CITY OF TAYLOR
ENGINEERING STANDARDS MANUAL

AUGUST 2019

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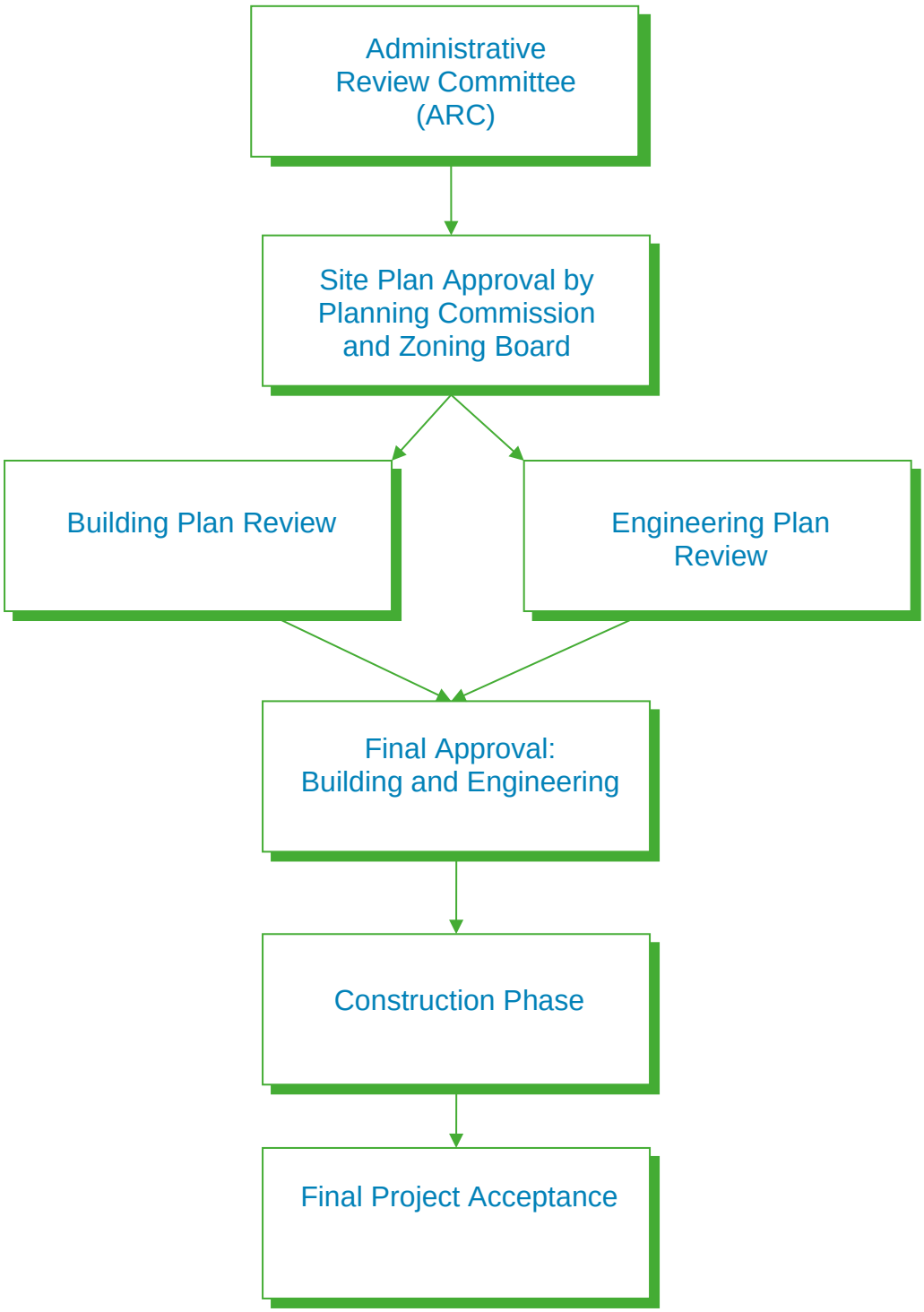
ENGINEERING STANDARDS MANUAL

CHAPTER I
PROJECT PROCESS OVERVIEW

The development process in the City of Taylor consists of seven 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 City of Taylor with the regulatory controls necessary to verify compliance with ordinances, policies, permitting 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. Building aspects are addressed with appropriate Building Codes and City Ordinances.

A. ARC and Planning Commission

Site Plan Review

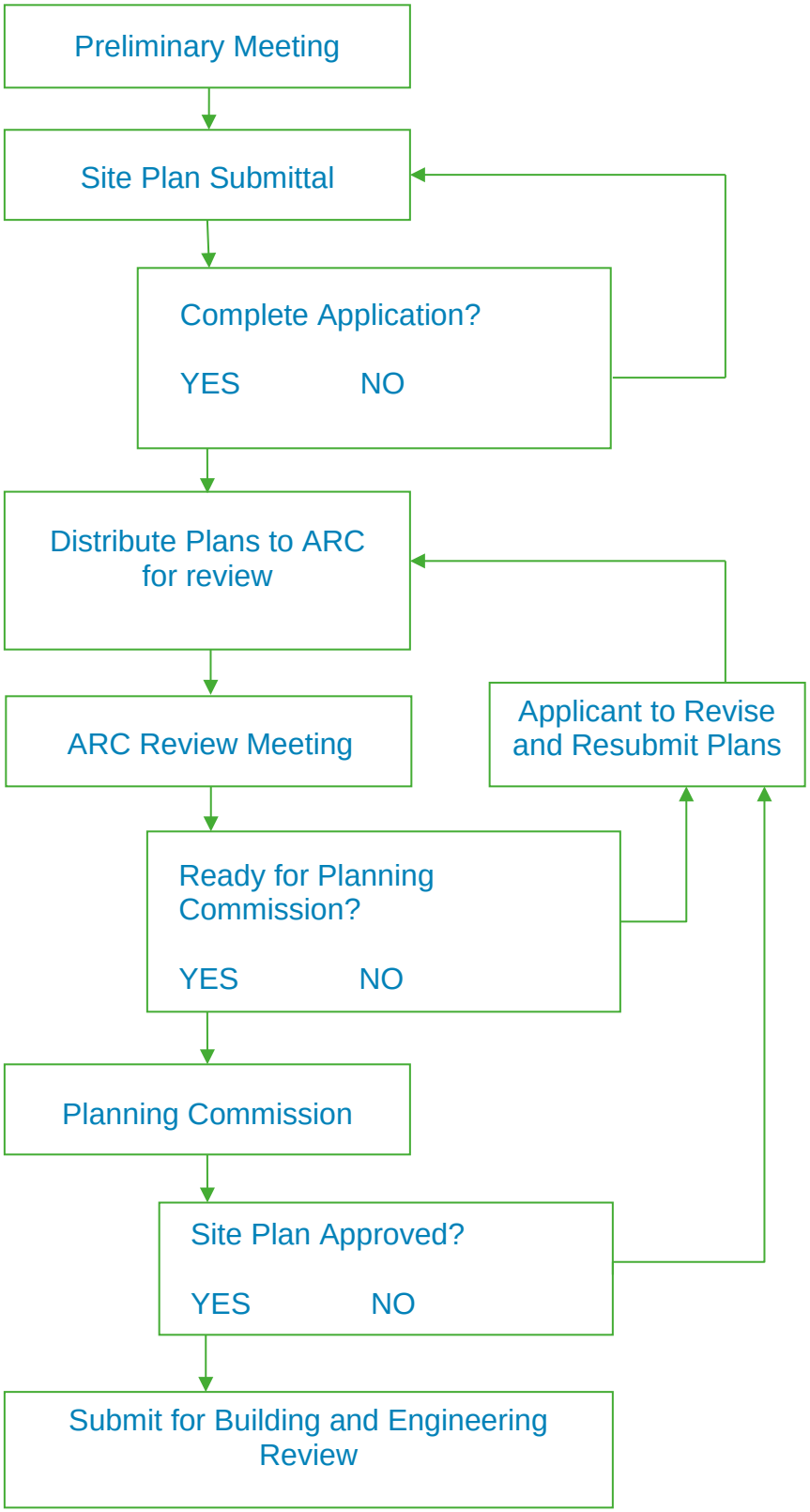
The purpose of the site plan review, from an engineering standpoint, is to determine if the proposed project can be constructed as presented by the Developer. Site access and municipal utilities such as water, sanitary sewer, and storm drainage are reviewed for general compliance with established City,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

SITE PLAN REVIEW PROCESS OVERVIEW



Site Plan Review
Preliminary Meeting
Site Plan Submittal
Distribute for Review
ARC Review Meeting
Planning Commission

Preliminary Meeting

The first step in the site plan review is to have a preliminary meeting with the City 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 plans and sketches to this meeting showing the basic layout of the project.

At the preliminary meeting, the City 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 be directed to the application packet and other important information, instructions and requirements that are needed to assemble a complete site plan submittal.

Site Plan Review
Preliminary Meeting
Site Plan Submittal
Distribute for Review
ARC Review Meeting
Planning Commission

Site Plan Submittal

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

- Completed Application for Site Plan Review (please refer to online application available on the City's website.
- Preliminary Site Plan Sheets (16 sets of drawings and one digital copy). Plans must be signed, stamped by a registered Architect/Engineer. Plans must include all data required by Section 19.04 of the Zoning Ordinance (available on the City's website). Plans must be collated and folded to 9"x12".
- Proof of Ownership must be provided (i.e. copy of Deed or Agreement to Purchase).
- Applicable Cross-Access Agreement must be provided.
- Payment of Review Fees (in accordance with current Schedule of Fees)

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

Site Plan Review
Preliminary Meeting
Site Plan Submittal
Distribute for Review
ARC Review Meeting
Planning Commission

Plan Review and ARC Review Meeting

Once the application is found to be complete, the site plans will be distributed to members of the Administration Review Committee (ARC) for review and comment. Attendees at the ARC may include representatives from:

- Planning Director
- Economic Development Director
- Department of Public Works Director
- City Engineer
- Building Department Director
- Police Department
- Fire Department

Typically, ARC review meetings are held weekly, every Tuesday. Applicants do not attend these meetings. The deadline for distribution of plans to the ARC is 12:00 p.m. on the preceding Friday. Plans will be distributed at the meeting whereby the attendees will be asked to provide comments at the following meeting (one week later). Comments from each reviewer will be discussed and consolidated into a site plan checklist then forwarded to the Applicant. Should revisions be necessary, the Applicant will be required to submit plan revisions for subsequent review by the ARC. This process will be repeated until all issues are resolved. Additional review fees will be required for resubmittals. Upon approval from the ARC, the plans will be forwarded to the Planning Commission for review and consideration of approval if necessary.

Site Plan Review
Preliminary Meeting
Site Plan Submittal
Distribute for Review
ARC Review Meeting
Planning Commission

Planning Commission

Once a site plan has been reviewed and approved by ARC, the plan will be sent to the Planning Commission. The Planning Commission usually meets the first and third Wednesdays of each month. The meeting schedule for the Planning Commission can be found on the City's website.

At the Planning Commission meeting, the plans will be reviewed. The outcome of the Planning Commission meeting(s) will be approval, an approval with conditions, a rejection with reason(s), or the matter may be postponed or tabled until a future date.

Planning Commission approval must be obtained prior to proceeding to formal Building and Engineering Review. Should revisions to the approved site plan be realized during the Building and Engineering review process, the Applicant may be required to resubmit to the Planning Commission for approval to the changes.

B. Building Plan Review

Building Plan Review
Plan Submittal
Plan Review
Plan Approvals

Building Plan Submittal

Once site plan approval has been granted by the Planning Commission, the developer may submit plans to the Building Department for the purpose of applying for and obtaining a Building Permit. This may be submitted concurrent with the site engineering review. The submittal includes several important documents, including the following:

- Application for review of building plans
- Complete signed and sealed construction plans (three sets of plan drawings and a digital copy on a CD or Flash Drive)
- Payment of Review Fees (outlined in the Fee Schedule on the City's website)

Current Building Code adherence/adoption is outlined on the City of Taylor website.

Building Plan Review
Plan Submittal
Plan Review
Plan Approvals

Building Plan Review

Building plans may be reviewed by either the Building Official or through the City's Consultant. The review will be based on the requirements outlined in the adopted Building Code(s).

The reviewer will generate a letter with review comments which will be sent to the municipality, the developer, and the design engineer. The review letter may detail changes that need to be made to the plans to be in conformance with the standards or it may recommend approval. If revisions are required, the developer and their designer should make the requested changes and resubmit revised plans for review. This process may continue until approval is granted. Associated review fees are the responsibility of the Project Sponsor.

Fire suppression reviews may be handled internally by the City Fire Department or through the City's Consultant. The appropriate review application, plan submittals, and associated review fees will be provided to the Developer by the City.

Building Plan Review
Plan Submittal
Plan Review
Plan Approvals

Building Plan Review

Once approval is recommended and any and all required performance guarantees or additional Planning Commission conditions are met, issuance of a Building Permit lies at the discretion of the Building Official, noting there is a desire to issue the Permit concurrent with final site engineering approval. All necessary Building Permit fees, bonds, letters of credit, insurance documentation, completed applications, etc., must be submitted to the City of Taylor Building Department prior to issuance of a Building Permit.

C. Site Engineering Plan Review

Engineering Plan Review
Plan Submittal
Plan Review
Plan Approvals

Site Engineering Plan Submittal

Once preliminary approval has been granted by the Planning Commission, the developer may submit plans to Engineering for review and approval. This may be submitted concurrent with the Building review. The plans may be reviewed by the City Engineer or assigned to the City's Engineering Consultant. The submittal includes several important documents, including the following:

- Two complete signed and sealed site civil construction plans and a digital copy on a CD or Flash Drive
- Detailed construction cost estimate of all site civil improvements (utilities, paving, grading, SESC)
- Payment of Review Fees

Upon receipt of the detailed construction cost estimate and plan sets, a letter will be issued to the developer and design engineer detailing the appropriate review fee. Once the review fees are deposited directly with the City of Taylor and a copy of the paid receipt is provided to the reviewer, the engineering review process will begin.

Engineering Plan Review
Plan Submittal
Plan Review
Plan Approvals

Site Engineering Plan Submittal

Engineering plans may be reviewed by either the City Engineer or through the City's Consultant. The review will be based on the requirements outlined in the City of Taylor's Ordinances and Engineering Standards.

The reviewer will generate a letter with review comments which will be sent to the municipality, the developer, and the design engineer. The review letter may detail changes that need to be made to the plans to be in conformance with City standards or the letter may recommend approval. If revisions are required, the developer and their designer should make the requested changes and resubmit revised plans for review. This process may continue until approval is recommended.

The review letter may further provide guidance as to additional outside agency permit(s) that may be required as well as details pertaining to required submittals such as:

- Insurance
- Easements
- Proof of Property Ownership
- Agreements
- Construction Contracts
- Construction Schedule

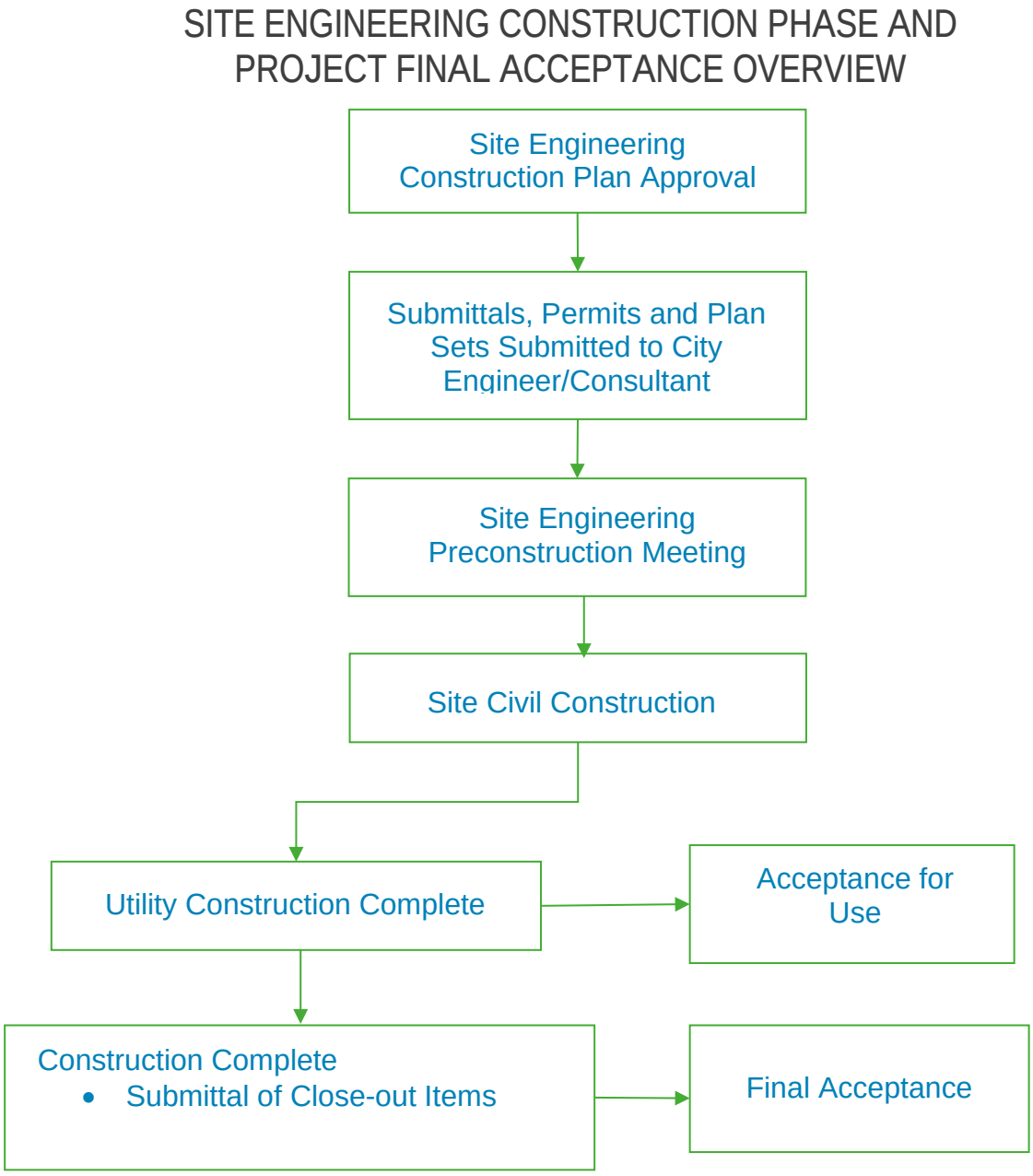
All outside agency permits must be received prior to recommendation of engineering approval by the City Engineer and/or the City's Engineering Consultant.

Engineering Plan Review
Plan Submittal
Plan Review
Plan Approvals

Site Engineering Plan Submittal

When the City Engineer and/or the City's Engineering Consultant determines the entire plan set complies with engineering standards, they will request the design engineer to submit ten (10) complete signed and sealed sets of plans for formal approval. Digital copies of the approved plans will also be requested (both CADD and PDF). Upon receipt of the necessary plans, a "Recommendation of Approval" letter will be drafted outlining outstanding submittals and may further detail the construction phase engineering fees that will need to be deposited with the City. All outstanding submittals and fees must be submitted to the City and/or the City's Engineering Consultant prior to scheduling the required preconstruction meeting. Copies of the approved plans will be distributed to the necessary parties.

D. Site Engineering Construction Phase and Final Project Acceptance



Construction/Acceptance
Precon Documentation
Preconstruction Meeting
Acceptance for Use
Final Acceptance

Preconstruction Documentation

The “Recommendation of Approval” letter will assist in summarizing outstanding submittals required before scheduling the site civil preconstruction meeting. A separate preconstruction meeting will be scheduled by the Building Department for activities associated with building construction (separate from site civil operations).

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 City Engineer/Engineering Consultant will set the time and location for the preconstruction meeting. The developer is responsible for making sure their contractor, subcontractors, and design engineer (at the developer’s discretion) attend the preconstruction meeting.

The preconstruction meeting is a chance for the developer, contractor, City, 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 the meeting attendees.

Construction/Acceptance
Precon Documentation
Preconstruction Meeting
Acceptance for Use
Final Acceptance

Acceptance for Use/Final Acceptance

Acceptance for a project is typically granted in two forms, acceptance for use and final acceptance. Acceptance for use occurs when the utility construction is complete, and the public utilities are ready to be turned over to the City. Final acceptance occurs when all construction is complete on the project. Prior to issuance of final acceptance, all close-out items must be submitted to the City Engineer/Engineering Consultant. These items may include, but are not limited to:

- Easements (revised if necessary)
- Executed Agreements
- Testing Results
- Final Measure Plans

For commercial/industrial projects, acceptance for use and final acceptance both usually occur when construction is complete (building and site civil construction) and prior to granting of a Certificate of Occupancy by the City. Issuance of a Certificate of Occupancy remains at the discretion of the Building Office.

E. 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 City 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.

City means City of Taylor, Michigan, represented by the City Council.

*City E*ngineer means the Engineer employed by the City.

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

Council shall mean the City Council, City of Taylor, Wayne County, Michigan.

Department shall mean the City'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 City Standard Details Drawings for water mains, storm sewers, sanitary sewers and road pavement adopted by City council resolution. They are considered a part of this manual.

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

F. 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 City. This manual is not intended to repeal, abrogate, annul, or in any manner interfere with existing regulations or laws of the City, 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.

G. Variance

The City Council 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 Council shall prescribe other conditions that it deems necessary or desirable for the public interest. No variance shall be granted unless the City Council 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 City 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 City ordinances, the Land Division 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 City of Taylor for approval. The plans shall be prepared under the supervision of a civil engineer licensed in the State of Michigan. 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 City of Taylor.

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 consideration of approval. Additional items may be required by the Planning Department. The Applicant is encouraged to review Planning/Site Plan submittal requirements as outlined by the Planning Department. Specific requirements for utilities can be found in Chapters III – IX. Other requirements such as City Zoning Ordinances requirements, Traffic Studies, Soil Borings, etc., as determined by the City of Taylor may be required prior to any approvals.

A. General Requirements

Plans are reviewed to verify conformance with the established City of Taylor 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 vertical elevations shall be on NAVD 88 datum.

2. Two complete, signed and sealed sets of drawings (preferably 24” x 36”) must be submitted along with an electronic copy of the same plans for detailed engineering review.

3. A north arrow and both the horizontal and vertical drawing (as appropriate) 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 and property address.
    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 to which the information on the sheet pertains.

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. Flood zones/contours, road names, units, utilities, pavement, site dimensions, phase lines, lot lines, Miss Dig information 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 and address.

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.

9. Flood zone depictions and contours as applicable.

10. Miss Dig information.

B. Site Plan Review Requirements

The following requirements apply to all plans submitted to the City for preliminary site plan approval. The Design Engineer is encouraged to reference Chapters III-IX for specific engineering requirements and design criteria for utility systems and pavements. The Designer is further encouraged to refer to Planning Department submittal requirements for additional criteria.

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, storm water pretreatment devices, storm water detention ponds and/or underground storm water detention areas.

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. The 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 where applicable. 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 as such 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. Appropriate site circulation must be clearly provided for emergency vehicles and where necessary, delivery trucks.

17. Radii of driveway returns and all other points of curvature should be clearly indicated on the plans.

18. A landscape plan should be included. The underground utilities should be shown on the landscape plan. Landscaping requirements may be further detailed by the Planning Department.

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

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

21. Typical sections for pavement, parking lots, bicycle path, driveways, and sidewalks should be shown on the plans.

22. Existing and proposed right-of-way dimensions should be indicated. Proposed right of way widths should be in conformance with Ordinance or Master Planning requirements.

23. The description of “Type of Use” being proposed, adjacent zoning, adjacent land uses, existing and proposed zoning should be provided on the plans.

24. Adjacent existing buildings and driveways should be provided on the plans.

25. All required and proposed building and parking side yard, front yard and rear yard setbacks must be clearly delineated on the plans.

26. The square footage of the proposed building(s) must be illustrated on the plans.

27. Proposed/required grease traps and dumpster pad locations, sizing and details must be provided. Enclosure details for the dumpster pad must further be provided.

28. Required notes:

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

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

C. Site Engineering Plan Review Requirements

The following requirements apply to all plans submitted to the City for site 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 City 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 18-inch 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 drop connections are not permitted).

    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 applicable local ordinances and regulations. All calculations 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 must be indicated on the plans. 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:

1) Structure number.
2) Diameter and type of structure.
3) Rim elevation.
4) Frame and cover model numbers.
5) Size, direction, and invert of connecting pipes.
6) Cover above top-of-pipe of connecting sewers.
7) 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: NAVD 88

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 City 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 City 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 City 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. Water Main Notes:

        - When connecting to an existing water main, a note must be added at all points of connection 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 City Engineer.”

        - Provide a pipe cover of 6.0 feet above water main measured from top of pipe.

- The Contractor will need to contact the City of Taylor for coordination of bacteriological testing.
- The water main bedding must be Michigan Department of Transportation Class II sand.
- Trench “A” backfill material used must be free of large lumps of clay, debris and rocks.
- Trench “B” sand backfill is required for water main trench located under or within three feet of pavement.
- All bolts for underground mechanical connections must be either mastic coated or Core-Blue T-bolt type.
- Thrust blocks are required at all bends, tees, crosses, hydrants and plugs at the end of a line.
- Domestic service two inches in diameter and smaller may be type “K” copper pipe or PVC.
- All proposed fire hydrants shall be EJIW “WaterMaster” 5BR model 250.
- Monument Box (Buffalo Box) similar to E.J. #6860 to be provided for domestic valve/shut-off.

b. Sanitary Sewer Notes:

- The minimum slope for the building lead is 1.0 percent.
- Commercial sanitary leads in excess of 100 lineal feet shall be videotaped or air tested.
- A nine-point mandrel test is required for all flexible pipe after installation is completed. The internal diameter shall not be reduced by more than 5% of its inside base diameter when measured not less than 30 days following completion of installation. Successful test results shall be submitted to the Field Engineer prior to final acceptance.
- No connection receiving storm water, surface water, or groundwater shall be made to sanitary sewer.
- No footing drains shall be connected to the sanitary sewer.
- Sand backfill is required for sanitary sewer trench located under or within three feet of pavement.
- The required pipe bedding is maximum ¾” diameter crushed stone.

- Trench “A” backfill material used must be free of large lumps of clay, debris and rocks.

- Trench “B” sand backfill is required for sanitary sewer trench located under to within three feet of pavement.

- At all connections to an existing sanitary sewer system:

  “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.”

- At all stubs for future connection:

  “To facilitate future construction only. No house leads shall be constructed until terminus manhole is constructed.”

c. Storm Water Notes:

- Storm sewer sump leads shall be constructed with 3-inch diameter Schedule 30 PVC pipe.

- The required pipe bedding is maximum ¾” diameter crushed stone.

- The edge drain should be perforated polyethylene pipe with geotextile wrap. The minimum diameter is 6-inch and the minimum and maximum depth is two feet and five feet, respectively.

- Trench “A” backfill material used must be free of large lumps of clay, debris and rocks.

- Trench “B” sand backfill is required for storm sewer trench located under or within three feet of pavement.

- All storm drainage structures in paved areas shall conform to City of Taylor Standard Detail Sheets.

- Manufactured detention systems must be installed and maintained in accordance with Manufacturer’s recommendations.

d. Site Grading Notes:

“The Project Sponsor is responsible for resolving any drainage problems on adjacent properties which are a result of the Project Sponsor’s activities.”

D. Soil Erosion and Sedimentation Control Plan Requirements

The following requirements apply to all plans submitted to the City for Soil Erosion and Sediment Control (SESC) plan approval and permit issuance. Any project with an earth change/disturbance over one acre in size and/or within 500 feet of a water of the State (lake, stream, wetland, drain) is subject to a SESC Permit.

This permit will be issued by the City of Taylor. The Design Engineer is encouraged to reference Chapter VIII 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 an address and 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 five 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 five 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 City's 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 City Engineer. Water mains are required to be extended along all road frontages abutting the proposed development.

b. Distribution 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 may be required for industrial developments.

d. Water mains shall be placed according to the typical cross sections shown in Appendix B. The following is a summary of the typical spacing requirements:

1)	60-foot wide right-of-way	8 feet inside right-of-way
2)	86-foot wide right-of-way	10 feet inside right-of-way
3)	120-foot wide right-of-way	22 feet inside right-of-way

e. 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 City of Taylor.

f. 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 City Engineer for future extension. Water main stubs shall terminate with a hydrant, followed by a gate valve in well.

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

h. The maximum deflection for ductile iron 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.

i. Provide six feet minimum cover from proposed ground surface to the top of all water mains.

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

k. Hydrants and valves shall be located on extensions of lot lines when feasible.

l. Plan 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 City Engineer.

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

n. Where required by the City 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.

o. A minimum of 18 inches of vertical clearance shall be provided between either the water main or water service line 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.

p. 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.

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

1) 450 feet for 8-inch mains.
2) 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.

r. 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.

s. Minimum fire flow requirements are 1,000 gpm at 20 psi for residential and 3,000 gpm at 20 psi for commercial and industrial areas.

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 City for maintenance and operation. The dedication of the water system must be in accordance with the City's 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 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 the City scheduling a preconstruction meeting.

2. Valves

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

1) 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.

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

3) There shall be valves on tees feeding dead end mains.

4) Valve spacing shall be a maximum of 800 feet (500 feet in commercial and industrial zoned districts).

5) 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.

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

b. Gate wells and other water main structures shall not be constructed in driveways, drive approaches or sidewalks.

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 gate wells unless otherwise permitted by the City Engineer. Gate valves at fire hydrants shall be installed in valve boxes.

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 City 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 50 feet of the siamese connection.

d. Generally, hydrants are to be placed five feet behind the curb.

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

f. In all cases, hydrants shall be located and maintained at 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

1) 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 250 feet from a hydrant. This distance shall be measured along the shortest feasible exterior route for laying fire hose.

2) 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 otherwise approved by the Fire Chief. 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. Hydrant runs longer than 10 linear feet shall be 8-inch diameter pipe with an 8-inch by 6-inch reducer placed before the hydrant assembly. 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. Water supply requirements for firefighting purposes shall be as determined by the applicable and current Fire Codes and Insurance Services Office formulas.

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:

1) For 3 - 15 units per building, 1.5-inch minimum service lead.
2) For 16 - 31 units per building, 2-inch minimum service lead.
3) 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 if required and approved by both the City Engineer and the railroad, of the encased water main. Grouting may not be desire or required.

b. Stream or river crossings. Water main shall be installed at crossings in accordance with State, County and/or City of Taylor requirements. A minimum six feet of cover between top of pipe and stream/river bed will be required.

B. Materials

1. General

a. No secondhand or salvaged materials or equipment will be permitted. Reuse of a relocated hydrant may be permitted pending review and acceptance of the City Engineer.

b. All fittings shall be ductile iron, pressure rating 350 psi, conforming to ANSI A21.53-11 (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. Domestic service two inches in diameter or smaller may also be HDPE DR 11 with 12-gauge solid core tracer wire, non-braided, or PVC C900 with 12-gauge solid core tracer wire, non-braided.

e. All necessary fittings for the installation of the water main are to comply with the Standard Details.

f. All water system bolts are to be new, cor-blue, mastic coated t-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

1) 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.

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

3) Ductile iron joints and fittings. Push-on type pipe joints, shall be in conformity with the current ANSI A21.11 (AWWA C11) 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.

4) Mechanical type joints, when specified, shall be in conformity to the current ANSI A21.11 (AWWA C11), Rubber Gasket Joints for Cast Iron Pressure Pipe and Pipe and Fittings. The bolts shall be of the high strength, low alloy steel type.

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

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

7) Water Service Taps. Brass corporation stop.

8) Poly wrap may be required at the discretion of the City Engineer.

3. PVC Water Mains

a. Open Cut Construction

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

2) 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 bituminous enamel coating inside and outside.

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, or approved equal.

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

4) Tracer wire must be provided. The alignment and location at all wells, hydrants and stop boxes lies at the discretion of the City Engineer.

b. Directional Drill Construction

1) Piping. AWWA C900, restrained joint, PVC plastic, Class 235 (DR 18) for 10-inch and 12-inch diameter pipe. 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.

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

a) Joints. Butt fusion welded.

3) 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 bituminous enamel coating inside and outside.

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, or approved equal.

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

a) 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. Service saddles shall be Ford, Model 202BS, with AWWA taper thread outlets. 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 are only permitted in warranted circumstances and when agreed to by the City Engineer. AWWA C906, Pressure Class 200 (SDR 11), Ductile Iron Pipe size.

1) Material. PE 4710.

2) Cell Classification. 445474C per ASTM D3350.

3) 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.

4) Mechanical joint fittings shall be, ductile iron compact fittings conforming to AWWA/ANSI C153/A21.53, with rubber gasket joints conforming to AWWA/ANSI C111/A21.11, with double thickness cement mortal lining and coal tar epoxy coating on the outside of the fittings. Fittings when joining to HDPE pipe shall be fused Mechanical Joint Adapters with Ductile Iron Backup rings.

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

6) 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, Mueller 2360 series, or U.S pipe Metorseal, 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 inlet and outlet connections compatible to the water pipe joints used on the system. Butterfly valves shall be used for sizes 16 inches and larger.

b. All gate wells shall be constructed of pre-cast reinforced concrete or block sections in accordance with City 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 #1040-1ZPT-B with Type "A" cover, or approved equal. Covers shall have the City logo.

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, 5-1/4-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 a minimum 18- 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. *(THIS MAY VARY FROM DEQ REQUIREMENTS*).

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 be 8” block wall with ½” cement plaster coat inside and outside of 5” thick precast concrete, ASTM C139.

i. See Standard Detail Sheets for additional information.

8. Curb stops shall be Ford, Minneapolis pattern, model B44-xxxM-Q, 1-inch minimum size, quick joint inlet and outlet, as compatible with copper and PVC water service leads. Curb boxes in non-paved areas shall be Ford, extension type with Minneapolis pattern base, model EM1-xx-46, 1-inch onside diameter (one-piece lid) 5-foot minimum extended length.

Curb boxes in paved areas shall be Ford, extension type with Minneapolis pattern base, model EM2-xx-46, 1-inch inside diameter, 5-foot minimum extended length (combination lid with Pentagon plug).

9. Corporation stops shall be Ford, Model F1000-x-Q, 1-inch minimum size, AWWA taper thread inlet and quick joint type outlet with solid insert stiffener.

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 requirements.

   b. City of Taylor installs 2-inch and under service leads from main to curb stop. Curb stop is provided by the City of Taylor. All applicable fees are paid directly by the Owner.

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

   d. All water mains are to be kept in service during construction operations unless arrangements are made with the City of Taylor Water Department. The City Water Department will be the only authorized personnel to operate the valves.

   e. When jacking or boring all voids outside of casing pipe shall be filled by means of pressure grouting (where grouting is required) with 1:3 cement-sand mortar. This work must be accomplished within 24 hours after the water main crossing has been completed. Boring shall extend 10 feet outside the edges of pavement.

   f. 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.

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

   h. All water mains shall have Class F-III bedding unless otherwise noted on the plans. Refer to Standard Detail Sheet MD-1 for bedding details.

2. Valves

   a. 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.

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 6-inch diameter fire hydrant valve shall be installed in the full open position.

d. The City Water Department will be the only authorized personnel to operate the valves or hydrants. The City's normal working hours are 7:30 a.m. – 4:00 p.m., Monday through Friday. The Contractor may obtain a permit to operate a single, specified hydrant from the City.

5. Thrust Block

a. Concrete thrust blocks shall be provided at all bends of 11¼° or greater, behind tees, at hydrant shoes, plugs, 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 City Engineer or City's Engineering Consultant is to have an inspector present when the pressure test is performed. Sufficient advance notification from the Contractor must be provided.

b. A testing lab approved by EGLE must be used for bacteriological testing. The City Engineer's representative 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 City Engineer and/or the City's Engineering Representative 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 connection to existing water mains shall be made before the newly constructed water mains have undergone a satisfactory pressure test as witnessed by the City Engineer or City's representative. 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 City Engineer or City Representative. 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 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 City Engineer or City Representative.

   b. All new water mains shall be disinfected in a manner acceptable to the EGLE.

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

   d. Bacteriological water samples shall be collected by the City Water Department. One sample shall be taken for each section of main disinfected. Analysis of each sample must be made by a certified laboratory.

   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:

      1) 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 City Water Department personnel or City Representative.

2) 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. City Water Department personnel will then collect and transport samples for bacteriological testing. Written confirmation of the results will be provided to the contractor.

3) Two consecutive samples with acceptable test results are required before the water main is placed into service. The time in between testing shall be 24 hours.

4) The City 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 City of Taylor.

CHAPTER IV
SANITARY SEWER STANDARDS

Chapter IV 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 chapter, 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 beginning 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 City rights-of-way or easements, formally dedicated to the City, that carries liquid and/or water-carried wastes from residences, commercial buildings, industrial plants and institutions.

Sanitary Sewage means wastewater discharged from homes, commercial or industrial 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. Sanitary sewer system and appurtenances shall be constructed as set forth herein and as shown on the City of Taylor Standard Sanitary Sewer Detail Sheets SS-1 and SS-2.

b. 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. Stubs for future extensions shall be provided to the property lines at locations as designated by the City Engineer.

c. Easements for sanitary sewers shall have a minimum width of 20 feet. The utility shall be centered in the easement unless otherwise permitted by the City Engineer. Such easements shall be deeded or dedicated to the City of Taylor 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.

d. Only one building (residential or commercial) shall be serviced from one service lead.

e. 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.

f. Sanitary sewer mains and services exterior to the building shall be located so unrestricted access for maintenance and inspection is provided. A paved access road may be required.

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

h. Sanitary sewer mains shall be placed according to the typical cross sections shown in Appendix B. The following is a summary of the typical spacing requirements (to be coordinated with storm sewer and water main locations):

1)	60-foot wide right-of-way	5 feet back of curb (typ)
2)	86-foot wide right-of-way	9 feet inside right-of-way
3)	120-foot wide right-of-way	12 feet inside right-of-way

i. All public sanitary sewer mains 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, centered on the main.

j. Sanitary sewer mains shall be constructed outside of paved parking areas, streets, and drives wherever possible.

k. 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 sewer systems shall be designed to serve all-natural tributary areas, anticipating full development of such areas, with due consideration given to topography, established zoning, and all City planning requirements.

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 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 sewer mains 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 unless otherwise approved by the City Engineer. Connections must be constructed in accordance with the City of Taylor Standard Details.

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 connection laterals and sanitary leads shall be provided for each proposed building as specified herein. Unless otherwise approved, construction of service leads from the public sewer main 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 main.

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 service leads to manholes is prohibited unless otherwise approved by the City Engineer.

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

e. Monument boxes, or approved equal, must be provided for cleanouts located within paved areas.

f. Where the construction of sewer service leads to the property line or easement is not required concurrently with the sanitary sewer construction, one six-inch wye for each lot shall be placed on sanitary sewer with a riser, unless otherwise noted. 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 sewer service lead shall be marked with a 2” x 2” (nominal dimension) hardwood marker to six inches below the ground surface.

g. Sewer service risers shall be installed to a depth of nine feet below finished ground elevation, unless otherwise authorized by the City. All risers that are installed without service 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 sewer services 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 approved by the Wayne County Health Department.

b. Where permitted, septic tanks must conform to all 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 permitted unless approved by the City Engineer and potentially City Council.

   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). Plastic pipe shall not be used in industrial areas unless otherwise approved by the City Engineer.:

   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. Polyvinyl Chloride (PVC) Solid Wall Pipe.

      1) PVC solid wall pipe and fittings for 6-inch through 15-inch diameter shall be as described under ASTM designation D3034 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 F679, SDR 23.5.

      2) 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 City 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.

3) Wyes or tees shall be a molded wye or tee fitting per ASTM F1336, 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.

c. Polyvinyl Chloride (PVC) Truss Pipe

1) 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.

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

3) Wyes or tees shall be a molded wye or tee fitting per ASTM D2680, with gasketed joints per ASTM D3212 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 City 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 meet the requirements of ASTM C478. Further details are provided on the City of Taylor Standard Details Sheets.

e. Where manholes are located in paved areas, final grade adjustment shall be made in accordance with Standard Details. Grade rings, frame and cover shall be per External Frame Seal detail on Standard Detail Sheet.

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 comply with ASTM C478. 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 1040AGS (Sanitary) with City logo.

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.

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 City 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. Pump station design shall also conform to other requirements as determined by the City 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 City Engineer. Cleanouts shall be placed at locations designated by the City Engineer. The Developer will supply a portable emergency power source which will become the property of the City if the City maintains the pumping station.

4. Service Leads

    a. Sanitary sewer service leads shall be: C700 ES Vitrified Clay pipe with premium joints for industrial use; and PVC pipe, ASTM D3034, SDR 23.5, 6-inch, and SDR 26, 8-inch for commercial and residential use.

C. Construction

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

2. Construction shall not commence without 24-hour notice provided to the City Engineer or authorized representative.

3. Manholes shall be constructed of precast reinforced concrete sections or block. 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 City Engineer.

    c. Concrete placed inside manholes to form the channel through the manhole shall be placed in a way that does not interfere 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 as indicated on the Standard Detail Sheets. 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 in accordance with the Standard Details.

4. Drop connections. Interior drop connections are not allowed unless otherwise approved by the City Engineer. An exterior 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 with watertight plugs shall be provided. Stubs shall be a minimum of two pipe sections, each 10-feet in length, for a total length of 20-feet.

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 City Engineer.

7. All bedding shall be as required in the City of Taylor Standard Detail Sheets.

8. Trench B sand backfill shall be placed within three feet of all structures as detailed in the Taylor Standard Detail Sheets.

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 main, the tap shall be made with the use of a tapping saddle and sleeve approved by the City Engineer and/or City of Taylor Water Department.

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

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

14. Risers on sanitary sewer leads shall be installed where the sewer lead is over nine feet deep to a depth of nine feet.

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 City Engineer or City Representative.

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:

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

    2) 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.

    3) 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 of the tapered cone section. Loss may be measured with a weir in the pipe at the downstream end. 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 City prior to placing the sewer in service. Copies of the television recording need to go to the City Engineer and the City's Representative in a format acceptable to the City 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.* Sewers shall be placed according to the typical cross sections shown in Appendix B. The following is a summary of the general spacing requirements (to be coordinated with sanitary sewer and water main locations):

1)	60-foot wide right-of-way	8 feet inside right-of-way
2)	86-foot wide right-of-way	16 feet inside right-of-way
3)	120-foot wide right-of-way	22 feet inside right-of-way

c. *In easements (Subdivisions).* Easements for sewers (when applicable) shall have a minimum width of 20 feet. The utility shall be centered in the easement unless otherwise permitted by the City Engineer. Such easements shall be deeded or dedicated to the City of Taylor 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.

1) Easements for possible extensions shall be provided to the property lines at locations designated by the City Engineer.

2) Sewer mains shall, whenever feasible, be constructed outside of paved parking areas, streets and drives, and not closer than ten feet to any building.

3) Private easements shall be provided for all drainage ditches and storm sewers located within a subdivision.

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

5) Easements shall be provided in size and location in accordance with the City planning efforts and requirements.

6) 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. This may be at the discretion of the State Permitting Agency.

7) Additional easements may be required by Wayne County when work is proposed in or around drains under Wayne County jurisdiction. Wayne County will provide the necessary requirements.

d. *Tributary area.* Sewers shall be designed to serve all- natural tributary areas and areas designated by the City with due consideration given to the topography, established zoning and the adopted City 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 and/or agreements. 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 of 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	Slope	Slope
		< 4%	4% - 8%	> 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:

1) 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

2) 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. Where 2.5 feet of cover is not possible at structures, a Type “D” manhole should be specified. The minimum cover for a Type “D” manhole is 19-inches.

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:

1) All changes in alignment.

2) Points where the size of the sewer changes.

3) Points where the grade of the sewer changes.

4) Junctions of sewer lines.

5) 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. Where multiple pipes are connected to one structure, the structure shall be sized so that a minimum 8-inches of manhole wall is provided between the outer walls of the pipes.

f. Catch basins are to be located as follows:

1) All low points in gutters and swales.

2) 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.

3) Maximum intervals of 300 feet along a continuous slope.

4) Upstream of driveways where possible.

5) 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. New field catch basins shall be provided at the low point of all swales and ditches 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 (i.e. subdivisions and condominiums) 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, 20-foot 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 City 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 up 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 City 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 City Engineer.

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

5. Drainage Ditch Enclosure

a. A Right of Way Permit is required from the City of Taylor Department of Public Services for construction activities that pertain to enclosing a drainage ditch. The application may be found on the City's website. Provide with the permit application a plan view of the proposed ditch enclosure and details of the material proposed to be used.

b. Below is an outline of the necessary procedure and required specifications.

1) Determine the direction of storm water flow in the existing ditch.

2) Clean debris, grasses, leaves and muck from the bottom of the existing ditch.

3) Place a bedding of stone or granular fill, 4” deep, graded in the direction of storm water flow.

4) Place 12” diameter polyethylene pipe with smooth interior wall, N-12 ST IB pipe, and connections, or approved equal, pitched in direction of storm flow.

5) Provide sound soil tight connections to existing upstream and downstream culverts.

6) Install a “T” section and place a frame and cover for a yard drainage structure.

7) Fill ditch and final grade surface to flow to the drainage structure.

6. 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.

7. 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 City 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 City 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 pipe invert to the bottom of slope as determined by the City engineer. Two types of riprap may be used:

1) 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

2) 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.

8. Special Structures and Appurtenances

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

9. Storm Drainage, Building Leads

All lots shall be provided with an individual storm drainage building lead so that footing drain and/or roof discharge can outlet directly into the enclosed storm drainage system, noting there is a preference for green space discharge where feasible. Invert elevations of the proposed building lead shall be shown on the grading and storm drainage plans.

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

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 storm leads. Where a storm and sanitary lead are both present, separate identifying caps shall be provided for cleanouts; cross connection must be avoided.

c. Monument boxes, or an approved equal, must be provided for cleanouts located within paved areas.

d. 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

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

2) 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.

3) 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.

4) 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.

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

6) For elliptical and non-circular pipe, the exterior of the joints shall conform to applicable ASTM requirements for 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 (concrete pipe). 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

1) 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 an elastomeric gasket meeting the requirements of ASTM F477 and be suitable for storm sewer service.

2) 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.

3) Acceptable manufacturers of Dual wall corrugated pipe include Contech A2000, Uponor ETI Ultra-Corr or City Engineer approved equal.

c. Smooth-Lined Corrugated Polyethylene Pipe

1) 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.

2) 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.

3) 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 may be permitted within paved commercial or industrial areas if permitted by the City Engineer.

2. Manholes

a. Manholes shall be constructed of concrete block or precast reinforced concrete sections in accordance with the City 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 City's Engineer.

c. Brick for casting adjustment, or concrete block for manhole, inlet, and catch basin construction shall conform to the requirements of C55, Grade S-II and ASTM C139 respectively, 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 provided in accordance with Standard Details.

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

3. Catch Basins

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

b. Catch basin and inlet frame and covers shall be provided in accordance with the Standard Details.

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 City'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. Refer to Standard Detail Sheets.

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. An alternate external sealing system may be used if reviewed and approved by the City Engineer.

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. A minimum of 24-hours shall pass before backfill is placed.

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. Sewer pipe bedding shall be provided in accordance with requirements outlined in the Standard Detail Sheets.

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

CHAPTER VI
STORM WATER STORAGE STANDARDS

Chapter VI 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 City planning and engineering requirements. Prior to the approval of a storm water plan, storm sewer and on-site storm water holding facilities shall be in accordance with the requirements of the City Engineer. Storm drainage facilities will generally be required for storm water conveyance, 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 City 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 engineering 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 (where deemed feasible).

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 generally not permitted unless permitted by the City Engineer with a letter of understanding provided by the Property Owner.

a. Storage Requirements

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

10-year design equations:

$$Q_a = 0.10A$$

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

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

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

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

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	Slope	Slope
		< 4%	4% - 8%	> 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

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

2) The volume of water associated with the permanent pool does not count towards the detention volume requirement.

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

4) Side slopes for a detention basin shall not be steeper than 1:6. Any variances will require approval from the City Engineer and strict adherence to fencing and maintenance access requirements.

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

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

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

8) 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.

9) 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 City Engineer. Should the outlet jurisdiction lie with Wayne County, adherence to Wayne County requirements will be necessary.

10) The allowable discharge shall be 0.10 cfs/acre.

11) A water quality system in the form of either a forebay or a mechanical device is required to protect the detention system from sediments. Sizing and approved types of the mechanical devices shall be in accordance with Wayne County requirements and/or at the discretion of the City Engineer.

12) The volume of water associated with the forebay may count toward the detention volume requirement.

c. Underground Storage

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

2) The design of the underground storage system must incorporate an emergency overflow in the event that the storage within the system is exhausted. It is understood the Wayne County Storm Water Ordinance does not permit overflow to any Wayne County road system (including roadside ditches).

3) 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 forebay or a mechanical device is required to protect the detention system from sediments.

1) Forebay

a) Forebays 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.

2) Manufactured System

a) The proposed water quality device must be approved by City Engineer.

b) Each manufactured storm water system shall be sized in accordance with Wayne County approved sizing criteria. It is noted these acceptable rates, without a need for an internal bypass, exceed 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.

3) Outlets

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

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

c) 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:

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

d) 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:

$$V_{t,bf} = 5{,}160AC$$

e) 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 and must be approved by the City Engineer.

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 City 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 City 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 City Engineer and shall be fenced. When fencing is required by this article the proposed materials, gates and access shall be in accordance with City Ordinance requirements and as approved by the City Engineer. A 4-foot minimum height is required.

3. Bioretention

Bioretention areas may be used to achieve a degree of stormwater treatment. Bioretention areas must be designed to store, filter and allow for infiltration of stormwater into the ground and must also include an outlet. If an outlet is not feasible, a geotechnical investigation, with accompanying recommendation from the Geotechnical Engineer, must be conducted to determine if acceptable soil conditions are present. Approval from the City Engineer will also be required. All proposed bioretention areas must comply with the Wayne County Storm Water Management Ordinance and Standards.

B. Construction

Detention/retention basins shall be constructed prior to any other construction for all projects in the City. 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 City may, at its discretion, allow the use of a lot for holding facilities when the lot has been oversized for this use.

In contaminated soil areas (i.e., landfills, dump sites, etc.), where open ditches are proposed, the ditches and any storm water holding facility shall be provided with a bentonite or vinyl liner to prevent the seepage of leachate into a watercourse. Associated approvals and permitting from EGLE will be required.

A method of facility maintenance acceptable to the City shall be submitted and approved prior to final plan approval. This method shall provide for private maintenance. If maintenance is not subsequently provided, the City may provide the necessary effort and charge the Owner for the associated labor and material costs. Copies of the Standard Agreement(s) are in the Appendix of this manual. The agreement allows the City 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 chapter, 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.

Shared Use Path means a permanent easement located outside of, or within, 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.

Non-Residential or Service 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 City area and the region beyond, and is designated as such by the City.

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

Parking Lot means that area of land which includes loading spaces, parking spaces and maneuvering lanes. A permanently surfaced area of land adequate to carry out the off-street parking regulations of the City zoning ordinance.

Parking Space means an area meeting the requirements of the City of Taylor Zoning Ordinance for each motor vehicle and fully accessible for the storage and parking of permitting 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 City, County or State.

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 be comprised of 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 curbed with Portland cement concrete curb or Portland cement concrete pavement with integral curbs, and provided with enclosed storm drainage systems and shall be approved by the City Engineer.

2. The following table sets forth minimum requirements for street right-of-way widths, pavement widths and pavement thicknesses (submit to review and approval by the City Engineer in accordance with Ordinance requirements).

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

Street Name/Note		Right-of-Way Width (feet)	Pavement Width (feet)	Pavement Thickness (inches and type)
Major Thoroughfare	*B*	120	60	9", reinforced concrete, epoxy-coated rebar
Collector, Nonresidential	*B*	86	48	9", reinforced concrete
Collector, Residential	*C*	86	37	8", plain concrete
Service Street, Non-residential	*B*	70	48	9", reinforced concrete
Minor Street, Multifamily Residential	*A*	60	31	7", plain concrete
Minor Street, Single-Family Residential	*A*	60	31	7", plain concrete
Marginal Access Street	*A*	35	22	7", plain concrete
Alley		20	20	7", plain concrete
Cul-de-Sac, Industrial (75" radius)	*B*	75	120	9", reinforced concrete
Cul-de-Sac, Residential (55' radius)	*A*	55	31	7", plain concrete
Planned Unit Development (PUD)	*A*	60	31	7", plain concrete

Notes (Reference to Table 1):

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, unless approved by City Engineer.*

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 (and approved by the City Engineer):

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 (if permitted) shall conform to the requirements of City standards and specifications; see Standard Detail Sheets.

4. The right-of-way widths set forth in Table 1 shall generally govern; however, if the City 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 Planning, the Administrative Review Committee (ARC) the Planning Commission, and/or the City Engineer.

5. Industrial and commercial street right-of-way widths may be reduced to 60 feet with two, 6-foot easements, subject to the review and approval of the City 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 City Engineer and City 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 geotechnical engineering 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 City Engineer may determine the additional need for undergrading, base material, subbase material, subgrade treatment, and any other special design requirements that the City 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 City 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 City 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:

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

        2) 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.

        3) 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:

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

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

        3) Residential driveways shall be constructed in accordance with City Ordinance requirements. Commercial driveways shall have a 30-foot radius.

        4) 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.

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

6) Cul-de-sacs shall be designed as shown in Table 1. Cul-de-sacs are to be designed with a landscaped island 32 feet in diameter.

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

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 City 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 four inches of bituminous on eight inches of aggregate base.

3. All driveways and the perimeter 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 City Zoning Ordinance. No parking areas shall be permitted in the future road right-of-way as designated in the City Master Land Use Plan. All parking spaces shall be striped.

5. 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 City Engineer. Maximum parking lot slopes shall be three percent unless otherwise approved by the City Engineer.

6. Maximum driveway slopes shall be eight percent.

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

8. 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 City Engineer.

9. 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.

10. 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 PVC pipe shall be installed and backfilled in accordance with City requirements 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 current ADA requirements. Sidewalks at street intersections shall meet current ADA requirements. ADA cross walks shall be six inches in thickness.

5. Sidewalk cross slope shall not exceed ¼” per foot.

6. 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.

Shared Use Path Design Criteria

1. Shared use 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 City.

2. Minimum shared use 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 City 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 City Engineer, unless specifically waived by the Planning Commission and/or City 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 (when approved by the City Engineer).

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

Section 601 Portland Cement Concrete for Pavements

Section 902 Aggregates (crushed concrete is not allowed)

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 the current MDOT Standard Specifications for Construction. Unless otherwise approved by the City Engineer, Leveling Course shall be MDOT 4E1 and Wearing Course shall be MDOT 5E1.

C. Construction

Street, Driveway and Parking Lot Construction (City Jurisdiction)

1. All construction methods, materials and equipment shall be in accordance with the MDOT standards and specifications, as supplemented by this section. In the case of conflict between these standards and the City, the City standards shall govern.

2. Concrete and bituminous paving will not be allowed between November 1 and the following May 1 without written special permission from the City 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 City Engineer and the Project Sponsor/Developer or his agents. A progress schedule must be approved by the City Engineer before beginning construction.

5. All pavement surfaces must be supported upon a prepared subgrade that has been compacted 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 City Engineer. Crushed concrete shall not be permitted as a base for pavement.

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 City 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 City. Deferment for placement of bituminous aggregate surface course for a period longer than one year may be granted by the City upon approval and recommendation by the City 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 City. The use of maintenance gravel is preferred as to avoid contamination.

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 City 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 City Engineer or building official, is provided.

CHAPTER VIII
GRADING STANDARDS

Chapter VIII 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 City Engineer. An on-site storm drainage system or storm drainage facility must be provided.

    g. Elevations for any site with a building shall have a grade sloping away from the walls of the building to permit the flow of surface water. Sunken or terraced areas may be permitted if they are constructed to prevent the runoff of surface water from flowing onto adjacent properties.

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 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 (unpaved) 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. Emergency overflow location(s) and pattern(s).

   e. Grades of swales, ditches and roads. Break points and grade change locations shall be called out on the plans.

   f. 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”.

   g. Finish floor elevation shall be no higher than two feet to adjacent properties, top of curb or top of bank of ditch line.

   h. Arrows showing the direction of drainage shall be placed on the grading plan in sufficient locations to make the drainage patterns apparent.

7. Residential site plans/grading plans shall be submitted with Building Permit Application for new dwellings and shall include, at a minimum, the following:

a. Legal description with lot number and address.

b. Location of 100-year floodplain boundaries, as applicable.

c. Scale.

d. Bench mark elevation and location with respect to lot.

e. Road name and right-of-way width.

f. Road drainage pattern including elevations.

g. Lot dimensions.

h. Structure dimensions.

i. Structure dimensions from front, side and rear property lines.

j. Existing elevations at property lines, existing grade contours, existing top of curb and pavement.

k. Elevations of abutting properties.

l. Proposed elevations: finished floor, top of brick ledge, finished grade adjacent to foundation at corners of foundation, new pavement.

m. Elevations for any proposed high points, swales or yard drainage structures.

8. Elevation and Grading Guidelines

Yard drainage shall comply with the 2015 Michigan Residential Code, Section R401.3 Drainage. Six (6) inches fall within the first ten (10) feet, unless conditions prohibit or drains or swales are proposed, then the slope shall be a minimum of 2% from foundation walls to property lines.

Height of masonry and concrete foundation walls above finished grade shall comply with the 2015 Michigan Residential Code, Section R404.1.6 Height Above Finished Grade.

B. Materials

1. Topsoil: Topsoil shall be fertile, friable, sandy clay loam without admixture of subsoil. Four inches of topsoil shall be provided over all graded areas. 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.

C. Construction

1. At all times the grading shall be conducted in a timely and orderly fashion acceptable to the City Engineer and/or City Representative. 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 applicable State, County and/or City 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 City 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 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.

CHAPTER IX
PUMP STATION STANDARDS

The use of a sanitary sewer pump station is governed by the sewer use ordinances of the City. 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 City before proceeding with plans.

Storm water pump stations are typically owned and maintained by the development, be that a homeowner's association or landlord. Storm water pump stations that are not to be turned over to the City 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, ABS or HDPE) 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 City.

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, EGLE requires that a maximum C factor of 120 be used. Newer pipe has a higher C factor (as much as 140) and old, worn pipe can have a C factor of 80 or less. 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 ($V^2/2g$), 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. The pump curve and system head curve must cross in the allowable operating region of the pump curve, as defined by the pump manufacturer.

For systems using multiple numbers of pumps on a single or multiple forcemains, Minimum and Maximum system head curves shall be calculated and submitted, graphically presenting the boundary conditions anticipated for the pumps operating at all conditions.

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 (required by EGLE unless pumps have specific approval, such as Flygt N impeller. The maximum speed of the pump should be 1800 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 for design purposes:

$$Hp = (GPM \times TDH\ [FT] \times 8.34) / (550 \times 60 \times Pump\ EFF \times Motor\ EFF)$$

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. Suction piping shall not have relative high points between the wet well and the pump.

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.
Consider trench type or self-cleaning wet wells if solids deposition is anticipated to be a problem.

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.

Wet Well and Suction Piping Layout

The recommendations of Hydraulics Institute Article 9.8 Pump Intake Design should be referenced and complied with.

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, ABS or HDPE) 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 considering 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.

   Dry wells require ventilation, 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. Normally, wet wells do not require positive ventilation; however, they must be “vented” to allow for changes in water elevation. 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.

   Refer to NFPA 820 for pump station ventilation requirements.

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 City 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 City system.

Consult with the City 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, should always be upstream 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 or variable speed pump 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 City 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 City. 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 City 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 City Engineer. Cleanouts shall be placed at locations designated by the City 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

        1) 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.

        2) 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.

        3) 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)

        1) 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.

        2) Joints shall be push or mechanical elastomeric gasket type, conforming to ASTM D 3139.

    c. High Density Polyethylene (HDPE)

        1) 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.

        2) Polyethylene Resin: PE 3408, minimum Cell Classification PE 345464C per ASTM D3350.

3) Joints: Butt Fusion Welded or Electrofusion Welded per ASTM D 2657.

4) Fittings in accordance with ASTM D3261 with a pressure rating equal to the pipe with an included 2:1 safety factor.

5) 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 City. 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 City for conformity and ease of maintenance.

E. Testing and Startup

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 City 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 City Engineer. Pressure testing shall be made in increments of 2,000 feet or less unless otherwise authorized by the City 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. City Engineer and City personnel must be present for the start-up. The Contractor will demonstrate the operation and maintenance of the equipment to the City, as well as test the controls and operation of the station. The Contractor shall supply the City 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 City of Taylor will apply for and is responsible only for submitting Sanitary Sewer and Water Main Construction Permits to the appropriate permitting agencies for review. The engineering design and 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 City Engineer and City's Engineering Consultant 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 both the City Engineer and the City's Engineering Consultant.

A. Sanitary Sewers on Wayne County System

Construction of sanitary sewers that are tributary to the Downriver Utility Wastewater Authority (DUWA) located in Wyandotte will require a permit from both DUWA and the Michigan Department of Environment, Great Lakes and Energy (EGLE). Following approval from the City of Taylor, the plans along with the EGLE permit form are submitted to DUWA first, and when approved are forwarded to EGLE through the MiWaters Program for review and permit issuance.

The following requirements apply to sanitary sewer permits within the DUWA sewer systems:

1. A permit application form is required for all public sanitary sewer construction. The standard EGLE application form is available on the EGLE website and is referred to as a Part 41 Wastewater Construction Permit. The City of Taylor will assist with the MiWaters online application procedure.

2. The plans and permit application forms are submitted to the City Engineer/Engineering Consultant for review and approval first. The City Engineer/Engineering Consultant will forward the plans to DUWA for approval. Once approved by DUWA, the plans are uploaded to the MiWaters site to EGLE for final review and issuance of the Part 41 Permit.

3. Four sets of plans are required. Plans must be signed and sealed by a registered professional engineer and stamped as approved by the City Engineer/Engineering Consultant.

4. 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.

5. A completed copy of the latest revision of the "DUWA, Sanitary Sewer Approval Checklist" must accompany the plan submittal. All of the requirements of the checklist should be completed.

6. Any associated review fees are the responsibility of the Project Sponsor.

B. Submittal for Water Main Construction Permit

Construction of water mains that are connected to the City water supply will require a permit from EGLE. The plans along with the completed EGLE Act 399 permit application form are submitted to the City Engineer/Engineering Consultant first, and when approved are forwarded to EGLE 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 EGLE website.

2. Four sets of plans are required. Plans must be signed and sealed by a registered professional engineer and stamped as approved by the City Engineer/Engineering Consultant.

3. Plans should include a water main listing all water main lengths, by size, type of pipe and by location (street, or appropriate segment).

4. Plans are approved by the City Engineer/Engineering Consultant and sent to EGLE. EGLE issues the Act 399 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. Any associated review/construction fees remain the responsibility of the Project Sponsor.

1. Work in Wayne County Right of Way (includes Drains, Easements, Parks, and any other Wayne Co. Owned Property):

    a. Three complete sets of signed and sealed plans are typically required along with the completed application and applicable plan review fee. Refer to Wayne County's website for more detailed information.

    b. Plans are sent to:

        Wayne County Department of Public Services Permit Office
        33809 Michigan Avenue
        Wayne County, MI 48184

    c. A copy of the approved permit from Wayne County must be provided to the City Engineer/Engineering Consultant prior to construction.

2. Work in Michigan Department of Transportation (MDOT) Right-of-Way

    a. All construction permit applications are submitted and purchased through the "MDOT Permit Gateway" online service. Additional information may be found at on MDOT's website.

b. A copy of the approved permit from MDOT must be provided to the City Engineer/Engineering Consultant prior to construction.

3. Work in City of Taylor Right-of-Way

a. A completed application, site plan or engineering drawing must be forwarded to the Department of Public Works for review and permit issuance. The application is available on the City of Taylor's website.

D. Soil Erosion and Sedimentation Control Permit

Construction activities which disturb land area may be subject to a Soil Erosion and Sedimentation Control (SESC) Permit. The City of Taylor is an Authorized Public Agency (APA) and is therefore responsible for overseeing the SESC Program and issuing the associated permits for disturbed areas within the City of Taylor.

1. Three sets of plans are required; plans must be signed and sealed by a registered professional engineer and forwarded to the City Engineer/Consulting Engineer for review and approval.

2. A completed permit application form is required.

3. Review and inspection fees will be assessed by the City Engineer/Engineering Consultant and must be paid directly to the City of Taylor.

E. NPDES – Construction Site Storm Water Permit

Construction activities which disturb more than five acres of land area are subject to a National Pollutant Discharge Elimination System (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. Sites of five acres or more require a Notice of Coverage Permit from EGLE.

2. The Applicant must first obtain the Soil Erosion and Sedimentation Control (SESC) Permit from the Authorized Public Agency (APA) for the Project (i.e. City of Taylor).

3. The "Notice of Coverage" application is completed through the online MiWaters account.

4. Payment of the application fee is required.

5. Upon receipt, a copy of the "Notice of Coverage" (NOC) must be submitted to the City Engineer/Engineering Consultant prior to construction.

F. Work in Wayne County Drain

Construction activities within or impacting a Wayne County Drain and/or Drain Easement will require a permit from Wayne County. Work in County Drains may also require a permit from EGLE for impacts to wetlands, floodplains or inland lakes and streams. Applicants should verify with Wayne County and EGLE which permits will be required.

Work in Drains is covered by the Wayne County Permit Office. All Wayne County reviews (road right-of-way, drains, parks, etc.) are done from one submittal through the Permit office.

G. Tree Removal Permit

A City of Taylor Tree Removal Permit is required for removal of trees six (6) inches DBH (diameter at breast height) or greater on property two (2) acres or more, noting Agricultural/Farming or Nursery/Tree Farms are exempt. The associated application and fee can be found on the City of Taylor's website.

H. State of Michigan - EGLE

The Michigan Department of Environment, Great Lakes and Energy (EGLE) governs a variety of construction activities as they may impact water features and environmentally sensitive areas. Applicants should contact EGLE to determine which permits may apply to their project. The EGLE land/water management permit forms, fee schedules, rules etc., are all available on EGLE's website. Upon receipt of the necessary Permit, a copy must be provided to the City Engineer/Engineering Consultant prior to construction.

I. 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 chapter 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 City.

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 City Engineer or City Representative to discuss the various project requirements with the Developer, Contractor and the City. Prior to scheduling a pre-construction meeting, items such as insurance binders, permits and other items as required by the City must be submitted for review and approved by the City Engineer or City Representative.

A. Preconstruction Requirements

PRECONSTRUCTION REQUIREMENTS

The following is a summary of preconstruction requirements, which shall be fulfilled (where applicable), and evidence supplied to the City Engineer prior to the scheduling of the preconstruction meeting. A detailed outline 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 City or a home owners association for use and maintenance.

PERMITS AND APPROVALS

Unless otherwise provided, the City 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 City 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 City 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.

SITE ENGINEERING CONSTRUCTION PHASE FEES

Appropriate fees and/or deposits for fees shall be deposited with the City for administration, construction engineering, staking (for public utilities when applicable) and observation. Geotechnical or material testing costs are the responsibility of the Project Sponsor.

CONSTRUCTION SECURITIES

Where applicable, the construction security (i.e., cash, escrow agreement, bank letter of credit – as determined by the City of Taylor) shall be as determined by the City of Taylor, noting it may be in the amount equal to 100 percent of the total cost of construction plus the contingent amount required by the City and shall be maintained until final acceptance of the Project by the City. The construction security amount should include the cost to construct public sanitary sewer, water main, storm sewer, paving including roads and parking lots and curb and gutter. The original should be provided to the City Engineer with a copy to the City's Engineering Consultant (where applicable). 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 public improvements payable to the City of Taylor 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 City 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 outlines the relationships and responsibilities of the Project Sponsor, Contractor, City, and Engineer. Evidence of acceptance of General Construction Requirements shall be supplied to the City Engineer by completing the Acceptance of General Construction Requirements form found in Appendix A.

EASEMENTS

Easements must be granted to the City for public improvements that traverse private property. Easement requirements can be found in Chapters III, IV and V for each type of improvement. Standard easement forms for Water Main and Sanitary Sewer are provided in Appendix A. Original executed easements shall be furnished to the City Engineer or City Representative.

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 City, with a copy furnished to the City engineer.

CONSTRUCTION SURVEY (STAKING)

The City's Engineering Consultant may provide construction staking for public improvements.

Unless Specifically waived, prior to the preconstruction meeting, the Project Designer shall furnish to the City's Engineering Consultant, three (3) copies of the plat, or stringer plan and control print indicating the type and location of monuments or survey points required for field staking the proposed public utilities. The plan(s) must locate all the public utility lines, manholes, valves, and hydrants in relation to these survey points by tie dimensions or coordinates.

A certified letter from the Professional Engineer/Surveyor responsible for staking private paving improvements, staking the improvements have been staked in accordance with the approved plans, must be submitted to the City Engineer or City's Representative at the appropriate time. Any grading variances from the approved plans should be noted in the certification letter.

PRECONSTRUCTION MEETING

Prior to construction, but after all of the above items have been complied with, the Contractor shall contact the City Engineer or City's Representative 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 confirm the previously submitted 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 City Engineer shall be required during the construction of subdivisions, site plan improvements and utility systems and roads located within the City. 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, SESC and pumping stations. Inspection personnel shall be provided by the City Engineer City staff and/or the City's Engineering Consultant. 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 City for inspection shall be paid by Project Sponsor prior to final acceptance of the project by the City 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 City Engineer or City's Representative.

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 City Engineer. All testing shall be subject to the direction and review of the City Engineer and/or City's Representative.

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 City 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 City 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 City 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 City Department of Public Works (DPW) and returned to the City DPW 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 City 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 City 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 City 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 the City of Taylor. Inspections of the site will be done by the City Engineer and/or City Representative. 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 City Engineer, the Contractor shall construct a concrete cradle or other type of bedding as approved by the City 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 Standard Details.

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 City 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 Standard Detail Sheets.

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 City Engineer with pipe deliveries. Certification forms shall include project name, location, Contractor and test lot number. Lot sizes shall be acceptable to the City 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 City 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 City Engineer, is unsuitable.

1. Backfilling immediately after installation. Unless otherwise authorized by the City 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 City 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 City 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 City 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 City 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. The backfill shall be compacted to 95 percent of its 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 City 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 City 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 City Engineer. The open cutting of public paved roadways will not be permitted, except under extremely unusual situations and with approval from the City Engineer.

1. Materials. See Standard Detail Sheets 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 City 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 City for Operation and Maintenance. Final Acceptance of a Project requires approval from the City Engineer and/or the City's Engineering Consultant. 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 City 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 City Engineer or City's Representative before an Acceptance for Use letter can be issued. Acceptance from the City Building Department is separate from Engineering Acceptance.

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 City Engineer, City Engineer field personnel must be present on-site to witness these tests.

   Water Mains shall pass a pressure and bacteriological testing prior to acceptance. City Engineer field personnel must be present. Please refer to Chapter III for further details.

2. Pump Station Initial Start-Up

   Sanitary sewer and storm water pump stations shall undergo an initial start-up process. City Engineer (or City Representative) and City personnel must be present for the start-up. The Contractor will demonstrate the operation and maintenance of the equipment to the City, as well as test the controls and operation of the station. The Contractor shall supply the City 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 plans must be completed by the Project Sponsor and submitted to the City Engineer/City's Engineering Consultant for review. GPS coordinates must be obtained for all as-built structures.

   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 for recordation at Wayne County. An original recorded easement must be submitted to the City, with a copy to the City's Engineering Consultant.

5. Project Walk Through

City Engineer/City's Engineering Consultant, City 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, the City Engineer/City's Engineering Consultant will issue a letter recommending that the City 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.

CITY OF TAYLOR
PRECONSTRUCTION REQUIREMENTS
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PRECONSTRUCTION REQUIREMENTS

1.0 GENERAL

A preconstruction meeting will be required between the Municipality, the City's Engineering Consultant, and the Contractor prior to the beginning of construction of improvements.

The following is a summary of preconstruction requirements which shall be fulfilled (where applicable) and evidence provided to the City Engineer and/or Engineering Consultant prior to scheduling the preconstruction meeting.

2.0 PERMITS AND APPROVALS

Unless otherwise provided, the City of Taylor will assist in obtaining Public Sanitary Sewer and Public Water Main Permits from the Michigan Department of Environmental Quality (MDEQ). Required fees for these permits are to be paid by the Contractor, Project Sponsor or Project Designer. All effort pertaining to design is the responsibility of the Project Designer.

All other permits and approvals shall be obtained by the Contractor, Project Sponsor or Project Designer and a copy provided to the City's Engineering Consultant prior to scheduling 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 the City's Engineering Consultant.

3.0 CONTRACTS

Bona fide copies of the Construction Contract(s) for the proposed improvements shall be provided to the City's Engineering Consultant.

4.0 FEES

Appropriate fees shall be deposited with the City of Taylor for administration, construction engineering, inspection and staking (where applicable for public utilities). Geotechnical or material testing costs are the responsibility of the Project Sponsor.

5.0 CONSTRUCTION SECURITIES

Where applicable, the construction security (i.e. cash, escrow agreement, bank letter of credit – as determined by the Municipality) shall be as determined by the Municipality, noting it may be in the amount equal to one hundred (100%) percent of the total cost of construction plus the contingent amount required by the City of Taylor and shall be maintained until final acceptance of the Project by the City. The original should be provided to the City of Taylor with a copy to the City's Engineering Consultant. This amount is in addition to the fees mentioned above.

6.0 BONDS

A Maintenance and Guarantee Bond shall be drawn in an amount equal to one hundred (100%) percent of the construction cost of public improvements payable to the Municipality and running for a period of one (1) year, or such period as may be required if longer than one (1) year, from the date of acceptance of the installation.

7.0 INSURANCE REQUIREMENTS

Prior to the preconstruction meeting, the Contractor will be required to supply the City Engineer and/or the City's Engineering Consultant with evidence of insurance meeting the requirements stated in Attachment I, "City of Taylor Municipal Insurance Requirements". No preconstruction meeting will be scheduled until all the Municipal Insurance Requirements are met.

8.0 ACCEPTANCE OF GENERAL CONSTRUCTION REQUIREMENTS AND MUNCIPAL INSURANCE REQUIREMENTS

Evidence of acceptance of the City of Taylor's General Construction Requirements, Attachment III, which outlines the relationships and responsibilities of the Project Sponsor, Contractor, Municipality and Engineer and the City of Taylor Municipal Insurance Requirements, Attachment I, by both the Project Sponsor and the Contractor shall by supplied to the City's Engineering Consultant prior to establishing a preconstruction meeting. This evidence is usually provided by completing Attachment II entitled, "City of Taylor Acceptance of General Construction Requirements and Municipal Insurance Requirements".

9.0 FINAL MEASURES

Final measure plans must be completed by the Project Sponsor and submitted to the City's Engineering Consultant for review. GPS coordinates must be obtained for all as-built structures.

10.0 EASEMENTS

Easements must be granted to the City of Taylor for public improvements that traverse private property. Generally, these easements are to be 12 feet wide for public water and 20 feet wide for public sanitary sewer, centered on the utility or utilities. Actual easement width requirements are determined on an individual basis. Executed easements shall be furnished to the City Engineer or the City's Engineering Consultant prior to scheduling the preconstruction meeting. When work is performed on, or requires the use of adjacent property, permission to do so must be obtained from the property owner in appropriate written form and filed with the Municipality, with a copy to the City Engineer or City's Engineering Consultant.

11.0 STORM WATER MANAGEMENT LONG TERM MAINTENANCE AGREEMENT

The original City of Taylor "Storm Water Long Term Maintenance Agreement", executed by the Property Owner, must be submitted to the City Engineer or City's Engineering Consultant prior to the preconstruction meeting. The Agreement outlines the Property Owner's maintenance responsibilities associated with the storm water conveyance, treatment and storage system.

12.0 PLAN SETS FOR APPROVAL

Upon verbal approval of the proposed civil site improvements, ten (10) complete signed and sealed sets of plans must be provided to the City Engineer or the City's Engineering Consultant for issuance of formal approval. The plan sets must include the applicable City of Taylor Standard Detail Sheets.

Electronic (CADD and PDF) field of the approved plans must be forwarded to the City Engineer and/or the City's Engineering Consultant.

13.0 CONSTRUCTION SCHEDULE

The Contractor will be required to provide a proposed construction schedule to the City Engineer and/or the City's Engineering Consultant.

14.0 PRIVATE UTILITIES

The Project Sponsor or Design Engineer is responsible for distributing approved plans to appropriate utility companies prior to the preconstruction meeting. It is recommended the Design Engineer distribute plans in a timely manner to allow enough time for utility companies to perform their review. Copies of the transmittals should be provided to the City Engineer and/or the City's Engineering Consultant.

15.0 CONSTRUCTION SURVEY (STAKING)

The City's Engineering Consultant may provide construction staking for public improvements. Unless specifically waived, prior to the preconstruction meeting, the Project Designer shall furnish to the City's Engineering Consultant, three (3) copies of the plat, or stringer plan and control print indicating the type and location of monuments or survey points required to field staking the proposed public utilities. The plan(s) must locate all the public utility lines, manholes, valves and hydrant in relation to these survey points by tie dimensions or coordinates.

A certified letter from the Professional Engineer responsible for staking private paving improvements, stating the improvements have been staked in accordance with the approved plans, must be submitted to the City Engineer and/or the City's Engineering Consultant's office at the appropriate time. Any grading variances from the approved plans should be noted in the certification letter.

16.0 MIX DESIGNS, SHOP DRAWINGS AND TESTING RESULTS

Mix designs and shop drawings approved by the Designer must be submitted to the City Engineer and/or the City's Engineering Consultant. Testing results as discussed during the preconstruction meeting must be provided to the City Engineer and/or the City's Engineering Consultant.

17.0 ATTACHMENTS

ATTACHMENT I	ACCEPTANCE OF CITY OF TAYLOR GENERAL CONSTRUCTION REQUIREMENTS AND MUNICIPAL INSURANCE REQUIRMENTS FORM
ATTACHMENT II	GENERAL CONSTRUCTION REQUIREMENTS
ATTACHMENT III	CITY OF TAYOR MUNICIPAL INSURANCE REQUIREMENTS
ATTACHMENT IV	STANDARD WATER MAIN EASEMENT
ATTACHMENT V	STANDARD SANITARY SEWER EASEMENT
ATTACHMENT VI	STORM WATER MANAGEMENT LONG TERM MAINTENANCE AGREEMENT (PUBLIC AND PRIVATE)
ATTACHMENT VII	MAINTENANCE AND GUARANTEE BOND
ATTACHMENT VII	FEE SCHEDULE

City of Taylor
Acceptance of General Construction Requirements
And Municipal Insurance Requirements

Project: _____

Job No. _____

Project Sponsor: _____

Contractor: _____

Designer: _____

Date: _____

We, hereby, fully and unconditionally accept the General Construction Requirements (GCR-1 through GCR-10) 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:

_____ _____

CITY OF TAYLOR
GENERAL CONSTRUCTION REQUIREMENTS
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GENERAL CONSTRUCTION REQUIREMENTS

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 for public water and public sewer; these services are to be paid by the Project Sponsor. 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. All remaining private utility, pavement and grading staking is to be completed by the Project Sponsor through their own Surveyor. The Surveyor must provide the Inspector and/or the Engineer's office with cut sheets prior to daily construction activities. It is requested that the structures labeled/numbered on the cut sheet correspond with the labeling/numbering on the approved engineering plans. All utility crossings must be staked and listed on the cut sheets. All bends require in and out offset stakes.

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 for all public water and public sewer. 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 and/or Municipality.

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 and/or Muncipality.

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/letter 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.

CITY OF TAYLOR MUNICIPAL INSURANCE REQUIREMENTS

The Contractor shall purchase and maintain during the term of the Project such insurance as will protect him, the Municipality, the Owners, the Engineer(s) and the Project Designer from claims arising out of the work described in the 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, plus appropriate endorsements to protect Owner, and Engineer(s) against claims, demands and lawsuits from employees of the Contractor, Subcontractor(s) and/or Sub-subcontractors, 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. 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.

    g. Broad form property damage.

    h. Cross liability endorsement.

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.

6. The City of Taylor must be made an additional insured on all General Liability Policies by

providing a standard Certificate of Insurance plus endorsement, or its equivalent, showing the following:

"The City of Taylor, and its Officials, Officers, Agents, Representatives, Employees, Boards, Commissions, Volunteers and the City of Taylor's Consulting Engineer, are named as additional insured parties and this coverage shall be considered to be primary coverage to these additional insureds and the City of Taylor's insurance coverage is non-contributory".

7. Where any of the work is within a railroad right-of-way, the Contractor will provide coverage in the name of each railroad company having jurisdiction over fights-of-way across which work under the contract is to be performed. The form of policy and the limits of liability shall be determined by the railroad company(ies) involved.

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 the City Engineer of cancellation or of intent not to renew. All work on the project by the contractor and/or subcontractors, shall cease until new insurance coverage acceptable to the Municipality is in place.

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 VII and a policyholder's service rating no lower than A-, as listed in A.M. Best's Key Rating Guide, current edition. Companies with ratings lower than A-, VII 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	$2,000,000
Products - Com/Ops Aggregate	$1,000,000
Personal and Advertising Injury	$1,000,000
Each Occurrence	$1,000,000
Fire Damage (any one fire)	$ 100,000
Medical Expense (any one person)	$ 5,000

Comprehensive Automobile Liability – Coverage Shall Include Owned, Non-owned, and Hired Autos

Combined Single Limit	$1,000,000

Umbrella or Excess Liability

As applicable

Owner’s and Contractor’s Protective Policy

Policy to be written with City of Taylor, Michigan and its Officials, Officers, Agents, Representatives, Employees, Boards, Commissions and Volunteers, and the Insured and the City’s Consulting Engineer and any other permitting agencies requiring insurance as Additional Insured

Each Occurrence	$2,000,000
General Aggregate	$1,000,000

*Certificates shall show that X, C, and U coverage is included.

PRIVATE SPONSORED PROJECT

EASEMENT FOR WATER MAIN

PARCEL/LOT & SUBN. _____
SIDWELL NO. _____

THIS INDENTURE made the _____ day of _____ A.D.20_____between _____ whose address is _____, (Grantor(s)), and the City of Taylor, whose address is 23555 Goddard Road, Taylor, Michigan 48180-4117, a Municipal Corporation, of the County of Wayne, State of Michigan, (Grantee).

1. The Grantor(s) for and in consideration of the sum of One Dollar and other valuable consideration to them in hand paid by the Grantee, the receipt whereof is hereby confessed and acknowledged, do, by these presents, grant unto the Grantee, its successors, and assigns, a permanent, nonexclusive easement for the purpose of access at any time and to install, construct, operate, inspect, repair, replace and maintain water lines, valves, connections, hydrants, and equipment (including replacements thereof, the Facilities) therefore in, unto, and upon that certain piece of land situated in the City of Taylor, County of Wayne, and State of Michigan, to-wit:

   See attached Exhibit A for PARCEL DESCRIPTION and EASEMENT DESCRIPTION

2. The granting of the above easement does not vest in the Grantee authority to use any portion of the said property for purposes other than herein designated.

3. The Grantor(s) also grants to the Grantee perpetual rights of entry upon, passage over, through or under, deposit of excavated earth, and temporary storage of material and equipment on the easement area as may be necessary or useful for the construction, installation, inspection, operation, replacement, maintenance and repair or such.

4. Grantor(s) agrees to reasonably restore the property to substantially the same condition which existed immediately prior to the installation, inspection, construction, repair, replacement or maintenance of the Facilities and to pay all costs and expenses associated with any construction, installation, inspection, operation, replacement, maintenance and repair of the Facilities.

5. Grantor(s) hereby covenants with the Grantee that they are lawfully seized and possessed of the real estate described in Exhibit A, that they have good and lawful right to convey it or any part thereof, and that they will forever warrant and defend the title thereto against the lawful claims of all persons whomsoever.

6. Grantor(s) retain all other property rights in the property but agrees not to construct any buildings or structures within the easement area.

7. The easement shall run with the land and be binding upon the Grantor(s), the Grantee and their heirs, personal representatives, successors and assigns.

8. Grantee agrees to pay applicable state and county transfer taxes resulting from the recording of this easement.

IN WITNESS WHEREOF, the Grantor(s) have hereunto set their hands and seals the day and year first above written.

GRANTOR(S):

_____

_____

Acknowledged before me in _____County, Michigan on _____, 2009 by _____.

_____
Notary's Stamp
[Notary Name, County, Acting in County and Date Commission Expires]

_____
Notary's Signature
Notary Public, _____County, Michigan
Acting in _____County, Michigan
My Commission Expires: _____

INSTRUMENT DRAFTED BY:

WHEN RECORDED RETURN TO:
City of Taylor
23555 Goddard Road
Taylor, MI 48180-4117
Ms. Cynthia A. Bower, Clerk

PRIVATE SPONSORED PROJECT

EASEMENT FOR SANITARY SEWER

PARCEL/LOT & SUBN. _____
SIDWELL NO. _____

THIS INDENTURE made the _____ day of _____ A.D.20_____between _____, whose address is _____, (Grantor(s)), and the City of Taylor, whose address is 23555 Goddard Road, Taylor, Michigan 48180-4117, a Municipal Corporation, of the County of Wayne, State of Michigan, (Grantee).

1. The Grantor(s) for and in consideration of the sum of One Dollar and other valuable consideration to them in hand paid by the Grantee, the receipt whereof is hereby confessed and acknowledged, do, by these presents, grant unto the Grantee, its successors, and assigns, a permanent, nonexclusive easement for the purpose of access at any time and to install, construct, operate, inspect, repair, replace and maintain sewer lines, valves, connections and equipment (including replacements thereof, the Facilities therefore in, unto, and upon that certain piece of land situated in the City of Taylor, County of Wayne, and State of Michigan, to-wit:

   See Attached Exhibit A for PARCEL DESCRIPTION and EASEMENT DESCRIPTION

2. The granting of the above easement does not vest in the Grantee authority to use any portion of the said property for purposes other than herein designated.

3. The Grantor(s) also grants to the Grantee perpetual rights of entry upon, passage over, through or under, deposit of excavated earth, and temporary storage of material and equipment on the easement area as may be necessary or useful for the construction, installation, inspection, operation, replacement, maintenance and repair or such.

4. Grantor(s) agrees to reasonably restore the property to substantially the same condition which existed immediately prior to the installation, inspection, construction, repair, replacement or maintenance of the Facilities and to pay all costs and expenses associated with any construction, installation, inspection, operation, replacement, maintenance and repair of the Facilities.

5. Grantor(s) hereby covenants with the Grantee that they are lawfully seized and possessed of the real estate described in Exhibit A, that they have good and lawful right to convey it or any part thereof, and that they will forever warrant and defend the title thereto against the lawful claims of all persons whomsoever.

6. Grantor(s) retain all other property rights in the property but agrees not to construct any buildings or structures within the easement area.

7. The easement shall run with the land and be binding upon the Grantor(s), the Grantee and their heirs, personal representatives, successors and assigns.

8. Grantee agrees to pay applicable state and county transfer taxes resulting from the recording of this easement.

IN WITNESS WHEREOF, the Grantor(s) have hereunto set their hands and seals the day and year first above written.

GRANTOR(S):

_____

_____

Acknowledged before me in _____County, Michigan on _____, 2009 by _____.

_____
Notary's Stamp
[Notary Name, County, Acting in County and Date Commission Expires]

_____
Notary's Signature
Notary Public, _____County, Michigan
Acting in _____County, Michigan
My Commission Expires: _____

INSTRUMENT DRAFTED BY:

WHEN RECORDED RETURN TO:
City of Taylor
23555 Goddard Road
Taylor, MI 48180-4117
Ms. Cynthia A. Bower, Clerk

City of Taylor
Department of Public Works
25605 Northline Road
Taylor, MI 48180
734-374-1473

RE: Storm Water Facilities Maintenance

Dear Developer/Engineer:

When a proposed project includes a storm water system, the City of Taylor requires the developer to accept long term maintenance through execution of the City's standard Storm Water Management Long Term Maintenance Agreement and Plan.

Enclosed please find the standard Storm Water Management Long Term Maintenance Agreement and Plan and instructions for execution.

Upon receipt of the Agreement, we will forward the executed agreement to Wayne county Register of Deeds for recording.

Enclosure

INSTRUCTIONS FOR COMPLETION OF
STORM WATER FACILITIES MAINTENANCE AGREEMENT AND PLAN

Page 3, Paragraph 1: Fill in date, owner of record (indicate whether a Michigan corporation, co-partnership, etc.), owner's address.

Page 3, RECITALS, Item 1: Name of project

Page 3, Signature Area: (Name of Owner)
a Michigan co-partnership/corporation (Type of business org)

WITNESSES:

Signature of Witness — By: Signature of Company Official/Owner
Print Name of Witness under signature — Its: Print Official Title

Signature of 2nd Witness
Print Name of Witness under signature

Have signatures notarized in notary area under the signature block.

Page 4: INSTRUMENT DRAFTED BY:

_____ Provide name and address of person who

_____ filled in the owner info and project name

_____

EXHIBIT A **Map Depicting Physical Limits of Storm Water Management System.**

EXHIBIT B **Long Term Maintenance Plan for the Proposed Storm Sewer Facilities.**

EXHIBIT C **Legal Description of Property.**

STORM WATER MANAGEMENT LONG TERM MAINTENANCE AGREEMENT AND PLAN

THIS AGREEMENT is made this _____ day of _____, 20__, by and between the City of Taylor, a municipal corporation, with principal offices located at 23555 Goddard Road, Taylor, Michigan 48180, hereinafter "City" and _____ a _____ Michigan Co-Partnership/Corporation, with principal offices located _____, hereinafter "Proprietor".

RECITALS:

1. The Proprietor is developing certain property located in the City of Taylor, Wayne County, Michigan as _____ ("Development") as more particularly described in Exhibit "C" attached hereto.

2. The Proprietor must construct a storm drainage system to provide adequate drainage in the proposed Development as more particularly described in Exhibit "A" attached hereto.

3. The City and Proprietor desire that the storm drainage system to be constructed in the Development be maintained in perpetuity to ensure that it functions properly as designed and in conformity with applicable laws and regulations.

NOW, THEREFORE, for and in consideration of the mutual covenants and benefits to be derived hereunder, the receipt, adequacy and sufficiency of which is hereby acknowledged, and fully incorporating the above-stated recitals into the agreement, the City and the Proprietor agree as follows:

1. The Proprietor shall fully, completely and unconditionally assume the obligations of maintaining the storm drainage system in the Development as follows:

A. That the Proprietor agrees it will inspect, repair, and maintain, at its own expense, the storm drainage system which is located within the Development in conformity with all applicable laws and regulations and in conformity with this Agreement. If Proprietor fails to do so, then, upon reasonable notice to Proprietor, The City may enter upon said premises for the purposes of inspecting, repairing and maintaining said storm drainage system, in which event the Proprietor agrees to pay to the City all reasonable charges and expenses incurred thereon.

2. Notwithstanding the Proprietor's assumption of the liabilities and expenses of Paragraph 1 hereof, the City shall retain jurisdiction over the storm drainage system granted to it by any applicable statute, ordinance, rule or regulation, and the City's rights and remedies under the same are hereby preserved. Without limitation of the foregoing, Proprietor, its successors and assigns, at its sole cost and expense shall perform maintenance of the storm water facilities as described in Exhibit "B" attached hereto and incorporated herein by reference.

3. The Proprietor, its agents, representatives, successors and assigns shall defend, indemnify and hold the City harmless from and against any claims, demands, actions, damages, injuries, costs or expenses of any kind or nature whatsoever, hereinafter "Claims", fixed or contingent, known or unknown, arising out of or in any way connected with the design, construction, use, inspection, maintenance, repair or operation (or omissions in such regard) of the storm drainage system which is the subject of this Agreement. This indemnity and hold harmless shall include any reasonable costs, expenses and attorney fees incurred by the City in connection with such Claims or the enforcement of this Agreement.

4. This agreement shall bind the Proprietor, its successors and assigns, and any person or entity claiming any right or ownership in the Development.

5. This Agreement shall be recorded at Proprietor's expense with the Wayne County Register of Deeds.

6. Despite the indication of the drafter indicated below, which is included for recording purposes only, this Agreement shall not be construed in favor or against either Proprietor or City, as it is the result of their mutual efforts.

IN WITNESS WHEREOF, the Proprietor and City have executed this Agreement on the day and year first above written.

_____
Michigan Co-Partnership/Corporation

By: _____

Print/Type Name: _____

Title: _____

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:

_____the _____of _____.

_____
Notary Public

_____ County, Michigan
My Commission Expires On: _____

CITY OF TAYLOR
A municipal corporation

By: _____
Keith Boc

Its: __Executive Director, DPW_____

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:

_Keith Boc__the Executive Director, DPW of the City of Taylor, Michigan_____.

_____
Notary Public

_____ County, Michigan
My Commission Expires On: _____

INSTRUMENT DRAFTED BY:

_____

_____

_____

_____

WHEN RECORDED RETURN TO:
City of Taylor
23555 Goddard Road
Taylor, MI 48180
Attention: Ms. Cynthia A. Bower, City Clerk

ATTACHMENTS

EXHIBIT A

Map Depicting Physical Limits of Storm Water Management System

EXHIBIT B

Long Term Maintenance Plan for the Proposed Storm Water Facilities

Detention Pond/Forebay

REQUIRED MAINTENANCE:

- Check the outlet regularly for clogging and clean when necessary (annually).
- If necessary based on surroundings, mow grass side slopes (two times per year).
- Inspect entire system at least annually including inlet/outlet pipes, restricted outlet structure(s), animal grates and filters.
- Check banks and bottom for erosion and correct as necessary (annually).
- Remove sediment when accumulation reaches six inches or if resuspension is observed.
- Reseed banks near inlet/outlet and stabilize eroded banks as necessary.
- Add grasses such as sedges and rushes.
- Add cattails (as necessary).
- Add wetland/flowering plants along and around about 50% of the perimeter.
- Add trees/bushes to banks (south and west side for shade as necessary).
- Remove dead vegetation (early spring) that obstructs flow.

If the outlet is pumped, then only a licensed electrician or company that provided the pump system should conduct any maintenance. Chemicals should not be applied to your detention basin, side slopes or buffer strip.

Manufactured/Underground Detention System

REQUIRED MAINTENANCE:

- Check the outlet regularly for clogging and clean when necessary (annually).
- Inspect entire system including inlet/outlet pipes, restricted outlet structure(s), and water quality structures (two times per year).
- Clean detention system if its volume has been reduced by more than 10 percent due to accumulation of silt and sediment.

Storm Sewer Distribution System

REQUIRED MAINTENANCE:

- Check the outlet regularly for clogging and clean when necessary (annually).
- Inspect entire storm sewer distribution system (two times per year).
- Clean storm sewer structures when accumulation of silt and sediment reaches 6-inches or greater.
- Clean grates on inlets, outlets, and other storm sewer structures should be cleaned regularly.
- Water channels should be cleaned regularly.

EXHIBIT C

Legal Description of Property

City of Taylor
Department of Public Works
25605 Northline Road
Taylor, MI 48180
734-374-1473

RE: Storm Water Facilities Maintenance (Requiring Wayne County Permit)

Dear Developer/Engineer:

When a proposed project includes a storm water system, Wayne County requests a resolution from the City of Taylor whereby the City of Taylor accepts long term maintenance jurisdiction for the storm water facilities on the property. In turn, the City requires the developer to assume that responsibility through execution of the City's standard Storm Water Management Long Term Maintenance Agreement and Plan.

Enclosed please find the standard Storm Water Management Long Term Maintenance Agreement and Plan and instructions for execution.

Upon receipt of the Agreement, we will forward the City resolution to Wayne County (we will need your Wayne County Review and Permit Number to be included in the resolution).

Enclosure

INSTRUCTIONS FOR COMPLETION OF
STORM WATER MANAGEMENT LONG TERM MAINTENANCE AGREEMENT AND PLAN
REQUIRING WAYNE COUNTY PERMIT

Page 3, Paragraph 1: Fill in date, owner of record (indicate whether a Michigan corporation, co-partnership, etc.), owner's address.

Page 3, RECITALS, Item 1: Name of project

Page 4, Signature Area: (Name of Property Owner)
a Michigan co-partnership/corporation (Type of business org)

Signature of Owner
By: Signature of Company Official/Owner
Print Name of under signature
Its: Print Official Title

Have signatures notarized in notary area under the signature block.

Page 6: INSTRUMENT DRAFTED BY:

_____ Provide name and address of person who

_____ filled in the owner info and project name

_____

EXHIBIT A **Map Depicting Physical Limits of Storm Water Management System.**

EXHIBIT B **Long Term Maintenance Plan for the Proposed Storm Sewer Facilities.**

EXHIBIT C **Storm Water Maintenance Permit issued by Wayne County to the City of Taylor.**

EXHIBIT D **Legal Description of Property.**

STORM WATER MANAGEMENT LONG TERM MAINTENANCE AGREEMENT AND PLAN

THIS AGREEMENT is made this _____ day of _____, 20__, by and between the City of Taylor, a municipal corporation, with principal offices located at 23555 Goddard Road, Taylor, Michigan 48180, hereinafter "City" and _____ a _____ Michigan Co-Partnership/Corporation, with principal offices located at_____, hereinafter "Proprietor".

RECITALS:

1. The Proprietor is developing certain property located in the City of Taylor, Wayne County, Michigan as _____ ("Development") as more particularly described in Exhibit "D" attached hereto.

2. The Proprietor must construct a storm drainage system to provide adequate drainage in the proposed Development as more particularly described in Exhibit "A" attached hereto.

3. Such storm drainage system will encompass or impact storm runoff from road rights-of-way in the Development.

4. The City has received a permit ("Permit") issued by the County of Wayne, Michigan, a public body corporate ("County") authorizing the construction, operation and maintenance of the storm drainage system which is located within the Wayne County Office of Public Services and/or the Michigan State Highway Department's right-of-way and/or drain, on or adjacent to the Development described in the Permit as Exhibit "C" attached hereto and incorporated herein by reference, so long as the City assumes jurisdiction for the operation and maintenance of the storm drainage system referred to in the Permit.

5. The Permit signed by the City will benefit the Proprietor and the proposed Development.

6. The City and Proprietor desire to transfer certain responsibilities of the City under the Permit to the Proprietor, or successors and assigns, and confirm the terms and conditions of such transfer of responsibility by this agreement between the City and Proprietor.

NOW, THEREFORE, for and in consideration of the mutual covenants and benefits to be derived hereunder, the receipt, adequacy and sufficiency of which is hereby acknowledged, and fully incorporating the above-stated recitals into the agreement, the City and the Proprietor agree as follows:

1. The Proprietor shall fully, completely and unconditionally assume the obligations of the City under the Permit for maintaining the storm drainage system in the Development as follows:

A. That the Proprietor agrees they will inspect, repair, and maintain, at their own expense, the storm drainage system which is located within the Wayne County Office of Public Services and/or the Michigan State Highway Department's right-of-way and/or drain, and on or adjacent to the Development described in the Permit as Exhibit "C" attached hereto and incorporated herein by reference. The City may enter upon said premises for the purposes of inspecting, repairing and maintaining said storm drainage system, in which event the Proprietor agrees to pay to the City all charges and expenses incurred thereon.

B. In the event of any failure or settlement in the road right-of-way, resulting from the said storm drainage system, the City shall take immediate steps to correct the situation so that the public health, safety and welfare shall not be endangered nor the road improvement damaged.

C. If it is found necessary to adjust or relocate all or any portion of said storm drainage system within the road right-of-way, the City shall cause such adjustment or relocation to be accomplished, and all expenses, including engineering, will be remitted to the City by the Proprietor. Prior to any work being performed in the road right-of-way, a permit shall be secured from the Wayne County Office of Public Services.

D. To pay the City upon written request any costs and expenses apportioned to the City under the Permit and paragraph 1A, 1B and 1C above.

2. Notwithstanding the Proprietor's assumption of the liabilities and expenses of Paragraph 1 hereof, the City shall retain jurisdiction over the storm drainage system and its rights and remedies under the Permit or any applicable statute, ordinance, rule or regulation are hereby preserved. Without limitation of the foregoing, Proprietor, its successors and assigns, at its sole cost and expense shall perform maintenance of the storm water facilities described in Exhibit "B" attached hereto and incorporated herein by reference.

3. The Proprietor, its agents, representatives, successors and assigns shall defend, indemnify and hold the City harmless from and against any claims, demands, actions, damages, injuries, costs or expenses of any kind or nature whatsoever, hereinafter "Claims", fixed or contingent, known or unknown, arising out of or in any way connected with the design, construction, use, inspection, maintenance, repair or operation (or omissions in such regard) of the storm drainage system referred to in the permit as Exhibit "C" hereto, appurtenances, connections and attachments thereto which are the subject of this Agreement. This indemnity and hold harmless shall include any costs, expenses and attorney fees incurred by the City in connection with such Claims or the enforcement of this Agreement.

4. In accordance with 1976 PA 453, the parties hereto covenant: (1) not to discriminate against any employee or applicant for employment with respect to hire, tenure, terms, conditions or privileges of employment, or a matter directly or indirectly related to employment, or a matter directly or indirectly related to employment because of race, color, religion, national origin, sex, age, height, weight or marital status.

5. This agreement shall bind the Proprietor, its successors and assigns, and any person or entity claiming any right or ownership in the Development.

6. This Agreement shall be recorded at Proprietor's expense with the Wayne County Register of Deeds.

7. Despite the indication of the drafter indicated below, which is included for recording purposes only, this Agreement shall not be construed in favor or against either Proprietor or City, as it is the result of their mutual efforts.

IN WITNESS WHEREOF, the Proprietor and City have executed this Agreement on the day and year first above written.

OWNER: _____
A Michigan co-partnership/corporation

By: _____

Print/Type Name: _____

Title: _____

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:

_____the_____of_____

_____
Notary Public

_____ County, Michigan
My Commission Expires On: _____

CITY OF TAYLOR
A municipal corporation

By: _____
Keith Boc

Its: __Executive Director, DPW_____

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:

Keith Boc, the Executive Director, DPW of City of Taylor, Michigan.

_____
Notary Public

_____ County, Michigan

My Commission Expires On: _____

INSTRUMENT DRAFTED BY:

_____

_____

_____

_____

WHEN RECORDED RETURN TO:
City of Taylor
23555 Goddard Road
Taylor, MI 48180
Attention: Cynthia A. Bower, City Clerk

ATTACHMENTS

EXHIBIT A

Map Depicting Physical Limits of Storm Water Management System

EXHIBIT B

Long Term Maintenance Plan for the Proposed Storm Sewer Facilities

Detention Pond/Forebay

REQUIRED MAINTENANCE:

- Check the outlet regularly for clogging and clean when necessary (annually).
- If necessary based on surroundings, mow grass side slopes (two times per year).
- Inspect entire system at least annually including inlet/outlet pipes, restricted outlet structure(s), animal grates and filters.
- Check banks and bottom for erosion and correct as necessary (annually).
- Remove sediment when accumulation reaches six inches or if resuspension is observed.
- Reseed banks near inlet/outlet and stabilize eroded banks as necessary.
- Add grasses such as sedges and rushes.
- Add cattails (as necessary).
- Add wetland/flowering plants along and around about 50% of the perimeter.
- Add trees/bushes to banks (south and west side for shade as necessary).
- Remove dead vegetation (early spring) that obstructs flow.

  If the outlet is pumped, then only a licensed electrician or company that provided the pump system should conduct any maintenance. Chemicals should not be applied to your detention basin, side slopes or buffer strip.

Manufactured/Underground Detention System

REQUIRED MAINTENANCE:

- Check the outlet regularly for clogging and clean when necessary (annually).
- Inspect entire system including inlet/outlet pipes, restricted outlet structure(s), and water quality structures (two times per year).
- Clean detention system if its volume has been reduced by more than 10 percent due to accumulation of silt and sediment.

Storm Sewer Distribution System

REQUIRED MAINTENANCE:

- Check the outlet regularly for clogging and clean when necessary (annually).
- Inspect entire storm sewer distribution system (two times per year).
- Clean storm sewer structures when accumulation of silt and sediment reaches 6-inches or greater.
- Clean grates on inlets, outlets, and other storm sewer structures should be cleaned regularly.
- Water channels should be cleaned regularly.

EXHIBIT C

Wayne County Storm Water Maintenance Permit issued to the City of Taylor and corresponding City of Taylor Resolution

EXHIBIT D

Legal Description of Property

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 City of Taylor, 23555 Goddard Road, Taylor, MI 48180 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

FEE SCHEDULE
PLANNING, BUILDING AND ENGINEERING REVIEW

The following can be used to assist in providing guidance in determining fees for various services provided by the City of Taylor. Fee schedules are adopted by the City each year and posted to the City's website.

1. *Site Plan Review*. At the time of submittal of plans the Project Sponsor shall deposit with the Planning Department a fee for review as specified in the City of Taylor Planning Department Fees. Please refer to the City of Taylor's website for application submittal requirements (i.e. application, plan submittals, fees).

2. *Site Engineering Plan Review.* Submittals for Detailed Engineering Plan Review shall include two (s) sets of signed and sealed plans, specifications and a detailed construction cost estimate of the proposed site civil improvements. The Project Sponsor shall deposit with the City of Taylor a fee for review as specified by the City's Engineering Consultant. Review fees are estimated at 1.75% of the site engineering improvements (utilities, detention, storm treatment, paving, grading SESC). The minimum review fee is $1,750.

3. *Site Engineering Construction Phase Fees.* Prior to scheduling the pre-construction meeting for the project improvements, the Project Sponsor shall deposit with the City of Taylor the following:

    a. Construction securities as defined by both the Planning and Building Department.

    b. Permitting fees as assessed by the Planning Department, Building Department and/or the Department of Public Works.

    c. A 2% City of Taylor Department of Public Works Administration Fee. This fee is based on the total contractual site civil improvement cost.

    d. Construction Engineering fees in the form of a cash escrow account in an amount as estimated by the City's Engineering Consultant. Fees are estimated in accordance with the schedule below:

ITEM	RATE/MINIMUM FEE	Fee Type
Storm Water Detention/Retention System	2.5% of Construction Cost/Minimum $2,500	Lump Sum Fee*
Site Utility Work – Water, Sanitary, Storm and Structures	6.0% of Construction Cost/Minimum $3,000	Lump Sum Fee*
Soil Erosion and Sedimentation Control	$300 per week of Construction	Time and Materials
Site Paving	2.5% of Construction Cost/Minimum $1,000	Lump Sum Fee*
Construction Engineering and Administration	2.0% of the sum of all Construction items above/Minimum $3,000	Lump Sum Fee*

*Non-refundable

Additional fees (as applicable):

1. Restaking due to Contractor Negligence: Consulting Engineer's Hourly Rate
2. Additional Meetings: $750 Each
3. Re-Testing of Materials and Work: Consulting Engineer's Hourly Rate

25251 Northline Road
Taylor, MI 48180
734.947.9700
800.482.2864
www.wadetrim.com