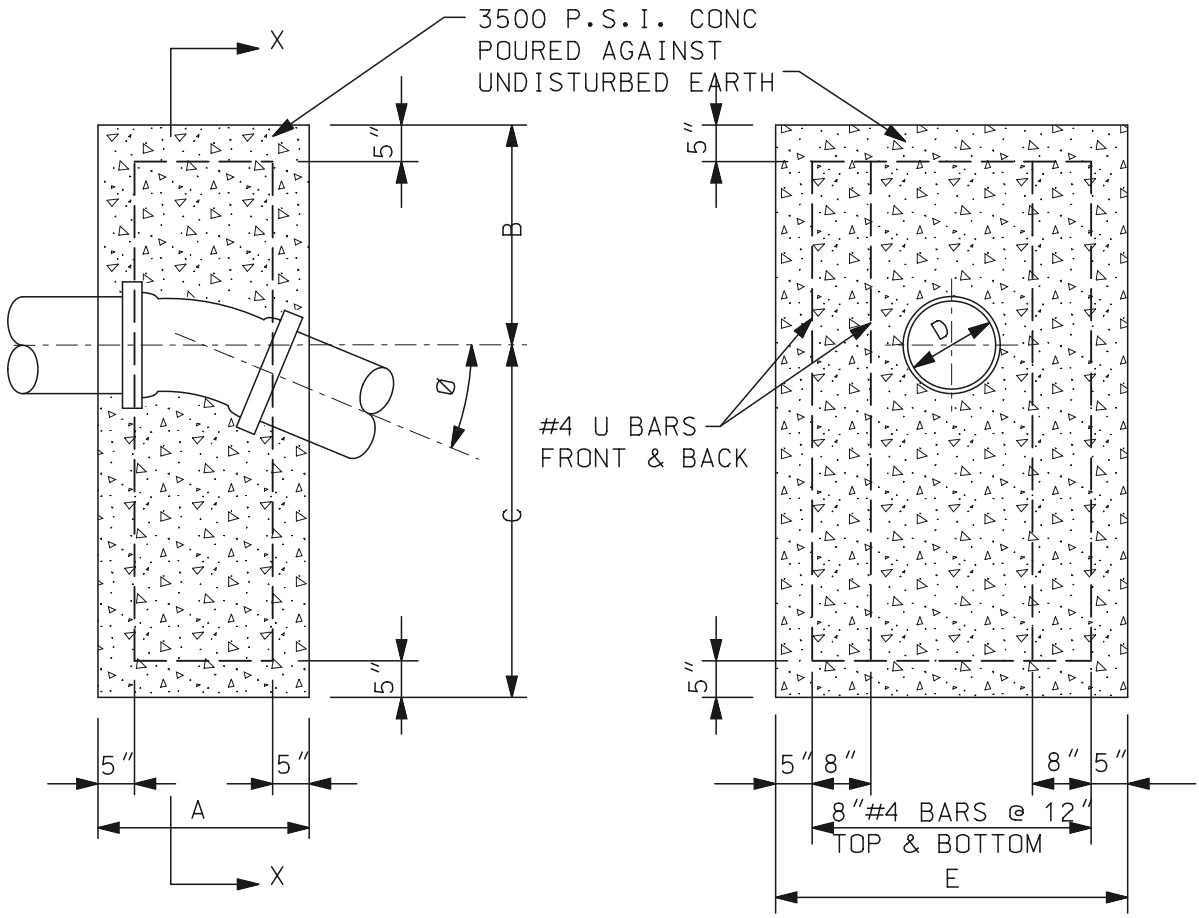
DATE	REVISION

WADETRIM

CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. WM-7



* CONTRACTOR SHALL SUBMIT DETAILS OF RESTRAINED JOINTS TO ENGINEER PRIOR TO USE.

D	Ø	A	B	C	E
6"	22 1/2°	1'-6"	1'-6"	1'-9"	3'-0"
	45°	1'-8"	1'-6"	2'-6"	4'-0"
8"	22 1/2°	2'-0"	1'-6"	2'-6"	4'-0"
	45°	2'-0"	2'-6"	3'-0"	4'-0"
10"	22 1/2°	2'-0"	2'-6"	3'-0"	4'-0"
	45°	2'-3"	2'-6"	4'-0"	5'-0"
12"	22 1/2°	2'-0"	2'-6"	4'-0"	4'-0"
	45°	2'-4"	3'-0"	4'-6"	5'-0"
16"	22 1/2°	2'-2"	3'-0"	4'-6"	5'-0"
	45°	*	*	*	*

ANCHORAGE DETAILS FOR VERTICAL BENDS

N.T.S.

DATE	REVISION

WADETRIM

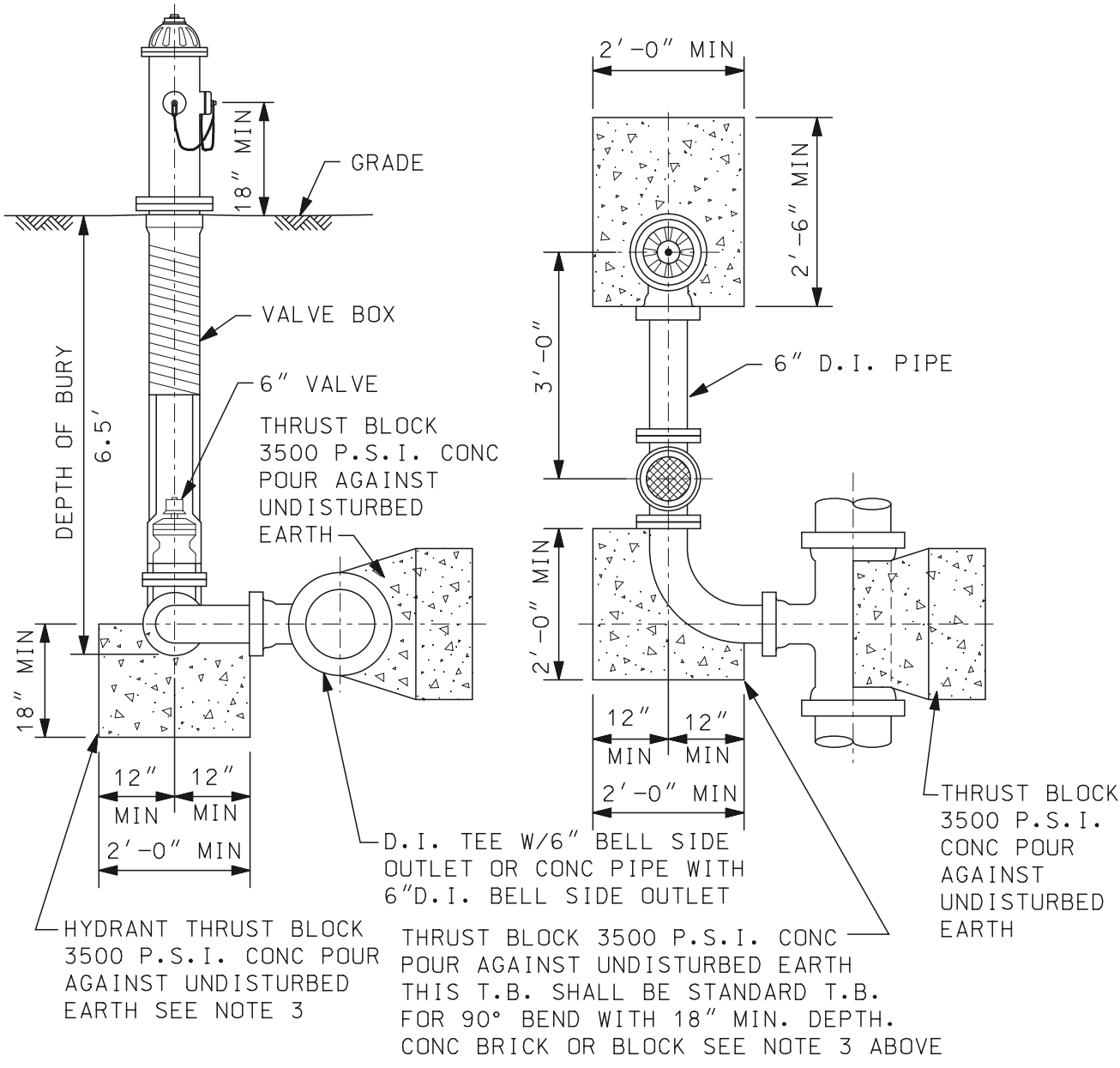
CHARTER TOWNSHIP OF VAN BUREN

ORIGINAL ISSUE: 04-22-14

SHEET No. WM-8

NOTES:

1. INSTALL ADDITIONAL FITTINGS & SPIGOT PIPE AS NECESSARY BETWEEN WATER MAIN & VALVE BOX TO ADJUST FOR PROPER LOCATION AND GRADE OF HYDRANT.
2. VERTICAL ANCHORAGES WILL BE REQUIRED ON ALL VERTICAL HYDRANT BENDS IN EXCESS OF 11 1/4°.
3. WHERE HYDRANTS ARE INSTALLED ON EXISTING MAINS THAT ARE TO BE PLACED BACK INTO SERVICE IMMEDIATELY, PLACE CONCRETE BRICK OR BLOCK TO UNDISTURBED EARTH AND ENCASE WITH CONCRETE OR USE RESTRAINING GLANDS.



STANDARD FIRE HYDRANT ASSEMBLY

CLOSE COUPLE TYPE

N.T.S.

DATE	REVISION

WADE TRIM

CHARTER TOWNSHIP OF VAN BUREN

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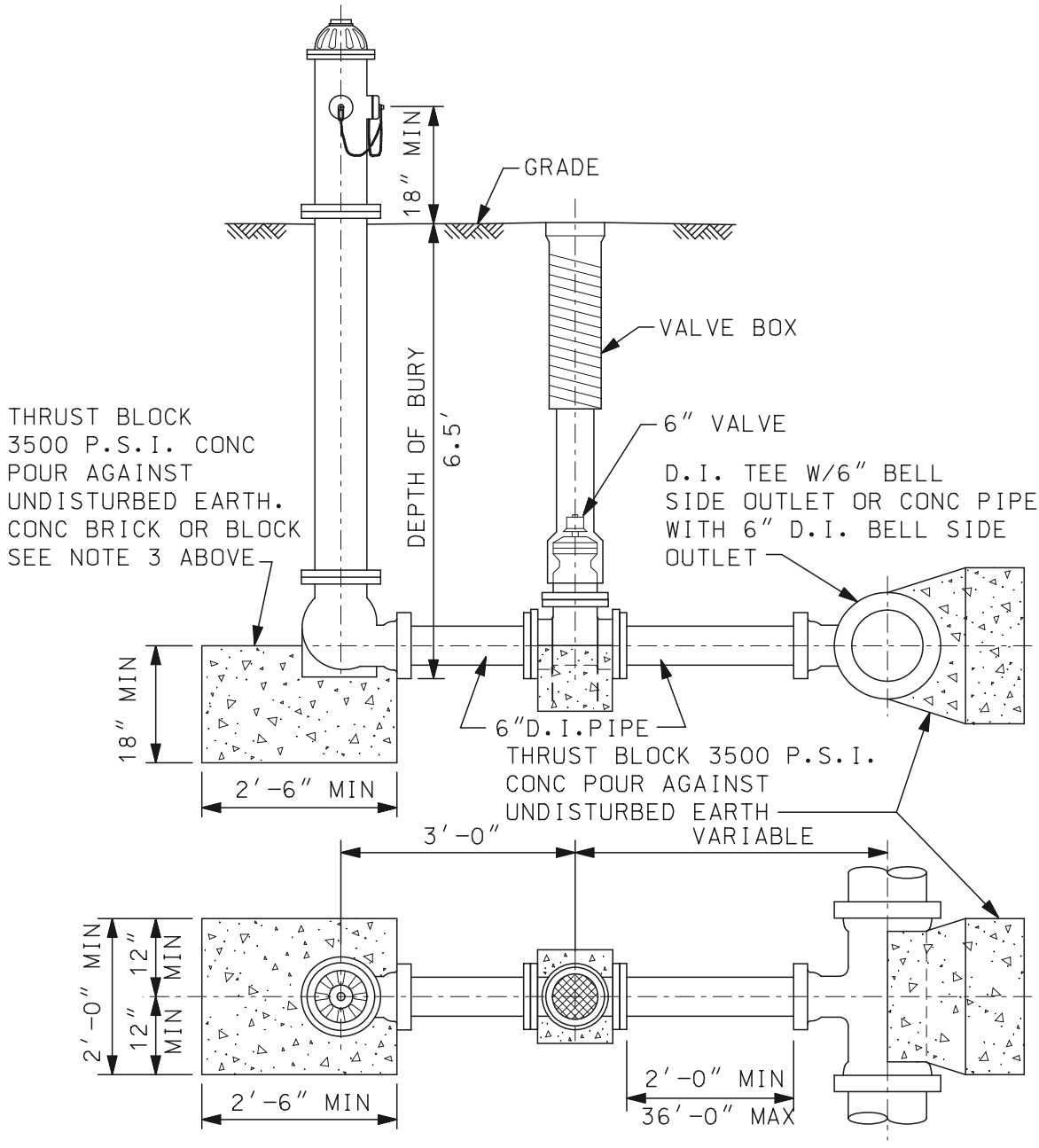
SHEET No. WM-9

NOTES:

1. INSTALL ADDITIONAL FITTINGS, BENDS & SPIGOT PIPE AS NECESSARY BETWEEN WATER MAIN & VALVE BOX TO ADJUST FOR PROPER LOCATION AND GRADE OF HYDRANT.
2. VERTICAL ANCHORAGES WILL BE REQUIRED ON ALL VERTICAL HYDRANT BENDS IN EXCESS OF 11 1/4°.
3. WHERE HYDRANTS ARE INSTALLED ON EXISTING MAINS THAT ARE TO BE PLACED BACK INTO SERVICE IMMEDIATELY, PLACE CONCRETE BRICK OR BLOCK TO UNDISTURBED EARTH AND ENCASE WITH CONCRETE OR USE RESTRAINING GLANDS.



STANDARD FIRE HYDRANT ASSEMBLY "T" TYPE

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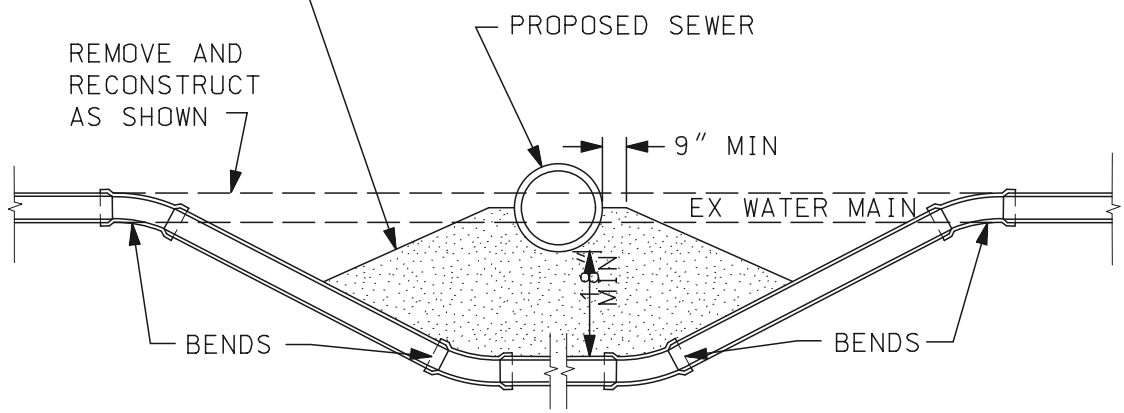
COMPACTED SAND OR FLOWABLE FILL SHALL EXTEND FOR 9" EACH SIDE OF PROPOSED PIPE AND SHALL SLOPE OUT AT 1 ON 4 SLOPE TO BOTTOM OF TRENCH, OR AS DIRECTED BY ENGINEER

NOTE:
FOR ANCHORAGE DETAILS AT BENDS SEE WATER DETAIL SHT-WM 2



NOTE:
FOR BEDDING OF WATER MAIN SEE STANDARD SAND ENCASEMENT CLASS "F-III" THIS SHT.

RELOCATION OF WATER MAIN

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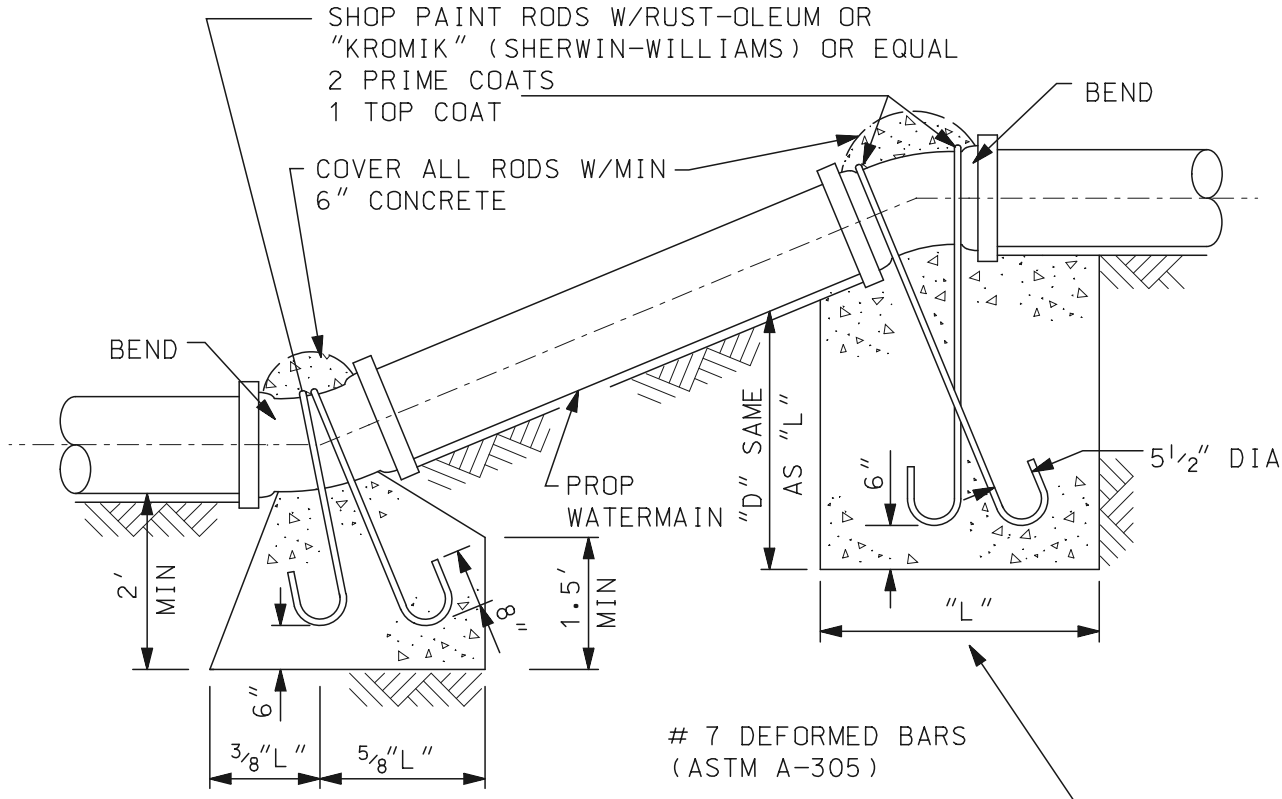

BLOCK WIDTH TO BE 1.5'
OUTSIDE EDGES OF
DISTURBED EARTH
(TUNNEL INTO TRENCH
SIDES) MIN 6.0' WIDE

6" & 8"	"L" = 2.5'
10"	"L" = 3.0'
12"	"L" = 3.0'
14"	"L" = 4.5'
16"	"L" = 5.5'
18"	"L" = 5.5'
20"	"L" = 6.5'
24"	"L" = 7.5'

NOTE:
4' MIN COVER ON ALL DITCH CROSSINGS,
BENDS IF REQUIRED TO BE PLACED PER VERTICAL
CONCRETE TO BE 3500 P.S.I.

VERTICAL REACTION BLOCKING

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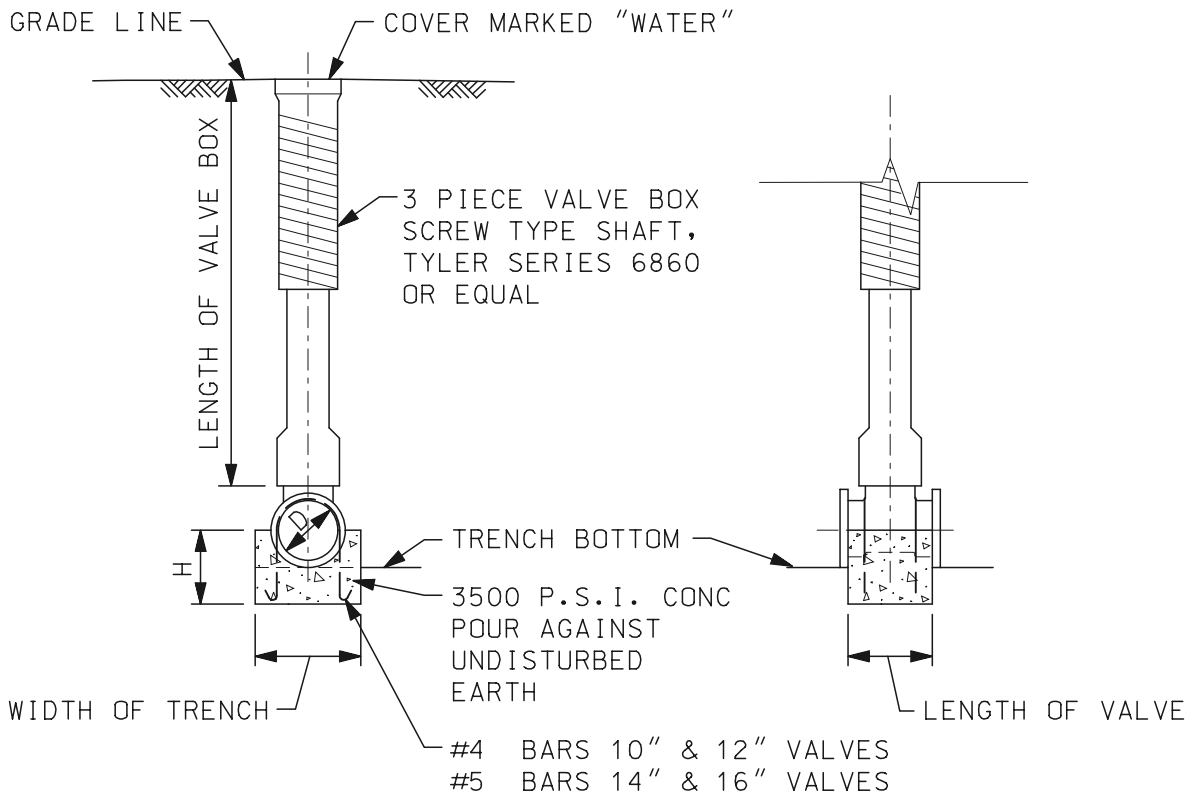

SIZE OF PIPE	H
6"	6"
8"	8"
10"	10"
12"	12"

VALVE BLOCK AND BOX DETAIL

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WATER MAIN NOTES

1. ALL WATER SYSTEM CONSTRUCTION SHALL CONFORM TO THE CURRENT STANDARDS AND GENERAL SPECIFICATION OF THE AGENCY OR AGENCIES HAVING JURISDICTION OF THE WATER SUPPLY SYSTEM AND CONSTRUCTION AREA.

2. WATER MAINS SHALL NOT BE CONSTRUCTED UNDER SIDEWALKS OR ROAD PAVEMENT AREAS.

3. ALL SURFACE STRUCTURES, SUCH AS HYDRANTS, GATE WELLS AND VALVE BOXES SHALL BE SET TO GRADE OR AS INDICATED ON THE PLANS.

4. FIRE HYDRANTS ARE TO BE INSTALLED PLUMB AND HAVE THEIR NOZZLES AS DETERMINED BY THE ENGINEER.

5. ALL FITTINGS SHALL BE DUCTILE IRON, PRESSURE RATING 350 P.S.I., CONFORMING TO ANSI/AWWA C 153/A21.53 COMPACT FITTINGS WITH DOUBLE THICKNESS CEMENT MORTAR LINING AND COAL TAR ENAMEL COATING INSIDE AND OUTSIDE.

6. GATE WELLS AND OTHER WATER MAIN STRUCTURES SHALL NOT BE CONSTRUCTED IN DRIVEWAYS, DRIVE APPROACHES, OR SIDEWALKS.

7. PROVIDE 7-FOOT MINIMUM COVER BELOW EXISTING PAVEMENT CENTERLINE OR GROUND AT WATER MAIN LOCATION, WHICHEVER IS LOWEST, WHEN PROPOSED WATER MAIN IS WITHIN 32 FEET OF CENTERLINE ON SECTION LINE ROADS, OR WITHIN 19 FEET OF CENTERLINE ON 1/4 LINE ROADS. SEVEN FEET COVER SHALL ALSO BE REQUIRED AT OTHER LOCATIONS AS NOTED ON THE PLAN. PROVIDE 6-FOOT MINIMUM COVER BELOW EXISTING ROAD CENTERLINE OR GROUND AT WATER MAIN LOCATION, WHICHEVER IS LOWEST, AT ALL OTHER LOCATIONS UNLESS OTHERWISE NOTED.

8. PLACE NATURAL BANK RUN SAND BACKFILL WITHIN THREE FEET OF ALL STRUCTURES, INCLUDING VALVE WELLS, FIRE HYDRANTS, ETC.

9. ALL WATER MAIN PIPE SHALL HAVE CLASS III BEDDING UNLESS OTHERWISE NOTED ON THE PLANS. SEE SHEET MD-1.

10. ALL PRECAST PRODUCTS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-478.

11. CONTRACTOR SHALL BAG ALL NEW FIRE HYDRANTS UNTIL THE WATER MAIN IS ACCEPTED FOR SERVICE.

12. WHEN THE FIRE HYDRANT IS BEING INSTALLED. THE 6-INCH DIAMETER FIRE HYDRANT VALVE SHALL BE INSTALLED IN THE FULL OPEN POSITION.

13. WATER MAIN TO BE PLACED LEVEL THROUGH ALL GATE WELLS.

14. ALL WATER SYSTEM BOLTS ARE TO BE COR-BLUE, MASTIC COATED, OR SPRAY PAINTED WITH UNDER COATING.

15. A FIRE HYDRANT SHOULD BE PLACED AT THE END OF ALL DEAD END WATER MAIN.

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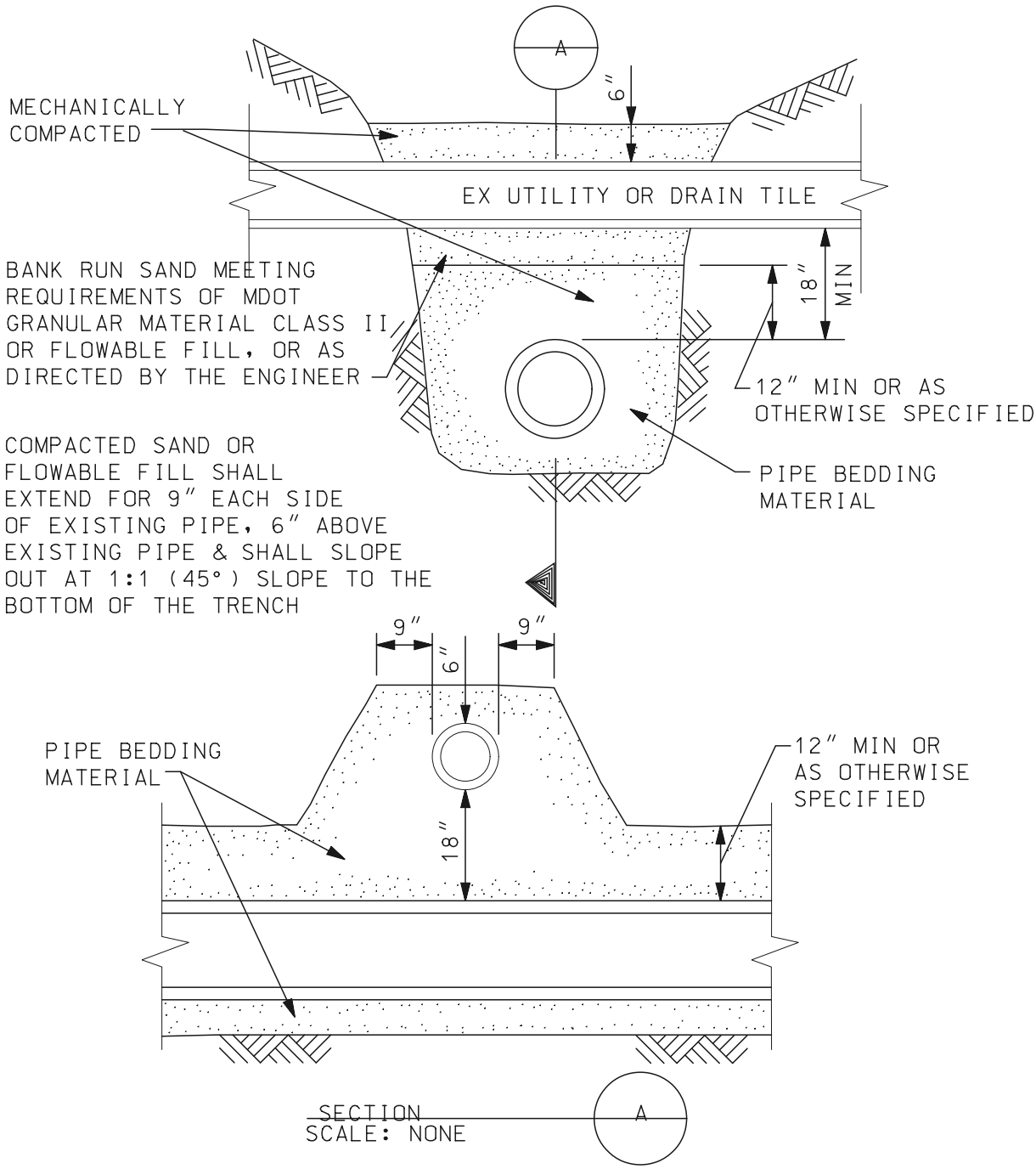
NOTE:
WHERE CONCRETE ENCASEMENT IS SPECIFIED FOR NEW UTILITY A 6" MINIMUM LAYER OF MECHANICALLY COMPACTED SAND SHALL BE MAINTAINED BETWEEN EXISTING UTILITY & TOP OF CONCRETE ENCASEMENT.



STANDARD PIPE SUPPORT

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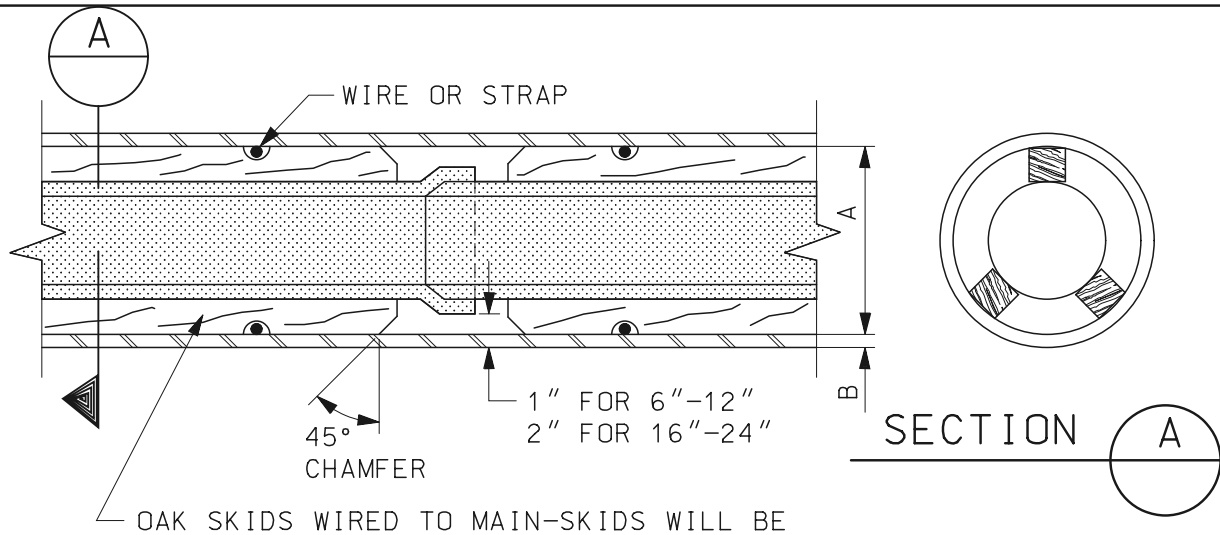

OAK SKIDS WIRED TO MAIN-SKIDS WILL BE NOTCHED TO PREVENT WIRE FROM RIDING AGAINST CASING PIPE.

DIA OF SEWER	DIA OF MAIN	MIN "A"	ROAD CROSSING MIN "B"	RAILROAD CROSSING MIN "B"
	6"	16"	.375	.375
	8"	16"	.375	.375
	12"	20"	.375	.438
10"	16"	24"	.375	.500
12" & 15"	20"	30"	.375	.500
18"	24"	36"	.375	.500

CASING PIPE SHALL BE WELDED STEEL PIPE A.S.T.M. A-252, GR 2 UNLESS OTHERWISE SPECIFIED.

NOTES:

1. NO WATER SHALL BE USED IN BORING UNDER RAILROADS.

2. MAINTAIN MINIMUM OF 5'-6" OF COVER BETWEEN BASE OF RAIL AND TOP OF CASING.

3. THE ENDS OF THE CASING SHALL BE SUITABLY PROTECTED AGAINST THE ENTRANCE OF FOREIGN MATERIAL, BUT SHALL NOT BE TIGHTLY SEALED.

4. WHEN BORING ALL VOIDS OUTSIDE OF CASING PIPE SHALL BE FILLED BY MEANS OF PRESSURE GROUTING WITH 1:3 CEMENT-SAND MORTAR. THIS WORK MUST BE ACCOMPLISHED WITHIN 24 HOURS AFTER THE CROSSING HAS BEEN COMPLETED. BORING SHALL EXTEND A MINIMUN OF 10 FEET OUTSIDE THE EDGES OF THE PAVEMENT.

5. SKIDS ARE TO BE MINIMUM OF 80% OF PIPE LENGTH.

6. CASING SPACERS AS ALLOWED BY THE ENGINEER.

STANDARD CASING SECTON

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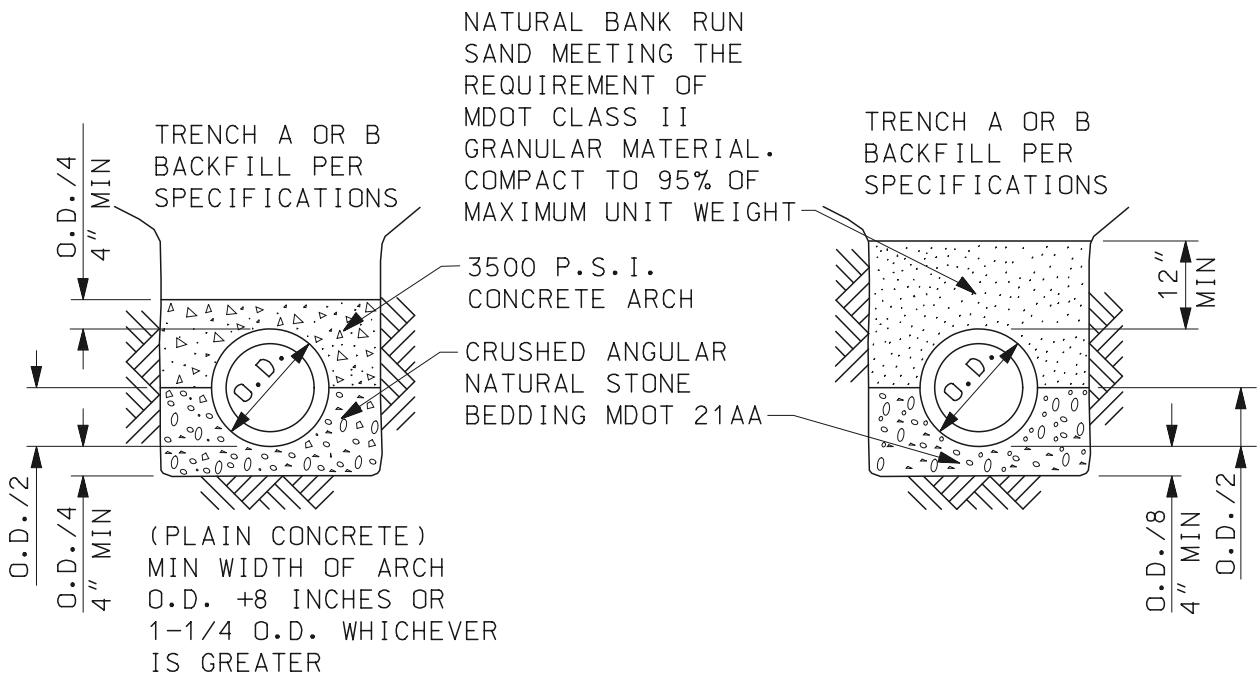

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CLASS "R-A"

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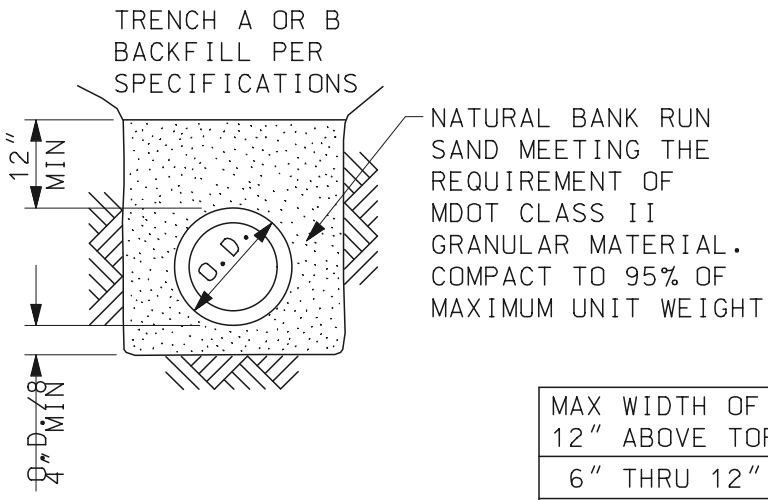
CLASS "R-B"



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CLASS "R-C"

MAX WIDTH OF TRENCH AT 12" ABOVE TOP OF PIPE
6" THRU 12" PIPE - 30" WIDE
15" THRU 36" PIPE - O.D. +16"
42" THRU 60" PIPE - O.D. +20"
OVER 60" PIPE - OUTSIDE DIAMETER OF PIPE +24"
MIN WIDTH OF TRENCH 12" ABOVE THE TOP OF PIPE SHALL BE 6" ON EACH SIDE OF PIPE

RIGID PIPE BEDDING DETAILS

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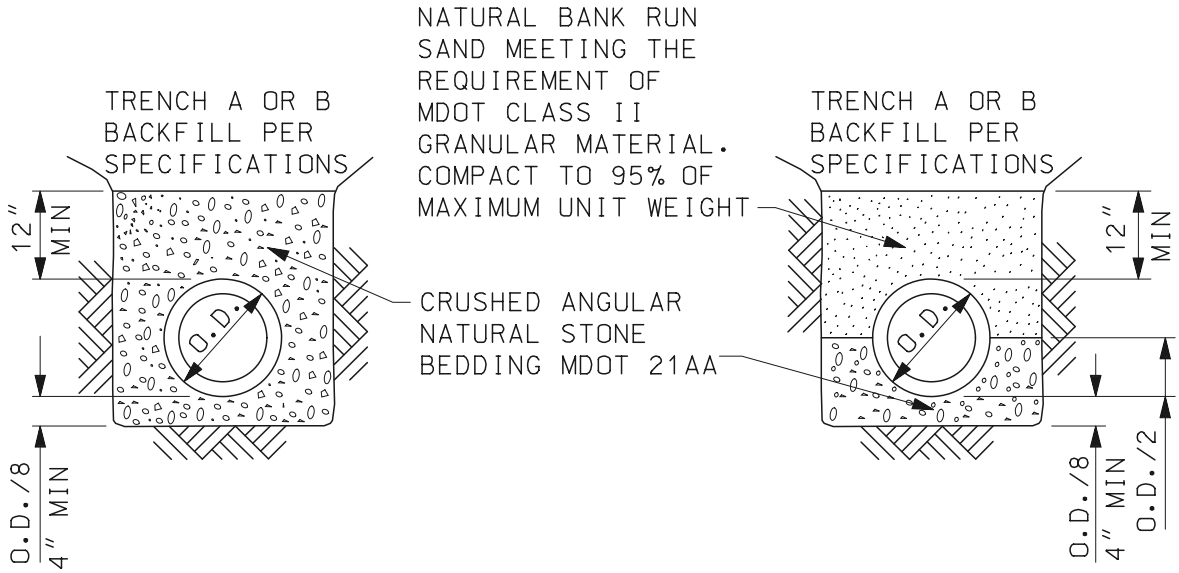

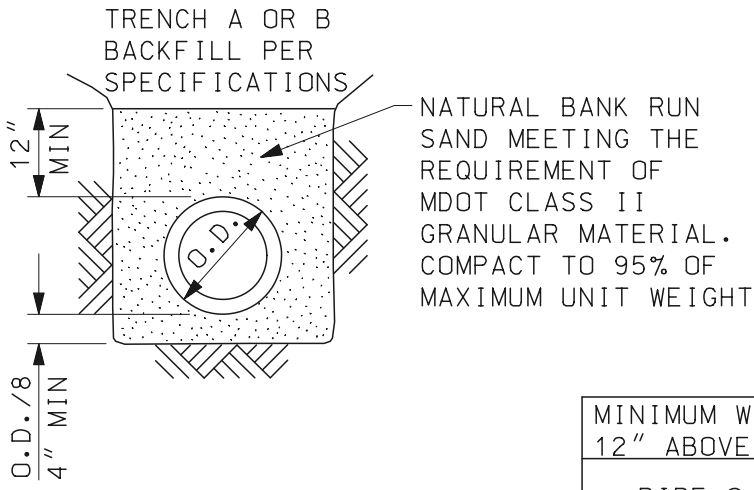

MINIMUM WIDTH OF TRENCH AT 12" ABOVE TOP OF PIPE	
PIPE O.D.	MINIMUM TRENCH WIDTH
UP TO 16"	O.D. + 16"
GREATER THAN 16"	O.D. x 1.25 PLUS 12"

FLEXIBLE PIPE BEDDING DETAILS

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GENERAL NOTES

1. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL ATTEND A PRECONSTRUCTION MEETING, AT A TIME AND PLACE AS ARRANGED BY THE COMMUNITY, IN WHICH VARIOUS UTILITY COMPANIES AND GOVERNMENTAL AGENCY REPRESENTATIVES WILL BE PRESENT.

2. PRIOR TO CONSTRUCTION, THE CONTRACTOR MUST HAVE IN HIS POSSESSION A COPY OF ALL PERMITS NECESSARY TO CONSTRUCT A CONNECTION TO, OR AN EXTENSION OF, THE WATER SUPPLY, SANITARY SEWER, OR STORM SEWER SYSTEMS.

3. THE CONTRACTOR SHALL MAINTAIN HIS CONSTRUCTION OPERATIONS WITHIN THE PRESENTLY EXISTING ROAD RIGHTS-OF-WAY AND EASEMENTS AS NOTED ON THE PLANS THROUGHOUT THE PROJECT. IN THE EVENT THAT THE CONTRACTOR DEEMS IT NECESSARY OR ADVISABLE TO OPERATE BEYOND THE LIMITS OF THE EXISTING RIGHTS-OF-WAY OR EASEMENTS, HE SHALL BE RESPONSIBLE FOR MAKING SPECIAL WRITTEN AGREEMENTS WITH THE PROPERTY OWNERS AND SHALL FURNISH SUCH COPIES OF AGREEMENTS TO THE COMMUNITY AND ENGINEER.

4. THE CONTRACTOR SHALL NOTIFY "MISS DIG" (800-482-7171) 3 DAYS (NOT INCLUDING HOLDAYS OR WEEKENDS) BEFORE STARTING CONSTRUCTION. HE SHALL MAKE ANY NECESSARY ARRANGEMENTS WITH UTILITY COMPANIES FOR RELOCATION OF EXISTING UTILITIES. THESE ARRANGEMENTS SHALL BE MADE IN SUFFICIENT TIME TO ALLOW THE RELOCATION WORK TO BE COMPLETED WITHOUT INTERFERING WITH OR DELAYING THE SEWER CONSTRUCTION.

5. THE CONTRACTOR SHALL NOTIFY ALL UTILITY COMPANIES AND THE ENGINEER 48 HOURS PRIOR TO UNCOVERING ANY EXISTING UTILITIES.

6. ON ALL WORK WITHIN THE WAYNE COUNTY RIGHT-OF-WAY, THE COMMUNITY 72 HOURS PRIOR TO THE START OF ANY CONSTRUCTION.

7. THE CONTRACTOR SHALL MAINTAIN ALL TRAFFIC AT ALL TIMES AS PER THE MICHIGAN MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.

8. THE CONTRACTOR SHALL AT ALL TIMES PROVIDE EMERGENCY ACCESS TO PROPERTY IN THE VICINITY OF THE CONSTRUCTION FOR POLICE AND FIRE EQUIPMENT, AMBULANCES OR OTHER EMERGENCY VEHICLES TO PROTECT LIFE, HEALTH AND PROPERTY.

9. THE CONTRACTOR SHALL MAINTAIN PUBLIC ROADS AFFECTED BY THE CONSTRUCTION OPERATIONS IN A PASSABLE CONDITION UNTIL SUCH TIME AS FINAL RESTORATION OF THESE IMPROVEMENTS CAN BE MADE. IF THE PUBLIC SAFETY IS IN DANGER OR THE NECESSITY EXISTS FOR MAINTAINING TRAFFIC, BACKFILLING MUST BE COMPLETED IMMEDIATELY. IN THE EVENT THAT THE NECESSARY BACKFILL MATERIAL AND EQUIPMENT ARE NOT AVAILABLE WHEN DIRECTION IS GIVEN FOR IMMEDIATE BACKFILL, THE TRENCH SHALL BE BACKFILLED WITH NATIVE MATERIAL TO PROVIDE FOR THE NECESSARY MAINTENANCE OF TRAFFIC AND SAFETY; HOWEVER,
   THE NATIVE MATERIAL SHALL BE REMOVED WITHIN 48 HOURS AND THE TRENCH PROPERLY BACKFILLED.

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GENERAL NOTES CONTINUED

10. NO STREET, ROAD OR SECTION THEREOF SHALL BE CLOSED TO THROUGH TRAFFIC UNLESS AUTHORIZED BY THE AGENCY WITH JURISDICTION OVER THE ROADS. PRIOR TO CLOSING A STREET, ROAD, OR SECTION THEREOF, THE CONTRACTOR SHALL PROVIDE THE ENGINEER WITH A COPY OF A DETOUR PLAN APPROVED BY THE AGENCY HAVING JURISDICTION OVER THE ROADS.

11. IN THE EVENT ROADS ARE TO BE CLOSED, THE CONTRACTOR SHALL NOTIFY THE LOCAL FIRE DEPARTMENT, POLICE DEPARTMENT, LOCAL ROAD AUTHORITY, AMBULANCE AND EMERGENCY SERVICES, DEPARTMENT OF PUBLIC WORKS, PUBLIC TRANSIT AUTHORITY, PUBLIC SCHOOL SYSTEM, LOCAL TRASH PICKUP AUTHORITY, AND PUBLIC AND PRIVATE UTILITIES DAILY AS TO WHAT STREETS WILL BE PARTLY BLOCKED OR CLOSED, THE LENGTH OF TIME THE STREETS WILL BE BLOCKED OR CLOSED AND WHEN THE STREETS WILL BE REOPENED TO TRAFFIC.

12. PAVED STREETS AND DRIVEWAYS SHALL BE MAINTAINED IN A REASONABLE STATE OF CLEANLINESS AND THE CONTRACTOR SHALL REMOVE ACCUMULATIONS OF DEBRIS CAUSED BY HIS OPERATIONS. THE CONTRACTOR SHALL HAVE, AS A MINIMUM, AN OPERATING SWEEPER BROOM ON THE SITE AT ALL TIMES. THE PAVEMENT SHALL BE CLEANED AT THE CLOSE OF EACH DAYS OPERATION AND AS OFTEN AS NECESSARY BEFORE THAT TIME. FAILURE TO COMPLY SHALL BE CAUSE TO STOP CONSTRUCTION. CONTRACTOR SHALL ALSO COMPLY WITH THE LOCAL AIR POLLUTION CONTROL ORDINANCE.

13. ALL GRAVEL AND DIRT ROADS, STREETS OR DRIVEWAYS USED SHALL BE MAINTAINED BY GRADING, PLACING DUST PALLIATIVES, AND MAINTENANCE GRAVEL IN SUFFICIENT QUANTITIES TO ELIMINATE DUST AND MAINTAIN TRAFFIC AS DIRECTED BY THE AGENCY.

14. CONTRACTOR SHALL PROVIDE ALL NECESSARY SHEETING, SHORING, DEWATERING, BRACING, TRENCH BOXES, ETC., TO PERFORM WORK SAFELY AND PROTECT EXISTING UTILITIES AND IMPROVEMENTS.

15. THE FLOW IN THE EXISTING SEWERS SHALL BE MAINTAINED AT ALL TIMES DURING CONSTRUCTION.16. CULVERTS, DITCHES, DRAIN TILES, TILE FIELD, DRAINAGE STRUCTURES, ETC., THAT ARE DISTURBED BY THE CONTRACTOR'S OPERATIONS SHALL BE IMMEDIATELY RESTORED.

16. ALL PROPERTY IRONS AND MONUMENTS, IF DISTURBED OR DESTROYED BY THE CONTRACTOR'S OPERATION, SHALL BE REPLACED BY A LICENSED LAND SURVEYOR AT THE CONTRACTOR'S EXPENSE.

17. AFTER ALL THE PIPE, STRUCTURES, ETC., HAVE BEEN LAID, CONSTRUCTED, AND BACKFILLED, THE SYSTEM SHALL BE TESTED AND FINAL INSPECTED. THE INSPECTION AND TESTING SHALL CONSIST OF A FIRST INSPECTION, TELEVISION INSPECTION (IF APPLICABLE) TESTING, AND FINAL INSPECTION AND MEASUREMENT. THE CONTRACTOR SHALL PROVIDE THE NECESSARY SUPERVISION, LABOR, TOOLS, EQUIPMENT, AND THE MATERIALS NECESSARY FOR THE TESTS WHICH SHALL BE CONDUCTED IN THE PRESENCE OF THE ENGINEER. HE ENGINEER SHALL BE NOTIFIED TWO (2) WORKING DAYS IN ADVANCE OF ALL TESTING.

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GENERAL NOTES CONTINUED

18. THE FIRST INSPECTION SHALL BE COMPLETED AND ALL REPAIRS MADE IN AMPLE TIME SO THAT THE TELEVISION INSPECTION OF THE UNDERGROUND PORTION OF THE SYSTEM CAN BE COMPLETED WITHIN FOUR (4) WEEKS OF THE COMPLETION OF THE CONSTRUCTION. WHEN RE-TELEVISION IS NECESSARY, AN ADDITIONAL TWO (2) WEEKS WILL BE ALLOWED FOR COMPLETION. TESTING OF THE SYSTEM AS HEREIN DESCRIBED SHALL IMMEDIATELY FOLLOW THE TELEVISION INSPECTION AND SHALL BE COMPLETED WITHIN A TWO (2) WEEK PERIOD.

19. FAILURE TO MAINTAIN A SCHEDULE IN COMPLIANCE WITH THESE TERMS WILL AUTOMATICALLY CAUSE THE STOPPAGE OF OTHER WORK AT THE PARTICULAR SITE IN QUESTION UNTIL SUCH TIME AS THE FINAL INSPECTION OF THE COMPLETED UNDERGROUND PORTION OF THE SYSTEM HAS PROGRESSED TO ACCEPTABLE LIMITS.

20. THE CONTRACTOR SHALL HAVE THE UNDERGROUND PORTION OF THE SEWER SYSTEM READY FOR THE FIRST INSPECTION WITHIN TWO (2) WEEKS AFTER THE COMPLETION OF UTILITY.

21. THE FIRST INSPECTION SHALL CONSIST OF A VISIBLE AND AUDIBLE CHECK OF SEWERS, MANHOLES, GATE WELLS, AND OTHER STRUCTURES TO ASCERTAIN THAT THE STRUCTURE STEPS HAVE BEEN PLACED, ALL LIFT HOLES PLUGGED, THE CHANNELING OF THE MANHOLE BOTTOMS COMPLETED, ALL VISIBLE OR AUDIBLE LEAKS STOPPED, ALL PIPE HAS BEEN PLACED STRAIGHT AND TRUE TO THE PROPER GRADES AND ELEVATION, THE REQUIRED ADJUSTING RINGS AND FRAME AND COVER PROPERTY INSTALLED, ALL TRENCHES AND STRUCTURES BACKFILLED IN AN ACCEPTABLE MANNER AND THAT THE SYSTEM HAS BEEN THOROUGHLY CLEANED.

22. THE FIRST INSPECTION SHALL BE CONSIDERED COMPLETED WHEN ALL TREE PAIRS HAVE BEEN MADE AND THE SYSTEM IS READY FOR A TELEVISION INSPECTION AND SUBSEQUENT TESTING.

23. TRENCH BACKFILL UNDER ROAD SURFACES, PAVEMENTS, CURBS, DRIVEWAY, SIDEWALK AND WHERE THE TRENCH EDGE IS WITHIN 3-FEET OF THE PAVEMENT SHALL BE TRENCH B (SAND) PER SPECIFICATIONS SECTION 312333, TRENCHING AND BACKFILLING.

24. AFTER ALL TESTING, TELEVISION INSPECTION, FINAL RESTORATION AND CLEAN-UP HAS BEEN COMPLETED, A FINAL INSPECTION AND MEASUREMENT WILL BE DONE. THE FINAL INSPECTION SHALL BE REQUESTED BY THE CONTRACTOR AND CONSIST OF, BUT IS NOT LIMITED TO, CHECKING FOR PROPER ALIGNMENT, PROPER GRADE, CLEANLINESS, LEAKS, CONFORMANCE TO THE PLANS AND SPECIFICATION, PROPER STRUCTURAL AND MECHANICAL ADJUSTMENTS, AND RESTORATION. FINAL MEASUREMENT INCLUDES STRUCTURE ELEVATIONS, DISTANCES BETWEEN STRUCTURES, AND CONFIRMATION UTILITIES ARE LOCATED WITHIN EASEMENT AND RIGHT-OF-WAY AREAS.

25. SUCCESSFUL COMPLETION OF ANY TEST OR INSPECTION SHALL NOT RELIEVE THE CONTRACTOR FROM THEIR RESPONSIBILITY TO CORRECT ANY DEFICIENCY OR NONCONFORMANCE TO THE PLANS OR SPECIFICATIONS WHICH MAY THEREAFTER BECOME KNOWN.

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SHEET No. MD-7

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