

DIVISION II
DESIGN STANDARDS

1. GENERAL

1A. Content of Plans and Specifications

Plans and Specifications for all public improvements shall be prepared by a Michigan Registered Engineer and each sheet of the plans shall bear the name of the firm and Engineer who has supervised the work. The cover sheet, or each individual plan sheet shall be signed and sealed by the responsible Registered Engineer. These Plans and Specifications shall be consistent with the site's approved site plan or final preliminary plat.

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

All drawings shall incorporate City of Ann Arbor standard 24"x36" mylars, using the current City title block, standard legends, profile grid, and symbols. When plans are to be computer generated by AutoCad or other approved drafting system, all notes and drawing details (i.e., lines, symbols, boring information, etc.) must also be computer generated. The mixing of drafting media for proposed construction information, will not be accepted. The mixing of drafting media will only be allowed when the existing conditions (base information) is prepared by computer generated methods, and all information regarding proposed construction is manually prepared.

Once construction plans have been approved, the Developer, or his/her designee, shall supply an "original" set of the final, approved plans to the Public Services Department for use in preparing as-built record drawings. If the plans have been manually drafted, this "original" set shall be produced as reverse-reading photographic mylars, or an approved equal. If the plans have been computer generated, the "original" set shall be contained in a 3.5" diskette as specified below:

- a) 3.5" High Density diskette, with 1.44 MB capacity (preferred), or 3.5" Double Density diskette, with 720 KB capacity (allowed, but not preferred).
- b) For data compression, use PKZIP sharware program.
- c) For files over 1.44 MB after compression by PKZIP needing to be split across multiple diskettes, the DOS 5.0 BACKUP command must be used. NO other DOS versions will be acceptable.
- d) The file type shall be AutoCAD version 11: .DWG. Lower AutoCAD version numbers are acceptable. The .DXF format is allowed, but not preferred. The IGES format is **not** acceptable.

- e) Any diskette submitted to the City shall be accompanied by documentation verifying that the diskette has been scanned for computer "viruses" prior to their submittal. This documentation shall include the name and version number of the program used to scan the diskette.

All plan sets must include a location sketch. In addition, if the plan set consists of two or more sheets, a cover sheet with an index of drawings must also be provided.

All construction drawings shall be 1" = 40' (horizontal) and 1" = 4' (vertical) scale. A 1" = 20' (horizontal) and 1" = 2' (vertical) scale may be used, if approved in writing by the Public Services Director.

If an individual proposed public utility requires two or more drawings, then a 1" = 100' scale overall utility plan shall also be provided in the construction plan set.

Plan and profile views shall be required for all utilities including fire hydrant and storm sewer inlet leads. The plan and profile are to be on the same sheet, and shall be vertically oriented. The crossing of all existing and proposed utilities, including leads, shall be shown on each profile.

No more than two proposed utilities shall be shown on the same profile sheet. Preferably the sanitary sewer and water main on one sheet, and the storm sewer and curb and gutter on another. The location of existing structures, features and site conditions within the influence area of the work, and within the right-of-way, including, but not limited to, all existing and proposed utilities, shall be shown on the plan view.

No applique shading or pattern films affecting the translucence of the originals may be used on utility drawings. Shading may be used on curb and gutter drawings, but no information of any significance shall be obscured.

All existing and proposed utility easements, including proposed locations, size and purpose, shall be shown on the appropriate plan sheets. Existing utility easements shall be labeled with the Liber and Page of the recorded easement.

Each plan sheet shall be oriented such that the north arrow shall point towards the top of the page or to the left.

Stationing shall be shown in both the plan and the profile views. Each utility and the roadway shall have its own separate stationing, along its respective center line.

All proposed utilities shall be drawn and labeled with a bold (#3 pen, 0.80mm pen) line, and all existing utilities shall be drawn and labeled with a thin (#0 pen, 0.35mm pen) line.

All top of casting elevations shall be shown for both proposed and existing utilities, including valve boxes and manhole covers. All finished grade-ring elevations of proposed fire hydrants shall be shown.

The pipe material, size, percent of grade, and length of run between manholes shall be shown in the profile view for all sanitary and storm sewers. All water main fittings and appurtenances shall be stationed in both the plan and profile views. The pipe material, size, and lengths between fittings shall be shown in the water main profile view.

All existing and proposed pipe invert elevations at all sanitary and storm sewer manholes and structures shall be shown in the profile view.

The percent of grade and invert elevation at the terminal end of all sanitary and storm sewer service leads shall

be shown in the plan view. All service tee or wye locations are to be stationed in the profile view.

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

Granular backfill, trench details, special bedding, bores, and special construction methods shall be shown in the profile view where applicable.

The existing ground profile and the proposed finished grade profile shall be shown on all profile drawings.

The location, and construction details, of all connections to existing utilities shall be clearly indicated, as well as the methods of connection. This includes trench and street repair details.

Street names, lot lines, and lot numbers shall be shown on all plan sheets. For special assessment projects, parcel addresses, tax code numbers, owners' names and addresses shall also be given.

All elevations shown on the Plans shall be referenced to NAVD 88 datum. **Note that this datum is not identical to the prior City of Ann Arbor datum, nor the USGS or USC & GS systems.** Benchmark locations and elevations for the work shall be indicated on the plans. A minimum of two benchmarks are required.

The following note shall be included on the cover sheet, or sheet 1 of the Plans:

"The construction covered by these plans shall conform to the City of Ann Arbor Public Services Department Standard Specifications which are included by reference."

A copy of the computed plat or a computer plotted working drawing with dimensions shall be submitted with all subdivision and site condominium plans.

A copy of the design calculations for all sanitary sewers and public storm sewers shall be submitted at the time of construction plan submittal.

IB. Construction Plan Review/Approval

Following the City Council approval of the Site Plan or Final Preliminary Plat for a site, the construction plans for all required public improvements shall be submitted to the Public Services Director for review and approval prior to construction.

Two sets of detailed proposed construction plans, including all calculations (particularly basis of design calculations for sanitary and storm sewers), and related data shall be submitted to the Public Services Department for the initial review, along with a completed Engineering Division Permit Application and a completed Request for Engineering Division Construction Plan Review worksheet. The applicable plan review fees are to be calculated and paid at the time of the plan submittal.

The Public Services Director will review the plans and respond with review comments.

After revising the plans in accordance with the Public Services Director comments, six sets of sealed and signed plans shall be submitted to the Public Services Department as follows:

- Two sets shall be complete plan sets for review, approval and calculation of

Engineering Division permit fees.

- Two sets shall contain the water main plans and profiles. The Public Services Director will submit these plans to the MDPH for issuance of a water main construction permit. (If the Engineer wishes to receive a stamped, approved set from the MDPH, a third set must be submitted to the Public Services Department).
- Two sets shall contain the sanitary sewer plans and profiles. The Public Services Director will submit these plans to the MDNR for issuance of a sanitary sewer construction permit. (If the Engineer wishes to receive a stamped, approved set from the MDNR, a third set must be submitted to the Public Services Department).

All other State, County, or City permits are the responsibility of the Engineer, Contractor, and/or Developer.

Prior to Engineering Division permit approval, all items required in **Division I - Section 1.D., Permits** shall be submitted to the Public Services Department.

1C. Easements

All public utilities shall be located in either public rights-of-way or easements dedicated to the City as described herein. Legal descriptions for all required public utility and right-of-way easements shall be submitted to the Engineering Division for review and approval based on the final approved construction plans. A copy of the current commitment for title insurance for the subject parcel and the name of the owner's contact person must accompany the legal descriptions. These legal descriptions must be approved by, and the commitment for title insurance received by, the Engineering Division prior to Engineering Permit approval. A copy of the approved legal descriptions will be forwarded by the Engineering Division to the City Attorney along with the commitment for title insurance. The City Attorney will draft the required easements using the approved descriptions and City standard forms for execution by the Owner. However, the Owner's attorney may draft the required easements using the approved descriptions on City standard forms. After the Owner has executed the easement documents, they shall be submitted to the City Attorney for review and approval. After this approval, construction may begin. Once these documents have been approved by City Council, they will be recorded by the City Attorney.

All water main easements shall be a minimum of 40 feet in width, with the water main centered in the easement. Special provisions will be required when water mains cannot be centered in a 40 foot wide easement. Special provisions will generally include Class 54 ductile iron pipe in steel casing pipe, river crossing pipe, or other method approved by the Public Services Director. These mains shall be located in a minimum 15-foot wide easement, with 5 feet being on one side of the main, and 10 feet on the other.

Sewer easement widths shall be equal to $2D+10'$, where D is the maximum depth of the sewer trench on a particular run of sewer. The minimum sewer easement width shall be 30 feet. The sewer shall be located 5' off of the center of the easement, leaving D feet on one side of the sewer and $D+10'$ on the other. Sewer easement widths may vary from run to run of sewer, provided that the above requirements are met. Special provisions will be required when sewer mains cannot be located in standard width easements. Special provisions will generally include Class 50 ductile iron pipe, or other method approved by the Public Services Director. The easement width in these cases must be approved by the Public Services Director.

Public access easements shall be a minimum of 30 feet in width. In exceptional circumstances, this minimum

width may be reduced to 20 feet only with the approval of the Parks and Recreation Superintendent. The public access walkway/bikeway shall be centrally located within the easement, however the walkway/bikeway may gently curve and meander through the easement. The walkway/bikeway must meet all barrier free access requirements for its entire length. If the access easement area is not naturally landscaped, it shall be topsoiled, seeded and mulched in accordance with **Division VIII** of these Standards to establish a grass turf within the easement area.

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

A dedicated street right-of-way or roadway easement may be used in whole or in part to satisfy the easement requirements, when approved by the Public Services Director.

Where practical, telephone, electric, gas, and cable television lines shall be located in private easements for public utilities.

Plans for all telephone, electric, gas, and cable television lines which are within City rights-of-way or City utility easements must be reviewed and approved by the Public Services Director prior to their construction. In addition, all required permits must be obtained from the Building Department and Transportation Division. (See **Division I, Section 1D. Permits**).

Every effort shall be made to place City utilities in dedicated public rights-of-way. City utilities which cannot be placed in rights-of-way shall be located in utility easements.

City easements shall not be located in areas of unusual topographic conditions.

2. SANITARY SEWER DESIGN

2A. Capacity Design

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

The *Recommended Standards for Sewage Works* by the Great Lakes-Upper Mississippi River Board of State Sanitary Engineers (also known as the "Ten State Standards") shall be followed, except as modified below. Sewer capacities (for residential developments) shall be for sewers flowing half-full, based upon 400 gallons per capita per day for service areas of 0-960 acres. A flow of 250 gallons per capita per day shall be used for service areas over 960 acres, unless otherwise directed by the Public Services Director.

For residential developments of single family homes, the design population shall be at least 3.0 persons per unit. For two-family housing developments, at least 2.5 persons per unit shall be used. For multiple-family housing developments, at least 2.0 persons per unit shall be used. For institutions, commercial and industrial developments, the Engineer shall submit detailed calculations to establish design flows sufficient for the ultimate tributary population.

2B. Size, Grade and Materials

Minimum size for sanitary sewer shall be 8" diameter, with the terminal run of 8" sewer at a uniform grade of

not less than 0.6% between manholes. On all other 8" runs, the minimum grade shall be 0.5% between manholes.*

Sanitary sewers which will serve only residential units may be polyvinyl chloride (PVC) pipe (up to 15" in size) or vitrified clay pipe (up to 18" in size) as specified in **Division III** of these Standards. Sanitary sewers up to 18", other than those allowed to be PVC pipe, shall be vitrified clay pipe as specified in **Division III** of these Standards. Sanitary sewers 21" and larger shall be reinforced concrete pipe as specified in **Division III**. Class 50 ductile iron pipe may be required by the Public Services Director in particular situations, such as extreme depth, narrow easements, well isolation, etc.

Minimum design velocity for sanitary sewers shall be 2.0 feet per second with the pipe flowing full. The 0.8 depth flow line of sewers shall be matched at manholes when changing sizes of sewers. Caution must be used when designing sewers with minimum grades to insure proper installation.

The maximum design velocity for sanitary sewers shall be 10.0 feet per second with the pipe flowing full. Special consideration will be given in areas of steep topography.

Following are minimum grades for each size of pipe:

<u>Pipe Diameter</u>	<u>Minimum Grade (%)</u>
8"	0.50*
10"	0.28
12"	0.22
15"	0.15
18"	0.12
21"	0.10
24"	0.08
27"	0.07
30"	0.06
36"	0.05

*Special consideration will be given for 0.40% in specific, isolated cases. This grade must be approved in writing by the Public Services Director.

2C. Information Required

Profiles of sanitary sewers shall include the information required in **Division II, Section 1A, Content of Plans and Specifications**, of these Standards.

A casting schedule shall be provided including manhole/structure number corresponding to the plan, casting type (manufacturer and catalogue number), top-of-casting elevation, manhole invert and manhole depth.

A copy of the basis of design for the sanitary sewers must be submitted with the construction plans.

2D. Sewer Depth and Location

Sewer depth design shall be based on the contours of the land being served and in all cases shall be deep enough to serve neighboring properties as the sewer is extended at a future date, as well as deep enough to serve proposed basements on the immediate site. The sewer shall be a minimum of 10 feet deep when fronting residential parcels to be directly connected to the sewer, as illustrated below:

(If basements are not to be constructed, the basement floor elevation in the above example shall represent the finished floor elevation, and the pertinent assumptions regarding the sewer and lead depth below that elevation still apply).

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

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. If this depth is exceeded, the pipe from manhole to manhole shall be encased to the top of the pipe with Class X concrete, or other method approved by the Public Services Director.

Sewers located in a public right-of-way shall be located in accordance with the Standard Utility Location Plan details in **Division X** of these Specifications.

There shall be a minimum of ten feet of horizontal clearance, and 18 inches of vertical clearance at perpendicular crossings, between sewers and water mains, measured outside edge to outside edge. In addition, there shall be adequate separation between sewers and all utilities to allow a 1:1 trench slope from the bottom of the deeper utility which will not undermine any shallower utility. There shall be a minimum of one foot of vertical clearance at perpendicular crossings with utilities other than water mains.

Where sewer lines have been previously provided to the limits of adjoining developments, they shall be extended by the Developer in like size, or as these Standards may require.

2E. Manholes

All manholes shall be precast concrete construction, and have eccentric cones.

Manholes shall be placed at every change of grade, direction, or pipe size, and at each junction of sewers.

The maximum distance between manholes shall be 400 feet for sewers 15 inches in diameter and smaller, and 500 feet for sewers 18 inches in diameter and larger.

Outside drop manhole connections shall be used whenever a sewer enters a manhole at an invert elevation of more than 24 inches above the manhole invert elevation. Inside drop connections will not be permitted. Outside drop connections shall be sized as at least one-half the size of the incoming sewer or next larger size, but in no case less than 8 inches in diameter. Larger diameter drop connections may be required as directed by the Public Services Director.

Whenever there is an increase in pipe size, the grades shall match at a line 0.8 of the diameters above the inverts of both the incoming and the outgoing pipes.

There shall be a minimum of 0.10 foot fall through a manhole where the sewer has a horizontal deflection of up to 30 degrees. For manholes where the sewer has a horizontal deflection from 30 degrees to 90 degrees, there shall be a minimum of 0.20 foot fall. There shall be no more than 90 degrees of horizontal deflection through a manhole.

Minimum inside diameter of manholes shall be 48 inches in accordance with the Standard Details located in **Division X** of these Standards. Minimum access diameter shall be 24 inches.

All manholes shall be located such that they will be directly accessible by vehicular maintenance equipment. All surfaces to be utilized for manhole access shall be designed to support a 16 kip dual wheel load (the weight of a fully loaded Vector truck).

Unless approved by the Public Services Director, manholes shall not be located in areas subject to flooding. If such locations cannot be avoided and are approved, watertight manhole covers and castings are required.

Not more than three sewer service leads may be designed to be tapped into a terminal manhole. All other leads are to be at wyes or tees at the sewer main. Leads tapped into a terminal manhole must be brought in at the 0.8 line of the sewer and in a formed channel, or through an outside drop connection.

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

2F. Sewer Leads

Unless otherwise approved by the Public Services Director due to exceptional circumstances, construction of the sewer service lead from the public sewer for each fronting parcel which the sewer is designed to serve, shall be included with construction of the sanitary sewer main. For a private development project the sewer service lead shall be constructed to ten feet beyond the public right-of-way line. For a City project the lead shall be constructed to within five feet of the right-of-way line. For sewer mains constructed in easements for a private development project, the lead shall be constructed to within five feet of the proposed building.

Sewer leads shall have a minimum of 5 feet of cover. When placed in the same trench as a water service lead, the water service shall be a minimum of 1.5 feet above the sewer lead and placed on a shelf of undisturbed earth.

Wye fittings are not allowed for leads with risers.

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

Minimum grade of sewer service leads shall be 1/8" per foot or 1.0% for 6" leads, and 1/4" per foot or 2.0% for 4" leads. The maximum allowed grade at sewer service leads shall be 10.0%. Minimum sewer service lead size is 4" diameter, and the normal location shall be at the middle of the lot. If a sewer service lead is 8" or greater, the minimum grade of the lead shall be that of the minimum grade of a sewer main of equal size.

The maximum service lead tap into an existing sewer shall be one-half the diameter of the sewer main (i.e., 4" maximum tap into 8" sewer main). Service lead connections greater than one-half the sewer diameter shall be made at manholes, as required in **Division II, Section 2E. Manholes**.

Downspouts, weep tile, footing drains, sump pump discharges, or any other conduit that carries storm or ground water shall not be allowed to discharge into sanitary sewer service leads or lateral sewer.

As required by Chapter 28, Title II of the City Code, a building sewer in an RE, I or M zoning shall have a monitoring manhole in the sewer service lead to facilitate observation, sampling and measurement of the wastes. Such manholes, when required, shall be safely located, accessible at all times, and constructed in accordance with City standard details in **Division X** of these Specifications. The manhole, metering and sampling devices shall be installed by the Owner or Developer at his/her expense.

2G. Interceptors

Grease, oil and sand interceptors shall be provided where required by Article 10 of the BOCA (Building Officials & Code Administrators International, Inc.) National Plumbing Code in accordance with Chapter 28, Title II of the City Code for the proper handling of liquid wastes containing grease in excessive amounts or any

flammable wastes, sand and other harmful ingredients. Interceptors shall not be required for private living quarters or individual dwelling units. However, an interceptor may be required if there will be a legal home occupation within the living quarters or individual dwelling unit which may generate grease, oil or sand in the sanitary wastes. All interceptors shall be installed in accordance with Chapter 98 of the City Code. They shall be located as to be readily and easily accessible for cleaning and inspection.

3. STORM SEWER DESIGN

3A. Capacity Design

Sewer capacities shall be based upon storm runoff computed by the Rational Method for a 10-year, 12-hour duration storm, $Q=CIA$, where:

Q	=	total storm runoff flow, in cubic feet per second (cfs)
C	=	runoff coefficient
I	=	rainfall intensity rate
A	=	total drainage area (acres)

Rainfall intensity rate (I) shall be determined by the formula $I = 170/(t+23)$, where, t = the concentration time (in minutes) of the portion of the site being developed (the time, in minutes, for runoff to be contributed to the point of concentration from the entire area of the site being developed).

The time of concentration and runoff coefficient shall be subject to the approval of the Public Services Director.

The hydraulic gradient shall be kept within the storm sewer pipe or 2 feet below storm casting rim elevations. Unusual conditions will be reviewed on an individual basis, and variances from this requirement must be approved by the Public Services Director.

Where the hydraulic gradient is above the top of the pipe, the 10 year storm hydraulic gradient shall be indicated on the storm sewer profiles.

The Engineer shall submit with the storm sewer basis of design computations, a map outlining the various areas which drain to the points of inlet used for design, including offsite upstream areas. The design computation sheet shall be sealed by the Registered Engineer who supervised the computations.

Sufficient capacity is to be provided in the storm sewer system to handle upstream drainage areas into the system, including allowance for future fully developed situations per current or anticipated zoning of the upstream areas.

3B. Size, Grade and Materials

Minimum size for public storm sewers, including inlet/catch basin leads, shall be 12 inch diameter if the sewer is receiving surface storm water. Eight-inch and ten-inch diameter sewers may be used for public storm sewers if the only contributing flow into the sewer is through a service lead connection (ie., sump pump, footing drain). Minimum size and grade for private storm sewer leads shall be 6 inch diameter at 1.0%.

Storm sewers up to 18" shall be either reinforced concrete pipe with premium joints, or high density polyethylene pipe with premium joints, as specified in Division III, of these Standards. Storm sewers which are 21" to 24" shall be reinforced concrete pipe with premium joints, high density polyethylene pipe with premium joints, or high density polyethylene pipe with wrapped joints, as specified in **Division III** of these Standards. Storm sewers which are 27" and larger shall be reinforced concrete pipe with premium joints, as specified in **Division III** of these Standards.

Minimum design velocity for storm sewers shall be 2.5 feet per second with the pipe flowing full. This is to be considered an absolute minimum, and higher velocities are encouraged for better self-cleansing action.

Maximum design velocity for storm sewer shall be 15 feet per second. Special consideration will be given in areas of steep topography.

The minimum and maximum gradients in percent slope are shown below for various sized pipe: (Based on concrete pipe, n=0.013).

<u>Pipe Diameter</u>	<u>Minimum Grade (%)</u>	<u>Maximum Grade (%)</u>
8"*	0.50	18.7
10"*	0.38	13.9
12"	0.34	11.0
15"	0.26	8.0
18"	0.20	6.3
21"	0.16	5.2
24"	0.14	4.3
30"	0.10	3.4
36"	0.08	2.5
42"	0.06	2.0
48"	0.05	1.75

*8" and 10" may only be used if not receiving any surface drainage.

3C. Information Required

Profiles of storm sewers, including inlet/catch basin leads, shall include the information required in **Division II, Section IA, Content of Plans and Specifications**, of these Standards. The hydraulic gradient shall be indicated in the profile view as specified in **Division II, Section 3A. Capacity Design**.

A casting schedule shall be provided including manhole/structure number corresponding to the plan, casting type, top-of-casting elevation, structure invert and structure depth.

A copy of the basis of design for the storm sewers must be submitted with the construction plans.

3D. Sewer Depth and Location

Sewer depth design shall be based on the contours of the land being served and in all cases shall be deep enough to serve neighboring properties as the sewer is extended at a future date.

Minimum depth of sewer shall be 3.5 feet from finish grade to the top of the pipe, including inlet/catch basin leads.

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

Sewers located in a public right-of-way shall be located in accordance with the Standard Utility Location Plan details in **Division X** of these Specifications.

There shall be a minimum of ten feet of horizontal clearance, and 18 inches of vertical clearance at perpendicular crossings, between sewers and water mains, measured outside edge to outside edge. In addition, there shall be adequate separation between sewers and all utilities to allow a 1:1 trench slope from the bottom of the deeper utility which will not undermine any shallower utility. There shall be a minimum of one foot of vertical clearance at perpendicular crossings with utilities other than water mains.

Where sewer lines have been previously provided to the limits of adjoining developments, they shall be extended by the Developer in like size, or as these Standards may require.

3E. Manholes

All manholes shall have eccentric cones. Manholes may be of either precast concrete or concrete manhole block construction.

Manholes shall be placed at every change of grade, direction, and/or pipe size, and at each junction of sewers.

The maximum distance between manholes shall be 400 feet for sewers 36 inches in diameter and smaller, and 500 feet for sewers 42 inches and larger.

Whenever there is an increase in pipe size, grades shall match at a line 0.8 of the diameters above the inverts.

There shall be a minimum of 0.10 foot fall through a manhole where the sewer has a horizontal deflection of up to 30 degrees. For manholes where the sewer has a horizontal deflection from 30 degrees to 90 degrees, there shall be a minimum of 0.20 foot fall. There shall be no more than 90 degrees of horizontal deflection through a manhole.

Manholes shall be located such that they will be directly accessible by vehicular maintenance equipment.

Not more than three sewer service leads may be designed to be tapped into a terminal manhole. All other leads are to be at wyes, tees, or taps at the sewer main. Leads tapped into a terminal manhole must be brought in at the 0.8 line of the sewer and in a formed channel, or through an outside drop connection.

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

3F. Inlets

Inlets/catch basins shall be placed in the curb line at all vertical road profile low points, at the point of curvature (spring point) of intersection radii, at locations deemed necessary to provide proper site drainage, and not more than 500 feet from a high point. Low points shall not receive drainage from a combined total of more than 700 lineal feet of roadway pavement in both directions. A single inlet grate shall not be designed to accept more than 2.5 cfs.

Double inlets shall be used at all local low points on streets, unless otherwise approved by the Public Services Director.

Maximum depth of inlet/catch basin structures shall be 6 feet from the top of the pavement to the invert of the structure.

Inlets and catch basins shall be designed with a two-foot deep sump.

Two-foot diameter inlets/catch basins directly above a 42" or larger storm sewer may be connected directly to the pipe using a precast tee section, rather than a manhole.

3G. Footing Drains/Sump Pump Discharges/Downspouts

As required by the City Council Policy on Footing Drain, Yard Drain, and Downspout Discharges (Resolution No. R-238-5-89, approved May 1, 1989), every site shall be served by an enclosed storm sewer system, either public or private. Footing drains shall be discharged by gravity, the use of sump pumps, or other means, through leads connected to the enclosed storm sewer system. Sump pump discharge lines shall not outlet directly to the streets. Sump pump discharge at the surface to a drainage swale located in a dedicated drainage easement may be approved by the Building Director under special circumstances, provided that the minimum longitudinal swale grade is 2% or greater as required by the Building Director. This surface discharge must be collected by regularly spaced yard inlets before it drains into the public right-of-way.

Sewer leads shall have a minimum of 5 feet of cover. When placed in the same trench as a water service lead, the water service lead shall be a minimum of 1.5 feet above the sewer lead and placed on a shelf of undisturbed soil.

Downspouts shall discharge to grade away from the building, or be connected directly to the storm sewer. Downspout discharge shall not outlet directly to the streets.

3H. Siltation/Soil Erosion Control

All storm sewer systems shall be designed with adequate provisions for the control of siltation and soil erosion within the project. All requirements of **Title V, Chapter 63 of the City Code, Division VII** of these Specifications, the project's grading permit, and the Land Development Coordinator/Building Department shall be met.

4. STORM WATER RETENTION/DETENTION

4A. General

The requirements and design of storm sewer retention/detention facilities shall be in accordance with the most current, approved version of **Title V, Chapter 63, Section 5:673** of the City Code. A copy of this section is included for reference in the Appendix of these Standards. However, if this Code section is revised prior to its revision in these Standards, all requirements of the revised Code section must still be met. (At the latest printing of these Standards, the current code section is dated 10/5/92).

4B. Location

Storm water retention facilities shall be located such that they do not encroach upon any existing or proposed public utility easement or right-of-way.

5. WATER MAIN DESIGN

5A. General

Each development shall be serviced by either a double source of water supply ("looped main"), or shall be designed so as to be served by a double source of water supply when adjacent properties are developed, if such concept is approved by the Public Services and Utilities Directors. Where water mains have previously been provided to the property limits of adjoining developments, they shall be extended by the Developer in like size, or larger as these Standards may require, either to a circulating water main of at least equal size, or to the property limits of the present proposed development.

Terminal dead-end water mains with water service connections are discouraged, and will not be allowed without the written approval of both the Public Services Director and the Utilities Director. This approval will only be granted if supporting data indicating that the "average day demand" for the proposed main will result in a complete turnover of the water in the dead-end main within a ___ period; and that the proposed dead-end main size and length is in accordance with **Division II, Section 5I.** of these Specifications. All dead-end water mains shall terminate with a complete fire hydrant assembly. This will be the only fire hydrant allowed on the dead-end main.

All water mains shall be carried to the limits of the development, for extension by the next development. All water mains shall be sized and placed in accordance with these Standards. Any water main in excess of 1,600 feet in length between interconnections may be required by the Public Services Director to be oversized at the Developer's expense. Each development must have one or more major mains depending on the size and nature of the development, the existing mains, and the development's Site Plan or Final Preliminary Plat. The Public Services and Utilities Directors may, at the City's expense, require the oversizing of any main in a development.

Water mains shall be designed and constructed with 5-1/2 feet of earth cover. Where changes in finish grade occur subsequent to installation of water mains, all manhole castings, gate valve boxes, air-relief boxes, curb stop boxes, hydrants and blow-offs shall be adjusted to the revised grade by the Developer at his/her expense. Where such changes in finish grade will result in a depth of cover of less than five feet or more than 6-1/2 feet, the water main shall be relayed by the Developer at his/her expense to a depth of cover of 5-1/2 feet. No service

connection will be made until corrective action is taken.

A minimum horizontal clearance of 5 feet (10 feet from sewers) shall be maintained whenever possible between water mains and any other underground utility or structure. A minimum of 18" vertical clearance shall be maintained above and below all water mains where they cross, or are crossed by, sanitary or storm sewers; a minimum of 12" of vertical clearance shall be maintained for crossings involving all other utilities. Where vertical bends are necessary to achieve the required vertical clearance at a utility crossing, for mains up to 12" in size, this crossing shall be made using restrained, push-on joint pipe as described in **Divisions III and IV** of these Specifications. The number of these restrained joints shall be determined using the most current edition of the Ductile Iron Pipe Research Association's Thrust Restraint Design Procedure for Ductile Iron Pipe, or other approved method. A copy of these design calculations shall be submitted with the construction plans. Clearances are to be measured outside edge to outside edge.

For a water main connection to be made in the dry (with the use of a tee and solid sleeve), the Mega-lug restraining system, as described in **Divisions III and IV** of these Specifications, shall be specified.

Water mains located in a public right-of-way shall be located in accordance with the Standard Utility Location Plan details in **Division X** of these Specifications.

Special provisions will be made when water mains are to be constructed under structures, under standing or flowing water, or within 20 feet of buildings. Special provisions will generally include Class 54 ductile iron pipe in steel casing pipe, river crossing pipe, or other method approved by the Public Services Director.

5B. Sites

R1 and R2 Zoning (Low Density)

The standard sizes of water mains in these areas shall be 8" and 6". Eight inch main may be used where it completes a good gridiron, intersecting at lengths of no more than 1,200 feet. Six inch main may be used where it completes a good gridiron, and the distance between intersecting or looping water mains of larger size does not exceed 800 feet, and for conforming dead ends.

R3, R6, O, Cl, ClB, RE Zoning (Medium Density)

The standard sizes of water mains in these areas shall be 10" and 8". Ten inch main may be used where it completes a good gridiron, intersecting at lengths of no more than 1,600 feet. Eight inch main may be used only where it completes a good gridiron and where the distance used between intersecting or looping water mains of larger size is 1,000 feet or less. Six inch mains may be used only for conforming dead ends.

R4, R5, CIA, CIA/R, C2, C3, MI, M2, ORL, PUD, or Other Zoning Not Listed (High Density)

The standard size of mains in these areas shall be 12" and 10". Twelve inch main shall be used where it completes a good gridiron, intersecting at lengths of no more than 2,000 feet unless otherwise approved by the Public Services Director. Ten inch main may be used only where it completes a good gridiron and where the distance used between intersecting or looping water mains of larger size does not exceed 1,200 feet. Eight inch main may be used only where it completes a good gridiron, where the distance used between intersecting or looping mains of larger size is 800 feet or less, and where no major fire service connection can be anticipated, or for conforming dead end mains. Fire hydrants shall have a 6" valve opening with 8" service leads.

5C. Appurtenances

For the purpose of this section, the term "in-line valve" shall be understood to refer to a conventional gate valve for sizes 12" and smaller. For valves larger than 12", it is understood to mean a butterfly valve. Gate boxes may generally be used on gate valves 12" and smaller. Gate wells will be required on valves larger than 12". Gate wells will be required where corporations are to be installed for chlorination and testing purposes. At least one such manhole will generally be required for each new development or phase of development.

In-line valve spacing, in general, will be regulated by the requirement that in any single case of accident, breakage, or repair, not more than one fire hydrant or the footage of main listed in the paragraph below will be removed from service by the resultant main shutdown. Exception will be allowed in the case of 12" and larger mains, where not more than two fire hydrants may be out of service for such cause, provided each hydrant has a separate backup hydrant located within 500 feet via an approved fire route. Consideration may be given by the Public Services Director on sharing the added cost of additional in-line valves required to accomplish this, on mains 16" and larger. The design must take into account the location of major building services when locating in-line valves, in order to obtain the maximum benefit from them, and minimize the effect of any single main shutdown on the development. In-line valves shall be spaced such that during a shutdown, a fire service lead will be isolated from the hydrant serving the Fire Department connection.

In-line valves shall be installed so that in any single case of accident, breakage, or repair, no more than 1,000 feet of water main (1,600 feet for 16" and larger mains) will be removed from service. This 1,000 feet is to be considered an absolute maximum. An average of 600 to 800 feet must be maintained throughout a development. The Public Services Director may add or rearrange in-line valves if, in his/her opinion, too large a portion of the development will be affected by a single isolation. Valves will be installed on all water mains extending into cul-de-sacs or dead ends. Such mains shall terminate with a fire hydrant. Valves shall be located on the extension of street right-of-way lines, or if located mid-block or within an easement they shall be located five feet from main tees, preferably hydrant tees. Check valves, or any other appurtenance required, shall be installed by the Developer as directed by the Public Services Director.

5D. Hydrants

Hydrants will be required at all street intersections and at intermediate locations on looping mains such that in no case will the distance between hydrants exceed five hundred feet via dedicated right-of-way or approved fire route. Hydrants shall be located such that all buildings and structures will be included in a 250-foot radius drawn around each hydrant serving the development or proposed construction, and such that the hose lay to any external portion of a structure via an approved fire route will not exceed 400 feet, unless otherwise approved by the Fire Marshal. A hydrant shall be required within 100 feet of a Fire Department connection via an approved fire route. This separation distance shall be increased to 150 feet for residential buildings three stories or less in height, sprinklered under NFPA 13R. All fire hydrants shall be located a minimum of 15 feet from all structures,

however a larger separation may be required by the Fire Marshal based on the use and type of the structure.

In one and two family residential (low density zoning) a 350-foot radius will be allowed and the 400-foot hose lay requirement waived. In medium and high density developments where buildings are located so as to be served by a hydrant from one direction only, a second hydrant will be required on a looping main at a distance of not more than 500 feet from the first hydrant via dedicated right-of-way or approved fire route. All hydrants installed in high density developments shall have a 6" hydrant valve opening (East Jordan Iron Works Model 6-BR with traffic flange) and a minimum 8" diameter service lead (branch).

Special attention will be given to insure proper access to all hydrants and proper hydrant placement with respect to proposed structures and parking. A minimum 20-foot aisle shall be provided up to the hydrant. No parking shall be allowed within 15 feet of each side of a fire hydrant (perpendicular to the pumper connection). Parking may be allowed behind a fire hydrant located on a landscape island in a parking lot. Fire routes used for access to hydrants shall be used and constantly maintained for vehicular travel.

The spacing and coverages outlined above are minimum standards. In addition to these requirements, additional hydrants shall be installed as may be required by the Fire Marshal in accordance with that Department's standards.

In general, hydrants shall be installed at street intersections 10 feet back from the extended street right-of-way line, and offset from the property line and set to grade. Where the above described hydrant spacing standards require intermediate hydrants, they shall be placed on the extension of side lot lines as illustrated below:

In all cases, hydrants shall be located in highly visible and accessible locations. Where both street rights-of-way are 100 feet or wider and buildings or residences are facing the street, hydrants shall be located alternately on both sides of the street.

All hydrant leads shall be not less than 6" and shall be sized in accordance with the chart relating to hydrant leads and dead-end main length contained in **Division II, Section 5I** of these Standards. Hydrants are to be placed such that the total pipe length to the nearest looping main is held to a minimum. All hydrant leads shall be valved at a point 3 feet from the hydrant. In no case shall the centerline of a hydrant be closer than 4 feet or farther than 10 feet from the face of a curb or the edge of a paved area.

All water mains and fire hydrants must be preliminarily accepted and placed into service by the Public Services Director, and a hard surface road in place for fire truck access to the site prior to the placement of combustible materials on the site.

5E. Domestic Service Connections

The Utilities Department will furnish and install service connections of such size and at such location as the applicant requests in writing, provided such requests are reasonable and provided that an adequate, existing, water main totally fronts the premises. The Utilities Department will review and approve the meter and service sizes before the service connections are constructed. The maximum size service connection shall be one standard size smaller than the water main it connects to. Where the main lies in a dedicated street, the service connection will be installed from the water main to a point in the lawn extension which shall be between the curb and sidewalk abutting the street, normally 7 feet from the front property line. Where the main lies in an easement, the service connection will terminate approximately 5 feet from the main, unless otherwise determined by the Utilities Department. Services may be extended up to 35 feet from the water main provided that the curb stop will be; outside of a paved surface; readily serviceable; operable; and, not deeper than 6 feet. Water service connection cost charges will assume centerline of the right-of-way and centerline of water main are the same. Payment for said service connection shall be made by the applicant or his agent in accordance with a schedule, which is a part of the Utilities Department rules and regulations and is included in Appendix A of these Standards. The service connection, whether located on public or private property, is the property of the City.

Water services in new developments which are 2" or smaller, will be installed upon completion of water main construction, testing and acceptance, but in all cases before street pavement is placed. Water service connections are installed from the main to the curb box or shut off exclusively by the Utilities Department. The owner is responsible for the installation and maintenance of water lines beyond the end of the curb-box or shut off. This work is to be inspected by the Building Department. Water services, once installed, are maintained by the Utilities Department up to the shut-off. Where curb box or service damage is attributed by the Utilities Department to construction of other utilities or to development construction, then repairs will be made by the Utilities Department or the Developer, at the Developer's expense, prior to acceptance of the curb box and meter installation by the Utilities Department.

Water services larger than 2 inch in developments where new water main is to be constructed, shall be constructed to within 5 feet of the building, and shall be tested by the contractor in conjunction with the water main construction. The service gate valve shall be located 5 feet from the main. This construction and testing will be inspected by the Engineering Department. From within 5 feet of the building, the construction will be inspected by the Building Department.

For services larger than two inch connecting to existing water mains, the Owner shall submit a plan showing the proposed service and indicating all pertinent details of the installation to the Utilities Department for review and approval. Upon approval, if requested, the Utilities Department will prepare an estimate of the cost of the proposed service. Charges for the service installation, however, will be based on the Department's actual time and material costs and not on the estimate. In any case, where disruption of service will create an unbearable inconvenience to the customer, the customer should consider installation of water main isolation valves on each side of his service or double service connections.

The Utilities Department permits the use of a combination fire and water service connection.

When under a single ownership, separate houses, buildings, living or business quarters on the same premises or on adjoining premises may be served at the option of the applicant either through a separate service connection and meter to each or any unit, or through a single service connection and meter to the entire premises. Separate premises shall be supplied through individual service connections and meters. The responsibility for payment of water and sanitary sewer charges for all service furnished to combined units, supplied through a single service connection, must be assumed by the Owner.

All domestic services shall be metered with a meter furnished and installed exclusively by the Utilities Department. By-passes are not required but are highly recommended on larger meters, and whenever meter removal and repair during regular working hours would cause an unbearable inconvenience to the customer due to the resultant water shut-off.

In the case of tall buildings and/or where marginal pressure requires the use of a booster pump on a domestic service, the pump shall be of the variable speed-constant pressure type except as noted below. Fixed speed pumps of not greater than one horsepower may be approved by the Public Services and Utilities Directors in cases where, in their opinion, the water main development will support such an installation without undue interference with other customers. Fixed speed pumps will be equipped with receiver tanks which insure cycling of not more than 10-15 times per hour; tanks to be equipped with a sight glass to insure non-waterlogging and a means of adding compressed air. All boosted systems shall include pressure gauges and other miscellaneous appurtenances, including a low pressure cut-off switch which will discontinue operation of the boosted system if the pressure of the City water main is lowered 10 psi from its normal static pressure, or to a pressure of 35 psi, whichever pressure is greater. A customer proposing to use a booster pump shall submit to the Public Services Department prior to installation, pump, piping and installation data for approval. On new systems, failure to receive approval prior to use shall constitute grounds for discontinuance of service. All existing pumped systems not previously reported to the Utilities Department shall be reported and data submitted for approval. In no case will deterioration of house service connections with resultant pressure losses be considered justification for installation of a domestic service booster pump.

5F. Fire Service Connections

The Utilities Department will furnish and install an unmetered fire service connection provided adequate provision is made to prevent the use of water from such fire service for purposes other than fire extinguishing. Payment for said fire service connection shall be made by the applicant or his agent in accordance with the schedule of charges outlined in the Utilities Department Schedule of Fees. The maximum fire service connection size shall be one standard size smaller than the water main it connects to.

Fire lines must have an in-line check valve and/or fire pump and check valve, and must be maintained at a pressure sufficiently greater than system pressure to insure that the check valve remains closed at all times except in case of fire. Fire system pressure shall be maintained by use of a metered by-pass booster pump (jockey pump) with appurtenances installed in accordance with the standard detail included in these Standards. An alternate to the preceding is the use of a metered detector check valve. Fire pumps shall have a low pressure alarm bell and light, which will indicate when the pressure on the suction side of the fire pump reaches 20 psi or less.

The applicant shall furnish the Public Services and Utilities Departments for approval, proposed plans and specifications covering the fire service connection, gate valves, check valves, pipes, and appurtenances, along with certified pump curves. When the construction has been completed, inspected and tested, an as-built set of plans shall be furnished.

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

5G. Meters

All premises using City water shall be metered. The Utilities Department will exclusively furnish and install all water meters. Prior to any meter being set, all water connection permit charges and sewer connection permit charges must be paid in full according to the Utilities Department Schedule of Fees. The meter remains the property of the City. Required routine maintenance of water meters shall be performed by Utilities Department personnel. Meters requiring replacement or repairs due to hot water damage, freezing or vandalism shall be made at the customer's expense.

The Utilities Department reserves the right to size and to determine the type of meter to be set for each meter installation. Single-family dwellings and other small buildings being served by a one inch water service qualify to receive a 5/8"x3/4" meter. For premises to be served by a 1-1/4" or larger service the builder, plumber, or his/her agent, shall provide to the Utilities Department a complete itemized building fixture count for use in the sizing of the meter and service.

The Utilities Department will furnish the plumber, for a reasonable period of time, normally two weeks, a meter template sized for 1-1/2" or larger meters for the purpose of properly plumbing the space for the meter. Once the meter has been plumbed, the template must be returned or the meter set ordered. Plumbers found in violation may be assessed charges on a daily basis.

Standard copperhorns and/or meter flanges for 2" and smaller meters will be furnished by the Utilities Department for meter installations. They are to be installed by the plumber prior to requesting the meter installation.

Premises served shall be allowed one domestic meter per service or a combination of one domestic meter and one water-only meter. In multiple-family dwellings, where the premises is owned by one individual, each unit of the premises may be metered from a single service provided that all of the meters are in a single location which is accessible to Utilities Department personnel at all reasonable times. In no case will the Utilities Department allow the manifolding of meters to feed a single unit; i.e., two 1" meters to provide 80 g.p.m.

Water meters shall be set in basements, utility rooms, boiler or mechanical rooms. The meter shall be positioned a maximum of 24" from the service entrance outside wall and located a minimum of 18" to a maximum of 48" above the basement or lowest floor. The meter shall always be set in an easily-accessible area which is heated and protected from the weather. The setting of water meters in such areas as crawl spaces and under kitchen sinks, etc., is not considered an easily-accessible area. Nothing shall be stored or placed in the area of the meter which would hinder a meter reader or serviceman from walking up to the meter for the purpose of reading, inspecting, repairing, or replacing it. Persons desiring to box in, finish off or camouflage the meter installation may do so with written Utilities Department approval.

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

All new meter installations shall be equipped with a remote readout furnished as part of the service expense. The plumber shall provide a 1/2" access hole in the immediate vicinity of the meter in order to run the required cable from the meter to the remote readout location. A 1/2" minimum conduit with a cord for pulling the cable shall be required if the cable access hole is located where the total cable length exceeds 15 feet from the meter to the remote readout. A 1/2" minimum conduit shall be required in any area where the remote cable is enclosed. Customers owning older buildings or dwellings may also obtain remote readouts on a shared cost basis. The Utilities Department will remove the existing meter and install a new or refurbished meter along with the remote

equipment.

5H. Tapping Sleeves and Valves

Use of a tapping sleeve and valve will be permitted and may be required by the Public Services Director or Utilities Director where a lead to a single fire hydrant is to be connected to the system. The existing water main must be 12" in diameter or larger.

Use of a tapping sleeve and valve will be considered and may be required by the Public Services Director or Utilities Director for the connection of new water mains to the system where a dry tap would require more than 1,600 feet of main to be placed out of service; cause a research, commercial or industrial customer to suffer a loss of service which would result in the loss of research projects, serious loss of business, or the loss of production; the shutdown would result in an unacceptable loss of transmission capacity within the existing water system; or, where the proposed connection is a 6" or 8" main connecting to a 16" or larger transmission main.. The use of a tapping sleeve and valve for connection of new mains to the system requires the approval of the Public Services Director and Utilities Director.

In all cases, a tapping sleeve and valve will only be permitted to connect a maximum size pipe of one standard pipe size smaller than the existing main. The gate valve shall be placed in a gate box, unless a manhole is required by **Division II, Section 5C**, or the main to be tapped is a concrete main requiring the use of a saddle sleeve, in which case the valve and sleeve shall be placed in a gate well which encloses both the sleeve and valve.

5I.

Chart Relating to Maximum Hydrant Lead Lengths/Dead-End Main Lengths*				
Looping Connecting Main Size	Hyd. Lead/ Dead-End Main Size From Looping Main	Low Density (Residential)	Medium Density	High Density (8" Lead 6" Hydrant Valve Opening)
6"	6"	60'	10'	N.P.
8"	6"	230'	80'	N.P.
	8"	600'	325'	100'
	10"	600'	475'	250'
10"	6"	270'	120'	N.P.
	8"	600'	500'	500'
	10"	600'	500'	500'
12"	6"	280'	130'	N.P.
	8"	600'	500'	290'
	10"	600'	500'	500'
16"	6"	300'	140'	N.P.
	8"	600'	500'	300'
	10"	600'	500'	500'
	12"	600'	500'	500'

N.P. = Not Permitted

*Dead-end mains must be approved in writing by the Public Services Director and Utilities Director. All dead-end mains shall terminate with a fire hydrant.

6. STREETLIGHTS

6A. General

Four copies of construction plans shall be submitted to the Transportation Division for review and approval prior to construction. No work shall begin until approval has been obtained from the Transportation Division.

Construction plans shall indicate location of poles, cables, conduit, photocells, handholes, disconnect cabinet, and transformer. Depth and distance from the curb of conduit and cable shall be indicated on the plans. Luminaire and pole size, manufacturer, and number shall be provided on the plans. Plans must state that the "City of Ann Arbor Transportation Division must be contacted prior to and during construction. Final inspection and approval must be made by the Transportation Division."

Three copies of "as-built" drawings shall be submitted to the Transportation Division prior to acceptance by the City. Streetlights will not be energized until "as-built" drawings have been received. As-built drawings shall reflect all information required on construction plans finalized with actual in-field data.

6B. Poles, Cable and Conduit

Streetlight and cable shall be located as shown on the Utility Location Plans, in **Division X, Standard Details** of these Standards.

In single and two-family residential developments, streetlights shall be located on the extension of side property lines.

Spacing of 100 watt HPS or 250 watt HPS streetlights shall not exceed 190 feet. Streetlights in the DDA district shall be installed 45 to 60 feet apart.

Cable and conduit sizes shall be shown on the construction plans. Conduit is required in all pole bases and wherever the cable crosses roads and driveways. If final driveway locations cannot be indicated on the plans, the entire length of the cable is to be placed in conduit. The minimum allowed conduit size shall be 2 inches, however, 3 inch conduit is required under roads or driveways.

6C. Photocells

Each light fixture is to have a photoelectric control.

6D. Handholes

Handholes shall be placed in conduit runs in concrete. Handholes shall be located such that the maximum distance between any two handholes, or a handhole and the adjacent streetlight, is 90 feet in commercial areas or 200 feet in residential areas. In addition, handholes shall be placed at all junctions of conduit pipes.

Located in earth

A 12-inch x 18-inch handhole shall be required where two conduits are tapped into the handhole (i.e. one conduit entering and one conduit exiting). Where more than two conduits are tapped into the handholes, a 13-inch x 24-inch rectangular handhole shall be required. The covers for both sizes of handholes shall be the bolt-down type.

Located in concrete

A 12-inch x 12-inch square handhole shall be required where two conduits are tapped into the handhole (i.e. one conduit entering and one conduit exiting). Where more than two conduits are tapped into the handholes, an 11-inch x 18-inch handhole shall be required. The covers for both sizes of handholes shall be the locking type.

In the DDA district, handholes are to be placed in the edge of existing concrete walk, out of brick pavers. The concrete walk shall be saw cut and a section removed that is large enough to facilitate the installation of the proposed handhole. Minimum removal shall be one flag of sidewalk. Conduit shall be laid under brick area next to the existing walk.

6E. Disconnect Cabinet

The lighting system shall have a disconnect mounted in a cabinet adjacent to the Detroit Edison power supply, not to exceed a distance of 10 feet. Cable entering the breaker must be #8 or larger.

6F. Transformer

The transformer location(s) shall be determined by Detroit Edison. The transformer pad shall be as specified by Detroit Edison. All work associated with the transformer(s) shall be coordinated with Detroit Edison.

6G. Luminaire

The size of the luminaires shall be dependent on the land use as approved by City Council or Planning Commission.

The following public street lighting levels are to be achieved:

<u>Use</u>	<u>Footcandles Average Maintained</u>	<u>Uniformity Ratio Average to Minimum</u>
Residential	0.4	6:1
Intermediate	1.0	3:1 to 6:1
Commercial	2.0	3:1

7. STREET DESIGN

7A. General

The *Policy on Geometric Design of Highways and Streets (1990 edition)* by the American Association of State Highway and Transportation Officials (AASHTO) shall be followed for all street designs except as modified below. Copies of all calculations and drawings verifying compliance with AASHTO and these Standards are to be submitted to the Public Services Director for review.

All streets are to be designed with a concrete curb and gutter, 24 inches wide. The curb and gutter in single and two-family developments shall be mountable roll curb as detailed in the City standard details in **Division X** of these Standards. Streets in all other locations are to have barrier curb as detailed in the City standard details, or MDOT C-4 curb where required by the Public Services Director.

The street drainage design shall conform to the requirements of **Division II, Section 3., Storm Sewer Design.**

All streets shall be designed to include 6 inch diameter, flexible, wrapped, perforated, PVC edge drains as indicated in the City standard details. Edge drains shall be connected to all drainage structures and shall extend a minimum of 100 feet upgrade. Additional edge drain may be required by the Public Services Director based on the condition of the subgrade. The grade of the edge drain is to match the road grade.

7B. Classification of Streets

Streets will be classified as either Minor Local, Local, Residential Collector, Commercial/Industrial Collector, or Arterial based upon their function as described below:

Minor Local - The sole function of these streets is to provide access to immediately adjacent properties. These streets are typically short looping streets or cul-de-sacs. These streets shall carry a maximum average daily traffic (ADT) of 100 trips/day, and in residential areas shall serve a maximum of 10 dwelling units. The minimum design speed for these streets shall be 25 mph. These streets will generally not have speed limits posted, but if so will be 25 mph.

Local - The sole function of these streets is to provide access to immediately adjacent properties. These streets shall carry maximum average daily traffic (ADT) of 1,000 trips/day, and in residential areas shall serve a maximum of 75 dwelling units. The minimum design speed for these streets shall be 30 mph. These streets will generally not have speed limits posted, but if so will be 25 mph.

Residential Collector - The function of these streets is to serve traffic between local and arterial streets, and provide access to immediately adjacent residential properties. Streets serving over 75 dwelling units shall be classified as residential collectors. The minimum design speed for these streets shall be 35 mph. These streets will generally be posted at 30 mph.

Commercial/Industrial Collector - The function of these streets is to serve traffic between local and arterial streets, and provide access to immediately adjacent non-residential properties. It will be anticipated that vehicles larger than single-unit (SU) trucks, such as buses or semi-trailer (WB-40), trucks will use these streets. The design of these streets shall accommodate this traffic. Special designs will be required if the anticipated ADT is over 6,000 trips/day, **or** over 10% of the traffic is anticipated to be heavy traffic (bus or WB-40).

Arterials - The function of these streets is to serve as the principal carrier of high volume traffic flow,

connecting areas of principal traffic generation. They should form a reasonably continuous and integrated system, and should help define residential neighborhoods, industrial sites and commercial areas.

The estimated ADT for a street shall be determined by traffic studies and by applying the Institute of Transportation Engineers (ITE) Trip Generation Handbook average trip generation for each type of expected development.

The minimum design speed for Local and Residential Collector streets may be lowered to 25 mph and 30 mph respectively (25 mph posting) due to extraordinary conditions, such as preserving natural features, if approved by the Public Services Director.

7C. Right-of-Way and Street Width

The minimum right-of-way width and street width as measured from edge-of-metal to edge-of-metal (E/E) shall be as follows:

<u>Classification</u>	<u>R.O.W. Width</u>	<u>Street Width (E/E)</u>
Minor Local	66'	24'
Local	66'	28'
Residential Collector	70'	33'
Commercial Collector*	80'	33'
Arterial (varies)	(varies)	

*The widths for Commercial/Industrial Collectors shall be determined by the Public Services Director after reviewing the development and expected traffic, but in no case shall they be narrower than these minimums.

7D. Vertical Alignment

Longitudinal street grades shall meet the following requirements:

<u>Minimum Longitudinal Classification</u>	<u>Preferred</u>	<u>Maximum Longitudinal Longitudinal Grade</u>	<u>Grade For Max. Grade</u>	<u>Special Conditions*</u>
Minor Local & Local		1.0%	7.0%	8.0%
Residential Collector		1.0%	5.0%	7.5%
Commercial/Industrial Collector		1.0%	4.0%	7.0%
Arterial	1.0%	4.0%		6.5%

*Use of these grades must be approved by the Public Services Director. All Minor Local, Local, and Residential Collector streets shall have a 2.5% transverse crown centered in the cross-section. All Commercial/Industrial Collector and Arterial streets shall have a 2.0% transverse crown centered in the cross-section.

Vertical curves are required at all intersecting grades where the change in grade exceeds 1.0%.

The lengths of all vertical crest and sag curves shall meet the requirements of the latest edition of *AASHTO's Policy on Geometric Design of Highways and Streets*. A copy of the calculations and the basis of design for these vertical curves shall be submitted with the plans.

Grades within a street intersection shall not exceed 3.0% for a distance of 100 feet from the intersection of the street centerlines. The curb grades may be separated as they approach an intersection to meet this requirement. The maximum separation shall be a 2% cross slope from radius spring point to radius spring point, measured from edge-of-metal to edge-of-metal (E/E).

7E. Horizontal Alignment

The use of superelevation of horizontal curves is not allowed unless required by unusual conditions and approved by the Public Services Director.

"Broken-back" curves (having a short tangent between two curves in the same direction) are not allowed. Rather a compound curve shall be used. In this compound curve, the radius of the flatter circular arc, R_1 , shall not be more than $1.5R_2$, where R_2 is the sharper circular arc.

There shall be a tangent between all reverse horizontal curves, as stated below.

The radius length to the center of the outside lane of all horizontal curves (for two or three lane pavement sections), and tangent lengths between reverse horizontal curves, shall meet the following minimum requirements:

<u>Design Speed (mph)</u>	<u>Crown</u>	<u>Minimum* Radius Length (ft.) (To Center of Outside Lane)</u>	<u>Minimum** Tangent Length (ft.)</u>
25	2.5%	185	110
30	2.5%	309	132
35	2.5%	478	154
35	2.0%	464	154
40	2.0%	675	176
45	2.0%	1,007	198

*Lengths are derived from the formula; $e+f = V^2/15R$; found in *AASHTO - A Policy on Geometric Design of Highways and Streets* (1990 edition), where $e = -0.02$ for 2% crown or -0.025 for 2.5% crown; f is from Fig. III - 17; and $V =$ design speed.

**Lengths are distances traveled in 3 seconds at the design speed.

These minimum radius requirements are for horizontal curves without super-elevation. The radius of any horizontal curve approved with the use of super-elevation by the Public Services Director, must meet the requirements of the latest edition of *A Policy on Geometric Design of Highways and Streets* by AASHTO. A copy of the calculations and the basis of design for these horizontal curves shall be submitted along with the plans.

7F. Sight Distance

Stopping Sight Distance

A continuous minimum stopping sight distance along the vertical and horizontal alignment of all streets shall be provided as follows:

<u>Design Speed (mph)</u>	<u>Minimum Stopping Sight Distance*</u>
25	150 ft.
30	200 ft.
35	250 ft.
40	325 ft.
45	400 ft.

*From Table III-1, AASHTO-*Geometric Design of Highways and Streets* (1990 edition)

This continuous line of vision shall be measured from a point six inches above the pavement to assumed driver's eye height of 3.50 feet above the pavement. There shall be no objects or structures located within this line of vision.

Intersection Sight Distance

At any uncontrolled intersection (no yield signs, stop signs, or traffic signals) there shall be an unobstructed sight triangle as illustrated below*:

*From Figure 1X-32A, AASHTO - *Geometric Design of Highways and Streets* (1990 edition).

The minimum length of each leg of the sight triangle shall be based on the design speed for each leg of the intersection. These minimum lengths shall be as follows:

<u>Design Speed (mph)</u>	<u>Distance, d</u>
25	110 ft.
30	130 ft.
35	155 ft.
40	180 ft.

Minimum stopping sight distance at the intersection of a street with a street of a higher classification, where stop control is to be provided on the secondary street shall be provided as follows:

<u>Design Speed of Major Street (mph)</u>	<u>Intersection Sight Distance*</u>
30	365 ft.
35	470 ft.
40	580 ft.
45	710 ft.

*From Figure IX-40, (curve B-2b) AASHTO-*A Policy on Geometric Design of Highways and Streets* (1990 edition).

The point of vision shall be located from the centerline of the secondary street at a point 3.5 feet above the proposed street grade, to a point 6 feet inside the curb lines of the major street (future curb line if major street is to be widened), 4.25 feet above the major street grade.

7G. Intersections

Street intersections shall be as near to a 90 degree angle as possible, but in no event less than 80 degrees.

Vertical road grades at an intersection shall comply with those specified in **Division II, Section 7D, Vertical Alignment**.

Intersections shall be designed such that the sight distances shall comply with those specified in **Division II, Section 7F, Sight Distance**.

Intersection curb radii for the various street classifications are as follows (measured to the back of the curb):

<u>Classification</u>	<u>Intersection Radii</u>
Minor Local	30 ft.
Local	30 ft.
Residential Collector	30 ft.
Commercial/Industrial Collector	35 ft.
Arterial	35 ft.

At the intersection of two different street classifications, the higher classification's required radii shall govern. The minimum percent of grade around the intersection radii at the gutter shall be 1.0%. The curb grades may be separated as they approach an intersection to meet this requirement. The maximum separation shall be a 2% cross slope from radius spring point to radius spring point, measured from edge-of-metal to edge-of-metal (E/E).

At the intersection of a street with a street of a higher classification, the 2.0% crown of the major street is to be carried through the intersection.

There shall be no low points within intersections. Drainage shall be carried outside of intersections.

A detail drawing of each intersection is to be submitted with the road plans which shall provide adequate spot elevations to verify and ensure that the pavement and gutters will drain properly and will meet the requirements of these Standards.

7H. Cul-de-Sacs

Cul-de-sacs shall be limited in length to 600 feet as measured along the center of the cul-de-sac from the right-of-way line extended of the cross street to the right-of-way line at the end of the cul-de-sac bulb.

The required right-of-way width and street width of cul-de-sac stems shall be determined in the same manner as outlined in **Section 7B, Right-of-Way and Street Width**.

At the bulb of the cul-de-sac, the right-of-way and pavement radii (to the edge of the pavement) shall be 60 feet and 45 feet respectively for streets with a 66 foot wide right-of-way at the stem, and 70 feet and 55 feet respectively for those with a 70 foot right-of-way at the stem. A landscape island centered in the cul-de-sac bulb with a radius of 20 feet (to the back of the curb) will be allowed, provided that an established association (e.g. condominium association) will maintain the island through a recorded agreement, such as a site development agreement.

The pavement in the cul-de-sac bulb shall have a minimum pavement cross grade of 2.5%, and the curb around the bulb shall have a minimum grade of 1.0%. A detail drawing of each cul-de-sac bulb is to be submitted with the road plans which shall provide adequate spot elevations to verify and ensure that the pavement and gutters will drain properly and will meet the requirements of these Standards.

7I. Pavement Design

A copy of the pavement design calculations shall be submitted with the road plans for review and approval. The design method to be used is that contained in the latest edition of the AASHTO *Guide for Design of Pavement Structures*. Documentation justifying the reasons for selecting the parameters and values used to determine the pavement design are to be submitted along with the calculations.

The following minimum parameters are to be included in the submitted pavement design calculations:

- a) **Design Life** shall be 20 years.
- b) **Original Serviceability Index (P_p)** shall be 4.5 for all new street construction.
- c) **Terminal Serviceability Index (P_t)** shall be 2.0 for minor local, local and residential collector streets; and, 2.5 for major arterial and commercial/industrial collector streets.
- d) **Reliability (R)**. The default value is 90%. If a different value is warranted, justification for the proposed value shall be submitted for review and approval.
- e) **Standard Deviation (S_o)**. The default value is 0.45 for flexible (asphalt) pavements and 0.34 for rigid (concrete) pavements. If a different value is warranted, justification for the proposed value shall be submitted for review and approval.

- f) **Drainage Coefficients** are to be proposed based on the availability and location of edge drains and storm sewers. These drainage coefficients shall be subject to the approval of the Public Services Director.
- g) **Traffic Estimate/Land Calculation**, based on the following:
 - 1. Use a 20 year projection for traffic volume.
 - 2. Determine traffic in one direction only.
 - 3. Determine truck traffic percentage in design lane.
 - 4. Determine total equivalent 18 kip axle loads in design lane (EAL) for 20 year design life.
 - 5. A traffic growth rate is to be determined based on the project's location and anticipated use. This growth rate shall be subject to approval by the Public Services Director.
- h) **Effective Resilient Modulus of Existing Subsurface Soils (M_R) (for flexible pavements) and Effective Modulus of Subgrade Reaction (k) (for rigid pavements)** shall be determined by the Engineer based on the laboratory analysis of existing soil conditions. Soil conditions shall be determined from soil borings obtained along the proposed roadway at distance intervals and at depths sufficient to provide an accurate overall soils profile. Copies of these soil borings shall be submitted with the design calculations.
- i) **Material Properties.** For flexible pavements, a required structural Number (SN) shall be determined using the equivalent axle loading (EAL), the effective resilient modulus (M_R), the design serviceability loss (P_o-P_f), the reliability (R), the overall standard deviation (S_o), and the AASHTO Flexible Pavement Design Nomograph or an accepted software program. The layer thicknesses used to achieve the required SN shall be determined using the drainage coefficients and layer coefficients, which have the following default values:

Asphalt	0.44	
Gravel	0.14	
Sand		0.11

If different values are warranted, justification for the proposed values shall be submitted for review and approval.

For rigid pavements, a Modulus of Rupture (S_C), Modulus of Elasticity (E_C) and Load Transfer Coefficient (J) shall be determined for the proposed concrete pavement. Justification for the values shall be submitted for review and approval.

All other design assumptions used and their related calculations shall be submitted to the Public Services Director for review and approval.

Flexible pavements are to be designed as outlined above, and shall meet the following minimum layer thickness requirements:

Total Asphalt Thickness	3 inches
Aggregate Base Course (22A dense-graded aggregate)	8 inches
Sand Subbase (Class II granular material)	6 inches (minor local, local & residential collector) 12 inches (all others)

7J. Utility Locations

1. All utility locations for residential streets shall conform to the standard locations shown on the Utility Location Plans included in **Division X** of these Standards.
2. Utility locations for commercial/industrial collector and arterial streets will be reviewed on an individual basis by the Public Services Director.

8. DRIVE APPROACHES, SIDEWALKS, AND BIKEPATHS

8A. Drive Approaches

The requirements and design of drive approaches with respect to number, location, and dimensions shall be in accordance with the following standards:

Location of openings.

- (a) No opening shall be closer than 15 feet to the right-of-way line of an intersecting street or extension of the street right-of-way of a street ending at the intersection, provided that no part of any approach shall encroach on any intersection turning area, except as otherwise required by this section.
- (b) No opening shall be closer than 10 feet from the right-of-way line of an alley, except in the case of a joint approach and provided the total width of the combined opening does not exceed that permitted in subsection (4) of this section.
- (c) No opening shall be closer than 4½ feet to the adjacent property line. No approach shall be so constructed that any part of same extends in front of property belonging to another person unless both property owners sign a joint application for a permit.
- (d) Any 2 openings shall be at least 9 feet apart; provided that this requirement shall not apply to openings for existing driveways on residential property.
- (e) All openings and approaches shall be so located as to provide adequate vertical and horizontal sight distances for safe access to the street in accordance with the design standards for sight distance, copies of which are on file with the department of streets, traffic and parking.

General Design criteria.

- (a) The angle of the driveway approach to the street shall be 90 degrees, except as otherwise provided for herein.
- (b) Driveways for single- and 2-family uses shall be constructed as follows:

- (i) Minimum permitted width of openings: 10 feet.
 - (ii) Maximum permitted width of openings: 24 feet.
 - (iii) Maximum permitted curb cut width: 44 feet.
 - (iv) Minimum turning radius: 5 feet.
- (c) Driveways for all other uses shall be constructed as follows:
- (i) Minimum permitted width of openings: 24 feet.
 - (ii) Maximum permitted width of openings: 30 feet.
 - (iii) Maximum permitted curb cut width: 60 feet.
 - (iv) Minimum permitted width of 1-way drives: 15 feet.
 - (v) Maximum permitted width of 1-way drives: 20 feet.
 - (vi) Minimum turning radius at pavement edge: 5 feet.
 - (vii) Maximum turning radius at pavement edge: 15 feet.
- (d) Upon a finding that traffic conditions would otherwise cause unnecessary congestion or practical difficulties, the Public Services Director or his designee may permit the following design features:
- (i) One of the driveway openings on each abutting street may be channelized with a separating island a minimum of 10 feet in width to form a separate opening for entrance and exit lanes; provided that the total of both lanes shall not exceed the maximum permitted width. If a median is to be used, its location with respect to the right-of-way line, and street curb must be approved by the Public Services Director.
- (e) Drive approaches shall be sloped toward the street. The minimum allowed grade shall be 3% (3/8" per foot), and the maximum allowed grade shall be 13% (1.56" per foot).
- (f) Provisions shall be made to ensure that excessive quantities of storm water drainage do not drain across the drive approach from the site into the public right-of-way. These provisions shall be subject to the approval of the Public Services Director, and may include inlet structures at the back of the public right-of-way, or grading of the private drive onto the site away from the right-of-way.

Standard for parking lots.

The following requirements shall apply to parking lots having more than 4 car spaces:

- (a) The minimum distance to intersections as measured from the extension of the street right-of-way line to the nearest edge of the driveway opening shall be 50 feet.
- (b) Where 2 or more openings are permitted, signs shall be erected, making 1 or more openings 1-way.
- (c) No opening shall be so located as to conflict with an existing opening on the opposite side of the street.

Drive Approach Types and Materials

Drive approaches shall have either Type M or Type L openings, as shown in the City Standard Details, and as described below:

Drive approaches serving up to 8 single or two-family dwelling units, sites within the DDA District, or a parking lot(s) with up to 24 parking spaces shall meet the adjacent sidewalk/bikepath grade. Thus the sidewalk/bikepath shall not be ramped down to the drive approach. Drive approaches may be either concrete or asphalt.

Minimum requirements for concrete approaches shall be 6" thick, non-reinforced Class A concrete, on a 6" base of Class II granular material or 22A dense graded aggregate..

Minimum requirements for asphalt approaches shall be 3" of 1100 20AA asphalt placed in one lift, on a 6" base of 22A gravel.

Private street intersections, and drive approaches outside of the DDA District which will serve a parking lot(s) with over 24 parking spaces or carry 50 or more trips during the peak hour, shall have a full curb face to the adjacent sidewalk/bikepath. The sidewalk/bikepath shall be ramped down to the drive approach with concrete ramps. Drive approaches may be either concrete or asphalt. The crosswalk across the approach shall be made either by pavement markings or scored concrete. In addition, a stop sign shall be installed at the exit of the drive, located on the property a minimum of two feet outside the right-of-way.

Minimum requirements for concrete approaches shall be 8" thick, non-reinforced Class A concrete, on a 6" base of Class II granular material or 22A dense-graded aggregate..

Minimum requirements for asphalt approaches shall be 3" of 1100 20AA asphalt placed in one lift, on an 8" base of 22A gravel.

Drive approaches to be constructed on existing concrete streets, or on streets with mountable curb, shall be trapezoidal approaches. The opening on an existing concrete street is to be a Type L opening with the back of the curb being horizontally sawcut.

8B. Sidewalks and Access Walks

Sidewalks shall be provided on both sides of all public streets. Sidewalks are to be typically located such that the outside edge is positioned six inches inside the right-of-way line. However, the sidewalk may meander within the right-of-way to protect and save trees, slopes, etc. if approved by the Public Services Director. This approval will be granted provided that any curve in the sidewalk has a minimum 15 foot radius, and that the minimum lawn extension width meets the requirements of **Section 8D., Lawn Extensions**.

Sidewalk ramps shall be constructed at all street intersections and shall meet the requirements of the Sidewalk Ramp detail in **Division X, Standard Details** of these Standards.

All sidewalks and access walks shall be 5 feet wide. They shall be 4 inch thick Class A concrete, except where crossing concrete drive approaches, where they shall meet the requirements of **Section 8A, Drive Approaches**. The concrete may be placed on native material provided that the material is stable and free of organic or other deleterious material. If the native material must be removed, the concrete shall be placed on a minimum 4-inch thick base of Class II granular material.

Sidewalks and public access walks are to have a transverse grade of 2% (1/4" per foot), with sidewalks draining toward the street.

The maximum allowed longitudinal grade for sidewalks and access walks shall be 5%. This shall not be exceeded, unless the road grade is of a steeper grade, in which case the longitudinal sidewalk grade shall not exceed the road grade.

Expansion and contraction joints shall be installed as shown on the Sidewalk and Curb & Gutter Joints detail in **Division X, Standard Details** of these Standards.

8C. Bikepaths

Bikepaths shall be provided where they will complete an existing bikepath, provide access to a park or school where the development is located on an Arterial Street which would have significant pedestrian and bicycle traffic, or where directed by the Bicycle Coordinator, Planning Commission or City Council.

Bikepaths shall have 8 foot minimum width. They shall be either concrete or asphalt.

Concrete bikepaths shall be constructed using the same cross section required in **Section 8B, Sidewalks**.

Asphalt bikepaths shall be 3 inches of MDOT II00T, 20A, AC 200-250 asphalt placed in one course, on a 6 inch base of MDOT 21AA crushed limestone.

Bikepaths shall be typically located such that the outside edge is positioned six inches inside the right-of-way line. However, the bikepath may meander within the right-of-way to protect and save trees, slopes, etc., if approved by the Public Services Director. This approval will be granted provided that any curve in the bikepath meets the requirements for a minimum 20 mph design speed (see table below), and that the minimum lawn extension width meets the requirements of **Section 8D., Lawn Extensions**. unless otherwise approved by the Public Services Director.

Bikepaths are to have a cross grade of 2% (1/4" per foot) draining toward the street.

The maximum allowed longitudinal bikepath grade shall be 5%. This shall not be exceeded, unless the road grade is of a steeper grade, in which case the longitudinal bikepath grade shall not exceed the road grade.

Bikepaths shall have vertical and horizontal curvature designed for a speed of 20 mph in accordance with the requirements of the AASHTO - *Guide for Development of New Bicycle Facilities* (1991 edition). For longitudinal grades in excess of 4%, a design speed of 30 mph shall be used.

<u>Design Speed</u>	<u>Minimum Radius (feet) for B/P on outside of horizontal road curve (positive superelevation)</u>	<u>Minimum Radius (feet) for B/P on inside of horizontal road curve (negative superelevation)</u>
20	95	110
25	155	185
30	250	300

Concrete bikepath ramps shall be constructed at all street intersections, meeting the requirements of the Sidewalk Ramp detail in **Division X, Standard Details** of these Standards.

8D. Lawn Extensions

"Lawn extension" shall be defined as the area between the back of the curb on a public street and either the public sidewalk, public bikepath, or right-of-way line.

The lawn extension shall be either sodded, grass seeded or paved. Any surface treatment other than sod or grass seed must be approved by the Parks and Recreation Superintendent. Gravel, stones or other "loose" materials are not approved surface materials. Lawn extensions to be improved within the DDA District are to be in accordance with the current DDA standards.

The minimum lawn extension width shall be 3 feet. This is an absolute minimum for short sections in specified circumstances. Normal lawn extensions shall be 11 feet or greater as indicated on the Utility Location Plans in **Division X, Standard Details** of these Standards. A greater minimum width will be required by the Public Services Director on Arterial Streets.

The lawn extension shall be graded to drain toward the street. From the edge of the sidewalk or bikepath for a minimum of one foot, the lawn extension grade shall be 3/8" per foot (3%). The remaining lawn extension shall have a minimum grade of 3/8" per foot (3%), and a maximum grade of 4" per foot (1:3).

The use of retaining walls in the public right-of-way must be approved by the Public Services Director. Construction plans for the proposed retaining wall shall be prepared by a registered professional engineer and submitted to the Public Services Director for review and approval. The Public Services Director may require specific materials (i.e., modular precast block) for any retaining wall to be placed in the right-of-way.