CITY OF Sterling Heights

ENGINEERING DESIGN STANDARDS

Adopted January 1, 2024

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INTRODUCTION

The following Engineering Design Standards shall serve as a minimum basis for the design of improvements, which are under the jurisdiction of the City Engineer. Such improvements include sanitary sewers, storm sewers, water mains, paving, site grading, retention basins, etc.

"Final Approval of the Preliminary Plat" for subdivision or "Preliminary Site Plan Approval" from the Office of Planning for all other developments must be obtained prior to submittal of the plans to the Office of Engineering for review.

Preliminary development meetings between the Developer/Owner, Consulting Engineers and the City are recommended for all site development. Please contact the Office of Engineering at (586) 446-2720 in advance to schedule a meeting.

GENERAL REQUIREMENT

1. All plans shall be submitted in a Portable Document Format (PDF) for engineering site plan review and approval.
2. Plans for sites of one acre, or less, must be to a scale of 1" = 20' or 1" = 30'. Larger sites, generally more than three acres, may be to a scale of 1" = 40' or 1"= 50'. Profiles must have a vertical scale of 1" = 5'.
3. Plan sheets shall be oriented with North pointing up or to the right.
4. All plans must be on standard size sheets: 24" x 36".
5. Plans must be prepared and sealed by a Professional Engineer or Architect licensed to practice in the State of Michigan. Subdivision plans, sanitary sewer plans, and water main plans, must be sealed by a Professional Engineer.
6. A detailed estimate of cost of all civil site improvements including temporary and permanent soil erosion and sedimentation control (SESC) measures, must be submitted with the site plans.
7. For projects having several sheets, a cover sheet having a scale of 1" = 100' or larger shall be provided.
8. The proposed site plan shall include the following:
    a. General location map in same orientation as plan.
    b. Legal Description of property.
    c. Existing and future right-of-way lines.
    d. North arrow and scale.
    e. Location of all proposed improvements including size and structure numbers for proposed utilities. Cover sheets should also indicate references to individual plan sheets.
    f. Street names.
    g. Street widths.
    h. Lot lines, lot numbers; including adjacent properties.
    i. Legend.
    j. Itemized quantity list for all site improvements (i.e. grading, paving, utilities, SESC, landscaping, etc.)
    k. Locations and type of existing utilities and structures pertinent to the project.
    l. Public utility easement(s) with Liber and Page number(s).
    m. Registered site with Michigan Department of Environment, Great Lakes, and Energy (EGLE) remediation.
    n. Floodplain, floodway, and wetland limits.

o. Special approvals (i.e. variances, PUD agreements, special land use, etc.)

p. Site information (i.e. zoning, setbacks, building size, parking calculation, etc.)

9. Survey

A complete topographical and property survey by a Registered Land Surveyor must be submitted with the plans. The survey shall cover a minimum of 100 feet offsite and opposite sides of any abutting streets. Existing elevations on a 50' cross section and locations of the following shall be included:

a. Centerline and edges (or curb and gutter) of street pavements.

b. Catch basins, manholes, gatewells, hydrants, upstream and downstream culverts and ditches – including top of castings and inverts.

c. Buildings, parking lots, drives, walks, etc.

d. Sufficient additional elevations offsite as required to show drainage patterns and/or unique features.

e. Elevations along all adjacent property lines.

f. Property lines must be indicated by distance and bearings or angles.

g. Sufficient benchmarks shall be indicated on the plans. Elevations shall be based on NAVD88 datum. If site is located within 500 feet of a floodplain, a FIRM benchmark is required.

10. As-built Submittal

A PDF (Portable Document Format) compatible "as-built" site plans shall be submitted to the Office of Engineering prior to final acceptance of the project. As-built site plans shall include all information per the City's As-built Requirements.

11. Utilities

Utilities within subdivision public rights-of-way are generally located as follows:

a. Water Mains

On the north or west side of the street and eight (8) feet off the property line.

b. Sanitary Sewers

On the south or east side of the street (opposite side from water main) and eight (8') feet off the property line. Deep sewers may be located in an easement abutting the right-of-way to eliminate excavation under pavement. Location and easement width shall be determined and approved by the Office of Engineering.

When the location of utilities on the sides of the street as indicated above would result in excessive utility crossings of the pavement or other adverse conditions, the utility locations may be reversed. Manholes, gatewells, and hydrants shall be located to avoid conflict with street pavement, driveways, and sidewalks.

12. Plan and Profile

a. Plan

The Plan shall indicate:

1) Street names and right-of-way widths.

2) Lot lines, lot dimensions, and numbers.

3) Pipe size, pipe material, pipe slope, and length of runs.

4) Manhole and catch basin structure numbers.

5) Intersecting and adjacent utilities.

6) Stationing.

7) Location of areas requiring porous backfill.

8) Offset distances.

9) Easements.

10) Existing and proposed grading.

b. Profile

Profiles are required for all sanitary sewers, storm sewers, water mains, and streets. The profile shall appear on the same sheet as the plan and shall generally be aligned with the plan view.

The profile shall indicate:

1) Length and slope of the run.

2) Type and class of pipe.

3) Size of the sewer or water main.

4) Invert and rim elevations of all structures.

5) Slope and appropriate elevation of the sewer, water main, or top of curb.

6) Profile of existing and proposed ground.

7) Proposed roadway elevation.

8) Manhole and catch basin structure numbers.

9) Location of all areas requiring porous backfill.

10) Pavement stationing.

11) Hydraulic gradient elevation at each storm sewer structure.

12) Hydraulic grade line.

13) All utility crossings.

14) Structure frame and cover types.

15) Catch basin sump depths.

13. The City of Sterling Heights "Specifications", " Standard Details", and "Standard Notes" are included as part of these "Design Standards" and shall be utilized for all construction under the jurisdiction of the City. The Office of Engineering will not review other standard details on the plans or other specifications with the exception of supplemental specifications necessary for a particular method of construction.

SUBMITTAL PROCEDURES

1. Complete engineering site plans shall be submitted for review.

   a. Site Plans are submitted to the Office of Planning for "Preliminary Site Plan Approval".

   b. Once "Preliminary Site Plan Approval" has been given by the Office of Planning, a PDF compatible file of the engineering site plans should be submitted to the Office of Engineering for review.

   c. Plans shall be emailed to the Office of Engineering at eng@sterling-heights.net.

2. The Office of Engineering will forward the plans to all departments or agencies having jurisdiction or requirements relating to the proposed development. Comments received by the Office of Engineering will be incorporated into the review. The Office of Engineering will not approve the plans until approval has been obtained from all other affected agencies. This does not relieve the developer from obtaining the required permits from regulatory agencies prior to the start of construction.

3. Upon completion of the engineering review, one complete digital set of site plans including site plan checklist will be returned to the Architect and/or Engineer. These plans will be stamped "Approved" or "Returned for Revisions". A copy of the letter of transmittal will be sent to the owner.

   On plans "Returned for Revisions", all indicated revisions shall be made and a PDF compatible file of the revised plans submitted for further review. The Office of Engineering will not review partially revised plans.

4. Upon approval of the site plan by the Office of Engineering, a digital copy of the "Approved" site plan will be forwarded to the Office of Planning for "Final Site Plan Approval". Approved digital copy of the site plans will also be forwarded to all affected departments and agencies.

   Engineering site plan approvals are valid for a period of one (1) year. If construction has not proceeded within one (1) year from the date of "Engineering Site Plan Approval", the site plan shall be resubmitted for review and revised, if necessary, to conform to current standards.

5. When the necessary fees have been deposited, the plans submitted, required permits obtained, and easements submitted, construction may proceed as follows:

   a. Subdivisions

      All public utilities and public streets must be constructed and accepted by the City prior to the issuance of building permits.

   b. Multiple Family

      All utilities must be completed and accepted by the City and suitable access roads constructed prior to the issuance of building permits. All paving must be completed prior to any occupancy.

c. Commercial and Industrial Sites

All utilities must be completed and accepted by the City and suitable access constructed prior to any occupancy or use. All site improvements including landscaping, must be completed prior to issuance of a final Certificate of Occupancy.

1. Capacity

   a. All sanitary sewers must conform to the Master Sanitary Sewer Plan. Sanitary sewers shall be designed to provide for future extensions to upstream areas. All sanitary sewer extensions servicing two or more buildings shall be public facilities. The minimum allowable size is ten (10") inches in diameter.

   b. A sanitary sewer design, sanitary sewer calculations, and a district map shall be required for all sanitary sewers. The design shall be based on the City's Master Sanitary Sewer Plan and requirements of the Michigan Department of Environment, Great Lakes, and Energy (EGLE).

   c. In Manning's Equation a roughness factor of n = 0.013 for concrete/vitrified clay pipe and n = 0.011 for plastic pipe shall be used.

   d. The partial velocity shall be two (2 fps) feet per second or greater. The design velocity shall not exceed ten (10 fps) feet per second.

   e. Increasing the pipe size in order to decrease the grade will not be permitted.

   f. Hydraulic gradients shall be maintained through manholes. Generally provide 0.1 foot drop at deflections of forty-five (45°) degrees or greater and match 0.8 lines at change of pipe size.

   g. The minimum slope for sanitary sewers shall be as follows:

PIPE SIZE	MINIMUM SLOPE (%)
10"	0.30
12"	0.24
15"	0.16
18"	0.12
21"	0.10

   The slopes on local residential sewers (10" Diameter) shall be increased to the following minimum slopes:

LOTS OR UNITS	SLOPE (%)
10 or less	0.80
11 to 19	0.60
20 or more	0.30

2. Manholes

   a. Maximum manhole spacing shall conform to the following:

DIAMETER OF SEWER	DISTANCE
10"-12"	300 feet
15"-24"	350 feet

   Lines larger than twenty-four (24") inches in diameter will be considered on an individual basis.

   b. Manholes shall be placed at every change in grade, direction, or pipe size, at every junction of two (2) or more lines, and at the end of all lines.

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

   d. Drop manholes shall be required whenever the difference in elevations between sewer inverts at a manhole is two (2') feet or greater. External drop connections shall be installed per the City Standard Detail. The use of internal drop connections are not allowed.

   e. Manholes shall have bolted down, water tight covers.

   f. Manholes shall be located within twenty (20') feet of paved access.

3. Service Leads

   a. A service lead shall be provided for every building, structure, or property (present, proposed, or future). Service leads under major roads (86' right-of-way or greater) are generally not permitted.

   b. Service leads shall be a minimum of six (6") inches in diameter and have a minimum grade of one percent (1%).

   c. All service leads shall extend from the sewer to the property or easement line at a minimum depth of nine (9') feet measured to the invert.

   d. Materials:

      Residential & Commercial: PVC Schedule 40

      Industrial: Vitrified clay pipe, extra strength, C-700

   e. House service leads shall generally be located in the center of each lot.

   f. Glue-joint only under road/paved areas (residential and commercial only).

   g. Service leads shall not be connected to manholes.

   h. Note riser information, if applicable.

4. Sanitary sewers shall have a minimum depth of nine (9') feet measured from the property line grade to the invert. The City Engineer may grant exceptions if conditions warrant.

5. Leads under major roads are general not allowed unless approved by the City Engineer. Major Road Crossings shall be tunneled or bored.

6. All sanitary sewers are public utilities. City "Sanitary Sewer Notes" and "Standard Details" must be attached to the plans.

7. All sanitary sewer extensions must have a Michigan Department of Environmental, Quality Great Lakes, and Energy (EGLE) permit prior to the start of construction. After approval by this office, submit one (1) digital PDF compatible file and two (2) paper copies of the plans, including Sterling Heights "Standard Details", "Sanitary Sewer Notes", and EGLE Permit Application for Wastewater Systems for forwarding to the appropriate agencies.

8. Pipe Materials

   All materials shall conform to the Standards and Specifications of the City of Sterling Heights.

   The following is a summary of the allowable types and classes of sanitary sewer pipe:

   a. Vitrified Clay Pipe: ASTM C-700 Extra Strength (required for all manufacturing zonings).

   b. Reinforced Concrete Sewer Pipe: ASTM C-76 Classes IV & V. Rubber Gasket Premium Joints are required.

   c. PVC Truss Pipe: Rubber Gasket Premium Joints required.

9. Sanitary Sewer Notes

   a. The Contractor shall provide Startup Notification (just prior to excavation) and Completion Notification (upon completion of the project) per the permit schedules in MiEnviro.

   b. All sewers to be placed on a Class "B" Bedding or better.

   c. Wyes, risers, and house leads are to be placed at locations shown on the plans or as directed by the Engineer.

   d. Each wye or house lead shall have a plug of the same type of joint as the house lead.

   e. House leads shall be a minimum of nine (9′) feet deep at the property line.

   f. Downspouts or other conduits carrying storm or ground water shall not be connected to the sanitary sewer.

   g. Whenever existing manholes or sewer pipe are to be tapped, holes are to be drilled at four (4″) inch center to center spacing around the periphery of the proposed opening to create a plane of weakness joint – a twelve (12″) inch thick concrete collar is to encase the new pipe and opening.

   h. Maximum infiltration shall not exceed one-hundred (100) gallons per inch of diameter per mile of pipe per twenty-four (24) hours. For purposes of testing infiltration a bulkhead with a one (1″) inch diameter pipe shall be provided at the downstream manhole.

   i. The inside joints for all sanitary sewers thirty (30") inches and larger shall be cement pointed within.

   j. All sanitary sewer manholes shall be provided with water tight bolt down covers.

k. All concrete sanitary sewer, manhole and pipe joint shall be modified grooved tongue with rubber gaskets as required under the current adopted A.S.T.M., C-443.

l. All sanitary sewer shall be pressure tested and video tested at least thirty (30) days after installation. Maximum five percent (5%) deflection allowed. Truss pipe installed less than twelve (12') feet below grade will be exempt for the deflection test.

m. Individual sewage treatment facilities and/or holding tanks are not allowed.

STORM SEWER

1. General

   a. All storm sewers must conform to the Master Drain Plan. Storm sewers shall be designed with adequate size and depth to provide for future extension to service upstream areas. Storm sewers providing drainage for the following must be public facilities: two or more parcels; separate, non-owned upstream areas; and public rights-of-way. The minimum allowable size public storm sewer is twelve (12") inches in diameter.

   b. All storm sewer design shall also meet the requirements of the City's Stormwater Management – Requirements, Rules, & Design Standards.

   c. Storm sewers are required to intercept storm runoff onsite and carry it to the appropriate outlet in accordance with the Master Drain Plan. Offsite improvements may be necessary in order to provide an adequate outlet. The storm sewer systems generally required for various developments are as follows:

      Subdivisions

      - Street storm sewers for runoff from rights-of-way and front lot areas.
      - Rear yard storm sewers for runoff from rear lot areas.
      - All storm sewers are public utilities.

      Site Condominium, Multiple-Family, Commercial, and Industrial Sites

      - Onsite storm sewers for runoff from: drives, parking lots, buildings, and greenbelt areas shall generally be private storm sewer systems except as in 1.a. above. Minimum allowable size is twelve (12") inches in diameter unless approved otherwise by Engineer.

2. Capacity

   a. Storm sewer design calculations and a storm drainage area district map shall be required for all storm sewers.

   b. Storm drainage systems shall be designed for a ten-year rainfall using the Rational Method (Q = CIA) for runoff determination.

      Q = Runoff (cubic feet per second)

      C = Runoff Coefficient

      Minimum Runoff Coefficient:

Multiple –Family (mid/high-rise), Commercial and Industrial	0.70
Multiple-Family (low-rise)	0.50
Single-Family Subdivisions / Condominiums	0.30
Golf Courses	0.20

I = Intensity (inches per hour = 175/(T+25))
T = Time (minutes –initial time = 20 minutes)

A = Area (acres)

c. The required pipe sizes shall be determined by Manning's Formula with a roughness coefficient (n) of 0.013.

d. The minimum allowable velocity is two-half (2.5 fps) feet per second and the maximum allowable velocity is ten (10 fps) feet per second.

e. The hydraulic gradient must be:

i. Maintained within the pipe whenever possible.

ii. Maintained at manholes and connections.

- Generally provide tenth (0.1') foot drop at deflections of forty-five (45°) degrees or more and match eight-tenths (0.8) point of pipes at change in pipe sizes.

The hydraulic gradient must be indicated at manholes and catch basins on the profile view of plans for all storm sewers.

f. Minimum and maximum design slopes, for concrete pipe, shall be as follows:

PIPE DIAMETER (INCHES)	MINIMUM SLOPE (FEET PER 100 FEET) > 2.5 FPS	MAXIMUM SLOPE (FEET PER 100 FEET) < 10 FPS
12	0.32	4.88
15	0.23	3.60
18	0.18	2.84
21	0.14	2.32
24	0.12	1.92
27	0.11	1.64
30	0.09	1.44
36	0.07	1.12
42	0.06	0.92
48	0.05	0.76
54	0.04	0.64
60	0.04	0.56

3. Catch Basins and Inlets

i. Catch basins shall be located at every low point to collect and convey surface runoff into the storm sewer system.

ii. Parking lot catch basins located within the gutter line shall have a concrete gutter widening per City Standard Detail.

iii. Note EJIW frame and cover types for manholes and catch basins in pavement and green areas.

iv. All pavement catch basins shall have a two (2') foot sump. No sumps allowed within any green areas/non-pavement catch basins unless approved by Engineer.

v. Catch basins shall be minimum four (4') foot rim to invert.

vi. Surface water flows shall not exceed the intake capacity of the structure casting.

vii. Two direction flow to a catch basin shall be limited to a maximum of nine hundred (900') lineal feet of drainage; one direction flow shall be limited to a maximum of six hundred (600') lineal feet.

viii. Drainage structures shall not be located in line with sidewalks.

ix. Note the sump depth for catch basins.

4. Manholes

a. Maximum manhole spacing shall conform to the following:

DIAMETER OF SEWER	DISTANCE
12"-15"	300 feet
18"-21"	350 feet
24"-30"	400 feet
36"-42"	450 feet
48"-larger	500 feet

b. Manholes shall be located at:

i. Deflections in alignment. Except that curved sewers are permitted for sizes forty-two (42") inch diameter and larger.

ii. Change in sewer size.

iii. Change in sewer grade.

iv. Junction of two or more lines. Except that blind taps will be permitted to sewers forty-two (42") inches or larger in diameter if the intersecting sewer is no larger than half (½) of the diameter of the trunk sewer and has a four (4') foot minimum diameter structure within sixty (60') feet of the blind tap.

v. At the upstream end of a line.

c. Combination catch basin-manholes are permitted on sewers thirty-six (36") inches in diameter or less.

d. All portions of a storm sewer system shall be within four hundred (400') feet of a four (4') foot diameter structure accessible to maintenance vehicles.

e. The minimum inside diameter of all manholes shall be forty-eight (48") inches except as provided in "Rear Yard Drainage Systems".

f. Note EJIW frame and cover types for manholes in pavement and green areas.

g. Precast or poured concrete channels shall be install in all manholes.

5. Edge Drain

   a. Roadways

      i. Six (6″) inch edge drain with sock and pea gravel backfill shall be installed along the perimeter of all roadways (both sides of roadway) and tied into drainage structure.

   b. Parking areas

      i. Six (6″) inch edge drain with sock and pea gravel backfill shall be installed at each pavement catch basin (4 @ 10 foot each or 16 foot diameter around perimeter of structure) and tied into drainage structure.

6. Sump Pump Outlets

   a. A three (3″) inch diameter sump pump outlet must be provided to each lot and extend to the lot line and/or easement line

   b. Sump pump outlet shall be connected by an approved method to a storm sewer. Outlet to a storm sewer structure is not permitted unless approved by the City Engineer.

   c. Sump leads may not extend under street pavements or connect to drainage structures in the pavement.

   d. The three (3″) inch sump pump outlet pipe shall be PVC Schedule 40 unless approved by the City Engineer. Minimum pipe slope is one percent (1.0%).

7. Rear Yard Drainage Systems

   a. All subdivisions shall have rear yard drainage systems for all lots. Exceptions may be granted in special cases. Rear yard catch basins shall be provided as indicated under "Grading".

   b. The outlet pipe for all positive low point catch basins shall be a minimum twelve (12″) inch diameter.

   c. Rear yard inlets and catch basins shall be located near the side lot line of every fourth (4) lot with a maximum spacing of two-hundred fifty (250′) feet.

   d. Thirty-six (36″) inch diameter rear yard inlets may be used at the upstream end of a line thirty-six (36″) inch inside diameter structures are not permitted on storm sewers deeper than four (4′) foot from rim to invert.

   e. Rear yard drainage systems shall be located as follows:

      i. External subdivision lines – Six (6′) feet off the property line in a nine (9′) foot wide easement. Sump leads to extend to the easement line.

      ii. Contiguous rear yard lines – Three (3′) feet off the rear yard line in a twelve (12′) foot wide easement (six (6′) feet on each side of the lot line). Sump leads to extend six (6″) inches into the opposite lot on one side and to the easement lot on the adjacent side.

   f. The maximum length of storm sewer from a structure accessible to cleaning equipment is four hundred (400′) feet.

g. All rear yard catch basins shall be wrapped with six (6") inch edge drain with sock and pea gravel backfill per City Standard Detail.

h. Sumps within rear yard drainage structures are not permitted.

8. Frame and Cover Types

STRUCTURE TYPE	SIZE	FRAME & COVER TYPE
Manholes	All sizes	EJIW 1040, Type "C"
Pavement Catch Basins	All sizes	EJIW 5105
Green Area Catch Basin	48" diameter	EJIW 1040, Type "N"
Green Area Inlet	24" & 36" diameter	EJIW 1170, Type "N"

9. Open Drains & Ditches

a. Open drains and ditches must be enclosed from property line to property line. Sizes will generally be determined by on-site requirements (if on-site storm sewer discharges into an open drain and/or ditch) and existing culverts, both upstream and downstream. Minimum allowable size is twelve (12") inch diameter.

b. Open drains and ditches are not permitted except for the following:

i. As indicated on the Master Drain Plan.

ii. As a temporary outlet across undeveloped property where the ultimate storm sewer size and location cannot be determined.

c. A pre-fabricated bar screen shall be used on all storm sewer openings twelve (12") inch in diameter and larger.

10. Retention

Stormwater retention shall meet the requirements of the City's Stormwater Management – Requirements, Rules, & Design Standards.

Any connection to a county drain, contact Macomb County Public Works Office (MCPWO) for their requirements and permit. If connecting to state drain, contact Michigan Department of Environment, Great Lakes, and Energy (ELGE) for their requirements and permit.

i. Dry Retention Basin

- Normal water depth: three (3') feet maximum

  Deeper than three (3') feet requires six (6') foot decorative fence around perimeter of basin with twelve (12') foot wide gate opening for maintenance. Fence permit from the Office of Building is required.

- Length to width ratio: 3:1 (H:V) maximum ratio

- Side slope: No steeper than 4:1 (H:V)

- Bottom slope: minimum one percent (1%) slope for both cross slope and longitudinal slope.
- The bottom shall have a six (6") inch under drain with non-woven geotextile fabric capable of handling the dry-weather flow installed from the drainage structure and extend the length of the basin.
- Minimum one (1') foot freeboard between high water elevation and top of embankment.
- Maintenance Buffer: minimum ten (10') foot wide buffer around perimeter of pond. Paved surface shall be provided to access basin for maintenance.
- Dry Retention Basins shall be designed with a single inlet/outlet pipe.
- Normal drainage flow shall not flow through the retention basin but only to back up into the retention basin when the normal flows exceed the restricted outlet capacity.
- A single inlet/outlet catch basin shall be installed at the low point of the basin. End sections and/or additional taps to the basin are not allowed unless approved by the City Engineer.
- In-line pipe storage is not permissible and shall not be included within the storage calculations.
- Air voids between aggregate materials shall not be included within the storage calculations.

ii. <u>Wet Retention Basin</u>

- Pond volume: Size per the City's Stormwater Management requirements.
  * There has been no deduction for wetlands or woodlands areas. These may vary with each development and can be taken into account at the time of application.
- Normal water depth: Minimum seven (7') feet.
- Parcel Size: Five (5) acres minimum.
- Flow through pattern: baffled or serpentine. Avoid short circuiting with straight direct flow through patterns.
- Length to width ratio: 3:1 (H:V) maximum ratio
- Outlet design: withdraw below water surface with a baffle to remove floatables.
- Side slopes:
  - Above normal pool – 6:1 (H:V)
  - Below normal pool – 10:1 for 10-20 feet, then 1:1 or 2:1 to pond bottom elevation
- Minimum one (1') foot freeboard between high water elevation and top of embankment.
- Permanent pool volume: minimum of ten percent (10%) of volume used for retention

- Wet ponds shall be designed with one (1) inlet pipe and one (1) outlet pipe. Additional taps to the ponds are not permitted unless approved by the Engineer.

iii. Underground Retention System

- The Underground Retention System shall meet all manufacturer recommendations and all design calculations, details, schematics, etc. shall be included within the site plan submittal.
- Underground Retention Systems shall have a minimum design life of seventy-five (75) years.
- The design must account for potential loading from vehicles, as appropriate, based on expected maximum loading, including consideration for emergency vehicles and construction equipment.
- Bedding materials
  - Underground storage using open-bottom chambers or perforated pipe systems will require detail drawings and an evaluation of sub-surface conditions (water table, soil type, etc…) to demonstrate infiltration feasibility.
  - Void space provided by linear chamber systems, plastic grids, or other related structures must be as specified by the manufacturer and noted in supporting documentation.
  - All bedding stone must be separated from soil media by a geotextile or a pea gravel filter to prevent sand, silt, and sediment from entering the system.
- A sufficient number of access points in the system must be provided to efficiently inspect and maintain the underground retention system.
- Pretreatment per the City's Stormwater Management standards is required.

iv. Concrete rip rap is required at all pipe entrances to the basin including the bank slope below the overflow.

v. Basins with pumped outlets:

- Prior to the use of a pump station, the Office of Engineering must approve that all gravity storm sewer design options have been exhausted.
- Duplicate pumps with 3-phase motors are required.
- The controls shall be used with electrodes or pressure switches.
- Complete specifications for the pumps and controls must be submitted for approval.
- Minimum ten (10') foot wide paved access is required to the pump station.

vi. Permits are required from the Office of Building for the fencing and all electrical work.

vii. Developments within the Smartzone/Local Development Finance Authority (LDFA) district shall adhere to the LDFA design guidelines for retention ponds, if necessary.

viii. Anything larger than three (3″) inch pump should require 8′ x 10′ concrete chamber, no manholes.

11. Pipe Materials

All materials shall conform to the Standards and Specifications of the City of Sterling Heights.

The following is a summary of the allowable types and classes of storm sewer pipe:

a. Clay Pipe: ASTM C-700 Extra Strength in twelve (12") inch to thirty-six (36") inch diameters.

Reinforced Concrete Sewer Pipe: ASTM C-76 Classes II through V in twelve (12") inch and larger diameters.

b. Roof and sump lead shall be Schedule 40 PVC.

c. All storm sewer shall have Rubber Gasket Premium Joints.

d. Bar Grates: A pre-fabricated bar screen should be designed to be self-cleaning so as to minimize plugging with debris and be installed on all end sections as determined by the Engineer.

12. Storm Sewer Notes

a. All storm sewers shall be installed on a Class "B" or Class "B" Modified (see Standard Detail) bedding unless indicated otherwise.

b. Joints for storm sewers shall be plain joints with Dewitt #10 or an approved equal unless noted otherwise.

c. The inside joints for all storm sewers thirty (30″) inches and larger shall be cement pointed.

d. Tees shall be provided for building drains or sump pump leads. Breaking into storm sewer for connection will not be permitted.

e. Whenever existing manholes or sewer pipe are to be tapped, holes are to be drilled at four (4″) inch center to center spacing around the periphery of the proposed opening to create a plane of weakness joint – a twelve (12″) inch (minimum) thick concrete collar is to encase the new pipe and opening. See detail on construction plans.

f. The class of concrete pipe to be used must be specified and capable of carrying the anticipated loads. Generally there should be a minimum of two (2′) feet between the top of pipe and the bottom of pavement.

g. Horizontal clearance between storm pipes and sanitary sewer and water mains shall be a minimum of ten (10′) feet.

h. Horizontal separation from buildings/structures shall be a minimum of ten (10′) feet or distance, which will allow a 1:1 (H:V) slope to the base of the foundation, whichever is greater.

i. Vertical separation distances between all utility crossings should be at least eighteen (18″) inches.

WATER MAIN

1. General

   a. All water mains must conform to the Master Water Plan and Subdivision Regulations. Water mains shall be designed to provide for future extensions and looping on adjacent undeveloped properties. Minimum size is eight (8") inch diameter.

2. Gate Valves and Wells

   a. Gate valve spacing shall conform to the following:

      i. No more than four valves shall be used to isolate a single section of water main.

      ii. No more than two hydrants shall be removed from service by the isolation of any single section of water main.

      iii. Gate valves in distribution systems shall be spaced to provide maximum sections of six hundred (600') feet except in single-family residential areas where the maximum section shall be eight hundred (800') feet.

      iv. Gate valves in residential areas shall be spaced so that no more than thirty (30) homes or units are without service by the isolation of a section of water main.

   b. Where possible, gate valves shall be placed at intersections, five (5') feet outside of the projected right-of-way line of the cross street.

   c. Gate valves shall be provided on each side of all rivers, expressways, and railroad crossings.

   d. A gate valve and well, with a ten (10') foot stub for future extensions, shall be placed at the end of all mains.

   e. All gate valves (8" or larger) except fire hydrant companion valves shall be installed in gate wells.

   f. Gate well covers shall be EJIW 1040, type A solid cover or approved equal. "Sterling Heights Water" shall be cast in the cover.

3. Fire Hydrants

   a. Fire hydrants shall be East Jordan Iron Works #5-BR (traffic type) with one (1) 3 ¾" standard pumper nozzle and one (1) 5" Storz pumper nozzle unless approved otherwise by City Engineer. Hydrant barrel length shall be necessary to satisfy depth requirements.

   b. Fire Hydrants shall generally be located as follows:

      i. Single and Two-Family Residential

         - So that all units are within two hundred fifty (250') feet of a fire hydrant.
         - At each street intersection fifteen (15') feet outside of the projected right–of-way line of the cross street.
         - Intermediate hydrants at the centerline of a lot.

ii. Multiple, Commercial, and Industrial

- So that every point on a building is within one hundred fifty (150') feet of a hydrant as measured along the shortest feasible exterior route for laying hose, two hundred (200') feet if internally sprinkled.
- No closer than fifty (50') feet to a structure.
- Within twenty (20') feet, unobstructed, of a drive suitable for fire equipment access.
- Minimum of fifteen (15') feet from parking areas, trash receptacles, or other obstacles.
- Hydrants must be protected a six (6") inch high curb no closer than five (5') feet from hydrant or by guard posts (per standard detail) if approved by Engineer.
- Located within one hundred (100') feet of the Fire Department Connection (FDC).

iii. In residential areas, on the street pavement side of the water main.

iv. At major intersections and along major thoroughfares, where it is impractical to string fire hoses across the street, hydrants should be located on diagonally opposite corners of intersections and also on each side of the major thoroughfare as necessary to achieve the required spacing for the type of development involved.

v. At the dead end of a water main, on the live side of the gate valve, and ten (10') feet from the valve.

vi. No closer than two (2') feet to sidewalk, pavement, or driveways.

c. Hydrant leads, six (6") inch diameter, shall not exceed one hundred (100') feet in length.

4. Pipe Materials

All materials shall conform to the Standards and Specifications of the City of Sterling Heights and shall be ductile iron (USAS-A 21.51 Class 54) unless approved otherwise by the City Engineer.

5. All water mains and fire hydrants are public facilities. City "Water Main Notes" and "Standard Details" must be attached to the plans.

6. All water main extensions must have a Michigan Department of Environment, Great Lakes, and Energy (EGLE) Water Supply Systems permit prior to the start of construction. After approval by this office, submit a PDF (Portable Document Format) compatible plan(s), including Sterling Heights "Standard Details", "Water Main Notes", and EGLE Permit Application for Water Supply Systems for forwarding to the appropriate agencies.

7. Service Taps, shut-off valve, and service line extensions to the property or easement line shall be made by the City of Sterling Heights Department of Public Works in conjunction with a building permit for all connections two and a half (2-1/2") inch and smaller. For a three (3") inch or larger water service connection, the water service connection may be installed by the owner, when the installation is being made concurrently with an on-site extension of the City of Sterling Heights water system under the jurisdiction and inspection of the City of Sterling Heights.

8. Profile all water main and shall include at a minimum all bends, fire hydrants, gate valves, depths, and utility crossings.

9. The plan shall indicate the finish grades of all fire hydrants and gate wells.

10. Horizontal separation from buildings/structures shall be a minimum of ten (10′) feet or distance, which will allow a 1:1 slope to the base of the foundation, whichever is greater.

11. Vertical separation distances between all utility crossings should be at least eighteen (18′) inches.

12. The minimum cover from finish grade to the top of the water main is six (6′) feet. Where water mains cross under drains, the clearance between the drains and water main must be six (6′) feet from open drains or eighteen (18″) inches from existing or proposed pipe, whichever is greater. Water mains may be allowed to cross over large drains where twelve (12″) inches of clearance and four (4′) feet of cover can be maintained.

13. Crossings of major roads shall be tunneled or bored.

14. Service leads shall have a minimum five (5′) foot separation.

15. Water Main Notes

    a. When it is necessary to shut down existing water mains, the Contractor shall contact the City of Sterling Heights Department of Public Services twenty four (24) hours prior to the shutdown and shall cooperate with the City forces in closing the necessary gate valves and in notifying the affected properties.

    b. Hydrant elevations and gate well top elevations shall be set to existing ground elevations unless otherwise directed by the Engineer.

    c. All water mains shall be constructed with a minimum cover of six (6) feet below finish grade, unless otherwise indicated on the plans.

    d. Connections to existing water mains shall not be made until after successful completion of bacteriological and pressure tests.

    e. All bends, tees, miscellaneous fittings, thrust blocks and sand backfill are to be incidental.

    f. The Contractor will be paid for horizontal distances only.

    g. All valves are to be right-hand open.

    h. Fire hydrants shall be East Jordan Iron Works #5-BR (traffic type) with one (1) 3 ¾″ standard pumper nozzle and one (1) 5″ Storz pumper nozzle unless approved otherwise by City Engineer. Hydrant barrel length shall be necessary to satisfy depth requirements.

    i. There shall be a three-quarter (¾″) inch corporation stops installed on both sides of each gate valve.

    j. Two brass wedges shall be installed at each joint on ductile iron pipe.

    k. Full seal rubber boot or an approved equal, shall be used around the water main at gatewell walls. Cadillac wrap shall only be used as approved by City Engineer.

    l. Service taps, shut-off valves, and service line extensions to the property or easement line shall be made by the City of Sterling Heights Department of Public Works, for connections smaller than three (3″) inches.

m. Where water mains must dip to pass under a storm sewer or sanitary sewer, the sections which are deeper than normal shall be kept at minimum of ten (10') feet from utility crossing using 45°, 22 ½ °, or 11 ¼ ° vertical bends properly anchored.

n. Hydrants shall be painted Sunrise Red (Rust-oleum' 7762 or equal). Nozzles and top flange shall be painted white with reflectorized hazard beads.

PAVEMENT DESIGN

All pavement must conform to the Master Road Plan and the Subdivision Regulations.

1. Pavement Widths

a.

RESIDENTIAL DEVELOPMENTS	
Local Streets	28 feet B/C TO B/C
Collector Streets (1/4 line Roads)	36 feet B/C TO B/C
Cul-de-sacs (outside radius)	28 feet B/C TO B/C (44 feet)
Boulevard Streets (each lane) (Boulevard width)	20 feet B/C TO B/C (10 feet)
*B/C – Back of Curb	

b.

INDUSTRIAL DEVELOPMENTS	
All Streets	36 feet B/C TO B/C
Cul-de-sacs (outside radius)	36 feet B/C TO B/C (60 feet)
*B/C – Back of Curb	

c.

SITE DEVELOPMENT	
Two-way Entrance Drive (at ROW line)	Minimum 26 feet wide Maximum 30 feet wide

2. Pavement Thickness

RESIDENTIAL DEVELOPMENTS	
Local Street	7" uniform plain concrete w/4" concrete mountable curb on 6" of 21AA aggregate base (8" uniform plain concrete in intersections)
Collector Street	8" uniform plain concrete w/4" concrete mountable curb on 6" of 21AA aggregate base

a.

INDUSTRIAL DEVELOPMENTS	
All Streets	8" uniform plain concrete w/ 6" concrete curb and gutter on 6" of 21AA aggregate base

b.

SITE DEVELOPMENT	
Concrete	Minimum 6" uniform plain concrete w/ 6" concrete curb and gutter
Asphalt	Minimum 4" asphalt pavement w/ 6" concrete curb and gutter on 6" 21AA aggregate base
*pavement shall be designed to maintain the anticipated loads	

3. Public & Private Roadways

   a. All proposed elevations are for top of curb unless otherwise noted.

   b. The pavement shall be centered in the Right-of-Way unless otherwise noted.

   c. Pavement jointing

      - (28' width roads) – longitudinal joints, seven (7') foot joint spacing
      - (36' width roads) – longitudinal joints, nine (9') foot joint spacing

   d. Expansion Joints

      - Expansion joints shall be place at the end of all intersection radii.
      - One (1") inch expansion paper spacing not to exceed five hundred (500') feet spacing for transverse joints.
      - One (1") inch expansion paper at all tangent points for transverse joints.
      - Fifteen (15') feet maximum transverse joint spacing, all roads.

   e. Pavement shall be crowned at the centerline of the roadway with a cross slope of two percent (2%).

   f. Concrete pavement joints shall be filled with hot poured rubber asphalt joint sealing compound (Federal Specification SS-S-164).

   g. Six (6") inch edge drain with sock and pea gravel backfill shall be installed along entire length of the back of curb and connected into catch basins.

4. Concrete Mix Design and Requirements

Concrete mix design(s) shall be submitted for review and approval by the Engineer prior to the start of construction.

Prior to any placement of concrete, a pre-production meeting will be conducted by the City to include all entities involved with the production, placement, and testing of concrete.

a. **Concrete Mixes:**

MDOT 3500	For use in sidewalks and curb (Slip Form and Handwork)
MDOT 3500 HP	For use in pavements and driveways (Slip Form and Handwork)

MDOT 3500 HP mixes will have an Optimized Aggregate Gradation as indicated herein.

b. **Materials:**

Cement	ASTM C150 Type I or Type II
Ground Granulated Blast Furnace Slag (GGBFS)	ASTM C 989 Grade 100 or 200
Coarse Aggregate	MDOT 6AA
Fine Aggregate	MDOT 2NS
Optimized Aggregate	Per Section 3.09 of the MDOT Quality Assurance Procedures Manual (substitute the "City of Sterling Heights" for all references to "the Department")
	Per Section 902.03 C. of the MDOT Standard Specifications for Construction
Admixtures	Must be listed the Qualified Products List (QPL) from the MDOT Materials Source Guide
	Fly Ash will <u>not</u> be permitted as a substitute for cement

c. **Alkali Silica Reaction (ASR):**

All mixes must be shown to be resistant to deleterious ASR by one of the following:

- Aggregates are shown to be non-reactive per ASTM C1260 (expansion less than 0.10%)
- Alkalis as Na_20 in cement are shown to be less than 0.60 % by a recent mill test report (Low Alkali)
- An ASTM C1260 Test is provided that shows an expansion of less than 0.10% for a potentially expansive aggregate at the proposed replacement of cement with GGFBS
- An ASTM C 1567 test is provided that shows an expansion of less than 0.10% for the specific combination of materials and proportions used for a particular mixture

An ASTM C 1293 test alone will <u>not</u> be sufficient to show that an aggregate is non-reactive.

d. **Total Cementitious Content:**

MDOT P1 Mixes	526 lbs/cy yd (6.0 Sack)
MDOT P1 Mod Mixes	526 lbs/cu yd (6.0 Sack) Maximum

e. **For Summer Mixes:**

Low Alkali Cement	15% Maximum GGBFS replacement
High Alkali Cement	25% Maximum GGBFS replacement

f. **For Winter Mixes:** Use Low Alkali cement with a maximum GGFBS replacement of 15%

g. **Water to Cement Ratio:** 0.43 maximum for all mixes

h. **Compressive Strength:** 3500 psi at 28 days (Cylinders cast, cured and tested per ASTM 31 and C 39)

i. **Air Content:** Designed for 6.5% Total Air Content

j. **Concrete Placement:**

Batch to Placement Time	90 minutes maximum for the time the concrete was batched For placements made by slip form paver, the "Placement Time" is the time the concrete has passed through the paver.
Concrete Temperature	90 degrees Fahrenheit Maximum
Slump	Within the range stated on the Approved Concrete Mix Design
Site Water Additions	A single addition of water is permitted, provided the slump after the addition is not outside the range stated on the Approved Concrete Mix Design The water addition must be charged into the mixer Water other than that charged into the mixer is not permitted.
Air Content	5.0% to 8.0% at the point of placement For pavements made by slip form paver, the air loss through the paver shall be established daily. Air tests from samples taken at the truck discharge shall be adjusted for this loss to determine compliance

k. **Curing:**

The following specification shall supersede and be in addition to Section 609.08 of the City's Concrete Pavement Specifications:

Compound	White membrane curing compound must meet requirements of ASTM C 309, Type 2 and packaged in clean containers
Coverage Rate	200 square feet of concrete per one (1) gallon of curing compound
Placement Timing	Immediately after surface moister has disappeared, but no later than thirty (30) minutes after concrete placement With approval of the Engineer, the timing of cure application may be adjusted due to varying weather conditions and concrete mix properties
Placement Procedures	Apply liquid curing compound in a fine atomized spray to form a continuous, uniform film on the horizontal surface, vertical edges, curbs and back of curbs The finished product shall appear as a uniformly painted solid white surface. Areas exhibiting a blotchy or spotty appearance shall be recoated immediately

l. **Ambient Conditions:**

Air Temperature	Do not place if the ambient air temperature is over 90 degrees Fahrenheit
Evaporation Rate	Do not place if the evaporation rate exceeds 0.20 psf/hr, calculated from the following NRMCA Formula: Evaporation Rate = $(T_c^{2.5} - r\,T_a^{2.5}) * (1+0.4V) * (1 \times 10^{-6})$ Tc = Temperature of Concrete, degrees Fahrenheit r = Relative Humidity, percent Ta = Ambient Air Temperature, degrees Fahrenheit V = Wind Speed, mph

m. **Quality Control Plan:**

Contractor shall provide a plan describing, in detail, all aspects of the production and construction for the project to ensure consistent control of quality to meet specification requirements. Quality Control Plan shall be provided to the City prior to the start of construction.

n. **Quality Assurance and Quality Control (QA & QC):**

- Tests for Temperature, Slump, Air Content
- Test for air loss through a slip form paver
- Testing at plant for Slump and Air Content
- Test Results coordinated with City and Developer/Owner

For P1 Mod mixes, optimized aggregate gradation checks are to be performed at regular intervals during production per Section 3.09 of the MDOT Quality Assurance Manual.

For P1 Mod mixes, optimized aggregate gradation checks will be performed prior to production and performed at regular intervals during production.

o. **Work in Progress Strength Determination:**

By cylinders cast and tested by the Contractor or Owner's representative and cured as near to the placement conditions as possible

By the Maturity Method (ASTM C 1074)

5. Sidewalks & Sidewalk Ramps

a. Sidewalks are required along public and private roadways unless approved otherwise by the Office of Planning.

b. Sidewalks are five (5') feet wide and located one (1') foot from the edge of the City's Master Plan right-of-way.

c. Sidewalks adjacent to parking spaces shall be a minimum of seven (7') feet wide with a six (6") inch curb to protect pedestrians on sidewalk. Bumper blocks are not allowed as an alternative method of protection.

d. Sidewalks shall generally conform to the grade of the existing topography. Transverse slopes shall not exceed two percent (2%), and longitudinal slopes shall not exceed eight percent (8%) for mainline sidewalks, with five to seven percent (5% - 7%) being the recommended range. Sidewalk ramps shall not exceed five percent (5%) longitudinal slope or two percent (2%) cross-slope.

e. Sidewalks shall be minimum four (4") inch thick concrete pavement on four (4") inches of MDOT Granular Material Class II Sand, compacted to ninety-five (95%) percent maximum density.

f. Joint sidewalk through all drive approach. Sidewalk to be same pavement thickness as drive approach.

g. The distance from the edge of the sidewalk to the back of curb or edge of the road shall clearly be called out on the plans. Sidewalks shall not be placed any closer than ten (10') feet, unless otherwise approved by the City Engineer.

h. Sidewalk ramps must be provided per the latest American with Disabilities Act (ADA) requirements.

i. Sidewalk ramps shall be constructed in accordance with the current edition of the Michigan Department of Transportation standard plan R-28 series.

j. ADA detectable warning plates shall be color contrasted and consist of pre-formed plastic/fiberglass materials. Pre-formed plastic detectable warning plates shall be "brick red" in color. Stamped concrete in not acceptable. Other color and/or material must be approved by the City Engineer.

k. Every handicap aisle adjacent to a sidewalk shall have an ADA ramp with detectable warning.

l. Every handicap space shall have a handicap sign. A van accessible sign is required for a van accessible handicap space.

6. Drive Approaches

a. Residential Drive Approach

i. All residential drive approaches shall be nonreinforced concrete pavement.

ii. Minimum six (6") inch thickness on compacted base material.

iii. Sidewalk to be jointed through approach with a minimum six (6") inch thickness.

iv. Minimum ten (10') foot depth measured from back of curb/edge of roadway.

v. Eighteen (18") inch flair required on both sides of approach.

vi. One (1") inch expansion paper must be installed at the back of curb/edge of roadway and half (1/2") inch expansion paper must be installed at top of approach and each side of sidewalk.

vii. Drive approach grades shall not exceed seven percent (7%) within the right-of-way (five percent (5%) recommended). Note: Drive approach slopes shall not exceed two percent (2%) through the portion of the drive approach that is to be utilized for existing and/or proposed sidewalks, in order to meet American with Disabilities Act (ADA) requirements.

viii. Drive Approach Flairs:

- Residential (Local Road) – Eighteen (18") inch flair on each side of approach
- Residential (Major Road) – With the flow of traffic, eight (8') foot flair ingress and six (6') foot flair egress.

b. Commercial/Industrial Drive Approach

i. All commercial and industrial drive approaches shall be concrete pavement.

ii. Minimum eight (8") inch nonreinforced concrete pavement (MDOT 3500 HP, 3,500 psi) on compacted base material.

iii. Seven (7") inch concrete curb per MDOT Standard Detail, R-30 series, Type C4.

iv. Detail "M" opening per City Standard Detail.

v. Drive Approach shall have a radius of twenty (20') feet.

vi. Drive Approach shall be a minimum twenty-six (26′) feet wide and a maximum thirty (30′) wide measured at the right-of-way line.

vii. Sidewalk to be jointed through approach with a minimum eight (8″) inch thickness.

viii. One (1″) inch expansion paper must be installed at the back of curb/edge of roadway and half (1/2″) inch expansion paper must be installed at top of approach and each side of sidewalk.

ix. Concrete pavement joints shall be filled with hot poured rubber asphalt joint sealing compound (Federal Specification SS-S-164).

x. Drive approach grades shall not exceed six percent (6%) within the right-of-way with a minimum one percent (1%) gutter slope. Note: Drive approach slopes shall not exceed two percent (2%) through the portion of the drive approach that is to be utilized for existing and/or proposed sidewalks, in order to meet American with Disabilities Act (ADA) requirements.

xi. Two (2′) foot wide stamped concrete pavement shall be installed at the back of all drive approach radii. The concrete pavement shall be eight (8″) inch thickness, brick red in color, and have brick stamped pattern.

7. Miscellaneous

a. For site condominiums all private streets shall conform to the improvement design standards as specified in the Subdivision Regulations and Engineering Design Standards for Public Streets, with the exception of the Right-of-Way Requirements.

b. All ditches on existing roads shall be enclosed across the frontage of the development.

c. A widening lane shall be constructed between new streets abutting existing roads when the centerline distance between streets is six hundred (600′) feet or less or when the proposed lots front on the road.

d. Acceleration and deceleration lanes shall be provided at all intersections to major roads.

- The acceleration lane shall consist of a seventy-five (75′) foot taper back to the existing pavement of edge.

- The deceleration lane shall consist of a fifty (50′) foot long lane with seven (7″) inch curb and a seventy-five (75′) foot taper back to the existing pavement.

e. A by-pass lane shall be required on the opposite side of all major roads where turning movements will interfere with safe traffic operations. The lane shall be twelve (12′) foot wide and have seventy-five (75′) foot tapers to the existing pavement.

f. Pavement intersection radii shall be:

Local Road – Local Road	16 feet
Local Road – Major Road	30 feet
Local Road – Collector Road	17 feet
Collector Road – Major Road	35 feet

g. A maximum of one hundred fifty (150′) feet of gutter drainage may be brought around a radius to a catch basin or inlet.

h. Two direction flow to a catch basin shall be limited to a maximum of nine hundred (900') lineal feet of drainage; one direction flow shall be limited to a maximum of six hundred (600') lineal feet.

i. Surface drainage shall not flow across an intersection except where the street abuts a major road in which case gutter lines may be carried through the intersection.

j. Plans submitted shall include detailed elevations and drainage flow.

k. Individual details of irregular intersections shall be included on the plans at a scale of 1" = 30'.

l. Standard dead-end barricades shall be provided at the end of all dead-end streets. Refer to City Standard Detail.

m. Twelve (12") inch wide pavement header shall be installed at the end of dead-end streets and removed if street is extended.

n. Butt joints shall be provided when new pavement abuts existing pavement at major roads.

o. Curve data shall be given for each curve on the sheet the curve appears.

p. The City Standard Paving Notes shall appear on the plans.

q. For concrete to concrete drive approaches, use the following notes as standard:

   i. Use one (1") inch expansion joint at back of curb.

8. Paving Notes

   a. General

      i. Asphalt (HMA) pavement design, materials and methods of construction shall meet the current standards of the Michigan Department of Transportation Specifications for Construction.

      ii. The pavement base shall be compacted to ninety five percent (95%) of the maximum density (Modified Proctor) prior to placement of the pavement.

      iii. All structures (manholes, gatewells, hydrants, etc.) shall be adjusted to the finish grade.

GRADING

1. General

   A grading plan is required for all Residential, Commercial, and Industrial developments.

2. Master Grading Plan – Residential Development

   The master grading plan provides all necessary information to grade all lots and includes the following:

   a. Generally on a scale of 1" = 100'.

   b. Street names, lot numbers, bench marks.

   c. Proposed storm sewer lines.

   d. Sump lead locations.

   e. Rim elevations of all structures with structure numbers including finish grade of a fire hydrants.

   f. Existing elevations along subdivision boundary lines and adjoining elevations.

   g. Drainage arrows indicating direction of flow.

   h. Residential lot grading

3. Residential lot grading, based on one hundred twenty (120') foot deep lot, shall conform to the following:

   a. Proposed finish grade elevations at all four (4) corners of the house.

   b. Proposed finish grade elevations at all property corners.

   c. Proposed high point grade elevations at all side yard property lines. Recommended at mid-point of buildable area.

   d. Minimum swale grades are one percent (1%).

   e. Front yard slopes (Based on thirty (30') front yard setback)

      i. Minimum fall from house to front property line is one (1') foot.

      ii. Maximum fall from house to front property line is one and a half (1.5') feet.

   f. Rear yard slopes (Based on thirty (35') rear yard setback)

      i. Minimum fall from house to rear property line is one (1') foot.

      ii. Maximum fall from house to rear property line is two and a half (2.5') feet.

g. Side yard slopes

i. Minimum six (6″) inches or 1:15 slope from house to side yard property line.

ii. Maximum 1:7.5 slope from house to side yare property line.

h. Front yard sidewalk elevations shall be a half (0.5′) foot above the top-of-curb elevation.

i. All rear yard drainage must be intercepted by drainage structures.

j. Subdivision boundary elevations must meet or be lower than existing elevations. Blocking overland flow is not permitted.

4. The maximum length of drainage swale without being picked up by a drainage structure is two hundred fifty (250′) feet.

5. Roadway Grading

a. Minimum Gutter Grade – 0.40%

b. Maximum Gutter Grade – 6%

c. One hundred (100′) foot vertical curves required for all grade changes in excess of one and a half percent (1.5%).

d. Fifty (50') foot tangent required for reverse curves on local roads

e. Two hundred twenty five (225') foot tangent required for reverse curves on collector roads

f. Minimum outside curb grade for cul-de-sacs and eyebrows shall be 0.60%

g. Minimum grade on all returns is one percent (1%)

h. Pavement cross slope shall be two percent (2%)

6. Roadway pavement profile view must include:

a. Existing ground elevations at the center of the right-of-way.

b. Station and elevation of all high points, low points, grade breaks, curb returns, intersecting property lines, and necessary information for vertical curves.

c. Top of curb elevations at each station. Elevation in vertical curves must be indicated at twenty-five (25′) foot intervals.

7. Site Development Grading

a. Sufficient proposed elevations (top of curb, gutter, sidewalk, buildings, etc.) must be shown on the plan. Proposed elevations must be underlined or boxed-in to differentiate from existing grades.

b. Concrete pavement shall have a minimum pavement slope of half percent (0.5%) and a maximum pavement slope of six percent (6%).

c. Asphalt pavement shall have a minimum pavement slope of one percent (1%) and a maximum pavement slope of six percent (6%).

d. The proposed grading should meet, or be lower than, abutting elevations. The use of retaining walls are not permitted unless approved by City Engineer.

e. Where run-off from abutting areas flows onto the site prior to development, provisions must be made for this run-off in the on-site storm design. Blocking of off-site run-off will not be permitted.

f. Development in floodplain areas must be in conformance with the Zoning Ordinance. Filling of floodplain areas is prohibited unless the impoundment capacity is maintained through compensating excavation. Filling and/or development within the floodplains of natural drainage courses will require approvals from the Michigan Department of Environment, Great Lakes, and Energy (EGLE) and the Federal Emergency Management Agency (FEMA).

g. Curb cuts for storm water runoff will not be permitted unless used as an approved method for stormwater management.

SOIL EROSION AND SEDIMENTATION CONTROL

1. All site plans shall include soil erosion and sedimentation control measures in conformance with the Soil Erosion and Sedimentation Act (P.A. 347 of 1972) and all current rules promulgated by the Michigan Water Resources Commission, and the "Standards and Specifications for Soil Erosion and Sedimentation Control" published by the Macomb County Soil Conservation District, and the City of Sterling Heights Ordinance No. 170.

2. All earth changes shall be designed, constructed and completed in such a manner to limit the exposed area of disturbed land for the shortest possible period of time.

3. Any temporary or permanent facility designed and constructed for the conveyance of water around, through, or from the earth change area should be designed to limit flow to a non-erosive velocity.

4. A PDF Digital File of the Soil Erosion and Sedimentation Control plan and permit application must be submitted to the Office of Engineering for review and approval.

5. The Soil Erosion and Sedimentation Control plan must contain the following:

    a. Location map, with North arrow, lakes, streams, ponds, and open drains.

    b. Topo map which will accurately show existing natural drainage patterns.

    c. Drainage arrow for proposed on-site drainage.

    d. All lakes, streams, wetlands, drains, etc., must be shown on plans.

    e. Proposed and existing storm sewers and basins.

    f. Identify ultimate drainage outlet.

    g. Sequence-of-Construction.

    h. Graphic location of Erosion and Sedimentation Controls on plan.

    i. Limits of earth disruption must be shown on plans.

    j. Construction/installation details of Erosion and Sedimentation Controls.

    k. Provisions for proper maintenance of Erosion and Sedimentation Controls.

    l. Legal description of site.

    m. Name of individual who prepared Erosion and Sedimentation Control Plan.

    n. Date plans were prepared.

    o. Statement on the site plan stating who is responsible for maintenance and that "THE SOIL EROSION CONTROLS WILL BE MAINTAINED WEEKLY AND AFTER EVERY STORM EVENT".

p. Distance and location to the nearest lake, stream, pond, open drain or wetland (shown on the site location map)

q. Soil information (types, locations, etc.)

6. Additional Soil Erosion and Sedimentation Control Items

a. Location of any structure or natural feature on the site or within fifty (50') feet of the site.

b. Elevations, dimensions, location, extent and slope of any proposed grading including building and driveway grades.

c. Plans of all drainage provisions, retaining walls, cribbing, planting, anti-erosion devices or any other temporary or permanent soil erosion and sedimentation control measures to be constructed in connection with, or as a part of, the proposed work.

d. The estimated total cost of the required temporary and permanent soil erosion and sedimentation control measures.

e. Any other information or data may be required by the City Engineer, such as a soil investigation report.

f. All modifications of the approved soil erosion and sedimentation control plan must be submitted and approved by the City Engineer.

g. All off-site work must be restored within seven (7) days from the start of construction.

7. Soil Erosion and Sedimentation Control General Notes

a. All erosion and sediment control work shall conform to standards and specifications of the City of Sterling Heights.

b. Daily inspections shall be made by the Contractor to determine effectiveness of erosion and sediment control measures, and any necessary repairs shall be performed without delay.

c. Erosion and any sedimentation from work on this site shall be contained on the site and not allowed to collect on any off-site areas or in waterways. Waterways include both natural and man-made open ditches, streams, storm drains, lakes, and ponds.

d. Erosion and sedimentation control measures are to be placed prior to, or as the first step in, construction. Sediment control practices will be applied as a perimeter defense against any transporting of silt off the site.

e. Contractor shall apply temporary erosion and sedimentation control measures as required and as directed on these plans. He shall remove temporary measures as soon as permanent stabilization of slopes, ditches, and other earth changes has been accomplished.

f. Permanent soil erosion control measures for all slopes, channels, ditches, or any disturbed land area shall be completed within five (5) calendar days after final grading or the final earth change has been completed. When it is not possible to permanently stabilize a disturbed area after an earth change has been completed or where significant earth change activity ceases, temporary soil erosion control measures shall be implemented within thirty (30) calendar days. All temporary soil erosion control measures shall be maintained until permanent soil erosion control measures are implemented. All permanent soil erosion control measures will be implemented and established before a certificate of compliance is issued.

g. All mud and soil tracked or spilled onto city and county roads and on paved surfaces from this site, due to construction, shall be promptly removed by the Contractor/Builder.

h. All onsite and offsite areas disturbed by construction shall be restored to equal or better conditions. All restoration shall consist of a minimum of four (4") inch of topsoil with seed, fertilizer, and mulch or three (3") inches of topsoil and a class "A" sod where existing condition require sod replacement.

EASEMENTS, RIGHT-OF-WAYS, AGREEMENTS, AND MASTER DEEDS

1. Subdivisions

   a. All easements and rights-of-way shall be indicated on the Plat in accordance with the Plat Act and the Subdivision Ordinance.

   b. Easements shall be provided for the surface drainage as indicated on the grading plan.

   c. Easements on interior lot lines shall generally be twelve (12') feet wide; six (6') feet on each side of the property line. Large diameter storm sewer may require additional easement width.

   d. On subdivision boundary lines, where an easement has not been provided on the adjacent property, the easement width shall be increased to nine (9') feet.

   e. Where it is necessary to install a public utility adjacent to a street right-of-way, the easement shall generally be ten (10') feet wide.

2. Site Developments and Condominiums

   a. Easements (minimum twelve (12') feet wide and centered on the utility) must be dedicated for all public facilities prior to final site plan approval. Large diameter storm sewer may require additional easement width.

      The easements will not be recorded until the utility construction is completed. If the "as-built" location is different from plan location, revised dedications must be submitted.

   b. On public roads, dedication of the ultimate right-of-way will be made.

   c. Proof of ownership must be submitted with all dedications.

   d. All public utility easements must be submitted on City Standard Form including Exhibits. Any changes to the City Standard Form must be reviewed by the City Attorney's Office and approved by City Council.

      All attorney fees associated with their review must be paid prior to engineering site plan approval.

3. Master Deeds

   a. For all condominium developments, a Master Deed including By Laws and Exhibits, must be submitted to the Office of Engineering and City Attorney's Office for review and approval.

   b. The Master Deed including By Laws and Exhibits must be approved and recorded prior to engineering site plan approval.

   c. All attorney fees associated with their review must be paid prior to engineering site plan approval.

4. Agreements

   a. Retention Basin Agreements

      i. Retention basin agreements must be submitted on City Standard Form and include Exhibits as referenced in the agreement.

      ii. If review and approval by the City Attorney's Office is required, all attorney fees associated with their review must be paid prior to engineering site plan approval.

      iii. Retention Basin agreements must be recorded by the Macomb County Register of Deeds prior to engineering site plan approval.

   b. Mutual Agreements

      i. When required, Mutual Agreements shall be submitted for review and approval by the Office of Engineering.

      ii. Agreements must describe the future appropriation of all cost improvements related to the maintenance of the agreement area.

      iii. If review and approval by the City Attorney's Office is required, all attorney fees associated with their review must be paid prior to engineering site plan approval.

      iv. Mutual Agreements must be recorded by the Macomb County Register of Deeds prior to engineering site plan approval.

5. Easement Vacation and Encroachment

   a. Easement Vacation

      i. When a public utility easement is to be partially/fully vacated, an Easement Vacation request must be submitted to the Office of Engineering for review and approval.

      ii. Easement Vacation request shall include:

         - The recorded easement document to be vacated
         - Letter requesting easement to be vacated
         - Letter requesting permission to work within existing easement while City Attorney's Office is drafting the vacation document.
         - Release and Hold Harmless Agreement
         - Exhibit showing existing easement to be vacated including easement description.
         - Exhibit showing proposed easement to be dedicated including easement description (if required).

      iii. Easement vacation must be approved by City Council.

iv. Easement vacation document will be drafted by the City Attorney's Office and must be signed and recorded prior to release of any occupancy permits.

v. Application fee, recording fee, and attorney fees associated with their review must paid prior to engineering site plan approval.

b. Easement Encroachment

i. For any structure to encroach into a public easement, an Easement Encroachment application (including fees) must be submitted on City Standard Form including Exhibits for review by the City and private utility companies.

ii. If the request is approved, an Easement Encroachment Agreement must be signed and notarized by the property owner(s) and submitted to the City for recording.

6. Master Deeds & By-Laws

a. For condominium developments, a Master Deed, By-Laws, and required Exhibits shall be submitted for review by the Office of Engineering and City Attorney's Office.

b. All attorney fees associated with their review must be paid prior to engineering site plan approval.

c. Mutual Agreements must be recorded by the Macomb County Register of Deeds prior to Engineering site plan approval and release of any building permits.

7. Dedications

a. If property is owned by:

Individual	Both husband and wife must sign
Partnership	All partners must sign (Evidence of authority must be provided)
Corporation	Signatories as authorized by Corporation must sign. (Evidence of authority must be provided)
Land Contract	Vendor and Vendee must sign (Evidence of contract must be provided)

b. All public utilities shall have a minimum twelve (12') foot wide public utility easement. Larger diameter and/or deeper utilities may require additional easement width.

c. All public utility easement shall be submitted on City Standard Form including exhibits A & B. (maximum paper size: 8 ½" x 14")

i. Exhibit "A" shall include:

- Site plan showing proposed utility easement
- Outline of structures, parking lots, roadways, etc.
- Legal description of utility easement

- Property lines
- North Arrow
- Street Names, Address, Parcel ID Number, etc.
- If multiple pages required, note each page as sheet # of sheet #.

ii. Exhibit "B" shall include:

- Parcel Legal Description
- Parcel ID Number
- Commonly Known Address
- If multiple pages required, note each page as sheet # of sheet #.

d. All signatures must be accompanied by typed or printed in black ink as well.

e. All easement, agreements, and right-of-way dedications must be notarized by a public notary.

f. Changes to these requirements by the Macomb County Register of Deeds may be required and shall be addressed prior to document recording.

ENGINEERING & SESC FEE SCHEDULE

All fees change July 1 of each year

Engineering and Soil Erosion and Sedimentation Control fees are determined/calculated using the current Engineering Fee Schedule.

1. Engineering Fees

   The engineering review fee includes all costs necessary to review plans two (2) times for conformance with current standards, specifications, and Master Plans. All additional review time shall be charged at the rate of payroll plus one hundred eighty percent (180%). Funds shall be deposited to defray the cost of additional review time prior to approval of the plans.

2. Soil Erosion and Sedimentation Control (SESC) Fees

   The design engineer shall submit an itemized estimate of cost for all site improvements including the cost of SESC temporary and permanent measures for review by the Office of Engineering. Based on this estimate, the SESC Fees will be calculated.

3. Miscellaneous Fees

   All other fees, escrow, and bond requirements are located within the current Engineering Fee Schedule.

INSPECTION & ACCEPTANCE

1. All construction within City rights-of-way* and of public facilities will be inspected on a full time bases by the Office of Engineering.

   * Public sidewalk and driveway construction required with a building permit in a single-family residential area requires a permit and inspection from the Building Department.

2. A forty-eight (48) hour notice is required for all inspections. Where construction is continuous for whole consecutive working days, additional notice will not be required.

   Where the construction operations result in repeated and excessive delays or "down time" for reasons other than inclement weather, the City reserves the right to withdraw inspection services.

3. Residential Development

   Upon completion of the construction, the contractor must request a final engineering and final utility inspections. All resultant "punchlist" repairs must be completed and re-inspection scheduled within ten (10) days. After satisfactory completion, the contractor shall submit the following:

   a. A two (2) year maintenance and guarantee bond in the amount of twenty-five percent (25%) of the contract cost for all public utilities and roadway paving.

   The Office of Engineering shall then notify the contractor, in writing that the construction has been completed in accordance with the plans, standards, and specifications.

4. Commercial/Industrial Development

   Upon completion of the construction, the contractor must request a final engineering and final utility inspections. All resultant "punchlist" repairs must be completed and re-inspection scheduled within ten (10) days.

5. Pump/Lift Station

   a. Operations manual for pumping stations.

   b. Wiring diagram for pumps and controls.

   c. Equipment guarantees and supplier's name and address for pumping facilities.

6. Underground utility installations must receive final approval prior to excavation for pavement in subdivisions and other projects with public street construction.

7. Televised recording of all sewers, and copy submitted for review to Office of Engineering required for approval of all sewers. This should include inclinometer data.

1. Construction Notes

The Contractor shall notify the City of Sterling Heights Office of Engineering, at (586) 446-2720, a minimum forty-eight (48) hours prior to the start of construction of public utilities or of construction within City Right-of-Way and public easements.

a. All construction shall conform to the current standards and specifications of the City of Sterling Heights which are included as part of these plans.

b. After the completion of construction of public utilities or construction within City right-of-way and public easements, the contractor must request a Final Inspection. Any punchlist items resulting from the Final Inspection must be resolved prior to final release and acceptance.

c. The existing utilities indicated on this plan are in accordance with available information. The contractor shall be exclusively responsible for determining the exact utility locations and elevations prior to the start of construction.

d. The Contractor shall notify "Miss Dig", at 1-800-MISS-DIG or 1-800-482-7171, at least three (3) working days prior to the start of construction.

e. The contractor shall at all times be aware of inconvenience caused to the abutting property owners and general public. Where undue inconveniences are not remedied, by the contractor, the City, upon four (4) hour notice, reserves the right to perform the necessary work and deduct the cost therefore from the money due the contractor.

f. During construction the contractor shall provide watchmen and flagmen as may be required for the safety and convenience of the public and shall furnish barricades, signs, and lights necessary to protect the public. Traffic shall be maintained at all times unless otherwise authorized by the City of Sterling Heights. Traffic control shall be in accordance with the current edition of the Michigan Manual of Uniform Traffic Control Devices by the Michigan Department of State Highways.

g. In cases where detour roads are necessary, traffic shall be routed over roads as directed by the City of Sterling Heights. In all cases, the detour roads shall be maintained with dust control and grading as required by the Engineer.

h. Existing roads used as haul routes shall be approved by the City of Sterling Heights and the Contractor shall maintain them with grading and dust control as required by the Engineer.

i. The Contractor is to provide adequate dust control when such a problem has been caused by his construction operations. Dust control methods must meet approval of the City.

j. All property irons and monuments disturbed, or destroyed by the Contractor's operations shall be replaced by a Registered Land Surveyor provided by the Contractor, at the Contractor's Expense.

k. Contractor shall provide Owner and Engineer a copy of written permission to use private property for storage of equipment and materials or for his construction operations.

l. Trench backfill under existing or proposed roadways, driveways, and parking areas, unless otherwise noted, shall be sand or gravel, placed in twelve (12″) inch layers (maximum) and consolidated to ninety-five percent (95%) maximum density as measured by modified proctor.

m. Gravel or slag roadways, driveways, parking areas, and shoulders shall be restored by placing eight (8″) inches of MDOT 21AA limestone and shall be maintained as settling takes place.

n. Trees and shrubs are to be protected during construction and bored where necessary, unless other arrangements are made with the abutting property owner from whom a written release shall be obtained and provided to the city. Unless specifically designated at a location on the plan, tunnel or bore of tree(s), shrubs, etc. shall be incidental to the unit price of the utility.

o. Existing fences shall be removed and restored to their original condition or better where in conflict with construction.

p. Driveways, culverts, ditches, drain tile, tile fields, drainage structures, etc., that are disturbed by the Contractor's operations shall be immediately restored.

q. All established lawn areas disturbed by the Contractor's operations shall be resodded with matching sod or Marion Blue Sod and three (3″) inches of topsoil. All other areas shall be seeded and mulched. Seeding and mulching shall be done in accordance with General Specifications. Seeding shall include four (4") inches of topsoil for both field seeding and lawn seeding. If for whatever reason, the seed does not grow the first time, then the contractor is obligated to come back and reseed the area at no additional cost until permanent growth is established.

r. All ditch slopes shall have established vegetation and be free from erosion.

s. All utility poles in close proximity to construction shall be supported in a manner satisfactory to the utility owner.

t. Drive culverts, which are removed or destroyed by the contractors operations, shall be replaced with a minimum of twenty-four (24′) feet of twelve (12″) inch corrugated metal pipe with end sections. The existing culvert may be reused if it meets City Standards.

u. Grading trench backfill shall be kept within one hundred (100′) feet of excavation. Soil shall be mounded over the trench continuously. Any surplus excavation (except topsoil) that is left in piles shall be removed from the site within seven (7) days.

v. Existing limestone, decorative stone, etc. drives shall be restored with eight (8″) inches of like material.

2. <u>Site Plan Notes</u>

a. All construction shall conform to the current standards and specifications of the City of Sterling Heights.

b. The Contractor shall notify "Miss Dig", at 1-800-MISS-DIG or 1-800-482-7171, at least three (3) working days prior to the start of construction.

c. The Contractor shall notify the City of Sterling Heights Office of Engineering, at (586) 446-2720, a minimum forty-eight (48) hours prior to the start of construction of public utilities or of construction within City right-of-way and public easements.

d. Handicapped parking spaces shall be identified with the international symbol.

e. Access to a structure shall be provided for the physically handicapped.

f. Onsite parking shall be provided for construction workers.

g. A PDF compatible "as-built" site plans shall be submitted to the Office of Engineering prior to final acceptance of the project. As-built site plans shall include all information per the City's As-built Requirements.

h. All on-site storage tanks, except those containing potable water, shall be provided with secondary containment equal to a minimum one hundred ten percent (110%) of tank capacity.

3. Standard Details

Standard detail sheets are located under the Engineering Department page of the City's website at www.sterlingheights.gov.