



**Design Criteria and  
Plan Requirements  
For Public Improvement Plans  
2025 Edition**



**CITY OF LENEXA**  
**Community Development Department**  
**[www.lenexa.com](http://www.lenexa.com)**

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**Design Criteria and Plan Requirements**  
**For Public Improvement Plans**  
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## **PURPOSE**

The purpose of this document is to summarize Lenexa's design criteria which stipulates the minimum requirements for design of infrastructure improvements in the City of Lenexa. Although general plan requirements remain the same, within areas of new development located in the "Lenexa City Center Neighborhood", there are alternate design standards and guidelines which shall be used. Contact the Community Development Department to view the boundaries of the "City Center" area and to obtain a copy of these design standards and guidelines.

PLEASE NOTE: Many elements of the design criteria are fully enumerated within the appropriate sections of the City Code. While there may be portions that have been provided within this design guide in a more abbreviated or partial manner in order to facilitate a more concise and simplistic guidance document, all design elements must conform to the design criteria shown in the City Code.

## **DESIGN CRITERIA**

### **A. STREETS**

**TABLE 1. Street Criteria**

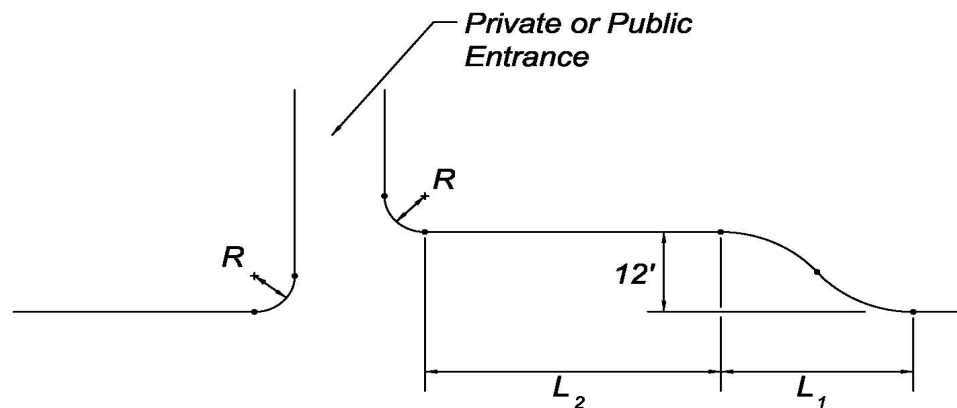
<b>STREET CLASSIFICATION</b>	<b>Min. ROW Width (ft.)</b>	<b>Min. Street Width (1,9) (ft.)</b>	<b>Grade Max/Min (%)</b>	<b>Design Speed (2,9,10) (mph)</b>	<b>Min. Curve Radius (8) (ft.)</b>	<b>Sidewalks/ Width (12) (ft.)</b>
Arterial 4-Lane, Divided	100 <sup>(3)</sup>	28 (per side)	6/1	45	1039	Both Sides/ 5 <sup>(4)</sup>
Collector 3-Lane	70	40	8/1	30-40	333-762	Both Sides/ 5
Collector 2-Lane	60	28	8/1	30-35	333-510	Both Sides/ 5
Residential Collector 2-Lane	50	26 <sup>(1)</sup>	8/1	30-35	333-510	Both Sides/ 5
Local 2-Lane	50	28 <sup>(5)</sup>	10/1	25	198	One Side/ 5
Industrial Street / Business Park	60 <sup>(6)</sup>	36	6/1	25-30	198-333	One Side/ 5 <sup>(7)</sup>

- <sup>1</sup> Street width measured from curb back to curb back. Additional width may be required to accommodate turn lanes and ADA sidewalk ramps as necessary.
- <sup>2</sup> Design speed criteria for horizontal and vertical alignment shall reasonably comply with the guidelines set out in the most recent edition of the AASHTO's *A Policy on Geometric Design of Highways and Streets*.
- <sup>3</sup> Minimum median width = 16 feet.
- <sup>4</sup> A multi-use trail with a width of 10 feet (typ.) shall be provided in lieu of one of the required 5-foot sidewalks in those locations designated for multi-use trails by the City Parks and Recreation Department.
- <sup>5</sup> 22' where approved by City Engineer. See Section 4-2-C-2(D) (13) of the City Code.
- <sup>6</sup> Right-of-way and paving width of 70' and 40', respectively, will be required where heavy truck traffic is anticipated.
- <sup>7</sup> A pedestrian circulation plan may be required where heavy truck traffic is anticipated.
- <sup>8</sup> Based on AASHTO's *A Policy on Geometric Design of Highways and Streets, Design for Low Speed Urban Streets*.
- <sup>9</sup> Superelevation will not be allowed, unless approved by the City Engineer.
- <sup>10</sup> The design speed as well as the posted speed shall be determined by the City Engineer. The posted speed shall not be more than the design speed.
- <sup>11</sup> Parking will not be permitted on arterial, collector, or industrial/business park streets. On residential streets, parking will typically be permitted on both sides of 28' wide streets and on one side of 22' wide streets.
- <sup>12</sup> The design of all sidewalks, multi-use trails, ADA ramps, and crosswalks shall meet PROWAG.

Streets shall be constructed in accordance with these criteria and in accordance with the City Standard Details. In addition to the criteria stated above, the following shall apply:

- Valley gutters shall not cross collector or arterial streets.
- A 6' minimum greenspace between the back of curb and the sidewalk/trail is required unless otherwise specified.

- Combined Utility Easement (U/E) and Sidewalk Easement (S/E) with a minimum width of 10' shall be required on both sides.
- At locations where high volumes of truck traffic are anticipated, curb returns shall be designed to accommodate WB-67 vehicles.
- Reverse curves will not be permitted. For Local Roads, the minimum distance between curves shall be 100'. For all other road classifications, a minimum distance between curves shall be 2 times "Lr" for the appropriate radius and speed from AASHTO's *A Policy on Geometric Design of Highways and Streets*, titled "Minimum Length of Superelevation Runoff, Lr", and  $e_{max} = 6\%$ .
- A geotechnical report that provides site-specific recommendations for the construction of public streets must be submitted for all street classifications. See Section S-212 – SUBGRADE from the City of Lenexa's Technical Specifications.
- The lengths of right/left-turn lanes at entrances along arterial streets shall be designed according to Figure 1 and Table 2 below.



**FIGURE 1. Access onto Arterial Streets**

**TABLE 2. Design Guide for Access onto Arterial Streets**

Arterial Speed	$L_1$	$L_2$
45 mph – Desirable	120	250
45 mph – Limiting	100	130
40 mph – Desirable	120	190
40 mph – Limiting	90	100
35 mph – Desirable	90	120
35 mph – Limiting	60	60

**NOTES:**

1. The desirable dimensions shall always be used, unless significant extenuating circumstances exist. The City Engineer shall determine if limiting dimensions can be used.
2. Dimensions are for right and left-turn lanes. Because  $L_2$  does not include any length for storage of vehicles, additional length will be required for left-turn lanes and may be required for right-turn lanes. The City Engineer shall determine the additional length required. A traffic study or traffic analysis may be required to assist in determining the necessary additional length.

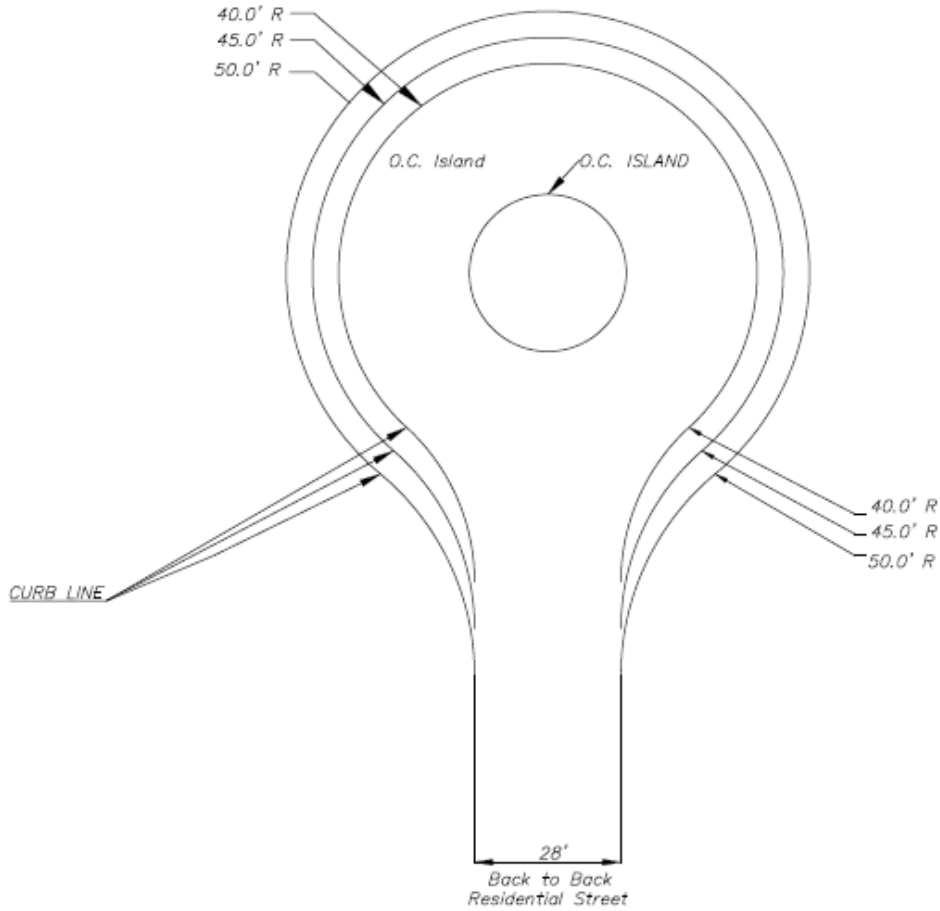
## B. CUL-DE-SACS

**TABLE 3. Cul-de-sac Criteria**

<b>STREET CLASSIFICATION</b>	<b>Max. Length<sup>(1)</sup> (ft.)</b>	<b>Min. ROW Width (ft.)</b>	<b>Min. Street Width<sup>(2)</sup> (ft.)</b>	<b>Min. Radius of ROW at Bulb (ft.)</b>	<b>Min. Radius of Pvmt. at Bulb<sup>(3)</sup> (ft.)</b>	<b>Min. Radius of Island</b>
Collector 3-Lane	1000	70	44	60	50	Island not Permitted
Collector 2-Lane	1000	60	36	60	50	Island not Permitted
Residential Local <sup>(5)</sup> 2-Lane	1000	50	28	50	40	(4)
Rural Local <sup>(5)</sup> 2-Lane	1000	60	24	50	40	(4)
Industrial Street / Business Park	1000	60	36	60	50	Island not Permitted

- 1 Measured from the “near side” of the ROW line of the intersecting street to the center line of cul-de-sac bulb.
- 2 Measured “back-to-back” of the curb and gutter sections except Rural Local 2-Lane Streets which are measured to the edge of pavement surface.
- 3 Radius measured at back of curb.
- 4 See residential cul-de-sac design alternatives FIGURE 2 for island application.
- 5 Maximum of 50 dwelling units.

**FIGURE 2.1 Residential Cul-de-sac**



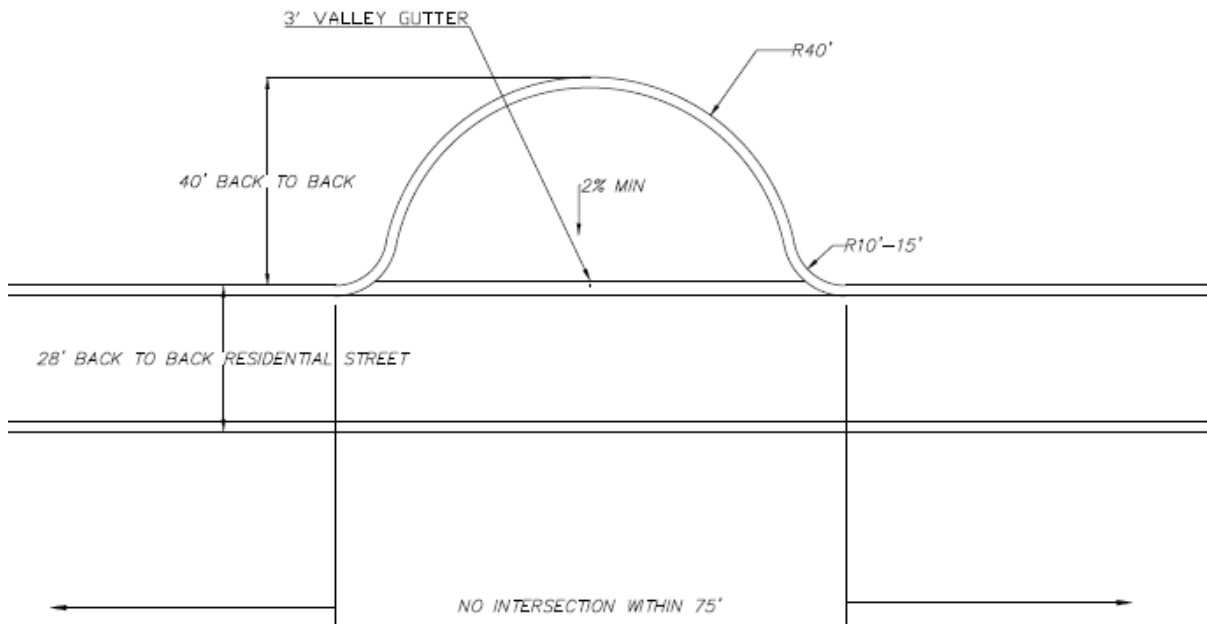
<i>Residential Cul-De-Sac Design Alternatives</i>	
<i>R/W Required</i>	<i>Pavement-Back of Curb</i>
<i>50' R + Transition</i>	<i>40' R w/ no island</i>
<i>55' R + Transition</i>	<i>45' R w/ O.C. island (Island Max. R= 15' Min. R=10')</i>
<i>60' R + Transition</i>	<i>50' R w/ O.C. island (Island Max. R= 20' Min. R=10')</i>

GENERAL NOTES:  
 Variations on these geometries such that clearances are maintained will be considered for design alternatives.

O.C. = On Center  
 NON-STANDARD CUL-DE-SACS SHALL ACCOMMODATE SU-30.



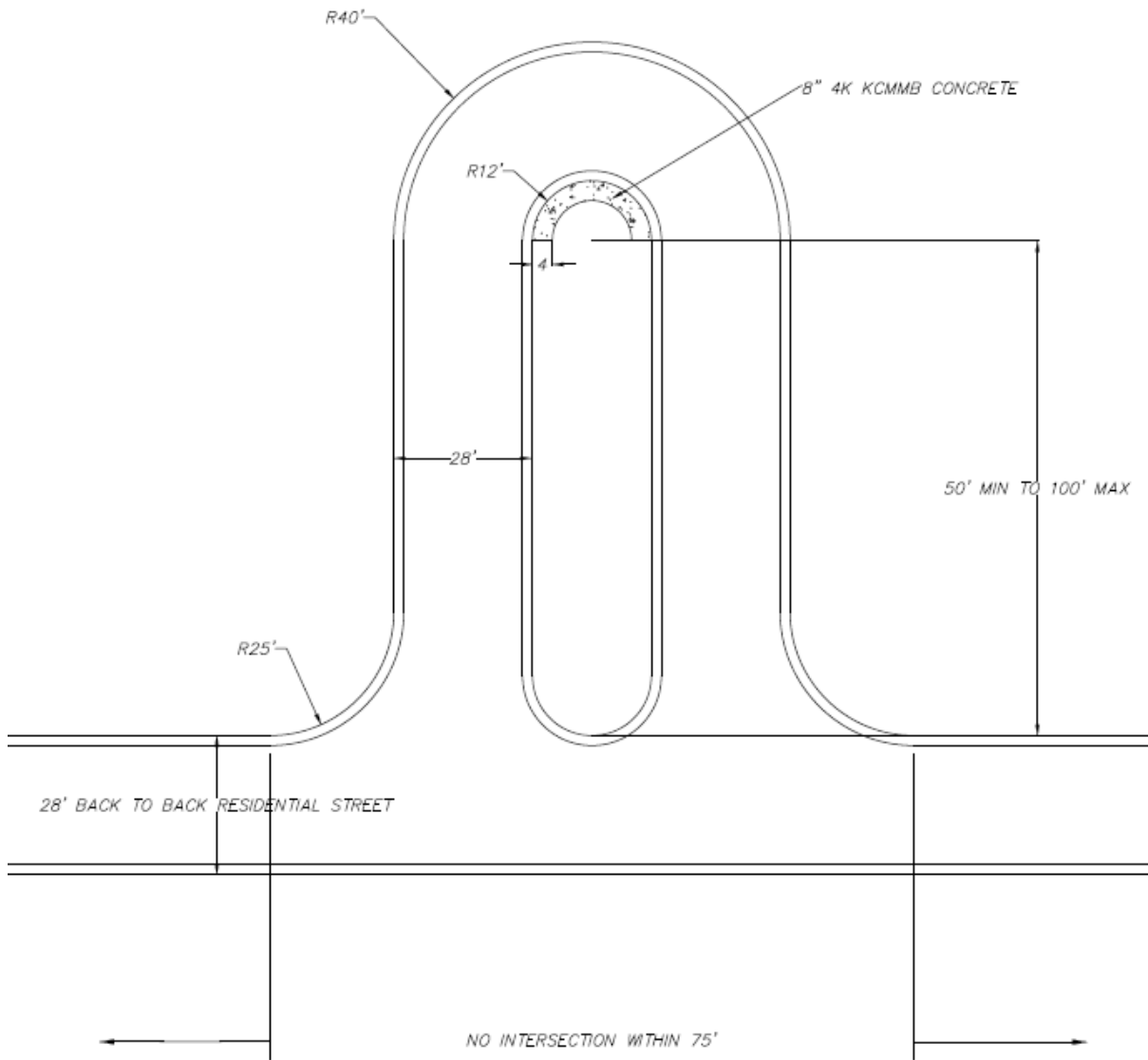
**FIGURE 2.2 Residential Partial Eyebrow**



GENERAL NOTES:

1. NOT PERMITTED ON THROUGH STREETS.
2. ISLANDS ARE NOT PERMITTED.
3. NOT PERMITTED WITHIN 75' OF AN INTERSECTION.

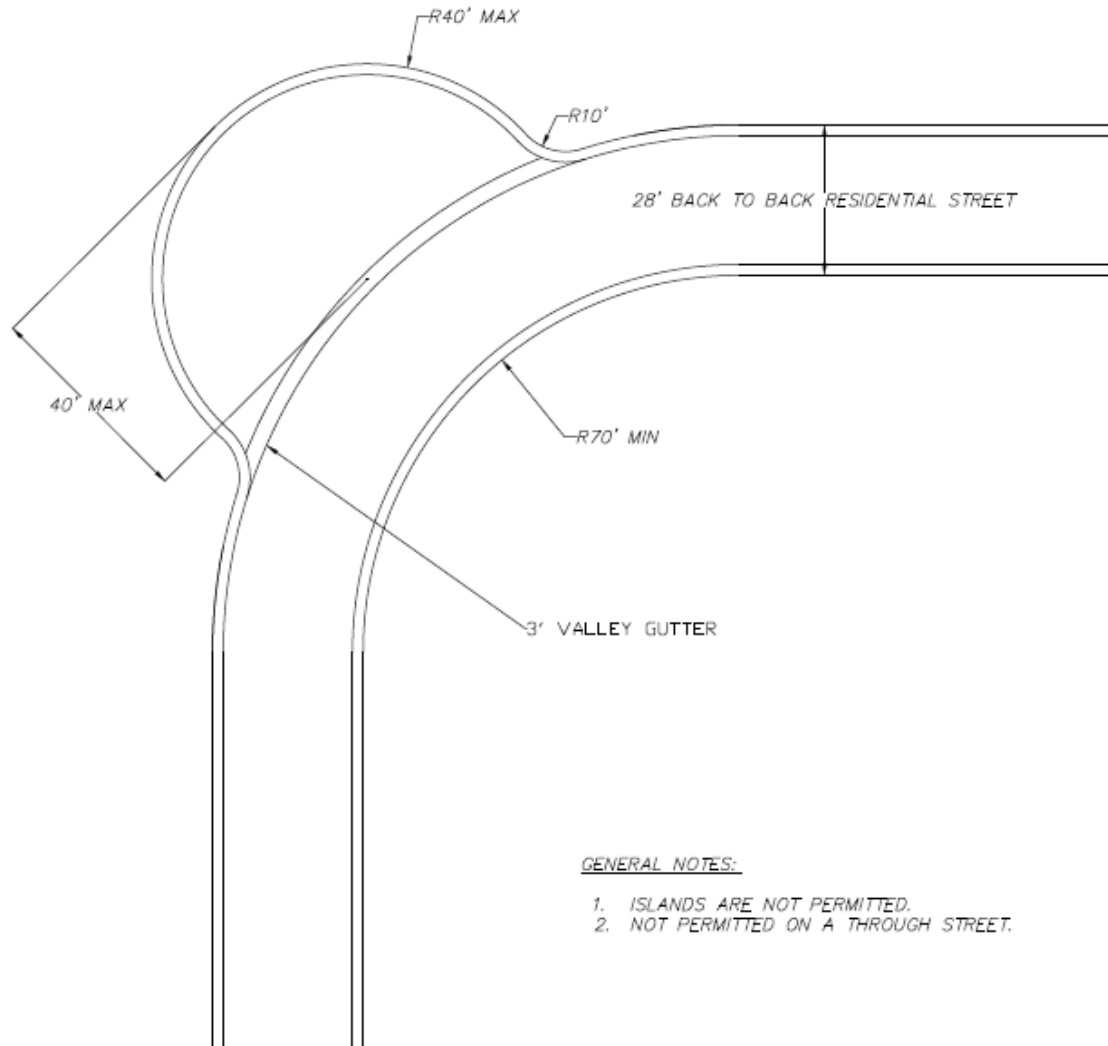
**FIGURE 2.3 Residential Eyebrow**



GENERAL NOTES:

1. NOT PERMITTED ON THROUGH STREETS.
2. ISLANDS ARE REQUIRED.
3. NOT PERMITTED WITHIN 75' OF AN INTERSECTION.

**FIGURE 2.4 Residential Knuckle**



## C. MEDIAN ISLANDS

### LOCAL STREETS

Median islands at the entrance to subdivisions on local streets (with a single lane in each direction on the local street) shall meet the criteria stated in table below:

**TABLE 4. Median Island Criteria**

Length <sup>(1)</sup>		Width <sup>(2)</sup>		Curb	Setback Distance <sup>(3)</sup>	Width of Adjacent Lanes		Radius of Island Nose
Min.	Max.	Min.	Max.	Type	Min.	Min.	Max.	Min/Max
40'	100'	6'	20'	B	3'	14'	16'	½ Width

- 1 A mountable nose (per City Standard Details) shall be installed at both ends of the island. Length of the mountable nose shall be included in the Min. and Max. island length.
- 2 Width shall be measured from back of curb to back of curb, but shall be determined by the ability to line up the lanes on streets opposite to the median and provide safe and efficient traffic operations at the intersecting street. At locations where there might be a roadway, driveway or entrance on the other side of the street, the island width shall be limited to 6 feet max.
- 3 Setback is the distance from the back of curb to the nearest point on any object within the median—including plantings other than grass.

Other dimensions and criteria may be required when, in the opinion of the Engineer, site conditions warrant. Regardless of the criteria applied, the configuration of the street and island shall accommodate a WB-50 design vehicle without encroachment onto the island, including the curb for the island. A Keep Right symbol sign (R4-7) with an object marker (OM 1-3) mounted below shall be installed on all entrance islands at each end of the island. Installation shall be in accordance with the latest edition of the *Manual on Uniform Traffic Control Devices* (MUTCD) and the City's standard details and technical specifications.

In addition to the above criteria, underdrain shall be placed around the perimeter of any cul-de-sac or subdivision entry island. This is not a design criterion but rather a construction requirement, as stated below in the plan requirements.

### ARTERIAL AND COLLECTOR STREETS

For arterial and collector streets where there are auxiliary lanes (i.e. left and right-turn lanes), the median configuration will not be subject to the requirements shown in the table above but shall be designed as per AASHTO's *A Policy on Geometric Design of Highways and Streets* for the individual intersection conditions. The need for auxiliary lanes shall be determined by the City Engineer or the Transportation Manager.

The design of the median nose varies. Semicircular median noses shall be designed for medians 8' wide and less. In contrast, a bullet-nose design shall be used for medians greater than 8' wide. The bullet nose is formed by a 60' control radius arc that terminates by a median nose that is normally one-fifth (1/5) the width of the median. For example, a bullet nose design for a 20' wide median would have a small nose radius of 4' that would connect a 60' radius with a tangent.

For new median island construction or for the modification of an existing median island when the width of the median island is less than or equal to 5', the entire length of the island shall be paved with brick pavers. All brick paver construction shall be in

accordance with the City's standard details. The colors and pattern of the brick pavers are determined on a project-by-project basis and will be communicated to the Designer by the City's Project Manager at the onset of the project.

Where median islands are greater than 5' in width and landscaping is included such as turf grass, trees, shrubs, and native grasses, an irrigation system may be required as part of the construction. The design of the irrigation system shall be in accordance with irrigation system design criteria in this document and with the City's standard details and technical specifications.

## **D. ROUNDABOUTS**

Roundabouts shall be designed in accordance with the latest edition of the Federal Highway Administration (FHWA) document, *Roundabouts: An Informational Guide*, (Publication No. FHWA-RD-00-067), the latest edition of the *Kansas Roundabout Guide*, and PROWAG.

The design of all roundabouts will be subject to the review and approval by the Kansas Department of Transportation (KDOT) in addition to the City of Lenexa.

## **E. MULTI-PURPOSE TRAILS**

Multi-use trails shall be designed in accordance with the latest edition of AASHTO's *Guide for Development of Bicycle Facilities* and PROWAG.

Multi-use trails shall be located within a development based on the alignments shown on the "Lenexa Trails Alignment Analysis" study, which can be found on the City of Lenexa's website on the Parks and Recreation Master Plan webpage under the Parks and Recreation Department, or as directed by the City Engineer.

The design and construction of the trail shall be in accordance with the City's standard details.

## F. STORM DRAINAGE

All stormwater drainage systems shall be designed in accordance with Section 5600 of the *Standard Specifications and Design Criteria*, published by the Kansas City Metropolitan Chapter of the American Public Works Association (APWA), and in accordance with the latest adopted edition of *The Manual of Best Management Practices (BMPs) for Stormwater Quality*, published by the Mid-America Regional Council (MARC) and the American Public Works Association, except that in Paragraph 5601.5 of the *Standard Specifications and Design Criteria*, published by the Kansas City Metropolitan Chapter of the American Public Works Association the following shall be added:

1. At the beginning of Section 5601.5 just prior to Subsection A, add the following sentence:

“In the event of any conflict between this Section and the provisions of the City’s Stream Setback Article (4-1-0), the Stream Setback Article shall govern.”

2. Under Section 5601.5 A following the first paragraph, add the following sentence:

“Generally, a public storm drainage system is constructed when the peak discharge is greater than 8 cfs for the 10% design storm and the drainage is generated by more than one lot or the drainage area is greater than two acres.”

3. Under Section 5601.5 A.4 following the first paragraph, add the following sentences:

“The City of Lenexa detention strategy is as follows: Peak runoff control is provided for the 10% and 100% storms with volumetric and/or extended detention control of the 90% mean annual event storm for protection of the receiving system from channel erosion. Detention of the 1% storm is required only if there is a downstream flooding problem. A downstream flooding problem is defined as existing flooding of an existing habitable structure, roadway, or public facility or modeled flooding of the same as a result of the proposed development. The potential for flooding should be checked downstream from the development to the point that the development is less than 10% of the entire watershed.”

“If flooding problems do not occur, as described above, detention of the 1% storm is not allowed.”

For all developments, peak runoff flow rates from the overall developed site must match the pre-development peak flow rates, for the 10% and 100% chance storm.

4. Under Section 5608.4 C, after the last paragraph, add the following sentence:

“For basin designs within the City of Lenexa, the designer shall match existing release rates for all applicable storms and provide 40-hour extended detention of runoff from the local 90% mean annual event (1.37”/24 hour rainfall). See Chapter 6 of the MARC/APWA BMP Manual for calculating volume.”

General location and width of stream setbacks are shown on the City of Lenexa website at [www.lenexa.com](http://www.lenexa.com) in the WORK tab, CITY CODE selection, VIEW button, TITLE 4-UNIFIED DEVELOPMENT CODE, Chapter 4-1 ZONING, Article 4-1-0 STREAM SETBACKS, Section 4-1-0-4 STREAM CORRIDOR, “Exhibit A”. Actual stream setbacks must be based on surveyed locations.



In general, storm drainage facilities, including enclosed pipe systems, open channels and stormwater detention facilities, are considered permanent facilities. As such, storm drainage facilities shall be designed in accordance with Section 5600. Furthermore, erosion and sediment control measures are considered temporary measures and generally, shall be designed in accordance with Section 5100 of the APWA Specifications and Criteria. (See Section H. of these criteria).

In addition to the Section 5600 requirements, the following requirements, as adopted by the City of Lenexa, shall apply:

- All Engineered Channels shall have a minimum slope of 3%.
- Vegetated Swales, when used as a BMP, may have a slope less than 3%.
- Open Channels, as defined by Section 5600, may also have slopes below 3%, when allowed by Section 5600.
- Engineered Channels and Open Channels shall be as defined by Section 5600. Vegetated Swales shall be defined per the MARC manual on BMPs, as adopted by Lenexa.
- All outlet stabilization structures (riprap blanket, stilling basins, or energy dissipators) shall be designed in accordance with Hydraulic Engineering Circular No. 14 (HEC-14), Third Edition, *Hydraulic Design of Energy Dissipators for Culverts and Channels*.
- The required design storm for all non-residential streets shall be the 25-Year.

The City of Lenexa General Conditions, Technical Specifications, and Standard Drawings shall control the construction, equipment, and materials of all public improvements.

Prior to beginning any construction, submittals are required for materials as listed in the Technical Specifications.

## G. EROSION CONTROL

The intent of these Erosion Control criteria is to:

- Fit the development/improvement to existing site conditions;
- Protect areas to be disturbed from storm water runoff;
- Minimize the extent and duration of exposure;
- Stabilize disturbed areas and minimize erosion at the outlet of all pipes and paved channels;
- Minimize sediment-laden runoff;
- Retain sediment on the site;
- Set criteria for inspection and maintenance of control measures;
- Criteria shall conform to performance measures and meet or exceed outcomes, as determined through a visual inspection of sediment transport within the site and sediment deposition off the site.

In general, storm drainage facilities, including enclosed pipe systems, open channels and stormwater detention facilities, are considered permanent facilities. As such, storm drainage facilities shall be designed in accordance with Section 5600 of the APWA Specifications and Criteria. Furthermore, erosion and sediment control measures are considered temporary measures and generally, shall be designed in accordance with Section 5100 of the APWA Specifications and Criteria, latest edition.

According to National Pollutant Discharge Elimination System (NPDES) requirements, owners or operators of a project, who engage in construction activities where one acre or more will be disturbed by the construction, need authorization to discharge stormwater runoff under the State's construction stormwater general permit. A Notice of Intent (NOI) application shall be completed and submitted to the Kansas Department of Health and Environment (KDHE) with the appropriate fee, to obtain authorization to proceed with the construction under this general permit. In addition, a Storm Water Pollution Prevention Plan (SWPPP) shall be developed and maintained at the construction site.

All public improvements, development, and land disturbance shall be designed in accordance with Lenexa's Land Disturbance Provisions (Article 4-1-N). Article 4-1-N references the latest edition of Section 5100 of the *Standard Specifications and Design Criteria* published by the Kansas City Metropolitan Chapter of the American Public Works Association.

## H. STREET LIGHTS

The street lighting system shall consist of one or more control centers/controllers, the distribution system, street light poles, luminaires and any other appurtenances required to provide a complete, operable street lighting system. Components of the system shall conform to the City of Lenexa's technical specifications and standard details.

The street lighting design and layout for shall be based on the ILLUMINANCE criteria set forth in the latest edition of the American National Standard Practice for Roadway Lighting, RP-8, published by the Illuminating Engineering Society and shall include the use of Light Emitting Diodes (LEDs) for all roadway, area and pedestrian lighting. The table below identifies the average maintained illuminance values and uniformity ratios for the various roadway classifications for non-residential streets.

**TABLE 5. Illuminance Criteria**

<b>Street and Area Classification</b>	<b>Average Maintained Illuminance Values (fc)</b>	<b>Average to Minimum Uniformity Ratio</b>
Major Arterial / Intermediate	1.3	3.0:1
Minor Arterial / Intermediate	1.1	3.0:1
Collector / Intermediate	0.9	4.0:1
Collector / Low	0.6	4.0:1
City Center Arterial / High	1.7	3.0:1
City Center Collector / High	1.2	3.0:1
Light Loss Factor (LLF) = 0.90		
Values based on R2 and R3 pavement classification for asphalt		

During the preliminary design stages of a project, the designer shall contact the City in order to determine which street and area classification shall be used for the project, as per the City's determination. Design calculations, including the design pole spacing, etc., shall be submitted with supporting data to the City to verify that the proper light levels have been achieved. The use of alternate light sources such as High Pressure Sodium (HPS), metal halide, mercury vapor, induction and fluorescent light sources is unacceptable.

Cobrahead luminaires shall be classified and labeled accordingly on the plans as follows:

- Type Z – typically used on arterials
- Type A – typically used on arterials and collectors
- Type B – uncommon; not typically used
- Type C – typically used arterials, collectors
- Type D – typically used on collectors, in industrial areas, and business parks
- Type E – typically used in industrial areas and business parks
- Type F – used only in residential areas

All luminaires shall have a correlated color temperature (CCT) of 4000K except for Type F fixtures. Type F luminaires shall have a CCT of 3000K. All luminaires shall have a minimum color rendering index (CRI) of 70. Additionally, a smart control node shall be installed on each luminaire and shall be attached and connected via the 7 PIN receptacle.

The standard spacings below for residential streets have been determined below. At locations where additional lighting may be beneficial such as around curves or at intersections, the pole spacings should be reduced to improve the lighting levels.

**TABLE 6. Standard Luminaire Spacing for Residential Areas<sup>1</sup>**

<b>STREET CLASSIFICATION</b>	<b>LOCATION</b>	<b>LUMINAIRE</b>	<b>POLE HEIGHT</b>	<b>POLE SPACING<sup>2</sup></b>
Residential – Local (22'-28')	Single Side	Type F	20'	200'
Residential – Collector (26'-36')	Single Side	Type F	20'	150'
Other Street Classification	As determined by a photometric analysis			
<sup>1</sup> Light Loss Factor (LLF) = 0.90 <sup>2</sup> Typical maximum pole spacings				

Street lighting on arterials and collectors shall typically consist of LED cobrahead-style luminaires mounted to 40-foot or 30-foot round, tapered poles. The use of single member luminaire arms is required. The use of truss-style arm requires special approval by the City for its use. Single member arms range from 6' to 10' in length while truss-style arms are 12' and 15' in length.

Street lighting in residential areas shall consist of LED cobrahead-style luminaires mounted to 20-foot round, tapered poles. The luminaires and the poles shall have a dark bronze finish (poles shall be anodized dark bronze), as specified in the Technical Specifications. The use of post-top luminaires mounted to 14-foot poles is no longer the standard residential fixture and light pole and therefore, requires special approval by the City for its use.

Anti-theft devices shall be used on 30' and 40' poles with breakaway bases, unless otherwise directed by the City.

The color temperature for LEDs on arterials and collectors shall be 4000K while the color temperature for LEDs in residential areas shall be 3000K. The Type A through Type Z luminaires shall be Type II distribution.

At intersections where STOP or YIELD signs are to be installed and street light poles are to be located in this vicinity as well, place the STOP or YIELD sign and street name sign posts as close to the intersection as possible. If there is a light pole in advance of the sign post, place the light pole at least 20 feet from the sign post or shift the light pole around the radius so that it's oriented over the intersecting roadway instead.

When designing a street lighting system in a residential area, a street light pole shall be installed at the edge of the plat instead of a junction box with a pull string. This will enable the City to connect to the lighting circuit more easily when the adjacent plat is constructed. In addition, street light poles in residential areas shall be installed on the property lines or as close to the property line as possible in order to avoid conflicts with driveways and to minimize the amount of ambient street light shining into adjacent houses. Street lights shall be installed on the same side of the street as the sidewalk, unless otherwise approved by the City.

All street light poles shall have a minimum setback of 3.5 feet from the back of curb to the center of the pole. Street light poles placed in the median shall be located a minimum of 15 feet from the end of the median nose to the center of the pole. In addition, street light poles installed in or within 18 inches of a sidewalk must have concrete foundations.

Screw-in foundations will NOT be accepted for street light poles installed in a sidewalk or within 18 inches of a sidewalk.

The distribution system shall be underground and installed in conduit. The distribution cable shall be sized so that the voltage drop does not exceed eight percent (8%) at any point in the system. The Designer MUST submit voltage drop calculations to the City for review before the lighting plans can be approved.

Conductors for the distribution system shall be No. 4 AWG. The use of No. 2 AWG distribution cable requires special approval by the City for its use. Pole and bracket cable shall be No. 14 AWG, 3-conductor stranded copper conforming to IMSA Specification 19-1.

All street lighting circuits shall be 240 volts and shall be laid out in a way that maximizes the use of each control center. Each lighting circuit shall be contained in a separate conduit, except for the conduit run between the control center and the adjacent Type II junction box. In that case, one 3-inch conduit shall be installed from the control center to a Type II junction box that is installed adjacent to the cabinet. Distribution cable for each of the lighting circuits shall be routed through this conduit to the junction box.

Junction boxes shall be installed on each end of a roadway crossing. However, junction boxes are not needed on each end of a residential or commercial driveway. The installation of junction boxes in sidewalks should be avoided. The installation of boxes in streets, driveways and handicap ramps is unacceptable. Type II junction boxes shall be used where more than two conduits enter/exit the box. Type I junction boxes shall be used where one or two conduits enter/exit the box. Junction boxes shall be installed at least 2 feet from the back of curb to the center of the box and no closer than 2 feet to any street light pole.

Splices may be made inside a junction box with approval by the City. All splices in junction boxes shall be made with set screw connectors enclosed in a reusable gel-filled waterproof kit.

The electrical system shall conform to the requirements of the National Electrical Code, the National Electrical Safety Code and service standards issued by the utility which will be supplying power to the street lighting system. The Designer shall coordinate and verify the location of proposed feed points with the utility company to ensure availability of service. In cases where a proposed feed point requires the installation of a new transformer, the Designer may need to include the construction of a transformer pad and conduit as part of the project. Additionally, for projects within EVERGY's service area, the Designer shall include the conduit AND the service cable from the secondary service point to the meter on the controller in the plans as the Contractor is now required by EVERGY to install the cable and the conduit.

Control centers should be located adjacent to and behind the sidewalk or at least 5 feet from the back of curb to the center of the control center where no sidewalk exists. When the location of the control center has been finalized and power has been verified with the utility company, the City will provide the Designer with an address and an identification number for each proposed control center. The address and identification number shall be placed in the lower right corner of the street lighting plan sheet above the titleblock. In addition, luminaires shall be numbered using the identification number. For example, street lights on Circuit 1 on Controller AB should be labeled as AB 1-1, AB 1-2, AB 1-3, etc. If twin luminaires are mounted to the street light pole, the luminaires should be labeled as AB 1-1 and 1-2, AB 1-3 and 1-4, AB 1-5 and 1-6, etc.

## I. TRAFFIC SIGNALS

The traffic signal system shall consist of the signal controller, signal poles, signal heads, cable, conduit, vehicle detectors and any other appurtenances required to provide a complete, operable traffic signal system. Components of the system shall conform to the City of Lenexa's technical specifications and standard details.

Signal poles shall typically be located a minimum of 6 feet from the back of curb to the center of the pole. Mast arm lengths shall be designed with an extra two (2) feet in length in order to accommodate varying field conditions. The Designer shall add a note to the signal plan indicating that a short section of the mast arm may need to be cut off, as directed by the City, depending upon the final location of the pole.

Turning templates shall be shown on the signal plan for review during preliminary plan submittals.

When pedestrian signal heads are used, signal poles with push buttons should be placed at locations that are convenient to the pedestrian. However, the City does not require that poles be aligned with the crosswalk locations. Signal poles within two feet of a sidewalk or ADA ramp shall have top-of-footing elevations called out on the plans. In addition, push buttons shall be audible as per PROWAG requirements.

All signal poles and controllers shall be shown on the intersection detail sheet(s).

When designing a traffic signal whether it's an existing signal or a new signal, the engineering consultant shall propose recommendations with regards to the signal phasing. Once these recommendations are discussed with the City, the City will make the final determination regarding the number and sequence of the phases. The City uses a standard phasing sequence which is shown below:

- Phase 1 – southbound left
- Phase 2 – northbound through
- Phase 3 – westbound left
- Phase 4 – eastbound through
- Phase 5 – northbound left
- Phase 6 – southbound through
- Phase 7 – eastbound left
- Phase 8 – westbound through

Traffic signal heads shall be placed in accordance with the *Manual on Uniform Traffic Control Devices* (MUTCD). In addition, the City has developed some guidelines in an effort to standardize the placement of signal heads:

- Typically, a standard three-section head (Signal Head A) should be centered over each EXITING lane for all through lanes of traffic.
- When a left-turn lane is provided without protected left-turn phasing, a separate signal head displaying the solid red arrow, solid yellow arrow and flashing yellow arrow indications should be centered over the left-turn lane for the permissive left-turn movement.
- When protected left-turn phasing is specified, the three-section head should typically be centered over the left-turn lane. Likewise, when dual left-turn movements are specified, a separate Signal Head B indication should be centered over each left-turn lane. In addition, a separate LEFT TURN SIGNAL sign (R10-10) shall accompany each Signal Head B indication.

- When protected/permissive left-turn phasing is specified, a four-section head with a flashing yellow arrow display should be centered over the left-turn lane.

All traffic signal and pedestrian indications shall be LED displays. Countdown displays shall be used for pedestrian indications. In addition, backplates shall be provided for all traffic signal heads that are mounted to the mast arm. Signal heads that are mounted to the signal pole should not be equipped with backplates.

Opticom emergency preemption equipment shall be shown on the signal plan and shall be designed for ALL directions of traffic at an intersection.

A Pan, Tilt, and Zoom (PTZ) camera and a four-way fixed video camera shall be included as part of the design at each signalized intersection. The exact locations of the PTZ and fixed video cameras shall be determined by the City.

A connection to the City's central control system either by wireless technology or by fiberoptic cable shall be part of the signal plan. Connection to this system may require the extension of the fiberoptic network.

All signalized intersections shall be fully actuated. Full actuation shall typically be achieved through the use of detector loops. In addition to loops, there are various vehicle detection technologies such as video detection camera systems, radar, microwave and induction loop systems. Use of these alternate detection technologies requires the special approval by the City. When advance vehicle detection is needed, as directed by the City, advance detection shall be achieved through the use of radar.

Standard loop dimensions for stop bar detection are 6 ft. x 50 ft. and shall be quadrapole loops (2-4-2 turns). In order to determine where to place a 6 ft. x 50 ft. stop bar detector loop, the City typically places the FRONT of the loop 15 to 20 feet from the nearest edge of the through lane of the intersecting road extended, except when the intersection road has a right-turn lanes and/or the crosswalk is skewed. When the crosswalk is skewed and one end is located a significant distance from the intersection road, the City suggests placing the FRONT of the loop in the middle of the crosswalk in order to minimize the excessive amount of loop in front of the stop bars. In other words, for a 6' wide skewed crosswalk, place the front of the loop 3' into the crosswalk.

Service boxes shall typically be provided whenever conduit changes direction and adjacent to signal poles and controllers. Junction boxes should typically be used adjacent to detector loop locations for the splicing of loop wire to the lead-in cable. Type I junction boxes shall be used where one or two conduit runs enter/exit the box. Type II junction boxes shall be used where more than two conduit runs enter/exit the box. Service and junction boxes shall be installed at least 2 feet from the back of curb to the center of the box and no closer than 2 feet to any pole. The distance between service and/or junction boxes shall not exceed 500 feet to facilitate the pulling of cable. The installation of boxes in streets, driveways and handicap ramps is unacceptable. In addition, the City prefers that boxes not be installed in the sidewalk.

All conduit for traffic signal installations shall be either Schedule 40 polyvinyl chloride (PVC) conduit or Schedule 40 high density polyethylene (HDPE) conduit. Rigid metallic conduit shall NOT be used. Below is a summary of typical conduit sizes for signals.

- Signal conduit that extends from signal poles to adjacent service boxes should typically be 3-inch conduit.
- Signal conduit that extends from the signal controller to the adjacent service box shall consist of two 4-inch conduits.

- Signal conduit that extends from service box to service box should be either 3-inch or 4-inch conduit, depending upon the number and size of conductors.
- Signal conduit for advance detector conduit runs should typically be 1.5-inch conduit.
- Conduit for signal interconnect/fiberoptic cable should typically be 2-inch conduit.

Please note, the conduit sizes above are typical applications. The Designer shall verify that the signal conduit is properly sized so that no more than 40 percent of the conduit cross-sectional area is filled. Additionally, street lighting cable is permitted in signal conduit runs and boxes. However, fiberoptic cable for the main trunk line is not permitted in signal conduit runs. This fiberoptic cable shall be contained in its own conduit runs.

The Designer shall coordinate and verify the location of the proposed secondary service point with the appropriate utility company to ensure availability of service. For projects within EVERGY's service area, the Designer shall include the conduit AND the service/power cable from the secondary service point to the meter on the controller in the plans as the Contractor is now required by EVERGY to install the cable and the conduit. A 2-inch conduit shall be used when EVERGY is providing the power; a 3-inch conduit shall be used when Westar is providing the service.

The controller cabinet shall be a Model 332D and shall include an 8-inch riser. A Model 332 or 336 may be used only if approved by the City's Transportation Manager. The actuated controller shall be a Rack Mount ATC Cobalt-C controller manufactured by Safetran and shall include the current firmware that is compatible with Operation Green Light (OGL). Controllers should typically be located adjacent to and behind the sidewalk or at least 10 feet from the back of curb to the center of the controller where no sidewalk exists. In locations where no curb exists, the controller should typically be placed more than 10 feet from the edge of pavement to the center of the controller if possible. When the location of the controller has been finalized and power has been verified with the utility company, the City will provide the Designer with an address and an identification number for the proposed controller. The address and identification number shall be placed in the lower right corner of the traffic signal plan sheet above the titleblock.

All signalized intersections shall include a battery back-up system.

The City has standardized the number of conductors required for the various types of traffic signal equipment. Cable for vehicle signal heads should consist of 7-conductor cable while cable for pedestrian and pushbutton detectors should consist of 5-conductor cable. Typically, the City uses 1-7c per phase for the vehicle signal heads regardless of how many heads are on the mast arm or the signal pole. When pedestrian heads and pushbutton detectors are used, 1-5c cable should extend from the controller to the signal pole for each pedestrian head and an additional 1-5c should extend from the controller to the signal pole for each push button. Detector lead-in cable should consist of 4-conductor cable while detector loop wire should consist of single conductor PVC/nylon with tube jacket. Street lighting distribution cable should consist of 3-1c No. 4 AWG while pole and bracket cable shall be No. 14 AWG 3-conductor stranded copper conforming to IMSA Specification 19-1. In addition, all street lighting cable for luminaires on signal poles should be spliced inside the signal pole, not the service box adjacent to the pole. Trunk fiberoptic cable shall consist of a 144-count fiber single-mode fiber assembly. The connection to the traffic signal controller shall be with an 8-count Gator Patch spliced into the main trunk fiber.

The City has developed some typical signal timings and some guidelines that should be used when developing timings for a proposed traffic signal. They are as follows:



- Maximum Green – to be determined by the City
- Minimum Green – 6 seconds for through and left-turn phases
- Walk – 7 seconds for through movements (no Walk time is given for left-turn phases)
- Flashing Don't Walk (FDW) – distance is measured from the face of curb to the edge of the edge line extended and then divided by 3.5 feet/second
- Total FDW and Walk – the sum of the FDW and Walk time shall be greater or equal to the distance measured from the pushbutton to the edge of the edge line extended on the far side of the crosswalk divided by 3.0 feet/second. If not, any additional time needed shall be added to the Walk time.
- Passage – 1 second for through and left-turning phases
- Yellow – to be determined using the methodology found in the ITE Journal article, *Application of the ITE Change and Clearance Interval Formulas in North Carolina*, from the January 2008 issue. See below.
- Red – to be determined using the methodology found in the ITE Journal article, *Application of the ITE Change and Clearance Interval Formulas in North Carolina*, from the January 2008 issue. See below.

**YELLOW CLEARANCE INTERVAL**

$$Y = t + \frac{v}{2a + 64.4g} = 1.5 + \frac{v}{2(11.2) + 64.4g} = 1.5 + \frac{v}{22.4 + 64.4g}$$

- t* Perception reaction time = 1.5 s (changed from 1.0 s to 1.5 s based on ITE Journal article)
- v* Speed in fps (mph x 1.47 = fps)
- a* Deceleration rate = 11.2 ft/s<sup>2</sup> (changed from 10 ft/s<sup>2</sup> to 11.2 ft/s<sup>2</sup> based on ITE Journal article)
- g* Grade in percent divided by 100

GRADE: Measure grade as the average from the stop bar to the following distances at each speed:

**TABLE 7. Distance Grade is Measured**

Speed	Distance
≤ 30 mph	100 ft
35 mph	150 ft
40 mph	200 ft
45 mph	250 ft
≥ 50 mph	300 ft

If the grade of the approach is:

**TABLE 8. Determination of Grade**

+7% or more	use +8%
+5% to +7%	use +6%
+3% to +5%	use +4%
-3% to +3%	use 0%
-5% to -3%	use -4%

-7% to -5%	use -6%
-7% or less	use -8%

Additional remarks:

- The minimum value for yellow should be 3.0 seconds.
- Positive grade should be factored into the yellow clearance calculation.
- The speed used for left-turn movements should be 20 mph.
- For protected/permissive phasing, use the same yellow time for both approaches (i.e. opposing approaches). When determining the yellow clearance value, use the worst case / greatest value for opposing approaches.

For grades of -3% to +3%, the following yellow times have already been calculated:

**TABLE 9. Typical Yellow Times**

Speed	Yellow Time
25 mph	3.1 sec
30 mph	3.5 sec
35 mph	3.8 sec
40 mph	4.1 sec
45 mph	4.5 sec

**RED CLEARANCE INTERVAL**

$$R = \frac{w}{v}$$

If the all-red clearance is greater than 3.0 seconds, use:

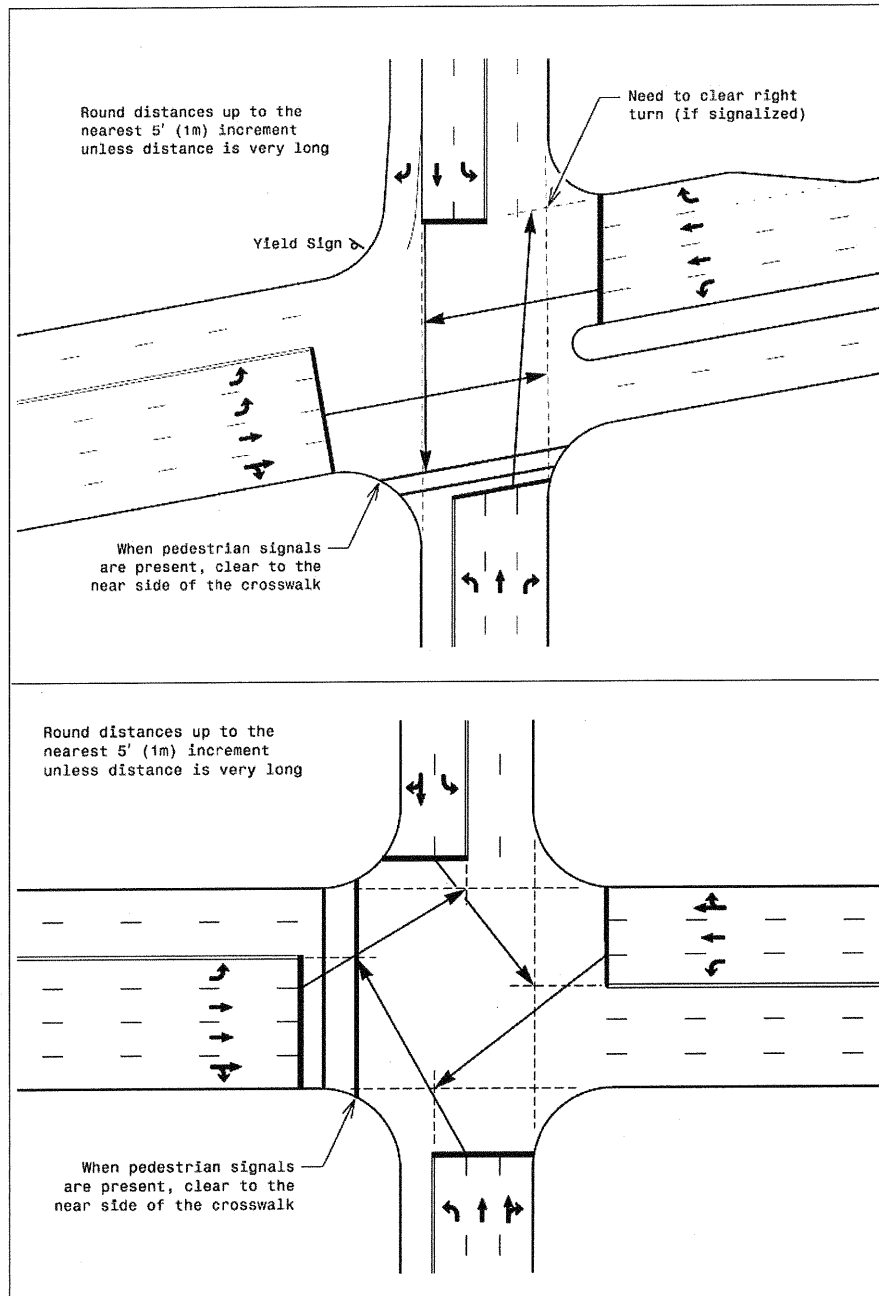
$$R = \frac{1}{2} \left( \frac{w}{v} - 3 \right) + 3$$

*w* Width of intersection (see Figure 3 from ITE Journal article below)

*v* Speed in fps (mph x 1.47 = fps)

NOTE: Length of vehicle (20 ft) has been deleted from the red clearance formula based on the ITE Journal article referenced above. Additional remarks are as follows:

- The minimum value for the all-red clearance should be 1.0 second.
- The speed used for left-turn movements should be 20 mph.
- To measure the width of an intersection for both through and left-turning movements, see Figure 6 below.
- For protected/permissive phasing, use the same all red time for both approaches (i.e. opposing approaches). When determining the all red clearance value, use the worst case / greatest value for opposing approaches.



**FIGURE 3. Measurement for Red Clearance Interval**

In Table 1 – Phase Functions, information should be entered into the following function categories:

- Vehicle Recall – typically the main street through phases
- Permit – all phases in use
- Pedestrian Phases – all phases in use
- Lead Phases – typically left-turn phases
- Start-up Green – typically the main street through phases

In the Emergency Flash table, the indications for all applicable signal phases shall be RED while the indication for pedestrian phases shall be DARK.

In the Detector Input File Layout, the detector loops for the through phases on the main street should typically be arranged in such a way that enables the City to count traffic. This is done by arranging the advance detector loops in the Extend and Count slots of the appropriate detector channel and inserting the stop bar loops in the Extend or Call slots.

In Table 4 – Detector Map, the City typically adds a 10-second delay for loops in exclusive right-turn lanes that are not on recall. The City also adds a 3-second delay for loops in left-turn lanes that could be called when a left-turning vehicle on the adjacent approach crosses the loop.

With regards to the Signal Output File Layout, the City prefers right-turn overlaps to be programmed instead of hard-wired. The one exception to this rule is when a left turn has permissive phasing (i.e. permissive or protected/permissive phasing). In this situation, the opposing right turn shall be hard-wired instead of programmed in order to avoid a potential conflict between a yellow indication for the permissive left and a green arrow for the opposing right turn. Programming a right-turn overlap is done by connecting the yellow and green arrows in the E<sub>d</sub> Signal Head to field terminals 105, 111, 114 and/or 120.

Overhead street name signs shall be either aluminum street name signs or LED-illuminated street name signs. Overhead aluminum street name signs shall be mounted to the mast arms using Sky-Brackets. There shall be a minimum of two brackets per sign placed no more than 3 feet apart with a maximum of 1 foot from the edge of the sign. Typically, the overhead street name signs should be placed between the signal pole and the first vehicle signal head. LED-illuminated street name signs should be mounted within 1 foot to 1-1/2 feet of the signal pole and shall be mounted to the mast arm according to manufacturer's recommendations. The City does not allow LED illuminated street name signs to hang and swing below the mast arms.

LED illuminated street name signs shall be installed at signalized intersections along all major arterial streets and/or truck routes. The LED signs shall be mounted to the mast arms located over the major street at these signalized locations. However, the street name signs mounted to the mast arms over the minor street at these intersections shall consist of the standard aluminum signs.

In addition to LED illuminated street name signs, advance street name signs/NEXT SIGNAL signs shall also be installed at signalized intersections along all major arterial streets and/or truck routes. The advance street name signs shall be standard aluminum signs and shall be placed 400-600 feet from the intersection. If the greenspace between the back of curb and the edge of the sidewalk is not wide enough to accommodate the advance street name sign and if there is minimal right-of-way behind the sidewalk to place the sign, the advance street name sign shall then straddle the sidewalk. The sign posts shall be located at least one foot (1') from the edge of the sidewalk to the sign posts. Additionally, the bottom of the sign shall be a minimum of 8 feet from the top of the sidewalk to the bottom of the sign.

Street lights attached to traffic signal poles shall be energized through and connected to the street lighting system. Additionally, the photocell on the traffic signal service enclosure is to be used only for illuminated street name signs. The street lights on the signal poles are to be controlled from the photocell in the street lighting control center.

## J. PAVEMENT MARKINGS

All proposed pavement markings shall conform to the City of Lenexa's technical specifications and standard details. Table 10 below illustrates the various types of pavement marking material that shall be used depending upon the age and type of the surface.

**TABLE 10. Pavement Marking Guidelines**

PAVEMENT MARKING LINE TYPE	PAVEMENT MATERIAL TYPE		
	Asphalt <sup>2</sup>	Concrete	Slurry Seal
WHITE lane line	Thermo	Multi-Component	Thermo
WHITE channelization line	Thermo	Multi-Component	Thermo
WHITE crosswalk lines	Thermo	Multi-Component	Thermo
WHITE stop bar	Thermo	Multi-Component	Thermo
WHITE diagonal	Thermo <sup>1</sup>	Multi-Component	Thermo
YELLOW solid centerline	Thermo	Multi-Component	Thermo
YELLOW broken centerline	Thermo	Multi-Component	Thermo
YELLOW diagonal	Thermo <sup>1</sup>	Multi-Component	Thermo
ARROWS	Preformed Thermo	Multi-Component	Thermo
ONLY	Preformed Thermo	Multi-Component	Thermo
RR Crossing	Preformed Thermo	Multi-Component	Thermo
<sup>1</sup> Preformed thermoplastic may be substituted for extruded thermoplastic. <sup>2</sup> Binder-sealer will be required on asphalt older than two months.			

Pavement markings shall be quantified according to pavement marking material type and shall be illustrated in the pavement marking quantity tables and in the bid item table as such.

Contrast pavement marking material shall be used on concrete pavement for the longitudinal lines and shall be applied prior to the installation of the multi-component material. The total width of the preformed contrast tape shall be an additional three inches wider than the standard width of the pavement marking that is specified. The additional 3-inch width shall be black non-reflective film with 1.5 inches on both sides of the white or yellow marking.

A conceptual pavement marking plan SHALL be submitted at the field check stage of the plans (or with public improvement plans) in order to enable the City to review lane configurations, transitions, etc.

Stop bars should typically be placed 4 feet in advance of and parallel to the nearest crosswalk line. Crosswalk lines shall be placed across each leg of a signalized intersection with pedestrian signals. When two crosswalks intersect at the corner of an

intersection, a 4-foot path shall be provided between the edge of pavement and edge of the intersecting crosswalk lines.

#### General Criteria

- Pedestrian crossings at a STOP controlled intersection do not need to be marked unless it is a major trail crossing or is a school crossing managed with a crossing guard. Note that a mixed-use side path is not considered a major trail.
- All marked pedestrian crosswalks shall be signed with the appropriate pedestrian crossing sign or be located on a STOP or signal controlled approach. Unmarked pedestrian crosswalks do not require signs.

#### Arterial and Collector Streets

- All pedestrian crossings at signalized intersections, RRFB or Hawk signals, major trails, major destinations (park or school), roundabouts, or future signalized intersections.
- Pedestrian crossings on arterial streets at an uncontrolled location should be avoided.
- Pedestrian crossings shall be marked with ladder and edge line markings.

#### Local and Local Collector Streets

- All pedestrian crossings at major trails, major destinations (park or school), signalized intersections, RRFB or Hawk signals, roundabouts, or future signalized intersections.
- Pedestrian crossings directly to a school where 10 or more students would normally cross daily.
- Local and local collector street pedestrian crossings shall be marked with 12" edge line markings.

#### Industrial Streets

- All pedestrian crossings at major trails, major destinations (park or school), signalized intersections, RRFB or Hawk signals, roundabouts, or future signalized intersections.
- Industrial street pedestrian crossings shall be marked with 12" edge line markings.

#### City Center Streets

- All pedestrian crossings on commercial and mixed-use streets shall be marked with edge line and ladder type markings.
- On residential streets only edge lines markings are required.

In the absence of a marked crosswalk, the stop bar should typically be placed at the desired stopping point, but should be placed no more than 30 feet nor less than 4 feet from the nearest edge of the intersecting traveled way. When determining the desired stopping point, turning templates for left-turning vehicles should be shown on the signal plan to determine where the stop bar should be placed without interfering with a left-turning vehicle on the adjacent approach to the intersection.

With regards to parking lots, pavement markings for parking stalls shall be white in color. Handicap parking stalls shall be marked with a 36-inch handicap symbol with a blue background. All other parking lot markings shall be in conformance with the MUTCD and with Lenexa's City Code.

Lane width dimensions shall be shown on the pavement marking plans and shall be referenced from the center of the lane line to the edge of pavement. As shown on the Standard Details, typical lane widths for a four-lane roadway should be 13 feet for the lane adjacent to the curb and 11 feet for the lane adjacent to either opposing traffic or to the median if the roadway is median-divided.

## **K. PERMANENT SIGNING**

"All signs shall conform to the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD), and the latest edition of the Standard Highway Signs manual. When designing a signing plan as part of a project, the proposed plan shall be placed on a signing plan sheet(s), separate from the pavement marking plans. In addition, proposed signs shall be identified on the plans with an MUTCD number and its associated sign face and size. Showing an MUTCD number without the sign face will be unacceptable.

On Capital Improvement Program (CIP) projects, all permanent signs, including post-mounted street name signs, shall be installed as part of the project by the Contractor. On non-CIP projects, the Contractor is responsible for purchasing the post-mounted street name signs (through the permitting process) and the City will then install these signs in order to ensure the uniformity of these signs. On non-CIP projects, the Designer shall show the post-mounted street name signs on the plans, but note that these signs are to be installed by the City. Also on non-CIP projects, the Contractor is responsible for providing and installing the sign posts for these City-installed street name signs. As a result, the Designer shall show sign posts for these street name signs on the plans and indicate that the Contractor is responsible for providing them.

At single-lane roundabouts, the City will provide the street name signs which will be mounted to the sign posts that are provided by the Contractor. At multi-lane roundabouts, the Contractor shall provide the street name signs. These street name signs shall contain 8" lettering and be mounted to two posts.

When a sign assembly is placed in a median nose, the sign shall be placed in a 4" PVC sleeve at a minimum distance of 10 feet from the tip of the median nose, as illustrated on the City's standard sign detail sheet.

When a new median is introduced on a roadway that does not currently include medians, a Keep Right symbol sign (R4-7) and a Type I object marker shall be installed in the median nose at least 10 feet from the tip of the median nose as specified above. For a new median constructed on a roadway that currently includes medians, a Type I object marker shall be installed.

For a street light pole that is mounted in the median and placed 15 feet from the end of the median nose, the Keep Right symbol sign and/or object marker shall be mounted to this street light pole.

In the signing quantity table, the sheeting performance for all signs shall be specified as High Intensity Prismatic sheeting.

For signalized intersections, advance street name signs (i.e. NEXT SIGNAL signs) shall be included in the plans for use on the legs of the signalized intersection that are on a major arterial and/or a truck route.

Where a side road intersects a multi-lane roadway that has a speed limit of 45 mph or higher, the minimum size of the STOP signs facing the side road approaches, even if the side road has only one approach lane, shall be 36x36 inches.

No U-Turn symbol signs shall be posted at the intersections of four-lane (or less) divided roadways (with auxiliary turn lanes), as determined by the City.

Signs shall be mounted to street light poles when applicable.

No Parking symbol signs (R8-3a) that are 12x12 inches shall be placed approximately every 600 feet on arterials and on other roadways where parking is prohibited.

Speed limit signs shall be installed on an entering road from an arterial or a collector and shall be placed approximately 300 feet from the intersection. The speed limit posted on the sign shall be determined by the City.

All signs that are to be disturbed as part of a project shall be replaced with new signs. Re-using existing signs is prohibited.



## **L. TRAFFIC CONTROL**

The traffic control plan shall conform to the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD). In instances where a street closure is necessary for the construction of a project, a detour plan will be required as part of the traffic control plan. Additionally, lane closures lasting longer than three (3) consecutive days shall be considered a long-term closure and requires the use of temporary tape which shall be included in the plan and shall be subsidiary to the Traffic Control bid item.

Temporary alternate pedestrian accommodations are required per PROWAG. The temporary route shall have a smooth surface and audible guide for visually impaired pedestrians.

## **M. IRRIGATION SYSTEMS**

The irrigation system shall consist of one or more feed points, distribution system, sprinkler heads, control system, valves, boxes, and any other appurtenances required to provide a complete, operable system. Components of the system shall conform to the City of Lenexa technical specifications and the standard details.

The irrigation layout shall be so designed as to provide the manufacturer's recommended operating pressure throughout the system. Sprinkler heads shall be placed so as to provide a 5% overlap in the spray patterns. No component of the sprinkler system shall be placed within 2 feet of the back of curb, except the supply line as it crosses the curb.

The designer shall coordinate the locations and components of the water line taps with WaterOne (Water District No. 1 of Johnson County). Valve sizes for the supply line shall be the minimum size sufficient to provide the required operating pressure. All material and work on the electrical system shall meet the requirements of the National Electric Code, and/or the International Building Code, as adopted by the City of Lenexa, whichever is more stringent.

The City of Lenexa General Conditions, Technical Specifications, and Standard Drawings shall control the construction, equipment, and materials of all public improvements.

Prior to beginning any construction, submittals are required for materials as listed in the Technical Specifications.

## N. LANDSCAPING

### General Design Considerations

Each site and design development process is as unique as existing conditions; context and design program will be different. Therefore, consideration shall be given to plant material types, growth rates, and canopy sizes in relationship to building location, signs, site lines, utilities, sight distance triangles, view corridors, parking, and other design influences. A variety of plant materials shall be incorporated into the project including indigenous, drought-tolerant vegetation, flowering trees and shrubs, evergreen trees, accent plantings, and ground covers. Evergreen, deciduous trees and shrubs, flowering ornamental trees, grasses, and groundcovers will be used in combination to provide year around seasonal interest and layering while maintaining the functional requirements.

Specific considerations related to selection must include survivability, maintenance, and aesthetic issues, as well as user concerns. Designers should carefully consider the many factors that may affect plant survivability for a given locale including, but not limited to:

- USDA Hardiness Zone
- Sun Exposure
- Soil conditions
- Moisture conditions
- Availability of irrigation
- Expected level of maintenance
- Wind conditions (leading to wind damage or drying)
- Presence of wildlife (deer)
- Proximity to overhead and buried utilities

The expected level of maintenance is an important consideration in the selection of plant material. As an example, some streets are “gateways” to the city or to neighborhoods and receive levels of maintenance that are higher than other streets. Designers should discuss with City staff the appropriateness of various levels of maintenance that would be expected for a given finished project. This may require discussion with Parks & Recreation Department and Community Development staff.

Aesthetic considerations should match the plants to the setting. The landscape should complement the adjacent street and architectural character of neighboring developments. Size, form, color, texture, and pattern must be considered in selecting plant materials. Careful attention must be paid to species’ branching patterns to provide 8’ vertical clearances for pathways / sidewalks and 14’ vertical clearances for streets. Plant growth habit should be suited for minimum maintenance to achieve clearances relative to proximity to streets and traffic. Designers must carefully consider each application and determine whether a particular species is matched to that application.

Designers should consult with local nurseries to determine the availability of plant materials and should specify materials accordingly. It is important that project managers and designers recognize the sequencing of landscaping and allow following-season planting when possible.

There is growing recognition that some plant species are invasive and threaten to displace native materials. Designers should consult with the Cooperative Extension Service prior to selecting plant materials to ensure that selected materials are not invasive.

Design considerations of special importance to public projects include:

- Location. The biggest challenge in the placement of landscaping in municipal right-of-way (ROW) is the location of conflicting land uses within the available space. Thus, it is important that landscaping is placed in areas within the ROW to minimize disturbance through the life of the facility. Designers must strive to consolidate utilities consistent with standard utility locations and to maximize aesthetics while providing a landscape that minimizes potential disturbance from road or utility reconstruction, or from routine snow plowing activities.
- Sight Distance Triangles. The term “Sight Distance Triangle” refers to the roadway area visible to drivers. The required length is the distance necessary to allow safe vehicular egress from a street, driveway, or alley to a major street. The height calculation must include consideration of the elevation relative to the driver’s eye. Thus, planters or curbs that elevate the plant must be considered when calculating tree branching height.
- Climate Zones. The selection of plant material should respond to the microclimatic conditions of the site. Lenexa is in USDA hardiness Zone 5b. Plants should be selected to withstand the environmental conditions of climate, vehicular traffic and general maintenance or the lack thereof. Consult with the Johnson County Extension Service should there be questions concerning the climatic zone of specific locations.
- Planting Details. Refer to City’s standard details and technical specifications for planting specifications.
- Evaluation of Plant Materials. Designs should include testing protocols or sourcing documentation to insure quality control. Contractor-furnished plant materials shall be closely inspected to ensure compliance with the contract documents. This will include inspections prior to planting and post planting.
- Irrigation. Landscape installations require access to a water source for use both during and after the contractor’s maintenance period. Irrigation should be applied to minimize runoff into public right of ways i.e. radii should be adjusted so as not to saturate sidewalks, head placement should provide coverage for the landscape area without impacting adjacent land uses.
- Soil amendments and seed bed preparation. Construction activities degrade and often remove valuable topsoil which impacts all landscaping activities. “Topsoiling”, where the uppermost horizons of a soil are mechanically removed and stockpiled prior to construction activities and then reapplied after construction is finished, helps to preserve the existing soil structure and fauna to facilitate better landscape success. Soil must be stockpiled and replaced by soil horizon sequence. Particular construction activities, like subsurface utility installations, can cause subsoil to be brought to the surface creating an inhospitable seed bed for vegetative restoration activities. Imported topsoil or high organic content amendments like compost should be used at a minimum to offset the low biological content of subsoils and encourage seed germination. Plant growth prevents erosion and provides water holding capacity in the soil to absorb stormwater runoff. For detailed biological soil preparation, see City Technical Specifications Section 701

## **Existing Vegetation**

Evaluation of Existing Vegetation: The quality of existing vegetation must be determined prior to the decision to protect or remove that vegetation. Trees must be evaluated based on species, size, and potential contribution to the design solution. Existing ground cover and shrubs must be evaluated as to species content. On most development sites, turf installation and native grass/forb enhancement or restoration will be required. Existing ground cover must meet the criteria for turf or native grass and forb species in order to be protected. Existing native vegetation may be preserved or restored in response to water quality Level of Service requirements. Details pertaining to those situations are provided in Section P of this document.

Protection of Existing Vegetation: The retention of existing vegetation is an important goal for many projects, whether the reason is aesthetics or function (wind break, visual barrier). Existing vegetation that is to remain on a project should be protected from construction operations. The plan documents should clearly denote areas to be protected and should specify procedures that contractors should employ to protect vegetation. Excavation and compaction of soils in the root zone of existing vegetation is a significant threat to the survival of plant material. This zone can generally be defined as that area on the ground directly under the branching structure of the tree or shrub, or within the "drip line". Designers shall require contractors to provide positive means of protecting the root zone, including such provisions as fencing or flagging of the drip line, temporary bracing, root pruning or other current horticultural practices recommended by an International Society of Arboriculture certified arborist. Specific provisions shall be in the contract documents to require replacement of plant materials where root zones are not protected or where other structural damage is inflicted on existing vegetation.

## **Trees and Shrubs**

Locations for trees and plants should be selected with maintenance operations in mind. Trees in lawn areas suffer from injuries from mowing equipment and string trimmers. New trees in lawn areas should be established with a well-defined watering saucer that is maintained with mulch. Outer edges of planting beds should maintain a minimum 7' clearance to allow mowing equipment between trees planted in lawn. Woody plant material in areas adjacent to curbs and medians where snow is stored often suffers serious annual damage. Trees and shrubs should be set back at least 4 feet from the back of curb wherever possible. Placement of woody plants should be avoided in temporary snow storage areas.

Tree Diversity: Tree diversity requirements shall be met as follows: 10 - 19 trees (no more than 50% of any one species), 20 and over trees (no more than 33% of any one species).

## O. GROUNDCOVER, STREAM CORRIDORS, AND STORMWATER BEST MANAGEMENT PRACTICES

### GROUNDCOVER

#### **Turf and Perennials**

Where color, texture, or pattern beyond that of turf would be a suitable addition to the landscape, perennials may be considered in lieu of turf in locations where snowplow damage will not remove perennial root stock.

Turf should be planted on prepared soil from seed or sod. Sod is generally required to establish turf areas. Where seed is determined to be appropriate, the following considerations must be taken into account. Seeding allows a greater turf selection, but requires approximately 6 months and regular maintenance to become established. Newly seeded areas require protection from pedestrians and must be kept moist until the seeds germinate. Considerations must be made to ensure proper preparation of the ground for the seedbed in accordance with the type of seeding. Designers must follow all technical specifications.

Recommended Turf Grasses:

- Tall Fescue / Turf Type blend – Deep green color, shade and salt tolerant, and drought-resistant because of its deep root system.
- Buffalo Grass – Buffalo grass is a fine-leaf warm-season grass that thrives in July and August. It needs well-drained soil and requires six to eight hours of full sun exposure. Buffalo grass has a deep root structure, around 8-10 feet, that makes it more drought-tolerant and a short growth habit that requires less frequent mowing than traditional turf. Seeding is recommended for Buffalo grass applications. Establishment can take longer because Buffalo grass does not form a dense stand like fescue but can be prompted to fill via stolon growth with proper establishment mowing. Combining Buffalo grass seed with Blue grama (*Bouteloua gracilis*) provides quicker establishment as well. Below is an example of reliable seed blend:

<b>Common Name</b>	<b>Botanical name</b>	<b>Bulk Rate lb/ac</b>	<b>%of Mix</b>
Buffalograss	<i>Bouteloua dactyloides</i>	54	60
Blue grama	<i>Bouteloua gracilis</i>	36	40

Seed cost is generally higher than fescue blends but application rates are lower so the materials are cost competitive. Recommended seed types are Sharps Improved, Cody, Bison, Tatanka, and Texoka. Seed should be sourced from a reputable supplier with verifiable testing standards. The Supplier should provide seed treated with potassium nitrate to break dormancy.

Fertilizer and herbicide applications and irrigation schedules for native turf varies significantly from traditional turf and should be communicated clearly by the designer. Kansas State University's Cooperative Extension Service provides excellent recommendations on care and maintenance. Below is an example of suggested establishment activities:

<b>Buffalograss Mix</b>	Mow vegetation to no less than 4" (inches), once per week maximum. Do not remove clippings. Mowing is to be conducted so that disturbance to the ground surface & vegetation is minimized. Momentum FX2 or equivalent selective herbicide shall be used to control broadleaf weeds. Irrigate with a deep watering during Jun-Aug every two weeks, based on weather conditions.
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### **Native Grasses and Forbs**

Designers must carefully consider each application and determine whether a particular species is matched to that context. Native plant materials are often suggested as a low maintenance solution to landscape issues. Native species performance can be limited in conventional high-density plantings where traditional irrigation is present. Suppliers of native plant materials must be verified to insure product quality and availability. Designers should consult with local nurseries to determine the availability of plant materials and should specify quality assurance and testing requirements (Association of Official Seed Analysts certification, for example).

#### Preserved or Restored Native Vegetation:

The following tables provide general guidance for native vegetation to be preserved, established, or restored, as in the Level of Service stormwater best management practice credit on private projects or as part of the commitment to native vegetation on public projects. Native vegetation preservation and establishment have the highest Water Quality Value Rating in Table 4.4 of the APWA Stormwater BMP Manual (2012). Preserving or enhancing native vegetation provides water quality benefits by protecting natural soil structure & microbial life, increasing infiltration and reducing surface runoff velocities. Site design is critical to the success of any stormwater management practice and soil moisture conditions, adjacent impervious surfaces and maintenance access need to be evaluated early in the design process.

Seed bed prep is critical when interseeding these enhancement mixes to insure seed-to-soil contact & viable germination. Seed bed prep may include prescribed burning, herbaceous species removal, low mowing of existing vegetation, or woody species removal and should be carefully considered in the project schedule. Dormant seeding (Dec 15-Mar 31) is recommended whenever possible to achieve optimal results.

A brief description of each grass mix is provided in the tables below. All mixes (EXCEPT Mix No. 1, which does not require a nurse crop due to short growth habit and planting season) should have a nurse crop of Canada Wild Rye (*Elymus Canadensis*) planted at 12lbs per acre in the cool season (April 1- June 1 or Sept 1- Oct 15). Application rates provided do NOT include nurse crop. The native grass seed blends below have been developed for use in public projects to provide a more uniform, suburban aesthetic quality throughout the city and to minimize maintenance operations.

<b>Table 12. Seeding Tables Summary</b>			
<b>Application</b>	<b>Seed Mix Number</b>	<b>Seeding Rate (lbs/acre) *</b>	<b>Establishment</b>
<b>Turf-type</b>	1	90	native grass mix
<b>primarily dry, sun, mid height</b>	2	15	native grass & forb mix
<b>primarily dry, sun, tall height</b>	3	15	native grass & forb mix
<b>periods of wet, sun, mid height</b>	4	15	native grass & forb mix
<b>periods of wet, sun, tall height</b>	5	15	native grass & forb mix
<b>stream corridors/wet or dry, shade</b>	6	15	native grass & forb mix
<i>* All rates given as Pure Live Seed (PLS) based on commonly accepted industry standards.</i>			

<b>Table 13. Seed Mix 1</b>			
<b>Common Name</b>	<b>Botanical Name</b>	<b>Height</b>	<b>Recommended % of Mix</b>
<b>Buffalo Grass</b>	Buchleo dactyloides	2" - 8"	60
<b>Blue Grama</b>	Bouteloua gracilis	6" - 20"	40

<b>Table 14. Seed Mix 2</b>			
<b>Common Name</b>	<b>Botanical Name</b>	<b>Height</b>	<b>Recommended % of Mix</b>
<b>Little Bluestem</b>	Schizachyrium scoparium	24" - 48"	30
<b>Prairie Dropseed</b>	Sporobolus heterolepis	24" - 36"	10
<b>Side-Oats Grama</b>	Bouteloua curtipendula	10" - 40"	30
<b>Tall Dropseed</b>	Sporobolus compositus	24" - 48"	10
<b>Forbs</b>	primarily dry, sun, mid height, 6 - 8 species		20

<b>Table 15. Seed Mix 3</b>			
<b>Common Name</b>	<b>Botanical Name</b>	<b>Height</b>	<b>Recommended % of Mix</b>
<b>Big Bluestem</b>	Andropogon gerardii	24" - 84"	25
<b>Indian Grass</b>	Sorghastrum nutans	36" - 84"	25
<b>Switchgrass</b>	Panicum virgatum	24" - 84"	20
<b>Bluejoint Grass</b>	Calamagrostis canadensis	36" - 72"	10
<b>Forbs</b>	primarily dry, sun, tall height, 6 - 8 species		20



Table 16. Seed Mix 4			
Common Name	Botanical Name	Height	Recommended % of Mix
Little Bluestem	Schizachyrium scoparium	24" - 48"	25
Fox Sedge	Carex vulpinoidea	12" - 36"	10
Northern Sea Oats	Chasmanthium latifolium	24" - 60"	20
Bottlebrush Grass	Elymus hystrix	20" - 48"	10
Virginia Wild Rye	Elymus virginicus	24" - 48"	15
Forbs	periods of wet, sun, mid height, 6 - 8 species		20

Table 17. Seed Mix 5			
Common Name	Botanical Name	Height	Recommended % of Mix
Prairie Cord Grass	Spartina pectinata	36" - 84"	20
Switchgrass	Panicum viratum	24" - 84"	20
Northern Sea Oats	Chasmanthium latifolium	24" - 60"	20
Bluejoint Grass	Calamagrostis canadensis	36" - 72"	20
Forbs	periods of wet, sun, tall height, 6 - 8 species		20

Forb Enhancement Mixes are provided in the following Table 18 at bulk application rates. Application rates provided do NOT include a nurse crop or grass components because seeding rates and installation methods vary significantly for forbs. Rate recommendations vary by seed type but a minimum 80% purity and 40% germination for these bulk seed mixes is based on generally accepted industry standards and should be attainable by a registered seed technologist per the Association of Official Seed Analysts. Certification of these minimums must be provided to the project manager or designer prior to construction.

Selection of forb species must include consideration of cost, availability, and appropriateness of the species for the site conditions and context. Some forbs listed may not be appropriate in certain applications. Once selections are approved by staff, any substitutions due to cost or availability must be approved by the owner, designer, or project manager *prior* to purchase of the product.

Table 18. Forbs			
Common Name	Botanical Name	Height	habitat
<i>Mid Height</i>			
Black-Eyed Susan	Rudbeckia hirta	12" - 36"	primarily dry, sun / periods of wet, sun
Butterfly Milkweed	Asclepias tuberosa	12" - 36"	primarily dry, sun
Pale Purple Coneflower	Echinacea pallida	16" - 36"	primarily dry, sun
Lead Plant	Amorpha canescens	12" - 36"	primarily dry, sun
Bitter Sneezeweed	Helenium amarum	4" - 24"	primarily dry, sun
Indian Blanket Flower	Gaillardia pulchella	4" - 24"	primarily dry, sun
Skyblue Aster	Symphyotrichum oolentangiense	8" - 40"	primarily dry, sun

<b>Slender Mountain Mint</b>	Pycnanthemum tenuifolium	16" - 40"	primarily dry, sun
<b>Tall Anemone (Thimbleweed)</b>	Anemone virginiana	12" - 40"	primarily dry, sun
<b>Purple Poppy-Mallow</b>	Callirhoe involucrata	6" - 36"	primarily dry, sun
<b>Lance-Leaf Sage</b>	Salvia reflexa	4" - 28"	primarily dry, sun / periods of wet, sun
<b>Hoary Vervain</b>	Verbena stricta	12" - 36"	primarily dry, sun
<b>Wild Quinine</b>	Parthenium integrifolium	12" - 36"	primarily dry, sun / periods of wet, sun / stream corridors
<b>Purple Prairie Clover</b>	Dalea purpurea	12" - 36"	primarily dry, sun
<b>Buckley's Penstemon</b>	Penstemon buckleyi	6" - 32"	Primarily dry, sun
<b>Wild Bergamot</b>	Monarda fistulosa	12" - 48"	primarily dry, sun / periods of wet, sun / stream corridors
<b>Plains Wild Indigo</b>	Baptisia bracteata	8" - 30"	primarily dry, sun / periods of wet, sun
<b>Snow-On-The-Mountain</b>	Euphorbia marginata	12" - 40"	primarily dry, sun / periods of wet, sun / stream corridors
<b>Southern Prairie Aster</b>	Eurybia hemispherica	8" - 24"	primarily dry, sun / periods of wet, sun
<b>Sulphur Cinquefoil</b>	Potentilla recta	12" - 30"	primarily dry, sun
<b>Blazing Star</b>	Liatris squarrosa	12" - 24"	primarily dry, sun
<b>False Boneset</b>	Brickellia eupatorioides	12" - 36"	primarily dry, sun
<b>Common Spiderwort</b>	Tradescantia ohiensis	12" - 36"	primarily dry, sun / periods of wet, sun
<b>Western Spotted Beebalm</b>	Monarda punctata	6" - 20"	primarily dry, sun
<b>Blue Lobelia</b>	Lobelia siphilitica	12" - 36"	periods of wet, sun / stream corridors
<b>Blue Flag Iris</b>	Iris versicolor	24" - 30"	periods of wet, sun / stream corridors
<b>Prairie Coneflower</b>	Ratibida columnifera	12" - 36"	primarily dry, sun
<b>Showy Evening Primrose</b>	Oenothera speciosa	4" - 20"	primarily dry, sun
<b>Button Snakeroot (Rattlesnake master)</b>	Eryngium yuccifolium	24" - 36"	primarily dry, sun / periods of wet, sun
<b>Sharp-Wing Monkey-Flower</b>	Mimulus alatus	12" - 32"	periods of wet, sun / stream corridors
<b>Emory's Sedge</b>	Carex emoryi	16" - 44"	periods of wet, sun / stream corridors
<b>Tall Height</b>			
<b>New England Aster</b>	Symphotrichum novae-angliae	24" - 72"	periods of wet, sun / stream corridors
<b>Tall Joe-Pye Weed</b>	Eupatorium altissimum	36" - 72"	primarily dry, sun
<b>Common Sunflower</b>	Helianthus annuus	24" - 144"	primarily dry, sun
<b>Showy Partridge Pea</b>	Chamaecrista fasciculata	4" - 48"	primarily dry, sun
<b>Cardinal Flower</b>	Lobelia cardinalis	12" - 60"	periods of wet, sun / stream corridors
<b>Swamp Milkweed</b>	Asclepias incarnata	24" - 96"	periods of wet, sun / stream corridors
<b>Foxglove Beardtongue</b>	Penstemon digitalis	24" - 60"	primarily dry, sun / periods of wet, sun
<b>Cup Plant</b>	Silphium perfoliatum	36" - 108"	primarily dry, sun / periods of wet, sun / stream corridors
<b>Ox-Eye Sunflower</b>	Heliopsis	36"-60"	primarily dry, sun

helianthoides			
<b>False Dragonhead</b>	Physostegia angustifolia	12" - 60"	primarily dry, sun / periods of wet, sun / stream corridors
<b>New England Aster</b>	Symphotrichum novae-angliae	24" - 72"	periods of wet, sun
<b>Compass Plant</b>	Silphium laciniatum	36" - 120"	primarily dry, sun
<b>Western Ironweed</b>	Vernonia baldwinii	24" - 60"	primarily dry, sun
<b>Blue Sage</b>	Salvia azurea	24" - 60"	primarily dry, sun
<b>White Wild Indigo</b>	Baptisia alba	20" - 80"	primarily dry, sun / periods of wet, sun / stream corridors
<b>Velvety Gaura</b>	Gaura parviflora	12" - 108"	primarily dry, sun
<b>Rigid Goldenrod</b>	Solidago rigida	12" - 60"	primarily dry, sun
<b>Whole-Leaf Rosinweed</b>	Silphium integrifolium	24" - 60"	primarily dry, sun / periods of wet, sun
<b>Giant Goldenrod</b>	Solidago gigantea	24" - 72"	primarily dry, sun / periods of wet, sun / stream corridors
<b>American Bellflower</b>	Campanulastrum americanum	24" - 72"	primarily dry, sun / periods of wet, sun / stream corridors

## STREAM CORRIDORS:

Disturbance in stream corridors due to utility installations or grading activities should be mitigated by a combination of seeding and tree planting, depending on the scope and scale of activity. Consideration should be given to existing tree species and plantings should replicate the pre-construction condition to the greatest extent possible. If the preconstruction condition is undesirable, restoration should be ecologically appropriate for the context. The following is a general guideline for minimum restoration activities in remote or rural areas.

Care should be taken to design corridors in urban areas with sensitivity to the adjacent property owners' expectation for maintenance, access and aesthetics. These recommendations may not be interchangeable for urban applications. This list is not comprehensive and should not be used to design full-scale stream corridor restorations.

## Seeding

Table 19. Seed Mix 6			
Common Name	Botanical Name	Height	Recommended % of Mix
<b>Northern Sea Oats</b>	Chasmanthium latifolium	24" - 60"	20
<b>Virginia Wild Rye</b>	Elymus virginicus	24" - 48"	20
<b>Canada Wild Rye</b>	Elymus canadensis	36" - 72"	20
<b>Caric Sedge</b>	Carex austrina	12" - 36"	10
<b>Switchgrass</b>	Panicum virgatum	24" - 84"	10
<b>Forbs</b>	stream corridors/wet or dry, shade, 6 - 8 species		20

## Tree species

The following are general guidelines for restoring shrubs, shade and understory trees in stream corridors to mitigate disturbance from utility construction or limited grading activities. A ratio of 3 shade trees to 2 understory stories is generally recommended. Bareroot stock (12-18 inch) is acceptable and planting spacing should be based on tree type and habitat requirements to create a natural aesthetic.

Table 20. Shrubs		
Common Name	Botanical Name	Height
Ninebark	Physocarpus opulifolius	24" - 96"
Spice bush	Lindera benzoin	72" - 144"
Lowgrow Sumac	Rhus aromatica 'Gro-Low'	18" - 24"
Smooth Sumac	Rhus glabra	108" - 180"
St. John's Wort	Hypericum calycinum	12" - 18"
False Indigo	Baptisia australis	36" - 48"
Buttonbush	Cephalanthus occidentalis	60" - 144"
Beautyberry	Callicarpa americana	36" - 72"
New Jersey Tea	Ceanothus americanus	36" - 48"
Wild Hydrangea	Hydrangea arborescens	36" - 60"
Arrowwood Viburnum	Viburnum dentatum	72" - 120"
American Elderberry	Sambucus canadensis	60" - 144"

Table 21. Shade Trees		
Common Name	Botanical Name	Height
Hardy Pecan	Carya illinoensis	480" - 840"
Shagbark Hickory	Carya ovata	840" - 1,080"
Hackberry	Celtis occidentalis	480" - 720"
Kentucky Coffee Tree	Gymnocladus dioica	600" - 960"
Black Walnut	Juglans nigra	900" - 1,200"
American Sycamore	Platanus occidentalis	900" - 1,200"
Black Cherry	Prunus serotina	600" - 960"
White Oak	Quercus alba	600" - 960"
Bur Oak	Quercus macrocarpa	600" - 960"
Honey Locust	Gleditsia triacanthos	720" - 960"
Black Locust	Robinia pseudoacacia	360" - 600"
Red Maple	Acer rubrum	480" - 840"
Boxelder	Acer negundo	360" - 600"
Sugar Maple	Acer saccharum	480" - 960"

<b>Shellbark Hickory</b>	<i>Carya laciniosa</i>	720" - 960"
<b>American Chestnut</b>	<i>Castanea dentata</i>	600" - 900"
<b>Catalpa</b>	<i>Catalpa speciosa</i>	480" - 840"
<b>Red Oak</b>	<i>Quercus rubra</i>	600" - 900"
<b>Shingle Oak</b>	<i>Quercus imbricaria</i>	480" - 720"
<b>Swamp White Oak</b>	<i>Quercus bicolor</i>	600" - 720"
<b>Eastern Cottonwood</b>	<i>Populus deltoides</i>	600" - 960"
<b>Bald Cypress</b>	<i>Taxodium distichum</i> var. <i>distichum</i>	600" - 840"
<b>River Birch</b>	<i>Betula nigra</i>	480" - 840"

<b>Table 22. Understory Trees</b>		
<b>Common Name</b>	<b>Botanical Name</b>	<b>Height</b>
<b>Gray Dogwood</b>	<i>Cornus racemosa</i>	120" - 180"
<b>Pawpaw</b>	<i>Asimina triloba</i>	180" - 360"
<b>Eastern Redbud</b>	<i>Cercis canadensis</i>	240" - 360"
<b>Roughleaved Dogwood</b>	<i>Cornus asperifolia</i> var. <i>drummondii</i>	72" - 180"
<b>Soapberry</b>	<i>Sapindus drummondii</i>	240" - 600"
<b>Ohio Buckeye</b>	<i>Aesculus glabra</i>	240" - 480"
<b>Serviceberry</b>	<i>Amelanchier arborea</i>	180" - 300"

## **STORMWATER BEST MANAGEMENT PRACTICES:**

### **Vegetative Components**

Many water quality best management practices, both structural and non-structural facilities, include native plantings. The MARC/APWA Stormwater BMP Manual provides detailed direction on the appropriate application of seed, plugs or other plant materials as well as a comprehensive plant list as a resource for designers. Plant selection will be tailored to the functional intent of structural BMPs or to the aesthetics and context of nonstructural practices.

A detailed Establishment and Maintenance Plan is required with the preliminary plan. Plans vary in depth and detail depending on the complexity of the facility but the intended audience is the onsite management staff who may not be familiar with native plantings or the significance of timely maintenance activities. A preliminary establishment and maintenance plan should generally address the items outlined below. The final version of an establishment and maintenance plan for the proposed vegetation must be submitted for Final Plan review and approval. The final plan should include added detail and specific information related to the types of plant material and the method of installation. In addition, comments from the preliminary submittal should be addressed.

### **Establishment (years 1 to 3 +/-):**

Establishment activities are critical to the success of native plantings. Properly timed establishment activities reduce weed pressure, encourage germination by allowing sunlight to reach the soil surface and provide the best return on investment on native seed installations. The following are suggestions for the first growing season after a

dormant season installation of native seed. It is not recommended to extend these activities past the few first growing seasons. The following information is a guideline and does not necessarily cover all required items for a particular site.

- Define establishment techniques for all types of installations utilized on site (seed, plugs, etc.).
- Define acceptable coverage for native growth at regular timeframes and provide measurement techniques.
- Address possible need for over-seeding and provide seed source and content information.
- Include statement “re-seed / plug disturbed areas using the same plant material as the original installation”.
- Identify problematic weeds and invasive species types and methods for eradication.
- Provide watering requirements and guidelines for supplemental watering at various stages of establishment.
- Address the use & application or prohibition of fertilizers / pesticides / herbicides.
- Insure access is provided for maintenance activities.
- Include statement “turf grass mowing adjacent to native vegetation shall be conducted in a manner in which the discharge of the turf grass mowers is away from native plantings”.

<b>TABLE 23 - NATIVE PLANTING ESTABLISHMENT</b>	
<b>Type of Seeding</b>	<b>Establishment Activities</b>
<b>Buffalo Grass Mix</b>	Mow vegetation down to 6" (inches) when it reaches 10" (inches) in height, up to 3 times per year. Do not remove clippings. Mowing is to be conducted so that disturbance to the ground surface & vegetation is minimized. Spot spray broadleaf weeds.
<b>Grass/Forb Mixs</b>	Mow vegetation down to 6" (inches) when it reaches 10" (inches) in height, up to 3 times per year. Do not remove clippings. Mowing is to be conducted so that disturbance to the ground surface & vegetation is minimized. Only noxious weeds shall be spot sprayed.
<b>Plug Plantings</b>	String trim above the height of the plug plants, spaced no less than 12" apart, when vegetation reaches 12" (inches) in height. NO hand pulling of weeds is permitted. Pre emergent herbicide (ex: Preen) may be used to control weeds in applications NOT adjacent to standing water. Contractor will take care to identify undesirable vegetation & limit damage to plugs from weed control activity.

**Maintenance (post establishment 3+ years):**

An Establishment & Maintenance Plan is a required plan submittal that may include these activities but also provides guidance extending through the first three years of the planting and beyond.

- Define preferred long-term maintenance techniques (mowing / burns / etc.) and timeframes.
- Address the need, or lack thereof, supplemental watering. (i.e. – dry years and need to maintain a good vegetative stand.)
- Include a short, general paragraph explaining the purpose of each BMP type (or one paragraph explaining the water quality benefits of all the BMP's and role of

plant material) and the requirement that any alterations to the facility (physical or vegetative) requires city review and approval.

- Surveyed location of stream setback must be delineated on plan.
- Dedications of stream corridors to the city must include access for future maintenance operations.

To encourage proper maintenance and emphasize critical activities, a monthly inspection checklist should be included with the Establishment & Maintenance Plan. Templates relate to the complexity of the BMP, but the checklist should include timelines for the most important activities like vegetation management, watering, or floatable trash removal. Example templates are available upon request.

### **Structural Components**

Preliminary plan submittal must include a preliminary operations and maintenance plan which should generally address the items outlined below. The final version of an operations and maintenance plan for the proposed facility must be submitted for Final Plan review and approval.

The final plan should include added detail and specific information related to the types of subsurface facility and the method of routine maintenance. In addition, comments from the preliminary submittal should be addressed. The following information is a guideline and does not necessarily cover all required items for a particular site. Manufacturer's recommendations should be included, if applicable.

- Shop drawings of the facility must be included with the operations and maintenance plan as well as manufacturer contacts for onsite staff reference. Websites or general contact information may suffice.
- A site plan should include a drawing showing access points and designated entry for any necessary maintenance equipment. This can include concrete access pads or vegetative pavement alternatives for vacuum trucks, dewatering activities, etc.
- Plans should clearly show manholes, ladder rungs, lids or other access points as well as locks, guards, gates or other security measures. If work is required within the facility, OSHA confined space procedures should be specifically recommended.
- Trash racks, sediment collection sumps or baffles should be shown on the plan such that access is apparent so that maintenance can be performed on them. Diagrams may be particularly helpful. Semi-annual inspection of these facilities should be suggested at a minimum.
- Evaluate the contributing drainage area for the facility to address potential erosion, pavement sweeping or landscape debris that may enter the subsurface facility. Helpful information might include opportunities for supplemental practice integration (catch basin inserts, for example).
- Structural components such as inlets, outlets, orifice plates, pipes or baffles should be evaluated at least annually to assess condition and identify repair needs.
- Repair any joints, pipe separations or points of vulnerability in the facility.
- Specify the need to prevent debris, oil, cleaning agents and sediment from entering the storm sewer system by properly containing & disposing of material removed from the facility. If washing or flushing the facility is recommended, wastewater should be directed to a sanitary sewer for treatment. Address disposal concerns in relation to potential contamination of waste or solid waste.
- Clearly delineate any load bearing limitations associated with the facility and the surface area to be protected.

- An inspection checklist, activity log or other documentation or work activities may be included. Manufacturers' directives should be included as well as any templates or certification programs available.
- Monitor downstream discharge point for erosion or channel degradation and insure appropriate structures are in place to protect neighboring public or private property. Animal activities such as beaver dams or muskrat tunnels can impact outflow from the facility and should be monitored as well to insure functionality.



## **P. PARK PROJECTS**

Parks projects are subject to many of the same aspects of development as are building/facilities and roadway projects. There are many specific technical specifications required for Parks Construction and Equipment that are found in the City's Technical Specifications. Close communication with the Parks staff is required to ensure that these projects are scheduled for appropriate reviews. Park development projects are also typically scheduled for presentations (both conceptual and final) before the Park Board. Master plans, in particular, must be presented to the appropriate Board prior to being scheduled before the Planning Commission

**Q. UTILITY COORDINATION** - The following procedure shall be followed to identify and resolve utility conflicts:

The Project Owner, Design Engineer and Utility Owner/Operators shall follow the APWA Metro Chapter's Section 5900 UTILITY COORDINATION FOR CAPITAL IMPROVEMENTS PROJECTS Best Management Practices which can be found on the KC Metro Chapter website at:

<http://kcmetro.apwa.net/content/chapters/kcmetro.apwa.net/file/Specifications/APWA5900.pdf>

Subsurface Utility Engineering may be requested for any City of Lenexa project. This may require the contracted design firm to subcontract to a qualified SUE engineering firm that has experience with *Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data (CI/ASCE 38-02)*.

The Design Engineer, after consultation with each utility company, will be required to indicate on the plans accurate locations, both horizontally and vertically, of all utilities located within the construction limits. Each utility company shall provide the Design Engineer with adequate assistance and information to accurately determine said locations, including maps, charts, and records, as well as flagging, marking in the field, probing, or actual exposure of the utility line.

Upon completion of the field check plans, the Design Engineer shall submit "Utility Field Check Plans"<sup>(1)</sup> along with a "Utility Conflict Matrix" which identifies locations of potential conflicts to each utility company. Included in this submittal will be a tentative project letting date established by the City Engineer.

The utility companies shall review the "Utility Field Check Plans" and "Utility Conflict Matrix" and verify their facilities are all inclusive and accurately located, both horizontally and vertically. After this review, the utility companies shall identify on the "Utility Field Check Plans" a proposed alignment for facilities which have been identified as being in conflict with the project. The " Utility Conflict Matrix " shall be completed by indicating a proposed resolution to the conflict and a timetable for completion of proposed remedial action. One set of marked "Utility Field Check Plans" and a completed, signed and dated copy of the "Project Utility Conflicts List" shall be returned to the Design Engineer within three (3) weeks of their receipt. The utility companies are to notify the Design Engineer of any pre-existing easements they have within the project limits.

The Design Engineer shall then schedule a utility coordination meeting between all parties involved to discuss the potential conflicts, the proposed remedial actions, and tentative relocation timetable that meets the relocation requirements as stated in Section 4-6-I-10 "*Relocation of Facilities*" of the Lenexa Unified Development Code.

Upon completion of the final check plans, the Design Engineer shall submit "Utility Final Check Plans"<sup>(1)</sup> with each conflict and remedial action clearly identified on the plans, along with a "Utility Conflict Matrix" which identifies conflicts, to each utility company. Included in this submittal will be an update on the scheduled letting date, as determined by the City Engineer.

Each utility company shall submit a firm timetable for the initiation and completion of proposed relocation work which satisfies the date established by the City Engineer for utility relocation. If it is determined by the City Engineer that it will be impractical for a utility company to relocate part of their conflicting facility prior to construction, it shall be the utility company's responsibility to submit to the Design Engineer a detailed description of

relocation work proposed to be completed during construction and a firm timetable for that work. The Design Engineer will include this information in the project manual as a "Supplementary Condition".

Once all engineering review comments have been addressed, the Design Engineer shall "Final Plans"<sup>(1)</sup> to each of the utility companies.

***(1) Two (2) full-size plan sets submitted on 22" x 34" paper and a digital submittal in PDF format***

## R. RIGHT-OF-WAY AND EASEMENT ACQUISITION

When the acquisition of right-of-way and easements is required for a project, the Designer shall obtain Ownership, Encumbrance and Easement Reports (O&E&E). Ownership & Encumbrance Reports (O&E) as well as O&E&E reports must be prepared by a Title Company and include the following information:

- Tract number
- Legal description of entire tract/parcel
- Property situs address
- Tax ID of parcel
- Deed information (Book & Page) and how title is shown. Include copy of deed and mailing address of property owner if different than situs address.
- Mortgage information (Book & Page) including any assignments (listing all mortgage/lien holder information). A lien holder has interest in the property and is informed if City proceeds to condemnation. Copies of mortgage documents are not necessary if lien holder address is listed on report.
- Judgments, state tax liens, mechanic's liens, etc. should be researched and listed, if applicable.
- Easement & ROW information (Book & Page) including any assignments. Any entity that has an interest to property by Easement or ROW must be listed as they are also informed if City proceeds to condemnation.
- Copies of the Easement & ROW (or commonly known as "supporting documents") are necessary to provide along with the O&E Report.
- Date of report should be no older than six (6) months in order to have current and correct information.

In addition, the Designer shall prepare colored right-of-way plans for the entire project area. Individual tract maps shall be prepared and a separate drawing for each type of taking (i.e. right-of-way, temporary construction easement, utility easement, sidewalk easement, etc.) shall be submitted to the City for review.

Legal descriptions for each taking for each tract shall also be prepared on separate sheets. Each legal description shall be in the following format:

Heading:	EXHIBIT "A"
Heading Information:	Tract # Owner Type of Taking
Body:	Legal Description  R.L.S. Seal, with signature and date

A hard copy of the legal descriptions as well as an electronic copy shall be submitted to the City. The electronic format shall be in the latest version of Microsoft Word. In addition, three (3) sets of colored right-of-way plans and tract maps shall be submitted to the City for use in acquiring right-of-way and easements.

## **PLAN REQUIREMENTS**

### **S. ADMINISTRATIVE ITEMS:**

1. Public improvements must coordinate with other public facilities, either existing or planned. The Designer should request copies of any studies, plans, or other City documents that might affect the design of the public improvements.
2. On development projects, the City may impose additional restrictions as part of the Planning process. Any such restrictions shall be incorporated into the plans when appropriate.
3. For CIP projects, an updated cost estimate shall be submitted with each plan submittal. For non-CIP projects, a cost estimate for the proposed improvements shall be submitted with the plans prior to approval of the plans.
4. On private plans where the new street ties into a collector or a thoroughfare, the Designer shall add a note requiring the Contractor to furnish evidence that his insurance meets City requirements.
5. Prior to commencing construction on the public improvements, all easements and right-of-way documents must be executed and in the hands of City staff. In the case of public improvements for subdivisions and commercial developments, the plat must be filed and/or easements and right-of-way documents must be executed and in the hands of City staff prior to issuance of any building permits.
6. Geometrics of all elements of the design will be reviewed for compliance with the AASHTO's *A Policy on Geometric Design of Highways and Streets*, including the geometrics of Deceleration/Turn lanes, islands, etc.
7. All utility conflicts should be resolved prior to start of construction. On arterial and collector streets, all utility conflicts within the limits of the pavement MUST be resolved prior to construction.
8. The Designer shall use City standard details for any standard items. Custom details will only be used where a City standard detail is not available. Changes WILL NOT be allowed to ANY City standard detail. CONSOLIDATION OF NOTES FROM 2 OR MORE CITY DETAILS WILL NOT BE ACCEPTED.
9. Development agreements may be required to address how some of the public improvements will be paid for. In addition, haul roads, future construction of private and public facilities, and other project specific items may require a development agreement.
10. Whenever a lane closure is required on an existing street, the Designer shall add notes requiring the Contractor to notify the City at least one week prior to closing the lane(s).
11. For each phase of the design process, a certain number of plan sets are required to be submitted to the City for review. See Table 24 below for Plan Submittal Requirements.

**TABLE 24. Plan Submittal Requirements**

	<b>Capital Improvement Projects (CIP)</b>	<b>Federal or State-Funded Projects</b>	<b>Privately Funded Projects</b>	<b>Utility Companies</b>
<b>Concept Plans</b>	2	1	--	--
<b>Field Check Plans<sup>4</sup></b>	2	1	--	2
<b>Office Check Plans<sup>4</sup></b>	2	1	--	2
<b>Final Plans</b>	3	1,3	3	2
<b>Bidding Documents</b>	2	1	--	--
<b>Record Drawings (As-built see pg. 77)</b>	3	3	3	--

NOTES: All plan sets shall be flattened; digital signatures are not allowed. The PDF document shall be bookmarked to reflect the index of the cover/title sheet and the document properties, security method shall be no security.

- 1 Digital submittal to KDOT Bureau of Local Projects and City in PDF format using Adobe X or newer.
- 2 Digital submittal in PDF format using Adobe X or newer.
- 3 Digital submittal in PDF format using Adobe X or newer and AutoCAD 2018 or newer.
- 4 Field check plans shall be considered 60% complete plans; office check plans shall be considered 90% complete plans.

When CIP and/or federally or state-funded projects are advertised for bid, the bidding documents will be housed and managed by Drexel Technologies. Drexel is used for the on-line bid process and is responsible for all bid offerings which include all or any of the following:

- Plans
- List of all Bidders (Plan Holders List)
- Addenda
- Reports
- Specifications

## T. PLAN SHEETS – GENERAL

Any set of public improvement plans submitted to the City should have the following list of sheets, preferably in the order listed:

- Title Sheet
- Bid Items / General Notes
- Recapitulation of Quantities
- General Layout Sheet / Survey Reference
- Typical Sections
- Grading Plans
- Plan & Profile Sheets
- Side Street Profiles
- Driveway Profiles
- Intersection Details
- Retaining Wall Plan & Profiles
- Bridge / RCB Sheets
- Roadway Details
- Storm Drainage Profiles
- Storm Drainage Details
- Stormwater Quality Plan Sheets
- Stormwater Quality Details
- BMP Layout Sheet
- Erosion & Sediment Control Plans
- Erosion Control Details
- Irrigation Plans
- Irrigation Details
- Landscaping Plans
- Landscaping Details
- Street Lighting Plans
- Street Lighting Details
- Traffic Signal Plans
- Traffic Signal Details
- Pavement Marking & Signing Plans
- Pavement Marking & Signing Details
- Traffic Control Plans
- Traffic Control Details
- Miscellaneous Details
- Drainage Basin Map Sheet
- Drainage Calculation Sheet
- Cross Sections

Plan Sheet Layout Criteria:

- All sheets submitted as part of street, stormwater, street light, and traffic signal improvement plans shall be submitted on 22" x 34" paper.
- A north arrow shall be placed on each plan sheet and shall be oriented to the top or to the left of the sheet.
- Minimum lettering size shall be 0.125".
- Drawing scale for plan sheets and profile sheets shall be either 1" = 50' or 1" = 20' horizontally and 1" = 10' vertically.
- Drawing scale for cross-sections shall be 1" = 10' horizontally and vertically.
- Materials and equipment for incorporation into such projects shall conform to the City of Lenexa Technical Specifications and Standard Details.

- Sheet format shall be FAS Plate 1 for plan and profile sheets, and Plate 3 for storm sewer profile sheets and cross-section sheets. Separate sheets may be used for plan and profile, but the grid pattern from Plate 1 shall be used for the profile portion.

The plan set shall include the following sheets (sealed, signed, and dated on each sheet) as a minimum:

## **TITLE SHEET**

The Title Sheet shall include the following information:

- Subdivision or Project Name – Add type of improvement, as Street-Storm-Street Lighting. Plans shall have the same name as the plat (i.e. Plat name is “Falcon Ridge 1<sup>st</sup>”, Project Name is “Public Improvements for Falcon Ridge 1<sup>st</sup>”).
- Show Location:

Section, 1/4 Section, Township, and Range  
Vicinity Map (1"=max. 500') with Location of Project

- Project Benchmark (tied to the Johnson County Vertical Control System)
- Coordinate System shall be NAD 1983 State Plane Kansas North US Feet.
- Index of Sheets
- City Project Number (if applicable)
- Date of Plan Preparation
- Utility Owners:

Contact's Name  
Address  
Phone Number

- Signature/Acceptance Block:

For Development Engineering Administrator on development projects OR for  
City Engineer on City-funded projects  
For Developer/Developer's Engineer  
For Owner/Contractor for Sediment Control

- Level of Subsurface Utility Engineering for the plan set. (For specific areas where the general level exceeds the overall plan, SUE level shall be noted on each sheet with the appropriate stationing noted for the higher SUE level.)
- North Arrow and Bar Scale (or note if “no scale”)
- Project Design Speed and Design ADT (ADT for arterial streets only)
- Total Statute Miles Added
- Total Lane Miles Added
- Total Pipe Length (feet) Added



## BID ITEMS / GENERAL NOTES SHEET

The City's standard detail D-100 GENERAL NOTES shall be included in the plans. The Summary of Quantities Table shall contain the applicable bid items shown below:

**TABLE 25. Bid Items Table**

<b>BID ITEMS</b>			
<b>NO.</b>	<b>ITEM DESCRIPTION</b>	<b>UNIT</b>	<b>QUANTITY</b>
1	BASE REPAIR	CY	
2	CLEARING AND GRUBBING	LS	
3	COMPACTION OF EARTHWORK	CY	
4	CONTRACTOR FURNISHED BORROW	CY	
5	REMOVAL OF EXISTING STRUCTURES	LS	
6	UNCLASSIFIED EXCAVATION	CY	
7	ASPHALTIC CONCRETE, SURFACE	SY	
8	ASPHALTIC CONCRETE, BASE	SY	
9	BITUMINOUS SEALING	SY	
10	CRACK REPAIR MEMBRANE	LF	
11	CRACK SEALING	LF	
12	MODIFIED SLURRY SEAL	SY	
13	MILLING	SY	
14	PAVEMENT PATCHING	SY	
15	SLURRY SEAL	SY	
16	TEMPORARY ASPHALTIC CONC. SURFACING	SY	
17	CONCRETE BRICK PAVERS	SF	
18	CONCRETE MEDIAN NOSES	EA	
19	CURBS AND GUTTERS, (TYPE)	LF	
20	HANDICAPPED RAMPS	EA	
21	INTEGRAL SIDEWALK RETAINING WALL WITH FORMLINER	SF	
22	PORTLAND CEMENT CONCRETE OVERLAY	SY	
23	PORTLAND CEMENT CONCRETE PAVEMENT (THICKNESS)	SY	
24	DRIVEWAY APRON, RESIDENTIAL	SY	
25	DRIVEWAY APRON, COMMERCIAL/INDUSTRIAL	SY	
26	CONCRETE SIDEWALK / TRAIL CONSTRUCTION	SF	
27	STABILIZED SHOULDERS	SY	

28	STONE MASONRY	SF	
29	TEMPORARY SURFACING	TON	
30	BIORETENTION FACILITY	SF	
31	CURED IN PLACE PIPE (CIPP) (SIZE)	LF	
32	DITCH LINER	SY	
33	END SECTION (SIZE) (TYPE)	EA	
34	GABIONS	CY	
35	GEOCELLULAR CONFINEMENT	SF	
36	PRECAST CONCRETE BOX CULVERT	LF	
37	REINFORCED CONC. BOX CULVERT	LF	
38	STONE RIPRAP (Light/Heavy Series) (Size)	SY	
39	STORM INLETS, (L x W)	EA	
40	JUNCTION BOXES, (L x W)	EA	
41	MANHOLES	EA	
42	STORM SEWER, (SIZE) (TYPE)	LF	
43	UNDERDRAINS	LF	
44	COIR FIBER LOGS	LF	
45	DITCH CHECK	LF	
46	FILTER BERM/TUBES	LF	
47	INLET PROTECTION	EA	
48	POLYACRYLAMIDES	ACRE	
49	ROLLED EROSION CONTROL PRODUCTS	SY	
50	SEDIMENT FENCE	LF	
51	SEDIMENT TRAP	EA	
52	TEMPORARY SEEDING	ACRE	
53	WATTLES / LOGS	LF	
54	BONDED FIBER MATRIX	SY	
55	BIOLOGICAL PLANTINGS (TYPE) (SIZE)	EA	
56	FENCING, AGRICULTURAL	LF	
57	FENCING, CHAIN LINK	LF	
58	FENCING, DECORATIVE	LF	
59	HERBACEOUS SPECIES REMOVAL	LS	
60	CONTROLLERS	EA	
61	SPRAY HEAD	EA	
62	ROTOR HEAD	EA	
63	SHRUB SPRAY HEAD	EA	

64	WATER METER / CONNECTION TO PUBLIC WATER MAIN	EA	
65	#" PIPE	LF	
66	#" VALVE	EA	
67	2-YEAR LANDSCAPE MAINTENANCE	LS	
68	NATIVE SEEDING	ACRE	
69	PRUNING EXISTING TREES	EA	
70	SEEDING	ACRE	
71	SODDING	SY	
72	TREE RELOCATION	EA	
73	TREE WELL	EA	
74	WOODY BRUSH REMOVAL	ACRE	
75	TRAFFIC SIGNAL INSTALLATION	LS	
76	PAVEMENT MARKING LINES (COLOR)(WIDTH)(TYPE)	LF	
77	PAVEMENT MARKING SYMBOLS	EA	
78	PAVEMENT MARKING LETTERS	EA	
79	CONDUIT (SIZE)	LF	
80	SERVICE BOX (SIZE)	EA	
81	FIBER OPTIC CABLE (# CT.)	LF	
82	UNDERGROUND SPLICE ENCLOSURE	EA	
83	FIBER OPTIC FUSION SPLICES	EA	
84	GATOR PATCH	EA	
86	FIBER OPTIC DISTRIBUTION CABINET	EA	
87	CCTV CAMERA	EA	
88	ETHERNET SWITCH	EA	
89	PERMANENT SIGNING	EA	
90	ADVANCE STREET NAME SIGN	EA	
91	STREET LIGHT POLE (HEIGHT) (DESIGNATION)	EA	
92	STREET LIGHTING DISTRIBUTION CABLE	LF	
93	STREET LIGHTING CONTROL CENTER	EA	
94	JUNCTION BOX (TYPE)	EA	
95	SERVICE BOX	EA	
96	CONDUIT (SIZE)(TYPE)	LF	
97	TRANSFORMER PAD	EA	
98	TRAFFIC CONTROL	LS	
99	PARK BENCH	EA	
100	PARK GRILL	EA	

101	FROST FREE HYDRANT	EA	
102	PEDESTRIAN BRIDGE	LS	
103	PLAYGROUND EQUIPMENT	EA	
104	PLAYING SURFACE	SY	
105	RESTROOM	EA	
106	SHELTER	EA	
107	TRASH RECEPTACLE	EA	
108	ADJUSTMENT OF MANHOLES AND VALVES	EA	
109	SANITARY SEWER	LF	
110	SANITARY SEWER ENCASEMENT	LF	
111	SANITARY SEWER SERVICE LINE	LF	
112	SANITARY SEWER LINE ADJUSTEMENT	EA	
113	WATER SERVICE LINE	LF	
114	WATER METER	EA	
115	BASE STABILIZATION	SY	
116	BORING	LF	
117	BOUND DRAINABLE BASE	SY	
118	STONE STABILIZED PAD	EA	
119	CONTRACTOR CONSTRUCTION STAKING	LS	
120	FIELD OFFICE	EA	
121	MODIFIED SUBGRADE	SY	
122	FLOWABLE FILL	CY	
123	GUARD FENCE	LF	
124	MODULAR CONCRETE RETAINING WALL	SFF	
125	LAND CORNER MONUMENT BOX	EA	
126	PAINTING OF METALLIC FIXTURES	EA	
127	PROJECT SIGN	EA	
128	STACKED STONE RETAINING WALL	SFF	
129	SURGE ROCK	TON	
130	PEDESTRIAN RAIL	LF	
131	AGGREGATE BASE (AB-3)(PUGGED)	SY	

Note: Any bid item not listed in the table above will require a special condition to be written and included in the Contract Documents, which will stipulate the criteria for the "Method of Measurement" and the "Basis of Payment".

### **RECAPITULATION OF QUANTITIES**

The Recapitulation of Quantities sheet shall include tables for each bid item that clearly show how quantities were calculated to enable the Project Inspector to reference and measure these items in the field once they have been constructed.

## **GENERAL LAYOUT SHEET**

The General Layout Sheet shall include the following information:

- North arrow and bar scale
- Site plan showing section lines and streets adjacent to the project
- Streets and street names (existing and proposed)
- Lot lines, subdivisions, and buildings within 200' of the proposed facility (screened to 65%)
- Section corner ties to the nearest corners on both sides of the project centerline and to the nearest section corner in the forward and reverse direction of the project centerline. In addition to tying the project to the centerline by distance and bearing (and angle when the section line/half section line crosses the centerline), the reference ties for the corner itself will be shown. The project shall be tied to state plane horizontal control points provided by the County.
- All existing and proposed easements shall be labeled.
- Horizontal alignment information for the centerline of all streets
- Street pavement edges and back of curb
- Project benchmark with horizontal state plane coordinates and elevation
- Legend of symbols and abbreviations used in the plan set

## **TYPICAL SECTION SHEET**

The sheets for typical sections shall include in accordance with the City Standard Details for the street classification with the following dimensions and notes (with dimensions for CUT on the left half of each section and for FILL on the right half of each section. The CUT and FILL shall be labeled below the section.):

Horizontal Dimensions for:

- R/W to R/W
- Back to Back of Curb
- Lane widths
- Compacted subgrade width
- Centerline and/or baseline to R/W
- Centerline to back of curbs on median
- R/W to edge of sidewalk

Vertical Dimensions (Thickness) for:

- Compacted and/or treated subgrade
- Base (Asphalt or Concrete)
- Surface (Asphalt or Concrete)
- Sidewalk
- Median pavers
- Special soils and other treatments in landscape areas in medians

Cross-slope for:

- Pavement, base, subgrade
- Sidewalk
- Grass (Between Curb & R/W, or between Sidewalk and R/W, or between sidewalk and curb)
- Median

Notes describing and specifying:

- Type of Curb and Gutter

- Type of Base
- Type of Surface
- Type of Compaction
- Overbreakage Treatment
- Others as Needed

Superelevation Diagram and Tables (Where Applicable)

## **GRADING PLAN SHEET**

Please note: the Grading Plan Sheet is required when cross-sections are not used. When the City funds the design of the improvements, cross-sections will be required and the Grading Plan Sheet is not required.

The Grading Plan Sheet shall be drawn at a scale of 1" = max 100', (Scales of 1"=20', 1"=50' or 1"=100' are acceptable), with match lines for multiple sheets, when multiple sheets are necessary, and shall include the following information:

- Existing Topographic Features -- Trees, hedges, brush, buildings, pavement, utilities, fences, curbs, drives, sidewalks, inlets, manholes, valves, and other manmade objects (screened 50%).
- The current physical features (both natural and manmade) of the property and adjacent land within 50' include contours at vertical intervals of not more than 5' where the slope is greater than 10% and not more than 2' where the slope is less than 10%. (screened 50%).
- Proposed physical and topographic features (both natural and manmade) of the property and adjacent land within 50' include contours at vertical intervals of not more than 5' where the slope is greater than 10% and not more than 2' where the slope is less than 10%. (screened 30%).
- Water features (creeks, lakes, etc.), with appropriate base flood elevations
- Elevations shall be marked on such contours based on the existing datum plane established by the U.S. Coast and Geodetic Survey (screened 50%).
- Include dates of topography (screened 50%).
- Include permanent and temporary benchmark locations and elevations. (screened 50%).
- Proposed contours shown at the same contour interval as the existing contours
- Lot and subdivision lines with lots and blocks numbered per the plat of the subject subdivision
- Street centerline alignment with edge of pavement lines, edge of sidewalk lines, back of curb lines, and proposed storm sewers
- North Arrow and Bar Scale
- Street names, R/W lines, easements--existing and proposed--(show centerline and limits of the easements)
- Appropriate general lot grading with developer created swales shown where needed for proper drainage (between houses, down rear property lines, etc.). Minimum grade in swales will be 3%.
- Overflow swales clearly defined for the overflow path and all overflow locations (including swale cross sections, flow properties, and dimension table).
- Easements for any grading outside of plat limits, with labels
- Construction limits
- Show MLO, with elevations, for any lots adjacent to overflow swales, and at any other appropriate lots.
- Show rear and front lot corner elevations for proposed grade.
- Limits of Surveyed Stream Setback clearly defining the zones (if applicable)

- 100-year flood elevations for each lot
- Provide detail for all open drainage swales shown on the plan, including a typical cross section.

Plan sheets do not necessarily need to be in the same order as presented above, but must contain all of the sheets listed unless otherwise stated in the sheet description.

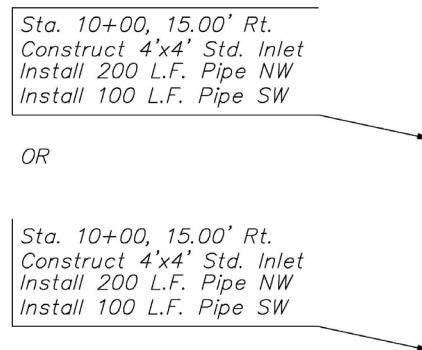
## **PLAN AND PROFILE SHEET**

The Plan and Profile Sheets shall include the following information:

### Plan View:

- North arrow and bar scale
- Existing topographic features -- Trees, hedges, brush, buildings, pavement, utilities (water, sewer, power, telephone, cable, others), fences, curbs, drives, sidewalks, inlets, manholes, valves, and other manmade objects--screened to 65%. Utility locations will be shown in accordance with ASCE Standard 38-02, Level D. Level A, B, or C may be required if the location is critical to the design or construction. The actual level shall be noted with appropriate stationing on each sheet.
- Horizontal alignment of the proposed streets (street, right of way, easements, storm, sidewalk, etc. must conform with the approved final plat), including the following data:
  1. Stationing
  2. Centerline (Show appropriate match lines between sheets)
  3. Tangent Bearings
  4. Section Lines, 1/2 Section Lines, with labels when they appear on the sheet
  5. Section Corners with labels when the corner appears on the sheet and angular and distance ties between the corner and the project centerline.
  6. Curve data including  $\Delta$ , R, L, T
  7. Dimensions of the street components (Pavement, curbs, sidewalk, right of way, etc.) whenever the section is other than the typical.
- Project benchmark (show location in plan view, and text with elevation information at the lower right side of the plan view)
- Cul-de-sac and island radii (proposed facilities only)
- For entry islands at subdivisions and for islands on cul-de-sacs, underdrain shall be provided for the full perimeter of the island.
- Proposed drainage structures numbered and/or labeled. Show inlet throat transitions to scale for the curb inlets. Pipes shall cross streets at an angle of as nearly 90° as possible. Crossings at angles less than 80° will require the approval of the City Engineer.
- Show end treatment at outfall, with dimensions and construction notes. Submit separate calculations to support the design of the end treatment.
- Other proposed structures
- Proposed edges of sidewalks. Sidewalks shall be constructed across islands whenever the sidewalk alignment crosses the island.
- Proposed edge of pavement and back of curb lines
- Curb transitions and areas where dry curb is used with appropriate notes and hatch patterns. Dry curb shall be shown whenever the curb needs to be tipped toward the pavement in order to provide drainage.
- Station equation at all proposed intersections (including an intersection of a proposed street with an existing street).
- Construction Notes for the following items:

1. Start/Stop station of proposed curb & gutter, sidewalk, islands, curves, tapers, street light conduits and sleeves (with lengths), including any transitions from one type of curb to another. Transitions shall be a minimum of 10' unless it is impractical to get 10'. In such cases, the maximum possible length of transition will be provided.
  2. Station, offset, and structure number for Ctr. of Proposed M.H., Ctr. of Jct. Box/Inlets--If longitudinal grade is over 5%, use deflector inlet (and include the deflector in the construction note). (Designer should compare the locations of the manholes and junction boxes/Inlets with possible future driveway locations to minimize future conflicts)
  3. Proposed length and type of pipe to be installed
  4. Adjustments for valve boxes, manhole tops, etc. to match proposed grades.
  5. Sta./Offset/Width of proposed (or replacement) drive aprons (residential and/or commercial)
  6. Proposed light poles, control centers, service and junction boxes. Designer should compare the locations of the light poles, control centers, service and junction boxes with possible future driveway locations to minimize future conflicts.
  7. Station and type of proposed handicap ramps. Designer should compare the locations of the handicap ramps with possible future driveway locations, to minimize future conflicts.
  8. Station of structures to be removed
  9. Other notes as required
- Construction notes shall generally have the form shown in Figure 4 below:



*Construction and Informational notes shall conform to the styles shown above. Informational and non-pay item notes shall be enclosed in a two sided box. Pay item notes shall be in a three sided box.*

#### **Figure 4. Construction Note Format**

- Property boundaries/lot numbers/owners. If only one owner, as for a subdivision, the owners name is not needed on the plan and profile sheet.
- Jurisdictional boundaries (City/ Drainage Districts)
- Street names, existing R/W, proposed ROW
- Section Lines & 1/2 Section Lines, with angles to the project centerline, and labels--when they appear on the sheet.
- Construction limits – When the entire project is within a subdivision and the improvements are for the subdivision, the construction limits need not be shown.



- Easements of all types, existing & proposed, including temporary construction easements. Whenever any part of the public improvements is outside the right-of-way, a permanent easement of the appropriate type shall be provided.
- Limits of 100-year flood plain shown (if applicable)
- Limits of the surveyed stream setback (if applicable)
- Drainage overflow routes for 100-year storm shown with flow arrows. Drainage easements should be provided for these overflow paths.
- Drainage swales carrying the water to yard/area inlets with notes as to how the swale and inlet will join
- Dimensions of lanes, ROW, etc. at non-typical areas
- Existing street light poles and control centers
- Proposed street light poles, control centers, cable, conduit, service boxes, junction boxes and other proposed appurtenances which would be visible in the plan view.
- Existing traffic signal poles and controllers
- Proposed traffic signal poles, controllers, conduit, service boxes, junction boxes and other proposed appurtenances which would be visible in the plan view.
- Existing signs

Profile View:

- Label grades on tangents in %
- Sta./El. of PVC/PVI/PVT at the approaches to intersections when the algebraic sum of the grades is equal to or greater than 4, a vertical curve will be required. When the sum is less than 4, a vertical curve may be required. At intersections of collector and arterial streets with other streets, a PI will not be allowed at the edge of pavement, and a vertical curve will be required if there is a need for a change in grade near the collector/arterial.
- Utility/Storm Sewer crossings with plus station and label
- Curve length, K value, SSD--(minimum curve length 100' (30M) unless approved by City Engineer)
- Profile of existing ground at centerline of project
- Profile of proposed ground at centerline of project
- Centerline elevations at 25' intervals
- Bar Scales horizontal and vertical
- Reference elevations at 10' intervals vertically with intermediate lines at 1' vertical intervals as a screened line
- Stationing at 100' intervals, tic marks at 50' intervals, with vertical reference lines at the station interval and intermediate vertical lines at the 50' tic marks.

## **INTERSECTION DETAIL SHEETS**

The Intersection Detail Sheets shall show the intersections at 1" = 20' or 1" = 10' and will include the following information:

- North arrow
- Bar scale
- Street centerline with back of curb and face of curb lines, edge of sidewalk lines, and edge of pavement lines
- Radius line for curb returns with length of radius labeled
- Storm inlets, manholes, other proposed items with top elevations labeled
- Plus station for start/stop of tapers, turn lanes, curb returns--with offsets
- Top of curb elevations and stations every 25' with plus station, elevations and offsets at curb returns, ¼ points, and at midpoint of curb returns.
- Horizontal alignment data (same as Plan and Profiles)
- Topographic data (same as Plan and Profiles)

- Location of sidewalks and handicap ramps (with type shown and station at center), with dimensions for sidewalks
- Lane dimensions, right-of-way dimensions, and other pertinent dimensions
- Construction notes (same as Plan and Profiles)
- Typical Sections to show curbs, sidewalks, and islands. This information could be shown on the Typical Section Sheet rather than the Intersection Detail Sheet.
- Handicap ramps with elevation and percent slope information.
- Street lighting poles, etc. (same as Plan and Profiles)
- Traffic signal poles, etc. (same as Plan and Profiles)
- Dry curb and gutter where required
- Appropriate curb and gutter type for the class of street shown
- Curb return profiles.
- Curb inlets and junction boxes (same as Plan and Profiles)
- Traffic signal poles with top of footing elevation, controllers and junction/services boxes (screened 50%).

## **STORMWATER PROFILE SHEET**

The Stormwater Profile Sheets shall be required when space is not available on the plan and profile sheets. When there is no street work entailed in the project, the storm sewer shall be shown on a separate plan and profile sheet. The Stormwater Profile Sheets shall include the following information:

- Profile of existing ground at centerline of storm sewer line
- Profile of proposed flowline of pipe or swale
- Profile of proposed hydraulic grade line, with appropriate labels. Elevations at each structure, at any outlets, and at any critical points in between.
- Profile of proposed top of pipe
- Pipe/swale grades in %, Pipe Length, Pipe Size, Pipe Type MH/Inlet location (& Sta.), type, size, Flowline in, Flowline out & top El. (See Standard Details for minimum clearances vertical and horizontal within manholes/inlets/junction boxes).
- End treatment shown at outfall. Provide Calculations separately to support the design.
- Utility/Storm Sewer crossings with plus station and label
- Flow fill shall be used to form a steep-slope stabilization collar at each joint for pipe runs over 10%.
- When swale velocities are over 5 fps, show the type of channel lining (per APWA), with start/stop stations. Provide calculations separately to support the design.
- Pipes under streets shall not be allowed to daylight within the "Clear Zone" of the street, as defined in the AASHTO's *Roadside Design Guide*, unless waived by the City Engineer. Such a waiver shall be requested in writing. When the requirement is waived, appropriate safety measures shall be applied.
- Stationing at 100' intervals, tic marks at 50'
- Reference elevations at 10' intervals vertically

## **BMP PLAN SHEET**

The BMP Plans Sheet shall show all drainage areas and the corresponding BMP's for level of service and/or detention/retention. This plan sheet shall clearly label all structural and nonstructural BMP's.

## **EROSION CONTROL PLAN SHEET**

The Erosion Control Plan Sheets shall show the erosion control plan for the project. At a minimum, the Erosion Control Plan Sheet will include:

- An attached vicinity map showing the location of the site in relation to the surrounding area's watercourses, water bodies, and other geographic and natural features, streets, and other significant structures
- Total acreage of the site and an estimated quantity of soil (in cubic yards) to be excavated, filled, stored, or otherwise utilized on site
- North arrow and bar scale
- All existing and proposed topographic features shown on any of the sheets noted above--screened to 65%.
- Existing and proposed contours at the interval required for the Grading Sheet with labels on index contours of even 5 or 10 feet. Existing contours shall be screened to 65%.
- Date of the survey that generated the topographic and contour information
- A layout of the site with the erosion and sediment control measures shown to scale and labeled (or shown in a legend on the same sheet). The site layout shall include as a minimum the proposed public improvements (centerline, right of way, easements existing and proposed, edge of pavement, back of curb, face of curb, edges of sidewalk, storm sewer pipes and structures with structure numbers shown, street names, overflow swales) and the lot lines and property lines with block and lot numbers shown.
- Stockpile areas with labels
- Concrete washout areas with labels
- Construction limits with labels
- Location of erosion and sediment control measures proposed for use on the project, including, but not limited to, silt fence, inlet filters (any and all types used), filter berms, siltation basins, construction entrance, temporary seeding (a reasonable quantity shall be defined), permanent seeding, and other measures deemed necessary.
- Location of other best management practices (BMPs) required to control potential stormwater contaminants (sanitary wastes, fuels, paints, etc.)
- Tree protection fencing
- Chart showing BMPs required for each phase of construction
- Stream setback limits with labels
- Location of any wetlands with notes for protection of such—or mitigation plan and permit numbers from appropriate federal agencies.
- The erosion control details noted under the Detail Sheet section of this booklet shall include The City Standard Detail for Erosion & Sediment Control General Notes Sheet (In its entirety—no additions, deletions, or modifications), as well as any City standard details for erosion control measures proposed for the site, and any additional details not included in the City standard details.
- The signature and seal of a Professional Engineer, a Landscape Architect, or a Certified Professional in Erosion and Sediment Control

In addition to the Erosion Control Plan Sheet, the consultant shall submit a copy of the application for an NPDES permit, if the area of disturbance is greater than one acre.

## **IRRIGATION PLAN SHEET**

The Irrigation Plan Sheets shall include the following information:

- North arrow and bar scale
- Existing topographic features – Trees, hedges, brush, buildings, pavement, utilities (water, sewer, power, telephone, cable, others), fences, curbs, drives, sidewalks, inlets, manholes, valves, and other manmade objects--screened to 65%. Utility locations will be shown in accordance with ASCE Standard 38-02, Level D. Horizontal alignment of the proposed streets (street pavement, right of way, easements, storm drainage inlets and pipes, sidewalk, etc. must conform with the approved final plans).
- Other proposed structures
- Proposed edges of sidewalks – Sidewalks shall be constructed across islands whenever the sidewalk alignment crosses the island.
- Proposed edge of pavement and back of curb lines. Designer should compare the locations of the Manholes and Junction Boxes/Inlets with possible future driveway locations, to minimize future conflicts.
- Proposed light poles, control centers, service and junction boxes. Designer should compare the locations of the light poles, control centers, service and junction boxes with possible future driveway locations, to minimize future conflicts.
- Street names, existing R/W, proposed ROW
- Construction limits. When the entire project is within a subdivision, and the improvements are for the subdivision, the construction limits need not be shown.
- Limits of the surveyed stream setback (if applicable)
- Existing street light poles and control centers
- Proposed street light poles, control centers, cable, conduit, service boxes, junction boxes and other proposed appurtenances which would be visible in the plan view.
- Existing traffic signal poles and controllers
- Proposed traffic signal poles, controllers, conduit, service boxes, junction boxes and other proposed appurtenances which would be visible in the plan view.
- Existing signs
- Irrigation Legend, using symbols in accordance to the Irrigation Association (IA) standards.
- All controllers, meters, valves and size of pipes shall be called out on plans.
- Size and Location of boring(s) shall be called out on plan sheet.

## **LANDSCAPE PLAN SHEET**

The Landscaping Plan Sheets shall include the following information:

- Detailed site and landscape plans must be prepared to clearly describe proposed improvements within the Perimeter Planting and Land Use Intensity Buffer areas, Internal Parking Lot Landscape areas, Pedestrian Oriented Public Open Space, stormwater management tracts/water quality BMP's and other common open space areas.
- Existing and proposed contours, [Minimum of five foot (5') intervals for slopes over ten percent (10%) and two foot (2') intervals for slopes under ten percent (10%)].
- Construction and Clearing Limits
- Plans must reflect pedestrian access to, as well as circulation within, common open areas. Public sidewalks must be completed with the initial street improvements. Pedestrian links to the public walks and trails within a planned development must also be reflected on plan.

- Permanent signing, street lighting and traffic signals (screened 50%).
- Identification of existing individual trees and significant other vegetation requested to be credited towards landscape requirements.
- A plant schedule to provide plant name (common and botanical), quantity, planting size, and unique planting and maintenance requirements.
- Calculations for required planting areas.
- Planting details to describe the various planting situations (tree, shrub, planting bed, tree protection, set back from parking stalls, deep cell plugs spacing diagram, seed mix lbs./ac. and composition.
- Major site furnishings (benches, fountains, planters, statuary, etc.) should be identified.
- Site feature buffering and screening as specified by code.
- Location of all utility meters, HVAC units, control boxes, pollution control units, etc. and proposed screening methods.
- Perimeter Planting and Land Use Intensity Buffer requirements will need to be addressed as they may apply to development within the common tract areas of residential developments (i.e. homes association pool, playgrounds and recreational areas).
- Plans must reflect all ground cover and pavement types.
- With regard to native grass and wildflower areas, the landscape plan must include detailed specifications to describe the proposed seed mix and explain how the native planting areas are to be established and maintained. Planting methods other than seeding may be determined necessary where plant uniformity or stability of the soil surface is considered essential.
- In addition to the landscape plan, the Landscape Architect must develop an establishment and maintenance plan for the proposed native plant species.
- Plans must indicate that all turf areas are to be established with the use of sod. Subject to City approval, seeding may be considered, primarily related to future development areas and less prominent lawn areas located on the interior of the project site (not to include front or side yard areas located adjacent to street frontage) provided that the planting schedule is appropriate and necessary soil surface stabilization measures are implemented until adequate turf density is realized. Following construction activities, existing turf area that is not disturbed will be further evaluated to determine the extent of renovation work necessary to address code provisions for maintenance. Limits of sod and seed areas and specifications for type and placement of sod and seed must also be included with the Landscape Plan.
- Landscape irrigation plans must be included to show location of hose bibs and sprinkler heads and must reflect suggested coverage.
- Other information as may be determined necessary by the Applicant/City to address site specific details.
- The final landscape plans must be properly sealed by a registered Landscape Architect, licensed to practice in the state of Kansas.

## **STREET LIGHTING PLAN SHEET**

The Street Lighting Plan Sheets shall include the following information:

- North arrow and bar scale. The scale should typically be 1"=50'.
- Legend
- Existing topographic features -- trees, hedges, brush, buildings, pavement, utilities, fences, curbs, drives, sidewalks, inlets, manholes, valves, and other man-made objects--screened to 65%
- Horizontal Alignment of the proposed streets, including the following data:

Stationing  
Centerline

- Proposed drainage structures
- Other proposed structures
- Proposed edges of sidewalk
- Proposed edges of pavement and back of curb lines
- Station equation at all proposed intersections (including an intersection of a proposed street with an existing street)
- Station/offset of all proposed light poles, control centers, service boxes and junction boxes (Provide sufficient service and junction boxes to meet requirements stated in criteria portion of this booklet).
- Poles labels per the criteria stated earlier in this booklet
- Property boundaries/lot numbers/owners
- Jurisdictional boundaries (City/drainage districts)
- Street names
- Existing and proposed right-of-way
- Construction limits
- Easements of all types, existing and proposed (including temporary construction easements)
- Proposed street light poles, control centers, direct-buried cable, conduit, junction boxes and other proposed appurtenances which would be visible in the plan view (Submit voltage drop calculations as a separate document, verifying that the voltage drop does not exceed 5%.)
- Existing street light poles, control centers, direct-buried cable, conduit, junction boxes and other existing appurtenances which would be visible in the plan view
- Proposed traffic signal poles and controllers
- Existing traffic signal poles and controllers
- Pole designation symbol and information
- Proposed and/or existing street light control center address and identification number in lower right hand corner of the plan sheet

## **TRAFFIC SIGNAL PLAN SHEET**

The Traffic Signal Plan Sheet(s) shall include the following information:

- North arrow and bar scale. The scale should typically be 1"=20'.
- Legend
- Existing topographic features -- trees, hedges, brush, buildings, pavement, utilities, fences, curbs, drives, sidewalks, inlets, manholes, valves, and other man-made objects--screened to 65%
- Horizontal Alignment of the proposed streets, including the following data:

Stationing  
Centerline

- Proposed drainage structures
- Other proposed structures
- Proposed edges of sidewalk
- Proposed edges of pavement and back of curb lines
- Proposed pavement markings
- Station equation at all proposed intersections (including an intersection of a proposed street with an existing street)

- Station/offset and elevation of all proposed traffic signal poles, controllers, service boxes and junction boxes
- Property boundaries/lot numbers/owners
- Jurisdictional boundaries (City/drainage districts)
- Street names
- Existing and proposed right-of-way
- Construction limits
- Easements of all types, existing and proposed (including temporary construction easements)
- Proposed street light poles, control centers, direct-buried cable, conduit, junction boxes and other proposed appurtenances which would be visible in the plan view
- Existing street light poles, control centers, direct-buried cable, conduit, junction boxes and other existing appurtenances which would be visible in the plan view
- Proposed traffic signal poles, controllers, conduit, junction boxes, service boxes and other proposed appurtenances which would be visible in the plan view
- Existing traffic signal poles, controllers, conduit, junction boxes, service boxes and other existing appurtenances which would be visible in the plan view
- Proposed and/or existing traffic signal controller address and identification number
- Signal phasing and signal faces diagram
- Pedestrian pushbutton diagram
- General Notes shall include but not be limited to:
  1. Traffic signal heads shall remain covered with ORANGE bags during construction until the entire installation is placed in operation. Black bags shall not be used to cover the new signal heads during construction.
  2. The new signal controller shall be delivered to the City for programming. The Traffic Superintendent (913) 477-7835 shall be contacted to arrange for delivery.
  3. The locations of existing underground utilities are shown in an approximate way only and have not been independently verified. The Contractor shall determine the exact location of all existing utilities before commencing work and agrees to be fully responsible for any and all damages which might be occasioned by the Contractor's failure to exactly locate and preserve any and all underground utilities.
  4. Signal cable shall be color-coded as follows:
    - Cable runs for northbound traffic: Color code BLUE
    - Cable runs for southbound traffic: Color code PURPLE
    - Cable runs for eastbound traffic: Color code YELLOW
    - Cable runs for westbound traffic: Color code RED
    - Cable runs for northbound left-turning traffic: Color code BLUE with ORANGE
    - Cable runs for southbound left-turning traffic: Color code PURPLE with ORANGE
    - Cable runs for eastbound left-turning traffic: Color code YELLOW with ORANGE
    - Cable runs for westbound left-turning traffic: Color code RED with ORANGE



## **WIRING DETAILS & TIMINGS**

The Wiring Details & Timings sheet shall include the following information:

- Wiring diagram containing the wiring layout of the signal, street lighting, and interconnect design
- Signal head numbers for the Signal Output File Layout table
- Detector loop numbers for the Detector Input File Layout table
- Phase functions for Table 1 – Phase Functions
- Signal timings for Table 1 - Phase Timing
- Delay and carryover information for Table 4 – Detector Map
- Detector information for the Detector Summary table

## **SIGNAL SUMMARY OF QUANTITIES**

The signal summary of quantities sheet shall include the signal quantities.

## **PAVEMENT MARKING AND SIGNING PLAN SHEET**

The Pavement Marking and Signing Sheet(s) shall include the following information:

- North arrow and bar scale. The scale should typically be 1"=50'.
- Legend
- Existing topographic features -- trees, hedges, brush, buildings, pavement, utilities, fences, curbs, drives, sidewalks, inlets, manholes, valves, and other man-made objects--screened to 65%
- Horizontal Alignment of the proposed streets, including the following data:

Stationing  
Centerline

- Proposed drainage structures
- Other proposed structures
- Proposed edges of sidewalk
- Proposed edges of pavement and back of curb lines
- Street trees (screened 50%) existing and proposed.
- Station equation at all proposed intersections (including an intersection of a proposed street with an existing street)
- Property boundaries/lot numbers/owners
- Jurisdictional boundaries (City/drainage districts)
- Street names
- Existing and proposed right-of-way
- Construction limits
- Easements of all types, existing and proposed (including temporary construction easements)
- Proposed and existing street light poles
- Proposed and existing traffic signal poles
- Stationing of all proposed pavement markings
- Lane width dimensions
- Stationing and MUTCD number for all proposed signs
- General Notes that shall include but not be limited to:

1. All markings shall be in accordance with the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD).

2. All existing markings that conflict with the proposed markings shall be completely removed.
3. The Contractor shall maintain ALL existing signs not shown on the plans as to be removed.

## **TRAFFIC CONTROL PLAN SHEET**

The Traffic Control Plan Sheet(s) shall include the following information:

- North arrow and bar scale
- Legend
- Existing topographic features -- trees, hedges, brush, buildings, pavement, utilities, fences, curbs, drives, sidewalks, inlets, manholes, valves, and other man-made objects--screened to 65%
- Horizontal Alignment of the proposed streets, including the following data:

Stationing  
Centerline

- Proposed drainage structures
- Other proposed structures
- Proposed edges of sidewalk
- Proposed edges of pavement and back of curb lines
- Station equation at all proposed intersections (including an intersection of a proposed street with an existing street)
- Property boundaries/lot numbers/owners
- Jurisdictional boundaries (City/drainage districts)
- Street names
- Existing and proposed right-of-way
- Construction limits
- Easements of all types, existing and proposed (including temporary construction easements)
- Construction sequencing and overall phasing plan
- Work areas identified by shading and/or line patterns
- Construction notes describing each phase of construction
- Detour plan (if applicable)
- Other designs to address site-specific conditions
- Construction haul routes

## **DETAIL SHEETS**

Detail Sheets shall include the following information:

- Current City Standard drawing for all City Standard items, including (but not limited to) street lighting, traffic signal details (if required for the project), traffic control details, erosion control details, inlets, junction boxes, manholes, trench backfill, curb and gutter, sidewalk, handicap ramps, etc.
- Detail drawings for any item required for construction that is not a City Standard
- Any inlet, yard inlet, or junction box over 10' in length, 8' in width, or 12' in depth shall be considered non-standard and a detail shall be shown. Any such detail shall be sealed by a structural engineer.

The street lighting, traffic signal, pavement marking & signing and traffic control standard detail sheets shall NOT be modified in any way, with the exception of the following items:

- Project name in titleblock
- Street name sign legends on the Signs for Traffic Signals sheet
- Quantities for the various quantity sheets

### **DRAINAGE BASIN MAP SHEET**

The Drainage Basin Map Sheet shall be drawn to such a scale as to fit on one sheet where possible, but shall not exceed 1" = 200', and shall include the following information:

- A plan view of the project, including, but not limited to, street centerline, edge of pavement, back of curb lines, and edges of sidewalk.
- A layout of all pipe and other storm sewer systems, with the structures numbered
- Boundaries of all basins (there shall be a sub-basin for each inlet) shall be shown, and each basin and sub-basin shall be labeled
- The area and runoff coefficient of each basin and sub-basin (shown within the boundary of that basin or sub-basin)
- Existing and Proposed contours
- Limits of Surveyed Stream Setback (If applicable)
- Design Calculations for drainage (See Table 26 below)
- Design Calculations for detention (Where applicable), including Stage Storage Table and Graph, Stage Discharge Table and Graph. Submit hydrographs and routing calculations as a separate submittal.
- A data table in the format shown on the following Table 26.

### **CROSS SECTION SHEETS**

Please note: on development initiated projects, the Grading Plan Sheet may be used in lieu of cross-sections.

The Cross Section Sheets shall be drawn on 10x10 grid sheets (heavier line every tenth line horizontally and vertically), equivalent to Federal Aid Sheet Plate 3, and shall include the following information:

- X-Section for every 50' along the centerline of the project
- X-Section for all entrance centerlines
- X-Section for other points considered critical
- Existing ground profile at cross-section station
- Proposed ground profile at cross-section station
- Vertical Line at centerline, labeled as centerline
- Elevation label at 10' vertical intervals for 20' each side of existing ground
- Centerline labeled as 0 and all sections on a page line up vertically at the centerline
- Horizontal label at 20' intervals and labeled left and right from centerline.
- Driveway grades on the private side of the Right-of-Way should generally be between 2% and 8%
- Driveway grades within the Right-of-Way shall conform to the Standard Detail for Residential Driveways
- Area of cut and fill at each cross section
- Adjacent property, right-of-way, and easement lines

**TABLE 26 – DRAINAGE CALCULATION SHEET**

DESIGN CALCULATION SHEET  
 STORM SEWER SYSTEM  
 Q=FKCiA  
 Where F=1.008(English)

Project:  
**Storm Frequency: 10 Res, 25 Com,**  
**50 Xing Collector, 100 Xing Arterial**

Sheet 1 of 1 Sheets  
 Date 00/00/00

Pipe Type: ADS N-12 HDPE or Equal/RCP  
 Manning's "n" =

0.01 HDPE/RCP

Project #: \_\_\_\_\_  
 Checked: \_\_\_\_\_

1	2	3	4	5	5A	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
LINE NO.	PT. NO.	K	C	INCREM AREA A (ACRES)	ACCUM. AREA (ACRES)	KxCxA	ACCUM KxCxA	I (in./hr.) See APWA	Q (CFS)	Q other (CFS)	Q total (CFS)	GUTTER SPREAD (FT)	LENG (FT)	SLOPE (%)	PIPE SIZE (in.)	FULL PIPE VEL. (FPS)	FULL PIPE FLOW (CFS)	FLOW TIME (min.) IN SECT.	TIME (min.) ACCUM TOTAL	COMMENT
1	403	1.1	0.8	0.36	(403) 0.36	0.30	0.30	8.529	3	0	3	10.5							5.00	
	402	1.1	0.8	0.08	(403+402) 0.44	0.07	0.36	8.512	3	0	3	10.5	42.27	7.33	15	14.23	17	0.05	5.05	
	401	1.1	0.8	0.07	(402+401) 0.51	0.06	0.42	8.472	4	0	4	10.5	35.05	1	15	5.26	6	0.11	5.16	
	903	1.1	0.8	0.3	(401+903) 1.76	0.25	0.67	8.529	6	7	12	10.5	62.43	1	15	5.26	6	0.20	5.00	
	902	1.1	0.8	0.74	(903+L2) 3.45	0.61	2.06	8.298	17	0	17	10.5	224	0.9	18	5.64	10	0.66	5.66	
	901	1.1	0.8	Jct. Box 0	(902+901) 3.45	0.00	2.06	8.267	17	5	22	10.5	75.43	5.2	18	13.55	24	0.09	5.76	
	900																			
2	905	1.1	0.8	0.44	(905) 0.44	0.36	0.36	8.529	3	0	3	10.5							5	
	904	1.1	0.8	0.51	(904+903) 0.95	0.42	0.78	8.349	7	0	7	10.5	162	1	15	5.26	6	0.51	5.51	
	903												67	1.58	18	7.47	13	0.15	5.66	



**TABLE 28. Utility Conflict Matrix Column/Field Description**

<b>Utility Conflict Matrix Column/Field Description</b>	
<b>Field</b>	<b>Description</b>
Project Owner	The owner of the transportation project, typically the DOT.
Project No.	A number given by the project owner to identify the project.
Project Description	A description of the project.
Highway or Route	The highway or route where the project is located.
Utility Conflict Matrix Developed/Revised By	The name of the person who developed or revised the utility conflict matrix.
Reviewed By	The name of the person who reviewed the utility conflict matrix.
<b>Column</b>	<b>Description</b>
Utility Owner and/or Contact Name	The name of the utility company or a contact at the utility company who has responsibility for utility facility in conflict.
Conflict ID	A unique identifier for the utility conflict within the project.
Drawing or Sheet No.	A reference to an engineering drawing or sheet number.
Utility Type	The type of utility facility. Example: Water, sanitary sewer, electricity, communications.
Size and/or Material	The size and/or material of utility facility. Example: 8" (PVC).
Utility Conflict Description	A short description of the utility conflict and the work needed to resolve the conflict.
Start Station and Offset	The station, offset, and side of the beginning of the utility conflict. Example: 241+22.35, Offset 57.24 (L).
End Station and Offset	The station, offset, and side of the end of the utility conflict. Example: 241+25.35, Offset 68.78 (L).
Utility Investigation Level Needed	The level of utility investigation needed to determine a resolution strategy for the utility conflict. Valid values are QLD, QLC, QLB, QLA, and Undetermined.
Test Hole	The number of a test hole associated with the utility conflict if QLA is chosen as Utility Investigation Level Needed
Recommended Action or Resolution	A text description of the recommended action to resolve the utility conflict.
Estimated Resolution Date	The estimate date to complete the adjustment or resolve the utility conflict.
Resolution Status	The status of the resolution of the utility conflict as of the date the utility conflict matrix was produced.
Cost Analysis	A link to a detailed cost analysis of potential utility conflict resolution alternatives.

## **RECORD DRAWINGS / AS-BUILT PLANS**

Record drawings / As-Built Plans shall be produced and maintained during construction of all projects. As-Built plans annotate any field changes that differ from the original design. The Construction Inspector shall be responsible for annotating as-builts using a red ink pen or red leaded pencil. The drawings shall be delineated in a neat and professional manner. The Contractor shall be responsible for providing as-built survey data to the Construction Inspector.

The Engineer shall compile a set of record documents conforming to the information furnished by the Contractor and Construction Inspector. This set of documents shall consist of record specifications and record drawings showing the reported location of work. Since record drawings are based on information provided by others, the Engineer shall have no responsibility for the accuracy of the information contained in such record documents. Nothing is to be blacked out. The original elevation, station or offset shall be lined-through and the as-built information shown as "clouded". The cover sheet shall be labeled as "Record Drawings".

The Design Engineer shall submit the as-built plans to the City in electronic format using AutoCAD 2018 or newer and in PDF format using Adobe X or newer. All plan sets shall be flattened; digital signatures are not allowed. The PDF document shall be bookmarked to reflect the index of the cover/title sheet and the document properties, security method shall be no security.

The As-Built plan checklist is as follows:

### **Storm Drainage System**

- Provide final invert elevations for all storm sewers and culverts.
- Show final locations of all inlets, manholes and pipes. Provide the as-built station and offset.
- Verify and show all as-built storm pipe length, size, material, class and slope.
- Show horizontal and vertical location of subsurface drainage pipes (underdrains).
- Headwalls or end sections are to be clearly noted and shown.

### **Detention/retention basins, bioretention cells**

- Contours or cross section elevations of entire pond and embankments
- Inflow and Outlet structures located, shown and adequate information provided

### **Roadway**

- Curbs or curb and gutters with top of curb elevations at 100' intervals, if significantly different from plan elevations
- Finish pavement elevations along centerline of roadway pavement at 100' intervals, if significantly different from plan elevations

### **Street Lighting**

- Stationing and offsets for street light poles, control centers, etc., if significantly different from the plans

### **Traffic Signals**

- Stationing and offsets for traffic signal poles and pedestals, controllers, etc., if significantly different from the plans

### **Duct Bank Construction**

- Duct bank location and elevation at 50' intervals, if significantly different from plan location or elevations