Title 13
ENGINEERING DESIGN STANDARDS AND SPECIFICATIONS FOR NEW INFRASTRUCTURE

CHAPTERS:

13-01 Administrative Enactments, Agency Controls and Reviews, and Work in Public Rights-of-Way
13-02 Reserved
13-03 Survey
13-04 Easements and Rights-of-Way
13-05 Engineering Design Reports
13-06 Construction Plans
13-07 Grading
13-08 Stormwater Management
13-09 Water, Sewer, and Other Underground Utilities
13-10 Streets
13-11 Reserved
13-12 Street Lighting
13-13 Fire Safety Requirements
13-14 Bicycle Facilities
13-15 Work in Public Rights-of-Way and Easements
13-16 Traffic Signals, Signing, and Pavement Markings
13-17 Erosion Control
13-18 Landscaping Standards for Rights-of-Way
13-19 Irrigation Systems
13-20 Reserved
13-21 Revisions to MAG Uniform Standards Specifications and MAG Uniform Standards Details
13-22 Glossary
13-23 Standard Drawings
CHAPTER 13-01
ADMINISTRATIVE ENACTMENTS, AGENCY CONTROLS AND REVIEWS, AND WORK
IN PUBLIC RIGHTS-OF-WAY

Divisions:

13-01-001 Administrative Enactments
13-01-002 Agency Controls and Reviews
13-01-003 Work in Public Ways
Division 13-01-001
Administrative Enactments

Sections:

13-01-001-0001 Adoption
13-01-001-0002 Applicability
13-01-001-0003 Savings Clause
13-01-001-0004 Violation and Penalties

SECTION 13-01-001-0001 Adoption

There are hereby adopted by the City Council of the City of Flagstaff Engineering Design Standards and Specifications for New Infrastructure, set out herein for the purposes of promoting the public health, safety, and general welfare, and to minimize public and private losses due to failure of infrastructure in the City of Flagstaff. These regulations shall be controlling for public and private construction within the corporate limits of the City of Flagstaff. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-01-001-0002 Applicability

The Engineering Design Standards and Specifications for New Infrastructure are applicable to the design and analysis of streets, curbs, gutters, sidewalks, water lines, sewer lines, and other facilities for both public improvement and private development projects within the City of Flagstaff.

The engineering regulations established herein are based on accepted engineering procedures and criteria. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-01-001-0003 Savings Clause

Nothing in this title shall be construed to affect any suit or proceeding now pending in any court, or any rights acquired, or liability incurred, or any cause or causes of action acquired or existing, under any act or ordinances replaced hereby. Nor shall any right or remedy of any character be lost, impaired, or affected by this chapter. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-01-001-0004 Violations and Penalties

A. Violations. It shall be unlawful for any person, firm or corporation to erect, construct, enlarge, alter, repair, move,
improve, remove, convert, demolish, equip, use or maintain public or private infrastructure or permit the same to be done in violation of this chapter.

B. Penalties. Any person, firm, or corporation violating any provision of this code shall be deemed guilty of a misdemeanor, and upon conviction thereof, shall be punishable by a fine and/or imprisonment set forth by the governing laws of the jurisdiction. Each separate day or any portion thereof, during which any violation of this code occurs or continues, shall be deemed to constitute a separate offense. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-01-002  
Agency Controls and Reviews

Sections:

13-01-002-0001 City
13-01-002-0002 County
13-01-002-0003 State
13-01-002-0004 Federal
13-01-002-0005 Utility Companies

SECTION 13-01-002-0001 City

A. All design and construction for public improvements shall be done in accordance with:

1. Flagstaff City Code, Title 13, Engineering Design and Construction Standards and Specifications for New Infrastructure.


B. Other standards that will apply when applicable shall include but are not limited to:


3. City of Flagstaff codes and ordinances.


5. The current Arizona Department of Environmental Quality (ADEQ) standards.

6. The current Occupational Safety and Health Administration (OSHA) standards.


10. The currently adopted American Association of State Highways and Transportation Officials (AASHTO) policies.

11. Flagstaff City Code, Title 5, Fire Regulations.

12. The current National Fire Protection Association Standards.


16. Flagstaff City Code, Title 12, Floodplains.

17. Flagstaff City Code, Title 11, General Plans and Subdivisions.


C. The City Engineer or his authorized representative must review and approve all engineering plans for improvements to be constructed in public rights-of-way and easements.

1. Permits from the City are required for work within the public right-of-way or easements, and for construction of any improvements which will become public upon their completion.

2. Inspection of the construction of public improvements will be conducted by the City, and final acceptance of the construction by the City Engineer is required before releasing the permit and transferring ownership of the improvements to the City. Upon acceptance by the City, the improvements shall be guaranteed against all defects in material and workmanship for one (1) year from the date they are accepted by the City Engineer. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-01-002-0002  County

The County requires that a permit be issued from its office for any work within the County rights-of-way or for on-site wastewater disposal systems. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-01-002-0003  State

A. The Arizona Department of Transportation (ADOT) requires that a permit be issued from its agency for any work performed in State rights-of-way. Should new right-of-way be contemplated in the development process which anticipates being established into the State Highway System by an Arizona Department of Transportation (ADOT) Board Resolution, to include fee or easement rights, temporary construction easements, drainage, access control, signals, or any other incidental use thereof, the City and developer agree to immediately communicate and coordinate with ADOT. At that time, ADOT will provide further direction and guidance on necessary processes required to meet State standards in order to legally establish the new right-of-way for the benefits of the traveling public.

B. Arizona Department of Environmental Quality (ADEQ) approval to construct water or sewer systems must be obtained prior to approval of construction plans by the City Engineer and issuance of a Public Works Permit from the City. Such approval must also be indicated by notation of the file number and approval date on the cover sheet of the water and sewer plans. Approval of construction shall be obtained prior to operating new water and sewer mains and prior to obtaining associated certificates of occupancy. It shall be the sole responsibility of the developer to obtain all applicable permits and approvals from ADEQ.

Arizona Water Commission approval is required for any proposed water system which does not tie directly to the City system. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-01-002-0004  Federal

The United States Environmental Protection Agency and ADEQ regulations control pollution of noise, air, water, and sewage. Any work must be coordinated through all controlling Federal, State and local agencies. Permits from controlling Federal agencies are required for any work on Federally owned land. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-01-002-0005 Utility Companies

A. Prior to the approval of construction plans by the City, officials of the local utility companies listed below shall sign the cover sheet of the plans for public improvements. By signing this sheet, the utility confirms that they have seen the plans, are aware of the scope of the project and have identified existing and proposed utilities and their potential conflicts in relation to the project.

1. Arizona Public Service Company.
3. CenturyLink.
4. Suddenlink.
5. City of Flagstaff Utilities Division.
6. Others when applicable. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-01-003
Work in Public Ways

Sections:

13-01-003-0001 Qualifications of Designer
13-01-003-0002 Work Not Intended to Become Public Property (e.g., Utility Company Installations)
13-01-003-0003 Work Intended to Become Public Property
13-01-003-0004 Qualifications of Contractor

SECTION 13-01-003-0001 Qualifications of Designer
All plans and designs for public improvements shall be prepared by a professional civil engineer registered in the State of Arizona and shall bear their seal and signature. Survey legal descriptions and plats shall be prepared by a land surveyor registered in the State of Arizona and must bear that land surveyor’s seal and signature. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-01-003-0002 Work Not Intended to Become Public Property (e.g., Utility Company Installations)
All improvements within City rights-of-way, not intended to become public property, shall be constructed or maintained under the terms of a franchise agreement or other authorization from the City. The location of such facilities, their installation, and the restoration of the area after installation, shall be done in accordance with these regulations. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-01-003-0003 Work Intended to Become Public Property
All improvements which are intended to become public property shall be constructed according to these regulations, conditions shown on the public works permit, and plans approved by the City Engineer. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-01-003-0004 Qualifications of Contractor
All improvements shall be constructed by contractors licensed by the Arizona State Registrar of Contractors, with a class of license(s) appropriate for the specific work being performed. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13-03
SURVEY

Divisions:

13-03-001  Applied Standards for Surveying
13-03-002  Boundary Survey
13-03-003  Topographic Survey
13-03-004  Mapping
13-03-005  Construction Survey
13-03-006  As-Built Survey
SECTION 13-03-001  Applied Standards for Surveying

The following standards are referenced throughout this chapter to provide additional guidance:

A. Arizona Boundary Surveys Minimum Standards (APLS MS) as adopted by the Arizona Professional Land Surveyors.

B. MAG Standard Specifications.

C. The National Map Accuracy Standards (NMAS) and the ASPRS (American Society for Photogrammetry and Remote Sensing) Class 1 Standards. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-03-002  
Boundary Survey

Sections:

13-03-002-0001 Definition
13-03-002-0002 Qualifications
13-03-002-0003 Basis of Bearings
13-03-002-0004 Coordinates
13-03-002-0005 Legal Descriptions
13-03-002-0006 Conveyances
13-03-002-0007 Monuments

SECTION 13-03-002-0001 Definition

"Arizona Boundary Survey" means any one or more of the following:

A. The marking of boundaries, the setting of monuments, or the restoration or rehabilitation of any monument marking a corner or line that controls real property.

B. The determination of the location, on the ground, of any appurtenance, which may potentially affect the rights and/or the enjoyment of real property.

C. The determination of the position of any monument, reference point, or any other mark, when such monument or mark controls the location of boundaries or rights of ownership in real property.

D. The presentation of any type of survey drawings, maps or plats, and/or reports-of-survey or any other documents as related to land boundary surveying, for identifying the location of real property.

Note: This definition is adopted in accordance with the APLS MS. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-03-002-0002 Qualifications

All boundary surveys shall be performed by, or under the direct supervision of, an Arizona registered land surveyor (RLS) with current Arizona registration. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-03-002-0003 Basis of Bearings

For every development, whether public or private, a basis of bearings shall be identified and noted as such. The basis of bearings may be any
line within the limits of the development that is defined by a survey monument at each end. All other lines, control and dimensions shall be oriented to the basis of bearings. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-03-002-0004 Coordinates

When coordinates are used they shall be given by northing/easting and display as many significant figures as are required to reproduce the bearing and distance annotation shown on the project documents.

A note shall be provided on each boundary survey and set of construction drawings stating the basis of bearings as well as the basis of coordinates.

The horizontal datum for any projection used shall be defined on each boundary survey and on each set of construction drawings.

Data for any horizontal map projection utilized shall include:

A. Define linear unit and geodetic datum used (e.g., International Foot, NAD 83(2007)).

B. Define the latitude of the grid origin and the longitude of the central meridian to the nearest whole arc minute (e.g., 35°07'40"N by 111°37'30"W).

C. Define the false northing by false easting of the grid origin by central meridian using large whole numbers with as few digits as possible (e.g., N = 10,000 by E = 50,000).

D. Define the scale factor on central meridian to no more than six (6) decimal places (e.g., SF = 1.000318). (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-03-002-0005 Legal Descriptions

New legal descriptions must be prepared and sealed by a registered land surveyor and accepted by the City Engineer. The description shall consist of two (2) parts; text as EXHIBIT ‘A’ and an eight and one-half (8-1/2) inch by eleven (11) inch drawing as EXHIBIT ‘B’.

Exhibit ‘A’ shall conform to the requirements of APLS MS and shall be labeled as EXHIBIT ‘A’ at the top of the first page. It shall conclude with a reference to EXHIBIT ‘B’.

Exhibit ‘B’ shall be a scale drawing in eight and one-half (8-1/2) inch by eleven (11) inch format of the parcel described in Exhibit ‘A’ and shall be labeled as Exhibit ‘B’. It shall identify the true point of
beginning and the basis of bearings. It shall include a north arrow and the scale of the drawing.

A cogo printout of the legal description courses shall be submitted to the City Engineer with Exhibits ‘A’ and ‘B’ for review and approval. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-03-002-0006 Conveyances

Where a conveyance is required the following sections shall govern:

A. Dedications to City (easements and rights-of-way) is per Chapter 13-04.

B. Right-of-way plans are per City of Flagstaff Engineering Standards Section 13-06-002-0006.

C. Minor land divisions, land splits/combinations are per Section 11-20.100. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-03-002-0007 Monuments

For the purposes of this section, a right-of-way line is defined as the boundary of any piece of land granted by deed or plat for a designated use such as a roadway, highway, railway or utility.

A centerline typically defines the line midway between the right-of-way lines. A construction centerline is defined as a temporary line established for the purpose of laying out construction improvements. A control line is defined as any line from which physical features, existing and proposed, are referenced and may be coincident with a right-of-way line, a centerline or a construction centerline.

A. The owner/developer shall engage a registered land surveyor to place all survey monuments. A copy of all field notes shall be supplied to the City if requested.

B. For new construction, survey monuments shall be placed on the centerline and on the right-of-way lines (both sides of centerline). Monuments shall not be placed to represent temporary location lines, such as construction centerline. Placement of survey monuments shall be subject to final review and acceptance by the City Engineer.

C. Survey monuments along centerlines shall conform to City Engineering Detail No. 3-02-070.
The surveyor shall provide reference marks and dimensions to the centerline monuments, existing and new. A minimum of two (2) "permanent" reference marks shall be established outside the vehicle travel way for each centerline monument. The angle formed by the centerline monument and the two (2) reference marks shall be approximately ninety (90) degrees. Examples of permanent reference marks include an "x" chiseled into the top of curb, a PK nail in concrete sidewalk and a nail with brass tag in the side of a utility pole. Any existing marks suitable for reference may be used.

Alternatively, the surveyor may determine and record the locations of centerline monuments using global positioning satellite (GPS) technology with survey-grade accuracy.

D. For subdivisions, an identifying marker, conforming to APLS MS requirements, shall be placed at all original tract corners, subdivision boundary control points, lot corners, centerline control points (intersections, P.C.s, P.T.s, cul-de-sacs, angle points) and any other point required by the City Engineer.

All survey monuments shall be described on the final plat.

Subdivision corner monuments shall be installed before recording the final plat. Lot corners shall be set upon completion of site grading and before issuance of any building permit.

E. Street centerline monuments shall be set and vertical control established thereon per NAVD 88 upon completion of street improvements and prior to acceptance of the off-site improvements.

City of Flagstaff vertical datum shall be utilized.

F. Existing monuments that define right-of-way, centerline, and/or survey control shall be preserved. When feasible, existing boxes and covers shall be adjusted to finish grade by the contractor without disturbing the survey monument. Monuments that are disturbed by construction shall be reset by the surveyor per Section 13-03-005-0004. Refer to Detail 3-02-070 "Installation of Survey Monument."

G. When establishing right-of-way in new areas, the control line shall be concentric with the right-of-way whenever possible. Whenever a portion of any parcel is acquired for right-of-way purposes, property corners adjoining the new right-of-way for that parcel shall be established and monumented.

H. Frame and cover monuments shall be used at section corners, quarter (1/4) corners, center of sections, and at the monument
line of right-of-way intersections of all arterial and collector streets with any other street. Also, each subdivision shall have a minimum of two (2) successive street monuments of sufficient distance on a common tangent to establish a baseline for future surveys.

I. It is the intent of the City of Flagstaff Engineering Section to maintain a database of existing survey monuments located within the City limits. The primary function of the database is to identify and perpetuate survey monuments. All construction plans shall identify survey monuments located within the project area as follows:

1. Monuments already listed in the City Engineering Section’s database shall be recovered and identified by note on the construction plans.

2. Monuments not listed in the City Engineering Section’s database shall be identified, shown on the construction plans and added to the City Engineering Section’s database.

3. Monuments that are set for points created by and/or reset by new construction shall be identified, shown on the as-built plans and added to the City Engineering Section’s database.

The necessary elements for survey monument data shall include the point number (as assigned by the City Engineer), the location with north-south street listed first and east-west listed second as applicable, the monument type (AC, BC, etc.) and the NAVD 88 elevation of the actual monument. Additionally a monument sketch shall be submitted by the surveyor to the City Engineer on eight and one-half (8-1/2) inch by eleven (11) inch in .pdf format for each point per A.R.S. Section 33-106. Monument data for sectional land corners shall be accompanied by a Corner Record Survey that complies with A.R.S. Section 33-106 inclusive of the County Instrument Number. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-03-003
Topographic Survey

Sections:

13-03-003-0001 Definition
13-03-003-0002 Qualifications
13-03-003-0003 Benchmarks
13-03-003-0004 Contours
13-03-003-0005 Positional Accuracy

SECTION 13-03-003-0001 Definition

Topographic surveys depict the planimetry and the elevation contours of a portion of the earth’s surface including natural and manmade characteristics.

The topographic survey shall be referenced to at least two (2) monumented property lines as indicated by a ROS (results of survey) per Division 13-03-002. Topography shall be shown at least twenty-five (25) feet outside of the project limits depending on the engineering design requirements. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-03-003-0002 Qualifications

All topographic surveys shall be performed by, or under the direct supervision of, a registered land surveyor (RLS) with current Arizona registration. The topographic survey shall identify the date of the survey, the surveyor, and the means by which the survey was completed. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-03-003-0003 Benchmarks

For every development, whether public or private, a series of elevation benchmarks shall be identified and/or established. Each benchmark shall be a relatively permanent object, natural or artificial, with an elevation established thereon. The elevation shall be in NAVD 88 datum with an elevation value to the nearest one-hundredth (0.01) feet.

Benchmarks for the project shall be shown on one (1) or more sheets of the construction/improvement drawings. Both the location and physical description of the monument shall be shown. Plans shall also indicate the benchmark and the elevation utilized in establishing the temporary benchmarks and elevations.

Benchmarks shall be established and shown on each site plan (at least three (3) per site) and at least every four hundred (400) linear feet
on alignment plans (e.g., roads, water lines, drainage channels). (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-03-003-0004   Contours

Contour interval shall be one (1) foot or two (2) feet, depending on the slope of the ground and the judgment of the Engineer or land surveyor. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-03-003-0005   Positional Accuracy

All mapping performed by other than photogrammetric methods shall meet the NMAS with ninety percent (90%) of horizontal features at one-fortieth (1/40) of map scale, ninety percent (90%) of spot elevations with one-quarter (1/4) of the contour interval and ninety percent (90%) of the contours within one-half (1/2) of the contour interval.

Mapping performed by photogrammetric methods shall meet the ASPRS Class 1 Standards with the horizontal root mean square error (RMSE) at one-hundredth (1/100) of map scale, the spot elevation RMSE at one-sixth (1/6) of the contour interval and the contour RMSE at one-third (1/3) of the contour interval. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Sections:

13-03-004 Conceptual Plats, Preliminary Plats, Final Plats
13-03-004-0001 Survey Requirements for Mapping

SECTION 13-03-004 Conceptual Plats, Preliminary Plats, Final Plats

Specific requirements for the conceptual plat, the preliminary plat and the final plat are per Title 11, General Plans and Subdivisions. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-03-004-0001 Survey Requirements for Mapping

A. A complete boundary survey based upon fieldwork shall be performed prior to submittal of the preliminary plat.

The boundary survey shall meet the requirements of Division 13-03-002 and shall be clearly referenced on the preliminary plat, including Coconino County recording information. A copy of the recorded survey shall be submitted with the preliminary plat.

B. Mapping (including contours) of the preliminary plat site and adjacent areas shall be sufficient to show clearly the influence of surrounding conditions (topography) as well as the influence of the proposed development on surrounding conditions. The topographic survey shall meet the requirements of Division 13-03-003. Topographic results may be obtained by photogrammetric means.

C. All vertical datum shall be on NAVD 88. Benchmarks shall meet the requirements of Section 13-03-003-0003, and shall be noted on the preliminary plat.

D. The topographic survey shall identify the surveyor and the date performed.

E. USGS 7.5 minute quadrangles will not be accepted as topographic data for most projects. The City of Flagstaff geographic information system (GIS) model may be utilized to provide mapping requirements; however, it will be the responsibility of the land surveyor who seals the plat to verify that the information complies with the precision tolerances of Division 13-03-003. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-03-005
Construction Survey

Sections:

13-03-005-0001  Construction Survey Definition
13-03-005-0002  Qualifications
13-03-005-0003  Coordinates
13-03-005-0004  Monument Protection

SECTION 13-03-005-0001  Construction Survey Definition

Construction surveys provide markings on the ground to be used to build and/or construct engineering improvements per an approved construction drawing (plan). (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-03-005-0002  Qualifications

The contractor shall be responsible for retaining, at his expense, a registered land surveyor (RLS) to provide construction staking. The RLS shall possess current registration in the State of Arizona. Stakes shall be of sufficient number to allow the contractor to build the project in substantial conformance to the plans. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-03-005-0003  Coordinates

If coordinates are used by the approved plans to define locations of improvements per Section 13-06-002-0007(A)(6), then the construction staking shall utilize the same system. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-03-005-0004  Monument Protection

Monument Protection shall be per MAG Spec. 107.9 "Protection and Restoration of Property."

Prior to any construction activity the contractor shall retain a registered land surveyor (RLS) with current registration in the State of Arizona to reference the monumented private property corners, right-of-way markers, centerline monuments and PLSS monuments depicted in the plans per Section 13-03-002-0007(G).

Any monuments to be re-monumented by the RLS as a part of the work will be identified as such in the plans and shall be paid for as a part of the work.
Any monuments that are disturbed or displaced by construction shall be reset by the RLS at contractor’s cost and not charged to the City, the developer or the owner. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-03-006
As-Built Survey

Sections:

13-03-006   As-Built Survey
13-03-006-0001   Survey Criteria
13-03-006-0002   Qualifications

SECTION 13-03-006    As-Built Survey

As-built plans shall meet the requirements of Section 13-06-002-0008 and the City of Flagstaff Engineering Sections’ "As-Built Plans/Record Drawings Checklist." Survey data shall meet the following requirements. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-03-006-0001    Survey Criteria

All as-built survey data shall tie into the same horizontal and vertical control as that used for the approved construction plans.

All stationing shall be relative to that of the plans. At least two (2) horizontal cross-ties shall be provided for each water valve box. The cross-tie is defined as an unobstructed horizontal measurement to the nearest one-tenth (0.1) feet from an object that is at least thirty (30) inches high and vertical (plumb) in nature. Examples are operating nuts on fire hydrants, utility poles, prominent building corners and fence corners which are set in concrete. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-03-006-0002    Qualifications

All survey data given by the as-built plans shall be performed by a registered land surveyor who is currently registered in the State of Arizona. As-built plan sheets with survey information shall show the seal and signature of the registrant. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13-04
EASEMENTS AND RIGHTS-OF-WAY

Divisions:

13-04-001 Easements
13-04-002 Public Right-of-Way
Division 13-04-001
Easements

Sections:

13-04-001-0001 City Action
13-04-001-0002 Uses
13-04-001-0003 Types
13-04-001-0004 Location
13-04-001-0005 Easement Conveyance by Other Than a Final Plat

SECTION 13-04-001-0001 City Action

A review of the completed instruments and all legal descriptions, exhibits and maps shall be made by the City Engineer prior to City Council acceptance and recordation. When an easement is required because of a new development, the developer shall provide the legal description and record the easement. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-04-001-0002 Uses

Easements are to be used when the fee title holder deems it undesirable to give up fee title for the described area covered by the easement. In such case, the grantor will continue to pay appropriate property taxes on the area covered by the easement as no fee title has been transferred. City policy is to require easements for utility lines, pedestrian ways, and certain drainageways. Streets, roads and some drainage ways require warranty deeds. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-04-001-0003 Types

A. Typical easement purposes are water, sewer, drainage, public utility, sidewalk, walkways, bike paths, urban trails, open space, slope, temporary turnaround, public service access, and temporary construction easements. However, any purpose agreed upon by both parties will constitute valid use. A vehicular no-access restriction may be required by the City, where vehicular access is not appropriate for safety or legal reasons.

B. More than one (1) type of easement may occupy the same ground, but if created at different times, the right and use by the senior grant may not be interfered with by the junior; nor can any easement be used for a purpose other than that recited in the grant.
1. The grantor may make use of the land subject to the easement but must not interfere with the particular easement use or access thereto.

2. The land owner must allow the authorized utility company or City representative access to any piping and/or appurtenances that lie within the public utility easement.
   a. Access is defined as the ability to walk to the piping and/or appurtenance.
      (1) In the event that no access is available from the installation of a nonedifice, a gate, four (4) feet, zero (0) inches minimum in width, may be required to be installed that will allow access.
      (2) The gate may be equipped with a City lock interlocked with a lock from the private resident.

3. No permanent structures will be allowed to be constructed within, or over the top of, the public utility or drainage easement.
   a. A permanent structure is defined as a masonry fence (including trash enclosures), or any part of a building or structure that requires a building permit.
   b. A nonpermanent structure is defined as a wooden or chain link fence, curb and gutter, parking lot, landscaping, and buildings or structures that do not require a building permit.
   c. In the event that the pipe and/or appurtenance must be repaired, maintained, or reconstructed, and a nonpermanent structure has been constructed over the easement, the City may require the property owner to remove the nonpermanent structure in order for the City to make the repair, perform maintenance, or do reconstruction.
      (1) The property owner may reinstall the structure at the owner’s expense.
   d. In the event that the pipe and/or appurtenance must be either repaired, maintained, or reconstructed, and a permanent structure has been constructed over the easement, the permanent structure must be removed by the property owner in order to complete the repair,
maintenance, or reconstruction and may not be reinstalled.

e. In the event that the structure, either permanent or nonpermanent, is not removed immediately, the City shall have the right to remove the structure and charge the property owner for this effort.

f. Private services shall not be installed in a public easement or right-of-way parallel to public utility lines.

C. Fences are not allowed across drainage easements with open channels. Removable fences with minimum eight (8) foot gates are permitted across drainage easements with underground storm drains.

D. An easement does not become void or nonexistent if it ceases to be used for the purpose for which granted unless the grant carries a limitation to that effect.

1. An easement can be of a temporary nature and cease to exist at the time specified on the grant. One (1) example would be a construction easement adjoining a permanent easement or a turnaround to be abandoned when the street is extended. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-04-001-0004 Location

When construction plans indicate roadway fill slopes, which extend beyond the limits of the right-of-way, then a slope easement will be required for those areas.

A. Public utility easements shall be a minimum of twenty (20) feet in width and provide access across lots and/or along rear or side lot lines where necessary; when water and sewer lines are in the same easement the minimum width shall be twenty-six (26) feet. When a water service or fire hydrant is located adjacent to, but outside of, the right-of-way or public utility easement (PUE) a PUE shall be extended to accommodate the appurtenance. The minimum dimensions of the PUE shall allow for three (3) feet of clearance from all sides of the appurtenance. Drainage easements shall be in accordance with City of Flagstaff Stormwater Management Design Manual.

B. Each cul-de-sac shall have provisions for a twenty (20)/twenty-six (26) foot wide easement to an adjacent street or to property lines to allow for future utility and pedestrian extension.
C. Drainage easements shall be provided conforming substantially with the lines of any watercourse, drainage way, channel, stream, or river, and sufficient in width to convey the runoff of the design storm with the required freeboard and maintenance access. Additional easement requirements may also apply as required by the City of Flagstaff Stormwater Design Manual. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-04-001-0005  Easement Conveyance by Other Than a Final Plat

Items required for a valid conveyance are:

A. A legal description and exhibit drawing in accordance with Section 13-03-002-0005 prepared and sealed by a registered land surveyor and accepted by the City Engineering Section.

B. An executed easement document that has been reviewed and accepted by the City Engineer.

C. If a business entity is the owner, provide the name of the officers or agents, who are authorized to execute the instrument(s) on behalf of the entity.

D. All easement conveyances shall be approved by the City Engineer and then signed by the property owner (and recorded) prior to construction plan approval. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-04-002
Public Right-of-Way

Sections:

13-04-002-0001 City Action
13-04-002-0002 Uses
13-04-002-0003 Right-of-Way Conveyance by Other Than a Final Plat
13-04-002-0004 Legal Descriptions

SECTION 13-04-002-0001 City Action

A review of the completed instruments and all exhibits shall be made by the City Engineer prior to being submitted, as necessary, to the Planning and Zoning Commission and City Council and prior to signing and recording. The City Clerk will be responsible for the recording of all instruments. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-04-002-0002 Uses

Public right-of-way shall be granted by a general warranty deed or plat.

A. When a public right-of-way is abandoned, public passage is terminated but easements within the right-of-way will be retained to cover the purposes constructed therein (e.g., water and power).

B. A permit from the City Engineer is necessary to construct or erect facilities, buildings, or structures of any type, permanent or temporary, on the public right-of-way.

1. Such construction shall be removed at the owner’s expense should it interfere with any legitimate use of the right-of-way. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-04-002-0003 Right-of-Way Conveyance by Other Than a Final Plat

Items required for a valid conveyance are:

A. A legal description and exhibit drawing in accordance with Section 13-03-002-0005 prepared and sealed by a registered land surveyor and accepted by the City Engineer.

B. An executed warranty deed that has been reviewed and accepted by the City Engineering Section and the City Attorney.
C. Provide a title report prepared by an independent title insurance company for each property from which right-of-way is being dedicated.

D. If a business entity is the owner, provide the names of the officers or agents, who are authorized to execute the instrument(s) on behalf of the entity.

E. All right-of-way conveyances shall be approved by the City Engineer and then signed by the property owner (and recorded) prior to construction plan approval. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-04-002-0004 Legal Descriptions

A. When additional right-of-way is required because of a new development, then the legal description of the right-of-way shall be provided by the developer.

1. When only a corner cut-off is required, then the City may provide the legal description, but the corners of the newly created right-of-way shall be monumented per Section 13-03-002-0007(A) prior to final project closeout.

B. Legal descriptions and exhibit drawings per Section 13-03-002-0005 must be prepared and sealed by a registered land surveyor and accepted by the City Engineer. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13-05
ENGINEERING DESIGN REPORTS

Divisions:

13-05-001 Engineering Design Reports
13-05-002 Impact Analyses
Division 13-05-001
Engineering Design Reports

Sections:

13-05-001-0001 Water and Sewer System Design Report
13-05-001-0002 Soils Report
13-05-001-0003 Storm Drainage Report

SECTION 13-05-001-0001 Water and Sewer System Engineer Design Report

A. A water and sewer design report, sealed by a registered professional engineer licensed in Arizona, is required for all new subdivisions, public water or sewer system additions or modifications, new roadways, or as determined by the City Engineer. This report is to assure that the engineer has dealt with water and sewer systems design and has offered solutions which conform to the approved preliminary plat or site plan and this title.

1. If, in preparation of the report, the engineer finds that substantial changes from the approved preliminary plat are required to produce an economical development, a revised preliminary plat shall be prepared.

   a. A forced engineering solution conforming to an approved preliminary plat is not acceptable.

   b. The report should be prepared in conjunction with the approved preliminary plat and/or construction drawings until all design problems are worked out.

2. The report is required with the initial construction plans submittal. The reports must be approved prior to the approval of the construction plans.

B. Water distribution systems shall be designed to adequately satisfy the requirements of Division 13-09-003, Water System Design. The engineer should investigate the maximum daily rate and the maximum hourly rate plus the required rate for fire protection, to determine which will govern the design. Consideration of future requirements and extensions shall be included in the report. Water lines shall be sized to maintain water pressure as required in Chapter 13-09 and shall adhere to all general requirements including valves, blow-offs, and fire hydrants. All calculations should be shown to justify the design.
C. Considerations of sewage flow shall include investigation of volume, strength, and types of flow to be collected by the system and the impact of development on the existing downstream system. The engineer shall account for future requirements and extensions if the design only covers part of the area to be served. All general requirements, as listed in Division 13-09-004, Sewer System Design, shall be adhered to. Calculations concerning pipe sizing, velocity and grades shall be shown for all lines. Requirements concerning loading on pipes should also be considered as part of the overall design. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-05-001-0002 Soils Report

A geotechnical soils report prepared by a registered professional engineer licensed in Arizona, specializing in geotechnical engineering, is required with the initial construction plans submittal of street structural section design or slope stability analysis.

A. The soils engineer shall address the following problems: shrink-swell potential, ground water, wetness, depth of rock, erosion, flood hazard, allowable velocity in earth drainage channels, bearing capacity, corrosion potential, organic layers, ease of excavation, and other pertinent issues. Correlated "R-values" that are used in the pavement structural section design should be determined from soil samples containing the highest amount of clay (PI values).

1. If higher PI values are reported but not considered in the determination of the correlated R-values, the engineer shall provide recommendations for removal of these materials, including specific areas of removals that must be reflected on the approval civil plans.

2. If cut and fill slopes are proposed which exceed those allowed by City standards and/or Title 4, Building Code, a slope stability analysis establishing maximum stable slope grades must be included.

   a. If problem areas are found, further analysis may be required in those specific areas.

B. If, in preparation of the report, the engineer finds that substantial changes from the approved preliminary plat are required to produce an economical development, he shall prepare a revised preliminary plat.

C. Forced engineering solutions to conform to an approved preliminary plat are not acceptable.
D. The report should be prepared in conjunction with the approved preliminary plat and/or construction drawings until all design problems are worked out. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-05-001-0003 Storm Drainage Report

A. A drainage report, prepared in accordance with the requirements of the Stormwater Design Regulations, is required and must be approved prior to approval of the construction plans.

1. If, in preparation of the report, the engineer finds that substantial changes from the approved preliminary plat are required to produce an economical development, he shall prepare a revised preliminary plat.

   a. Forcing engineering solutions to conform to an approved preliminary plat is not acceptable.

2. The report should be prepared in conjunction with the approved preliminary plat and/or construction drawings until all design problems are worked out.

B. If low impact development (LID) is proposed in the right-of-way, the following shall be addressed to the satisfaction of the City Engineer and the Public Works Section Head:

1. Measures provided to ensure the preservation of adjacent pavement section, or other associated infrastructure, as the result of infiltration and/or standing water associated with an IMP.

2. A detailed operations and maintenance manual that, at a minimum, shall include a narrative describing the purpose and function of the IMP, required maintenance activities, and needed inspection activities. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Divison 13-05-002
Impact Analyses

Sections:

13-05-002-0001 Water Impact Analysis
13-05-002-0002 Sewer Impact Analysis
13-05-002-0003 Transportation Impact Analysis
13-05-002-0003.1 General
13-05-002-0003.2 Process
13-05-002-0003.3 Requirements
13-05-002-0003.4 Analysis Methods and Report Format
13-05-002-0003.5 Study and Report Format
13-05-002-0004 Stormwater Impact Analysis

SECTION 13-05-002-0001 Water Impact Analysis

The City of Flagstaff shall prepare the water impact analysis that is required as part of the submittal process for any development that involves: an annexation, extension of service beyond the urban growth boundary, specific or small area plan, development master plan, subdivision plat, change of zoning request (medium or large in accordance with the zoning code), main extension, or a site plan submittal for any development which will generate a peak hour demand greater than the equivalent flow of ten (10) single-family dwelling units (the requirement may be waived at the discretion of the City Engineer and the Utilities Director).

A. The analysis shall establish the parameters of the system which satisfies the requirements of Division 13-09-003, Water System Design.

1. The analysis shall evaluate the maximum daily rate plus the required flow rate for fire protection, and the maximum hourly rate to determine which will govern the design.

2. The system analysis shall include the development, as well as adequate surrounding areas to determine that the new development will not negatively impact adjacent developments and the encompassing water pressure zone.

3. All calculations should be shown to justify the design.

4. Approval of any proposed development will require the correction of any deficiencies indicated in the report by the developer, including inadequate flow to the development.

B. This analysis need not be made if the site has previously been included in a complete water impact analysis for a larger area.
and the land use and intensity assumed for the site in that previous analysis is the same as that of the proposed development.

C. A computer model of the proposed water system for the development will be performed by the City for a fee that is separate from the development plan review fee.

1. Adequate information regarding the project’s water demands must be provided by the developer to the City, in order to run the model.

2. The information provided will determine the upper limit of demand that the development may place on the water system.

3. In the event that a proposed development exceeds the maximum demand, as determined in the impact analysis, a new water impact analysis may be required.

4. The model will determine the impact of the development on the City’s water system as well as the impact of the City’s water system on the development.

D. The analysis and report shall be submitted with the development application. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-05-002-0002 Sewer Impact Analysis

The City of Flagstaff shall prepare, at the expense of the developer, a sewer impact analysis that is required as part of the submittal for any development that involves: an annexation, extension of service beyond the urban growth boundary, specific or small area plan, development master plan, subdivision plat, change of zoning request, medium or large in accordance with the zoning code), main extension, or a site plan submittal for any development which will generate a peak hour discharge greater than the equivalent flow of ten (10) single-family dwelling units (the requirement may be waived at the discretion of the City Engineer and the Utilities Director).

A. All general requirements, as listed in Division 13-09-002, Sewer System Design, shall be adhered to.

1. The developer must provide adequate information regarding the project’s sewer discharge to the City, in order to run the model.

   a. The information provided will determine the upper limit of discharge that the development may place on the sewer system.
2. In the event that a proposed development exceeds the maximum discharge, as determined in the impact report, a new sewer impact analysis may be required.

3. The model will determine the impact of the development on the City’s sewer system. However, the computer model will not address the functionality of the development’s sewer system.

B. The analysis and report shall be submitted with the development submittal application.

C. The analysis shall include the following: estimate of flows generated from the proposed development, capacity of existing downstream mains from the tie-in point of the development to the Rio de Flag sewer trunk line, and the impact development flows will have on these downstream mains.

1. The calculated off-site impacts shall be based on a steady-state flow pattern using the peak flows established in Chapter 13-09 (the loadings and patterns may be modified at the discretion of the Utilities Director).

2. The Rio de Flag sewer trunk line shall be defined as the sewer line between manhole R-065 and manhole 23-001.

3. Approval of any proposed development will require the correction of any deficiencies by the developer to any off-site mains between the development and the nearest downstream treatment plant.

D. The analysis need not be made if the site has previously been included in a complete sewer impact analysis for a larger area and the land use and intensity assumed for the site in that previous analysis is the same as that of the proposed development. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-05-002-0003 Transportation Impact Analysis

SECTION 13-05-002-0003.1 General

A. The impact of traffic generated by new developments and redevelopments on the City’s transportation network shall be considered in the approval process for all developments. The purpose for this consideration will be to:
1. Determine the transportation impacts of the project on the existing and future public transportation networks and identify measures to mitigate these impacts.

2. Highlight any special or unusual transportation conditions which may exist and describe how they will be handled.

3. Provide sufficient information for an assessment of the fair costs to mitigate the impacts of the development.

4. Coordinate circulation aspects of the project with those of other projects, existing developments, and the City’s general and specific plans.

5. Ensure uniform requirements and treatment for all developers.

6. Provide data for the City’s ongoing capital improvement and long range planning programs.

B. The analysis and report shall be prepared under the supervision of a professional engineer (civil) registered in the State of Arizona. The report shall be sealed and signed. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-05-002-0003.2 Process

The City Traffic Engineer shall approve the level, scope, and impact area for the analysis for each project, as well as any special conditions and issues to be addressed. The Engineering Section Project Manager will communicate the analysis requirements to the developer and/or the developer’s engineer at the first concept review meeting where the project is considered.

A. Acceptance by the City of the TIA shall be a condition of approval of a development project as follows:

1. For annexation, general area plan, specific plan, subdivision plat, or change of zoning request (medium or large) in accordance with the zoning code, the analysis must be accepted prior to staff scheduling the project for Planning and Zoning Commission for public hearing, or prior to staff approval of a development agreement, whichever comes first.

2. For individual development types not included in the previous categories, the analysis must be accepted prior to site plan approval. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-05-002-0003.3 Requirements

The need and level of analysis for a TIA shall be based on the number of vehicle trips generated by the development during the peak hour. The criteria for determining the analysis category, study horizon, and minimum study area are summarized in Table 13-05-01.

A. Category 0 – Very Small Developments. A traffic impact analysis may be required for developments that generate fewer than one hundred (100) peak hour directional trips. The requirement will be based on existing or anticipated special conditions or traffic problems near the site that may be aggravated by the development. The analysis shall address the impact of the development with respect to these conditions.

B. Category 1 – Small Developments. A Category 1 analysis is required for developments that generate between one hundred (100) and five hundred (500) peak hour directional trips. The analysis will generally focus on site access and the impact of the development on the adjacent circulation network.

C. Category 2 – Moderate or Large Developments. A Category 2 analysis is required for developments that generate more than five hundred (500) peak hour directional trips. The analysis will cover the circulation system within the influence area of the development and may include analysis at different future stages of the project.

D. Exceptions. Very small developments will often be excepted from the requirement of a full traffic impact analysis. The City Engineer’s scoping statement will serve for the development approval requirement.

Developments that have been anticipated in a previously accepted analysis may be excepted from the requirement to perform a full analysis; provided, that the proposed development substantially complies with the conditions and assumptions made for the transportation impacts of that development in the original analysis. These conditions and assumptions would include land use type and intensity, trip generation and distribution, site configuration and access points, and adjacent roadway configuration and traffic conditions. Special conditions or traffic problems near the site may require an analysis to address the impact of the development with respect to these conditions.

E. Coordination with Arizona Department of Transportation (ADOT). The developer of any project that has access to or frontage upon a State highway within the City limits shall contact the assigned ADOT Traffic Engineer in order to determine the Department’s impact analysis requirements for the project. To the extent that
these exceed the City’s requirements, they shall be incorporated into the scope of the analysis required by the City. The intent here is that the developer is required to perform only a single TIA that satisfies the requirements of both agencies.

Table 13-05-01
Traffic Impact Analysis Category

<table>
<thead>
<tr>
<th>ANALYSIS CATEGORY</th>
<th>DEVELOPMENT CHARACTERISTICS</th>
<th>STUDY HORIZON</th>
<th>MINIMUM STUDY AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Very Small Development &lt;100 peak hour</td>
<td>City Engineer shall set or waive requirements for traffic analysis for very small projects on a case-by-case basis</td>
<td></td>
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<tr>
<td></td>
<td>directional trips</td>
<td></td>
<td></td>
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<tr>
<td>1</td>
<td>Small Development 100 - 500 peak hour</td>
<td>Opening year</td>
<td>- Site access drives and adjacent streets</td>
</tr>
<tr>
<td></td>
<td>directional trips</td>
<td></td>
<td>- Adjacent signalized and/or major street intersections</td>
</tr>
<tr>
<td>2-M</td>
<td>Moderate, single phase 500 – 1,000 peak hour</td>
<td>Opening year</td>
<td>- Site access drives and adjacent streets</td>
</tr>
<tr>
<td></td>
<td>directional trips</td>
<td></td>
<td>- Street network and major intersections within 1/2 mile</td>
</tr>
<tr>
<td>2-L</td>
<td>Large single phase &gt; 1,000 peak hour</td>
<td>Opening year of each phase</td>
<td>- Site access drives and adjacent streets</td>
</tr>
<tr>
<td></td>
<td>directional trips</td>
<td>City planning horizon year</td>
<td>- Street network and major intersections within 1 mile</td>
</tr>
<tr>
<td>2-MULTI</td>
<td>Moderate or large, multi-phase</td>
<td>Opening year of each phase</td>
<td>- Site access drives and adjacent streets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>City planning horizon year</td>
<td>- Street network and major intersections within 1 mile</td>
</tr>
</tbody>
</table>

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-05-002-0003.4 Analysis Methods and Report Format

A. Study Area and Study Horizon Years. The minimum study area and the horizon years for the study shall be determined by the project size and type based on Table 13-05-01. The City Engineer may determine that the study area and horizon shall be adjusted based on the following conditions:
1. Special traffic conditions or capital projects underway which may exist outside the minimum study area but which will be affected by the project’s traffic.

2. Coordination with and accounting for the impact of other development projects in the vicinity of the development which contribute traffic to the street network in the geographic area of the traffic impact analysis.

B. Analysis Time Period. In most cases only the afternoon weekday peak period shall be analyzed. This may be varied if:

1. The proposed project is expected to generate very few trips during the weekday evening peak, in which case the peak hour of generation for the project shall also be analyzed; or

2. The peak traffic hour on the streets in the study area occurs during a different time period, such as noon, morning, or weekend, in which case that period shall also be analyzed.

C. Data Collection. All data shall be collected in accordance with the latest edition of the ITE Manual of Traffic Engineering Studies or as directed by the City Engineer. Existing traffic volume studies may be extrapolated for a period of two (2) years, with the concurrence of the City Engineer, in lieu of performing a required study.

1. Turning Movement Counts at Intersections and Driveways. Turning movement counts shall be obtained for all existing cross-street intersections and major driveways to be analyzed during the analysis time period. Turning movement counts at other times may also be required. These counts shall include classification of pedestrians, and bikes.

2. Traffic Volumes. Current and projected daily traffic volumes shall be presented in the report for all streets within the study area. A directional mechanical count for a minimum forty-eight (48) hours shall be made at each location. The data shall be taken in fifteen (15) minute increments.

3. Accidents. An analysis of accidents and the impact of the development on the accident patterns may be required.

4. Street and Intersection Geometry. Roadway and intersection geometric information for existing and future streets and intersections shall be obtained. This shall include width, number of lanes, turning lanes, vertical grade, location of driveways, vertical and horizontal geometry, and sight distance.
5. Existing Traffic Control Devices. The location and type of traffic control devices adjacent to the development, including pavement markings, signs, and signals shall be identified. All traffic signals within the study area shall be identified along with their phasing, timing, and coordination programs.

6. Other information may be required in order to perform a complete analysis including but not limited to:
   a. Transit routes and stops;
   b. Pedestrian generators and circulation patterns;
   c. Bicycle facilities;
   d. Emergency response time.

D. Trip Generation. Trip generation shall be developed using the latest edition of ITE’s Trip Generation. Other sources may be used with the approval of the City Engineer if the ITE manual does not include trip rates for a specific category of land use, or if the local trip generation rates have been shown to differ from the ITE rates.

E. Distribution and Assignment. Projected trips shall be distributed to the street network and added to the projected nonsite traffic within the study area.

1. The specific assumptions and data sources used in deriving trip distribution and assignment shall be documented.

F. Capacity Analysis.

1. Level of service shall be computed for all signalized and main unsignalized intersections within the study area. Level of service at site driveways shall also be computed. Level of service shall be determined in accordance with the latest edition of the Highway Capacity Manual.

2. Queue lengths for dedicated turn lanes at signalized intersections shall be determined.

G. Improvement Analysis. A traffic signal needs study shall be conducted for any new signal proposed for the development.

1. The study shall identify when the signal will be warranted, and the conceptual design for the signal and its operation.
2. The report shall identify the steps to be taken to mitigate any adverse effects of the traffic generated by the development on the street network within the study area.
   
a. This shall include, but not be limited to:
   
   (1) Improvements to existing signalized and unsignalized intersections.
   
   (2) Future signalization of unsignalized intersections.
   
   (3) Maintenance of street capacity at site driveways.
   
   b. Where the impact to be mitigated is less than the capacity improvement created by the mitigation, then sufficient information to determine a fair proportional distribution of cost to the developer for the mitigation shall be presented. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-05-002-0003.5 Study and Report Format

Full documentation of the analysis is required in the report. The report format should be scaled to the required category of the analysis. Table 13-05-02 shows the minimum requirements for inclusion in the report for each level of analysis.

<table>
<thead>
<tr>
<th>ANALYSIS CATEGORY</th>
<th>0</th>
<th>1</th>
<th>2-M</th>
<th>2-L</th>
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<tr>
<td>INCLUSION</td>
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<td>INTRODUCTION</td>
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<td>SITE PLAN</td>
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<td>PHASING AND TIMING</td>
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<td>STUDY AREA CONDITIONS</td>
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<td>X</td>
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<td>X</td>
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</table>
* For multi-phase developments projected traffic and the traffic and improvements analysis shall be made for each phase of the development and for the City’s planning horizon.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-05-002-0004  Stormwater Impact Analysis

A stormwater impact analysis shall be required for a general plan amendment or a request for a zoning change. When required, the following shall be provided in a report for review and approval.
A. Calculations for pre- and post-development runoff volumes.

B. Downstream impacts as the result of increased volumes shall be assessed as scoped by the City’s Stormwater Management Section and may include:

1. Hydrologic calculations to determine discharges at various downstream points pre- and post-development.

2. Corresponding hydraulic calculations to determine any increase in water surface elevations.

3. A geomorphic analysis to determine channel stability and sediment transport concerns as the result of increased flow duration created by increased volumes and clear water runoff created by development.

4. Other hydrologic and hydraulic calculations necessary to determine and resolve impacts.

C. Water surface increases may be allowed; provided, that they are less than one-tenth (1/10) of one (1) foot (0.1 feet) and there are no structures with known or calculated flooding problems or other major concerns. Water surface increases for Lake Continental, aka Big Fill Lake, (impoundment located on the Rio de Flag upstream of Route 66/I-40) are prohibited. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Divisions:

13-06-001 General
13-06-002 Plans Required
13-06-003 Grading Plans
13-06-004 Drainage Plans
13-06-005 Water and Sewer Plans
13-06-006 Street Plans
13-06-007 General Notes
13-06-008 Construction Traffic Control Plans
13-06-009 Franchise Utility Plans
Divison 13-06-001
General

Sections:

13-06-001-0001   General

SECTION 13-06-001-0001   General

Submit all plans and reports to the Engineering Project Manager assigned to the project.

For private development, all plan check fees must be paid at the time of plan submittal. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-06-002
Plans Required

Sections:

13-06-002 Plans Required
13-06-002-0001 Review by City Engineer
13-06-002-0001.1 Modifications and Appeals
13-06-002-0001.1.1 Modifications
13-06-002-0001.1.2 Appeals
13-06-002-0002 Content of Plans
13-06-002-0003 Format
13-06-002-0004 Drafting Standards
13-06-002-0005 Cover Sheets
13-06-002-0006 Right-of-Way Plans
13-06-002-0007 Construction Plan Sheets
13-06-002-0008 As-Built Plans
13-06-002-0009 Final Plan Submittal

SECTION 13-06-002 Plans Required

Engineering plans are required for construction of any new improvements within existing or proposed public rights-of-way or easements. Plan requirements may be waived by the City Engineer for jobs that are deemed minor, such as driveway cuts and sidewalk replacement. Plans shall be prepared by a registered professional engineer licensed in Arizona. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-002-0001 Review by City Engineer

Prior to issuance of any public works permit for construction, plans shall be reviewed and approved by the City Engineer or his authorized representative. Such review is intended to ensure general compliance with preliminary plats, engineering design reports, and all applicable City codes, standards, and regulations. This review is not intended to ensure accuracy of all plan details or assume design responsibilities from the designing engineer. In the event of plan errors or omissions, City standards will take precedence over the plans. Approval of the plan(s) by the City Engineer does not imply that the City is responsible for the correctness or completeness of the plans or for the cost of corrections to the plans and extra work resulting from changes that may be required during construction. Any difficulties encountered during construction will be settled to the satisfaction of the City Engineer by the developer. Approval of these plans by the City is for a one (1) year period, subsequent to the date of approval. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-06-002-0001.1 Modifications and Appeals

SECTION 13-06-002-0001.1 Modifications

A. In the event there is a need to modify the approved Engineering Standards, the design engineer shall submit a written request to the City that includes:

1. The applicable standard specification and/or detail for which the modification applies.
2. The requested modification to the standard.
3. A narrative as to why the standard cannot be met. Cost is not a justification for modifying standards.
4. Identify other options/alternatives and their impacts to the project.
5. Documentation as necessary to demonstrate that the modification:
   a. Meets the general intent of the standard;
   b. Will result in an equivalent level of service for health, safety, and welfare to the general public;
   c. Will result in improvements that are adequate and meet the City’s needs.

B. The request shall be submitted to the City Engineer, through the Development Engineering Project Manager assigned to the project. Whenever possible, modifications should be submitted with a concept plan review and approved prior to site plan or preliminary plat approval.

C. The process outlined in subsection (A) of this section shall be utilized in cases where a project seeks to implement a new technology that is likely to improve the longevity and resilience of project infrastructure. Additional requirements and conditions may be imposed by the City Engineer on a case-by-case basis. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-002-0001.1.2 Appeals

The decision of the City Engineer may be appealed to the City Manager. The process for appeal shall be as follows:
A. Both the applicant and the City Engineer will provide submittals to each other justifying their position on the modification, in layman’s terms. The submittal shall follow the criteria in Section 13-06-002-0001.1.1(A). In addition, the following shall be included with the submittal: a copy of the pertinent civil plan, and any pictures, exhibits, and references to standards and practices that further validate each party’s position on the modification request (e.g., City of Flagstaff Engineering Standards, AASHTO, etc.).

B. The applicant and the City Engineer shall develop a rebuttal to the opposing submittal. All submittals and rebuttals will be submitted to the City Manager for review.

C. The City Manager will review the materials submitted by each party and, if necessary, provide follow-up questions to both parties for clarification. The parties will exchange their respective responses to the questions posed by the City Manager and provide rebuttals, if warranted. All responses and rebuttals will then be submitted to the City Manager for final review and decision.

D. The City Manager may, at his/her discretion, hire a third-party professional engineer to assist with the review and decision making process. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-002-0002 Content of Plans

Plans are to meet the minimum requirements set forth in this title and must be based on minimum design criteria listed in the sections dealing with each specific item (e.g., grading, streets, water and sewer, and other public improvements). (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-002-0003 Format

A. All construction plans (grading, drainage, street, water, and sewer) must be submitted in a clear, neat format, with an uncluttered appearance, which conveys all pertinent information at a one (1) inch equals forty (40) feet (1:500) scale horizontal (one (1) inch equals twenty (20) feet may be required if necessary to meet the appearance of objectives), and one (1) inch equals four (4) feet, (1:50) vertical, or larger. Overall drawing size shall be twenty-four (24) inches by thirty-six (36) inches and shall have a left margin of two (2) inches and a margin of one half (1/2) inch on all other sides. An index map to a set of detailed plans in excess of two (2) sheets shall be presented.

B. The design engineer may request a variance for a particular project, where the above plan format criteria are not
appropriate. The City Engineer may grant an exception to the format criteria where, in his opinion, it is appropriate. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-002-0004 Drafting Standards

A. Symbols to be used should conform to ADOT Drafting Guidelines or any other widely accepted, clearly defined set of standard symbols.

B. Standard drawings must be referred to by number for inclusion as part of plans and in the quantity section.

C. A minimum lettering size of eight-hundredth (0.08) inches shall be used on all plans.

D. Direction of north arrow will be determined by stationing. All stationing will read from left to right. To accomplish this, the project should have increasing stationing from west to east or south to north.

E. Plan originals shall be on a high quality transparent mylar similar or equal to K & E four (4) mil. reverse double matte.

F. Stick-on materials, other than standard Blue Stake stickers, will not be allowed on plan originals. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-002-0005 Cover Sheets

A separate cover sheet shall be submitted with all plans and shall include the following when applicable:

A. Concept approval note (located above the City signature blocks):

"The City approves these plans for concept only. The City shall not be liable for errors or omissions of the design engineer."

B. Vicinity map (including a north arrow).

C. Project title.

D. Developer and engineering firm names and addresses.

E. Signature block for City Engineer.

F. Signature block for City Public Works Director.
SECTION 13-06-002-0006 Right-of-Way Plans

A. Right-of-way plans shall be submitted for all construction projects that require right-of-way acquisition. Right-of-way plans shall consist of a title sheet, ownership record sheet, vicinity map, and plan sheets, and may be a part of the construction plans if they were previously approved by the City Engineer. All sheets shall be sealed by a registered land surveyor.

1. This requirement may be waived if right-of-way dedications are minor or insignificant and previously approved by the City Engineer.

B. Right-of-way plans are to be used in conjunction with the acquisition and disposal of property and property rights. They shall contain sufficient data to allow them to be used as the primary source for the field location of all public right-of-way and property lines affected by the right-of-way changes shown on the plans. Except as authorized otherwise, they shall be based upon a previously recorded record of survey drawing prepared for the given project.

C. For those projects where right-of-way plans are not required, the existing right-of-way location and dimensions will still be needed for roadway design, except as authorized otherwise. If material discrepancies exist or there are insufficient survey
monuments to determine right-of-way limits, the description of the existing right-of-way shall be based upon a result of survey prepared for the given project and shall be shown on the construction plans.

D. Right-of-way plans shall show:

1. Right-of-way control/monument line.
2. All existing and proposed right-of-way limit lines.
3. Dimension from monument line to existing and new right-of-way limit line.
4. Monument line stationing with appropriate ties to intersecting property lines and changes in right-of-way width.
5. Any new or existing easements, either temporary or permanent.
6. For each parcel to be acquired:
   a. A parcel identification number.
   b. The property ownership lines.
   c. The County Recorder’s numbers for affected parcels including all existing rights-of-way and easements.
   d. The area in square feet or acres (square meters or hectares) of the part to be taken and of each remainder of a partial taking.
   e. Bearings and distances around the perimeter of all takings.
7. All intersections of the monument line with an established section line.
   a. The appropriate stationing shall be shown.
   b. All section lines shall be shown with bearings and distances to the monument line.
8. Thorough descriptions of all sectional control.
9. Basis of bearings in accordance with Section 13-03-002-0003.
E. The size, form, and arrangement of right-of-way plans shall conform to the general requirements for construction plans and should contain sufficient dimensional and angular data to permit ready identification and correlation with the legal descriptions of all parcels.

F. For all acquisitions, the ownership record sheet shall show the name of owner, brief description of the property to be acquired, and area of each parcel of land affected. It shall be prepared in uniform order with each parcel number being in numerical sequence. The ownership record shall contain the following:

1. Parcel number - a number shall be assigned to each individual parcel affected.
2. County recording instrument number or docket/page number.
3. Description - a brief description of that part of the parcel being affected.
4. Parcel area - area of the newly created right-of-way or easement; area may be shown in acres unless so small that a fractional part of an acre would be deceiving.
5. Remainder - area of the parcel remaining after the right-of-way or easement has been taken from the total parcel.
6. Sheet number - a number indicating the sheet on which the parcel can be located.

G. A vicinity map showing the project and its relationship to the surrounding area shall be shown. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-002-0007 Construction Plan Sheets

A. The following information is generally required for each construction plan sheet:

1. North arrow (with north up or to the left or right).
2. Horizontal control points and stationing.
3. Temporary benchmarks (T.B.M.s) and elevations in accordance with Section 13-03-003-0003.
4. Property lines, easement lines, and right-of-way limits. Survey monuments identified in accordance with Section 13-03-002-0007(A).
5. Street names, lot numbers and subdivision names.

6. Horizontal location of proposed and existing improvements relative to existing and proposed right-of-way, centerline, and easements. If coordinates are used by the approved plans to define locations of improvements, coordinate tables shall be shown for points on at least one (1) sheet of the construction/improvement drawings which depict right-of-way, easements, or property boundaries. All angle points, survey control points, and curve PCs, PTs and PIs for boundaries, rights-of-way and easements for the entire project shall have coordinates provided.

Additionally, coordinates should be provided for proposed construction features and utilities in sufficient quantity to define feature locations. The preferred method of coordinate depiction is to print a point number next to each point and a corresponding coordinate table for the points shown. Coordinates shall be given by northing/easting and display as many significant figures as are required to reproduce the bearing and distance annotation on the sheet and/or bearings and distances shown on other project documents.

7. Stationing along centerline and ties to property lines.

8. The signed seal of the professional engineer.

9. Title and revision block.

10. Legend identifying symbols and abbreviations.

11. All grading limits, including top of slope and toe of slope locations and slope gradients if separate grading plans are not required.

12. Location and gradients of all swales and flow lines if separate grading plans are not required.

13. Typical roadway and drainage cross-sections including cross slopes, right-of-way, and easement limits located relative to the proposed improvements.


15. Blue Stake sticker.

16. Resource protection areas.

17. Accurate location of all proposed and existing utilities.
18. Clearly differentiate between public and private improvements.

19. All construction plans shall reference, by City of Flagstaff project name and number, previously completed construction projects on adjacent properties. Additionally, as-built information from the previous plans must be referenced as related to the proposed project including but not limited to: benchmark and basis of bearing, horizontal and vertical utility information, and all relevant roadway improvement information. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-002-0008 As-Built Plans

A. Definition. When referred to in these standards, the terms "as-built plans" mean as-builts, as-constructed, or record drawings.

B. Intent. Prior to the City’s final approval of any public improvement or the final acceptance of any public utilities, which the City may accept currently or in the future for maintenance and operation, as-built plans must be submitted to the City for review and acceptance.

C. Procedure.

1. All as-builts shall have an applicant transmittal attached as documentation of who is submitting them. This is necessary in order to process the plans and for contact information when the review is complete. Plans will not be reviewed if this documentation is missing and/or the submittal is deemed incomplete based on the checklist.

2. All as-built plans submitted for review shall consist of two (2) clean blue or black line paper sets (copied from the original mylars, not a permit set), containing all the original signatures. One (1) set will be reviewed and returned if there are City comments. All comments must be addressed. Two (2) revised plan sets will be required with each resubmittal along with the previous redlined review set until final City approval.

3. Upon City approval, one (1) set of mylars shall be submitted to the City for permanent record. If the project is developed in phases, as-built information/plans will be submitted once the work is complete in that phase.
D. Criteria. As-built drawings shall contain, but are not limited to, the following information:

1. The plans shall contain the type and detail of information shown on the approved construction plans.

2. All public improvements (water, sanitary sewer, storm sewer, and streets) shall be as-built. For a list of all required items see the "as-built" checklist available from the City Engineer or his authorized representative.

3. As-built drawings shall be created using computer aided drafting (CAD) computer software.

4. All as-built survey data shall be in accordance with Section 13-03-006-0001.

E. Certification. All as-built plans shall contain a statement by a licensed professional engineer who is currently registered in the State of Arizona certifying the drawings to be as-built. All plans must also contain the seal and signature of said registered professional.

Refer to Section 13-03-006-0002 for the requirements of a registered land surveyor. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-002-0009 Final Plan Submittal

Upon approval of the construction plans, but prior to the issuance of a permit for construction, one (1) complete set of plan originals (which shall be a four (4) mil reverse double matte mylar of legible quality) and one (1) additional cover sheet shall be submitted to the City for signatures. One (1) signed cover sheet will be returned to the consultant for their records. The City will retain the complete original set as the official plans for the project. The consultant will then provide the City with blueline plan sets for issuance of construction permits. In addition, unless specifically exempted by the City Engineer, the consultant shall provide to the City the approved plans digitally, as required by the City’s "Digital Data Submission Standards" (when developed and adopted). (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Sections:

13-06-003-0001 Plan and Support Information Required
13-06-003-0002 Plan Presentation

SECTION 13-06-003-0001 Plan and Support Information Required

A. Approval of these plans by the City is for a one (1) year period, subsequent to the date of approval. If construction work is not started within the one (1) year period, or has been discontinued for any reason for longer than one year, the plans shall be resubmitted for review and re-approval.

B. Grading plans shall meet all requirements of Appendix J of the currently adopted International Building Codes and the City of Flagstaff Stormwater Management Design Manual. Supporting soils analysis and hydrologic studies may be required. Any excavation or fill exceeding fifty (50) cubic yards will require a grading plan and grading permit. When a soils report is required, it shall be referenced on the grading plans by firm, project number, and date.

C. To ensure coordination between grading and landscaping plans, the following note shall appear on all grading plans:

By signing these plans, the designer of the landscaping plans confirms that these grading plans have been reviewed, is aware of the scope of the project, and has identified and addressed any potential conflicts between the grading and landscaping plans.

_____________________________ ______________
Landscape Designer Date
D. To ensure coordination between grading and landscaping plans, the following note shall appear on all landscaping plans:

By signing these plans, the designer of the grading plans confirms that these landscaping plans have been reviewed, is aware of the scope of the project, and has identified and addressed any potential conflicts between the grading and landscaping plans.

_____________________________ ______________
Engineer/Designer Date

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-003-0002 Plan Presentation

One (1) mylar (four (4) mil. double matte) of the approved grading and drainage plan(s) shall be submitted as public record prior to issuance of the grading permit.

At a minimum, the grading plan shall be prepared in accordance with the City of Flagstaff Stormwater Design Manual and the latest edition of the International Building Code. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-06-004
Drainage Plans

Sections:

13-06-004-0001  Drainage Plans

SECTION 13-06-004-0001  Drainage Plans

Public improvement drainage plans shall be in accordance with the requirements set forth in the City of Flagstaff Stormwater Management Design Manual and Section 13-06-002-0007. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-06-005  
Water and Sewer Plans

Sections:

13-06-005-0001  ADEQ Approval
13-06-005-0002  Plan Presentation
13-06-005-0003  Existing Utilities
13-06-005-0004  Sewer Plans
13-06-005-0005  Water Plans

SECTION 13-06-005-0001  ADEQ Approval

All water and sewer plans must have received ADEQ approval prior to City approval. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-005-0002  Plan Presentation

A. A benchmark in accordance with Section 13-03-003-0003 shall be referenced on each plan sheet.

B. Utility main lines and service lines must be located and dimensioned with respect to property lines, easement lines, right-of-way lines and other established points. Stationing must be clear and correlated to profiles and established points of survey. Sufficient elevation information must be shown to allow visualization in three (3) dimensions of utilities, streets, and lots. Typical trench details shall be shown on the plans.

C. The cover sheet or second sheet with a master utility plan at no smaller than one (1) inch equals one hundred (100) feet (1:1,000) shall be in the final construction plans, showing the limits of each plan sheet, street outlines and locations of all valves, fire hydrants, blow-offs, and manholes. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-005-0003  Existing Utilities

All known existing utilities or other pertinent structures are to be shown on the plans. Where crossings of underground utilities occur, vertical separations need to be shown. If any utility company imposes special conditions or precautions concerning their utility, notation of those instructions shall be included on the plans. Accurate elevation and alignment of all utilities shall be shown on the plans. Potholing shall be utilized in determining utility elevations and alignment if necessary. It is the responsibility of the engineer to
locate and determine utility locations. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-005-0004 Sewer Plans

Sewer plans are to meet criteria of Arizona Department of Environmental Quality (ADEQ) Engineering Bulletin No. 11. Plans and profiles shall be provided which adequately show all manhole stationing, sewer sizes, manhole invert and rim elevations, and length of reach and grades of lines. Stations and dimensions of sewer services are to be shown to each lot. A plan layout of water lines is to be shown on the sewer plan with horizontal distances to water lines shown. Water line crossings shall be shown in the sewer profile. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-005-0005 Water Plans

A. Water plans may be presented with sewer plans.

B. Plans are to show water pipe class and types of materials, sizes, pressure zones, fittings, valves and fire hydrants, and any other special information required for clarity. Elevations or profiles of water lines extending into older unimproved streets may be required if depth of water lines is critical to future or planned development. Water line profiles shall be included wherever water line depth is different than the typical standard depth and wherever necessary to clarify clearances to existing or proposed facilities. Water lines larger than twelve (12) inches shall be profiled in any case. A plan layout of sewer lines is to be shown on the water plans, with horizontal distances to sewer line shown. A detail showing locations of water meters within rights-of-way or public utility easements is to be included. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-06-006  
Street Plans  

Sections:  
13-06-006-0001  Layout  
13-06-006-0002  Plan Presentation  

SECTION 13-06-006-0001  Layout  
Street plans are to conform to the layout of the approved site plan, preliminary plat, a previously recorded plat or to recorded right-of-way documents and easements, and the street design criteria in this document. (Ord. 2017-22, Rep&ReEn, 07/05/2017)  

SECTION 13-06-006-0002  Plan Presentation  
Plans, profiles, and typical cross-sections are required, which contain the following minimum information:  
A.  Plans.  
   1.  Street names.  
   2.  Lateral dimensions of streets and rights-of-way, including all pertinent survey data and curb return data.  
   3.  Location of existing and proposed utilities and existing streets to be joined.  
   4.  Drainage structures, including cross gutters, culverts, catch basins, or similar items. Distinguish between existing drainage structures and those proposed. Show a positive outlet for all drainage and any effects on the downstream property.  
   5.  Curb, gutter, sidewalks, and asphalt structures.  
   6.  Benchmarks in accordance with Section 13-03-003-0003.  
   7.  New traffic control devices, all existing traffic control devices within the area of the project, and changes in traffic control devices in the vicinity of the project, which are required as a result of the project.  
   8.  Existing and new streetlights conforming to the approval site plan or preliminary plat.
9. The top and toe of slope for both cuts and fills.

10. All curve data shown on the plans shall show a delta, radius, length of arc, and tangent.

11. Survey monument installation shall be in accordance with Section 13-03-002-0007.

12. Additional information needed to clarify plans or deal with specific conditions.

13. All plans shall meet requirements of Division 13-06-003 if separate grading plans are not included.

14. Blue Stake sticker on all sheets.

15. Resource protection areas.


17. Erosion protection measures for roadway slopes (cut and fill).

18. All areas disturbed by grading shall be seeded in accordance with Chapter 13-17.

B. Profiles.

1. Benchmarks in accordance with Section 13-03-003-0003 shall be shown.

2. Existing and Finished Grade Profiles. Triple profiles of centerline and both sides of top of curb or edge of pavement if no curb is proposed are required. The presentation must clearly show and distinguish existing profiles and other profile information.

3. Finished elevations, including PVC, PI, and PVT of vertical curves, intersection points, and all other points needed for good vertical control of construction.

4. Slopes and vertical curve lengths.

5. Curb return profiles at intersections.

6. Drainage structures and utilities crossed.

7. Extension of profile a minimum of two hundred (200) feet past the end of the improvement project or as required by
the City Engineer to ensure that design is compatible with future extension.

8. Consistent stationing throughout the plans.

9. Additional information needed to clarify profiles or deal with special conditions, e.g., profile of drainage channels, stationing and elevations at beginning and end of all curb returns, grade breaks, and beginning and end of construction.

C. Cross-Sections.

1. Typical Cross-Sections. A typical cross-section is needed for each condition encountered and should be clearly identified as to where it is applicable.

2. Materials and thickness, including select material, aggregate base, prime coat, asphaltic concrete, chip seal coat, curb and gutter, and sidewalk, with notation of the engineering firm preparing the soils report and that report number. The specification and type of material shall be stated. Under-drains may be required if deemed necessary.

3. Horizontal dimensions to all key points.

4. Cross slopes (maximum and minimum if cross slope varies).

5. Parkway Conditions. Maximum and minimum slopes are to be shown for cuts, fills, and side hill conditions. Any side ditches or other special conditions are to be shown.

6. Shall show right-of-way widths, relation to centerline, and shall identify by name, the street to which it is applicable.

7. Identify limits of applicability by station if necessary.

8. Shall show typical location of traffic signals, signs, street lights, fire hydrants, and other pertinent manmade features.

9. When an existing road is being widened, sufficient information shall be provided to demonstrate that the new improvements will match the existing road while meeting City standards of cross-slope and longitudinal slope. Minimum information shall include elevations of the existing road at centerline and edge of pavement at twenty-five (25) foot intervals. This information shall be shown in plan view and on cross-sections together with the proposed improvements.
In certain instances, this may require moving portions of an existing road to meet these objectives. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-06-007
General Notes

Sections:

13-06-007-0001 General Notes
13-06-007-0002 Water and Sewer Notes (Water and Sewer Plans)
13-06-007-0003 Paving Notes (Paving Plans)
13-06-007-0004 Landscaping Notes

SECTION 13-06-007-0001 General Notes

A. The following notes are to appear on applicable plans:

1. Approval of these plans by the City Engineer is for a one (1) year period, subsequent to the date of approval. If construction work is not started within the one (1) year period, or has been discontinued for any reason for longer than one (1) year, the plans shall be resubmitted for review and re-approval.

2. Plan review by the City does not extend to material quantities shown on the plans.

3. A public works permit, issued by the City, is required for all work in City rights-of-way or easements and for construction of any improvements intended to become public property.

4. The City shall be notified twenty-four (24) hours prior to beginning different phases of construction so that City Inspectors may be scheduled.

5. All materials and workmanship shall comply with Title 13, Engineering Design Standards and Specifications for New Infrastructure, current "MAG Uniform Standard Specifications and Details for Public Works Construction," the City of Flagstaff Stormwater Design Manual, and with generally accepted engineering design and construction practice. All work and materials, which do not conform to the standards and specifications, are subject to removal and replacement at the contractor’s expense. The contractor is responsible for reviewing Chapter 13-21, which makes minor modifications to certain MAG Specifications and details.

6. Any work performed without the knowledge and approval of the City Engineer or his authorized representative is subject to removal and replacement at the contractor’s expense.
7. The City Engineer or his authorized representative may suspend the work by written notice when, in his judgment, progress is unsatisfactory, work being done is unauthorized or defective, weather conditions are unsuitable, or there is danger to the public health or safety.

8. The City Engineer may order any or all materials used in the work to be tested according to the American Association of State Highway and Transportation Officials (AASHTO) and the American Society for Testing and Materials (ASTM) Standards. The Contractor shall, at his expense, supply all samples required for testing.

9. Access that meets Section 13-13-004-0001, Fire Access, shall be in place and approved before and at all times during on-site combustible construction and/or prior to issuance of building permits in new subdivisions. Fire Department and Engineering Section approval is required for obstruction of access or water system shutdown.

10. The contractor shall be responsible for maintenance of the streets and of partially completed portions of the work until final acceptance of the work. The contractor shall submit to the City Engineer for approval a construction schedule for any streets required to be closed or partially closed for the construction activity. The contractor shall reopen the streets no later than the opening date shown on the construction schedule or upon order of the City Engineer. The regulation and control of construction traffic shall be as directed by the City Engineer or his authorized representative.

11. Approval of a portion of the work in progress does not guarantee its final acceptance. Testing and evaluation may continue until written final acceptance of a complete workable unit. Any defects which appear in the work within one (1) year from the date of acceptance and which are due to improper workmanship or inferior materials supplied shall be corrected by or at the expense of the owner/developer or the contractor.

12. Acceptance of completed public improvements will not be given until defective or unauthorized work is removed, and final clean-up is complete.

13. Location of underground utilities before work is begun is to be accomplished in accordance with A.R.S. Section 40-360.22.
14. If work is done on private property in relation to a project constructed under these standards, the contractor will provide the City with written authorization from the property owner to do so.

15. The establishment and use of temporary construction yards shall conform to the current City zoning code standards for temporary uses.

16. All excavated material shall be disposed of in accordance with applicable City codes and regulations. The contractor shall obtain all required City approvals and permits as deemed necessary by the City to dispose of excavated material.

17. All construction staking shall be the responsibility of the contractor/developer and performed under the direct supervision of a registered land surveyor or civil engineer.

18. All traffic sign sheeting shall be Type VIII as designed by ASTM D4956-07e1 Standard Specifications for Retroreflective Sheeting for Traffic Control, unless specified otherwise on the construction plans.

19. When the construction plans specify graffiti control on bridges or other structures, the contractor shall seal the structure first using Monochem Aquaseal ME 12 and then apply Monochem Permasheild, Sacrificial Graffiti Control System (or approved equal).

20. All areas disturbed during construction shall be stabilized and reseeded in accordance with Chapter 13-17. In the event that the construction activity disturbs more than one (1) acre, a stormwater pollution prevention plan (SWPPP) shall be prepared in order to obtain a construction general permit from ADEQ. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-007-0002 Water and Sewer Notes (Water and Sewer Plans)

All design, construction, testing and inspection shall conform to the ADEQ requirements: water distribution in accordance with Bulletins 10 and 8, and sewer collection in accordance with AAC Title 18. In the event the ADEQ requirements conflict with these standards, the more restrictive shall apply.

A. Rough grading shall be completed within one-tenth (1/10) of a foot of plan grade and approved by the City Engineer’s authorized representatives prior to installation of underground utilities.
B. No trench shall be filled with bedding material or backfill until the excavation and pipe laying, respectively, have been approved by the City Engineer’s authorized representative.

C. A water pressure test is required of all water lines and a hydrostatic or air test is required of all sewer lines and manholes. Tests are to be conducted after backfilling is complete and compacted on all public and/or private underground utilities.

D. Water and sewer service lines are to be marked as shown on the standard service details.

E. Water line disinfection is to be accomplished as outlined in Arizona Department of Environmental Quality (ADEQ) "Bulletin No. 8."

F. Water pipe classification shall be Class 305 for A.W.W.A. C-900 PVC and Class 350 for ductile iron unless otherwise approved by the City Engineer. C-900 shall conform to cast-iron-equivalent outside diameter and have elastomeric gaskets and couplings. All ductile iron pipe shall be polyethylene encased in accordance with MAG Specifications.

G. All materials that come into contact with drinking water shall conform to NSF Standard 61 including, but not limited to, gaskets, lubricants, pipe fittings, and valves (NSF-pw seal) (R18-4-119B).

H. All public sanitary sewer lines and private sewer service lines within a public utility easement or right-of-way will be inspected prior to acceptance by the City.

I. Water and sewer mains shall be separated in order to protect public water systems from possible contamination. All distances are measured perpendicularly from the outside of the sewer main to the outside of the water main. Separation requirements are as follows:

   1. A water main shall not be placed:

      a. Within six (6) feet, horizontal distance, and less than two (2) feet, vertical distance, above the top of a sewer main unless extra protection is provided. Extra protection shall consist of constructing the sewer main with mechanical joint ductile iron pipe or with slip-joint ductile iron pipe if joint restraint is provided. Alternate extra protection shall consist of encasing both the water and sewer mains in at least six (6) inches of concrete for at least ten (10) feet beyond the area covered by this subsection.
b. Within two (2) feet horizontally and two (2) feet below the sewer main. When a water main is placed below a sewer main, extra protection is always required regardless of the vertical separation.

2. No water pipe shall pass through or come into contact with any part of a sewer manhole. The minimum horizontal separation between water mains and manholes shall be six (6) feet, measured from the center of the manhole.

3. The minimum separation between force mains or pressure sewers and water mains shall be two (2) feet vertically and six (6) feet horizontally under all conditions. Where a sewer force main crosses above or less than six (6) feet below a water line, the sewer mains shall be encased in at least six (6) inches of concrete or constructed using mechanical joint ductile iron pipe for ten (10) feet on either side of the water main.

4. Even when extra protection is utilized, the minimum clearance between water and sewer shall be one (1) foot.

5. The separation requirements do not apply to building, plumbing, or individual house service connections.

J. When hydrostatic testing is performed, sewer lines shall be tested for infiltration/exfiltration in accordance with ADEQ Engineering Bulletin No. 11. Manholes shall be tested by filling the manhole with water. The applicant shall ensure that the drop in water level does not exceed one-thousandth (0.001) of the total manhole volume in one (1) hour.

When air testing is performed, sewer lines shall be tested in accordance with ASTM F1417-92. Manholes shall be tested in accordance with ASTM C1244.

K. Sewer pipe shall be SDR 35, ASTM D3034 for PVC pipe, or Class 150 DIP lined with Protecto 401 ceramic epoxy or HDPE ASTM F894. All ductile iron pipelines shall be polyethylene encased in accordance with MAG Specifications. Special design considerations may require a higher class rating of DIP.

L. No water settling of trench fill material is allowed.

M. All water and sewer design and construction shall conform to the current Arizona Department of Environmental Quality (ADEQ) requirements. When ADEQ requirements are in conflict with these standards, the more restrictive shall apply.
N. Tracer wires and tapes shall be installed prior to testing the water or sewer main as required by Section 13-09-001-0002. (Strip wire two (2) inches at termination of the service.)

O. Water valves shall be adjusted in accordance with City of Flagstaff Engineering Detail No. 9-03-060 and manholes shall be adjusted in accordance with City of Flagstaff Engineering Detail No. 9-03-062.

P. One hundred percent (100%) of the sewer line shall be tested for uniform slope by remote camera and tested for short-term deflection.

1. When a sewer service is required to be abandoned, it shall be abandoned at the property line and capped using the appropriate materials (PVC, clay, or concrete).

2. When an existing water service is required to be abandoned, it shall be abandoned at the main. The saddle and corp. stop shall be removed and the main clamped with an approved full circle repair clamp.

Q. The location of water services shall be identified by branding a "W" on the top or face of curb.

R. Sewer service locations shall be identified by branding an "S" on the top or face of the curb. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-007-0003 Paving Notes (Paving Plans)

A. Exact point of matching termination and overlay, if necessary, shall be determined in the field by the City Engineer or his authorized representative. When a longitudinal joint associated with a trench path, pavement matchup or other occurs on a street that includes a bike lane, the joint shall be located outside the bike lane.

B. No job will be considered complete until:

1. All curbs, pavements, sidewalks, catch basins, storm drains, and manholes have been cleaned of all dirt and debris;

2. Survey monuments are installed and stamped; and

3. All frames, covers, and valve boxes are adjusted to grade.

C. No paving construction shall be started until all utility lines are completed and approved under proposed paved areas.

(Revised 10/17)
D. Base course will not be placed until subgrade has been approved by the City Engineer or his authorized representative.

E. The location of all water valves, fire hydrants, and manholes must at all times during construction be referenced and made accessible to the City.

F. Utility facilities in conflict with this work will be relocated by the permittee or the utility owner. This activity shall be coordinated with the owner of the utility to prevent any unnecessary interruption of service to existing customers.

G. Existing street name signs, traffic signs and devices associated with the project shall be maintained during construction and relocated by the contractor as shown on the approved plans.

H. Any changes or additions to pavement markings caused by pavement overlay, chip seal, or installation of underground facilities shall be shown on the approved plans.

I. On projects where the contractor causes excessive damage to an existing paved street or there are multiple street cuts (maximum of four (4) in five hundred (500) feet) an asphalt overlay shall be required.

J. A prime coat is not required unless so specified in the soils and pavement report and/or shown on the plans.

K. All curb and gutter, sidewalk, driveways, and sidewalk ramps shall be constructed on a minimum three (3) inches of aggregate base course (ABC). The ABC shall be constructed in accordance with MAG Section 310, and shall be compacted to ninety-five percent (95%) relative density. All precast structures such as manhole bases, catch basins, and box culverts shall be constructed on a minimum of three (3) inches of ABC.

L. Permanent Pavement Markings.

1. Longitudinal pavement markings shall be installed in accordance with Section 13-16-006-0001.

2. Transverse pavement markings such as stop bars, crosswalks, arrows, and legends shall be installed in accordance with Section 13-16-006-0002.

M. Temporary Pavement Markings.

1. Temporary pavement markings, when approved, shall be installed in accordance with Sections 13-16-006-0001 and 13-16-006-0002.
NOTES:

1. The use of temporary markings is strongly discouraged and may only be used with prior approval.

   When it is used, the contractor must be available to restripe as needed until the permanent markings can be installed.

2. When it is impracticable for the contractor to provide permanent markings, the City Public Works Department may install the markings on behalf of the contract provided the fee for the work is agreed upon and paid for in advance.

N. The maximum thickness of a single lift of pavement shall be four (4) inches. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-007-0004 Landscaping Notes

Adjacent site improvements, pavement construction, irrigation installation and finish grading shall be completed prior to planting work. Do not plant when conditions are not suitable for digging, mixing, raking and/or grading. Planting needs to occur during the months that irrigation systems are in operation. Therefore, planting may occur between April 1st and September 30th.

A. Tree and Shrub Installation.

1. Soil excavated from the planting pit shall be typically considered acceptable as backfill material for planting.

2. All containers shall be removed prior to plant installation in a manner that does not disturb the potted soil or root ball.

3. Set the root ball on six (6) inches of firm planting soil, plumb and in the center of the pit with the root ball crown slightly above the same elevation as adjacent finished landscape grades. Remove any wire, twine, burlap, or other material from the upper one-third (1/3) of the root ball of balled and burlapped stock. Wire baskets and synthetic burlap shall be completely removed after the root ball has been placed in its final location.

4. Once plant is set, place backfill material around base and sides of root ball and work each layer to settle backfill and eliminate voids. When backfilling is two-thirds (2/3) complete, water thoroughly. Place the remainder of the
backfill and repeat watering until no more is absorbed. Place the final layer of backfill and water.

5. All deciduous trees shall be wrapped from the ground line up to and including the first primary crotch formed by the first major branch. Wrapping shall be done after the plant has been installed.

6. Two (2) to three (3) inches of specified mulch shall be placed in the area disturbed by excavation of the planting well.

B. Ground Cover Installation.

1. Prior to planting activities, completely remove existing weeds, including roots. Immediately prior to installation, cultivate ground cover areas to a depth of six (6) inches and grade smoothly and uniformly. Plant ground cover so the root crown is at or slightly above the bed’s finish grade. After planting of ground cover and prior to mulching, spread pre-emergent weed control over planting bed soil surface in accordance with manufacturer’s written directions. Install the specified mulch to a depth of two (2) inches over the entire ground cover bed.

C. Landscape Completion.

1. Prune dead or damaged branches, making all cuts at branch collar. Maintain the natural habit, shape and specified size. Remove all tags, labels, and other material. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Construction traffic control plans shall be in conformance with the requirements of the Federal Highway Administration’s Manual of Uniform Traffic Control Devices (MUTCD). All traffic control plans shall be approved by the City’s Traffic Engineering Manager prior to issuance of any permits associated with the plans. When a project involves construction that requires a substantial traffic control plan, the plan shall be submitted together with the construction plans to allow for the necessary review time. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-008-0002 Plan Presentation

A. Construction traffic control plans are required for controlling public and construction traffic through work areas and zones as well as for other permitted activities within the public rights-of-way and easements. Traffic control plans may reference particular typical drawings contained in Part VI of the MUTCD for work of a minor nature. Traffic control plans shall be prepared by persons knowledgeable with the fundamental principles of temporary traffic control and the work activities to be performed.

B. The traffic control plan shall include, but is not limited to, the following:

1. Scaled drawings conforming to City Standard Specification No. 6-05-010 of the construction zone, detours, construction stages, and affected surrounding areas. The scale of the drawings shall be one (1) inch equals twenty (20) feet (1:200), for construction zones under three hundred (300) feet in length and one (1) inch equals forty (40) feet (1:500) or one (1) inch equals fifty (50) feet (1:500) for construction zones greater than three hundred (300) feet in length.

2. Project name and address.

3. City permit number.
4. Plan preparation date.

5. Time of day (if applicable) that construction traffic control is to be in place.

6. Traffic control responsibility (name, address, telephone number and contact person for barricade company).

7. A listing of all traffic control devices specified for installation.

8. The size of the work area (all dimensions).

9. The location of the work area in relation to the cross streets, alleys, or other major reference points (show all distances and dimensions).

10. How existing pedestrian and bicycle facilities will be temporarily or permanently rerouted through or around the construction zone.

11. Relocation of transit stops and the continuation of pedestrian access to them.

12. Impacts on access to existing parking facilities including, but not limited to, garages, carports, and surface lots.

13. Provisions for special human resource requirements, such as flaggers (equipment, clothing, and flagging methods are required to conform to the MUTCD in every instance).

14. Telephone numbers of persons to be contacted in an emergency and for maintenance of traffic control devices.

15. A construction schedule, as well as a schedule of the times of day when work is permitted or when certain lanes are to remain open. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-06-008-0003 Traffic Control Device Maintenance Requirements

A. The permittee shall make daily inspections of all permitted traffic control devices. The following elements are the minimum number of items that shall be inspected on a daily basis:

1. Conformance to design.

2. Condition of devices.


B. In order to improve public comprehension, compliance, and safety, City off-site inspectors may approve minor changes to the approved traffic control plan, based on observed field conditions. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Sections:

13-06-009-0001 Construction Plans

SECTION 13-06-009-0001 Construction Plans

A. For utilities located outside standard locations (such as common trenches with City utilities and public utility easements as shown on the approved plans), all franchise utilities, including power, gas, telephone, and cable, shall submit, or cause to be submitted, concept construction plans depicting the utility location(s), with the first submittal of all public improvement plans.

B. Regarding the City of Flagstaff approval, consideration shall include but not be limited to maintenance concerns, resource and slope protection, street buffer-yards, floodplain concerns, impact to public facilities, utility location, and clear view zones. The City of Flagstaff may require utility relocation as the result of these considerations. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13-07
GRADING

Divisions:
13-07-001 Grading
13-07-002 Soils Analysis
Division 13-07-001
Grading

Sections:

13-07-001-0001    Design Criteria

SECTION 13-07-001-0001    Design Criteria

A.    All design and construction for public and private grading shall be in accordance with these standards and:

2. The currently adopted International Building Codes.
4. The engineered soils report (if applicable). (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Sections:

13-07-002-0001 Soils Analysis

SECTION 13-07-002-0001 Soils Analysis

A soils analysis by a registered professional engineer licensed in Arizona specializing in geotechnical engineering may be required to substantiate the design of the grading plan. Any exceptions to standards involving soils (steeper side slope, for example) must be justified by such a soils report. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13-08
STORMWATER MANAGEMENT

Divisions:

13-08-001 Stormwater Management
Division 13-08-001
Stormwater Management

Sections:

13-08-001-0001 Stormwater Management

SECTION 13-08-001-0001 Stormwater Management

The design and construction of all public and private stormwater management facilities shall be in accordance with these regulations and with the City of Flagstaff Stormwater Management Design Manual and these standards. In the event of a conflict, the more stringent regulation shall apply. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13-09
WATER, SEWER, AND OTHER UNDERGROUND UTILITIES

Divisions:

13-09-001 Underground Utilities
13-09-002 Sewer System Design
13-09-003 Water System Design
13-09-004 City Participation In Utility Extensions
13-09-005 Recapture Agreement
13-09-006 Sewer and Water Line Materials
13-09-007 Reclaimed Wastewater System Design
Division 13-09-001
Underground Utilities

Sections:

13-09-001 Underground Utilities
13-09-001-0001 Underground Utilities
13-09-001-0002 Tracer Wires and Warning Tapes for Water, Reclaimed Wastewater and Sewer
13-09-001-0003 Water Main Depths and Separation
13-09-001-0004 Sewer Main Depths and Separation
13-09-001-0005 Separation from Storm Drains and Culverts
13-09-001-0006 Separation from Other Utilities
13-09-001-0007 Pipe Crossing of Existing Pavement
13-09-001-0008 Utility Alignment and Easement Requirements

SECTION 13-09-001 Underground Utilities

Typical locations of utilities in streets are shown in Engineering Detail 9-01-010. Water, reclaimed wastewater, storm drain and sewer mains should be located in the paved roadway section (minimum four (4) feet from outside of pipe to lip of curb) far enough from the curb and gutter to allow backhoe access for maintenance without disturbing existing curb and gutter. Where possible, water shall be ten (10) feet north or east of centerline and sewer on the centerline. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-001-0001 Underground Utilities

A. Utilities within easements must be located to minimize interference with one another, to provide required horizontal and vertical separations, and, to provide maintenance access without violating easement boundaries.

B. For utilities located outside standard locations (such as common trenches with City utilities and public utility easements as shown on the approved plans), all franchise utilities, including power, gas, telephone, and cable, shall submit, or cause to be submitted, concept construction plans depicting the utility location(s), for review and approval prior to start of construction by the public improvement contractor.

C. Regarding the City of Flagstaff approval, consideration shall include, but not be limited to, maintenance concerns, resource and slope protection, floodplain concerns, impact to public facilities, intersection sight triangles (clear view zones) and utility location. The City of Flagstaff may require utility
relocation as the result of these considerations. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-001-0002 Tracer Wires and Warning Tapes for Water, Reclaimed Wastewater and Sewer

A. A tracer wire shall be installed on all water, sewer, and reclaimed wastewater mains. Additionally, tracer wire shall be installed on all sewer services, fire lines and water services (strip wire two (2) inches at termination).

B. The tracer wire shall be taped to the top of water, sewer, and reclaimed wastewater mains with ten (10) mil tape and shall be plastic covered No. 12 AWG type UF 600V. Plastic cover for tracer wires shall be blue for water lines, green for sewer lines, and purple for reclaimed wastewater lines.

C. An approved type, five (5) pound magnesium anode shall be installed for each one thousand (1,000) linear feet of tracer wire or at least one (1) anode at each end of the project.

   1. The anodes for water line tracer wires shall be installed near the curb and next to a water service, (but at a minimum of one (1) foot apart) and in a separate cast iron valve box.

   2. The anode shall be placed at a tracer wire connection station under the valve box.

   3. The anodes for reclaimed wastewater tracer wires shall be installed inside the curb and on the south or west side of the pipeline.

D. A tracer wire connection station shall be installed at each fire hydrant, street intersection, and one (1) station for each five hundred (500) linear feet of water, sewer, and reclaimed wastewater main, and at each end of the project (located on the same side of the street).

   1. For water lines at an intersection, the tracer wire shall be installed with a water service or fire hydrant run and set in a cast iron valve box next to the fire hydrant.

   2. No tracer wires shall be wrapped around a fire hydrant barrel.

   3. Tracer wire stations for sewers shall be located in conjunction with sewer services.
4. For reclaimed wastewater lines at an intersection, the tracer wire shall be spliced into the main tracer wire and run to a cast iron valve box or located on the southwest corner of the intersection.

5. For long lengths of water main without intersections the connection station shall be installed with a water service every five hundred (500) feet to the north or east side of the water line.

6. For long lengths of reclaimed wastewater main without intersections, the connection station shall be installed to a valve box every five hundred (500) feet on the south or west side of the reclaimed wastewater line.

7. Eight (8) feet of tracer wire shall be loosely coiled inside a separate cast iron valve box top section without a valve.

E. The City Inspector shall observe the tests of all tracer wire performed by the installer or their agent prior to paving and acceptance by the City to show that all water/sewer/reclaimed wastewater mains and services can be located by this means. These tests shall be witnessed by the City Inspector.

F. The City Inspector shall be provided all information necessary to "as-built" the location of all tracer wire, anodes, and connection stations.

G. All tracer wire splices shall be carefully soldered and wrapped. Wires are to be wrapped with Scotch 3M electrical tape and inserted into a direct burial splice, use Scotch 3M DBR-6 or equivalent.

H. The tracer wire, anodes, and connection stations shall be detailed on the water main, sewer main, and reclaimed wastewater main construction plans.

I. A six (6) inch wide plastic warning tape, twelve (12) inches to twenty-four (24) inches below finished grade, shall be installed above all water, reclaimed wastewater and sewer mains.

1. The plastic warning tape for water mains shall be blue, green for sewer lines, and purple for reclaimed wastewater lines.

2. The tape shall be permanently printed at least every thirty-six (36) inches with "BURIED WATER LINE BELOW" for water mains, "BURIED RECLAIMED WASTEWATER LINE BELOW" for reclaimed wastewater mains, or "BURIED SEWER LINE BELOW" for sewer mains. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
A. Minimum cover is to be measured to subgrade unless there is no
pavement; then it is measured to finished grade.

1. Water lines shall have a minimum cover to subgrade of three
(3) feet over the top of the pipe as shown in Engineering
Detail 9-01-010.

2. Water lines shall have a maximum depth of six (6) feet,
measured to top of pipe, unless approved by the City
Engineer. Exceptions to this include vertical realignments
to avoid other utilities.

3. To minimize the potential for cross contamination, water and
sewer mains shall not be located closer than six (6) feet
horizontally and two (2) feet vertically as described in AAC
R18-4-502 and illustrated in MAG Standard Detail No. 404-1
with the following supplemental requirements:

   a. When a water main is below a sewer main, the minimum
      separation is two (2) feet and extra protection is
      always required in accordance with MAG Specifications.

   b. When a water main is above a sewer main, extra
      protection is required when the water main is closer
      than two (2) feet to the sewer main.

4. A one (1) foot minimum vertical separation shall be provided
between a storm drain crossing a water main. The minimum
vertical separation is measured from outside of water main
to outside of storm drain. Extra protection is required in
accordance with MAG Specifications when these requirements
are not met.

5. A six (6) foot minimum horizontal separation shall be
provided between a sewer main or storm drain and a water
main. The minimum horizontal separation is measured from
outside of pipe to outside of pipe.

6. Whenever two (2) parallel water mains are required, there
shall be a six (6) foot minimum horizontal separation
between the two (2) mains to allow for tapping, tie-over,
and maintenance.

7. A three (3) foot minimum horizontal separation shall be
provided between a fire hydrant and any water service line.
B. Reclaimed wastewater mains shall be considered the same as water mains for the purpose of minimum cover and separation. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-001-0004 Sewer Main Depths and Separation

A. Minimum cover is to be measured to subgrade unless there is no pavement; then it is measured to finished grade. In all cases, sewer lines are to be at a depth sufficient to provide gravity service to all adjacent building pads. Service lines are to be laid at grades and depths prescribed in the International Plumbing Code, which has been adopted by the City. Vertical and horizontal separations of water and sewer shall conform to A.R.S. requirements and in accordance with ADEQ requirements.

1. Sewer line shall have a minimum cover of four (4) feet over the top of the pipe as shown in Engineering Detail 9-01-010.

2. Sewer lines shall have a maximum depth of twenty-five (25) feet, measured to bottom of pipe invert.

3. Vertical clearance between water mains and sewer service connections: the water main shall not be less than six (6) inches above the sewer service even if the sewer service connection is constructed with ductile iron pipe in accordance with MAG Standard Detail 404-1. When the sewer service is above the water main, minimum clearance shall be one (1) foot. The sewer service connection must be constructed with PVC SDR 35 or ductile iron Class 350 SVC pipe with minimum one (1) foot of separation with no pipe joints within six (6) feet of pipe. Alternate is to install in accordance with MAG Standard Detail 404-1. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-001-0005 Separation from Storm Drains and Culverts

Water and sewer mains shall maintain six (6) feet horizontal and one (1) foot vertical separation from storm drains and culverts. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-001-0006 Separation from Other Utilities

Water and sewer mains shall be separated from other utilities in accordance with Engineering Detail 9-01-010 for joint trench utilities. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-09-001-0007  Pipe Crossing of Existing Pavement

Pavement replacement for crossings on existing paved streets shall be as described in the typical trench details. Crossing of Federal, State, or County highways will be in accordance with specific requirements of the controlling agency. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-001-0008  Utility Alignment and Easement Requirements

A. The City of Flagstaff Utilities Division requires safe and quick access to all City water and sewer mains at all times in order to repair main breaks, install taps, and perform preventive maintenance. For this reason, City of Flagstaff water and sewer mains shall be constructed in streets within the public right-of-way. Where possible, water shall be ten (10) feet north or east of centerline and sewer on the centerline. Water mains in easements create access problems and will not be permitted except under the following special circumstances.

B. Easements will only be considered in the following cases:

1. For a short segment of main where it is not technically feasible to design the utility mains in the right-of-way without violating City codes or ordinances and that, in the opinion of the Utilities Division, the proposed alignment of the water or sewer main in an easement results in more efficient operation of the utility system.

2. The project route is in conflict with other utilities, a wash, or drainage corridor.

C. Minimum easement widths:

1. For one (1) utility main, the minimum easement width shall be twenty (20) feet in width.

2. For two (2) utility mains, the minimum easement width shall be twenty-six (26) feet.

3. When a water service or fire hydrant is located adjacent, but outside of, the right-of-way or public utility easement (PUE), a PUE shall be extended to accommodate the appurtenance. The minimum dimensions of the PUE shall allow for three (3) feet of clearance from all sides of the appurtenance.

D. In addition to the above, all appurtenances (e.g., blow-offs and hydrants) shall be provided with an easement dimensioned to
provide a minimum of three (3) feet of clearance on all sides of the utility.

E. Easement widths may be increased to accommodate the required construction and maintenance activities, particularly where utility lines are deeper or larger than normal. Sewer and water mains shall be centered within the easement and separated by six (6) feet when there are both.

F. When a water or sewer main is located adjacent to a building, the main shall be offset a minimum of ten (10) feet from the building in a minimum twenty (20) foot easement.

G. Public utility easements shall be free of all obstructions and shall at all times be accessible to City service vehicles and equipment. No buildings, sport courts, fences, shade structures, or permanent structures of any kind shall be constructed upon, over, or under a water, sewer, or drainage easement. No landscaping shall be placed within an easement which would render the easement inaccessible by equipment. The City of Flagstaff Utilities Division has the right to cause any obstruction to be removed without notice to the property owner and all related costs shall be the property owner’s responsibility.

H. For sewer or water easements not located within a public street, an all-weather access road is required if manholes, valves, fire hydrants, or other appurtenances requiring City access lie within the easement. The access road shall have a minimum width of ten (10) feet and shall be constructed in accordance with the structural section in Standard Detail No. 14-01-010 (unpaved). The access road shall connect to a public or private road. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-09-002
Sewer System Design

Sections:

13-09-002-0001  Guide for Design
13-09-002-0002  Wastewater Design Flows
13-09-002-0002.1 Peak Flows
13-09-002-0003  Sewer Design Capacities
13-09-002-0004  Minimum Pipe
13-09-002-0005  Velocities of Flow
13-09-002-0006  Alignment
13-09-002-0007  Design and Spacing of Manholes
13-09-002-0008  Design of Deep Sewer Lines
13-09-002-0009  Private Sewer Lines
13-09-002-0010  Sewer Services
13-09-002-0011  Sewer Mains
13-09-002-0012  Private Pressure Sewer Mains and Services
13-09-002-0013  On-Site Disposal Systems

SECTION 13-09-002-0001  Guide for Design

A. Arizona Revised Statutes establishes the control for the design, construction, and operation of sewage systems and waste treatment works to be with the Arizona Department of Environmental Quality (ADEQ). Engineering bulletins produced by ADEQ are to serve as guides for designs of sewage systems. These include, but are not limited to:


B. More restrictive criteria of design stated in these regulations shall take precedence over ADEQ criteria.

C. Proposed public sewer systems must be gravity flow. No public sewer lift stations will be permitted within the City system. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-002-0002  Wastewater Design Flows

A. Design flows utilized in the preparation of engineering design reports, plans and specifications shall conform to the criteria set forth in this section as a minimum.
B. Average daily flow estimates based on land use, shall conform to Table 9-1, Average Daily Flows by Land Use. Where the project land use does not fit within the tabulated categories, an average daily unit flow of one hundred (100) gallons per person per day shall be used.

Table 9-1 Average Daily Flows by Land Use

<table>
<thead>
<tr>
<th>LAND USE</th>
<th>AVERAGE DAILY FLOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Average dry weather flow (ADWF)</td>
</tr>
<tr>
<td>Residential Single-Family, Townhouses</td>
<td>Use 3.5 persons per dwelling unit</td>
</tr>
<tr>
<td></td>
<td>75 gallons per capita per day (gpcd)</td>
</tr>
<tr>
<td>Residential Manufactured Homes, Mobile Homes</td>
<td>Use 3.0 persons per dwelling unit</td>
</tr>
<tr>
<td></td>
<td>75 gallons per capita per day (gpcd)</td>
</tr>
<tr>
<td>Residential Condos, Apartments</td>
<td>Use 2.5 persons per dwelling per unit</td>
</tr>
<tr>
<td></td>
<td>75 gallons per capita per day (gpcd)</td>
</tr>
<tr>
<td>Hotel, Motel Tourist</td>
<td>Use 2.0 persons per hotel/motel room</td>
</tr>
<tr>
<td></td>
<td>75 gallons per capita per day (gpcd)</td>
</tr>
<tr>
<td>Commercial</td>
<td>Use number of acres</td>
</tr>
<tr>
<td></td>
<td>1,000 gallons per acre per day (gad) 3,000 gad PEAK</td>
</tr>
<tr>
<td>Industrial</td>
<td>Domestic flows only</td>
</tr>
<tr>
<td></td>
<td>1,000 gallons per acre per day (gad) 3,000 gad PEAK</td>
</tr>
<tr>
<td>Schools, Colleges</td>
<td>Use enrollment per building</td>
</tr>
<tr>
<td></td>
<td>90 gallons per capita per day (gpcd)</td>
</tr>
</tbody>
</table>

Factors are based on average dry weather flow (ADWF) from City of Flagstaff "Wastewater Management System Facility Plan," prepared by Brown and Caldwell Engineers.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-002-0002.1 Peak Flows

All gravity sewer mains shall be designed for peak flow conditions. Peak flow is calculated as the product of the peaking factor and the average daily flow. The peaking factor should be obtained from Figure 9-1, Ratio of Peak Flow to Dry Weather Flow, based on population.
SECTION 13-09-002-0003  Sewer Design Capacities

Sewer systems, trunk lines, and out-fall lines are to be designed to service the ultimate density of the drainage area. Capacities of lines are to be determined for an entire drainage area, developed or undeveloped, which may be reasonably serviced by the proposed system or by future extensions of the system. Densities will be estimated from the land use plan of the current Regional Land Use and Transportation Plan. Use Table 9-1, to determine number of persons per unit for different dwelling types. All sewer lines must be designed for peak flow in accordance with Table 9-1 and Figure 9-1. The maximum ratio of the depth of flow to the diameter of the pipe, \( d/D \), shall be seventy percent (70%). (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-09-002-0004 Minimum Pipe

Gravity sewer lines shall be sized to accommodate the peak design flow subject to the following limitations:

A. The d/D ratio for gravity sewer pipes shall be no greater than seven-tenths (0.7) at the peak flow condition.

B. Minimum pipe size shall be eight (8) inches in diameter.

C. A maximum of one hundred twenty (120) acres of combined commercial and residential development shall drain into an eight (8) inch diameter line. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-002-0005 Velocities of Flow

A. Velocities in sewer lines shall be determined for design capacities using Mannings formula \( V = \left(\frac{u}{n}\right) (R)^{2/3} (S)^{1/2} \) where \( V \) is the average velocity (fps, m/s), \( u \) is 1.49 for English units and one (1) for Metric units, \( n \) is the Mannings roughness coefficient (as appropriate for the pipe to be used), \( R \) is the hydraulic radius (ft), \( S \) is slope in (ft/ft).

B. Design velocities are to be within the range of two (2) fps to ten (10) fps flowing full.

1. A minimum velocity of two and one-half (2.5) fps is recommended in order to prevent deposition. The following chart is a guideline for the limits of slope for smaller diameters based on velocity and the \( n \) value for the pipe flowing full condition. Capacity must also be considered.

<table>
<thead>
<tr>
<th>Pipe Size (inches)</th>
<th>Min. Slope (%) 2 fps</th>
<th>Max. Slope (%) 10 fps</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n = 0.010 )</td>
<td>( n = 0.013 )</td>
</tr>
<tr>
<td>8</td>
<td>0.20</td>
<td>0.34</td>
</tr>
<tr>
<td>10</td>
<td>0.15</td>
<td>0.26</td>
</tr>
<tr>
<td>12</td>
<td>0.11</td>
<td>0.20</td>
</tr>
<tr>
<td>15</td>
<td>0.085</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Note: PVC \( (n = 0.010) \) DIP \( (n = 0.013) \)

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-09-002-0006  Alignment

Sewers shall be laid with straight alignments between manholes. Curvilinear sewers are not permitted. Straight alignment shall be checked by using a laser beam. Sewers shall be located in street right-of-way (ROW) and shall generally run parallel to property lines or street centerline and located out of the wheel path (preferably in the center of the street). Gravity sewer alignments shall be located as set forth in the latest edition of standard utility locations for the City of Flagstaff Engineering Details. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-002-0007  Design and Spacing of Manholes

A. Manholes are to be installed at the end of each line; at all changes in grade, size, horizontal or vertical alignment, pipe material; at all intersections of mains and service connections greater than six (6) inches in diameter; and at distances not greater than four hundred (400) feet for sewers twelve (12) inches or less, and five hundred (500) feet for sewers greater than twelve (12) inches.

B. Five (5) foot diameter manholes are required wherever the sewer main diameter is twelve (12) inches or greater, whenever there are two (2) or more inlets, whenever the manhole depth is twelve (12) feet or greater or whenever the manhole is designed with a drop sewer connection. Clean-outs are not allowed.

<table>
<thead>
<tr>
<th>PIPE SIZE (INCHES)</th>
<th>MAXIMUM MANHOLE SPACING (FEET)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 12&quot;</td>
<td>400</td>
</tr>
<tr>
<td>Greater than 12&quot;</td>
<td>500</td>
</tr>
</tbody>
</table>

Table 9-02-002
Minimum Manhole Diameter

<table>
<thead>
<tr>
<th>PIPE SIZE (INCHES)</th>
<th>MANHOLE DEPTH (FT)</th>
<th>MANHOLE DIAMETER (INCHES)</th>
<th>FRAME AND COVER DIAMETER (INCHES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 12&quot;</td>
<td>12 and less</td>
<td>48</td>
<td>24</td>
</tr>
<tr>
<td>Greater than 12&quot;</td>
<td>Greater than 12</td>
<td>60</td>
<td>30</td>
</tr>
<tr>
<td>15&quot; and larger</td>
<td>Any</td>
<td>60</td>
<td>30</td>
</tr>
<tr>
<td>Drop Manholes</td>
<td>Any</td>
<td>60</td>
<td>30</td>
</tr>
</tbody>
</table>
C. A drop manhole is to be used when a sewer enters a manhole two and one-half (2.5) feet or more above the manhole invert in accordance with MAG Detail No. 426.

1. If there is less than two and one-half (2.5) feet of fall, redesign of sewer grades is required to result in a maximum of one-half (0.5) foot above the flow line of the outlet.

2. Sewer grades shall be normally designed to provide one-tenth (0.1) foot fall from the flowline inlet to the flowline outlet within the manhole.

3. When a sewer main joins a ten (10) inch or greater main, the top of each pipe shall match at their intersection of the manhole.
   a. The maximum horizontal deflection angle (inlet to outlet) for an eight (8) inch main shall be ninety (90) degrees.
   b. For mains ten (10) inches and larger the maximum deflection angle shall be sixty (60) degrees.
   c. The minimum flow line radius shall be two (2) feet.

D. Concrete caps on manholes located outside roadways or parking lots shall have a continuous No. 3 rebar centered in the cap.

E. One (1) adjustment ring or one (1) row of bricks is required on all manholes. The ring and cover shall not be set directly on the cone.

F. Manhole covers must have a pickhole and watertight manhole covers must have a concealed type pickhole for removal of the cover. Bolts on watertight manhole lids shall be stainless steel.

G. Where corrosive conditions due to septicity or other causes are anticipated, consideration shall be given to providing corrosion protection on the interior of the manholes.

H. Manholes shall be pre-cast concrete or poured-in-place concrete type. Manhole lift holes and grade adjustment rings shall be sealed with non-shrinking mortar.

1. Inlet and outlet pipes shall be joined to the manhole with a gasketed, flexible water-tight connection or any water-tight connection arrangement that allows differential settlement of the pipe and manhole wall to occur.
I. Watertight manhole covers shall be used whenever the manhole is located in a floodplain, wash, or other areas known to be subject to stormwater runoff.

J. Locked manhole covers may be required in isolated easement locations or where vandalism is anticipated. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-002-0008 Design of Deep Sewer Lines

When the depth of a sewer line exceeds fifteen (15) feet, then: services will not be allowed; the pipe must be class 350 ductile iron or designed to withstand the trench and traffic loads; and, an easement wider than twenty (20) feet may be required. Sewer lines deeper than twenty-five (25) feet will not be allowed. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-002-0009 Private Sewer Lines

Private sewer mains shall not be allowed. Existing private sewer mains shall be maintained as required and regulated by the Arizona Department of Environmental Quality. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-002-0010 Sewer Services

A. Sewer services shall be installed perpendicular (not parallel) to the right-of-way or easement, within the right-of-way or easement, and shall not be installed across another’s private property. Sewer services are prohibited on sewer transmission mains that are eighteen (18) inches or larger.

B. Sewer service locations shall be located by branding an "S" on the top or face of the curb.

C. Sewer services shall be located a minimum of five (5) feet from the outside of a manhole wall.

D. An approved backwater valve shall be installed when the finished floor elevation of a building is one (1) foot or less above the nearest upstream manhole or clean-out rim elevation. A self-explanatory tabulated numerical listing of the lots requiring backwater valves shall appear on the plans. The backwater valves shall not be installed within a public right-of-way or easement.

E. If sewer services are installed via saddles, the minimum spacing between services shall be five (5) feet, and there shall be one (1) connection per length of VCP and two (2) per length of PVC main.
F. When a sewer service is required to be abandoned, it shall be abandoned at the property line and capped using the appropriate material (PVC, clay, or concrete). (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-002-0011  Sewer Mains

A. Where reasonable, sewer mains shall be located under a paved surface. Where this is not possible, the engineer should give consideration to access and maintenance issues. The engineer should examine the possibility of redesigning and the project layout, e.g., roads, building envelopes, and drainage patterns, in order to facilitate access and maintenance to all sewer pipes and appurtenances with the appropriate equipment and vehicles for repairs and/or preventive maintenance operations.

B. Dead end easements shall be avoided unless they are for a sewer which has no potential for future extension.

C. Manholes shall be located in the right-of-way or an easement which provides access for emergency response, repairs, and/or preventative maintenance operations.

D. Sewer lines constructed in washes and floodways shall have their crowns at least two (2) feet below the one hundred (100) year storm scour depth and shall be constructed with DIP. The DIP shall extend a minimum of ten (10) feet each side of the one hundred (100) year storm scouring. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-002-0012  Private Pressure Sewer Mains and Services

A. All proposed public sewer systems shall be gravity flow. Public pressure sewer systems including piping, lifts, and appurtenances are prohibited. No public sewer lift stations will be permitted within the City system.

B. Private pressure sewer systems, including individual pressure sewer services are not allowed unless approved by the Utilities Division and the City Engineer. Off-site extensions of the public system in order to provide gravity service may be required. Should a private system be allowed, the following criteria shall be addressed prior to plan approval:

1. A provision for continued operation by the appropriate Class or Grade Operator as required in AAC R18-05-114.
2. A provision for scheduled routine operation and maintenance by qualified personnel and an operation and maintenance manual approved by ADEQ.

3. An emergency spill prevention and response plan shall be kept at the site and include provisions for twenty-four (24) hour response and mitigation by qualified personnel.

4. In accordance with AAC R18-9-E301, sewer collection, force mains, and lift stations having the design flow of ten thousand (10,000) gpd or more shall maintain and revise, when needed, an operation and maintenance plan at the operator’s control center (office) and the appropriate field person’s vehicle.

5. When a lift station is installed as an interim condition until the future extension of a gravity main, the developer shall pay to the City Utilities Division the estimated cost of decommissioning and removing the lift station and connecting to the gravity main. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-002-0013 On-Site Disposal Systems

On-site disposal systems will be permitted only as outlined in AAC R18-9-A309. On-site disposal systems shall be designed to allow immediate future ties to sewer lines when available. Percolation testing and design shall meet County Health Department and ADEQ requirements. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-09-003  
Water System Design

Sections:

13-09-003-0001 Guide for Design
13-09-003-0002 Extension and Network Design
13-09-003-0003 Water System Overview
13-09-003-0004 Water Demand Criteria
13-09-003-0004.1 General
13-09-003-0004.2 Domestic Demand
13-09-003-0004.3 Fire Flow Demand
13-09-003-0005 Valve Locations
13-09-003-0006 Valve Box Assembly
13-09-003-0007 Water Services
13-09-003-0007.1 Copper Tubing and Fittings
13-09-003-0007.2 Service Saddles
13-09-003-0007.3 Corporation Stops
13-09-003-0007.4 Curb Stops
13-09-003-0007.5 Service Extensions and Repairs
13-09-003-0008 Meter Requirements
13-09-003-0008.1 Multiple Meter Service Connections
13-09-003-0008.2 Compound Meters
13-09-003-0009 Water Main Repairs
13-09-003-0010 Combination Air Release Valves
13-09-003-0011 Thrust Block Design
13-09-003-0012 Pumping Stations and Reservoirs
13-09-003-0013 Wells
13-09-003-0013.1 General
13-09-003-0013.2 Construction Materials
13-09-003-0013.3 Design Considerations
13-09-003-0013.4 Abandoned Wells
13-09-003-0014 Water Storage Facilities
13-09-003-0014.1 General
13-09-003-0014.2 Construction Materials
13-09-003-0014.3 Storage Capacity Sizing
13-09-003-0014.4 Design Considerations
13-09-003-0015 Water Systems Not a Part of City Systems

SECTION 13-09-003-0001 Guide for Design

Arizona Revised Statutes establishes the control for water system design with the Arizona Department of Environmental Quality (ADEQ). Engineering bulletins produced by ADEQ are to serve as guides for water system design along with other criteria established by the City. Pertinent Engineering Bulletins include, but are not limited to:

B. Bulletin No. 8 - Disinfection of Water Systems. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0002 Extension and Network Design

A. Any extension of a water line or network of water lines shall be designed to provide for required fire flows and peak hour flows (in accordance with Section 13-09-003-0004) simultaneously with no residual pressures in the system dropping below twenty (20) psi. In order to assure that a twenty (20) psi residual pressure within the public system is maintained, a minimum static pressure of forty (40) psi is required at the highest point within the public system.

1. Future extension of a proposed system will increase the possibility of residual pressures dropping below twenty (20) psi.

2. System analysis is required and shall include anticipated future expansions.

B. Water mains shall be designed to maintain between forty (40) and one hundred thirty (130) psi during peak hour demand conditions at a flow velocity of less than or equal to five (5) fps, or they are to maintain a pressure greater than or equal to twenty (20) psi at a point of maximum fire flow, at a flow velocity of less than or equal to ten (10) fps.

1. The pipe diameter shall be the largest diameter calculated for the two (2) conditions above.

C. The maximum allowable head loss for transmission lines is eight (8) feet per one thousand (1,000) feet and ten (10) feet per one thousand (1,000) feet for distribution lines.

D. Required water pipe sizes will be determined by a network analysis (Hardy Cross or equivalent), but in no case will public lines smaller than eight (8) inch diameter be permitted (in connection with a grid network).

1. A new minimum eight (8) inch main is required if the existing main is less than six (6) inches and a new or larger service (even a three-quarter (3/4) inch) is required.

   a. A six (6) inch diameter pipe may be permitted only in special cases (such as dead end stubs-outs less than ninety (90) feet which have no potential for extension), with approval of City Fire Department, Utilities Division and Engineering Section.
2. All dead end systems longer than one thousand (1,000) feet, or with more than three (3) fire hydrants, shall have two (2) or more connections to an existing main, and the main shall have at least one (1) valve between the connections.

3. Fire hydrants shall be served from an eight (8) inch or larger water line and, depending on distance, may be required to be off a looped line.

E. Performance of a planned network shall be based on the existing pressure zones of the City water system. System designs must be adequate for extreme cases; e.g., reservoirs near empty, peak hourly demands in effect, and the required fire flow.

F. Where reasonable, water mains shall be located under a paved surface. Where this is not possible, the engineer should give consideration to access and maintenance issues. The engineer should examine the possibility of redesigning the project layout, e.g., roads, building envelopes, and drainage patterns, in order to facilitate access and maintenance to all water pipes and appurtenances. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0003 Water System Overview

A. Pressure Zones.

1. Approximately five (5) operating pressure zones serve the municipal distribution system for the City of Flagstaff. These zones operate nominally within a static pressure range between forty (40) to one hundred thirty (130) psi.

2. With regard to typically high seasonal water demand variations among pressure zones with elevated storage, operating pressure fluctuations are normal. Information on pressure zones serving the various areas of the City can be obtained from the City of Flagstaff Utilities Division. All pressure zones have elevated storage within the City of Flagstaff.

3. In areas where a static pressure in excess of eighty (80) psi is realized, individual pressure reducing valves are required to be installed and maintained by the owner/developer in accordance with the International Plumbing Code. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-09-003-0004 Water Demand Criteria

The City of Flagstaff municipal water system has dual functions. It supplies potable water for industrial, commercial and domestic use and supplies water for fire protection. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0004.1 General

Minimum pipe sizes shall meet the criteria established in Section 13-09-003-0002; however, may not be adequate to meet all system water demands. For some projects, a detailed analysis of domestic and fire flow demands may be required to properly define requirements for system design. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0004.2 Domestic Demand

For the purposes of system design the Utilities Division has established factors for maximum daily consumption for various domestic uses. Although the list is not all-inclusive, it does serve to establish a general baseline for system evaluation and analysis. Table 9-3, and Table 9-4, Water Demand Criteria, show the water demand factors to be used for the determination of maximum daily consumption. No allowances for fire protection or fire flows are included in these factors. For information not included herein, the designer shall contact the Utilities Division for consultation and agreement on design demand.

All water mains are to be designed using the following tables from the City of Flagstaff "Water System Improvement Program" report (November 1980) and ADEQ Bulletin No. 12.

Table 9-3
Average Population Densities

<table>
<thead>
<tr>
<th>Type of dwelling units</th>
<th>Number of persons/unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile home</td>
<td>3.0</td>
</tr>
<tr>
<td>Single-family</td>
<td>3.5</td>
</tr>
<tr>
<td>Multifamily</td>
<td>2.5</td>
</tr>
<tr>
<td>Hotel/motel</td>
<td>2.0</td>
</tr>
</tbody>
</table>
It is stressed that fire flow requirements are not included in the above example. The calculated flow rates and quantities shall be added to the required fire flows prior to the design of water mains, booster pumps, storage reservoirs and other system components. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

**SECTION 13-09-003-0004.3 Fire Flow Demand**

A. Required fire flow and peak day flow rate shall be available in the system. Municipal fire flow required by the City for any one
(1) particular location varies depending on the land use. The number of hours that the required fire flow shall be available also varies depending on the land use and ranges from two (2) to ten (10) hours.

B. When a reservoir is to provide a second source of water to a development, the capacity shall include the sizing necessary to provide the required fire flows for a minimum of two (2) hours. Reservoir supplement shall meet Utility Department approval.

C. The increased use of automatic extinguishing systems, whether they use water or some other agent, will affect the quantities of water required. Table 9-5, Minimum Fire Flow Requirements, outlines the required fire flows. Fire sprinkler demands are in addition to the flow requirements shown in Table 9-5, Minimum Fire Flow Requirements. Flows in the table represent the fire flow of the public system at fire hydrants. It shall be noted that the Fire Department may require a fire flow greater than shown in the table due to building construction materials, contents, or other factors. These cases require consultation with Utilities Division and Fire Department staff.

<table>
<thead>
<tr>
<th>Table 9-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Fire Flow Requirements</td>
</tr>
<tr>
<td>1,000 gpm for single-family residential</td>
</tr>
<tr>
<td>1,500 gpm for multifamily residential</td>
</tr>
<tr>
<td>1,500 gpm for commercial and industrial areas</td>
</tr>
</tbody>
</table>

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0005   Valve Locations

A. Valves shall be located in the network so that no single accident, breakage, or repair to the system will necessitate the removal from service of a length of pipe greater than five hundred (500) feet in high value (commercial, industrial) districts. Sufficient valves shall be provided on water mains to minimize inconvenience, degradation of fire protection and sanitary hazards during repairs. Variations in this spacing may be required for special applications. Valves are to be located so that no closure of a valve on a main line is required unless there is breakage on the main itself.

(Revised 10/17)
B. Valves shall be generally located as follows, unless otherwise approved by the Utilities Division:

1. At intervals to isolate no more than two (2) fire hydrants at any time.

2. At minimum intervals of five hundred (500) feet in commercially zoned areas and residential off-site water mains.

3. In residential areas to isolate a maximum of thirty (30) services (approximately six hundred (600) feet).

4. At minimum intervals of eight hundred (800) feet for transmission lines.

5. Valves shall not be located in street gutters, valley gutters, concrete aprons, or in driveways.

6. Three (3) valves are required on a four (4) way cross, two (2) valves minimum are required on all three (3) way tee fittings.

C. The valve location is to be a minimum of ten (10) feet upstream of the cap or blow-off assembly.

D. Every fire hydrant is to have a valve on the lead line.

1. Blow-off valves are required at the ends of dead end lines, whether temporary or permanent.
   a. When a fire hydrant is required at or near the end of a dead end main, it shall be installed at the end of the main instead of a blow-off.

2. No fire hydrant or water services will be allowed on the water line between temporary blow-off valves and the plug. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0006 Valve Box Assembly

A. All valve boxes shall be DOMESTIC (nonimport), Tyler Series No. 6855 or East Jordan Iron Works Model No. 8555 or equivalent, having a minimum shaft diameter of five (5) inches ID, and lid marked "WATER."

B. Valve boxes shall be sliding, adjustable, with lip on all sections. No lock type, screw type, cast iron no-hub sewer pipe,
caulder couplings, bands, tin, gaskets, grout, or any other material will be allowed in valve box assemblies.

C. No butt-joints will be allowed. All sections shall have a minimum of two (2) inch overlap.

D. No bricks will be allowed around a valve.

E. Center the valve box over the valve. No part of the box should contact the valve. Material around the valve shall be compacted to ninety-five percent (95%).

F. Fill material shall be compacted to ninety-five percent (95%) around valve and valve boxes up to finished grade in one (1) foot lifts.

G. If a valve nut, whether existing or new, ends up to be sixteen (16) inches or less from finish grade, one (1) top section box, with lip, of appropriate length will be allowed.

H. If any contractor has to adjust to grade a new or existing valve box for any reason, the adjustment will start from the valve nut up to finished grade to eliminate any existing broken, dirty, cracked, crooked, too small, or otherwise substandard valve boxes.

I. If a bottom section is in good condition, clean and centered, it can remain but the old top section will be removed to allow for additional bottom sections and a top.

J. Two (2) piece valve box assemblies are preferred as shown in Engineering Detail 9-03-060, Figure A. Bottoms come in lengths of up to sixty (60) inches. Tops come in lengths of up to twenty-six (26) inches.

K. Another option is adjusting with one (1) or more bottom sections and a top section as shown in Engineering Detail 9-03-060, Figure B.

L. Valves not located in the street will be marked by a blue, two and one-half (2-1/2) inch by seventy-two (72) inch "Carsonite" valve marker with concrete ring. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0007 Water Services

A. All pipe and fittings for water services shall have a minimum pressure rating of two hundred (200) psi.
1. Where not otherwise noted on the plans, all water services shall be at least three-quarters (3/4) inch I.D. and shall have a minimum cover of thirty (30) inches and a maximum depth of forty-eight (48) inches except for the last two (2) feet adjacent to the curb stop.

B. The location of water services shall be installed branded on top or face of curb with a "w."

C. Other utilities such as phone and electric shall be a minimum of four (4) feet from the water service including no crossings near the curb stop.

D. Installation of three-quarters (3/4) inch and one (1) inch curb stops shall include a brass plug to protect the threads and keep out dirt.

E. Restrictions.

1. Water services are not allowed on transmission mains that are sixteen (16) inches or larger, fire sprinkler lines or on the six (6) inch lead line between the six (6) inch valve and the fire hydrant on fire hydrant assemblies.

2. Only one (1) meter per lot, three-quarters (3/4) inch maximum, is allowed on existing two (2) inch water lines.

3. No multifamily or commercial connections may be made on a two (2) inch line. No more than sixteen (16) three-quarters (3/4) inch meters will be allowed on any two (2) inch diameter water main.

F. Water services, meter, and box shall be installed perpendicular (not parallel) to the main line, within the right-of-way or easement, and shall not be installed across another’s private property. Water service lines between a water main and water meter shall be installed perpendicular to the water main unless otherwise approved by the City Engineer.

G. When an existing water service is required to be abandoned, it shall be abandoned at the main. The saddle and corp. stop shall be removed in the main clamped with an approved full circle repair clamp. In the event the meter is no longer needed, it shall be salvaged to the Utilities Division. When an existing water stub is to be abandoned, it shall be abandoned at the main, the valve removed, and a blind flange installed on the tee.

H. Gas service lines installed jointly with a water service need to be separated the last three (3) feet to allow a minimum separation of two (2) feet between curb stop and gas line; or the PE gas line
must be sleeved inside a pipe Schedule 40 or greater. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0007.1 Copper Tubing and Fittings

A. Copper tubing for three-quarters (3/4) inch and one (1) inch shall be new seamless copper conforming to all the requirements A.S.T.M. Designation B-88-49 Type K soft copper. Copper tubing for one and one-half (1-1/2) inch and two (2) inch shall be Type L or better rigid copper.

B. All fittings used in connection with three-quarters (3/4) inch and one (1) inch Type K soft copper tubing shall be Mueller or Ford Quick Joint couplings (Type K copper). No other pack joint couplings will be accepted.

C. All fittings used in connection with one and one-half (1-1/2) inch and two (2) inch Type L rigid copper tubing shall be Mueller or Ford Quick joint couplings (Type K copper). No other pack joint couplings will be accepted.

D. Sweat Fittings.

1. All sweat fittings shall be brazed with a silver flow type brazing rod that shall equal or exceed phosphorus-copper brazing alloy, A.S.T.M. B260-52T AWS/A5.8 – class bcup-2; tensile strength ninety thousand (90,000) psi (six hundred twenty-one (621) MPa) self-fluxing, lead-free, manufactured by turbo-torch. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0007.2 Service Saddles

A. When a service connection is proposed on a ductile iron, cast iron, or asbestos cement main, a bronze double strap or stainless steel double bolt service saddle with neoprene gasket shall be used. Service saddles shall be AWWA I.P. thread. All service saddles shall equal or exceed those manufactured by Mueller BR2B Series; BR25, Ford Style 202B; or Jones J-979.

B. When a service is proposed on a PVC C-900 or approved main, a PVC service saddle with neoprene gasket shall be used. Service saddles shall be bronze with stainless steel double bolt straps. HINGED TYPE CLAMPS SHALL NOT BE PERMITTED. All services shall maintain a minimum of eighteen (18) inches from any other service, coupling or joint on the main. All clamps shall equal or exceed those manufactured by Mueller BR2S Series; Ford Style 202BS; or Rockwell Model No. 393. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-09-003-0007.3 Corporation Stops

A. All three-quarters (3/4) inch and one (1) inch corporation stops shall equal or exceed those manufactured by Mueller B-25028, Ford FB1100Q, or approved equal.

B. All one and one-half (1-1/2) inch and two (2) inch corporation stops shall be bronze ball type valves which shall equal or exceed those manufactured by Mueller B2969, Ford FB500, or other approval equal.

C. Corporation stops of three-quarters (3/4) inch and one (1) inch shall be I.P. thread inlet. One and one-half (1-1/2) inch and two (2) inch shall be tapered c.c. or I.P. thread inlet x male iron pipe outlet. Mueller 110 and Ford Quick Joint couplings may be substituted on three-quarters (3/4) inch and one (1) inch corporation stops only (no pack-joint couplings will be accepted).

D. All corporation stops shall be installed at a forty-five (45) degree angle toward the lot to be served.

E. Corporation stops of one and one-half (1-1/2) inch and two (2) inch shall include a swing type connection consisting of two (2) ninety (90) degree brass ells and one (1) one and one-half (1-1/2) inch by two and one-half (2-1/2) inches or two (2) inch by two and one-half (2-1/2) inch brass nipple between the ninety (90) degree ells. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0007.4 Curb Stops

A. All three-quarters (3/4) inch and one (1) inch curb stops shall be bronze of the ball valve outlet type with quarter turn check. Only Mueller 110 (B25170) or Ford Quick Joint Compression (B41-333WQ) connections by iron pipe shall be accepted. They shall be installed with a brass plug to protect the threads and keep out dirt. Curb stops shall be backfilled with cinder sand, six (6) inches under and up to six (6) inches below finished grade.

1. No oriseal type curb stops are allowed.

B. All one and one-half (1-1/2) inch and two (2) inch meter valve connections shall be I.P. x I.P. ball valve type equal to or exceeding those manufactured by Mueller B-25170, Mueller 110 or Ford Quick Joint Compression Connections; Ford; B41-666WQ; or BA41-333WQ.
1. No inverted key or pack joint will be accepted for one and one-half (1-1/2) inch or two (2) inch meter valve connection.

C. Angle stop valves for three-quarters (3/4) inch shall meet or exceed those manufactured by the Mueller B-2427, or Ford BA41-333WQ or approved equal. For one (1) inch angle stop valves, use Mueller No. B24274 or Ford No. BA41-444WQ or equal.

D. Angle stop valves for one and one-half (1-1/2) inch and two (2) inch shall meet or exceed those manufactured by the Mueller B-24276; Ford BRA43-666WQ, BFA43-777WQ, Mueller 110 or Ford Quick Joint Compression Connections.

1. Flare or pack joint will not be accepted for one and one-half (1-1/2) inch and two (2) inch. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0007.5 Service Extensions and Repairs

A. All service extensions shall extend to the property line. All extension couplings shall be a sweat type, City of Flagstaff approved silver flow brazing alloy, Mueller 110, or Ford Quick Joint Compression Connection only. (No pack joint couplings will be accepted.)

B. Service extensions shall be staked vertically and horizontally in the field by a registered land surveyor.

C. A twelve (12) gauge (minimum) galvanized or copper wire with blue insulation shall be fastened to the curb stop and tied to a brick, extending above the end of the service line and placed at finished grade for future locations. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0008 Meter Requirements

In accordance with City Code, every separate building supplied with City water must have its own separate meter. The requirement to have individual water meters applies to commercial, single-family homes, townhouses, duplexes, and triplexes. A single service line and a "Master Meter" can be used for condominium, apartment or trailer court developments where two (2) or more buildings are located on the same parcel of land.

A. Water Meter Boxes.

1. The City of Flagstaff Utilities Division requires that prior to setting a meter, the contractor shall expose the curb
stop, protect it from freezing, and provide one-half (1/2) CY of cinder sand within ten (10) feet of the hole for the installation of the meter box.

2. Water meter boxes shall be installed over the meter as to allow easy access to both the inlet and outlet meter couplings.
   a. The curb stop shall be set a maximum of two (2) inches from the inside of the inlet side of the box and twenty (20) inches below finished grade. (See Detail No. 9-03-070.)
   b. The curb stop shall be located in accordance with Detail No. 9-03-070.

3. There shall be a clear, level working area within a three (3) foot distance in all directions of the meter box with no obstructions such as fences, fire hydrants, signs, rock walls, phone/electrical pedestals, landscaping rocks, logs, bushes, or other impediment. Three (3) foot clearance shall be maintained based on full maturity of plants or trees.

4. After meter is installed and a plumber makes the customer side connection, the meter and boxes shall be backfilled with cinder sand six (6) inches beneath the bottom of the box (minimum) and up to six (6) inches beneath the finished grade around boxes (twelve (12) inches minimum).

5. Meter box locations must be out of traveled roadway, sidewalk or driveway. They may be located in landscape areas or parking lot islands. Boxes shall be set one (1) inch above finished grade to minimize flooding. Meter locations shall be easily accessible from a street or traveled way and must be located in right-of-way or easements.

6. Required private or voluntary plumbing appurtenances such as pressure reducing valves, backflow devices, curb stops (stop and wastes), shall be set with a minimum twelve (12) inch separation from the outlet coupling of meter; none of these are allowed inside the meter box.

7. Customer side shut off valves are required on all new and existing meters and shall be located just outside of the meter box, in accordance with the International Plumbing Code, Section 606.
   a. The valve must have its own acceptable valve box. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-09-003-0008.1 Multiple Meter Service Connections

A. U-Branches.

1. U-branches will be accepted only if there is a minimum of two (2) three-quarters (3/4) inch branches off a single one (1) inch service.

2. U-branches shall be straight line with three-quarters (3/4) inch iron pipe outlets and a minimum of thirteen and one-half (13-1/2) inch center to center separation.


B. Multiple Meters: Manifolds.

1. Multiple meters in excess of two (2) on one (1) service line shall be accepted on one and one-half (1-1/2) inch and two (2) inch service connections only. The maximum number of meters allowed on one (1) service depends on the size of the service and the size of the meter. Refer to the table below:

<table>
<thead>
<tr>
<th>Service Size</th>
<th>Meter Size</th>
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<tbody>
<tr>
<td>3/4 inch</td>
<td>1 inch</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>1</td>
</tr>
<tr>
<td>1 inch</td>
<td>2</td>
</tr>
<tr>
<td>1-1/2 inch</td>
<td>4</td>
</tr>
<tr>
<td>2 inch</td>
<td>8</td>
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</tbody>
</table>

2. Each manifold of three (3) or more meters shall be constructed of copper sweat fittings (with City of Flagstaff approved silver flow brazing) with a separation of thirteen and one-half (13-1/2) inches. Each service curb stop shall have a minimum of eighteen (18) inches separation from the service connection. Each service from the service connection shall be type K soft copper.

   a. Meter manifolds shall be installed in accordance with City of Flagstaff Detail No. 9-03-081.

3. All one and one-half (1-1/2) inch and two (2) inch service connections with manifolds shall have a control valve within eighteen (18) inches to twenty-four (24) inches of the
manifold with cast iron valve box equal to or exceeding those manufactured by Tyler Corporation 562-A or 564-A or refer to City of Flagstaff Detail No. 9-03-081.

4. All one and one-half (1-1/2) inch and two (2) inch meter installations shall require a separate service connection per meter.

5. All meters from a manifold shall be located within the right-of-way or public utility easement. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0008.2 Compound Meters

Compound meters shall be installed in accordance with City of Flagstaff Detail No. 9-03-082 and fire service meters shall be installed in accordance with City of Flagstaff Detail No. 9-03-083. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0009 Water Main Repairs

A. Clamps. Repairs on existing water mains shall be made with stainless steel, double band, full circle repair clamps. Clamps shall equal or exceed those manufactured by JCM models 102, 132, or Smith Blair Model 227.

B. Transition Couplings. Any existing water main requiring repairs or horizontal or vertical realignments, where a transition coupling is to be used, shall require the use of transition couplings that equal or exceed those manufactured by Powerseal Model 3501 or Ford Model FC2A. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0010 Combination Air Release Valves

Combination air release valves shall be required at all in-line high points in water mains. Locate air release valves near property corners and maintain three (3) feet of clear level area. Maintain a minimum of three (3) feet horizontal separation from water meter boxes. Air release valves shall be installed in accordance with City of Flagstaff Detail No. 9-03-101 for pipes as large as twelve (12) inches in diameter, and Detail No. 9-03-100 for larger sizes. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-09-003-0011  Thrust Block Design

Engineer’s design must fit the main size and soils conditions. When joint restraints are specified in lieu of, or in addition to, thrust blocks, they shall be used at all bends and fittings or where joint restraint devices are specified by the approved construction plan. Restrained joint calculations shall be prepared and submitted when necessary, keeping in mind that concrete thrust blocks are not to be considered in the calculations. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0012  Pumping Stations and Reservoirs

A. Generally, the existing City network cannot service development above certain elevations depending on the pressure zones of the main. Therefore, any development that cannot meet design minimums require pump stations or reservoirs, or both. Hydropneumatic systems are not desirable but may be allowed by the City Council where it is shown that elevated reservoirs are not practical. Decisions as to whether such systems can be added to the City network are made by the City Council, based upon recommendations of the Utilities Director, the City Engineer, and the Water Commission. If the system is outside the urban growth boundary, then approval by the Planning and Zoning Commission is required.

1. Such systems are also subject to a fee equal to the estimated amount of operation and maintenance expenses for a period of twenty (20) years. Such fee shall be agreed to by the City and Developer and paid prior to any occupancy being allowed in the development.

   a. Operation and maintenance expenses shall be based on all personnel, contractual, commodities, and replacement capital costs that are estimated for the first twenty (20) years of operation. Replacement capital costs shall be based on a ten (10) year life of pumps and motors.

   b. Capital with a life of greater than ten (10) years shall be depreciated based on its life expectancy.

2. The actual amount paid shall be based on the future value of the estimated amounts assuming a five percent (5%) rate of inflation, discounted back to their present value using a factor equal to the previous average six (6) month interest paid by the Arizona State Treasurer’s Office paid on the Local Government Investment Pool or other investment vehicles the City may have.
B. Pump station facilities shall be designed for peak hour demand of the peak day with provisions for fire flow. Peak day flow shall be two and one-half (2.5) times the average day demand flow.

1. Pump stations are to be designed to meet all minimum requirements of flow in the network with any one (1) of the pumps out of service. Standby power shall also be provided which is adequate to operate at peak day demands.

2. The pump building shall be weather proof, fire and vandal resistant, and architecturally harmonious with the surroundings.

3. All pump station facilities require site plan and building safety review and approval by the Utilities Division. Such review may result in additional requirements that must be satisfied.

C. Reservoir storage capacity required is to be at least two hundred fifty thousand (250,000) gallons.

D. Pump stations for residential, industrial and commercial areas shall be designed by the developer’s engineer with regard to expected water usage and fire flows. This design capacity will be reviewed and approved by the City Engineer and City Utilities Director.

1. Pump stations used to fill reservoirs shall be capable of completely filling the reservoir in twenty-four (24) hours with one (1) pump out of service while under normal demand conditions.

E. No development that is outside the City limits shall be served by City services. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0013 Wells

SECTION 13-09-003-0013.1 General

Wells shall conform to the requirements of the ADEQ Engineering Design Guidelines for the Construction of Water Systems. A drilling permit from the Arizona Department of Water Resources (ADWR) shall be obtained. A design report of system capabilities and production influence will be required. This section of the standards covers the basics in well design. A more detailed description of well requirements can be found in AWWA-A100. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-09-003-0013.2 Construction Materials

A. The acceptable materials for well casings are:


2. Single-ply high strength, low alloy steel conforming to ASTM A714.


B. Acceptable joint types for casing materials are welded or threaded AWWA C206. All screens and fittings shall be stainless steel including twenty (20) foot blank pump chambers. Spacers shall be of the same material as the blank casing and well screen. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0013.3 Design Considerations

A. Minimum design considerations by the Utilities Division for well facilities are as follows:

1. A six (6) foot tall chain link perimeter fence with locked entrance enclosing the compound.

   a. The fencing shall be compatible with the surrounding environment, including landscaping.

2. The facility entrance shall have a twelve (12) foot wide double drive access gate with at least twelve (12) feet clear space.

3. The station shall have a paved access road at least twelve (12) feet wide with a maximum slope not to exceed twelve percent (12%).

   a. A forty-five (45) foot radius turnaround shall be provided if the access road exceeds fifty (50) feet in length.

4. The interior of the compound shall be surfaced with four (4) inches of asphaltic cement pavement.

5. Service vehicle access to major station components shall be incorporated in the station design.
6. Down cast facility lighting, both wall mounts and pole mounts shall be provided with at least one (1) photocell operated light.
   a. The light switch shall be located next to the access gate in the interior of the compound.
   b. Lights shall be dark sky compliant.

7. Heavy equipment access for a well workover rig shall be incorporated in the site layout.

8. The site shall be graded to provide adequate drainage away from structures.

9. On-site chlorine equipment (as required in consultation with the Utilities Division).

10. Well casing.

11. Screen.

12. Column pipe.

13. Discharge piping plus pitless adapter.

14. Check valve on discharge line.

15. Hose bib type sampling tap on system side of check valve.

16. Well vent.

17. Pump plus motor.

18. Sanitary well seal air and water tight.


20. Air release valve between the pump and check valve.

21. After placement of the pump, wells shall be disinfected in accordance with ADEQ Engineering Bulletin No. 8, Disinfection of Water Systems.

22. Air and sand removal shall be included in the design of the well house.

B. The pump base concrete slab shall extend a minimum of six (6) feet from the center of the well, be six (6) inches thick and slope away from the well head a minimum of one-quarter (1/4) inch per
foot. The site shall drain away from the well and be protected against erosion to prevent surface runoff from entering the well. The screen length, aperture size and construction shall be in accordance with AWWA A100. The well shall be sealed and protected from the entry of contaminants or water from any source other than the selected aquifers. Sealing of the well shall consist of grouting the following:

1. The annular space between the casing and bore hole to a minimum depth required to exclude pollution, or five hundred (500) feet, whichever is greater.

2. All zones containing water of undesirable quality or zones to be protected but excluded from final well completion.
   a. These areas shall be grouted from at least five (5) feet above the zone to at least five (5) feet below the zone.

3. All passages or formations that pollutants may enter such as outcrops, old wells, excavation, limestone, sandstone or fractured rocks.
   a. Joints between screen sections and blank casing spacers shall be welded or threaded and be water tight, straight and as strong as the screen.
   b. The top of the well shall be constructed so that no foreign matter or surface water can enter during or after construction.
   c. On completion of the well, the well shall be temporarily capped to prevent surface pollutants from entering until pumping equipment is installed.

C. Below ground pits to house the pumping equipment are prohibited.

D. Wells shall be constructed round, plumb, and true to line within the following tolerances:

1. The alignment must be satisfactory for the successful installation and operation of the permanent pumping equipment.

E. Wells shall be tested for alignment and plumb in accordance with AWWA A100, Section 8.

F. New wells shall be performance tested to acquire water samples and to determine well capacity, draw down and production on a
long-term basis. Testing methods shall be in accordance with AWWA A100, Section 10.

G. All facilities require site plan and building safety review and approval by the Utilities Division. Such review will result in additional design requirements that must be satisfied. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0013.4 Abandoned Wells

A well abandonment plan and notice of intent to abandon must be submitted and approved by the ADWR. See State statutes regarding abandonment for State requirement. Abandoned wells and test wells shall be sealed by an ADWR licensed well driller to restore the controlling geological conditions that existed before the well was constructed. An acceptable alternative is to completely fill the well with concrete. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0014 Water Storage Facilities

SECTION 13-09-003-0014.1 General

A. Water storage facilities shall conform to the requirements of the ADEQ Engineering Design Guidelines for the Construction of Water Systems. Reservoir capacity for residential, industrial, and commercial areas shall be designed by the developer’s engineer with regard to expected water usage and fire flows.

B. The overall objectives of finished water storage are to:

1. Assist in meeting peak flow requirements.
2. Equalize system pressures.
3. Provide emergency water supply in case of component failure.
4. Permit high service pumps at treatment plants to operate at a relatively uniform rate.
5. Provide for fire flows. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0014.2 Construction Materials

The materials and designs used for finished water storage units shall provide stability and durability as well as protect the quality of the water. Steel structures shall follow the current AWWA Standard D100
concerning steel tanks, standpipes, reservoirs and elevated tanks. The materials and design are subject to Utilities Division approval. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0014.3 Storage Capacity Sizing

A. The Utilities Department requires that storage facilities be sized to accommodate the average daily flow plus fire flow storage requirements. The average day demands are established using the criteria set forth in these regulations.

1. Water storage sizing shall be based on net capacity.

   a. Net capacity is less than gross capacity due to the unusable volume of the storage facility.

B. The storage design capacity will be reviewed and approved by the City Engineer and City Utilities Director.

C. Minimum reservoir storage capacity required is to be at least two hundred fifty thousand (250,000) gallons. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0014.4 Design Considerations

A. The minimum design considerations for water storage facilities are as follows:

1. A six (6) foot tall masonry perimeter wall or fencing with locked entrance enclosing the compound. The wall shall be compatible with the surrounding environment, including landscaping.

2. The facility entrance shall have a panel style, dual swing access gate with at least sixteen (16) feet clear space.

3. The station shall have a paved access road at least twelve (12) feet wide with a maximum slope not to exceed twelve percent (12%).

4. The interior of the compound shall be surfaced with a four (4) inch compacted aggregate base including a weed barrier.

5. Service vehicle access to major station components shall be incorporated in the station design.

6. Down cast facility lighting, both wall mounts and pole mounts, shall be provided with at least one (1) photocell-
operated light. The light switch shall be located next to the access gate in the interior of the compound. Lights shall be dark sky compliant.

7. For nonelevated storage, a backup power supply capable of operating the pump station for eight (8) hours during power outage. Specific criteria for backup generation type and capacity shall be given during design process.

8. The site shall be graded to provide adequate drainage away from structures.

9. On-site chlorine generation equipment (if required).

10. Storage tank with acceptable interior and exterior coating systems for potable water.

11. Concrete foundation ring.

12. Inside and outside steel ladders.


14. Water level indicator.

15. Tank vent housing.

16. Two (2) separate thirty-six (36) inch, square-hinged roof access openings (one (1) with inside and outside ladder).

17. Cathodic protection system as required in consultation with the Utilities Division.

18. Overflow pipe and splash pad.

19. Hinged shell manhole.

20. Altitude valve, isolation valves, bypass line and vault.

21. Tank discharge line.

22. Tank fill line.

23. Booster station suction line (where applicable).

24. Tank drain.

25. Disinfection system as required in consultation with the Utilities Division.
26. Electrical and SCADA/telemetry system.

27. Pressure transmitter for telemetry.

28. A clear area around reservoir to allow vehicle passage. Clearance width shall be sized in consultation with the Utilities Division.

All facilities require site plan and building safety review and approval by City of Flagstaff. Such review may result in additional requirements that must be satisfied. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-003-0015 Water Systems Not a Part of City Systems

A. No development that is outside the City limits shall be served by City services.

B. Any development, which does not tie to the City water system, is required to meet the approval of all applicable agencies. Such approval, to be obtained by the developer, is in addition to City and Health Department approvals required. All subdivisions and minor land divisions are required to be served by public water, sewer, and roads.

C. Private fire mains shall not be allowed. Existing private fire mains shall be maintained as required and regulated by the City Fire Department. No private water lines may cross into or over the public utility easement, right-of-way, or private property owned by others. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-09-004
City Participation in Utility Extensions

Sections:

13-09-004-0001 City Participation in Utility Extensions

SECTION 13-09-004-0001 City Participation in Utility Extensions

A. In the event that an area to be serviced by a developer is smaller in size than the maximum area to be serviced by the proposed main sewer or water line, and its laterals, the City may require that the main be designed, engineered, and constructed to serve the maximum area described. The City of Flagstaff reserves the right to increase the diameter of any sewer or water extensions, if it deems it advisable. If future extensions of a proposed water line will require an increase in the line size, the City may request the line size be increased. The City of Flagstaff may participate by paying the difference in construction and design costs between the line size required to serve the development and that size deemed necessary by the City to serve all future expansion.

B. The construction cost of the oversize shall be determined in accordance with City and State public bidding requirements and agreed upon by the City Council prior to commencement of construction, or as otherwise authorized by law. The cost difference to be paid by the City shall be determined using the low bid for the larger size alternative less the bid for the smaller size alternative in the same low bid. Costs of lateral and branch lines and their appurtenances will not be included in the agreed construction cost. Differences between water valve costs may be included in the construction costs; however, fire hydrants and water services will not be included. The City Council reserves the right to reject the cost breakdown and not participate in the oversizing if it is inconsistent with current costs of equivalent construction in the City. A contract shall be prepared by the City stating the terms of the City participation in the utility extension. Interest costs are not to be included in participation costs.

C. After the completion of construction and installation of an extension, the developer shall submit a detailed statement of the costs and expenses of such construction and installation to the City Engineer for approval and payment. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-09-005
Recapture Agreement

Sections:

13-09-005-0001 Recapture Agreement

SECTION 13-09-005-0001 Recapture Agreement

A. If a property owner or developer extends a water or sewer main across undeveloped property to reach his development or property, and wishes to be reimbursed for the cost of installing said extension by future customers along the length of the lines, he may request a recapture agreement be drawn up by the City. Developers may request a recapture agreement when a line is constructed across the frontage of parcels not currently receiving service from the City. When the owner of the designated parcel requests service, a prorated cost of the line is collected by the City and returned to the developer. Recapture agreements are set up through the Utilities Division. For questions or details on the procedure to initiate an agreement, contact the Utilities Division.

B. The maximum period of time of the recapture agreement shall be ten (10) years. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-09-006-0001  Sewer and Water Line Materials and Construction

A. New public sewer lines may be constructed using the following materials:

1. Polyvinyl chloride (PVC), SDR 35, plastic sewer pipe conforming to the appropriate MAG section for diameters fifteen (15) inches and less. For pipe diameters greater than fifteen (15) inches, ductile iron pipe (DIP) shall be used as specified in subsection (A)(2) of this section.

2. Class 150 ductile iron pipe (DIP) conforming to the appropriate MAG section. DIP may be used for sewer lines, eight (8) inches through fifty-four (54) inches in diameter. All ductile iron pipelines shall be polyethylene encased in accordance with MAG Specifications. When DIP is used, it shall be lined with Protecto 401 ceramic epoxy. Special design considerations may require a higher class rating of DIP.

3. High density polyethylene (HDPE) sewer pipe conforming to MAG Sections 603 and 738. The maximum pipe allowed shall be ten (10) inch for HDPE.

4. When utilizing "pipe-bursting" technology to replace an existing sewer service, HDPE SDR17 pipe, conforming to AWWA
C901/C906 and ASTM D2239, D2237, D3035, and F714, may be used.

B. New public water lines may be constructed using the following materials:

1. Polyvinyl chloride (PVC) plastic water pipe conforming to AWWA C-900.

2. Class 350 ductile iron pipe (DIP) four (4) inch to ten (10) inch diameter, and Class 250 DIP for twelve (12) inch and larger, conforming to MAG Sections 750.2 and 750.3, with polyethylene corrosion protection conforming to MAG Section 610.6.2. Deflected ductile iron pipe shall be designed to deflect no more than one-half (1/2) the maximum as recommended by the manufacturer, horizontally and vertically. Ductile iron pipe mains shall be protected from exterior corrosion. This protection may consist of encasement in a polyethylene protective wrapping or other approved methods.

3. Ductile iron pipe fittings shall be new and conform to MAG Section 750.4 with UL and FM approvals. Domestic fittings are allowed; imported fittings are allowed if they meet these standards and are approved by the Utilities Director and City Engineer.

4. Valves. Gate valves with AWWA C515 two hundred fifty (250) psi rating shall be used on water mains that are twelve (12) inches and smaller in diameter. Gate valves with nonrising stems shall be used for all locations and be resilient seat and epoxy coated inside and out. Butterfly valves with C504 two hundred fifty (250) psi rating shall be used on all water mains fourteen (14) inches and larger in diameter. All butterfly valves shall be resilient seat and epoxy coated.

5. Pipe Casing. Casings are required on all pipes installed using boring methods or other special conditions. The casing material used shall be a minimum of one-quarter (1/4) inch thick steel (design calculations must be submitted by the developer’s engineer) and conform to ASTM A283, Grade B, C, or D. All joints shall be welded. Interior joints shall be grounded to a smooth finish. All welding shall be performed in accordance with AWWA C201, AWWA Standard for Fabricated Electrically Welded Steel Water Pipe. Coatings for steel casings are not required. The pipe casing shall be laid true to line and grade with no bends or changes in grade for the full casing length. The pipe shall be symmetrically supported about its centerline inside the casing at each joint end, with a City of Flagstaff Utilities Department
approved stainless steel casing spacer (sized and designed in accordance with manufacturer recommendations). The casing ends shall be sealed with end seals by Advanced Products and Systems, or approved equal. (See Detail 9-06-010.)

For water and sewer lines greater than eight (8) inches in diameter, the City Engineer may authorize the use of alternate pipeline materials when shown and detailed on the construction plans.

C. The design engineer may submit a carefully documented and considered written proposal for alternate pipeline materials and construction methods. The City Engineer and the Utilities Director will review this proposal for use of alternate pipeline materials and methods. Proposals found to be in conformity with good engineering design that can be easily maintained by the City may be given written approval for incorporation into the construction plans if found to be in the public interest. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-006-0002 General Requirements

A. No water settling will be allowed in trenches.

B. The pipe shall be handled and installed in accordance with the manufacturer’s recommendation when not in conflict with other City specifications.

C. Affidavits of compliance by the manufacturer stating that the materials comply with all applicable provisions of City specifications may be required and shall accompany each truck or carload of pipe at the time of delivery. Affidavits shall be forwarded to the City by the contractor. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-006-0003 Pipe Bedding

A. The City of Flagstaff will accept backfilling of trenches with a non-shrink backfill as an alternative to standard trench backfill material. The non-shrink backfill shall be proportioned as follows: two thousand six hundred (2,600) pounds of three-eighths (3/8) inch minus aggregate, eight hundred (800) pounds sand, ninety-four (94) pounds cement and eleven (11) gallons of water. All material shall be mixed by means of a ready mix truck. Non-shrink backfill may be used in either paved or unpaved sections of City right-of-way.
1. Mechanical compaction will not be required when this non-shrink backfill is used.

2. No compaction testing will be required.

B. The utility governing use of the trench shall determine the appropriate installation criteria for its facility. Refer to the applicable standard (Detail 9-06-030). (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-006-0004 PVC Pipe for Sanitary Sewers

A. The pipe material used shall be SDR35.

B. The pipe shall be installed in accordance with MAG Specifications.

C. All pipes shall be checked for deflection with a properly sized deflection mandrel after backfill and before acceptance. Any deflection shall not exceed the manufacturer’s recommendation. Any pipe with excessive deflection shall be removed and replaced with a full length of the pipe. No cutting and splicing will be allowed. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-006-0005 PVC Pipe for Water Lines

SECTION 13-09-006-0005.1 General

A. PVC water line, in conformance with AWWA C-900 standards and the City of Flagstaff requirements, will be allowed for water distribution mains, eight (8) inch to twelve (12) inch. C-900 PVC shall conform to AWWA C-900 standards, Table 2, Cast-Iron-Pipe Equivalent outside diameters with elastomeric gasket couplings. Ductile iron pipe shall be used for mains greater than twelve (12) inches unless written approval is obtained from the City Engineer for each individual situation.

B. All other standards applying to water line construction shall continue to apply.

C. The contractor shall furnish the City of Flagstaff any information from the manufacturer upon request so that the products furnished under this specification may be properly evaluated for acceptance or rejection. Only products of approved manufacturers will be accepted. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-09-006-0005.2 Specifications

A. All polyvinyl chloride (PVC) pipe shall be new and shall conform to AWWA specification C-900, latest revision, except as modified herein.

B. All PVC pipe shall be Class 305, unless otherwise designated.

C. All PVC pipe furnished shall be integral bell with elastomeric gaskets or plain ends with elastomeric gaskets and couplings. Deflected pipe shall be designed to deflect no more than one-half (1/2) the maximum as recommended by the manufacturer, horizontally and vertically.

D. The type of pipe furnished shall be marked in accordance with AWWA C-900 specifications, Section 2.5, include date of manufacture and manufacturer’s code.

E. PVC connections to cement asbestos and ductile iron pipe shall be accomplished by transition couplings ductile iron solid sleeve.

F. PVC pipe shall be provided in nominal twenty (20) foot (plus or minus one (1) inch) laying lengths for all sizes. Short lengths may be field cut for making required horizontal or vertical deflections. At least eighty-five percent (85%) of the total footage of pipe in any class and size shall be furnished in standard lengths, the remaining fifteen percent (15%) in random lengths. Random lengths shall not be less than ten (10) feet long. All standard, random, and short pieces and couplings shall have proof of meeting applicable hydrostatic testing provisions of AWWA C-900 standards at the point of manufacture.

G. Shipping, handling, unloading, cutting, joining, installation and storage of PVC pipe shall be accomplished in accordance with the manufacturer’s guidelines to insure the integrity and quality of the PVC pipe.

1. Storage shall be accomplished in such a manner as to protect the PVC pipe from prolonged exposure to sunlight and/or extreme heat.

H. Lubricant for joining of PVC pipe joints shall be completely compatible for use with a potable water system, and meet pipe manufacturer’s guidelines.

I. Disinfection of PVC pipe shall be in accordance with ADEQ Bulletin No. 8. Tablet method of chlorination shall not be accepted.

J. All PVC pipe furnished shall be such as to be tapped with standard tapping (over two (2) inches) and drilling tools (three-quarters
(3/4) inch to two (2) inches). All tapping with sleeves and/or service connections shall be accomplished in accordance with the manufacturer’s guidelines and applicable City of Flagstaff standard specifications and practices. Direct tapping without the use of saddles will not be permitted.

K. Pipe fittings for PVC pipe shall be mechanical joint. Pipe is not to be longitudinally deflected at fittings.

L. Fittings and valves furnished for use with PVC pipe shall be ductile iron and polyethylene encased in accordance with applicable City specifications and AWWA C-110 (minimum pressure rating is two hundred fifty (250) psi).

M. Hydrostatic pressure testing and leakage testing shall be in accordance with the applicable portions of City and AWWA specifications as directed by the Engineer, and in accordance with the following specifications:

1. Test pressures for all sizes Class 305 PVC pipe shall be two hundred (200) psi at the lowest end of the section under test. Test duration shall be a minimum of two (2) hours.

2. Allowable leakage for the PVC pipe shall be in accordance with the following table and formula:

   **Table 9-6**
   
   **Allowable Leakage for Ductile Iron Pipe, and PVC Plastic Pipe with Elastomeric Joints**

   U.S. GALLONS PER HOUR
   AVERAGE TEST PRESSURE IN LINE - 200 P.S.I.

<table>
<thead>
<tr>
<th>Nominal Pipe Size Inches</th>
<th>Allowable Leakage (gph) (per 1,000 Feet or 50 Joints)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>0.57</td>
</tr>
<tr>
<td>8</td>
<td>0.76</td>
</tr>
<tr>
<td>10</td>
<td>0.96</td>
</tr>
<tr>
<td>12</td>
<td>1.15</td>
</tr>
</tbody>
</table>

   Formula
   
   $L = \left( ND \times \frac{P1}{2} \right) / 7,400$
   
   Design Basis
   
   WHERE: $L = \text{Allowable Leakage (gph)}$
SECTION 13-09-006-0005.3 Affidavit of Compliance

Affidavits of compliance by the pipe manufacturer shall be required of all tests applicable under AWWA Specification C-900, latest revision, except that all inspection and testing shall be performed in the United States of America at the pipe manufacturer’s plant, or at an approved testing laboratory in the United States. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-006-0005.4 Approved Manufacturer and Model

A. Manufacturer submittal required for the establishment of an approved list. The manufacturer shall submit five (5) sets of its written guidelines for shipping, handling, unloading, cutting, joining, installation, storage, and/or any other facets of working with its PVC pipe to the City of Flagstaff along with his submittal and affidavit of compliance.

1. Approved Manufacturer List.
   a. Vinyltech.
   c. Certainteed.
   d. PW Pipe by Pacific Western Extruded Plastics Co.
   e. Uponor ETI.
SECTION 13-09-006-0006 Fire Hydrants

SECTION 13-09-006-0006.1 Fire Hydrant Testing

A. Fire hydrants shall be installed in accordance with standard fire hydrant installation drawings.

B. Fire hydrant main valve and auxiliary main valve shall be in the full open position during the filling of the system for the first time in order to allow all of the air in the lines to escape. Filling shall be done at a very slow rate to avoid compressing the entrapped air in the lines.

C. Fire hydrant main valve may be closed as soon as water is clear, no longer milky, and running free. The line test is then continued against the closed main valve until completed. The use of a fire hydrant for testing with the main valve open shall not be considered as a true test of the line’s ability to hold pressure.

D. Fire hydrant auxiliary valve may be closed after the line test is completed and the fire hydrant main valve fully opened. With a hose cap removed, the hydrant may be flushed by throttling with the auxiliary valve. Should an obstruction be encountered in the main valve, the main valve shall not be forced into a closed position, rather opened several times to flush out the obstruction. If the obstruction remains, the main valve shall be removed. With all internal parts removed, the auxiliary valve may be opened slowly until the obstruction is flushed out. Should the obstruction remain, it shall then be removed manually from the bottom of the hydrant.

E. Fire hydrant main valve may be opened with the hydrant caps securely tightened and tested for leaks at the normal main pressures. When this test is completed, the main valve shall be shut and a cap removed. When placing the palm of the hand over the end of the nozzle, suction should be felt if the hydrant drain is operating correctly. Allow hydrant to drain fully before installing caps.

F. Fire hydrant main valve shall be closed tightly but not forced, the auxiliary valve shall be in an open position, and the nozzle caps shall be snug tight. Thus, the hydrant will be in a ready condition for Fire Department use.

G. Fire hydrants shall never be forced in the open or closed position as stops are provided inside the hydrant to stop the travel of
the main valve. Forcing will result in damage to the hydrant. The fire hydrant operating nut shall be packed off slightly into the free play position after closing the hydrant. Damage resulting from improper installation or care of the fire hydrant during installation shall be the sole responsibility of the contractor involved.

H. Fire hydrants shall not be used to take samples for bacteriologic testing. AWWA C601-68:

1. "Samples for bacteriologic analysis shall be collected in sterile bottles treated with sodium thiosulfate. No hose or fire hydrant shall be used in collection of samples."

2. Installation of a saddle and corporation stop for testing is required. After testing is completed, the corporation stop shall be removed and the saddle plugged.

I. A dry-barrel hydrant with unplugged drains shall not be tested at the same time as the water main; the main shall be tested with the hydrants closed (see AWWA C600). The water main cannot be tested satisfactorily if the hydrant is connected to it because of allowable leakage through the hydrant drains (see subsection (J) of this section). If desired, the gate valve in the hydrant lateral may be closed and the hydrant pressure tested by introducing water under pressure through an outlet nozzle.

J. Dry-barrel hydrants with unplugged drains may exhibit slight leakage (up to five (5) fl. oz. per min) through the drains in accordance with the current AWWA Standards for Testing. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-006-0006.2 Fire Hydrant Specifications

A. Hydrants shall be designed, manufactured, and tested in compliance with the latest edition of AWWA C502 "Standard for Dry-Barrel Fire Hydrants" as published by the AWWA.

B. Hydrants shall be "TRAFFIC" type with a replaceable "breakable" flange unit immediately above the ground line for minimizing repairs due to traffic damage. Nozzle section must rotate 360°. Traffic flange shall be a minimum of two (2) inches above ground level, six (6) inches maximum above finish grade of curb, sidewalk, or landscaping.

C. Hydrant shall be of a dry barrel configuration to prevent water loss due to traffic damage and freezing.
D. Hydrants shall be constructed such that the main valve closes with water pressure (opens against) to assure no loss of water in the event of damage to the upper portion of the fire hydrant or if the operating stem should shear and to allow maintenance of upper portion of fire hydrant without having to close the lead valve.

E. Main valve opening shall have a diameter of at least five and one-quarter (5-1/4) inches to assure optimum flow.

F. Standpipe (hydrant barrel) inside diameter shall not be less than seven and one-quarter (7-1/4) inches.

G. Hydrant shall have a sealed oil reservoir type bonnet with O-ring seals to allow lubrication of stem threads.

H. Hydrant operating nut must turn left (counter-clockwise) to open.

I. Operating and cap nuts will be pentagon in shape; dimension shall be one and one-half (1-1/2) inches point to flat (National Standard).

J. Hydrants shall have a six (6) inch inlet of MJ design.

K. Hydrants shall have an automatic drain operated by the main valve rod and shall have a minimum of two (2) drain ports in the shoe of the hydrants. These drain ports shall be brass lined to prevent rusting.

L. Hydrants shall have two (2) two and one-half (2-1/2) inch nozzles and one (1) four and one-half (4-1/2) inch pumper nozzle having national standard threads.

M. Hydrants shall have a main valve seat ring of bronze threaded into a bronze drain ring; all working parts should be removable through the upper barrel.

N. Hydrant shall have nozzles mechanically locked into the nozzle section; no leaded nozzles will be accepted.

O. All barrels above ground shall have one (1) primer coat and two (2) coats of epoxy enamel yellow paint.

P. The center of the lowest nozzle shall have a ground clearance of not less than fifteen (15) inches.

Q. All fire hydrants, when installed, shall have a clear, level working area extending not less than three (3) feet around the hydrant. No obstructions such as fences, phone pedestals, trees, street signs, landscaping logs, or other impediments will be allowed within this three (3) foot area. Banks shall be excavated
to obtain such clearance and an approved retaining wall with footing shall be constructed where the excavated bank exceeds eighteen (18) inches in height, as shown in the Engineering Standard Detail 13-03-011.

R. A class "A" concrete pad four (4) to six (6) inches thick and three (3) feet by three (3) feet square shall be placed around a fire hydrant barrel a minimum of three (3) inches below the bottom of a traffic flange; six (6) inches maximum.

S. Fire hydrant types shall be limited to Waterous Pacer Model WB-67-250 with eighteen (18) inch upper standpipe, Mueller Super Centurion Model 250, and A423 and Clow Medallion Model F-2545. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-006-0006.3 Fire Hydrant Installation Notes

A. All fire hydrant installations shall conform to the City Fire Code and the following requirements of the Utilities Division (see Detail 13-03-011):

1. A thrust block shall be placed at the back of the hydrant shoe from the ditch bottom to a point three-quarters (3/4) of the way up the back of the shoe and "V" shaped to solid ground. Thrust blocks shall be a minimum of two (2) feet wide at this point and shall not obstruct bolts or drain holes on the shoe. All bolts below grade shall be checked for tightness before backfilling.

2. Pipes, valves, and fittings shall be ductile iron with mechanical joint (MJ) connections except when the valve is located at the main it shall be flanged to the tee at the main.

3. Hydrant barrels must be installed plumb and the lead line must be level.

4. In the event of a long fire hydrant run, or if a run is eight (8) inches and reduced to six (6) inches, there shall be two (2) valves; one (1) flanged x MJ at the main and one (1) MJ x MJ by the fire hydrant a minimum of two (2) feet from the fire hydrant with the valve meg-lugged to the hydrant lead run.

5. Fire hydrants shall also be strategically located to avoid conflicts with vehicular traffic as follows:
a. When a hydrant is located near the intersection of two (2) streets, it should be located no less than ten (10) feet from the curb returns of the intersection.

b. When a hydrant is located adjacent to a driveway of a private property, it shall be located behind the sidewalk and no less than ten (10) feet from the edge of the driveway.

6. Fire hydrants installed within curbed islands shall be located a minimum of six (6) feet from the edge of the fire hydrant to the back of curb. If this cannot be achieved, bollards will be required around the fire hydrant. (See Detail 13-03-012).

7. Fire hydrants shall be installed within three hundred (300) feet of all parts of a commercial building. Hydrants shall also be placed within one hundred (100) feet of Fire Department connection to sprinkler and standpipe systems.

8. Off-site spacing shall be three hundred (300) feet between hydrants for commercial areas and five hundred (500) foot spacing for one (1) and two (2) family subdivisions.

9. Fire hydrants will have a maximum six (6) foot bury.

10. Where a fire hydrant is located in a concrete section (sidewalk, slab, or other concrete structure) a four (4) foot by four (4) foot block out shall be required around the hydrant.

11. In cul-de-sacs, where a fire hydrant is required at or near the end of a dead end main, it shall be installed at the end of the main instead of a blow-off.

12. Detector check devices with bypass meter assemblies may be required when one (1) or more of the following conditions exists or will exist:

   a. The on-site water system includes outlets for future connections.

   b. The on-site water system allows fire demand flow rates to occur without activating an alarm.

   c. There is or will be an obvious means by which water from the on-site fire system might be used for purposes other than fire fighting.
13. If a developer is required to move an existing fire hydrant, the existing top portion of the hydrant must be salvaged and provided to the City, and the developer shall install a new hydrant at the developer’s cost. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-006-0006.4 Fire Lines

A fire line is a private pipe system connected directly to the City water system. A fire line, by the nature of its function and use, is susceptible to backflow. Consequently, it is subject to the requirements for backflow prevention contained in these regulations.

All commercial fire sprinkler lines shall have a minimum four (4) inch (FLANGE x MJ) valve at the main. The four (4) inch valve shall be public, but the remainder of the line (including all fittings and gaskets on the outlet side of the valve) from the valve to the building shall be private. All commercial fire sprinkler lines shall be separate from domestic lines unless approved by the Utilities Division. Fire lines may not exceed one hundred (100) feet in length from the water main to the backflow assembly inside the fire riser room.

A. The fire line backflow assembly shall be installed immediately inside the building being served, but in all cases, before the first branch line leading off the service line. Such backflow prevention device assembly(ies) shall be installed and approved before water service shall be provided. All backflow prevention device assemblies, once installed, shall be inspected by the City of Flagstaff Industrial Waste Section, and before use, shall be tested by a State of Arizona certified backflow tester paid for by owner/developer with the results forwarded and received by the City of Flagstaff Industrial Waste Section, prior to acceptance of service.

B. Above-ground installation of backflow prevention devices shall conform to the City ordinance on backflow prevention and cross-connection control, and City of Flagstaff Standard Engineering Details for Backflow Assemblies, Details 9-06-071 through 9-06-075.

C. All fire risers, commercial and residential, shall be designed with a testable backflow prevention assembly that has been approved by the City of Flagstaff’s Industrial Waste Section. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-09-006-0007  Backflow Prevention Devices

Backflow preventers shall be installed as required by Section 7-03-001-0015, Cross Connection Control, and shall be installed in accordance with City of Flagstaff Details 9-06-071 through 9-06-075. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-09-007
Reclaimed Wastewater System Design

Sections:

13-09-007-0001 Guide for Design
13-09-007-0002 Valve Locations
13-09-007-0003 Reclaimed Wastewater Services
13-09-007-0004 Thrust Block Design
13-09-007-0005 Pumping Stations and Reservoirs
13-09-007-0006 City Participation in Reclaimed Wastewater Line Extensions
13-09-007-0007 Reclaimed Wastewater Line Materials and Construction
13-09-007-0007.1 General Requirements
13-09-007-0008 PVC Pipe for Reclaimed Wastewater Lines

SECTION 13-09-007-0001 Guide for Design

Reclaimed water shall be used for nonpotable applications such as irrigation, dust control, construction water. It shall not be used as potable water applications including fire protection and buildings. The City of Flagstaff reclaimed wastewater distribution system is designed to provide pressure to certain irrigation users at the same level of service as the City’s Zone B domestic water system. Prior to designing a system for reclaimed wastewater, the prospective user’s project requires review by the City of Flagstaff Water Commission and approval of a user agreement by the City Council. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-007-0002 Valve Locations

A. It is necessary to be able to isolate sections of reclaimed wastewater piping for repairs while still having the ability to supply reclaimed wastewater to other customers. The location of valves and the number of valves shall be based on the location of customers and the amount of piping that requires dewatering for necessary repairs.

B. Valves shall be generally located as follows, unless otherwise approved by the Utilities Department:

1. At intervals to isolate no more than two (2) fire hydrants at any time.

2. In residential areas to isolate a maximum of thirty (30) services (approximately six hundred (600) feet).

3. At minimum intervals of eight hundred (800) feet.
4. Valves shall not be located in street gutters, valley gutters, concrete aprons, or in driveways.

5. Three (3) valves are required on a four (4) way cross, one (1) valve minimum is required on all three (3) way tee fittings.

C. The valve location is to be a minimum of ten (10) feet upstream of the cap or blowoff assembly. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-007-0003 Reclaimed Wastewater Services

Acceptable materials for reclaimed wastewater services shall meet those requirements specified for water services. All reclaimed wastewater services shall be identified with warning tape in accordance with Section 13-09-001-0002. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-007-0004 Thrust Block Design

Engineer’s design must fit main size, design, and soil conditions. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-007-0005 Pumping Stations and Reservoirs

A. Pump stations, reservoirs, or both, may be required to supply adequate working pressure for applications above the seven thousand (7,000) foot elevation contour. Decisions as to whether such systems can be added to the City system are made by the City Council based on recommendations of the Utilities Director, the City Engineer and the Water Commission.

B. Pump stations are to be designed to meet all minimum requirements of flow in the network with any one (1) of the pumps out of service. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-007-0006 City Participation in Reclaimed Wastewater Line Extensions

The City encourages the use of reclaimed wastewater for irrigation of large projects. As such, the City may agree to reimburse the user of reclaimed wastewater the cost incurred of extending a reclaimed wastewater line and connecting the service in accordance with a user agreement that has been reviewed by the City Water Commission and approved by the City Council. The amount of reclaimed wastewater used
shall be a factor in determining whether the City participates in the line extension. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-007-0007 Reclaimed Wastewater Line Materials and Construction

New reclaimed wastewater lines may be constructed using the same materials as those specified in these construction standards for new public water lines. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-007-0007.1 General Requirements

See construction of public water lines. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-09-007-0008 PVC Pipe for Reclaimed Wastewater Lines

All PVC pipe requirements for reclaimed wastewater lines shall comply with those set forth in these construction standards for water lines except for the disinfection requirement. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13-10
STREETS

Divisions:

13-10-001 General
13-10-002 Street Design
13-10-003 Street Naming and Addressing
13-10-004 Dead End Streets
13-10-005 Alleys
13-10-006 Intersection Design
13-10-007 Horizontal Alignment
13-10-008 Vertical Alignment
13-10-009 Structural Section
13-10-010 Driveways
13-10-011 Resource and Slope Design Criteria
13-10-012 Standards for Thoroughfares Applied in Traditional Neighborhood Districts
13-10-013 Use of Uncompleted Streets within a Subdivision
13-10-014 Roadway Functional Classifications and Truck Routes
Division 13-10-001
General

Sections:

13-10-001-0001 General

SECTION 13-10-001-0001 General

The arrangement, character, extent, width, grade, and location of streets shall conform to these standards and/or the approved preliminary plat if there is one. Due consideration shall be given to their relation to existing and planned streets, topographical conditions, excessive cuts and fills, drainage, public convenience and safety, and to the proposed uses of land to be served by the streets. Rules as may be established by the Arizona Department of Transportation relating to entrance upon and departure from State Highways, shall also apply.

The design of all new or reconstructed streets and alleys shall be based on the facility’s functional classification and the volume and character of the projected traffic, except for thoroughfares in traditional neighborhoods districts as described in Division 13-10-012. The City Engineer shall approve all such design.

Functional classifications are defined in Division 13-10-014. Alignments for existing and future arterial and collector streets are further designated in that document. Design traffic volumes on a given street segment are those projected for the then-current planning horizon year. Additional traffic factors to be considered in design include the following: nature of the predominant vehicle trips (i.e., mobility vs. access); the percentages of local delivery vehicles; through heavy vehicles; the number and types of pedestrians and cyclists; and the presence of multi-use trails. Special design conditions also apply to streets identified as truck routes in Division 13-10-014.

Divisions 13-10-001 through 13-10-011 generally apply only to conventional suburban developments. Streets (i.e., thoroughfares) in traditional neighborhood developments as approved by the City Council and subject to the provisions of Title 10, Flagstaff Zoning Code, shall be designed in accordance with the provisions of Division 13-10-012. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Sections:

13-10-002-0001 Street Design

SECTION 13-10-002-0001 Street Design

Street design shall:

A. Provide for appropriate continuation of existing and proposed arterial and collector streets and bikeways in accordance with the most recently adopted version of the Regional Plan and Division 13-10-014.

B. Provide sufficient rights-of-way for local service or a frontage street along major highways, or other treatment by separation to protect residential properties along arterial and collector streets.

C. Correlate with the drainage facilities when streets are used for on-site local drainage.

D. Be designed so that through traffic in residential districts is carried on arterial and collector streets. Residential subdivisions shall be designed so that the local streets provide vehicular, bicycle, and pedestrian access to the residences and services of the homes fronting the streets. Table 10-10-01 identifies the application of the different street cross sections, which are based on the total traffic volumes of the street.

1. In order to provide neighborhoods that are safe, functional, and express an atmosphere of community, subdivisions should be designed so that the local streets carry volumes no greater than five hundred (500) ADT. When the traffic volumes on a given street exceed five hundred (500) ADT, it should only provide access to a local street and not to residential properties. In those instances, the typical street section used shall be a minor collector as follows: The section will exclude the center left turn lane (left turn lanes will be required as needed where the minor collector intersects another collector or arterial street).

E. Require that new designs incorporate traffic calming techniques into all new residential streets. The goal is to reduce residential traffic speeds to within the design speed limits, while maintaining safe and reasonable access for all intended
normal traffic. In order to achieve this objective, the maximum length of a roadway section between speed control points shall be six hundred sixty (660) feet. A speed control point is defined as any one (1) of the following:

1. Any design condition that requires a complete stop such as the intersection of a local residential street with a collector or arterial street, or a "T" intersection between local streets. (Note: Stop sign control at the intersection between local streets does not qualify.)

2. A horizontal curve that does not exceed a radius of three hundred (300) feet and a corresponding delta of thirty (30) degrees minimum.

In the event that there are circumstances where it is not practical to achieve traffic calming measures with design features as stated above, Table 10-10-02 is intended to provide the design engineer with a list of alternative traffic calming design features (listed in order of preference).

See Design Criteria, Table 10-10-01, for the design overview.

F. LID Integrated Management Practices (IMPs) as detailed in the City’s LID Guidance Manual as adopted as part of the City of Flagstaff Stormwater Management Design Manual may be allowed in the right-of-way on a case-by-case basis as approved by the City Engineer and Public Works section head.

Only stormwater generated in the public right-of-way will be allowed to be associated with an IMP. No stormwater generated on private property will be allowed to be associated with an IMP in the right-of-way.

LID IMPs, if allowed in the public right-of-way, shall be considered private drainage infrastructure. Ownership and maintenance responsibilities for LID IMPs shall be as described in the amendments to the Floodplain Management Regulations. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Sections:

13-10-003-0001  Street Naming and Addressing
13-10-003-0002  Street Name Policy

SECTION 13-10-003-0001  Street Naming and Addressing

A. The City of Flagstaff Engineering Section shall be responsible for assignment of addresses and for changing any conflict in an existing address or street name.

B. Developers should select appropriate names for new streets; however, the Engineering Section will review any proposed street name to determine if it duplicates or conflicts with existing street names within the City or County or if it would otherwise cause confusion.

1. This review takes place when the preliminary plat is filed.

2. The City has a list of historical names, which may be used for street names. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-003-0002  Street Name Policy

A. The Engineering Section has established the overarching standards for street name extensions:

<table>
<thead>
<tr>
<th>Type</th>
<th>Extension Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Misc. arterial/collector street</td>
<td>Boulevard (Blvd.)/Road (Rd.)</td>
</tr>
<tr>
<td>East/west arterial/collector</td>
<td>Avenue (Ave.)</td>
</tr>
<tr>
<td>North/south arterial/collector</td>
<td>Street (St.)</td>
</tr>
<tr>
<td>East/west local</td>
<td>Drive (Dr.)</td>
</tr>
<tr>
<td>North/south local</td>
<td>Lane (Ln.)</td>
</tr>
<tr>
<td>Miscellaneous local</td>
<td>Way/Circle (Cir./Loop (Lp.)</td>
</tr>
</tbody>
</table>

B. If a street is on the same alignment as an existing street, and is likely to be physically connected to that existing street in the future, then the new street shall assume the name of the existing street.
1. If, because of topography or other development, it will not be possible to connect the new to the old street, then a new name should be assigned.

C. A street name shall not be assigned to a cul-de-sac serving as access to fewer than six (6) dwellings if its end will be clearly visible when viewed by a driver from the nearest intersection. Lots on such a cul-de-sac will have addresses on the main street. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-10-004
Dead End Streets

Sections:

13-10-004-0001    Dead End Streets
13-10-004-0002    Warning Devices

SECTION 13-10-004-0001    Dead End Streets

A. No dead end street of a permanent nature shall be longer than one thousand two hundred (1,200) feet. The street will terminate with a cul-de-sac, as shown in the Standard Details. If the "dead end" is of a temporary nature, the street shall terminate at a paved temporary turn-around. If the street is paved, then those structures deemed necessary by the City Engineer to provide adequate service and drainage are required. Any dead end street with no more than one (1) lot on each side need not have a turn-around but must have barricades at the end of the street.

B. The temporary turn-around shall be constructed in accordance with the appropriate engineering detail for cul-de-sacs and paved with the same pavement section and edge treatment as the adjacent street. Street drainage leaving temporary dead end streets must be conveyed in a controlled manner in public drainage easements or right-of-way. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-004-0002    Warning Devices

Dead end streets, streets closed because of construction, bridge wash-outs, boundary or half streets, or other like circumstances, shall have barricades and/or hazard signs. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Sections:

13-10-005-0001 Alleys

SECTION 13-10-005-0001 Alleys

A. All alleys in new subdivisions shall be private and shall be owned and maintained by the homeowners’ association.

B. When it is desired by the City that a new alley is public, the developer shall address the following issues to the satisfaction of the City: snow removal, snow storage, sweeping, and proximity of garages, utilities, fences, and other culture to the right-of-way line.

C. All alleys shall be improved in accordance with the appropriate MAG alley detail or designed specific for the development as may be required. The minimum width of an alley shall be sixteen (16) feet with a minimum pavement width of twelve (12) feet. The minimum offset from garages to the alley/property line shall be eight (8) feet.

D. When an existing alley is used for ingress-egress to required parking, the alley shall be improved where it adjoins the parcel and to one (1) or both ends as necessary to accommodate the new traffic pattern, in accordance with the appropriate MAG alley detail. Existing alleys shall not be used to convey on-site (private) drainage whenever possible. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Sections:

13-10-006-0001 Intersection Design
13-10-006-0002 Intersection Sight Triangles, Clear View Zones

SECTION 13-10-006-0001 Intersection Design

A. Intersections concerned with an arterial or collector shall be joined to provide a minimum length of tangent (at right angles to the adjoining street and measured from the curb return of the adjoining street) as follows: arterial – one hundred (100) feet, major collector – seventy-five (75) feet, minor collector – fifty (50) feet, and local – fifty (50) feet. The only exception to this is when a local street intersects a minor collector.

B. Intersections not involving arterial and major collector streets shall have a minimum intersecting angle of seventy-five (75) degrees. Where two (2) residential local streets intersect, the minimum angle shall be sixty (60) degrees.

C. Curb return radii shall be as shown in Table 10-10-01.

D. Distances between centerlines of adjacent intersections shall be a minimum of one hundred thirty-five (135) feet, regardless of the direction of the intersecting streets.

E. Traffic control device locations shall be shown on the construction plans. Materials and workmanship shall be approved by the City Engineer and shall be in conformance with the guidelines of the Federal Highway Administration and the Manual on Uniform Traffic Control Devices (M.U.T.C.D.) current edition. All traffic controls shall be installed by the developer prior to occupancy.

F. Monuments shall be placed at the intersection of right-of-way centerlines. Refer to Section 13-03-002-0007 for survey monuments.

G. Additional right-of-way will be required at intersections where turn lanes are required.

H. Intersection grades shall conform to City of Flagstaff Standard Engineering Details except the maximum grade on all approaches to a signalized intersection or an intersection, which is likely to be signalized in the future, shall be plus or minus two percent.
(2%) for a distance of three hundred (300) feet from the center of the intersection.

I. The minimum spacing of driveways to signalized and unsignalized intersections shall be according to Table 10-06-01. The minimum spacing shall be greater as needed to avoid the functional area of an intersection or the influence area of another driveway.

The functional area extends both upstream and downstream from the physical intersection area and includes the longitudinal limits of auxiliary lanes. The influence area associated with a driveway includes (1) the impact length (the distance back from a driveway that cars begin to be affected), (2) the perception-reaction distance, and (3) the car length. Additionally, the impact length represents the distance upstream when the brake lights of through vehicles are activated or there is a lane change due to a turning vehicle. Limited access driveways (i.e., right-in and right-out only) and driveways with right turn deceleration lanes may allow a shorter minimum spacing.

Minimum spacing shall be measured from curb return of the intersecting street to the pavement edge of the driveway.

Table 10-06-01

<table>
<thead>
<tr>
<th>Minimum Spacing of Driveways to Intersections</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGNALIZED</td>
</tr>
<tr>
<td>Posted Speed (mph)</td>
</tr>
<tr>
<td>Minimum Spacing to Intersection (ft)</td>
</tr>
<tr>
<td>&lt; or =30</td>
</tr>
<tr>
<td>230</td>
</tr>
<tr>
<td>35</td>
</tr>
<tr>
<td>275</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>320</td>
</tr>
<tr>
<td>45</td>
</tr>
<tr>
<td>365</td>
</tr>
<tr>
<td>UNSIGNALIZED</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>115</td>
</tr>
<tr>
<td>35</td>
</tr>
<tr>
<td>135</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>155</td>
</tr>
<tr>
<td>45</td>
</tr>
<tr>
<td>180</td>
</tr>
</tbody>
</table>

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-006-0002 Intersection Sight Triangles, Clear View Zones

All intersections of public streets with private streets, driveways, alleys, and other public streets shall be designed to provide
unobstructed visibility on any leg of the intersection; including visibility for pedestrian, bicycle and vehicular traffic approaching the intersection. The clear view zones shall be determined in accordance with the criteria for intersection sight triangles in the current edition of "A Policy on Geometric Design of Highways and Streets" published by AASHTO. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Sections:

13-10-007-0001 Horizontal Alignment
13-10-007-0002 Other Design Considerations

SECTION 13-10-007-0001 Horizontal Alignment

Alignment shall be so arranged as to discourage through traffic on local streets. It shall also provide for through traffic around residential districts. Street alignment shall provide adequate access for police and fire protection, snow plows, and for other road maintenance equipment on local streets and good access on arterial and collector streets. The alignment shall provide for the continuation of arterial and collector streets to adjoining properties not yet developed. When topographic or other considerations make such continuance undesirable or impractical, these conditions may be modified. In either case, the access needs of the adjacent developed and undeveloped land must be addressed in the engineer’s design report. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-007-0002 Other Design Considerations

A. Tangents from centerline deflection shall be connected by a curve in accordance with Table 10-10-01.

B. Reverse curves shall be separated by a minimum tangent length equal to the greater of 100 feet or a length sufficient to accommodate super-elevation and crown run-out, residential streets excepted.

C. The maximum tangent length of residential local streets should be five hundred (500) feet to discourage high speeds. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-10-008-0001 Vertical Alignment

The street plan of a proposed subdivision shall bear a logical relationship to the topography of the property. All streets shall be arranged to allow most of the building sites to be at or above the grade of the streets. Vertical alignments are controlled to assure that the street grades can be negotiated in adverse weather conditions and that sight distances are adequate for safety. Sufficient data shall be given on each curb line or edge of paving and on the crown of paving so that the elevation of any point may be mathematically calculated. Grade or slopes on curved streets shall be computed and recorded for the true length of curbing as measured at the back of curb. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-008-0002 Other Design Considerations

Other design considerations shall be based as follows:

A. Grades. Maximum grade for any street varies from six percent (6%) to ten percent (10%) depending on street classification (Table 10-08-01). Minimum flow line tangent grades shall be four-tenths percent (0.4%) (the preferred minimum is five-tenths percent (0.5%)).

B. Maximum grades around curb returns at intersections or on the inside curb on horizontal curves shall not exceed the maximum allowed centerline grade for that functional classification of street by more than two percent (2%).

C. Vertical Curves. All straight grades that deflect by more than one percent (1%) must be joined by a parabolic vertical curve. The length shall be determined using the current AASHTO "Policy on Geometric Design of Highways and Streets." The minimum vertical curve length for a given design speed is determined in Table 10-08-01 as the greater of the value in the ‘Minimum Length’ column or the length calculated from the ‘Rate of Vertical Curvature’ column by the formula:
L = K x A (where: L = minimum curve length (ft.))

K = rate of vertical curvature (ft./%) 

A = algebraic difference in grades (%) 

Table 10-08-01

<table>
<thead>
<tr>
<th>DESIGN SPEED</th>
<th>MINIMUM LENGTH</th>
<th>RATE OF VERTICAL CURVATURE K (ft. per % grade change)</th>
</tr>
</thead>
<tbody>
<tr>
<td>mph</td>
<td>ft.</td>
<td>CREST</td>
</tr>
<tr>
<td>20</td>
<td>60</td>
<td>7</td>
</tr>
<tr>
<td>25</td>
<td>75</td>
<td>12</td>
</tr>
<tr>
<td>30</td>
<td>90</td>
<td>19</td>
</tr>
<tr>
<td>35</td>
<td>105</td>
<td>29</td>
</tr>
<tr>
<td>40</td>
<td>120</td>
<td>44</td>
</tr>
<tr>
<td>45</td>
<td>135</td>
<td>61</td>
</tr>
<tr>
<td>50</td>
<td>150</td>
<td>84</td>
</tr>
</tbody>
</table>

Vertical curve data recorded shall include the length, P.I. elevation, correction factor or finished grade at the mid-point of the curve, and elevations at twenty-five (25) foot stations.

D. Curb Returns. Data shall be given which will include curb elevations at one-half (1/2) delta, (one-quarter (1/4) delta preferred) around the return, tangent slopes, P.I. elevations, and other related features.

E. Benchmark. Permanent benchmarks shall be established in projects having no benchmark in the immediate area in accordance with Section 13-03-003-0003. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-10-009
Structural Section

Sections:

13-10-009-0001 Structural Section

SECTION 13-10-009-0001 Structural Section

A. For all new public and private streets, a structural section shall be designed by a registered professional engineer licensed in Arizona specializing in geotechnical engineering. A structural section design shall be performed based upon an adequate number of soil samples. The minimum number of samples shall be one (1) every five hundred (500) feet, or as determined by the engineer. The pavement shall be designed for a twenty (20) year life and meet the requirements of the Western Technologies, Inc., 1983 report (or most current revision): "Asphalt Concrete Pavement Design for the City of Flagstaff." The final street construction shown on the construction plans shall meet the recommendations of the design or the minimal structural section requirements of Detail 10-09-010, whichever is greater.

B. Overall street sections are shown in the Standard Drawings. Other design considerations shall be based on the following standards:

1. On projects where the contractor causes excessive damage to an existing paved street or there are multiple street cuts (maximum of four (4) in five hundred (500) feet), an asphalt overlay shall be required.

2. Except on super-elevated curves and at intersections, all new street sections will have a crown to provide drainage from the centerline to each gutter. The slope provided by the crown shall not be more than two percent (2%) or less than one percent (1%) as measured from centerline to edge of pavement.

3. Finish slope resulting from excavation or embankment shall not exceed 2:1 unless approved by the City Engineer upon receipt of a sealed certificate in writing by the engineer via a soils report that the steeper slope, as constructed, will be stable.

4. All publicly and privately constructed cut and fill slopes shall be adequately protected to prevent erosion. Cut and fill slopes greater than two (2) horizontal to one (1) vertical shall not be permitted unless the slope is determined to be stable as demonstrated by a quantitative
geotechnical analysis prepared by a registered geologist or other qualified registrant. Slopes of two (2) horizontal to one (1) vertical exceeding six (6) feet in height shall use rigid or semi-rigid erosion protection products including, when appropriate, reseeding pursuant to Chapter 13-17, Erosion Control. All slopes of three (3) horizontal to one (1) vertical slopes or greater, including two (2) horizontal to one (1) vertical slopes of less than six (6) feet in height, shall be reseeded pursuant to Chapter 13-17, Erosion Control. To provide retention of the required seeding, the City Engineer may require the use of filter fabrics to prevent erosion of the seeding and/or mulch prior to the establishment of vegetation growth.

5. A chip seal fee is required for all new public pavement improvements including streets, turn lanes, pavement matchups, trench repairs, and all other cases where a new asphalt surface course is constructed. The fee shall be payable to the City of Flagstaff and shall be calculated as defined in Section 3-10-001-0002. The fee shall be paid at the time of the applicable construction permit. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-10-010-0001 Driveways

A. Driveways shall be designed and constructed in accordance with the current MAG Standards and Details.

B. The City Engineer shall review and permit all new driveways onto the public street system. While the primary purpose of local streets is for access to adjacent properties, the primary purpose of the collector and arterial streets is the safe and efficient movement of the traffic thereon.

1. Access drives onto local streets will be reviewed and permitted as necessary to facilitate convenient and safe access to on-site circulation.

   a. The City Engineer shall limit the number, location, and design of access points from adjacent developments to arterials and collectors based on operation and safety considerations. Access to major arterials should be limited to major driveways only, while access to minor arterials and major collectors should be major or combined driveways, and access to minor collectors may be individual but head-out only. The minimum spacing of driveways where practicable shall be in accordance with Table 13-10-010-0001.

   b. Mitigation of problems created by such access points may also be required such as raised medians, turn restrictions, or right turn lanes.

<table>
<thead>
<tr>
<th>Minimum Drive Spacing (Measured Edge to Edge) on Arterials and Collector Streets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Street Type</strong></td>
</tr>
<tr>
<td>Major Arterial</td>
</tr>
<tr>
<td>Minor Arterial and Major Collector</td>
</tr>
<tr>
<td>Minor Collector</td>
</tr>
</tbody>
</table>
c. When a property fronts on more than one (1) street, its access drives may be restricted to the lower classification street(s).

C. Residential driveways are defined as those serving single-family or duplex housing. Those serving more than two (2) dwelling units are classed as commercial driveways. Residential driveways shall be located a minimum of ten (10) feet from the curb return of an intersection.

1. Residential driveway access to arterial and major collector streets is prohibited.

D. Unless the City Engineer determines that it is not feasible, commercial driveways on opposite sides of arterial or major collector streets with two (2) through lanes shall be either lined up directly opposite each other or separated, center to center by one hundred twenty (120) feet along the street.

E. Parking areas shall not be designed to require backing maneuvers out of driveways onto arterial or collector streets, or any commercial driveway on any street.

F. Docking, loading, and parking areas shall be designed so that no portion of a circulation or approach maneuver is accomplished by using a public street.

G. Maximum commercial driveway slope shall be ten percent (10%), with a minimum of twenty (20) feet of tangent at a maximum grade of two percent (2%) behind the sidewalk, or curb if no sidewalk exists.

H. When a building permit is required for a commercial use, or there is a change in use, existing driveways shall be reconstructed to conform to these standards. If an existing driveway is not proposed to be used, it shall be removed and replaced with curb, gutter and sidewalk (if sidewalk exists or is proposed).

I. Horizontal saw cutting of curb face for driveway openings or handicap access ramps is allowed subject to the following general conditions:

1. The cut edge along the curb is to be ground smooth and rounded to approximately the radius at the top of the existing curb face.

2. The intersection point between the wing cut and the bottom cut is to be ground smooth and repaired as necessary to eliminate any depressions.
3. The finished cut shall conform to the slopes and dimensions in accordance with the current MAG Standards and Details.

J. When the design of a driveway includes a diverter island to direct traffic, the curb shall be MAG 220 Type D. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-010-0002 Right Turn Deceleration Lane Warrants

Right turn deceleration lanes shall be required at driveways based on the following set of curves. The curves are based upon design peak hour (DPH) volume of the curb lane (current planning horizon year volume), DPH right turning volume and posted speed limits. Data points that land above the given curve warrant a right turn lane and points below the curve do not automatically warrant a right turn deceleration lane. Refer to Detail 10-10-020 or ADOT Policies, Guidelines, and Procedures, Section 430 for design.
Figure 10-10-01

Right-Turn Lane Warrant


(Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-10-011
Resource and Slope Design Criteria

Sections:

13-10-011-0001 Resource and Slope Design Criteria

SECTION 13-10-011-0001 Resource and Slope Design Criteria

A. Tree and shrub resources located in existing or proposed right-of-way or easements granted or to be granted to the City of Flagstaff shall be considered in the civil design. The resources shall be saved and integrated into the design. Prior to the start of construction, resources shall be fenced, as required, so as to protect them during the construction process.

B. Roadway design criteria shall consider existing topography so as to minimize cuts and fills. Except as provided herein respecting maximum slope criteria, roadways shall follow existing topography as best as possible. Slope protection shall be provided pursuant to the City of Flagstaff Stormwater Design Manual (Chapter 10). If retaining walls are warranted, the design shall meet the following criteria:

1. Walls shall blend with the natural features of the setting by the use of native rock or other materials that convey a scale, color, and texture similar to that of traditional rock (split face block and scored and textured concrete are examples).

2. Limit the height of a retaining wall to five (5) feet or less when feasible.

3. Where greater heights are necessary, use a series of terraced or stepped walls with the width of the terrace no less than three (3) feet.
<table>
<thead>
<tr>
<th>Functional Classification(*)</th>
<th>Major Arterial</th>
<th>Minor Arterial</th>
<th>Major Collector</th>
<th>Minor Collector</th>
<th>Commercial Local</th>
<th>Residential Local (Wide)</th>
</tr>
</thead>
<tbody>
<tr>
<td>URBAN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Through Lanes</td>
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<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Maximum Average Daily Traffic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On Street Parking</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>Not allowed</td>
</tr>
<tr>
<td>Bicycle Provision</td>
<td>4.5'</td>
<td>4.5'</td>
<td>4.5'</td>
<td>4.5'</td>
<td>4.5'</td>
<td>4.5'</td>
</tr>
<tr>
<td>Total A.C. Width</td>
<td>68', **68'/64'</td>
<td>68', **68'/68'</td>
<td>68', **68'/68'</td>
<td>68', **68'/68'</td>
<td>68', **68'/68'</td>
<td>68', **68'/68'</td>
</tr>
<tr>
<td>Min. A.C. Width @ Signal w/o Median</td>
<td>68', 68', 68'</td>
<td>68', 68', 68'</td>
<td>68', 68', 68'</td>
<td>68', 68', 68'</td>
<td>68', 68', 68'</td>
<td>68', 68', 68'</td>
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<tr>
<td>Min. Park. No. 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. A.C. Width @ Signal w/o Median</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. Parkway</td>
<td>5'</td>
<td>5'</td>
<td>5'</td>
<td>5'</td>
<td>5'</td>
<td>5'</td>
</tr>
<tr>
<td>Parking Lane Width</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Min. A.C. Width @ Signal w/o Median</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Revised 10/17)
### Table 10-10-01
Functional Classification/Design Criteria (Continued)

<table>
<thead>
<tr>
<th>Functional Classification(*)</th>
<th>Major Arterial</th>
<th>Minor Arterial</th>
<th>Major Collector</th>
<th>Minor Collector</th>
<th>Commercial Local</th>
<th>Residential Local &quot;Wide&quot;</th>
<th>Residential Local</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. A.C. Width at Nonsignalized Inters. w/o Median</td>
<td>48'</td>
<td>48'</td>
<td>48'</td>
<td>48'</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Corner Cut-Off (See Note No. 4)</td>
<td>25'</td>
<td>25'</td>
<td>20'</td>
<td>15'</td>
<td>15'</td>
<td>15'</td>
<td>15'</td>
</tr>
<tr>
<td>Curb Ret. Radius</td>
<td>30'</td>
<td>30'</td>
<td>25' **</td>
<td>20' **</td>
<td>20'</td>
<td>15'</td>
<td>15'</td>
</tr>
<tr>
<td>Design Speed</td>
<td>45 MPH</td>
<td>40 MPH</td>
<td>35-40 MPH</td>
<td>30 MPH</td>
<td>25 MPH</td>
<td>20 MPH</td>
<td>20 MPH</td>
</tr>
<tr>
<td>Superelevation (See Note No. 5)</td>
<td>4% Max.</td>
<td>4% Max.</td>
<td>4% Max.</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Min. Curve Radius (See Note No. 5)</td>
<td>900'</td>
<td>667'</td>
<td>454' (35 mph)</td>
<td>300'</td>
<td>181'</td>
<td>100'</td>
<td>100'</td>
</tr>
<tr>
<td>Maximum Grade</td>
<td>6%</td>
<td>6%</td>
<td>6%/7%</td>
<td>8%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Property Access (See Note No. 6)</td>
<td>Major D/W Only</td>
<td>Major D/W Only</td>
<td>Major or Combined D/W Only</td>
<td>Individual D/W Head Out</td>
<td>Individual D/W Head Out</td>
<td>Individual D/W Back Out</td>
<td>Individual D/W Back Out</td>
</tr>
</tbody>
</table>

* Functional classifications are further defined in Division 13-10-014.

** 1. For travel lanes adjacent to a raised median, increase travel lane width by one (1) foot.
   2. For all truck routes, there must be a minimum through lane width of twelve (12) feet and a thirty (30) foot curb return radius at intersections.

*** Rolled curb is permitted on streets in townhome and planned options where lot widths are less than or equal to forty (40) feet. This is limited to those streets within the development that front the houses.
<table>
<thead>
<tr>
<th>Functional Classification (*)&amp;</th>
<th>Major Arterial</th>
<th>Minor Arterial</th>
<th>Major Collector</th>
<th>Minor Collector</th>
<th>Local</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Through Lanes</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>On Street Parking</td>
<td>6'</td>
<td>6'</td>
<td>6'</td>
<td>6'</td>
<td>6'</td>
</tr>
<tr>
<td>Bicycle Provision</td>
<td>5'</td>
<td>5'</td>
<td>5'</td>
<td>5'</td>
<td>In travel lane</td>
</tr>
<tr>
<td>Total A.C. Width</td>
<td>81'</td>
<td>81'</td>
<td>81'/77'</td>
<td>55'</td>
<td>36'</td>
</tr>
<tr>
<td>Width (B.C. to B.C.)</td>
<td>85'</td>
<td>85'</td>
<td>85'/81'</td>
<td>59'</td>
<td>40'</td>
</tr>
<tr>
<td>Minimum R.O.W. (See Note No. 2)</td>
<td>117'</td>
<td>113'</td>
<td>113'/109'</td>
<td>87'</td>
<td>68'</td>
</tr>
<tr>
<td>Through Lane Width (**.*)</td>
<td>12'</td>
<td>12'</td>
<td>12'&gt;=40mph</td>
<td>11'</td>
<td>12'</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12'&lt;40mph</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auxiliary Lane Widths</td>
<td>11'</td>
<td>11'</td>
<td>11'</td>
<td>11'</td>
<td>11'</td>
</tr>
<tr>
<td>Min. Sidewalks</td>
<td>10'</td>
<td>10'</td>
<td>10'</td>
<td>10'</td>
<td>10'</td>
</tr>
<tr>
<td>Furnishing Strip</td>
<td>5'</td>
<td>3'</td>
<td>3'</td>
<td>3'</td>
<td>3'</td>
</tr>
<tr>
<td>Offset</td>
<td>1'</td>
<td>1'</td>
<td>1'</td>
<td>1'</td>
<td>1'</td>
</tr>
<tr>
<td>Parking Lane</td>
<td>6'</td>
<td>6'</td>
<td>6'</td>
<td>6'</td>
<td>6'</td>
</tr>
<tr>
<td>Minimum Median Width (See Note No. 7)</td>
<td>15'=11' lane + 4' median</td>
<td>15'</td>
<td>15'</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Max. Number of Lanes at a Signal w/o Median</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>NA</td>
</tr>
</tbody>
</table>
Table 10-10-01 (Continued)
Functional Classification/Design Criteria

<table>
<thead>
<tr>
<th>Functional Classification (*)</th>
<th>Major Arterial</th>
<th>Minor Arterial</th>
<th>Major Collector</th>
<th>Minor Collector</th>
<th>Local</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Number of Lanes at a Nonsignalized Intersection w/o Median</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>NA</td>
</tr>
<tr>
<td>Corner Cut-Off (See Note No. 4)</td>
<td>25'</td>
<td>25'</td>
<td>25'</td>
<td>15'</td>
<td>15'</td>
</tr>
<tr>
<td>Curb Ret. Radius</td>
<td>30'</td>
<td>30'</td>
<td>20' **</td>
<td>20' **</td>
<td>25'</td>
</tr>
<tr>
<td>Design Speed</td>
<td>45 MPH</td>
<td>40 MPH</td>
<td>35-40 MPH</td>
<td>30 MPH</td>
<td>25 MPH</td>
</tr>
<tr>
<td>Superelevation (See Note No. 5)</td>
<td>4% Max.</td>
<td>4% Max.</td>
<td>4% Max.</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Min. Curve Radius (See Note No. 5)</td>
<td>900'</td>
<td>667'</td>
<td>667' (40 mph)</td>
<td>300'</td>
<td>181'</td>
</tr>
<tr>
<td>Maximum Grade</td>
<td>6%</td>
<td>6%</td>
<td>6%/7%</td>
<td>8%</td>
<td>10%</td>
</tr>
<tr>
<td>Property Access</td>
<td>Major D/W Only</td>
<td>Major D/W Only</td>
<td>Major or Combined D/W Only</td>
<td>Individual D/W Head Out</td>
<td>Individual D/W Back Out</td>
</tr>
</tbody>
</table>

* Functional classifications are further defined in Division 13-10-014.
** 1. For travel lanes adjacent to a raised median, increase travel lane width by one (1) foot.
2. For all truck routes, there must be a minimum through lane width of twelve (12) feet and a thirty (30) foot curb return radius at intersections.
* Functional classifications are further defined in Division 13-10-014.
** 1. For travel lanes adjacent to a raised median, increase travel lane width by one (1) foot.
** 2. For all truck routes, there must be a minimum through lane width of twelve (12) feet and a thirty (30) foot curb return radius at intersections.

<table>
<thead>
<tr>
<th>Functional Classification (*)</th>
<th>Major Arterial (See Note No. 3)</th>
<th>Minor Arterial (See Note No. 3)</th>
<th>Major Collector (See Note No. 1)</th>
<th>Minor Collector (See Note No. 1)</th>
<th>Local</th>
<th>Local Narrow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Through Lanes</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>On Street Parking</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>Not striped</td>
<td>Not striped</td>
</tr>
<tr>
<td>Bicycle Provision</td>
<td>4'</td>
<td>4'</td>
<td>4'</td>
<td>4'</td>
<td>In travel lane</td>
<td>In travel lane</td>
</tr>
<tr>
<td>Total A.C. Width</td>
<td>32'</td>
<td>32'</td>
<td>32'</td>
<td>30'</td>
<td>26'</td>
<td>20'</td>
</tr>
<tr>
<td>Minimum R.O.W. (See Note No. 2)</td>
<td>60'</td>
<td>60'</td>
<td>60'</td>
<td>60'</td>
<td>50'</td>
<td>44'</td>
</tr>
<tr>
<td>Through Lane Width (**)</td>
<td>12'</td>
<td>12'</td>
<td>12'</td>
<td>12'</td>
<td>13'</td>
<td>10'</td>
</tr>
<tr>
<td>Edge Treatment</td>
<td>6 Foot Compacted Shoulders and Drainage Swales/Curb and Gutter Is Optional (See Note No. 9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sidewalks</td>
<td>No Sidewalks or Parkway Section</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking Lane</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Corner Cut-Off</td>
<td>30'</td>
<td>30'</td>
<td>20'</td>
<td>20'</td>
<td>20'</td>
<td>20'</td>
</tr>
<tr>
<td>Fillet Radius</td>
<td>30'</td>
<td>30'</td>
<td>20' **</td>
<td>20' **</td>
<td>20'</td>
<td>20'</td>
</tr>
<tr>
<td>Design Speed</td>
<td>45 MPH</td>
<td>40 MPH</td>
<td>35-40 MPH</td>
<td>30 MPH</td>
<td>20 MP</td>
<td>20 MP</td>
</tr>
<tr>
<td>Superelevation (See Note No. 5)</td>
<td>4% Max.</td>
<td>4% Max.</td>
<td>4% Max.</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Min. Curve Radius (See Note No. 5)</td>
<td>900'</td>
<td>667'</td>
<td>667' (40 mph)</td>
<td>300'</td>
<td>100'</td>
<td>100'</td>
</tr>
<tr>
<td>Maximum Grade</td>
<td>6%</td>
<td>6%</td>
<td>7%</td>
<td>8%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Property Access</td>
<td>Major D/W Only</td>
<td>Major or Combined D/W Only</td>
<td>Major or Combined D/W</td>
<td>Individual D/W Head Out</td>
<td>Individual Back Out</td>
<td>Individual Back Out</td>
</tr>
<tr>
<td>Min. D/W to Intersection</td>
<td>(See Note No. 10)</td>
<td>(See Note No. 10)</td>
<td>(See Note No. 10)</td>
<td>(See Note No. 10)</td>
<td>10'</td>
<td>10'</td>
</tr>
</tbody>
</table>
NOTES:

1. Rural residential local streets are for local access in lower density residential areas only. They provide a less intrusive design option for streets, which will experience low traffic volumes and no on-street parking. Critical to their successful operation is a site design that eliminates virtually all demand for on-street parking by providing large setbacks, long driveways, and many convenient on-site parking spaces for each dwelling.

The following minimum development criteria must be met for the rural residential local streets:

Cluster and Single-Family Detached Development – The rural residential local street shall be used where the minimum lot size is twenty-five thousand (25,000) square feet. The rural residential local "narrow" street shall be used where the minimum lot size is one (1) acre.

2. Additional right-of-way and/or easements may be required to accommodate turn lanes, traffic signals at intersections, drainage features, et cetera.

3. Sidewalks wider than five (5) feet may be required if high volumes of pedestrian traffic are expected, or in order to match existing adjacent sidewalks and master development plans.

4. The corner cut-off is normally a straight diagonal right-of-way line. A circular arc of this radius may be used if approved by the City Engineer.

At the intersection of two (2) streets of different classifications, the corner cut-off dimension and the curb return or fillet radius of the higher classification street shall be used.

5. For arterial and major collector streets, the relationship between super-elevation rate, runoff, and curve radius shall be determined from AASHTO tables for e-max equals four percent (4.0%). For local streets, the minimum delta angle (D) must be greater than thirty (30) degrees. Minimum curve radii in the table are based on no super-elevation.

6. Pavement edge tapers shall be designed in accordance with City of Flagstaff Detail No. 10-10-031.
7. Medians shall be required on all arterials and major collectors and as outlined in Table 10-10-01, or as required by the City Engineer.

8. Where new sidewalk is required in an existing development, the City Engineer may waive the requirement of a parkway if it is not practical to construct.

9. Where two (2) local residential "narrow" streets do not intersect at a right angle, the radius of curb returns on the acute angles shall be twenty (20) feet.

10. See Section 13-10-006-0001 for location of driveways adjacent to intersections.

11. For design criteria not addressed in this table, refer to AASHTO.
**Table 10-10-02 – New Design and Retrofit of Existing Streets**  
**Traffic Calming Design Features for Local Residential Streets**

<table>
<thead>
<tr>
<th>Design Option</th>
<th>Description</th>
<th>Diagram</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Neighborhood Traffic Circle | Raised circular islands placed in intersections, around which traffic circulates. Typically, min. 14' diameter and includes 2-foot wide mountable truck apron and landscaping | ![Traffic Circle Diagram](image1) | a. Effective moderating speed  
b. Improves safety  
c. Located at intersections, the ability to calm two streets  
d. Fixes grid that is adjacent  
e. Aesthetic landscape opportunity | a. Difficult for large trucks to circumnavigate  
b. Designed such that the travel lane does not encroach upon crosswalks  
c. May eliminate on-street parking  
d. Maintenance  
e. Larger trucks may have to violate lane to navigate |

- **Roundabout**  
  a. Local to collector  
  b. Local to arterial  
  c. Permitted under special circumstances  

  Larger than traffic circles and typically extends a minimum of 20' from center with 2' truck apron. The inscribed diameter should be 88' and 200'. Circulating roadway has a width of 14' to 19' | ![Roundabout Diagram](image2) | a. Moderates traffic speeds on arterials  
b. Enhanced safety as compared to signalization  
c. Less operating expenses as compared to signalization | a. May be difficult to navigate with large trucks  
b. Designed such that the travel lanes do not encroach into crosswalks  
c. Eliminates some on-street parking |
### Table 10-10-02 – New Design and Retrofit of Existing Streets
Traffic Calming Design Features for Local Residential Streets (Continued)

<table>
<thead>
<tr>
<th>Design Option</th>
<th>Description</th>
<th>Diagram</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Curb Extension         | a. Swells                                                                    |         | a. Improves pedestrian circulation and space  
                          | b. Elephant ears                                                          |         | b. Through and left-turn movements are easily negotiable by large vehicles  
                          | c. Located at intersections only                                          |         | c. Creates protected on-street parking bays  
                          | Comprises an angled narrowing of the roadway and widening of the sidewalk |         | d. Reduces speeds, especially for right-turning vehicles  
                          |                                                                                |         |                                                                                                    | a. Effectiveness is limited by the absence of vertical or horizontal deflection  
                          |                                                                                |         | b. May require the elimination of some on-street parking near the intersection  
                          |                                                                                |         | c. May require slow right-turning emergency vehicles  
                          |                                                                                |         | d. May require bicyclists to briefly merge with vehicular traffic  
                          |                                                                                |         | e. May create pedestrian conflict                                                                 |                                                                                                |
| Center Island Narrowing| A raised island located along the centerline of a street that narrows the travel lanes at that location. A min. of 6' x 20' and landscaped with pedestrian cut-through |         | a. Increases pedestrian safety  
                          |                                                                                |         | b. Reduces traffic volume  
                          |                                                                                |         |                                                                                                    | a. Speed reduction effect is limited by absence of any vertical and horizontal deflection  
                          |                                                                                |         | b. Eliminates some on-street parking  
                          |                                                                                |         | c. 300' to 500' spacing between center islands for smooth speeds                                                                 |---------------------------------------------------------------------------------------------------|
### Table 10-10-02 - New Design and Retrofit of Existing Streets
Traffic Calming Design Features for Local Residential Streets (Continued)

<table>
<thead>
<tr>
<th>Design Option</th>
<th>Description</th>
<th>Diagram</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Realigned Intersection | Changes in alignment that convert T-intersections with straight approaches into curving streets that meet at right-angles | ![Diagram](image) | a. Effective at reducing speeds and improving safety at T-intersections that have been ignored by motorists  
b. Eliminates unnecessary pavement  | a. Curb realignment could be costly  
b. May require additional right-of-way |
| Choker             | Midblock curb extensions that narrow the street by expanding the sidewalk or adding a planting strip and often are installed at midblock crossings | ![Diagram](image) | a. Easily negotiated by large vehicles  
b. Reduces speed and volume  | a. Effect upon speed is limited by the presence of vertical and horizontal deflection  
b. Bicycles briefly merge with traffic  
c. Eliminates some on-street parking |
### Table 10-10-02 – New Design and Retrofit of Existing Streets
#### Traffic Calming Design Features for Local Residential Streets (Continued)

<table>
<thead>
<tr>
<th>Design Option</th>
<th>Description</th>
<th>Diagram</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Chicane           | Literal shifts that alternate on both sides of the street creating a S-shaped path of travel | ![Diagram](image1) | a. Reduces speed through horizontal deflection  
b. Larger vehicles can easily negotiate | a. Designed to prevent drivers from varying from lane  
b. Curb alignment and landscaping could be costly  
c. Drainage a consideration  
d. May eliminate some on-street parking  
e. Snow plowing may be difficult to maneuver |
| Textured Pavement | A surface material on the roadway (such as stamped asphalt or concrete) which is installed to produce small, constant changes in vertical alignment | ![Diagram](image2) | a. Reduces speed over an extended length  
b. Located at intersection, can reduce speeds on two streets | a. Generally expensive due to material  
b. Cross-walk application may cause difficulties for those with disabilities and cyclists to traverse  
c. Less effective |
### Table 10-10-02 - New Design and Retrofit of Existing Streets
Traffic Calming Design Features for Local Residential Streets (Continued)

<table>
<thead>
<tr>
<th>Design Option</th>
<th>Description</th>
<th>Diagram</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Truncated Diagonal Diverter | A diagonal diverter with one end open to allow for additional turning movements | ![Diagram](image) | a. Discourages commuter traffic by forcing turns | a. Reduces local access  
b. Displaces traffic to other streets  
c. Costs |
| One-Way, Two-Way | Curb bulge or center island narrows 2-lane, forcing traffic for each direction to take turns | ![Diagram](image) | a. Limited, rarely used | a. Limited, rarely used |
| Median Barriers (Applied at intersections in special circumstances) | Intersection island blocking movement of a through street | ![Diagram](image) | a. Improves safety at an intersection of a local street and a major street by prohibiting dangerous turning movements  
b. Reduces traffic volumes on a cut-through route that intersects a major street | a. Requires available street width on the major street  
b. Limits turns to and from the side street for local residents and emergency services  
c. Reduces access to driveways on major arterials |
<table>
<thead>
<tr>
<th>Design Option</th>
<th>Description</th>
<th>Diagram</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement Markings</td>
<td>Painted striping or channelization to guide traffic</td>
<td></td>
<td>a. Modestly affects speed</td>
<td>a. Extreme unacceptable aesthetic</td>
</tr>
<tr>
<td>Full Closures Note:</td>
<td>Full closures divert traffic off the street, creating pedestrian and bicycle friendly areas</td>
<td></td>
<td>a. Maintains pedestrian and bicycle access</td>
<td>a. Causes circuitous routes for local residents and emergency service vehicles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. Effective in reducing traffic volume</td>
<td>b. May be expensive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>c. May limit access to businesses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>d. May increase volumes in remaining routes</td>
</tr>
<tr>
<td>Half Closures Note:</td>
<td>Similar to full closures, are barricades located in the street and constructed of landscaped walls, gates, side-bollards, or other obstructions</td>
<td></td>
<td>a. Maintains pedestrian and bicycle access</td>
<td>a. Causes circuitous routes for local residents and emergency service vehicles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. Effective in reducing traffic volume</td>
<td>b. May limit access to businesses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>c. Depending on the design, drivers may be able to circumvent the barrier</td>
</tr>
</tbody>
</table>
Diagonal Diverters
Note: Applies only to retrofit of existing streets

A barrier placed diagonally across an intersection disconnecting the legs of the intersection

<table>
<thead>
<tr>
<th>Design Option</th>
<th>Description</th>
<th>Diagram</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a. Does not require a closure per se, only a redirection of existing streets</td>
<td><img src="image" alt="Diagram" /></td>
<td>a. Cause circuitous routes for local residents and emergency service vehicles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Able to maintain full pedestrian and bicycle access</td>
<td></td>
<td>b. May be expensive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Reduces traffic volumes</td>
<td></td>
<td>c. May require reconstruction of corner curbs</td>
<td></td>
</tr>
</tbody>
</table>

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-10-012
Standards for Thoroughfares Applied in Traditional Neighborhood Districts

Sections:

13-10-012 Standards for Thoroughfares Applied in Traditional Neighborhood Districts

13-10-012-0001 Applying a Thoroughfare Type in a Traditional Neighborhood

13-10-012-0001.1 Transect Zone
13-10-012-0001.2 Speed/Movement Types
13-10-012-0001.3 Functions of Thoroughfares
13-10-012-0001.4 Other Considerations
13-10-012-0001.5 Arterials and Major Collectors as Described in Division 13-10-014

13-10-012-0002 Bicycle Facilities in Traditional Neighborhoods

13-10-012-0003 Special Districts

13-10-012-0004 Tables: Thoroughfare Standards in Traditional Neighborhood Districts

13-10-012-0005 Utilities in Traditional Neighborhood Districts

13-10-012-0005.1 Utility Placement in Thoroughfares in Traditional Neighborhood Developments

13-10-012-0005.2 Planning of Utilities in Traditional Neighborhood Developments

13-10-012-0006 Vehicular Parking/Right-of-Way Assemblies

SECTION 13-10-012 Standards for Thoroughfares Applied in Traditional Neighborhood Districts

This chapter provides the standards for thoroughfares to be applied in traditional neighborhood districts as approved by the City Council based on the provisions of the City of Flagstaff Zoning Code.

New terms and concepts typically associated with traditional neighborhoods are introduced in this chapter and the zoning code. A general explanation of the concepts behind traditional neighborhood development is provided in Appendix 1.2 of the zoning code. Specific terms used throughout this chapter that are capitalized may refer to Chapter 10.80, Definitions, of terms for traditional neighborhood districts in the zoning code. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-012-0001 Applying a Thoroughfare Type in a Traditional Neighborhood

 Transect zones, speed/movement type, functions of thoroughfares, arterials as described in Division 13-10-014, and other considerations should be taken into account in determining the correct application of
a thoroughfare type in a traditional neighborhood. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-012-0001.1 Transect Zone

A. A traditional neighborhood district is based on the delineation of transect zones. Transect zones are ordered from the most natural to the most urban and they describe the physical character of place at any scale according to the density and intensity of urbanism. The urban form and character of a transect zone will dictate the type of thoroughfare that should be placed within or adjacent to it. Determining the urban form and character and its associated land uses first, and thoroughfare type secondarily, is critical to ensuring a thoroughfare system that accommodates all users (pedestrians, cyclists, public transit and automobiles) with an emphasis on walkability and pedestrian safety. The following types of transects may be applied in a traditional neighborhood.

1. **T1 Natural Zone** consists of lands approximating or reverting to a wilderness condition, including lands unsuitable for settlement due to topography, hydrology or vegetation.

2. **T2 Rural Zone** consists of sparsely settled lands in open or cultivated state. These include woodland, grasslands, parks and open space areas. Typical buildings are farmhouses, agricultural buildings or cabins.

3. **T3 Sub-Urban Zone** consists of low-density residential areas, adjacent to higher density zones that include some mixed use. Home occupations and outbuildings are allowed. Planting is naturalistic and setbacks are relatively deep. Blocks may be large and the roads irregular to accommodate natural conditions.

4. **T4 General Urban Zone** consists of mixed-use but primarily residential urban fabric. It may have a wide range of building types, such as single-family, sideyard buildings, and rowhouses. Setbacks and landscaping are variable. Streets with curbs and sidewalks define medium-sized blocks.

5. **T5 Urban Center Zone** consists of higher density mixed-use buildings that accommodate retail, offices, rowhouses and apartments. It has a tight network of streets and small blocks, with wide sidewalks, regularly spaced street planting, and buildings set close to the sidewalks.

6. **T6 Urban Core Zone** consists of the highest density and height, with the greatest variety of uses, and civic
buildings of regional importance. It may have larger blocks, and streets have regularly spaced tree planting with buildings set close to the wide sidewalks. The T6 urban core is typically associated with downtown Flagstaff, thus this transect would not be applied in other locations within the City.

B. Special districts such as an industrial area or business park consist of areas with buildings that by their use, placement or configuration cannot, or should not, conform to one (1) or more of the six (6) normative transect zones. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-012-0001.2 Speed/Movement Types

A. The design speed for pedestrian safety and mobility is the primary determinant of movement types. Movement types associated with assigned lane widths and curb radii are applied in each transect zone.

1. **YIELD**: Drivers must proceed slowly, with extreme care and must yield to approaching traffic when vehicles are parked on both sides of the thoroughfare. A yield street is the functional equivalent of traffic calming. Design speed of twenty (20) miles per hour or less.

2. **SLOW**: Drivers can proceed carefully with an occasional stop to allow a pedestrian to cross or another car to park. The character of the street should make drivers uncomfortable exceeding the design speed due to the presence of parked cars, sense of enclosure from buildings and street trees, tight turning radii, and other design elements. Design speed of twenty (20) miles per hour.

3. **FREE**: Drivers can generally expect to travel without delay at the appropriate design speed. Street design supports safe pedestrian movement at the higher design speed. This movement type is appropriate for thoroughfares designed to traverse longer distances or connect to higher intensity locations. Design speed of twenty-five (25) miles per hour.

4. **SPEED**: Drivers can expect travel similar to conventional suburban street design, but with continued emphasis on pedestrian safety and comfort. Design speed of thirty (30) miles per hour.

5. **RURAL**: This is a conventional street design in which drivers can expect a separation of modes (i.e., bike lanes, walking paths and roads) allowing automobile travel to be unimpeded
by pedestrians or walkability concerns. This movement type is rarely used in traditional town planning, but may be needed when a thoroughfare crosses through T1 or T2 transect zones. Design speed may be above thirty-five (35) miles per hour.

NOTE: The design criteria for yield, slow, and free streets shall be commensurate with local streets and the speed and rural with minor collector streets. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-012-0001.3 Functions of Thoroughfares

The design of thoroughfares significantly shapes the form and character of cities, towns and neighborhoods. An understanding of a thoroughfare’s function helps to determine the correct application of a thoroughfare type in a traditional neighborhood. The five (5) basic functions of movement are:

A. The street as a CARRIER - The thoroughfare serves as a carrier or conveyor of pedestrians, vehicles, bicycles, trucks, or other traveler.

B. The street as a CONNECTOR - The thoroughfare serves to connect one (1) or more activities or uses that are separated from each other.

C. The street as "SPACE/SHELTER" - The thoroughfare or the public realm serves an important role as a location for public activity, such as cafes, restaurants, outdoor shopping, to mention a few. Creating a safe walkable streetscape is important for the successful achievement of this function.

D. The street as a "SYMBOL" - As a "symbol," the design of a thoroughfare can provide messages and information about a place, enable drivers and pedestrians to find specific locations or activities, and to use the street as a means of orientation and place-finding. It can also have a monumental or symbolic function. Route 66 is a good example of a thoroughfare with symbolic meaning.

E. The street as "CITY BUILDER OR DESTROYER" - The thoroughfare as described here may enhance land values, land uses and architectural scale, or destroy these if improperly regarded. In other words, thoroughfares can create a strong sense of community, or if not carefully designed, break down and even divide that community. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-10-012-0001.4 Other Considerations

A. Other factors to be considered in the selection of an appropriate thoroughfare type in a traditional neighborhood include:

1. Topography: Thoroughfares that traverse steep slopes may need to incorporate additional design consideration for such elements as drainage facilities, bicycle lanes on the uphill side of the street, and others.

2. Parking: Parking availability on site or on the thoroughfare will determine the appropriate thoroughfare type. Parking will also be determined by lot size and use.

3. Truck access: Thoroughfares that provide access to high volumes of large trucks.

4. Bus service: Thoroughfares that will serve as a public transit or school bus route. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-012-0001.5 Arterials and Major Collectors as Described in Division 13-10-014

A. Major and minor arterial roads and major collector roads as described and mapped in Division 13-10-014 should ideally be placed on the periphery of proposed traditional neighborhood districts. This ensures that the arterial and major collector roads maintain their integrity to convey vehicles effectively, and that the traditional neighborhood maintains its integrity as a walkable neighborhood.

1. Where these arterial and major collector roads are located on the edge of a proposed traditional neighborhood or cross through it when no other alternative location is practical or feasible, then the arterial and major collector road should be designed as a boulevard (see Illustration 13-10-012-0001.5 below).

B. A boulevard is a thoroughfare designed for high vehicular capacity and moderate to high speeds. A bike lane will typically be provided adjacent to these vehicle travel lanes. A boulevard is also designed to accommodate an access road (synonymous with frontage road) that is designed for slow speeds and where bicycles can also be safely accommodated on the outer edge of the right-of-way and separated from the faster vehicle lanes by a median as illustrated below. In order to ensure the safety of pedestrians crossing the boulevard, all medians shall be a minimum of eight (8) feet in width to provide a pedestrian refuge. With this
design, a boulevard satisfies the carrier and connector functions required of a regional arterial network, while also accommodating the space/shelter functions of a thoroughfare in a traditional neighborhood.

Illustration 13-10-012-0001.5: A Typical Boulevard

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-012-0002  Bicycle Facilities in Traditional Neighborhoods

Thoroughfares in traditional neighborhoods are designed as "complete streets," i.e., based on the surrounding land use or transect zone first, and then on the speed of vehicles and the character of the thoroughfare second. As a result, accommodations for surrounding land uses, pedestrians, bicycles and vehicles can be provided to ensure maximum functionality of the thoroughfare and safety for all users.

A. Street design practices for conventional suburban developments may not be integrated with thoroughfare design concepts in traditional neighborhoods.

B. In transect zones T4 and T5, design features such as narrower travel lanes, street trees, wide sidewalks to accommodate mixed land uses such as restaurants, retail stores, offices, and
residences on higher floors, careful building placement are necessary to create a well-defined outdoor room, and on-street parking.

C. For bike lanes in transect zones T4 and T5 (exclusive of multi-modal corridors and bikeway corridors), see Table 13-10-12-01.

D. In transect zones T1, T2, and T3 (as shown in Table 13-10-12-01), bike lanes may be provided based on vehicular speed in the thoroughfare, and on the uphill side of thoroughfares where grades exceed seven percent (7%).

E. When a free or speed thoroughfare is proposed in a traditional neighborhood district and the Regional Plan indicates that a multi-modal corridor or bikeway corridor is required within or adjacent to the traditional neighborhood district, accommodations for bicycle facilities must be provided in the thoroughfare design. This determines what bicycle facilities are required to ensure the connectivity of the multi-modal and bikeway corridors within the City. The City Engineer, or designee, shall have approval authority over appropriateness and fit of design selection. When a boulevard is proposed as described in Section 13-10-012-0001.5, a bike lane is to be incorporated into the thoroughfare section as shown in Illustration 13-10-012-0001.5. The following factors will be taken into consideration when deciding the most appropriate type of bicycle facility:

1. Intensity of activity and use anticipated within the transect zone and its associated land uses. For example, when there is a high intensity of pedestrian activity as a result of the mix of land uses adjacent to the thoroughfare, the thoroughfare should be designed and appropriate signage posted to provide for the shared use of the vehicle lane by cyclists, and bike lanes should not be provided.

2. Volume of through traffic projected for the multi-modal corridor.

   When the volume of traffic on a thoroughfare increases, there may be a greater need for bicycle facilities to ensure the safety of cyclists.

3. As speed increases in a multi-modal corridor, the need for bicycle facilities also increases. This relationship is reflected in Table 13-10-12-01.

4. The layout of existing and proposed thoroughfares is used to determine if alternate routes for bicycles can be established that provide an equivalent level of connectivity and directness.
5. The development review process may result in other measures necessary to ensure that the thoroughfare design conforms to guidelines provided in the Regional Plan, that it maintains its integrity as a walkable environment based on the transect zone within which it is located, and that it provides a safe and convenient environment for all modes of travel. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-012-0003 Special Districts

The standards and regulations for the design of thoroughfares in special districts as defined in Title 10, Flagstaff Zoning Code, shall be established by the City staff in consultation with the developer for final approval by the City Council. City staff shall base their decision on the proposed use(s) in the special district as well as the anticipated character of vehicle and pedestrian traffic. These standards and regulations shall be included in the form-based code and regulating plan associated with the proposed traditional neighborhood district. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-012-0004 Tables: Thoroughfare Standards in Traditional Neighborhood Districts

The following tables provide standards and regulations for the application and design of thoroughfares in traditional neighborhood districts:

A. Table 13-10-12-01 – Vehicular/Parking/Right-of-Way Assemblies.

B. Vehicular Lane Assemblies (located in Title 10, Flagstaff Zoning Code).

C. Thoroughfare Assemblies (located in Title 10, Flagstaff Zoning Code).


E. Public Frontages – Specific (located in Title 10, Flagstaff Zoning Code).

F. Public Lighting (located in Title 10, Flagstaff Zoning Code).

G. Public Planting (located in Title 10, Flagstaff Zoning Code). (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-10-012-0005 Utilities in Traditional Neighborhood Districts

SECTION 13-10-012-0005.1 Utility Placement in Thoroughfares in Traditional Neighborhood Developments

A. Generally water, sewer and stormwater facilities shall be placed under the street pavement. Where possible, water shall be ten (10) feet north or east of centerline and sewer on the centerline.

B. Electric, telephone, cable and gas utilities ("dry" utilities) shall be located in alleys or lanes where these are provided to minimize above-ground utility meters and boxes in the front of the property.

1. Design of the utilities must be completed prior to the approval of the public improvement plans and the final plat. This is necessary so that public utility easements (PUEs) that accommodate phone and cable pedestals, transformers, switching cabinets, and other elements are shown in both documents.

C. The typical location of utilities is illustrated in Engineering Details 9-01-010 and 9-01-011.

D. Regardless of whether utilities are located in the thoroughfare, the right-of-way adjacent to the thoroughfare, a utility easement, or a combination of these, utility access locations shall be provided. Ideally utilities shall be placed under the street (vehicle lanes) within the thoroughfare. Where this is not practical, utility access easements shall be required. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-012-0005.2 Planning of Utilities in Traditional Neighborhood Developments

Franchise utility plans are to be developed to a level that takes into consideration the location of public utility easements in alleys, lanes, and other thoroughfares so that required equipment such as transformers, switching cabinets, among others, are accommodated on the construction plans and final plat. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-012-0006 Vehicular Parking/Right-of-Way Assemblies

A "Thoroughfare Selection Report" shall be prepared for all new developments subject to the provisions of Section 10-60.10.080, and submitted to the City Traffic Engineer for review and approval. The
thoroughfare selection report may be included in a required traffic impact analysis or traffic impact study. The thoroughfare selection report shall demonstrate what criteria or rationale was used for selecting thoroughfare types. See Table 13-10-12-01 below.

**Table 13-10-12-01**  
**Vehicular/Parking/Right-of-Way Assemblies**

This table is provided to assist designers and reviewers in selecting appropriate design specifications for thoroughfares in traditional neighborhood districts.

<table>
<thead>
<tr>
<th>T1 and T2 Movement Type</th>
<th>SPEED</th>
<th>TRAVEL Lane</th>
<th>BIKE Lane</th>
<th>PARKING</th>
<th>EDGE</th>
<th>PARKWAY</th>
<th>PATH</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLOW</td>
<td>20 mph</td>
<td>10'</td>
<td></td>
<td>R</td>
<td>5'-10'</td>
<td>8'-10'</td>
<td></td>
</tr>
<tr>
<td>FREE</td>
<td>25 mph</td>
<td>10'</td>
<td></td>
<td>R or C</td>
<td>5'-10'</td>
<td>8'-10'</td>
<td></td>
</tr>
<tr>
<td>SPEED</td>
<td>30 mph</td>
<td>10'</td>
<td>Required</td>
<td>R or C</td>
<td>5'-10'</td>
<td>8'-10'</td>
<td></td>
</tr>
<tr>
<td>RURAL</td>
<td>35 mph</td>
<td>11'</td>
<td>Required</td>
<td>R or C</td>
<td>5'-10'</td>
<td>8'-10'</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T3 Movement Type</th>
<th>SPEED</th>
<th>TRAVEL Lane</th>
<th>BIKE Lane</th>
<th>PARKING</th>
<th>EDGE</th>
<th>PARKWAY</th>
<th>PATH</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Lots &gt; 1 acre)</td>
<td>20 mph</td>
<td>10'</td>
<td></td>
<td>R or C</td>
<td>5'-10'</td>
<td>5' min.</td>
<td></td>
</tr>
<tr>
<td>SLOW</td>
<td>20 mph</td>
<td>9'</td>
<td></td>
<td>6.5'</td>
<td>C</td>
<td>5'-10'</td>
<td>5' min.</td>
</tr>
<tr>
<td>FREE</td>
<td>25 mph</td>
<td>10'</td>
<td></td>
<td>6.5'</td>
<td>C</td>
<td>5'-10'</td>
<td>5' min.</td>
</tr>
<tr>
<td>SPEED</td>
<td>30 mph</td>
<td>10'</td>
<td>Required</td>
<td>6.5'</td>
<td>C</td>
<td>5'-10'</td>
<td>5' min.</td>
</tr>
<tr>
<td>REAR LANE</td>
<td>n/a</td>
<td>12'</td>
<td></td>
<td></td>
<td></td>
<td>4'</td>
<td>n/a</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T4 Movement Type</th>
<th>SPEED</th>
<th>TRAVEL Lane</th>
<th>BIKE Lane</th>
<th>PARKING</th>
<th>EDGE</th>
<th>PARKWAY</th>
<th>PATH</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLOW</td>
<td>20 mph</td>
<td>11'</td>
<td></td>
<td>6.5'</td>
<td>C</td>
<td>5' min.</td>
<td>6' min.</td>
</tr>
<tr>
<td>SLOW (w/45° parking)</td>
<td>20 mph</td>
<td>12'</td>
<td></td>
<td>18.5'</td>
<td>C</td>
<td>7' min.</td>
<td>6' min.</td>
</tr>
<tr>
<td>FREE</td>
<td>25 mph</td>
<td>11'</td>
<td>S</td>
<td>6.5'</td>
<td>C</td>
<td>5' min.</td>
<td>6' min.</td>
</tr>
<tr>
<td>FREE (w/45° parking)</td>
<td>25 mph</td>
<td>12'</td>
<td></td>
<td>18.5'</td>
<td>C</td>
<td>7' min.</td>
<td>6' min.</td>
</tr>
<tr>
<td>SPEED</td>
<td>30 mph</td>
<td>11'</td>
<td>S</td>
<td>6.5'</td>
<td>C</td>
<td>5' min.</td>
<td>6' min.</td>
</tr>
<tr>
<td>ALLEY</td>
<td>n/a</td>
<td>21'</td>
<td>Ribbon</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T5 and T6 Movement Type</th>
<th>SPEED</th>
<th>TRAVEL Lane</th>
<th>BIKE Lane</th>
<th>PARKING</th>
<th>EDGE</th>
<th>PARKWAY</th>
<th>PATH</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLOW</td>
<td>20 mph</td>
<td>11'</td>
<td></td>
<td>6.5'</td>
<td>C</td>
<td>5' min.</td>
<td>8' min.</td>
</tr>
<tr>
<td>SLOW (w/45° parking)</td>
<td>20 mph</td>
<td>12'</td>
<td></td>
<td>18.5'</td>
<td>C</td>
<td>5'-7'</td>
<td>8' min.</td>
</tr>
<tr>
<td>FREE</td>
<td>25 mph</td>
<td>11'</td>
<td>S</td>
<td>6.5'</td>
<td>C</td>
<td>5' min.</td>
<td>8' min.</td>
</tr>
<tr>
<td>FREE (w/45° parking)</td>
<td>25 mph</td>
<td>12'</td>
<td></td>
<td>18.5'</td>
<td>C</td>
<td>5'-7'</td>
<td>8' min.</td>
</tr>
<tr>
<td>SPEED</td>
<td>30 mph</td>
<td>11'</td>
<td>S</td>
<td>6.5'</td>
<td>C</td>
<td>5' min.</td>
<td>8' min.</td>
</tr>
<tr>
<td>ALLEY</td>
<td>n/a</td>
<td>21'</td>
<td>Ribbon</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 13-10-12-01
Vehicular/Parking/Right-of-Way Assemblies (Continued)

This table is provided to assist designers and reviewers in selecting appropriate design specifications for thoroughfares in traditional neighborhood districts.

<table>
<thead>
<tr>
<th>T1 and T2 Movement Type</th>
<th>SPEED</th>
<th>TRAVEL Lane</th>
<th>BIKE Lane</th>
<th>PARKING</th>
<th>EDGE</th>
<th>PARKWAY</th>
<th>PATH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curb Radius (assumes 90 degree intersections)</td>
<td></td>
<td>Curb Radius w/Parking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOVEMENT TYPE</td>
<td>SPEED</td>
<td>Curb Radius w/Parking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLOW</td>
<td>20 mph</td>
<td>5'-10'</td>
<td>C = Curb edge treatment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FREE</td>
<td>25 mph</td>
<td>10'-15'</td>
<td>Ribbon = Ribbon Curb (18 inches)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPEED</td>
<td>30 mph</td>
<td>15'-20'</td>
<td>S = When authorized by staff</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RURAL</td>
<td>35 mph</td>
<td>25'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE 13-10-12-01 NOTES:

1. Parking lanes are measured from the edge of pavement to the edge of the adjacent travel lane.

2. Bike lanes shall be four (4) feet for rural edge streets, four and one-half (4-1/2) feet for curbed streets, and five (5) feet when adjacent to a striped parking lane. Where cyclists share a travel lane with a car, shared lane marking for bicycles and vehicles may be provided. Also, refer to Section 13-10-012-0002. Bike lanes may also be required where uphill grades exceed seven percent (7%) or to provide continuity between neighborhoods. Where a bike lane is provided adjacent to a path, the path width may be reduced to five (5) feet.

3. Right-of-way shall be located two (2) feet from back of sidewalk or at the back of sidewalk when adjacent to buildings.

4. Arterial and major collector roads, as identified in Division 13-10-014, shall be designed as boulevards (see Section 13-10-012-0001.5).

5. Thoroughfares shall be designed according to the type of vehicle expected to use each thoroughfare on a daily basis recognizing that occasionally, large vehicles may cross the centerline when making turning movements.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
Use of uncompleted streets within a subdivision by construction or residential traffic will be allowed; provided, that:

A. All on-site and off-site collector and arterial streets associated with the development are complete and accepted by the City Engineer.

B. All local streets have at a minimum a two (2) inch lift of asphalt pavement in place.

C. The developer has posted an assurance with the City that covers the remaining streets construction.

D. All other private and public infrastructure, including dry utilities, associated with the development must be complete and accepted by the City Engineer.

E. All water valve boxes within the development that are within the first lift of asphalt shall be paved up to the box and cover (excluding the concrete collar).

F. All sewer manholes within the development that are within the first lift of asphalt shall be paved up to the ring and cover (excluding the concrete collar).

G. An agreement has been executed by the subdivision developer that obligates the developer to ensure the continued repair and maintenance of street improvements until acceptance by the City. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-10-014
Roadway Functional Classifications and Truck Routes

Sections:

13-10-014-0001   Roadway Functional Classifications
13-10-014-0001.1 Definitions
13-10-014-0002   Truck Routes
13-10-014-0003   Map

SECTION 13-10-014-0001   Roadway Functional Classifications

This division defines the roadway functional classes, and also provides a map of the City of Flagstaff with the various roadway classifications and truck routes. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-014-0001.1 Definitions

"Commercial local" refer to streets that provide for direct vehicle, bicycle, and pedestrian access to commercial land uses. The streets do not serve trans-regional trips and provide no route continuity beyond the areas they connect. Adjacent land uses include commercial areas, industrial sites, and institutional sites.

"Freeways" refer to high-speed facilities with access permitted only at traffic interchanges.

"Major arterials" provide relatively high-capacity roadways for longer trips. They provide direct service to major regional centers or activity and often serve as boundaries between districts. Major arterials provide roadway continuity and length for trans-regional, inter-regional and inter-state trips and connect the Flagstaff region to surrounding regions. Throughput capacity will be emphasized over local access. Adjacent land uses include commercial areas, open space, public lands, industrial sites and institutional sites. Residential property will not abut major arterials unless separated by adequate buffering.

"Major collectors" collect traffic from minor collectors and local streets within a district and deliver that traffic to major or minor arterials. They are generally not intended to serve trans-regional trips and generally will not provide route continuity for more than a mile or two (2) (except in rural areas where they may be longer). These roadways are generally contained entirely within a district and connect the neighborhoods of that district with each other. Adjacent land uses include residential and commercial areas, open space, public lands, industrial sites, and institutional sites.
"Minor arterials" provide capacity and continuity for travel between different districts of the region. Adjacent land uses include residential and commercial areas, open space, public lands, industrial sites, and institutional sites. The activity center for a district will often be located along a minor arterial or at the intersection of a minor arterial with another minor arterial or a major collector.

"Minor collectors" collect traffic from local streets and deliver it to major collectors or minor arterials. They will not serve trans-regional trips and will not provide route continuity for more than a mile (except in rural areas where they may be longer). Adjacent land uses include residential and commercial areas, open space, public lands, industrial sites, and institutional sites. The contribution of minor collectors to the structural framework of the region is minimal, but affects neighborhood form. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-014-0002 Truck Routes

The Truck Routes Map positively identifies where trucks are to operate for cross and through-town trips. The Regional Plan policies direct the City and County to develop regulations for specifying how trucks may make deliveries (i.e., make use of the shortest route in and out of a residential area, during certain hours in certain zones). The map will guide investment and design decisions so that trucks may operate in the Flagstaff region safely and efficiently. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-10-014-0003 Map

Please see the map found in the "Roadway Functional Classification Map" which is attached to the ordinance codified in this division and hereby incorporated herein by this reference as "13-10-014-0003 Map."
CHAPTER 13-12
STREET LIGHTING

Divisions:

13-12-001 General
13-12-002 Lighting Required
13-12-003 Lighting Layout
13-12-004 Pedestrian Lighting
13-12-005 Street Light Equipment
13-12-006 Plan Submittals
13-12-007 Modifications to the Existing System
13-12-008 Repair and Replacement
DIVISION 13-12-001
General

Sections:

13-12-001-0001 General

SECTION 13-12-001-0001 General

Public thoroughfares are illuminated to achieve a number of different objectives that include: providing for clear and comfortable visibility at night, making streets and sidewalks more inviting during hours of darkness, reducing nighttime accidents, facilitating vehicular and pedestrian circulation, and promoting business and use of public facilities during the night hours.

The regulations in this chapter are for fixed lighting of the different functional classifications of public streets, including the adjacent pedestrian walkways and associated bikeways. They are appropriate to meet the range of the community’s goals, which compete simultaneously for both more and less artificial nighttime illumination. They provide for traveler safety and comfort as well as enhance nighttime business and social activity while reducing the degradation of the nighttime visual environment. Additionally, they are designed to meet other community goals such as supporting local astronomical and tourism industries by minimizing light pollution, glare, and light trespass, and by conserving energy and natural resources.

These regulations cover the requirements for City capital improvement projects and private developments subject to off-site improvements requirements. They shall be used as guidelines for all other instances relative to lighting public ways.

Title 10, Flagstaff Zoning Code, establishes lighting standards for public thoroughfares in traditional neighborhood developments as approved by the City Council. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-12-002
Lighting Required

Sections:

13-12-002-0001 Lighting Required

SECTION 13-12-002-0001 Lighting Required

Streetlights shall be installed on all public and private streets in accordance with this section. The developer shall be responsible for the design and installation and all costs associated with the installation of the street lighting system. Plans shall be submitted to the City Engineer for review and approval, and shall conform to City standards. The streetlights shall become the property of the City when the final inspection of all off-site improvements is made and the City Engineer accepts said improvements.

When a development project includes both public and private street lighting, then the construction plans shall clearly note for each light fixture whether it is a public fixture or a private fixture. This distinction shall also be shown on any summary or quantities list.

The streetlights on public streets shall become the property of the City when the final inspection of all off-site improvements is made and the City Engineer accepts said improvements.

The electrical lines serving the streetlights on public streets shall be installed to Arizona Public Service (APS) standards and will become, upon acceptance, the property of APS. The developer shall be responsible for making necessary arrangements with APS for the installation of the electrical service for the street lighting system.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-12-003-0001 Lighting Layout

The intent of roadway lighting is for improved transportation safety and efficiency. The individual elements that compose the lighting installation shall complement this intent. The street lighting design shall include safety considerations to minimize hazards presented by poles as roadside and pedestrian obstacles, and as vision obstructions. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-12-003-0002 Streetlights at Intersections

SECTION 13-12-003-0002.1 General

A. Luminaire Wattage – Single Installation. The size (wattage) of a streetlight at an intersection where only one (1) light is required is determined from Table 12-03-01 based on the functional classification of the street over which the light extends.

B. Luminaire Wattage – Multiple Installation. At intersections where more than one (1) streetlight is required, all lights shall be the same size. The size shall be determined from Table 12-05-01 for the functional classification of the leg of the intersection requiring the highest wattage luminaire. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-12-003-0002.2 Streetlights at Nonsignalized Intersections

A. A streetlight shall be installed at each nonsignalized public street intersection with the following exceptions:

1. Street Width. At intersections where the width of one (1) or more of the approaches is greater than or equal to fifty
(50) feet as measured to the back of curb (on urban street sections) or edge of pavement (on rural street sections), two (2) streetlights shall be installed on diagonally opposite corners.

2. Urban Local Streets. At the intersection of two (2) urban local streets, a streetlight may be omitted if its installation would violate the spacing and uniformity criteria of Section 13-12-003-0003 along either street.

3. Rural Local and Rural Collector Streets. Streetlights are not required at intersections involving only rural local or rural collector streets. Should a designer choose to install streetlights on streets with these classifications, then the respective urban local or urban minor collector street criteria for intersections and spacing along the streets shall apply. Streetlights are required at all intersections on rural arterial streets.

B. Streetlights at unsignalized intersections shall be installed near the curb return with the luminaire extending perpendicular to the street centerline. The luminaire shall extend over the continuous roadway at a "T" intersection or over the roadway with the higher classification at a four (4) way intersection. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-12-003-0002.3 Streetlights at Signalized Intersections

Streetlights shall be installed on the signal poles at signalized intersections as follows:

At a minimum, four (4) streetlights shall be installed, one (1) on each corner of the intersection. For every leg of an intersection where the width of the leg is greater than or equal to eighty (80) feet, measured at the curb returns, an additional streetlight will be installed. The additional streetlight shall project over the right hand curb on that approach. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-12-003-0003 Spacing of Streetlights

In addition to intersection locations, streetlights shall be spaced along streets in accordance with the following table (12-03-01):

Table 12-03-01
Streetlight Spacing

<table>
<thead>
<tr>
<th>FUNCTIONAL CLASSIFICATION</th>
<th>SIZE (watts)</th>
<th>TYPE</th>
<th>LUMENS</th>
<th>SPACING</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAJOR ARTERIAL</td>
<td>180</td>
<td>LPS</td>
<td>33K</td>
<td>300'</td>
</tr>
<tr>
<td></td>
<td>135</td>
<td>LPS</td>
<td>22.5K</td>
<td>250'</td>
</tr>
<tr>
<td>MINOR ARTERIAL</td>
<td>180</td>
<td>LPS</td>
<td>33K</td>
<td>300'</td>
</tr>
<tr>
<td></td>
<td>135</td>
<td>LPS</td>
<td>22.5K</td>
<td>250'</td>
</tr>
<tr>
<td>MAJOR COLLECTOR</td>
<td>135</td>
<td>LPS</td>
<td>22.5K</td>
<td>300'</td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>LPS</td>
<td>13.5K</td>
<td>250'</td>
</tr>
<tr>
<td>MINOR COLLECTOR</td>
<td>90</td>
<td>LPS</td>
<td>13.5K</td>
<td>300'</td>
</tr>
<tr>
<td></td>
<td>55</td>
<td>LPS</td>
<td>8K</td>
<td>300'</td>
</tr>
<tr>
<td>COMM. LOCAL</td>
<td>55</td>
<td>LPS</td>
<td>8K</td>
<td>300'</td>
</tr>
<tr>
<td>LOCAL</td>
<td>55</td>
<td>LPS</td>
<td>8K</td>
<td>300'</td>
</tr>
</tbody>
</table>

Note: When streetlights are constructed along an existing street, the wattage and corresponding spacing shall match that of existing lights on the street, or this table, whichever is more restrictive. On new street construction, the designer shall select the most appropriate wattage and spacing from this table based on intersection spacing, driveway locations and other roadway features that would benefit from street light proximity.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-12-003-0004 Location and Placement of Equipment

A. In addition to the table, the following layout criteria shall be used:

1. When a streetlight location falls near an unlit intersection, the light shall be located at the intersection.

2. Streetlights should be located at property lines to the greatest extent possible, but not in conflict with other utility service locations.

3. Pole spacing along a street may vary from the criteria of Table 12-03-01 by up to ten percent (10%), provided the
spacing does not exceed three hundred (300) feet. For uniformity of appearance, the variance in spacing between adjacent spans should not be more than ten percent (10%).

4. With relation to roadway cross-sections, poles shall be located as follows (measured to the near edge of the pole):
   
   a. If either the sidewalk is at the back of curb or the parkway is less than four (4) feet wide, one (1) foot from back of sidewalk.
   
   b. When the sidewalk is separated from the curb by a parkway greater than or equal to four (4) feet in width, two (2) feet back of curb.
   
   c. When there is curbing but no sidewalk, two (2) feet from back of curb.
   
   d. On a rural street, eight (8) feet from the edge of pavement with a widened shoulder similar to the fire hydrant location in standard drawing 13-03-012.

5. Existing utility poles should be used whenever possible.

6. Wiring for streetlights shall be underground and located behind curb.

7. Additional lighting may be required when potential traffic hazards are identified in the plan review process.

8. On streets that are wider than seventy (70) feet (back of curb) the required streetlights shall alternate on either side of the street. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Sections:

13-12-004-0001 Pedestrian Lighting

SECTION 13-12-004-0001 Pedestrian Lighting

A. Lighting for pedestrian or other activity in excess of this street lighting standard is not normally required. However, publicly owned and operated pedestrian level lighting may be installed with the approval of the City Engineer, or required by the City Engineer on public right-of-way and walkway easements in special cases where there is a demonstrated need for additional illumination to supplement the required street lighting. Examples of such cases would include:

1. Walkways and mid-block crosswalks where there is an extended, high level of nighttime pedestrian activity.

2. The approaches to pedestrian under-crossings or other unusual pedestrian facilities.

3. Areas where special guidance is required to aid pedestrian navigation and decision making.

4. Locations with special walking hazards such as stairways.

5. Locations where a walkway serving a high level of nighttime pedestrian activity adjacent to the street diverges from the street far enough that it is not illuminated by the street lighting.

B. In addressing supplementary pedestrian level street lighting, the designer or developer shall meet all City standards governing all outdoor lighting in the City, whether public or private as follows:

1. All fixtures shall be fully shielded.

2. Fixtures and their installation shall minimize light trespass and glare to pedestrians and other road users.

3. Pedestrian level lighting shall use low-pressure sodium as the preferred source unless there is compelling reason that accurate color rendition is important in the pedestrian task.
4. The designer shall develop a design that uses only the minimum illumination necessary to accomplish the identified pedestrian task. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-12-005
Street Light Equipment

Sections:
13-12-005-0001 Luminaire
13-12-005-0002 Streetlight Support Structures
13-12-005-0003 Structure Colors and Paint Specifications
13-12-005-0004 Streetlight Equipment and Service Line Ownership

SECTION 13-12-005-0001 Luminaire

Luminaire for street lighting shall be full cut-off fixtures meeting the following criteria for weight and effective projected area (EPA):

Table 12-05-01
Luminaire Weight and EPA Criteria

<table>
<thead>
<tr>
<th>Luminaire Wattage</th>
<th>Maximum Weight Including Ballast, Slipfitter, Lamp and Photo Cell (Pounds)</th>
<th>Maximum EPA (Square Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>55 LPS</td>
<td>30</td>
<td>1.4</td>
</tr>
<tr>
<td>90 LPS</td>
<td>35</td>
<td>1.6</td>
</tr>
<tr>
<td>135 LPS</td>
<td>50</td>
<td>2.0</td>
</tr>
<tr>
<td>180 LPS</td>
<td>65</td>
<td>2.0</td>
</tr>
</tbody>
</table>

The City Engineer will maintain a list of acceptable luminaire. Luminaire not on this list will require submittal of technical information for review and approval by the City Engineer. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-12-005-0002 Streetlight Support Structures

Streetlight support structures consist of the base, pole, and mast arms. The standards of construction for streetlight equipment shall follow those of Arizona Public Service (APS) Construction Standard Drawing No. 8040. The streetlight pole, mast arm, and luminaire assembly shall be in accordance with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (2001 Design Criteria), to withstand a wind speed of ninety (90) miles per hour.

Contact APS for a copy of the current construction standards.
The geometry of the support structure varies with the luminaire size as shown in Table 12-05-02:

<table>
<thead>
<tr>
<th>LUMINAIRE (Watts)</th>
<th>MOUNTING HEIGHT (ft)</th>
<th>POLE (ft)</th>
<th>MAST ARM</th>
</tr>
</thead>
<tbody>
<tr>
<td>55 LPS</td>
<td>26</td>
<td>30</td>
<td>20&quot; X 6'</td>
</tr>
<tr>
<td>90 LPS</td>
<td>26</td>
<td>30</td>
<td>20&quot; X 6'</td>
</tr>
<tr>
<td>135 LPS</td>
<td>34</td>
<td>38</td>
<td>3' X 8'</td>
</tr>
<tr>
<td>180 LPS</td>
<td>39</td>
<td>38</td>
<td>8' X 8'</td>
</tr>
</tbody>
</table>

Mast arms of different rise and length may be required when existing utility poles are utilized. The design of the mounting and mast arm chosen shall be such as to place the luminaire at the appropriate nominal mounting height and above the curb or edge of the pavement of the street. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-12-005-0003 Structure Colors and Paint Specifications

The City Engineer will evaluate new projects that have streetlights to determine whether the support structure and luminaire will be colored. If it is so determined, then the following will apply:

A. Poles and mast arms shall be galvanized inside and out. The surfaces to be painted shall be acid washed and cleaned prior to painting. Galvanized coatings on surfaces not being painted shall be protected from the acid wash.

B. Painting and priming of luminaire and other fixture housings shall be done in accordance with the requirements of ADOT Standard Specification Sections 610 and 1002.

C. The color of the support structure shall match Sherwin-Williams Drylac RAL6012 or approved equal. Alternate colors may be acceptable if approved by the City Engineer.

D. Supplementary pedestrian level lighting structures and luminaire may be finished in other colors providing that the color chosen is sensitive to and complements the environment surrounding the installation. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
A. For streetlights on public roadways, the division point for ownership is at the junction point where the service line is tapped or spliced for the service to each light. Thus, the streetlight equipment including foundation, pole, mast arm, luminaire, and wiring within each pole and to the junction point, are property of the City of Flagstaff. The electric circuit feeding the lights, the junction box at the foot of each pole, and the connections, splicing, fuses, and other equipment within the junction box are the property and responsibility of the electrical utility that provides power to the streetlights.

B. On private streets, the streetlight ownership, operation, and maintenance are by separate agreement with the utility and the homeowners’ association, entity, or organization responsible for the private street. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-12-006
Plan Submittals

Sections:

13-12-006-0001 Plan Submittals

SECTION 13-12-006-0001 Plan Submittals

All new site plans, preliminary plats, or construction plan submittals shall show adjacent existing streetlights with their luminaire type and wattage.

A. New streetlights, auxiliary equipment, changes to streetlights and equipment in the vicinity of the project, which are required as a result of the project, shall also be shown on these plan submittals with the luminaire type, wattage, and other pertinent information.

B. For cases where the support structure or luminaire vary from these standards and in all cases of supplementary pedestrian level lighting, construction and materials details shall be included in the construction plans. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Sections:

13-12-007-0001 Modifications to the Existing System

SECTION 13-12-007-0001 Modifications to the Existing System

Individual requests for additions to, or deletions from, the City’s streetlight system, which are not in accordance with the lighting layout of the standard, shall be acted on by the City Engineer or his authorized representative. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-12-008
Repair and Replacement

Sections:

13-12-008-0001  Repair and Replacement

SECTION 13-12-008-0001  Repair and Replacement

If an existing streetlight installation that is not in conformance with these standards suffers damage to such an extent that the cost of repairing the damage is greater than fifty percent (50%) of the cost of replacing the nonconforming installation, then either:

A. The light shall not be repaired, but rather, replaced with an installation which fully conforms to these standards if such an installation would be in conformance with the intersection and spacing requirements of the standards; or

B. The light shall be removed if its repair or replacement would violate the intersection and spacing requirements of the standards.

If the repair cost is less than fifty percent (50%) of the replacement cost then the installation shall be repaired in accordance with these standards whenever possible. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13-13
FIRE SAFETY REQUIREMENTS

Divisions:

13-13-001  Fire Safety Requirements
13-13-002  Fire Flow
13-13-003  Fire Protection Water Supplies
13-13-004  Access
13-13-005  Addressing
13-13-006  Reservoir Capacity
13-13-007  Power Supply and Pumps
Division 13-13-001
Fire Safety Requirements

Sections:

13-13-001-0001 Fire Safety Requirements

SECTION 13-13-001-0001 Fire Safety Requirements

When applicable, these requirements shall conform to the adopted International Fire Code (IFC) and/or National Fire Protection Association (NFPA) standards. Fire requirements are under the sole jurisdiction of the City of Flagstaff Fire Chief. As such, the following requirements are included for the purpose of consolidating minimum design requirements in this document. If any portion of the currently adopted IFC or NFPA standards conflicts with these standards, the more restrictive requirement shall apply. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-13-002
Fire Flow

Sections:

13-13-002-0001 Fire Flow

SECTION 13-13-002-0001 Fire Flow

A. For minimum fire flow demands please refer to Section 13-09-003-0004.3.

B. For fire flow requirements for buildings refer to Appendix B of the International Fire Code.

C. The Fire Chief is authorized to approve alternative materials or methods regarding fire related requirements, upon application in writing by the owner, lessee, or a duly authorized representative, when there are practical difficulties in the way of carrying out the provisions of these requirements; provided, that the proposed design, use or operation satisfactorily complies with the intent of the Fire Code. Refer to Section 104 of the International Fire Code for additional details. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-13-003
Fire Protection Water Supplies

Sections:

13-13-003   Fire Protection Water Supplies
13-13-003-0001   Fire Hydrants
13-13-003-0002   Fire Lines
13-13-003-0003   Mains

SECTION 13-13-003   Fire Protection Water Supplies

For fire protection water supplies refer to Section 507 of the International Fire Code. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-13-003-0001   Fire Hydrants

For fire hydrant construction specifications and design requirements refer to Section 13-09-006-0006. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-13-003-0002   Fire Lines

For fire line construction specifications and design requirements refer to Section 13-09-006-0006.4. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-13-003-0003   Mains

For water main construction specifications and design requirements refer to Division 13-09-003. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-13-004
Access

Sections:
13-13-004-0001  Fire Access
13-13-004-0002  Dead End Fire Access
13-13-004-0003  Technical Reports

SECTION 13-13-004-0001  Fire Access
A. For fire access requirements refer to Section 503 and Appendix D of the International Fire Code.
B. For most situations, fire access has been incorporated into the required street section details of these standards. Refer to Details 10-09-032 through 10-09-048 and Section 13-10-012-0006 for thoroughfare street sections. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-13-004-0002  Dead End Fire Access
A. For dead end fire access requirements refer to Appendix D – Fire Apparatus Access Roads of the International Fire Code.
B. For dead end streets construction specifications and design requirements refer to Division 13-10-004 and cul-de-sac Details 10-04-010 and 10-04-011. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-13-004-0003  Technical Reports
A technical report may be required to determine the suitability of emergency response routes in correlation with accepted industry standards such as National Fire Protection Association (NFPA) 1710. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-13-005
Addressing

Sections:

13-13-005-0001 Addressing

SECTION 13-13-005-0001 Addressing

A. For addressing requirements refer to Section 505.1 (Address Numbers) of the International Fire Code.

B. For City of Flagstaff Engineering addressing requirements refer to Division 13-10-003. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-13-006
Reservoir Capacity

Sections:

13-13-006-0001  Reservoir Capacity

SECTION 13-13-006-0001  Reservoir Capacity

For reservoir capacity as it pertains to fire flow requirements, please refer to Section 13-09-003-0004.3. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-13-007
Power Supply and Pumps

Sections:

13-13-007-0001 Power Supply and Pumps

SECTION 13-13-007-0001 Power Supply and Pumps

For power supply and pump requirements refer to Section 913 (Fire Pumps) of the International Fire Code and NFPA 20 - Stationary Fire Pumps of the National Fire Protection Association Standards. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13–14
BICYCLE FACILITIES

Divisions:

13-14-001 Bicycle Facilities
Division 13-14-001
Bicycle Facilities

Sections:

13-14-001-0001 Bicycle Facilities

SECTION 13-14-001-0001 Bicycle Facilities

Bicycle facilities and multi-use trails shall be designed in accordance with the City of Flagstaff and Coconino County's "Pedestrian and Bicycle Design Guide." (Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13-15
WORK IN PUBLIC RIGHTS-OF-WAY AND EASEMENTS

Divisions:

13-15-001 Permit Requirements
13-15-002 Project Clean-Up Requirements
Division 13-15-001
Permit Requirements

Sections:
13-15-001-0001 Permit Requirements

SECTION 13-15-001-0001 Permit Requirements

A. This permit is for the time period indicated. Should the permittee be unable to complete the work in the specified time (adverse weather conditions excepted), the permittee shall make application to the City of Flagstaff for a time extension and pay to the City an amount equal to fifty percent (50%) of the original permit fees.

B. All work permitted shall be done at no expense to the City of Flagstaff, and the permittee shall indemnify, defend, and hold harmless the City of Flagstaff from and against any and all liability or responsibility for any accident, loss, damage to persons or property, or expenses (including reasonable attorney fees and court costs), arising from and/or occurring as a result of any death, bodily injury, personal injury, or property damage of any kind or description that may directly or indirectly relate to or stem from any work or activities under the terms of this permit. In essence, permittee shall assume all said liabilities and/or responsibilities and protect and/or restore all property both public and private damaged as a result of the activities of the permittee, its agents, employees, or contractor. Prior to the issuance of a permit, the permittee shall provide the City of Flagstaff with one (1) copy of a certificate of commercial general liability insurance naming the City as an additional insured. The minimum limits of coverage shall be those currently required by the City of Flagstaff Risk Management Section. This insurance shall in no way limit the extent or enforcement of the above listed hold harmless agreement.

C. The permittee shall adhere to all Federal, State, and local laws, ordinances, and regulations.

D. All permitted work shall be performed in accordance with the requirements of the City Engineer, the Uniform Standard Specifications for Public Works Constructions (MAG Specifications), City of Flagstaff Addendum to MAG, Flagstaff City Code, Title 13, Engineering Design Standards and Specifications for New Infrastructure, Uniform Standard Details for Public Works Construction (MAG Details), and the City of Flagstaff Stormwater Design Manual; and the approved plans, construction schedules, and traffic control plans submitted with the application for permit.
E. Where a proposed underground utility is installed under an asphaltic or Portland cement concrete surfaced roadway, the installation shall be made by boring or jacking beneath the road surface. Pavement cuts are permitted only when:

1. Physical constraints such as bedrock or indeterminable infrastructure prevent boring or jacking.

2. An unsuccessful attempt has been made to bore or jack the installation.

3. Connection to an existing utility located beneath the paved portion of the roadway is necessary.

4. Right-of-way limits do not accommodate a boring operation.

5. Boring will result in an inordinate cost when compared to an open cut (two (2) times the cost as demonstrated by an engineer’s estimate or actual construction bid).

6. The surface of the roadway is in a badly deteriorated condition such that a pavement cut will not detract from the integrity of the surface, as determined by the City Engineer.

F. When trenching is necessary and permanent, pavement patch is not practicable, temporary trench pavement shall consist of UPM (Unique Paving Material), HPTM United Metro or approved equal. In lieu of placing UPM, the permittee may elect to completely backfill the trench to within two (2) inches of the finish trench grade with non-shrink slurry backfill conforming to Section 13-09-006-0003. The final two (2) inches shall be MAG Class C concrete.

G. Permittees shall submit to the City for approval:

1. Two (2) copies of the construction plans. The City Engineer may waive this requirement for minor work, in which case the applicant shall submit two (2) copies of a sketch that depicts in suitable detail the proposed work.

2. For work in public rights-of-way that requires the restriction of traffic or closure of public streets, the permittee shall submit two (2) copies of a traffic control plan conforming to the requirements of the MUTCD. The City Engineer may suspend this requirement for minor work.

H. Streets or alleys shall not be closed without written authorization of the City Engineer.
I. Should blasting be required, an additional permit shall be obtained from the City of Flagstaff Fire Department.

J. The permittee shall notify the City of Flagstaff Engineering Section, (928) 779-7650, on the working day immediately preceding the date work will commence, or recommence after a stoppage.

K. The permittee shall fully conform to the requirements of A.R.S. Section 40-360.21 et seq. (Blue Stake requirements, call 1-800-STAKE-IT).

L. The permittee shall fully conform to the requirements of A.R.S. Section 40-360.21, restrictions for working near or over power lines.

M. The permittee shall be fully responsible for all work performed under this permit, including, but not limited to, workmanship and worksite clean-up as specified in Division 13-15-002.

N. All work permitted herein shall be guaranteed against all defects in material and workmanship for one (1) year from the date it is accepted by the City Engineer.

O. Upon acceptance by the City Engineer, all public roadway drainage, water, and sewer facilities shall become and remain the property of the City of Flagstaff.

P. The permittee may be required to perform special requirements as determined by the City Engineer. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Sections:

13-15-002-0001  Project Clean-Up Requirements

SECTION 13-15-002-0001  Project Clean-Up Requirements

A. All contractors working within the City of Flagstaff, both on public property or private property, shall perform their work in such a way as to minimize the dust, dirt, mud, trash and other debris that leaves, by any means, the construction area. This may include necessary watering (the use of City reclaimed wastewater is encouraged and it is required on all major construction activity in accordance with Section 7-03-001-0015, Cross Connection Control), a dust palliative, silt fencing, best management practices, or whatever else that may be necessary to protect private and public property from undue inconvenience or hazards.

B. Any public or private property that is damaged, soiled, muddied, or otherwise marred shall be restored and returned to its original condition by the contractor, developer or property owner. This work may include repairs to street pavement, removal of mud and debris, street sweeping, watering (the use of City reclaimed wastewater is encouraged), and other work as necessary to restore the public property to its previous condition. The restoration of private property shall include sweeping, debris removal, and other clean-up or repairs needed to restore the private property to its original condition.

C. When, in the opinion of the City Engineer, Street Superintendent, or Chief Building Official construction activity results in undue inconvenience or hazards to the public, the City Official may give a written order instructing the contractor to do any of the following:

1. Change the work methods causing the damage or hazard within a specified time frame.

2. Perform the necessary clean-up work or repairs to remove the damage or hazard.

3. Cease immediately the construction activity causing the damage or hazard.

D. The contractor or property owner, if no contractor is on the project, is responsible for any needed clean-up resulting from
the construction activity on the property owner’s project. This responsibility shall include damage resulting from vehicles or machinery of the subcontractor and materials suppliers.

E. Should the contractor or property owner not perform the needed repair or clean-up within twenty-four (24) hours of written order, the City may arrange for the needed clean-up or repairs to be performed. The contractor or property owner, as the case may be, shall pay the cost of the clean-up or repairs to the City prior to the acceptance of the public improvements or occupancy of on-site buildings. Any unpaid charges may be collected from any sureties for the project on deposit with the City.

F. Contractor shall not store material within the rights-of-way of public streets without the written permission of the City Engineer or his authorized representative. When allowed, storage shall be performed to minimize inconvenience and hazard to the public. A traffic control plan shall be submitted by the contractor for review by the City Traffic Engineer. The Traffic Control Plan shall show all devices necessary to conform with MAG Part 400. Under normal conditions, storage of materials will be allowed only on streets closed to public travel.

G. The City Engineer may direct that the contractor access construction sites by routes causing the least potential inconvenience and damage to public and private property. This direction may include the use of alternate routes for construction vehicles, workers access to the construction site and delivery materials. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13-16
TRAFFIC SIGNALS, SIGNING, AND PAVEMENT MARKINGS

Divisions:

13-16-001 General
13-16-002 Signal Design Elements
13-16-003 Signal Equipment
13-16-004 Signal Construction
13-16-005 Traffic Signs
13-16-006 Pavement Markings
Division 13-16-001
General

Sections:

13-16-001    General
13-16-001-0001 Standards and Applicable Documents
13-16-001-0002 Professional Certification

SECTION 13-16-001    General

The necessity for installation or removal of traffic signals shall be determined through traffic studies or a traffic impact analysis approved by the City Traffic Engineer. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-001-0001    Standards and Applicable Documents

A. Except as contained in this chapter, all designs, materials, and construction shall conform to the current version of the following:

1. The Arizona Department of Transportation Standard Specifications for Road and Bridge Construction.

2. The Arizona Department of Transportation Traffic Signal and Lighting Standard Drawings.

3. The Arizona Department of Transportation Signing and Marking Standards.


5. International Municipal Signal Association, Inc., Wire and Cable Specifications.


10. The City of Flagstaff Traffic Signal Approved Products List.  
    (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-001-0002  Professional Certification

The design of traffic signals for private development and capital projects shall be under the direction of a Civil Engineer registered in the State of Arizona, and having a Professional Traffic Operations Engineer certification from the Institute of Transportation Engineers.  
    (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-16-002
Signal Design Elements

Sections:

13-16-002-0001 Plan Set
13-16-002-0002 Intersection Design Requirements

SECTION 13-16-002-0001 Plan Set

A. For clarity of presentation and understanding, the plan set for a new traffic signal installation should contain the following sheets: the cover sheet, signal plan sheet, pole schedule sheet, conductor schedule sheet, civil plan sheet, signing and pavement markings sheets, and a detail sheet. The contents of the plan set may vary from this for projects involving modification of existing signals or where the new signal is included as a part of a larger construction project.

1. The cover sheet shall meet the requirements of Section 13-06-002-005, Cover Sheets.

2. The traffic signal plan sheet (one (1) inch equals twenty (20) feet) shall show the signal-related details, such as: cabinets, poles, conduits, pull boxes, phasing indications, detection, and pavement markings. It should also show utility locations and existing, current, and future roadway construction. Minor civil construction improvements may be included on this sheet. The plan sheet shall include general notes and notes for the signal construction.

3. The pole and conductor schedule sheets shall each include a reduced scale intersection plan view to serve as an index to the schedules on these sheets. The reduced scale plan shall include curb lines, pavement markings, cabinets, poles, and conduits with their designations, and signal heads with their phasing.

4. The pole schedule sheet shall also include separate phasing diagrams for the new signal, future phasing, if any, and preemption and other special programs. It shall also include the timing to be programmed for initial operation at start-up.

5. The conductor schedule sheet shall include a table showing individual conduits and sizes; the cables, conductors or pull wires to be placed within each of them; notes relating to cable, conductor, and electrical service; and ADOT standard schedules for IMSA multi-conductor cables.
6. The civil plan sheet(s) shall be provided to show, separate from traffic signal installation plan, the design of other elements included in the project. These elements include such work as replacement of curb or sidewalk, additional pavement for turn lane storage, drainage structures, relocations of existing improvements and utilities, and new sidewalk ramps.

7. The signing and pavement markings sheet shall detail type, size, and location of all permanent and temporary signs and pavement markings and any additional information required to manage traffic safely at each phase of the construction.

8. The detail sheet shall be used for any design and construction details that are unique to the particular project or are not included in the references standards and other documents.

B. All drawings shall distinguish clearly between existing features, proposed construction with this project, and future construction or construction by others. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-002-0002  Intersection Design Requirements

Refer to Division 13-10-006, Intersection Design, for geometric standards.

A. Curb returns shall be constructed or reconstructed to provide dual ramps and minimum ten (10) foot spacing between signal poles in accordance with Standard Drawings 10-10-034 through 10-10-039.

B. Signal equipment shall be located to accommodate anticipated future widening or additional approaches in order to minimize future modifications to the signal.

C. Cabinets shall be located out of clear view zones for traffic at the intersection and at adjacent driveways.

1. Consideration shall be given to locating cabinets and other signal equipment so as not to block driver view of adjacent, preexisting commercial advertising signs or businesses.

D. The foundation for the traffic signal cabinet shall be oriented such that the door of the cabinet opens away from intersection. A concrete technician’s maintenance pad, four (4) inches thick, four (4) feet wide, and the length of the cabinet foundation shall be placed on the door side of the foundation. The elevation of the top of the pad shall be two (2) inches above adjacent curb
for positive drainage. The cabinet foundation shall be four (4) inches higher than the technician’s maintenance pad.

E. Signals shall be designed with an "8-pole" design; that is, two (2) signal poles on each corner of the intersecting streets.

1. The minimum distance between the two (2) poles shall be ten (10) feet in accordance with ADA requirements for separation of pedestrian detection.

F. Street lighting at the intersection shall be accommodated on combination signal poles rather than by the installation of separate streetlight poles.

1. The number and location of luminaires varies with the size of the intersection, in accordance with Section 13-12-003-0002.

2. Luminaire shall be installed on twenty (20) foot mast arms unless otherwise specified.

G. Poles shall be located so as not to impede sidewalk or ramp traffic. All poles having a pedestrian push button station shall be located adjacent to a sidewalk or sidewalk ramp, or shall have an access pad installed to meet the requirements of the Americans with Disabilities Act. Reach distance to push button stations shall not exceed ten (10) inches.

H. Each pole foundation shall be provided with a one-half (1/2) inch PVC drain to allow water to drain from the pole adjusting-nut sump.

I. Overhead left turn signal heads shall be ADOT Type G, unless protected only phasing, when Type R shall be utilized.

J. Side of pole mounted left or right turn signal heads shall be ADOT Type G, each installed on an individual Type V mount.

K. Pole top mounted right or left turn signal heads shall be ADOT Type G. These may be mounted on a combination mount with one (1) other signal head.

L. Mast arm mounted signal heads shall be centered vertically over traffic lanes.

M. Seven (7) conductor IMSA cable shall be run to each outboard signal head.

N. The intersection will be "boxed" with two (2) three (3) inch diameter conduits.
1. One (1) conduit shall contain higher voltage signal and lighting conductors.

2. The second conduit shall contain lower voltage detection, preemption and communications conductors.

O. All splicing will occur in the No. 7 pull box.

P. When the intersection lies along the path of a future fiber optic interconnect route, two (2) additional three (3) inch conduits, each with a No. 8 green THW pull wire, shall be installed along that route throughout the project limits. Interconnect pull boxes shall not be placed in sidewalk areas when possible, but behind sidewalks or in greenways to minimize tripping hazards.

Q. All trenches in existing pavement shall be slurry backfilled and T-topped.

R. A minimum of one (1) No. 7 pull box, with extension, shall be installed on each corner of the intersection, and at each fiber optic interconnect location.

S. Controller operation shall be NEMA dual ring. Phase 2 shall be used for the main street through movement, either the eastbound or northbound direction.

T. Flashing mode shall be all red. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-16-003
Signal Equipment

Sections:

13-16-003-0001 Required/Approved Product List
13-16-003-0002 Controller Cabinet
13-16-003-0003 Electrical Service Cabinet
13-16-003-0004 Uninterruptable Power Supply System
13-16-003-0005 Pull Boxes
13-16-003-0006 Traffic Signal Mounting Assemblies
13-16-003-0007 Traffic Signal Heads and Indications
13-16-003-0008 Pedestrian Signals
13-16-003-0009 Painting of Traffic Signals
13-16-003-0010 Detection Systems

SECTION 13-16-003-0001 Required/Approved Product List

The City Traffic Engineer maintains a list of traffic signal components and products that are either required to be used, or that are pre-approved for use in City of Flagstaff traffic signals. This list is updated as new products and technologies come onto the market. Because of communication, compatibility, and inventory concerns, certain components are specified by manufacturer and model. Alternatives to these components will not be accepted in new signal installations. Additional components are also specified by manufacturer and model. Submittal of components for approval as "equal" to items on the list may require the submittal of additional information or product samples for testing and review before acceptance in a specific signal design. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-003-0002 Controller Cabinet

A. Cabinet shall be NEMA TS2, Type One design with all inputs and outputs through BIU interface. The back panel shall include sixteen (16) load switch bays.

B. The signal cabinet shall be unpainted aluminum, and provided with and mounted on a sixteen (16) inch high aluminum elevator base.

C. The cabinet shall include a vehicle detection rack to accommodate sixteen (16) channels of detection.

D. The cabinet shall include a telemetry interface.

E. The cabinet shall provide mounting for four (4) channels of 3M Opticom preemption.
F. The cabinet shall include a GPS based time clock with digital display, which can supply a momentary dry relay closure to the controller programmable for any half (1/2) hour of the day. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-003-0003 Electrical Service Cabinet

A. Electrical Service Cabinet.

1. Shall be a pedestal type, mounted separate from the traffic signal cabinet unless otherwise specified.

2. Shall provide metered numbers 120/240 vac power for signal and lighting loads.

3. Shall include a one hundred (100) amp main disconnect for all underground service conductors.

4. Shall provide space for a minimum of eight (8) one (1) inch circuit breakers.

5. Shall be of sufficient size to permit three (3) two (2) inch conduits to enter the customer section of the enclosure.

6. The electrical service cabinet may be combined with the UPS system cabinet and equipment. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-003-0004 Uninterruptable Power Supply System

A traffic signal UPS system shall be supplied. The UPS system shall include four (4) batteries of sufficient amp-hour rating to support the continuous full operation of a traffic signal drawing one thousand (1,000) watts for a minimum of four (4) hours; the UPS shall not operate the street lighting. The transfer switch shall be manually operated and accommodate the removal of the system control unit and batteries while the signal is operating on line power. The UPS system shall include provisions for generator operation on a signal including a utility acceptable knife type transfer switch and a NEMA Type L14-30R cord inlet with a walkable cover. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-003-0005 Pull Boxes

Only polymer concrete fiberglass reinforced pull boxes, lids and extensions shall be installed. Pull box lids will be marked "Traffic Signal." (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-16-003-0006  Traffic Signal Mounting Assemblies

A. All mounting assemblies shall be ADOT standard types, manufactured of bronze.

B. All mounting hardware shall have cast serrations. Serrated locking rings will not be permitted.

C. ADOT Type II mounts will be used for all overhead signals. Type I mounts will not be permitted. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-003-0007  Traffic Signal Heads and Indications

A. All signal heads shall be shipped fully assembled. Back plates and visors may be packaged and shipped separately for field installation.

B. All signal head back plates shall be made from one (1) piece of anodized flat black sixteen (16) gauge aluminum sheet having a nonlouvered, five (5) inch border.

C. All vehicle signals indications shall be light emitting diode (LED modules, which meet the requirements of ITE VTCSH Standards. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-003-0008  Pedestrian Signals

All pedestrian signal indications shall be LED countdown type unless otherwise specified. Modules shall have filled, not outlined hand and man displays. Modules shall meet the requirements of ITE VTCSH Standards. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-003-0009  Painting and Traffic Signals

A. All metal surfaces of traffic signal heads, pedestrian signal heads, push button assemblies and mounting framework shall be pre-treated and electrostatically power coated flat black.

B. All traffic signal poles, signal mast arms, luminaire mast arms, and luminaire housings shall be painted Sherwin Williams Drylac RAL6012 or approved equal. Alternative colors may be accepted if approved by the City Engineer.

C. Prior to painting, poles and mast arms shall be galvanized inside and out. The surfaces to be painted shall be acid washed and
cleaned prior to painting. Galvanized coatings on surfaces not being painted shall be protected from the acid wash.

D. Luminaire housings shall be painted in accordance with ADOT Standard Specifications, Sections 610 and 1002. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-003-0010 Detection Systems

A. A complete traffic signal video detection system shall be installed for vehicle detection.

1. A complete system for modifications to existing signalized intersections utilizing NEMA TS1 cabinets shall include cameras, housing (with lens heater), mounting assemblies, cables and fittings, individually fused power supplies for each camera, video processor modules, interface to NEMA TS2-Type 1 controller, and a twelve (12) inch black and white monitor for each signal.

2. A complete traffic signal video detection system for NEMA TS2 installations shall include:

   a. A system architecture that fully supports Ethernet networking of system components through a variety of industry standard and commercially available infrastructures that are used in the traffic industry. The data communications shall support direct connect, [modem,] and multi-drop interconnects. Simple, standard Ethernet wiring shall be supported to minimize overall system cost and improve reliability, utilizing existing infrastructure and ease of system installation and maintenance. Both streaming video and data communications shall optionally be interconnected over long distances through fiber optic, microwave, or other commonly used digital communications transport configurations.

   b. A system network software application side integrated through a client-server relationship. A communications server application shall provide the data communications interface between as few as one (1) to as many as hundreds of machine vision processor (MVP) sensors and a number of client applications. The client applications shall either be hosted on the same PC as the communications server or may be distributed over a local area network of PCs using the industry standard TCP/IP network protocol. Multiple client applications shall execute simultaneously on the same
host or multiple hosts, depending on the network configuration. Additionally, a web-browser interface shall allow use of industry standard Internet web browsers to connect to MVP sensors for setup, maintenance, and playing digital streaming video.

c. Video system hardware shall consist of three (3) components: (1) a color, 22x zoom, MVP sensor, (2) a modular cabinet interface unit, (3) a communication interface panel. Additionally, an optional personal computer (PC) shall host the server and client applications that are used to program and monitor the system components. The real-time performance shall be observed by viewing the video output from the sensor with overlaid flashing detectors to indicate the current detection state (on/off). The MVP sensor shall optionally store cumulative traffic statistics internally in nonvolatile memory for later retrieval and analysis.

(1) The MVP shall communicate to the modular cabinet interface unit via the communications interface panel and the software applications using the industry standard TCP/IP network protocol. The MVP shall have a built-in, Ethernet-ready, Internet Protocol (IP) address and shall be addressable with no plug in devices or converters required. The MVP shall provide standard MPEG-4 streaming digital video. Achievable frame rates shall vary from five (5) to thirty (30) frames/sec as a function of video quality and available bandwidth. The MVP sensor embedded software shall incorporate multiple applications that perform a variety of diagnostic, installation, fault tolerant operations, data communications, digital video streaming, and vehicle detection processing. The detection shall be reliable, consistent, and perform under all weather, lighting, and traffic congestion levels. An embedded web server shall permit standard Internet browsers to connect and perform basic configuration, maintenance, and video streaming services.

(2) There shall be a suite of client applications that reside on the host client/server PC. The applications shall execute under Microsoft Windows XP, Vista or Windows 7. Available client applications shall include the following: master network browser, configuration setup, operation
log, software install, streaming video player, data retrieval, and communications server functions.

(3) The modular cabinet interface unit shall communicate directly with up to eight (8) MVP sensors and shall comply with the form factor and electrical characteristics to plug directly into a NEMA type C or D detector rack providing up to thirty-two (32) inputs and sixty-four (64) outputs or a one hundred seventy (170) input file rack providing up to sixteen (16) contact closure inputs and twenty-four (24) contact closure outputs to a traffic signal controller.

(4) The communication interface panel shall provide four (4) sets of three (3) electrical terminations for three (3) wire power cables for up to eight (8) MVP sensors that may be mounted on a pole or mast arm with a traffic signal cabinet or junction box. The communication interface panel shall provide high-energy transient protection to electrically protect the modular cabinet interface unit and connected MVP sensors. The communications interface panel shall provide single-point Ethernet connectivity via RJ45 connector for communication to and between the modular cabinet interface module and the MVP sensor.

B. The City Traffic Engineering Section may require the installation of inductive loop detectors, due to special conditions.

1. All inductive presence detection loops shall be quadrupole design.

2. Preformed loop detectors are preferred, however, cut in place loops shall be considered when appropriate.

3. Standard loop configuration shall be:
   a. Left turn lanes require a six (6) by forty (40) front loop and a six (6) by twenty (20) rear loop separated by twelve (12) feet.
   b. Through and right turn lanes require a six (6) by fifty (50) loop.
   c. Bike lanes require a three (3) by ten (10) loop.
d. High-speed approaches may require one (1) more six (6) by six (6) square advance extension loops per lane.

4. Loop detector amplifiers shall be two (2) channel units with programmable extension and delay timing.

C. Pedestrian push button stations shall be ADOT Type 2 design and shall be ADA compliant. Buttons shall utilize PEIZO-electric switching and provide visual and audible indications of activation.

D. Single channel dual detection Global Traffic Technologies Opticom EVP detectors shall be installed on all approaches. Detectors shall be installed on a band-on mounting bracket. GTT Opticom cable shall be utilized. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-16-004
Signal Construction

Sections:

13-16-004-0001  General
13-16-004-0002  Damage to Signal Equipment
13-16-004-0003  Controller Cabinet
13-16-004-0004  Construction Procedure, Scheduling, and Inspection
13-16-004-0005  Activation
13-16-004-0006  Documentation and Warranties

SECTION 13-16-004-0001  General

A. The location of utilities shown on plans is approximate and not all utilities may be shown. The contractor is responsible, in accordance with Section 730-6 of the ADOT Standard Specifications, for contacting all utilities for exact location prior to excavation.

B. The contractor shall be responsible for the Blue Stake location of underground signal utilities until final acceptance.

C. The contractor shall maintain a safe and secure worksite during working and nonworking hours. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-004-0002  Damage to Signal Equipment

A. The contractor shall immediately report any damage to traffic signal equipment to the City Inspector.

B. Costs related to the repair or replacement of damaged traffic signal equipment as a result of the contractor’s negligence shall be borne by the contractor.

C. Damage to traffic signal equipment, including controller cabinet and equipment, detection loops, pull boxes, conduit, wire and cables, poles, mast arms, signal heads or related equipment as a result of project work is the responsibility of the contractor. Damage shall be repaired by an IMSA certified Traffic Signal Level II Technician. A City of Flagstaff Traffic Signal Technician shall inspect these repairs.

1. A signal cannot be dark for more than one (1) hour.

2. A signal cannot remain in flash for more than four (4) hours.
3. Damaged detection loops shall be replaced within two (2) weeks unless the City agrees in writing to a longer period.

4. Video detection and pedestrian detection shall be repaired within twenty-four (24) hours.

5. A loss of communications shall be repaired within twenty-four (24) hours.

D. If the contractor cannot respond, or cannot complete the repairs within the specified time, the City of Flagstaff Traffic Signal Shop will complete repairs. The contractor shall be charged for these repairs. The amount charged for each repair shall be the greater of either the actual accumulated charge for employee time, materials and equipment, or the mobilization cost of a two (2) person crew with service truck for two (2) hours plus materials and equipment. Charges for employee time shall include City overhead costs. Materials will be billed at replacement cost, including taxes and freight. Equipment rates will be based upon the most recent schedule of equipment rental rates for force account work, as approved by the Arizona Department of Transportation.

E. If there is a problem with a traffic signal that is not the result of the contractor’s or a subcontractor’s work, the City of Flagstaff Signal Shop will respond. If it is determined that the contractor’s work caused the problem, the contractor shall pay all costs of the repair work as described above. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-004-0003 Controller Cabinet

A. The traffic signal controller cabinet and all controller equipment shall be delivered to the City of Flagstaff Traffic Signal Shop, 500 N. Aztec Street, for testing and inspection a minimum of two (2) weeks before expected installation. Modify ADOT Standard Specification 734-2.01 to change all references from the Department to the City of Flagstaff. Contact the Senior Signal Technician at 928-774-0810 to schedule delivery.

B. After testing is complete, the contractor shall pick up, transport, and install the cabinet at the intersection. The City Signal Technician will connect all wiring inside the control cabinet. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
A. At least one (1) International Municipal Signal Association (IMSA) certified Traffic Signal Level II technician shall be on site during all traffic signal work. Prior to the start of construction, the contractor shall provide the City with a list of IMSA certified personnel. If a job site inspection reveals that a certified technician is not on site, the job will be shut down.

B. The contractor shall work with the City’s assigned off-site inspector regarding inspections, material and other project-related issues. A City traffic signal technician will provide technical support to the off-site inspector.

C. Contractor requests for inspection shall be submitted twenty-four (24) hours prior to the requested inspection.

D. Construction inspections shall include, but are not limited to, the following:
   1. A field meeting prior to project start.
   2. Before backfilling trenches and boring pits, and before covering conduit.
   3. Before filling pull box excavations with aggregate.
   4. Before excavating pole and cabinet foundations.
   5. When pole foundations are ready for concrete.
   6. When placing concrete for foundations.
   7. After installation of the electrical service cabinet.
   8. After installation of the signal cabinet.
  10. Prior to drilling signal poles for mounting hardware.
  11. Pre-turn-on inspections to verify signal completion and operation.
  12. Prior to placement of permanent signing and pavement markings.

E. The electrical service cabinet shall be inspected and approved by the City electrical inspector prior to a request for APS service.
connection. The City will supply a street address for electrical billing.

F. The contractor shall be responsible for contacting, and coordinating with APS and for meeting all service connection requirements.

G. The placement of loop detectors shall be field verified before installation.

H. Cut in place loop detectors shall be tested in accordance with ADOT specifications. Detectors not passing this inspection will not be accepted.

I. The contractor shall have all above-ground equipment on site before beginning any of the above-ground installation. Once above-ground work begins, it shall proceed continuously, until testing reveals the installation is ready for the turn-on to be scheduled.

J. Erection of the traffic signal supports shall not begin until:

1. The signal cabinet has been shop-tested and installed.

2. The electrical service cabinet has been installed and energized.

K. Above-ground construction procedure:

1. All traffic signal and pedestrian heads will be "bagged" as they are installed. Proposed material for signal bagging shall be included with material submittals for approval. Signal or pedestrian heads bagged with unapproved materials shall be removed immediately until approved bagging material is available. The bagging material will not be removed until the signal turn on has begun.

2. Install signal poles and luminaire mast arms.

3. Install signal mast arms and heads for stop-sign-controlled approaches. Signal mast arms shall not be installed for nonstop-controlled approaches at this time.

4. Install all underground wire and cable.

5. Install and wire pole mounted signal hardware, vehicle and pedestrian signal indications, pedestrian push buttons, and video detection equipment.
6. Test all pole mounted equipment in the presence of the inspector. When all foundation grounds, wiring, vehicle and pedestrian indications, vehicle and pedestrian detection, and street lighting have been tested trouble-free, the intersection will be scheduled for turn on.

7. On the scheduled date for turn on, remaining signal mast arms and heads shall be installed. All vehicle and pedestrian indications, vehicle and pedestrian detection will again be tested in the presence of a City Inspector. Following a test, which reveals no malfunctions, the signal will immediately be turned on. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-004-0005 Activation

A. Normally, turn on will be without an extended flashing period. The contractor shall provide a police officer to control traffic throughout the turn-on process, unless alternate traffic control is submitted and approved by the City Traffic Engineering Section prior to the scheduled turn on.

B. Appropriate short-term advance construction traffic control signage warning of the new signal and change in traffic control shall be included in the design. "TRAFFIC SIGNAL AHEAD" signage shall be placed during the hour immediately before turn on and taken down thirty (30) days after turn on, unless directed otherwise by the City Traffic Engineering Section. Signs may be preplaced and covered until signal activation.

C. Permanent pavement markings specific to the operation of the traffic signal such as stop bars, lane use markings, signal ahead signs, or other notifications shall not be installed more than twenty-four (24) hours prior to signal turn on, but must be installed within one (1) hour after turn on, unless otherwise directed by the City Traffic Engineer. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-004-0006 Documentation and Warranties

A. Prior to final acceptance, the contractor shall document and provide to the City the following documentation:

1. Construction plans – one (1) copy in digital format (.dwg).

2. Signal cabinet plans – three (3) printed copies, one (1) mylar copy, and one (1) copy in digital format (.dwg).
3. As-built plans - three (3) printed copies and one (1) mylar copy.

4. Operation and maintenance manuals for all traffic signal equipment and systems shall be provided in printed and digital format (.pdf).

B. The contractor shall provide and document the following warranties, effective from the date of final acceptance:

1. Five (5) years for the traffic signal controller and traffic signal LED modules.

2. One (1) year for all other equipment, materials, and labor, including settlement of trenches. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-16-005  
Traffic Signs

Sections:

13-16-005-0001 Traffic Signs
13-16-005-0002 Sign Installation

SECTION 13-16-005-0001 Traffic Signs

A. Pedestrian push button signs shall be R10-3eAZ (Arizona Manual of Approved Signs) to match the pedestrian signal display.

B. City of Flagstaff Standard Engineering Details 16-05-010 and 16-05-020, Street Name Signs, shall be mounted on each pole mast arm in accordance with ADOT Standard Drawing S-9. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-005-0002 Sign Installation

A. Traffic signs shall be installed on square tube post in accordance with ADOT Signing and Marking Standard Drawings Detail S-1. Materials shall meet the requirements of ADOT SS 607. All sign blanks shall be one-eighth (0.125) gauge aluminum, in accordance with ADOT SS 608-2.07. All signs shall utilize high intensity prismatic sheeting to comply with M.U.T.C.D. retroreflectivity standards.

B. Existing signs and posts, which are disturbed by a project, shall be replaced with new HIP signs and square tube posts. Existing signs and posts shall not be relocated, but shall be salvaged to the City. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Sections:
13-16-006-0001 Longitudinal Pavement Markings
13-16-006-0002 Transverse Markings, Symbols, and Legends

SECTION 13-16-006-0001 Longitudinal Pavement Markings

A. Permanent Markings. Permanent pavement markings shall be installed in accordance with ADOT Standard Specification 708.

B. Temporary Markings. Temporary longitudinal pavement markings, when approved, shall be installed in accordance with ADOT Standard Specification 701-3.05.

Note: This item of work shall apply to all longitudinal pavement markings and other pavement markings not specified to be preformed plastic. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-16-006-0002 Transverse Markings, Symbols, and Legends

A. Permanent markings shall be either:

1. Dual component markings (epoxy) shall be installed in accordance with ADOT Standard Specification 709; or

2. Preformed markings installed in accordance with ADOT Standard Specification 705 Type I (may only be used if total project is less than three hundred (300) square feet).

B. Temporary markings, when approved, shall be either (two (2) options are):

1. Preformed markings installed in accordance with ADOT Standard Specification 705 Type II; or

2. Preformed markings installed in accordance with ADOT Standard Specification 705 Type III.

NOTE: This item of work shall apply to all lane use arrows, all transverse pavement markings such as crosswalks and stop bar markings, and all pavement legend markings, except those required for bicycle lanes. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13-17
EROSION CONTROL

Divisions:

13-17-001 General
13-17-002 Native Seeding
13-17-003 Temporary Seeding
Division 13-17-001
General

Sections:

13-17-001 General

SECTION 13-17-001 General

Erosion control applies to improvements within the City and as part of the erosion control section of a stormwater pollution prevention plan (SWPPP). Materials, means and methods for erosion control and stabilization, best management practices (BMPs), erosion control plans (ECPs), and SWPPPs are described in the City of Flagstaff Stormwater Design Manual.

The owner, developer and/or contractor is responsible for complying with the requirements of the National Pollutant Discharge Elimination System (NPDES) permit program. This generally includes submittal of a notice of intent to the Arizona Department of Environmental Quality (ADEQ) and notice of termination to ADEQ for the project. Preparation and implementation of a stormwater pollution prevention plan (SWPPP) for the site is required in accordance with ADEQ and City of Flagstaff Engineering Standards.

All disturbed areas within the project site and as shown on the plans shall be stabilized. Work shall be performed according to the provisions of this section and shall include but not be limited to the furnishing, hauling, placement and application of erosion control materials.

It is recommended that contractors see the ADEQ Smart NOI (notice of intent) program website for information and processes. (http://az.gov/webapp/noi/main.do) (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-17-002
Native Seeding

Sections:

13-17-002-0001 Description
13-17-002-0002 Definitions
13-17-002-0003 Materials
13-17-002-0004 Seedbed Cultivation and Preparation
13-17-002-0005 Execution
13-17-002-0005.1 General Seeding
13-17-002-0005.2 Broadcast Seeding
13-17-002-0005.3 Mulching for Broadcast Seeding
13-17-002-0005.4 Drill Seeding
13-17-002-0005.5 Hydraulic Seeding (Hydroseeding)
13-17-002-0005.6 Watering
13-17-002-0005.7 Establishment Period

SECTION 13-17-002-0001 Description

The work under this chapter shall consist of seedbed preparation, furnishing required materials, sowing seed, covering seed and proper compaction of the seedbed and other necessary operations as described herein. Work under this section shall also include temporary seeding as may be required. An establishment period may be included as part of the required work under this chapter. Area to be seeded shall include any areas adjacent to the project areas, which are disturbed by construction activities. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-17-002-0002 Definitions

"Broadcast seeding" is sowing seeds using a mechanical means often a cyclone spreader driven by a power take off or hand operation.

"Grassland drill seeding" is planting seed using a grassland drill seeder. A grassland drill has multiple seed boxes (to accommodate the variety of seed characteristics of native plants), creates a furrow, meters and drops the seed, sets the seed to a specific depth, covers the seed and firms the seedbed in one (1) action.

"Hydraulic seeding," more commonly known as hydroseeding, distributes seed and mulch in one (1) operation through a water-based slurry system with a tacking agent.

"Pure live seed (PLS)" is a percentage of pure seed that will germinate expressed as a percentage of a given weight of seed thereby providing a basis for comparing seed lots that differ in purity and germination.
PLS provides for a means to adjust seeding rates. Purity and germination rate are from the seed tag or analysis report.

Calculations Related to PLS

- **Pure Live Seed (PLS) =** Percent Purity x Percent Germination Rate/100
- **Quantity of PLS =** Lbs. of Seed x (Percent Purity x Percent Germination Rate)
- **Seeding Rate for Mixture =** Percent of Plant in Seed Mix x Lbs. of PLS/Acre
- **Bulk Weight of Seed per Unit Area (e.g., acre, 1,000 SF) =** Recommended Seeding Rate PLS in Lbs. per Unit Area/Percent PLS

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-17-002-0003 Materials

A. Delivery. Deliver mulch and tackifier materials in original, unopened, undamaged containers, showing weight, analysis (if applicable) and name of manufacturer. Material shall be stored to prevent wetting and deterioration. Submit manufacturer’s product data for tackifier and wood fiber mulch.

Seed shall be delivered in standard, sealed, undamaged containers. Each container shall be labeled in accordance with Arizona Revised Statutes and U.S. Department of Agriculture rules and regulations under the Federal Seed Act. For each seed species, submit seed supplier’s certification of variety or strain of seed, percentage by weight for purity, germination, pure live seed (PLS), weed seed content and the date of analysis. Date of analysis shall not be more than nine (9) months prior to the delivery date.

B. Seed. Seed shall be fresh, clean and latest season’s crop. Legume seed shall be inoculated with appropriate bacteria cultures in accordance with the manufacturer’s instructions. Manufacturer’s preinoculated seed with protective coating may be used. Contractor inoculated seed that is not sown within eight (8) hours shall be inoculated again. Seed rates are expressed as ounces of pure live seed (PLS) per one thousand (1,000) square feet. The seed mix shall consist of the following species mix of all grasses plus five (5) flowers plus one (1) nurse crop:

<table>
<thead>
<tr>
<th>Grasses</th>
<th>Percentage of Total Mix</th>
<th>25# Total/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Bouteloua curtipendula</em></td>
<td>Sideoats Grama Grass 12%</td>
<td>3# PLS/Acre</td>
</tr>
<tr>
<td><em>Bouteloua dactyloides</em></td>
<td>Buffalo Grass 36%</td>
<td>9# PLS/Acre</td>
</tr>
</tbody>
</table>

(Revised 10/17)
Alternative species may be acceptable but are subject to prior approval from the City Engineer or duly authorized representative.

C. Fertilizer. No fertilizer is required for native seeding.

D. Mulch. Mulch for dry application shall be straw from grain crops of the current season and shall be free of noxious weeds, mold or other objectionable material.

E. Wood Fiber. Mulch for hydraulic application (hydroseed) shall be fiber mulch consisting of specially prepared wood cellulose fiber processed to contain no growth or germination inhibiting factors. Maximum moisture content, air-dry weight, twelve percent (12%) plus or minus three percent (3%) at the time of manufacture, pH range: four and one-half (4.5) to six and one-half (6.5).

F. Tacking Agent. Tacking agent shall be an organic muciloid liquid concentrate diluted with water, containing no agents toxic to

### Flowers

<table>
<thead>
<tr>
<th>Species</th>
<th>Variety</th>
<th>Percentage</th>
<th>Price/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bouteloua gracilis</td>
<td>Blue Grama Grass</td>
<td>20%</td>
<td>5# PLS/Acre</td>
</tr>
<tr>
<td>Festuca arizonica</td>
<td>Arizona Fescue</td>
<td>16%</td>
<td>4# PLS/Acre</td>
</tr>
<tr>
<td>Festuca ovina</td>
<td>Sheep Fescue</td>
<td>16%</td>
<td>4# PLS/Acre</td>
</tr>
</tbody>
</table>

**Total/Acre** 16#

### Nurse Crop (added to native grass + wild flower mix)

<table>
<thead>
<tr>
<th>Species</th>
<th>Variety</th>
<th>Price/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avena sativa</td>
<td>Oats</td>
<td>20 lbs/acre</td>
</tr>
<tr>
<td>Lolium multiflorum</td>
<td>Annual Ryegrass</td>
<td>20 lbs/acre</td>
</tr>
<tr>
<td>Trifolium pretence</td>
<td>Red Clover</td>
<td>20 lbs/acre</td>
</tr>
</tbody>
</table>

(Revised 10/17)
seed germination. When applied, the tacking agent shall form a transparent crust permeable by water and air.

G. Erosion Control Blankets. Erosion control blankets shall be straw, coir or a natural fiber blend. Straw blankets shall be used for cut and fill slopes that are greater than six (6) feet in height and steeper than 3:1 slopes and may be used for short-term protection during a single growing season. Natural fiber blend and coir blankets shall be used for steeper slopes, low flow channels and where protection is needed for multiple growing seasons.

H. Water. The preferred water source for hydraulic seeding shall be reclaimed water, available at various bulk loading sites. Specific locations are available from the City Utilities Department. Current utility rate charges for the reclaimed water shall apply.

I. Soil Amendments. Soil amendments shall be well-composted animal manure, plant compost or materials as approved by the City Engineer or duly appointed representative. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-17-002-0004 Seedbed Cultivation and Preparation

When required, soil conditioners shall be applied and incorporated into the top six (6) to eight (8) inches of the areas to be seeded. Incorporation shall be completed prior to seedbed preparation.

All areas to be seeded that are accessible to machinery shall be tilled to a minimum depth of four (4) inches. Areas inaccessible to machinery shall be hand tilled and prepared to a minimum depth of two (2) inches. Cut slopes of 2:1 or steeper do not require tilling. Cultivation on sloping terrain shall run perpendicular to the direction to the slope. If weeds or herbaceous plant material interferes with proper seedbed preparation, the contractor shall remove them from the seedbed. Contractor shall remove and dispose of all debris and other objectionable material that may interfere with seeding operations.

The area to be seeded shall be left furrowed and all surface irregularities (e.g., rills, tire marks) shall be filled and firmed to conform to the desired cross sections.

After broadcast seeding operations, the seedbed shall be lightly rolled with a minimum of one (1) pass of a cultipacker or drag harrow to insure seed to soil contact. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-17-002-0005 Execution

SECTION 13-17-002-0005.1 General Seeding

Broadcast seeding with straw mulch, drill seeding and hydraulic seeding (hydroseeding) and mechanical application are approved methods.

Seed shall be sown when conditions will promote germination and growth. Normal nonirrigated permanent seed application dates are between April 1st and June 15th and between August 15th and September 20th. Seeding work shall be performed only after planting and other work affecting ground surface is complete.

When cut or fill slopes are greater than six (6) feet in height and steeper than 3H:1V, the seeded area shall be covered with erosion control blankets. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-17-002-0005.2 Broadcast Seeding

All seed shall be thoroughly mixed prior to placement into the hopper. Use a carrier medium of damp sand to aid in distribution of seed. Sowing rates for broadcast seeding shall be twenty-five percent (25%) more than the rate specified in the seed mixes identified in Section 13-17-002-0003.

Broadcast seeding shall be performed in a two (2) pass operation with half of the seed distributed in one (1) direction and the second half sown ninety (90) degrees to the initial application. Following the broadcast application of the seed, follow with a minimum of one (1) complete rolling with a cultipacker or light drag harrow. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-17-002-0005.3 Mulching for Broadcast Seeding

Mulching for broadcast seeding shall be applied as soon as seed is sown and final rolling is complete. Mulch shall be uniformly distributed and crimped into the soil (typical anchorage is achieved using a serrated disc). The application rate for reasonably dry material shall be one and one-half (1-1/2) to two (2) tons per acre with the goal of one-half (1/2) inch depth and less than seventy percent (70%) coverage. Operations shall minimize displacement of the soil and disturbance of the design cross section. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-17-002-0005.4 Drill Seeding

Drill seeding shall be performed using a grassland seed drill or a no-till grassland seed drill. Grain drills are not acceptable.

No mulch application is required for drill seeding. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-17-002-0005.5 Hydraulic Seeding (Hydroseeding)

Seed application shall follow the preparation of the seedbed as described in Section 13-17-002-0004, Seedbed Cultivation and Preparation. The seed, mulch, tacking agent (when required) and water shall be combined in the proportions specified herein and allowed to mix for a minimum of five (5) minutes prior to starting application. Seed shall be applied within thirty (30) minutes after mixing with water. The mulch shall be added to the slurry after the seed and fertilizer have been added. Continuous agitation will be required. The slurry mixture shall be homogeneous and applied uniformly resulting in an even distribution of material.

Per acre application rates are as follows:

<table>
<thead>
<tr>
<th>Material</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tacking Agent</td>
<td>40#</td>
</tr>
<tr>
<td>Wood Fiber</td>
<td>200#</td>
</tr>
<tr>
<td>Seed</td>
<td>50% more than the rate indicated in MAG Section 430.3.2</td>
</tr>
</tbody>
</table>

Seed areas within contract limits and areas adjoining contract limits disturbed because of construction operations. Payment for seeding areas outside of contract limits shall be at contractor’s expense.

Immediately remove overspray materials which are deposited on adjacent plant materials, sidewalks, roadways, structures and areas where seeding is not specified. Materials applied to excessive depths in seeding areas shall be removed and the area reseeded as specified.

The seed, mulch, tackifier, and water shall be combined in the proportions specified herein and allowed to mix for a minimum of five (5) minutes prior to starting application. Seed shall be applied within thirty (30) minutes after mixing with water. Seed, mulch and tackifier shall be applied in a two (2) step process. All spraying applications shall maintain a uniform color and texture consistent with specified application rate.
The initial application shall be a slurry mix of water, seed and wood fiber mulch. The initial application rate shall be as follows:

- Seed shall be applied at the rates shown in MAG Section 430.3.2.
- Wood fiber mulch shall be applied at a rate of five (5) pounds per one thousand (1,000) square feet.

The second application shall be a slurry mix of water, wood fiber mulch and tackifier. The second application rate shall be as follows:

- Wood fiber application rate shall be forty five (45) pounds per one thousand (1,000) square feet.
- One Tackifier application rate shall be two (2) pounds per thousand (1,000) square feet.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-17-002-0005.6 Watering

If watering is a required component of establishment and maintenance, the following watering schedule shall be followed. Water the hydroseed areas one (1) time per day for two (2) weeks, to a ground moisture depth of one-half (1/2) inch. During the third and fourth week, water the hydroseed areas three (3) times per week (every other day) to a ground moisture depth of one-half (1/2) inch. Watering for the remainder of the establishment period shall be once a week to a ground moisture depth of one-half (1/2) inch. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-17-002-0005.7 Establishment Period

Following acceptance of the seeding and mulching, the contractor shall be responsible for maintaining and stabilizing the seeded and mulched areas for a forty-five (45) calendar day period. During the establishment period, the contractor shall repair and restore eroded or damaged areas.

Within the one (1) year warranty period, the contractor shall perform two (2) mowing operations during the growing season. The cutting height shall be approximately six (6) to eight (8) inches. The mowing operation shall insure that bunching or windrowing of mowed vegetation will not occur. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-17-003
Temporary Seeding

Sections:

13-17-003 Temporary Seeding

SECTION 13-17-003 Temporary Seeding

Temporary seeding shall be used for site stabilization, stockpile stabilization, and to comply with conditions established in the AZPDES General Permit.

Preapproved temporary seeding shall be one (1) of the following:

- Annual ryegrass (*Lolium multiflorum*) 30 lbs/acre
- Oats (*Avena sativa*) 30 lbs/acre
- Red Clover (*Trifolium pretense*) 30 lbs/acre
- Regreen© (*Triticum aestivum x Elytrigia elongata*) 30 lbs/acre

Alternative species may be acceptable but are subject to prior approval from the City Engineer or duly authorized representative.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13-18
LANDSCAPING STANDARDS FOR RIGHTS-OF-WAY

Divisions:

13-18-001 Intent, Purpose, Application, and Enforcement/Waivers
13-18-002 Landscape Design
13-18-003 Material Selection
13-18-004 Installation, Placement, and Planting
13-18-005 Maintenance
13-18-006 Tree Protection Measures
13-18-007 City of Flagstaff Rights
13-18-008 Enforcement
13-18-009 Definitions
Section 13-18-001-0001 Intent, Purpose, Application, and Enforcement/Waivers

A. Intent. The City Council has recognized that landscaping contributes to the aesthetic value, quality of life, ambiance, and economic value of properties within the City of Flagstaff. These standards are intended to promote visual definition of streetscapes, appropriate species selection, planting techniques, and manageable maintenance costs and to improve the City’s image and increase community pride.

It is the intent of the City Council that landscaping of the right-of-way in accordance with these standards, including the installation of street trees, shall be considered an integral and necessary part of all street improvements.

B. Purpose. The purpose of these guidelines is to organize and present comprehensively the landscaping standards that apply to all rights-of-way within the City of Flagstaff. These standards cannot be all-inclusive or address each unique site condition. Nor is it possible to meet every requirement in every design solution. However, it is possible, and required, to find design solutions that meet the intent of these standards.

C. Application. The landscape standards for rights-of-way shall apply to all landscaping within public rights-of-way.

Public lands other than rights-of-way: Landscaping on public lands other than rights-of-way, such as parks and open spaces, are exempt from the requirements of these standards. However, these standards may be used as a basis for construction and planting activities on all public land.

D. Enforcement/Waiver. Requests to vary from the standards may be directed in writing to the City Engineer or duly appointed designee. Refer to Section 13-06-002-0001.1, Modifications and Appeals. (Ord. 2017-22, Rep&ReEn, 07/05/2017)


Division 13-18-002
Landscape Design

Sections:

13-18-002-0001 Preface
13-18-002-0002 Nomenclature
13-18-002-0003 General Design Goals
13-18-002-0003.1 Context Sensitive Design
13-18-002-0003.2 Complete Streets
13-18-002-0003.3 Other General Design Goals
13-18-002-0004 Quantitative Landscape Design Parameters
13-18-002-0004.1 Table Notes
13-18-002-0005 Project Metrics

SECTION 13-18-002-0001 Preface

This division identifies and quantifies desired "landscape design concept" or "theme" for rights-of-way for the City of Flagstaff.

A. The designer must rely on the discipline of landscape architecture and landscape architecture professionals to determine the appropriate landscape concept or theme for rights-of-way.

B. Landscaping is context specific. The contexts through which rights-of-way pass include several spectrums, ranging from very natural areas to very urbanized areas, and through various micro-climates, soil conditions, topography, and many more. The various combinations of these different spectrums make up a broad range of contexts through which rights-of-way pass. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-002-0002 Nomenclature

For the purposes that transects are used herein, the particular project area need not be a part of a traditional neighborhood design and need not have mapped transects.

As used in Flagstaff, traditional neighborhood design describes the community in six (6) standard transects, described as follows:

T-1 - The most rural, undisturbed, natural land.

T-2 - Rural, but modified lands, including agricultural lands and a range of park lands from primitive open space parks to developed parks, with only agricultural and park serving built elements.
T-3 – The edge areas of a town or city, suburban areas characterized primarily by low density housing with limited land use mixing.

T-4 – An area that is characterized by higher density and a greater mix of land uses, though the residential character is prevalent.

T-5 – Typically a neighborhood center with a yet higher density and a mix of land uses in which the commercial character is dominant.

T-6 – The most urbanized area; downtown Flagstaff.

SD – Finally, industrial districts, gateway sites, and other areas that are not described by transects T-1 through T-6 are classified as "special districts."

Greater detail in the descriptions of transects is provided in Title 10, Flagstaff Zoning Code. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-002-0003 General Design Goals

SECTION 13-18-002-0003.1 Context Sensitive Design

In context sensitive landscape design, landscaping occurs within a natural and built environment and specific solutions shall respond in such a way as to be inherently congruent. As a whole, and for the various design elements that make up the whole, proposed work shall be compatible with its context – "context" collectively referring to the significant resources of the property itself, the surrounding properties, and the neighborhood. Work is compatible if it is designed to complement the contexts’ significant visual and physical characteristics, is cohesive and visually unobtrusive in terms of scale, texture, and continuity, and if it maintains the overall patterns of the context. Compatibility utilizes the basic design principles of composition, rhythm, emphasis, transition, simplicity, and balance in the design.

A. Natural Context. Flagstaff, at an elevation of approximately seven thousand (7,000) feet, is at the base of the highest mountains in Arizona. The surrounding terrain generally slopes away, is incised by intermittent drainages, and contains a wide range of vegetation zones, including riparian, semi-arid, and conifer species. The general USDA plant zone is Zone 1, though microclimates may allow for Zone 2 plant materials. Eight (8) local habitats are identified as (1) dry ponderosa pine forest habitat (open woodland); (2) high-elevation cold moist habitat; (3) warm ponderosa pine forest/pinon-juniper woodland; (4) streamside and moist canyon habitat; (5) mid-elevation sunny meadow habitat; (6) chaparral habitat; (7) high desert grassland
habitat; and (8) ephemeral streams and seasonal runoff. [See www.thearb.org/]

Soils in the area vary widely in type and character, including coarse and fine grained materials and expansive clays. Highly permeable cinder soils and fractured rocks allow precipitation to percolate. Flagstaff and the surrounding area are underlain by a complex series of volcanic and sedimentary rocks. The rock sequence that underlies the volcanic formations comprises a series of consolidated sedimentary formations laid down prior to tectonic disturbance and subsequent volcanic activity.

Groundwater is generally found around five thousand five hundred (5,500) feet in depth. In some areas, groundwater perched on volcanic formations is close to the surface and supplies seeps and springs supporting very diverse ecosystems. Flagstaff receives enough precipitation during an average year to support a significant amount of vegetation—approximately twenty-one (21) inches of precipitation during the year, including an average of eighty-six (86) inches of snow. However, these amounts are quite variable from one (1) year to the next.

Flagstaff enjoys over three hundred (300) days of sunshine per year and low humidity. Weeks can pass in spring and autumn without any rain, whereas the summer monsoon season in July and August brings intense lightning and rainstorms. In the peak of summer, daily high temperatures rarely exceed eighty-five (85) degrees, though winter storms and temperatures can be severe. With the last killing frost generally in May, sometimes as late as June, Flagstaff has a ninety (90) to one hundred twenty (120) day growing season.

Fire is a natural and frequent occurrence with roughly six hundred (600) ignitions per year.

1. Baseline Design Theme. Preservation of, and compatibility with, Flagstaff’s natural environment is the baseline design theme. Landscape designs shall maximize the amount of land retained in its natural state. Projects shall be designed to preserve and protect native vegetation, particularly existing trees and attractive natural features. New landscaping for rights-of-way shall seek the restoration of the natural environment disturbed by construction.

The baseline theme may vary depending on location and use. For example, landscaping along a forest road (T-1) may have areas where there are trees and native grasses and other areas where just native grasses are appropriate. On such a road, the use of native species only, and more natural spacing, is appropriate.
B. Urban Context. As rights-of-way contexts become more urban in character, the less appropriate it is to mimic the natural environment. For the various transects in between a forest road (T-1) and downtown (T-6), the immediate context and the degree of urbanity guide the design of landscaping toward a natural or urban theme.

1. Gateways, more structured, ornamental, formal, and dense plantings are appropriate. They serve as an exclamation point, highlighting an entrance or major feature and welcoming passersby.
   a. Neighborhoods may have a gateway area, serving a smaller scale area within the City.
   b. Notably, gateways are relatively small sites and a particular landscape project area may be sufficiently large so as to include a gateway area as well as other contexts.

2. Evaluation of the project context shall include determining if the project area is, or contains, a gateway area.

The designer and the project review staff should establish the degree of urbanity, or transect, and shall establish the appropriate landscaping design measures. The determination shall encompass the character of the neighborhood as a whole, including the forestation and development on the adjacent private property; and, to the greatest extent possible, shall consider the proposed or desired future conditions over existing conditions. This determination measures how much deviation from the baseline design theme is appropriate or desirable. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-002-0003.2 Complete Streets

Modern transportation design recognizes that streets are a part of public street space and serve various transportation modes, users, and uses (complete streets), and that an ideal street is in fact a place and not simply for vehicle conveyance. Landscaping is a critical part of complete streets and landscaping design solutions for all rights-of-way shall always include the purpose of placemaking and the design of complete streets.

A. Street Trees. Street trees planted in a parkway separating the travel lanes from the pedestrian way is an important landscape element. Walkable streets provide a sense of safety for pedestrians, sun and wind control, aesthetics, traffic calming
and much more. Street trees are required for complete streets and are always required for landscaping of rights-of-way.

1. Sometimes under unique circumstances such as retrofits, street trees may be located behind the sidewalk.

2. Street trees shall provide the shading, visual enhancement, and continuity for the streetscape. A continuous street edge with trees normally placed midway between curb and walk is required.
   a. Any existing specimen or mature street tree shall remain and shall be considered a planted tree for purposes of meeting density requirements.
   b. Tree placement should consider visibility of signage and storefronts, as well as public views, and shall be located offset from building entrances.

3. As a general rule, for transects T-4, T-5, and T-6, evenly spaced street trees are required.
   a. A "skyline" or "canopy tree" function in the design should be included, though occasional ornamental trees are appropriate.
   b. At the urban transect T-4, such plantings should be more rural in character and at the T-6 end, trees should be planted in boxed out planters with iron tree grates.

4. In rural transects T-1 and T-2, the design of street trees, types, density, and placement should help restore the natural environment.
   a. Through design solutions, trees will both function as a typical street tree and as a part of the natural context.

5. For urban areas in suburban transect T-3 that are more urban, the urban solutions in transects T-4, T-5, and T-6 should be employed.

6. For natural areas, natural street tree designs in transects T-1 and T-2 are appropriate.
   a. An area in the forest with lot sizes measured in acres may not need evenly spaced "street trees."
b. An area with small lots, especially where most of the forest has been removed, the evenly spaced planting of street trees may be appropriate.

A list of pre-approved trees is provided in the zoning code found in Title 10. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-002-0003.3 Other General Design Goals

A. Grading.

1. Rights-of-way projects shall conclude with ground forms that are natural in character. Contour lines shall be organic and curvilinear and without the sharp corners commonly associated with the machine grading necessary for infrastructure improvements.

   a. Landscape designs may, and if appropriate shall, use finish grading to achieve this result.

2. Swales and similar drainage courses shall be designed as gently rolling, free form ground sculpture with a natural appearance. Where space and hydrological needs permit, they should be broad shallow channels with established vegetation designed to promote infiltration and trap pollutants. Dissipation structures, if any, shall be designed to be as natural in appearance as possible such as the use of rock lining.

3. Where appropriate and where space permits, earthen berms shall be incorporated into finish grading. Berms are usually two (2) to six (6) feet high and shall be designed as gently rolling, free form ground sculpture with an undulating top. The ridge of berms should be rounded (i.e., neither flat nor meeting at the peak). Continuous planting along the ridgeline of berms should be avoided.

B. Maintenance. Landscape designs should balance the value of landscaping and the obligations for maintenance.

C. Other Built Elements. Landscape projects should incorporate elements other than plants that create a comfortable, safe, and attractive public experience.

1. Benches, receptacles, bike racks, newspaper racks, water fountains, lighting and public art are good examples and should be identified in the scope of work.
a. The design should evaluate opportunities during the course of developing specific landscape solutions.

2. In designing elements in response to the scope of work or an apparent opportunity, calibration to the transect is appropriate.

a. In considering the selection of such elements, boulders may be used in rural transects T-1 and T-2 to accent the landscape design, while plazas or benches are appropriate in urban transects T-4, T-5, and T-6.

b. In considering basic layouts, pedestrian ways (sidewalks) can be organic in rural transects T-1 and T-2 and have a formal character in urban transects T-4, T-5, and T-6.

D. Plant Placement.

1. For the natural environment, plant placement shall be informal groupings of trees, shrubs and ground covers.

a. Plantings on slopes shall have varied heights.

2. More urbanized areas warrant more structured plant placement. In more urbanized areas, more formal, unobstructed visibility to building entrances, key architectural features, signage, and public spaces are to be maintained.

a. Use of landscaping to define, accent, or soften adjacent buildings is appropriate.

E. Screening. As rights-of-way landscaping designs are developed, landscaping shall screen adjacent parking and service areas, and exterior transformers, utility pads, cable television, telephone boxes, and similar objects to the greatest extent possible.

F. Water Usage. Landscape designs should balance the value of landscaping and the value of responsible water usage. Selection, density, and placement of plants relative to available water supplies need to be considered in the design concept. The selection of native and drought tolerant species is encouraged. Use of reclaimed water for irrigation substantially addresses this balance.

Plantings in transects T-1, T-2, and some of T-3 may not need irrigation after the establishment period. During that period, temporary systems may serve the need. In transects T-4, T-5, and T-6, ornamental, formal plantings will need more water.
G. Winter Conditions. Trees should be selected and placed so as to minimize winter icing on roads, walkways, and other paving. Placement relative to winter sun angles, spacing, type as deciduous or conifer, and material density should be considered.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-002-0004 Quantitative Landscape Design Parameters

Table 13-18-01a - Quantitative Landscape Design Parameters provides guidance regarding landscape design in terms of plant types, densities, and placement in the context of transects.

A list of pre-approved trees, shrubs, and ground cover is provided in the zoning code found in Title 10. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-002-0004.1 Table Notes

As Practical - The placement of evenly spaced trees is noted in the table as "As Practical" recognizing that some deviation in spacing may be necessary to accommodate utilities, driveways, and other similar objects in the right-of-way. The quantity of trees shall still be determined in accordance with the density column of the table, and any surplus trees due to a necessary deviation in spacing, shall be planted elsewhere in the right-of-way or if need be, elsewhere within the project.

Boulders - For transects T-1, T-2, and T-3, to encourage the use of boulders in landscape designs, up to fifteen percent (15%) of shrubs indicated in the table may be replaced by native boulders on an "area covered" basis. One-third (1/3) of the boulder’s height should be buried.

Clusters - The natural forest density is not monolithic and varies from meadows to clusters of trees and shrubs. In emulating the natural surrounds in accordance with the table, the table indicates when clustering is expected to be appropriate.

Coverage at Maturity - The area covered by the plant material when it has reached maturity, based on industry standards for size at maturity, compared to the planting area in which the plant material is located.

Existing Plants - Existing plant materials that are protected and that survive construction count toward the density requirements of the table.

Match Surrounds - This term is used to indicate that new landscaping should match the existing context. Context refers to the general area of a project or even sub-areas of a project (see this division).
Median – As used in the table, a median is the area between vehicular travel lanes.

Parkway – As used in the table, a parkway is the area between the curb and the sidewalk.

Road Segment – As used in the table, a road segment is generally a block, but could be a group of blocks that as a whole make up a single logical design element. A boulevard is an example of such an element.

Species Appropriate Spacing – Spacing based on industry standards. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-002-0005 Project Metrics

To serve as a baseline metric for specific landscaping projects, Table 13-18-01a - Quantitative Landscape Design Parameters shall be considered baseline (minimum) requirements and any deviation from such parameters shall be at the sole discretion of the City of Flagstaff as determined by the project review staff.

Table 13-18-01a - Quantitative Landscape Design Parameters

<table>
<thead>
<tr>
<th>Trees</th>
<th>Type</th>
<th>Density</th>
<th>Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-1: The most rural, undisturbed, natural land.</td>
<td>Parkways, Medians, and Other Areas</td>
<td>Match Surrounds</td>
<td>Match Surrounds including Clusters (Max. 100 per acre)</td>
</tr>
<tr>
<td>T-2: Rural, but modified lands.</td>
<td>Parkways, Medians, and Other Areas</td>
<td>Match Surrounds per T-1 and Add 15% (Max. 100 per acre)</td>
<td>Match Surrounds Clusters</td>
</tr>
<tr>
<td>T-3: The edge areas of a town or city, suburban areas - Large lot subdivisions and substantially forested lands.</td>
<td>Parkways, Medians, and Other Areas</td>
<td>Match Surrounds per T-1 and Add 30% (Max. 100 per acre)</td>
<td>Match Surrounds Clusters</td>
</tr>
<tr>
<td>T-3: The edge areas of a town or city, suburban areas - Small lot subdivisions and/or substantially denuded lands.</td>
<td>Parkways</td>
<td>Max. Two Types per Road Segment</td>
<td>(1) per 45 FT</td>
</tr>
<tr>
<td></td>
<td>Medians</td>
<td>Max. Two Types per Road Segment</td>
<td>(1) per 45 FT</td>
</tr>
</tbody>
</table>
### Table 13-18-01a - Quantitative Landscape Design Parameters (Continued)

<table>
<thead>
<tr>
<th>Type</th>
<th>Density</th>
<th>Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Areas</td>
<td>Match Surrounds</td>
<td>Match Surrounds including Clusters</td>
</tr>
<tr>
<td></td>
<td>per T-1 and Add 30% (Max. 100 per acre)</td>
<td></td>
</tr>
<tr>
<td>T-4: Higher density mixed-use area - residential prevalent.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkways</td>
<td>Max. Three Types per Road Segment</td>
<td>(1) per 45 FT</td>
</tr>
<tr>
<td>Medians</td>
<td>Max. Three Types per Road Segment</td>
<td>(1) per 45 FT</td>
</tr>
<tr>
<td>Other Areas</td>
<td>Match Surrounds</td>
<td>per T-1 Add 15% (Max. 100 per acre)</td>
</tr>
<tr>
<td>T-5: Higher density mixed-use area - Commercial prevalent.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkways, Tree Wells</td>
<td>Max. Two Types per Road Segment</td>
<td>(1) per 45 FT</td>
</tr>
<tr>
<td>Medians</td>
<td>Max. Two Types per Road Segment</td>
<td>(1) per 45 FT</td>
</tr>
<tr>
<td>Other Areas</td>
<td>Should not occur in urban area; where occurs, see Special District.</td>
<td></td>
</tr>
<tr>
<td>T-6: Downtown Flagstaff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkways, Tree Wells</td>
<td>One Type per Road Segment</td>
<td>(1) per 45 FT</td>
</tr>
<tr>
<td>Medians</td>
<td>One Type per Road Segment</td>
<td>(1) per 45 FT</td>
</tr>
<tr>
<td>Other Areas</td>
<td>Should not occur in urban area; where occurs, see Special District.</td>
<td></td>
</tr>
<tr>
<td>Special Districts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkways</td>
<td>Max. Three Types per Road Segment</td>
<td>(1) per 45 FT</td>
</tr>
<tr>
<td>Medians</td>
<td>Max. Three Types per Road Segment</td>
<td>(1) per 45 FT</td>
</tr>
<tr>
<td>Other Areas</td>
<td>Match Surrounds</td>
<td>per T-1 and Add 30% (Max. 100 per acre)</td>
</tr>
<tr>
<td>Shrub Type</td>
<td>Density</td>
<td>Placement</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td><strong>T-1:</strong> The most rural, undisturbed, natural land.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkways, Medians, and Other Areas</td>
<td>Match Surrounds including Clusters</td>
<td>Match Surrounds including Clusters</td>
</tr>
<tr>
<td><strong>T-2:</strong> Rural, but modified lands.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkways, Medians, and Other Areas</td>
<td>Match Surrounds including Clusters</td>
<td>Match Surrounds including Clusters</td>
</tr>
<tr>
<td><strong>T-3:</strong> The edge areas of a town or city, suburban areas - Large lot subdivisions and substantially forested lands.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkways, Medians, and Other Areas</td>
<td>Match Surrounds including Clusters</td>
<td>Match Surrounds including Clusters</td>
</tr>
<tr>
<td><strong>T-3:</strong> The edge areas of a town or city, suburban areas - Small lot subdivisions and/or substantially denuded lands.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkways</td>
<td>Where Occurs - per Medians</td>
<td>None or per Medians</td>
</tr>
<tr>
<td>Medians</td>
<td>(1) per (50) Plants to Max. (5) Types Min. 15% per Type</td>
<td>Min. 25% Coverage at Maturity less Ground Cover</td>
</tr>
<tr>
<td>Other Areas</td>
<td>Match Surrounds</td>
<td>per T-1 and Add 30%</td>
</tr>
<tr>
<td><strong>T-4:</strong> Higher density mixed-use area - residential prevalent.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkways</td>
<td>Where Occurs - per Medians</td>
<td>None or per Medians</td>
</tr>
<tr>
<td>Medians</td>
<td>(1) per (50) Plants to Max. (5) Types Min. 15% per Type</td>
<td>Min. 50% Coverage at Maturity less Ground Cover</td>
</tr>
<tr>
<td>Other Areas</td>
<td>Match Surrounds</td>
<td>per T-1 and Add 15%</td>
</tr>
<tr>
<td><strong>T-5:</strong> Higher density mixed-use area - Commercial prevalent.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkways, Tree Wells</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
**Table 13-18-01b - Quantitative Landscape Design Parameters (Continued)**

<table>
<thead>
<tr>
<th>Shrubs</th>
<th>Type</th>
<th>Density</th>
<th>Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medians</td>
<td>(1) per (50) Plants to Max. (5) Types Min. 15% per Type</td>
<td>Min. 75% Coverage at Maturity less Ground Cover</td>
<td>Species Appropriate Spacing with Diamond Pattern</td>
</tr>
<tr>
<td>Other Areas</td>
<td>Should not occur in urban area; where occurs, see Special District.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**T-6: Downtown Flagstaff**

<table>
<thead>
<tr>
<th>Parkways, Tree Wells</th>
<th>None</th>
<th>None</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medians</td>
<td>(1) per (50) Plants to Max. (5) Types Min. 15% per Type</td>
<td>Min. 75% Coverage at Maturity less Ground Cover</td>
<td>Species Appropriate Spacing with Diamond Pattern</td>
</tr>
<tr>
<td>Other Areas</td>
<td>Should not occur in urban area; where occurs, see Special District.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**T-6: Special Districts**

<table>
<thead>
<tr>
<th>Parkways</th>
<th>Where Occurs – per Medians</th>
<th>None or per Medians</th>
<th>Where Occurs – per Medians</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medians</td>
<td>(1) per (50) Plants to Max. (5) Types Min. 15% per Type</td>
<td>Min. 25% Coverage at Maturity less Ground Cover</td>
<td>Species Appropriate Spacing with Diamond Pattern</td>
</tr>
<tr>
<td>Other Areas</td>
<td>Match Surrounds</td>
<td>per T-1 and Add 30%</td>
<td>Match Surrounds</td>
</tr>
</tbody>
</table>
### Table 13-18-01c - Quantitative Landscape Design Parameters

<table>
<thead>
<tr>
<th>Type</th>
<th>Density</th>
<th>Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Living Ground Cover</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>T-1: The most rural, undisturbed, natural land.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkways, Medians, and Other Areas</td>
<td>Native Grass and Wildflower Seed Mix</td>
<td>100% Coverage of Disturbed Areas</td>
</tr>
<tr>
<td><strong>T-2: Rural, but modified lands.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkways, Medians, and Other Areas</td>
<td>Native Grass and Wildflower Seed Mix</td>
<td>100% Coverage of Disturbed Areas</td>
</tr>
<tr>
<td><strong>T-3: The edge areas of a town or city, suburban areas - Large lot subdivisions and substantially forested lands.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkways, Medians, and Other Areas</td>
<td>Native Grass and Wildflower Seed Mix</td>
<td>100% Coverage of Disturbed Areas</td>
</tr>
<tr>
<td><strong>T-3: The edge areas of a town or city, suburban areas - Small lot subdivisions and/or substantially denuded lands.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+Parkways</td>
<td>Where Occurs – per Medians</td>
<td>None or per Medians</td>
</tr>
<tr>
<td>Medians</td>
<td>(1) per (500) Plants to Max. (5) Types Min. 15% per Type</td>
<td>Min. 25% Coverage at Maturity less Shrubs</td>
</tr>
<tr>
<td>Other Areas</td>
<td>Native Grass and Wildflower Seed Mix</td>
<td>100% Coverage of Disturbed Areas</td>
</tr>
<tr>
<td><strong>T-4: Higher density mixed-use area - residential prevalent.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkways</td>
<td>Where Occurs – per Medians</td>
<td>None or per Medians</td>
</tr>
<tr>
<td>Medians</td>
<td>(1) per (500) Plants to Max. (5) Types Min. 15% per Type</td>
<td>Min. 50% Coverage at Maturity less Shrubs</td>
</tr>
<tr>
<td>Other Areas</td>
<td>Native Grass and Wildflower Seed Mix</td>
<td>100% Coverage of Disturbed Areas</td>
</tr>
</tbody>
</table>
Table 13-18-01c - Quantitative Landscape Design Parameters (Continued)

<table>
<thead>
<tr>
<th>Type</th>
<th>Density</th>
<th>Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-5: Higher density mixed-use area - Commercial prevalent.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkways, Tree Wells</td>
<td>per T-4 (Tree Wells per Medians)</td>
<td>per T-4 (Tree Wells per Medians)</td>
</tr>
<tr>
<td>Medians</td>
<td>(1) per (500) Plants to Max. (5) Types Min. 15% per Type</td>
<td>Min. 75% Coverage at Maturity less Shrubs</td>
</tr>
<tr>
<td>Other Areas</td>
<td>Should not occur in urban area; where occurs, see Special District.</td>
<td></td>
</tr>
<tr>
<td>T-6: Downtown Flagstaff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parkways, Tree Wells</td>
<td>per T-4 (Tree Wells per Medians)</td>
<td>per T-4 (Tree Wells per Medians)</td>
</tr>
<tr>
<td>Medians</td>
<td>(1) per (500) Plants to Max. (5) Types Min. 15% per Type</td>
<td>Min. 75% Coverage at Maturity less Shrubs</td>
</tr>
<tr>
<td>Other Areas</td>
<td>Should not occur in urban area; where occurs, see Special District.</td>
<td></td>
</tr>
</tbody>
</table>

Special Districts

<table>
<thead>
<tr>
<th>Type</th>
<th>Density</th>
<th>Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parkways</td>
<td>Where Occurs - per Medians</td>
<td>None or per Medians</td>
</tr>
<tr>
<td>Medians</td>
<td>(1) per (500) Plants to Max. (5) Types Min. 15% per Type</td>
<td>Min. 25% Coverage at Maturity less Shrubs</td>
</tr>
<tr>
<td>Other Areas</td>
<td>Native Grass and Wildflower Seed Mix</td>
<td>100% Coverage of Disturbed Areas</td>
</tr>
</tbody>
</table>

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-18-003
Material Selection

Sections:

13-18-003  Material Selection
13-18-003-0001  General Requirements
13-18-003-0002  Irrigation (See Chapter 13-19)
13-18-003-0003  Trees
13-18-003-0003.1  Pre-Approved Trees
13-18-003-0003.2  Prohibited Trees
13-18-003-0004  Shrubs
13-18-003-0004.1  Pre-Approved Shrubs
13-18-003-0005  Ground Cover
13-18-003-0005.1  Pre-Approved Ground Cover
13-18-003-0006  Landscape Materials
13-18-003-0006.1  Mulch
13-18-003-0006.2  Pre-Approved Mulch
13-18-003-0006.3  Root Barrier
13-18-003-0006.4  Pre-Emergent Weed Control
13-18-003-0006.5  Weed Barrier
13-18-003-0006.6  Tree Wrap
13-18-003-0006.7  Planting Soils
13-18-003-0006.8  Landscape Fabric
13-18-003-0007  Furnishings

SECTION 13-18-003  Material Selection

See Table 13-18-02.
<table>
<thead>
<tr>
<th>Symbol Scale @ 2/3 Maturity</th>
<th>Genus and Species</th>
<th>Common Name</th>
<th>Qty.</th>
<th>Planting Size</th>
<th>Estimated Mature Size Height x Width</th>
<th>Design Spacing O.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Overstory/Canopy Trees</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fraxinus pennsylvanica</td>
<td>Green Ash</td>
<td>12</td>
<td>2.5&quot; Cal.</td>
<td>65' x 40'</td>
<td>35'</td>
</tr>
<tr>
<td></td>
<td>Populus tremuloides</td>
<td>Quaking Aspen</td>
<td>25</td>
<td>2.5&quot; Cal. Multi Stem</td>
<td>28' x 18'</td>
<td>24'</td>
</tr>
<tr>
<td></td>
<td><strong>Ornamental Trees</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Malus sargentii</td>
<td>Sargent Crabapple</td>
<td>30</td>
<td>1.5&quot; Cal.</td>
<td>10' x 16'</td>
<td>14'</td>
</tr>
<tr>
<td></td>
<td>Prunus padus</td>
<td>Common Birdcherry</td>
<td>15</td>
<td>1.5&quot; Cal.</td>
<td>24' x 20'</td>
<td>18'</td>
</tr>
<tr>
<td></td>
<td><strong>Evergreen Trees</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pinus ponderosa</td>
<td>Ponderosa Pine</td>
<td>5</td>
<td>6' B&amp;B</td>
<td>80' x 30'</td>
<td>30'</td>
</tr>
<tr>
<td></td>
<td><strong>Shrubs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Potentilla fruticosa 'Gold Drop'</td>
<td>Gold Drop Bush Cinquefoil</td>
<td>200</td>
<td>2 Gallon</td>
<td>2' x 2'</td>
<td>2'</td>
</tr>
<tr>
<td></td>
<td>Pinus mugo mughus</td>
<td>Dwf. Mugho Pine</td>
<td>50</td>
<td>3 Gallon</td>
<td>2.5' x 3'</td>
<td>2.5'</td>
</tr>
<tr>
<td></td>
<td><strong>Ground Covers and Perennials</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vinca minor</td>
<td>Periwinkle</td>
<td>300</td>
<td>3&quot; Pot</td>
<td>Ground Cover</td>
<td>1'</td>
</tr>
</tbody>
</table>

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-18-003-0001 General Requirements

A list of pre-approved trees, shrubs, and ground cover is provided in the zoning code found in Title 10.

Selection and use of native and drought tolerant plant species is preferred. All plant species shall be cottonless, nonfruiting, and, except for ground cover, minimally seeding.

Plant material shall be true to name, variety and size and shall comply with the applicable provisions of the most recent edition of the American Standard for Nursery Stock (ANSI Z60.1).

A. Application. Plant material shall be of the quantity, genus, species, variety and size specified. If the specified plant material is not obtainable, submit a statement of nonavailability together with a proposal for use of equivalent material. Substitutions require prior approval from the City of Flagstaff representative.

Trees are allowed only in medians and parkways that have a minimum width of five (5) feet. In retrofit situations, the minimum median and parkway width shall be four (4) feet and tree selection shall be submitted for prior review and approval by the City Engineer or duly appointed designee.

Shrubs, perennials and ground covers are allowed only in medians and parkways that have a minimum width of two (2) feet.

Medians and parkways less than two (2) feet in width shall be infilled with approved inert materials. Widths are from back of curb to back of curb.

In lieu of those specified in these standards, landscape materials previously approved by a homeowners’ association or approved by an adopted area/special improvement plan are also allowed. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-003-0002 Irrigation (See Chapter 13-19)

Irrigation system technical specifications are contained in Chapter 13-19.

A. Except as follows, all landscaped areas within rights-of-way shall be provided with permanent automatic irrigation systems designed to minimize water usage but provide adequate watering for all plant materials.
1. Exception. Areas designated as native planting areas, riparian, and similar areas that are designed and planted accordingly may install temporary automatic irrigation systems as required to establish plant materials as determined solely by the City, on a case-by-case basis.

B. Irrigation systems should be designed to permit turf grass to be irrigated separately from all other planting areas.

1. Turf irrigation zones should be further separated by water needs for slopes, exposure, and turf-type.

2. Spraying of walks, decks, patios, driveways, buildings and fences should be avoided.

3. Normal spray patterns should be confined to mass vegetated areas or root zones of plants.

C. Irrigation schedules should be set when pedestrians are not likely to be present. Controllers shall be timed to spray at night to reduce conflicts with users and to reduce water consumption. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-003-0003 Trees

A. All single trunk trees shall have a minimum two (2) inch caliper and a minimum height of eight (8) feet immediately after planting. Tree heights shall be measured from the top of the root ball to the tip of the highest branch.

B. All conifer trees shall have a minimum height of six (6) feet measured from the top of the root ball to the tip of the leader.

C. Multi-trunk trees are not allowed in medians and parkways within rights-of-way. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-003-0003.1 Pre-Approved Trees

A list of pre-approved trees is provided in the zoning code found in Title 10. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-18-003-0003.2 Prohibited Trees

Specifically prohibited for landscape use in rights-of-way are the following plant materials:

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acer negundo</td>
<td>Box Elder</td>
</tr>
<tr>
<td>Elaeagnus angustifolia</td>
<td>Russian Olive</td>
</tr>
<tr>
<td>Populus acuminate</td>
<td>Lance Leaf Cottonwood</td>
</tr>
<tr>
<td>Populus alba</td>
<td>White Poplar</td>
</tr>
<tr>
<td>Populus augustfolia</td>
<td>Narrow Leaf Cottonwood</td>
</tr>
<tr>
<td>Populus fremontii</td>
<td>Fremont Cottonwood</td>
</tr>
<tr>
<td>Populus nigra</td>
<td>Black Poplar</td>
</tr>
<tr>
<td>Salix species</td>
<td>Willows</td>
</tr>
<tr>
<td>Ulmus parvifolia</td>
<td>Chinese Elm</td>
</tr>
<tr>
<td>Ulmus pumila</td>
<td>Siberian Elm</td>
</tr>
</tbody>
</table>

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-003-0004 Shrubs

Shrubs shall be well rooted container stock and shall have a minimum size of three (3) gallons. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-003-0004.1 Pre-Approved Shrubs

Shrub species selected from the list of pre-approved shrubs found in Title 10 are acceptable. Other species may be acceptable but are subject to approval by the City Engineer and the Public Works Division. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-003-0005 Ground Cover

Ground cover (other than turf grass) shall be a minimum of four (4) inch well rooted container stock spaced no more than eight (8) inches on center. Well rooted two and one half (2-1/2) inch container stock may be substituted and spaced no more than six (6) inches on center. Ground cover plants shall show a number of vigorous woody runners or a well developed crown.

A list of pre-approved ground cover is provided in the zoning code found in Title 10. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-18-003-0005.1 Pre-Approved Ground Cover

Ground cover species selected from the pre-approved list found in Title 10 are acceptable. Other species may be acceptable but are subject to approval by the City Engineer and the Public Works Division. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-003-0006 Landscape Materials

SECTION 13-18-003-0006.1 Mulch

Mulch shall be used in areas where soils have been disturbed as a result of the planting activities and/or where designated on the approved landscape plan. Hydroseeding may be used where designated on the approved landscape plan. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-003-0006.2 Pre-Approved Mulch

A. Wood mulch shall be ground or shredded wood products processed specifically as landscape mulch. Depth of installation shall be two (2) inches minimum and three (3) inches maximum. Prior to mulch installation pre-emergent weed control and a geotextile weed barrier shall be installed.

B. Rock mulch shall be decomposed granite, landscape rock, river rock, pea gravel, red cinders or black cinders. Red and black cinders shall be a minimum of one-half (1/2) inch in diameter. Depth of installation shall be two (2) inches minimum and three (3) inches maximum. Prior to mulch installation pre-emergent weed control and a geotextile weed barrier shall be installed. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-003-0006.3 Root Barrier

A. Root barriers shall be one (1) continuous piece, a minimum of twenty four (24) inches in depth and installed such that the top is even with the top of adjacent pavement.

B. Root barriers shall be installed parallel and adjacent to curb and gutter, sidewalks or similar permanent surfaces. The root barrier shall extend four (4) feet each way of the tree center. Root barriers shall be used in parkways with a width of eight (8) feet or less. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-18-003-0006.4 Pre-Emergent Weed Control

Pre-emergent weed control shall be Dacthal or equal and shall be used prior to the installation of wood and rock mulch materials. Installation shall be in accordance with the manufacturer’s written instructions. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-003-0006.5 Weed Barrier

Weed barrier shall be a synthetic, nonwoven, water permeable geotextile. Manufacturer’s technical information and a nominal four (4) inch square sample shall be submitted for City of Flagstaff’s prior approval. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-003-0006.6 Tree Wrap

Tree wrap shall be heavy, crinkle crepe paper, four (4) to ten (10) inches wide and manufactured specifically as tree wrap. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-003-0006.7 Planting Soils

A. General Planting Soil. Soil excavated from the planting pit shall generally be deemed acceptable as backfill material for planting unless specifically designated by the owner as unacceptable.

1. If quantity of usable soil is inadequate, the contractor shall supply planting soil, which shall be clean, fertile and friable with four percent (4%) to twenty-five percent (25%) organic matter.

2. Imported planting material shall require prior approval by the owner.

3. Mechanically ground or pulverized soil is not acceptable.

B. Structural Soil Mix.

1. Street trees planted within a tree grate shall be planted in topsoil backfill using a structural soil system between tree pits beneath pavement areas.

2. Structural Soil Mix. The structural soil mix shall be a uniformly blended, three (3) part mix consisting of a 5:1 ratio of crushed stone to clay loam, by weight, with three- hundredths percent (0.03%) hydrogel added. Total moisture
at mixing shall be ten percent (10%) in accordance with AASHTO T-99 (optimum moisture).

The stone shall be clean, angular, gap graded, three-quarters (3/4) to one and one-half (1-1/2) inch crushed stone with no fines. Volcanic rock is explicitly excluded.

The clay loam shall consist of less than five percent (5%) gravel, twenty-five percent (25%) to thirty percent (30%) sand, twenty percent (20%) to forty percent (40%) silt and twenty-five percent (25%) to forty percent (40%) clay with two percent (2%) to five percent (5%) organic matter in accordance with the USDA soil classification system.

Hydrogel shall be A1000C Hydro-Gel as manufactured by Finn Corporation, Fairfield, Ohio, or an approved equal. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-003-0006.8 Landscape Fabric

A weed inhibiting material shall be placed underneath all areas to be mulched prior to installation. Color should be grey or black at four (4) ounce weight. Plastic products are prohibited. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-003-0007 Furnishings

All furnishings shall be acquired from a recognized manufacturer that produces products for use in public places and to the greatest extent possible, be of the same make and model as existing street furniture elsewhere within the City. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-18-004
Installation, Placement, and Planting

Sections:

13-18-004-0001 General Requirements
13-18-004-0001.1 Execution
13-18-004-0001.2 Safety
13-18-004-0002 Warranty
13-18-004-0003 Finish Grading
13-18-004-0003.1 Berms
13-18-004-0003.2 Drainage Courses
13-18-004-0004 Pre-Installation Weed Control Treatment
13-18-004-0005 Trees
13-18-004-0005.1 Street Trees
13-18-004-0005.2 Urban Street Trees
13-18-004-0005.3 Root Control
13-18-004-0005.4 Structural Soils
13-18-004-0005.5 Root Barriers
13-18-004-0005.6 Staking
13-18-004-0005.7 Wrapping
13-18-004-0006 Hardscape
13-18-004-0007 Landscape Boulders and Rockwork
13-18-004-0008 Hydroseeding

SECTION 13-18-004-0001 General Requirements

A. Except for ground cover, placement of landscape materials shall respect the width of the planting area such that adequate clearance is maintained between curbs and plant materials so as to minimize damage from snow removal, cindering operations, and vehicular traffic.

B. All landscape materials shall be placed, including the quantity and spacing of plant materials, in accordance with a streetscape plan consistent with landscape design industry standards and approved by the City Engineer.

C. Nothing shall be planted during freezing or excessively windy, hot, or wet weather or otherwise when the conditions cannot be properly worked for digging, mixing, raking, or grading. Nothing shall be planted until the adjacent site improvements, pavements, irrigation installation and finish grading are completed.

D. Certain landscape elements, particularly hardscape elements, are subject to other codes and standards and require permits. These standards are in addition to other requirements and do not in any way alter, diminish, or alleviate other requirements. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-18-004-0001.1 Execution

A. Excavation.

1. Plant material locations shall be laid out in the field, as shown on the plan(s). Incorrectly placed plants shall be relocated at no expense to the City.

2. The planting pit shall be excavated to provide at least six (6) inches of planting soil backfill around and beneath the root system.

3. Where conditions prevent digging a planting pit as required, obtain approval from the City to modify the location and/or dimensions.

4. Planting soil for backfilling shall be kept separate from excavated subsoil material.

5. Trees shall be planted with the root flare one (1) inch above finish grade.

B. Ground Cover Installation.

1. Immediately prior to installation, ground cover areas are to be cultivated to a depth of six (6) inches and grade smooth and uniform.

2. Ground cover shall be planted to within eighteen (18) inches of tree trunks or shrubs planted within the area. Ground cover is to be planted so that the root crown is at or slightly above the prepared bed’s finish grade.

3. After planting of ground cover and prior to mulching, pre-emergent weed control shall be spread over planting bed soil surface in accordance with the manufacturer’s written directions.

4. Specified mulch shall be installed to a depth of two (2) inches over the entire ground cover bed.

C. Container and Balled and Burlapped (B&B) Plant Material Installation.

1. Nonplantable containers shall be removed prior to planting in a manner that does not disturb the potted soil or root ball.

2. Plantable containers are to be removed in the same manner as nonplantable containers. If the plantable container is
left in place, any part of the container that extends above the soil level within the container is to be removed and a minimum of three (3) full height cuts in the container sides shall be made.

3. The root ball shall be set on six (6) inches of firm planting soil, plumb and in the center of the pit with the root ball crown slightly above the same elevation as adjacent finished landscape grades.
   
   a. Wire, twine, natural burlap, and other material on the upper one-third (1/3) of the root ball of B&B stock shall be completely removed.
   
   b. After the root ball has been placed in its final location, wire baskets and as much synthetic burlap as possible shall be removed.

4. Backfill material shall be added around base and sides of root ball after the plant is set with each layer to be worked for purposes of settling backfill and eliminating voids and air pockets.
   
   a. When excavation is approximately two-thirds (2/3) full, water thoroughly before placing the remainder of the backfill. Repeat watering until no more is absorbed.
   
   b. Water again after placing the final layer of backfill.

5. Mulch shall be placed at a depth of two (2) to three (3) inches in the area disturbed by excavation of the planting well or in planting bed areas as designated on the plan(s).
   
   a. Pre-emergent herbicide shall be applied prior to mulch installation in all planting beds.
   
   b. Mulch shall be installed by the end of each work day for all plant material installed during that day.

D. Staking and Guying.

1. Single stem, deciduous trees between one (1) and three (3) inch caliper and evergreen trees between six (6) and eight (8) feet in height shall be firmly tied between two (2) vertically driven stakes.

2. Single stem, deciduous trees over three (3) inch caliper and evergreen trees more than eight (8) feet in height shall be guyed with three (3) lines spaced evenly about the tree.
a. Line shall attach to the tree trunk about two-thirds (2/3) of the tree height and be anchored at the ground to the specified earth anchors at a thirty (30) to forty-five (45) degree angle.

E. Miscellaneous Work.

1. Dead or damaged branches shall be pruned and removed from the plant material. Make all cuts at branch collar. The natural habit, shape, and specified size of plant material is to be maintained.

2. All single stem, deciduous trees shall be wrapped from the ground line up to and including the crotch formed by the first major branch.
   
a. Wrapping shall be done after the plant has been installed.

3. Remove all tags, labels, and/or other material on plant.

4. The contractor shall be responsible for legal disposal of excess soil, packing material, burlap, trimmings, and other debris associated with the planting operation.
   
a. Paved surfaces shall be broom cleaned.
   
b. Clean up work shall be considered incidental to the work.

5. If planting work is performed after lawn preparation is finished, the contractor shall provide protection to the lawn areas and immediately repair any damage resulting from planting operations at no cost to the City.

6. Maintenance of plants shall commence immediately and continue until acceptance of the work. A written recommended maintenance program is to be provided to the City prior to acceptance of the work.
   
a. Maintenance performed by the City in accordance with the recommended program shall not affect the contractor’s obligation to guarantee and replace defective plant material. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
A. Lines of Sight. At intersections and driveways, landscaping proposed to be located within the triangular area on a corner lot formed by measuring twenty (20) feet along both street side property lines from their intersection, or ten (10) feet from the intersection of a property line adjacent and parallel to a public street and a private street or driveway, shall be selected for and maintained at a maximum thirty (30) inch top height. Trees located within or overhanging these triangular areas shall have canopies selected for and maintained at seven (7) feet above street level. The end fifty (50) feet of medians, measured parallel to the directions of traffic, shall be treated in the same manner.
B. Blockage. Landscaping materials should be placed and/or maintained so that they do not interfere with street lighting, traffic signs, access to fire hydrants and similar emergency apparatus, overhead or underground utilities, or operational needs within rights-of-way.

1. Trees and shrubs shall not be placed within fifteen (15) feet of emergency apparatus.

2. Trees and shrubs shall not be placed within ten (10) feet of light standards, overhead or underground utilities, or utility boxes and similar items within rights-of-way that require service operations.

C. Winter Icing. Landscaping materials should be selected and placed so as to minimize winter icing on roads, walkways, and other paving. Placement relative to winter sun angles, spacing, type as deciduous or conifer, and material density should be taken into consideration. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-004-0002 Warranty

Plants that do not survive during the first year after planting shall be replaced with variety and size to match the original plant material. Private parties performing work within rights-of-way shall warrant plant material to remain alive and be in a healthy, vigorous condition for a period of one (1) year after acceptance. Warranty shall
specifically include rodent control during the warranty period. Warranty shall not include damage caused by fires, floods, drought, freezing rains, lightning storms, winds over seventy-five (75) miles per hour, winter kill caused by extreme cold and severe winter conditions not typical of planting areas, acts of vandalism or negligence on the part of the City. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-004-0003 Finish Grading

SECTION 13-18-004-0003.1 Berms

Where space permits, earthen berms may be incorporated into finish grading. Berms shall be between two (2) and six (6) feet high, gently rolling, free form ground sculpture. The top of berms should be undulating to provide a natural appearance. The ridge of berms should have an area at the top that is rounded (i.e., neither flat nor meeting at the peak). The sides of the berm should not exceed a 3:1 slope ratio. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-004-0003.2 Drainage Courses

Swales and similar drainage courses shall be designed as gently rolling, free form ground sculpture with a natural appearance. Where space and hydrological needs permit, they should be broad shallow channels with established vegetation designed to promote infiltration and trap pollutants. Dissipation structures, if any, shall be designed to be as natural in appearance as possible such as the use of rock lining. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-004-0004 Pre-Installation Weed Control Treatment

A. Existing weeds, including roots, are to be completely removed prior to planting.

B. Soil solarization is the preferred method for weed control when time permits. Manual, mechanical, and chemical treatments are acceptable methods.

1. Adverse environmental impacts shall be considered when using chemical treatments and materials.

2. Particular attention shall be paid to protection of standing water bodies and waters directed into drainage courses. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-18-004-0005 Trees

A list of pre-approved trees, shrubs, and ground cover is provided in the zoning code found in Title 10. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-004-0005.1 Street Trees

A. Street trees shall avoid random changes in species installed in public rights-of-way for all developments and shall be typically planted midway between curb and walk at a minimum of forty-five (45) foot intervals. Any existing specimen or mature street tree shall remain and shall be considered a planted tree for purposes of meeting spacing requirements.

B. Tree placement should consider visibility of signage and storefronts, as well as public views and shall be located offset from building entrances. (Plant trees in accordance with Standard Detail 18-04-050.) (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-004-0005.2 Urban Street Trees

Urban street trees shall typically be placed in accordance with the following schedule:

<table>
<thead>
<tr>
<th>Tree Size</th>
<th>Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>10 to 15 feet</td>
</tr>
<tr>
<td>Medium</td>
<td>15 to 20 feet</td>
</tr>
<tr>
<td>Large</td>
<td>20 to 25 feet</td>
</tr>
</tbody>
</table>

A list of pre-approved trees is provided in the zoning code found in Title 10.

A. Structural Soils. Structural soil mixes shall be used in urban and tree grate situations. Structural soil mixes shall be submitted to the City of Flagstaff for prior approval. See Section 13-18-003-0006.7 for recommended design mix.

B. Site Disturbances.

1. Verify locations and clearance depths of underground utilities prior to excavation work.

2. Verify location and clearance heights of overhead utility lines, architectural items, site accessories, street lights, and/or other installed/constructed items.
3. Perform work in a manner to avoid damage.

C. Planting with Improved Substrate (Underlying Base) and Tree Grates.

1. Provide approximately three hundred (300) cubic feet of improved substrate material for each urban street tree.

2. Substrate below proposed walks and pavements, adjacent to proposed street tree locations, shall be backfilled with the structural soil mix specified in Section 13-18-003-0006.7.

   a. Structural soil shall be placed in six (6) to eight (8) inch lifts and mechanically compacted to not less than ninety-five percent (95%) standard Proctor density (AASHTO T-99).

   b. A six (6) inch base course of clean, loose, rounded stone (e.g., river rock) shall be installed and overlaid with a geotextile soil separator.

   c. Tree shall be planted in accordance with Section 13-18-004-0001.1.

See Detail Drawing 18-03-050.

D. Tree Grate Installation.

1. Tree grates shall comply with the requirements of the Americans with Disabilities Act (ADA).

2. Grates shall allow for breakaway ring removal to expand the opening.

3. Rectangular or square tree grates shall have a minimum grate area of twenty-four (24) square feet. Circular tree grates shall have a nominal minimum grate area of twenty-three and three-quarters (23.75) square feet (five and one-half (5.5) foot diameter).

4. Tree grate and frame shall be installed in accordance with the manufacturer’s written instructions.

5. If large area tree grates are not available or cannot be used, multiple tree grates may be used to effectively create a single tree grate around the tree with the use of permeable materials (e.g., pavers) over the remainder of the specified minimum area.
E. Staking and Guying. Trees located within tree grates shall not require staking or guyng. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-004-0005.3 Root Control

Trees planted within four (4) feet of buildings, roads, walkways, and similar situations, shall be provided with root control system specified in Section 13-18-004-0005.5. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-004-0005.4 Structural Soils

Structural soil mixes are two (2) phase systems comprised of a stone skeleton or lattice for strength, and soil for horticultural needs. Proprietary distributors shall provide specifications, compaction data, and testing results. Designs shall be submitted that support the long-term health of the tree and minimize heaving of adjacent paving. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-004-0005.5 Root Barriers

Root barriers shall be one (1) continuous piece (not interlocking), shall be a minimum of twenty-four (24) inches in depth, and installed such that the top is even with the top of pavement. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-004-0005.6 Staking

A. Staking and strapping shall be provided for all tree installations. Stakes are to be driven three (3) feet vertically into firm soil outside the plant pit and shall be placed according to tree height or caliper as follows:

1. Deciduous trees two (2) inches and under - one (1) stake oriented northwest.

2. Deciduous trees larger than two (2) inches but less than three (3) inches and evergreen trees less than five (5) feet in height - two (2) stakes oriented northwest and southeast.

3. Deciduous trees three (3) inches and larger and evergreen trees five (5) feet and larger - three (3) stakes with one (1) oriented northwest and the other two (2) oriented one hundred twenty (120) degrees in either direction from northwest.
Stakes shall be parallel or slightly angled away from the trunk.

B. A double strand of wire shall be run through one (1) grommet in the strap, the strap wrapped around trunk at no more than one-third (1/3) the height of tree, after which the wire shall be run through other grommet and back to stake.

1. Strap and wire attachment between the stake and tree shall be adjusted so that straps are under just enough tension to avoid visible sag in lines.

   a. Rigid guying shall not be accepted.

   b. Straps and wires shall be placed so as to be perpendicular to the trunk. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-004-0005.7 Wrapping

A. All deciduous trees shall be wrapped between October 15th and November 30th of the year in which they are planted. Specified tree wrap shall be cut in a continuous strip of sufficient length to wrap the tree. This wrapping shall begin at the ground line with overlapping wraps of one and one-half (1-1/2) inches terminating above the lowest main branch of the tree.

1. Final wrap shall be secured with tape in at least three (3) places.

B. Tree wrap should be removed between April 1st through 15th of the following spring. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-004-0006 Hardscape

This title provides standards for the design and construction of medians and parkways, sidewalks, and similar hardscape elements, and is incorporated herein by reference. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-004-0007 Landscape Boulders and Rockwork

A. Boulders may be incorporated into landscaping of rights-of-way in a manner that reflects the character of the community’s natural environment.
1. Selected boulders shall be native to the region unless an alternate selection is used and approved for a specific design effect.

2. Boulders shall have rounded natural edges and a character and shape consistent with natural rock settings.

3. No split, bruised face, slab type, layered or slide boulders shall be used without prior approval and acceptance.

B. Boulders shall be set on compacted native material and shall be set into the finish grade, approximately one-third (1/3) the depth of the boulder.

C. Rockwork joints shall be made tight by butting natural faces together in place. Soil grades shall be adjusted to stabilize rocks in position and regraded in place to establish the placement of each rock so that they blend naturally into adjacent terrain. Rockwork is to be placed by terracing or stepped layers to achieve a naturalized effect. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-004-0008    Hydoseeding

Hydoseeding means, materials and methods are described and specified under Chapter 13-17, Erosion Control. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-18-005
Maintenance

Sections:

13-18-005-0001 Responsibility
13-18-005-0002 General Requirements
13-18-005-0003 Irrigation

SECTION 13-18-005-0001 Responsibility

The adjacent property owner is responsible for maintenance of the right-of-way area bounded by the property line and the face of the curb (or edge of road pavement) for the full width of the property. A maintenance district, a business improvement district, homeowners’ association, or the City of Flagstaff may, by prior agreement, be responsible for such maintenance. The City of Flagstaff performs maintenance of all medians. Contact the Parks Division for more information. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-005-0002 General Requirements

A. Maintenance shall be performed on an ongoing basis as needed.

B. Required maintenance includes irrigation, weeding, mowing, pruning, replacement of dead or diseased plants, cleaning, raking, snow removal, pest control, and otherwise caring for and repairing all the landscape materials, including sidewalks and street trees. Required maintenance also includes removal of wildfire fuels such as dead plants and limbs, thinning of tree and shrub densities, and weed control.

C. Replacement and repairs shall be in accordance with the approved streetscape plan, or in the absence thereof, in accordance with these standards.

D. Maintenance priority shall be given to installation, placement, and planting safety items including lines of sight, blockage, and winter icing.

E. Maintenance of plant materials, specifically including trimming and pruning, shall conform to applicable horticulture and arboriculture standards.

F. General weeds shall not be permitted to exceed a height of six (6) inches.
   1. Noxious weeds shall be entirely removed.
2. Cut or otherwise removed weeds shall be collected and properly disposed of and shall not be left on the ground. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-18-005-0003 Irrigation

A. Newly planted trees should be watered daily for the first two (2) weeks and then once a week from April through October and approximately twice a month through the winter.

1. In the third year, if there has been a lack of moisture, extreme heat or drying winds, this amount of watering may still be necessary.

B. The watering schedule for mature trees will be determined based on the species, the soil, and the weather.

C. Irrigation shall be monitored to avoid over- or under-watering. Watering programs and automatic systems shall be adjusted as warranted.

1. Automatic irrigation systems shall receive appropriate design, installation, maintenance, repair, and winterizing so as to comply with water conservation strategies. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Sections:

13-18-006-0001 Tree Protection Measures

SECTION 13-18-006-0001 Tree Protection Measures

A. Construction in rights-of-way, including landscaping, shall be subject to the tree preservation and protection measures of Title 10, Flagstaff Zoning Code, which are herein incorporated including procedures and requirements for root protection, temporary fencing, and grade changes.

B. Dirt, rock, construction materials, equipment, and debris should not be stored around existing trees.

C. Trees to be retained should be protected with suitable fencing such as plywood boarding. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Section 13-18-007-0001  City of Flagstaff Rights

Nothing in this section shall diminish the right of the City of Flagstaff to direct responsible property owners to perform required maintenance so as to ensure public health and safety or to preserve the aesthetic value of the community in accordance with these standards. Nor shall any aspect of this section diminish the right of the City of Flagstaff to enhance, re-design and/or replace, remove, or maintain, any or all of the landscaping in the right-of-way. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
If the responsible property owner fails to perform required maintenance within the time period provided in the notice by the City, or if an immediate hazard exists by virtue of unperformed maintenance, the City shall have the right to perform such maintenance at the expense of the property owner.

The City shall have the right to prune or remove plant material upon private property at the expense of the property owner when it: (A) interferes with the proper spread of light along the street from a street light, (B) interferes with the visibility of any traffic control device or sign, or (C) otherwise poses a threat to the public safety.

The costs of such maintenance shall be assessed against the property owner and shall constitute a lien on the property until paid. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-18-009
Definitions

Sections:

13-18-009-0001 Definitions

SECTION 13-18-009-0001 Definitions

"Berm" refers to a mound of earth.

"Hardscape" includes walkways, sidewalks, plazas, site walls, retaining walls, garden walls, furniture, bus shelters, boulders, fountains, sculpture, and other nonplant materials used in landscaping.

"Landscape" refers collectively to the plants and hardscape in a prescribed area, and may include nonliving ground covers, grading, irrigation systems, and similar ancillary materials, processes, and systems.

"Landscaping" is sometimes used in lieu of the word "landscape," but can also mean the placement of landscape materials in a prescribed area in an organized and harmonious fashion.

"Median" refers to a nondriving surface within a street, between the two (2) curbs, generally along the flow of traffic and serving as a divider between opposing directions or movements.

"Mulch" is an inert or organic material placed around plants to prevent evaporation of moisture, freezing of roots, growth of weeds, and for aesthetic value.

"Noxious weeds" are specified by law or regulation to be particularly undesirable, destructive, and difficult to control.

"Parkway" refers to the area between the curb and the sidewalk or trail. Where there is no curb, the edge of pavement shall delineate the parkway. Where there is no sidewalk or trail, the parkway shall extend to the right-of-way boundary line.

"Plants" are living trees, shrubs, and ground covers.

"Right-of-way" refers to any property under the ownership and/or control of the City and used for public street, access, trail, or similar and related purposes.

"Soil solarization" is a nonchemical technique that utilizes the sun’s heat to kill weeds using clear plastic sealed over moist soils and allowing a few weeks for a few seed germination cycles.
"Street improvements" include new installations, renovations, replacements, or significant repairs to road surfaces, sidewalks, curbs and gutters, and similar hardscape elements within the right-of-way, but does not include maintenance work such as sealing or striping.

"Street trees" are trees planted within parkways or medians.

"Urban street trees" are trees in tree wells within narrow parkways or medians that other standards would require paving instead of landscaping.

"Weeds" are plants that are competitive, persistent, and pernicious or interfere with human activities and as a result are undesirable. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13-19
IRRIGATION SYSTEMS

Divisions:

13-19-001 Criteria
13-19-002 Irrigation Plans
13-19-003 System Flushing and Testing
13-19-004 Products, Material, and Equipment
SECTION 13-19-001-0001 General Design Criteria

A. Sprinkler irrigation system installation shall be in accordance with MAG Specification 440 unless modified by City of Flagstaff Engineering Standards. Wherever available, preference is given for the use of reclaim water irrigation systems.

1. Irrigation system static pressure range shall not vary by more than ten percent (10%) and shall be designed to provide for a maximum pressure of eighty-five (85) psi.

2. Design irrigation system lateral piping to limit pressure drops to less than twenty percent (20%) of the average sprinkler operation pressure.

3. Install sprinkler heads and nozzle types of the same manufacturer and pressure rating within the same irrigation zone.

4. Zone the irrigation system according to plant water requirements, targeting plants with similar water requirements. Zone trees, shrubs, planting beds, turf and hydroseed areas separately.

5. Integrate existing and new irrigation systems to insure a homogeneous system with balanced coverage. When there is an alteration to an existing irrigation system, test existing mainline, control valves, lateral lines, sprinklers, drip lines and wiring prior to alteration. Perform mainline static and working pressure tests, lateral line working pressure, GPM and coverage tests and circuit continuity testing for control wiring.

6. Design all sprinkler layouts for head to head coverage.

7. Provide matched precipitation rates for sprinklers within the same irrigation zone.

8. Contingent upon soil texture and slope, precipitation rates shall not exceed infiltration rates.
9. Design mainline flow based upon the largest zone GPM plus a single quick coupler at twenty (20) GPM.

10. Design piping with a horizontal layout on slopes. Do not design with elevation changes that exceed the capacity of sprinkler check valves. Compensating emitters shall be required on slopes.

11. Irrigation system as-built plans shall be provided to the Parks and Recreation Division. Preference is for as-built plans to be submitted on compact disc (CD). Provision of as-built plans is a condition of project acceptance.

12. The backflow prevention device shall be tested by a certified tester prior to project acceptance.

13. The contractor shall be responsible for providing and installing all necessary signage for reclaimed water systems. Reclaim work shall comply with Title 18, Chapter 9, Articles 6 and 7 of the Arizona Administrative Code. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-19-001-0002 General System Criteria

A. A manual shutoff ball valve is required to isolate the irrigation system from the water supply main.

B. Provide a quick coupler valve at a maximum distance of two hundred (200) feet throughout the project. Locate quick coupler valves to minimize the necessity of water hoses crossing walkways, driveways and roads.

C. Sprinkler swing assemblies shall be one (1) piece and shall not exceed twenty four (24) inches.

D. Provide two (2) spare control wires to all remote mainline legs. A spare common wire shall be installed through the entire project. A spare hot wire is required to be run to every valve.

E. The ProMax remote controller shall be hard wired into each irrigation controller in accordance with the manufacturer’s written instructions.

F. Provide a three (3) foot loop of irrigation wiring at each valve box.

G. All irrigation wiring shall be contained in adequately sized conduit.
H. Locate valve boxes, valves and quick coupler valves at a minimum of thirty-six (36) inches from hardscape edges.

I. All backflow prevention devices shall be contained in an insulated hot box.

J. Isolation ball valves are required before all electric control valves.

K. A quick coupler is required immediately following the backflow prevention device.

L. A filter is required immediately prior to the backflow prevention device.

M. Strainers are required a minimum of every two hundreds (200) linear feet in the main irrigation line.

N. A surge protection device and quick disconnect box shall be placed before the irrigation controller.

O. A twenty (20) amp breaker is required in the backflow prevention device hot box (for heat tape use).

P. Provide a tee, with a plug facing up, after the water meter and before the backflow prevention device.

Q. Provide a ball valve on the main water line after the curb stop and before the tee with plug. Ball valve and plug shall be contained within the same irrigation box.

R. Emitters shall come off of PVC line and not drip tubing.

S. A manual drain valve shall be placed at the end of the irrigation water main line and at the end of each system line.

T. Telescoping unions (slip fix) shall be placed after the electric control valves.

U. Sleeves are required below sidewalks, driveways, trails, retaining walls, and/or other similar features, and shall extend ten (10) inches past the structures. Sleeves shall be set a minimum of twenty four (24) inches deep.

V. All drip tubing shall be installed at a minimum of three (3) inches deep.

W. The main irrigation line and the irrigation wires shall share the same trench. The trench shall be a minimum of twenty four (24) inches deep.
X. The trench for lateral irrigation lines shall be a minimum of eighteen (18) inches deep.

Y. Trenches shall not be backfilled until all required inspections and tests are performed.

Z. All PVC irrigation lines shall be bedded, shaded and backfilled to four (4) inches above the top of pipe with clean native or fine granular import material, free of clods, stone or other deleterious material, one-half (1/2) inch in diameter or larger. Backfill above the initial backfilling, as described above, shall be clean native or fine granular import material, free of clods, stone or other deleterious material, one and one-half (1-1/2) inch in diameter or larger. In turf areas, the one-half (1/2) inch maximum size of clods, stone or other deleterious material shall apply for all backfill.

AA. Pipe backfilling shall be in six (6) inch maximum lifts, mechanically compacted, to a dry density equal to adjacent undisturbed soils in landscaped areas. Compaction beneath pavements and other hardscape shall be as specified on the plans and/or in the applicable specifications.

BB. Backfill shall conform to the line and elevation of adjacent grades with no surface irregularities.

CC. If settlement occurs, the Contractor shall make all necessary adjustments and repairs to pipes, valves, heads, lawns, plantings and other construction at no cost to the owner.

DD. Irrigation marking tape is required to be installed over the irrigation water main at a nominal depth of twelve (12) inches. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Sections:

13-19-002-0001 Irrigation Plans

SECTION 13-19-002-0001 Irrigation Plans

Minimum plan requirements include a schematic utility connection detail, irrigation legend, piping diagrams, pipe diameter and design calculations. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-19-003
System Flushing and Testing

Sections:

13-19-003-0001 System Flushing and Testing

SECTION 13-19-003-0001 System Flushing and Testing

A. MAG Section 440.10, Flushing and Testing, shall apply.

B. An operational test of the irrigation system in the presence of the City of Flagstaff authorized representative is required. The coverage test shall be performed after sprinkler heads have been installed and shall demonstrate that each section or unit in the irrigation system is balanced to provide uniform head to head coverage of the service area.

C. Irrigation systems shall be warranted against defects in materials and workmanship for one (1) year from date of acceptance. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
Division 13-19-004
Products, Material, and Equipment

Sections:

13-19-004-0001 Supplemental Products, Materials, and Equipment
13-19-004-0002 Products, Materials and Equipment

SECTION 13-19-004-0001 Supplemental Products, Materials, and Equipment

A. Provide supplemental inventory of the following items to the City:

1. For each size of unit installed, provide one (1) additional quick coupling valve, quick coupling valve operating key and quick coupling valve hose swivel.

2. Provide one (1) additional controller key pad for each type of irrigation controller installed.

3. Provide one (1) additional controller programming/access key per project for the solar irrigation controller.

4. Provide one (1) ProMax remote controller and adapter cord with plug at each end.

5. Provide an additional ten percent (10%) of the installed quantity of sprinkler heads, emitters and irrigation control valves. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-19-004-0002 Products, Materials and Equipment

All products are indicative of the quality anticipated for the work and "or equal" is applicable with prior City of Flagstaff approval:

<table>
<thead>
<tr>
<th>Backflow Prevention Device</th>
<th>Febco 825 YA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backflow Enclosure</td>
<td>Lock Box or Hot Box</td>
</tr>
<tr>
<td></td>
<td>Shall be an insulated box. Cage is not acceptable.</td>
</tr>
<tr>
<td>Pressure Regulator</td>
<td>Watts or Febco</td>
</tr>
<tr>
<td>Quick Coupling Valves</td>
<td>Rainbird 44 LRC, 44K (1&quot;) valve key and hose swivel</td>
</tr>
<tr>
<td></td>
<td>Rainbird 7, 1 piece body, 7K (1-1/2&quot;) valve key and hose swivel</td>
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(Revised 10/17)
<table>
<thead>
<tr>
<th>Control Valves</th>
<th>Weathermatic 11000 Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation Valve Boxes</td>
<td>Carson No. 1 and No. 2, Model 1220</td>
</tr>
<tr>
<td></td>
<td>Reclaim shall be purple. Potable shall be green.</td>
</tr>
<tr>
<td>Strainers</td>
<td>Watts or Febco</td>
</tr>
<tr>
<td>Drip System Pressure Regulator</td>
<td>Watts or Febco</td>
</tr>
<tr>
<td>Drip System Emitters</td>
<td>Quadra Bubbler</td>
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<tr>
<td></td>
<td>Octa Bubbler System</td>
</tr>
<tr>
<td></td>
<td>Bowsmith ML 200 Multi-emitter</td>
</tr>
<tr>
<td></td>
<td>Bowsmith SL 206 Single Emitter</td>
</tr>
<tr>
<td>Electric Irrigation Controllers</td>
<td>Rainbird MaxiCom Central Control System</td>
</tr>
<tr>
<td></td>
<td>- ProMax remote control required</td>
</tr>
<tr>
<td></td>
<td>Rainsafe Control System - preassembled with controller unit, master valve flow sensor</td>
</tr>
<tr>
<td></td>
<td>Rainbird ESP-SAT Series Controller (when required)</td>
</tr>
<tr>
<td>Spray Heads</td>
<td>Hunter: I-40/PGP/I-25 Stainless Steel</td>
</tr>
<tr>
<td></td>
<td>Riser/PS Series 2&quot; and 6&quot;</td>
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<tr>
<td></td>
<td>Toro: Series 300 or 570 or 640 or Super 600 or V-1550</td>
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<tr>
<td></td>
<td>Rainbird: 1800 Series - 6&quot;, 8&quot; and 12&quot;</td>
</tr>
<tr>
<td>Piping</td>
<td>PVC pipes and fittings shall be schedule 40</td>
</tr>
<tr>
<td></td>
<td>PVC Cement: medium bodied, primer required</td>
</tr>
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<td></td>
<td>Copper tubing shall be K copper</td>
</tr>
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<td></td>
<td>Poly drip tubing: allowed only after emitters</td>
</tr>
<tr>
<td>Manual Valves</td>
<td>Shall be resilient seated ball valve</td>
</tr>
<tr>
<td>Master Valves - required</td>
<td>Less than 2&quot;: Griswold Master Valve</td>
</tr>
<tr>
<td>on main line of irrigation system</td>
<td>- a pressure reducing valve is required</td>
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<tr>
<td></td>
<td>2&quot; or larger: Singer Model No. 106-PR-SC24V</td>
</tr>
<tr>
<td>Flow Sensor</td>
<td>Compatible with MaxiCom System. Required on main line of irrigation system.</td>
</tr>
</tbody>
</table>

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13-21
REVISIONS TO MAG UNIFORM STANDARDS SPECIFICATIONS AND MAG UNIFORM STANDARD DETAILS

Divisions:

13-21-001 Revisions to MAG Uniform Standard Specifications
13-21-002 Addendum to MAG Uniform Standard Details for Public Works Construction
Division 13-21-001
Revisions to MAG Uniform Standard Specifications

Sections:

13-21-001-0010 Flagstaff Addendum to MAG Uniform Standard Specifications for Public Works Construction
13-21-001-104.1.3 MAG Spec 104.1.3 – Clean-Up and Dust Control
13-21-001-106.2 MAG Spec. 106.2 – Control of Materials – Samples and Tests of Materials
13-21-001-107.7 MAG Spec. 107.7 – Barricades and Warning Signs
13-21-001-108.5 MAG Spec 108.5 – Limitations of Operations
13-21-001-211.2 MAG Spec. 211.2 – Fill Construction – Placing
13-21-001-211.3 MAG Spec 211.3 – Fill Construction – Compacting
13-21-001-301.3 MAG Spec. 301.3 – Sub-Grade Preparation – Relative Compaction
13-21-001-310.2 MAG Spec. 310.2 – Untreated Base – Placing
13-21-001-311.2 MAG Spec. 311.2 – Soil Cement Base Course – Materials
13-21-001-311.4 MAG Spec. 311.4 – Soil Cement Base Course – Construction Methods
13-21-001-321.5 MAG Spec. 321.5 – Asphaltic Concrete Paving – Placing, Spreading, and Finishing
13-21-001-321.5.3 MAG Spec. 321.5.3 – Asphaltic Concrete Pavement – Leveling Course
13-21-001-321.5.4 MAG Spec. 321.5.4 – Asphaltic Concrete Pavement – Asphalt Base and Surface Course
13-21-001-321.6 MAG Spec. 321.6 – Asphaltic Concrete Pavement – Corrective Requirements for Deficiencies
13-21-001-330.2.1 MAG Spec. 330.2.1 – Asphalt Chip Seal – Materials – Asphalt
13-21-001-330.3 MAG Spec 330.3 – Asphalt Chip Seal – Time of Application and Weather Conditions
13-21-001-330.4.8 New Sub-Title: MAG Spec. 330.4.8 – Asphalt Chip Seal – Protection to Adjacent Property
13-21-001-336.2.1 MAG Spec 336.2.1 – Pavement Widening or Extensions
13-21-001-336.2.3 MAG Spec. 336.2.3 – Temporary Pavement Replacement
13-21-001-336.2.4 MAG Spec. 336.2.4 – Pavement Matching and Surface Replacement – Permanent Pavement Replacement
13-21-001-340.2 MAG Spec. 340.2 – Concrete Curb, Gutter, Sidewalk, Driveway and Alley Entrance – Materials
13-21-001-340.3 MAG Spec. 340.3 – Concrete Curb, Gutter, Sidewalk, Driveway and Alley Entrance – Construction Methods
13-21-001-342.2.1 MAG Spec. 342.2.1 – Decorative Pavement – Sand Aggregate Base Course
13-21-001-342.2.4 MAG Spec. 342.2.4 – Decorative Pavement – Brick
13-21-001-342.3.3 MAG Spec. 342.3.3 – Decorative Pavement – Header

(Revised 10/17)
<table>
<thead>
<tr>
<th>Spec Code</th>
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<tr>
<td>13-21-001-0342.3.4</td>
<td>MAG Spec. 342.3.4. - Decorative Pavement - Concrete Paving Stones</td>
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<td>13-21-001-0342.3.6</td>
<td>MAG Spec. 342.3.6 - Decorative Pavement - Sand Laying Course</td>
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<tr>
<td>13-21-001-0345.2</td>
<td>MAG Spec. 345.2 - Adjusting Frames, Covers, Valve Boxes, and Water Meter Boxes - Adjusting Frames</td>
</tr>
<tr>
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<td>MAG Spec. 345.3 - Adjusting Frames, Covers, Valve Boxes, and Water Meter Boxes - Adjusting Valve Boxes</td>
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<tr>
<td>13-21-001-0401.5</td>
<td>MAG Spec. 401.5 - Right-of-Way and Traffic Control General Traffic Regulations</td>
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<td>MAG Spec. 405.2 - Monuments - Materials</td>
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<td>13-21-001-0505.3</td>
<td>MAG Spec. 505.3 - Concrete Structures - Forms</td>
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<td>13-21-001-0505.6</td>
<td>MAG Spec. 505.6 - Concrete Structures - Placing Concrete</td>
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<td>13-21-001-0505.6.2</td>
<td>MAG Spec. 505.6.2 - Concrete Structures - Adverse Weather Concreting</td>
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<td>13-21-001-0601.2.3</td>
<td>MAG Spec. 601.2.3 - Water and Sewer - Trench Grade</td>
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<td>13-21-001-0601.2.9</td>
<td>MAG Spec. 601.2.9 - Water and Sewer - Trench Excavation, Backfill and Compaction - Shoring and Shetting</td>
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<td>MAG Spec. 601.4.4 - Water and Sewer - Trench Excavation, Backfill and Compaction - Compaction Densities</td>
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<td>13-21-001-0610.10</td>
<td>MAG Spec. 610.10 - Connection to Existing Mains</td>
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<td>13-21-001-0625.3</td>
<td>MAG Spec. 625.3 - Manhole Construction and Drop Sewer Connections - Construction Methods</td>
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<tr>
<td>13-21-001-0702.1</td>
<td>MAG Spec. 702.1 - Base Materials - General</td>
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<tr>
<td>13-21-001-0702.2.2</td>
<td>MAG Spec 702.2.2 - Base Materials - Crush Aggregate - Grading</td>
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<td>13-21-001-0710.2.1</td>
<td>MAG Spec. 710.2.1 - Asphaltic Concrete - Material - Asphalt Binder</td>
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<td>13-21-001-0710.2.2</td>
<td>MAG Spec. 710.2.2 - Asphalt Concrete - Aggregate</td>
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<td>MAG Spec 710.3.1 - Asphalt Concrete - Mixed Design Requirements - General</td>
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<td>MAG Spec 710.4.2 - Asphalt Cement Content</td>
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<td>13-21-001-0713.1</td>
<td>MAG Spec. 713.1 - Emulsified Asphalts - General</td>
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<td>13-21-001-0716.2.1</td>
<td>MAG Spec. 716.2.1 - Cover Material - Stone Chips - General</td>
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<td>MAG Spec. 716.2.3 - Cover Material - Stone Chips - Gradation</td>
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<td>13-21-001-0725.1</td>
<td>MAG Spec. 725.1 - Portland Cement Concrete - Classes of Concrete</td>
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<td>13-21-001-0725.3</td>
<td>MAG Spec. 725.3 - Portland Cement Concrete Aggregates</td>
</tr>
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13-21-001-0725.5 MAG Spec. 725.5 – Portland Cement Concrete – Water
13-21-001-0750.2 MAG Spec. 750.2 – Iron Water and Pipe Fittings, Ductile Iron Water Pipe
13-21-001-0750.3 MAG Spec 750.3 – Iron Water and Pipe Fittings, Joint Requirements
13-21-001-0760.1 MAG Spec. 760.1 – Coating Corrugated Metal Pipe and Arches – General

SECTION 13-21-001-0010 Flagstaff Addendum to MAG Uniform Standard Specifications for Public Works Construction

This addendum is based on the Maricopa Association of Governments Uniform Standard Specifications and Standard Details for Public Works Construction (MAG Specs and Details) latest revisions.

Each chapter number indicates the section of MAG Specifications on which the change is made.

Paragraph number references are counted from the beginning of the respective title. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-104.1.3 MAG Spec 104.1.3 – Clean-Up and Dust Control

Revise to include the following:

The use of City reclaimed wastewater is encouraged on all construction activity, and it is required on all major construction activity in accordance with City Code, Section 7-03-001-0014, Water Conservation.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-106.2 MAG Spec. 106.2 – Control of Materials – Samples and Tests of Materials

Third paragraph, revise second sentence to read as follows:

Unless otherwise specified, samples and tests will be made in accordance with either; the Materials Testing Manual of the Contracting Agency; the standard methods of AASHTO, ASTM, or ADOT, which were in effect and published at the time of advertising for bids.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-21-001-0107.7 MAG Spec. 107.7 – Barricades and Warning Signs

Revise to include the following:

The Traffic Barricade Manual referred to under this section and thereafter in the Standard Specifications shall be part of VI of the Federal Highway Administration’s Manual on Uniform Traffic Control Devices (MUTCD).

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0108.5 MAG Spec. 108.5 – Limitations of Operations

Add new fifth and sixth paragraphs:

The on-site contractor shall confine all construction and employee operations to the site for which a permit has been issued. No employee parking, construction activity, or fabrication shall be allowed in public right-of-way or easements.

The contractor shall apply for an encroachment permit for utilizing public right-of-way for material storage or a construction office, except for work authorized by a right-of-way permit.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0211.2 MAG Spec. 211.2 – Fill Construction – Placing

Fourth paragraph, revise last sentence to read as follows:

However, such material shall not be placed within 3 feet of the finished subgrade of the fill.*

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0211.3 MAG Spec 211.3 – Fill Construction – Compacting

Fifth paragraph, revise last sentence to read as follows:

Each layer shall be compacted to a uniform density of not less than 95 percent, or as directed by the Engineer.
Sixth paragraph, revise first sentence to read as follows:

When fill material contains by volume over 25 percent of rock larger than 6 inches in the greatest dimension, the fill (up to 4 feet below finished subgrade) may be constructed in layers of a loose thickness not exceeding the maximum size of rock in the material. In no case shall such layers exceed 3 feet in thickness.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0301.3 MAG Spec. 301.3 – Sub-Grade Preparation – Relative Compaction

Revise paragraph to read as follows:

The subgrade shall be scarified and loosened to a depth of 9 inches. When fill material is required, a layer of approximately 3 inches may be spread and compacted with the subgrade material to provide a better bond. The subgrade cut and fill areas shall be constructed to achieve a uniform soil structure having the following density when tested in accordance with AASHTO T-99, Method A; T-191 or ASTM D-2922; and D-3017 with the percent of density adjusted in accordance with the rock correction procedures for maximum density determination, standard detail No. 190, to compensate for the rock content larger than that which will pass a No. 4 sieve:

a. Major streets 95 percent
b. Other streets and traffic ways 95 percent
c. Curbs, gutter and sidewalks 90 percent

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0310.2 MAG Spec. 310.2 – Untreated Base – Placing

Fourth paragraph, revise to read as follows:

Untreated base may vary not more than 1/4 inch above or below required grade and cross-section.

Untreated base compaction shall be 95% under curb/gutter, sidewalk, driveway and alley entrances, handicap ramps, and catch basins.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-21-001-0311.2 MAG Spec. 311.2 – Soil Cement Base Course – Materials

Second sentence, revise to read as follows:

The soil for the mixture shall consist of the material in the area to be paved or approved selected material.

Last sentence, revise to read as follows:

The cement content shall be determined by the procedures set forth in AASHTO T136-50 or ASTM D560-67. The selection of a cement content based on compressive strength requirements without regard to freeze-thaw durability will not be allowed.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0311.4 MAG Spec. 311.4 – Soil Cement Base Course – Construction Methods

Second paragraph, revise to include the following:

Soil cement base course shall not be mixed with or placed on any frozen material; at the time of mixing and placing, the air temperature shall be 40°F (5°C) and rising, and the surface temperature shall be 45°F (10°C). The soil cement base course shall be protected from freezing for a minimum period of seven (7) days.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0321.5 MAG Spec. 321.5 – Asphaltic Concrete Paving – Placing, Spreading and Finishing

Add the following paragraphs after the first paragraph:

Asphalt concrete shall only be placed upon a surface of at least 70°F. The temperature of the asphalt concrete of any course, just prior to the dumping of the material from the hauling vehicle, shall be at least 265°F; a lower temperature is allowed if written approval is given by the Engineer. Compaction and finishing shall be completed before the mix has cooled to 180°F. The Engineer may authorize placement of asphalt concrete upon surfaces having a temperature of 45°. For above, providing those mentioned above and the following conditions are met.

a. The underlying surface is dry.
b. The weather is dry and without threat of precipitation.

c. The temperature of the asphalt concrete mixture is such that the sum of the air temperature plus the temperature of the mixture when placed is at least 310°F.

d. Asphalt concrete shall not be placed on grade that appears to be frozen unless specifically authorized by the Engineer.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0321.5.3 MAG Spec. 321.5.3 – Asphalthic Concrete Pavement – Leveling Course

Seventh paragraph, revise second sentence to read as follows:

An acceptable surface shall not vary more than 1/2 inch from the lower edge of a 10 foot straightedge when placed parallel to the centerline of the roadway.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0321.5.4 MAG Spec. 321.5.4 – Asphalthic Concrete Pavement – Asphalt Base and Surface Course

Third paragraph, revise fourth sentence to read as follows:

The transverse surface joints shall be tested with a 10 foot straightedge and shall conform to the requirements herein for acceptable surface tolerance.

Delete seventh paragraph (beginning with "When more than one width...").

After the eleventh paragraph, revise to include the following:

Finish rolling shall be started after the pavement has cooled sufficiently to permit removal of the roller marks, and shall be continued in whatever direction is necessary to produce a pavement surface free of indentations.

Twelfth paragraph, revise second sentence to read as follows:

An acceptable surface tolerance shall not vary more than 1/4 inch from the lower edge of a 10 foot straightedge when placed parallel to the centerline of the roadway.
Twelfth paragraph, the second sentence, revise to include the following:

The following transverse surface tolerance shall apply at right angles to the centerline where the plans call for a straight transverse grade. The transverse surface shall not vary more than one-quarter of an inch from the lower edge of a 10 foot straightedge when placed at right angles or radially to the centerline where the approved plans call for a uniform transverse finish grade. This surface specification shall not apply where the plans call for a break in transverse grade, such as at a roadway crown or swale.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0321.6  MAG Spec. 321.6 – Asphalitic Concrete Pavement – Corrective Requirements for Deficiencies

Third paragraph, revise first sentence to read as follows:

When the deficiency of the pavement thickness exceeds 1/2 inch, the pavement shall be overlaid on the area affected. In no case shall this overlay be less than one City block or 660 feet in length, whichever is less. This overlay shall be placed over the full width of pavement with a new mat of material specified by the Engineer; equal in thickness to the deficiency, but not less than 1 inch in any instance.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0330.2.1  MAG Spec 330.2.1 – Asphalt Chip Seal – Materials – Asphalt

Revise to include the following:

Emulsified asphalt Type CRS-2P shall be used for the chip seal coat.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-21-001-0330.3  MAG Spec 330.3 – Asphalt Chip Seal –
Time of Application and Weather Conditions

Second paragraph, revise second sentence to read as follows:

The ambient air temperature shall be at least 70°F and rising.

Third paragraph, revise to read as follows:

Asphalt chip seal shall be performed between June 1 and August 31 unless specifically permitted otherwise by the City Engineer.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0330.4.8 New Sub-Title: MAG Spec 330.4.8 –
Asphalt Chip Seal – Protection to Adjacent Property

Revise to include new subsection as follows:

The Contractor shall protect all manhole covers, water valve boxes, survey monuments, and/or other man-made features so that no bituminous material or cover material remains and so that covers can be easily accessed after sweeping. All adjacent sidewalks and driveways shall be swept and maintained clear of loose cover material.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0336.2.1  MAG Spec 336.2.1 – Pavement Widening or
Extensions

First paragraph, revise second sentence to read as follows:

The minimum depth of the cut shall be four (4) inches or Depth/4, whichever is greater.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0336.2.3  MAG Spec 336.2.3 – Temporary Pavement Replacement

Temporary pavement replacement, as required in Section 601, shall be with UPMTM or an approved equal with a minimum thickness of two (2) inches and shall conform to the following requirements:
DESCRIPTION:

1. The paving material shall be composed of an aggregate, as specified herewith, and plant mixed with Unique Paving Material (U.P.M.tm) liquid asphalt blend from the Sylvax Corporation or approved equal. The bituminous material shall be capable of coating wet aggregates without stripping, shall be available in various grades, and permit any one grade to be stockpiled and remain pliable and workable at a temperature of -15°F for a minimum period of 12 months.

2. The paving material shall be capable of maintaining adhesive qualities in an uncovered stockpile or in paved areas, which were damp or wet at the time of application, for a minimum period of 12 months.

MATERIALS:

1. The aggregate gradation shall meet the following requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>85-100</td>
</tr>
<tr>
<td>No. 8</td>
<td>10-40</td>
</tr>
<tr>
<td>No. 16</td>
<td>10</td>
</tr>
<tr>
<td>No. 50</td>
<td>0-5</td>
</tr>
<tr>
<td>No. 200</td>
<td>2 maximum</td>
</tr>
</tbody>
</table>

2. The aggregate shall also meet the following criteria:

<table>
<thead>
<tr>
<th>Sand equivalent</th>
<th>45 min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crushed faces</td>
<td>70% min.</td>
</tr>
<tr>
<td>Flakiness index</td>
<td>25 max.</td>
</tr>
<tr>
<td>Absorption</td>
<td>1.0 - 2.5%</td>
</tr>
<tr>
<td>Specific gravity</td>
<td>2.55 - 2.75%</td>
</tr>
</tbody>
</table>

3. Bituminous material:

The bituminous material shall be UPMTM liquid asphalt blend from the Sylvax Corporation or approved equal. When prepared from a base asphalt stock of either AC-10 or AC-20 and blended, it shall meet the following requirements:

Flash point (TOC) 200°F (94°C) min.
Distillate Test

(volume of original sample)

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Residue (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>To 437°F</td>
<td>0%</td>
</tr>
<tr>
<td>To 500°F</td>
<td>0 - 55%</td>
</tr>
<tr>
<td>To 600°F</td>
<td>0 - 20%</td>
</tr>
<tr>
<td>Residue from Distillate @ 680°F</td>
<td>78 - 95%</td>
</tr>
</tbody>
</table>

Residue Test:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute Viscosity @ 140°F</td>
<td>125 poises</td>
</tr>
<tr>
<td>Penetration</td>
<td>200 min.</td>
</tr>
<tr>
<td>Ductility @ 39°F</td>
<td>100 min.</td>
</tr>
<tr>
<td>Solubility in Trichloroethylene</td>
<td>99% min.</td>
</tr>
</tbody>
</table>

4. Composition of Mixture:

The mixture shall consist of an aggregate as specified and a bituminous material as specified mixed in such a manner as to contain approximately 6% of bituminous material per finished ton.

5. Preparation of Mixture:

The asphalt shall be heated to a temperature between 150°F and 300°F and mixed with the heated aggregate until all aggregates are uniformly coated. The mixed temperature shall not exceed 170°F.

6. Plant and Equipment:

A batch-type mixer of approved design and capacity shall be used in mixing the ingredient materials.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
Tenth paragraph, revise first sentence to read as follows:

The surface course shall consist of an asphalt concrete material in accordance with Section 710 as specified by the engineer to match the existing surface.

Last paragraph, revise to read as follows:

Where deep lift asphalt concrete (asphalt concrete base and asphalt concrete wearing course) exists, the base course replacement shall be made in lifts not exceeding 4 inches in compacted thickness to within 1-1/2 inch of the finish grade.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

First paragraph, revise to read as follows:

Concrete shall be Class A, containing 5 to 7% air entrainment, and conforming to applicable requirements of Section 725.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

Seventeenth paragraph, revise to include the following:

The longitudinal extent of any curb and gutter removal, replacement necessary because of nonconformity with the plans or specification, and replacement due to damage prior to acceptance shall not be less than the appropriate contraction joint spacing.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-21-001-0342.2.1 MAG Spec 342.2.1 - Decorative Pavement - Sand Aggregate Base Course

Revise paragraph to read as follows:

The sand laying course shall be clean washed concrete sand conforming to ASTM C-33. The mortar sand shall be clean washed sand conforming to ASTM C-144. The aggregate base course shall be aggregate base in accordance with MAG Section 702.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0342.2.4 MAG Spec. 342.2.4 – Decorative Pavement – Brick

Revise paragraph to read as follows:

Brick shall not be used for decorative pavement.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0342.3.3 MAG Spec. 342.3.3 – Decorative Pavement – Header

Revise paragraph to read as follows:

The header shall be a Class A concrete with 5 to 7% air entrainment, and in accordance with Section 725.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0342.3.4 MAG Spec 342.3.4 – Decorative Pavement – Concrete Paving Stones

First paragraph, revise to read as follows:

The concrete paving stones shall be installed on the undisturbed sand laying course with gaps of 1/16 to 1/8 of an inch between each stone and adjacent stones or retention curb. After the stones are in place, a plate vibrator compactor shall be used to compact the stones. This will require two passes at 90 degrees to each other. After this operation, approximately 1/4 inch of mortar sand will be placed on the stones followed by a minimum of two passes with the compactor. Any excess sand shall be swept into the joint and/or removed. The completed installation shall be washed down and cleaned. Any cutting of the pavement stone shall be accomplished with a saw.

(Revised 10/17)
Second paragraph, revise to read as follows:

The contractor shall lay the paving stones starting from the longest straight line and from a true 90 degree corner. If the corner of the edge retention is not a true 90 degree corner, the paving stones must be laid slightly away (about half the length of a brick) from the edge at a 90 degree angle.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0342.3.6 MAG Spec. 342.3.6 - Decorative Pavement - Sand Laying Course

Revise paragraph to read as follows:

The thickness of the sand laying course shall be 1 inch, and screeding boards shall be used to ensure a uniform thickness. The sand shall not be compacted or walked on, and should be wet enough to cling together when compressed lightly in the hand and not fall apart when the hand is reopened.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0345.2 MAG Spec. 345.2 - Adjusting Frames, Covers, Valve Boxes, and Water Meter Boxes - Adjusting Frames

Second paragraph, revise third sentence to read as follows:

Class A concrete, with 5 to 7% air entrainment, shall be placed around and under the frames to provide a seal and properly seat the frame at the required elevation and slope.

For new manholes, the maximum dimension from top of lid to the top of the cone shall be 22". The maximum dimension from the top of the lid to the bottom of the flat top shall be 24".

For existing manholes to be raised in previously paved areas, the maximum dimension from the final finished grade to the bottom of the manhole neck shall be 28 inches. It is the contractor’s responsibility to examine each existing manhole and determine the exact nature of the work required to adjust each manhole.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-21-001-0345.3  MAG Spec 345.3 – Adjusting Frames, Covers, Valve Boxes, and Water Meter Boxes – Adjusting Valve Boxes

Second paragraph, revise second sentence to read as follows:

   Any excavated area shall be filled with Class A concrete, with 5 to 7% air entrainment, in accordance with the standard detail, or as directed by the Engineer.

Third paragraph, revise second sentence to read as follows:

   This collar shall be of Class A concrete with 5 to 7% air entrainment.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0401.5  MAG Spec. 401.5 – Right-of-Way and Traffic Control – General Traffic Regulations

Eleventh paragraph, revise to read as follows:

   The contractor will reinstall all permanent traffic control devices as required by the approved construction plans and specifications.

Twelfth paragraph, revise to read as follows:

   Existing traffic signs, including stop, yield and street name signs, shall be maintained by the contractor until such time as construction renders them obsolete. The contractor shall be responsible for furnishing and installing all permanent traffic signs as required by the construction plans and specifications.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0405.2  MAG Spec. 405.2 – Monuments – Materials

Second paragraph, revise to read as follows:

   All concrete shall be Class A with 5 to 7% air entrainment.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-21-001-0505.3 MAG Spec. 505.3 – Concrete Structures – Forms

Tenth paragraph, revise to read as follows:

The contractor may, with the permission of the engineer, pour such portions of the concrete for the structure directly against the side of the excavation or sheathing without the use of outside forms, provided that the following conditions are met.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0505.6 MAG Spec. 505.6 – Concrete Structures – Placing Concrete

First paragraph, add the following after the first sentence:

No concrete shall be placed without the approval of the City Inspector.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0505.6.2 MAG Spec. 505.6.2 – Concrete Structures – Adverse Weather Concreting

Subsection (B), revise to include the following:

Concrete operations shall not be continued when a descending air temperature in the shade and away from artificial heat falls below 40°F, nor shall concrete operations be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F.

Mixing and placing concrete shall continue no later in any day than to allow sufficient time to place and protect the concrete already placed before the air temperature drops to 35°F.

Concrete operations may be allowed although the air temperature in the shade away from artificial heat is below the limit permitted above. Where concrete operations are thus allowed, the contractor shall use equipment to heat the aggregates, or water, or both, prior to mixing. Aggregates shall be uniformly heated to at least 60°F and shall have no chunks of ice. Equipment used to heat the aggregates shall obtain uniform temperature throughout the aggregate within each batch and from one batch to another. Water shall not be heated in excess of 150°F.

The contractor shall provide adequate protection via insulation, heat, or both, for the concrete after placement. This protection
shall be to the extent required to maintain a temperature under the insulation of 60°F to 90°F for a period of 72 hours after placement, and from 40°F to 90°F for an additional 96 hours. Regardless of the air temperature at the time of mixing and placing the concrete, the protection specified above shall be provided at all times when the air temperature is below 35°F.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0601.2.3 MAG Spec. 601.2.3 – Water and Sewer – Trench Grade

First paragraph, revise the first sentence to read as follows:

Alignment and elevation stakes shall be furnished by the contractor at a minimum of 50 foot intervals and agreed upon offsets.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0601.2.9 MAG Spec. 601.2.9 – Water and Sewer – Trench Excavation, Backfill and Compaction – Shoring and Sheeting

Revise to include the following:

It shall be the contractor’s responsibility to provide such trench bracing, sheeting, or shoring as may be necessary to protect existing improvements outside the trench and to support and ensure the ground alongside the excavation will not slide or settle. Existing improvements outside the trench, either public or private, damaged due to lack of adequate trench bracing, sheeting, or shoring shall be removed and replaced in kind at the Contractor’s expense.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0601.4.3 MAG Spec. 601.4.3 – Trench Excavation, Backfill and Compaction – Backfill

Second paragraph, revise to read as follows:

Water consolidation (flooding, jetting, or other discharge) will not be permitted.

(Revised 10/17)
Fourth paragraph, revise to read as follows:

When mechanical compaction is used, backfill shall be placed in lifts not exceeding one foot in compacted height, regardless of pipe size, material, or backfill type.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0601.4.4  MAG Spec. 601.4.4 – Water and Sewer – Trench Excavation, Backfill and Compaction – Compaction Densities

Table 601-2, revise to read as follows:

<table>
<thead>
<tr>
<th>Backfill Type</th>
<th>Location</th>
<th>From Subgrade to 2' Below Subgrade</th>
<th>From 2' Below Subgrade to 1' Above Top of Pipe</th>
<th>From 1' Above Top of Pipe to Bottom of Trench</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Under any existing or proposed pavement, curb, and gutter, sidewalk, or such construction included in the contract; or when any part of the trench excavation is within 2' of the above.</td>
<td>100% for Granular 95% for Nongranular</td>
<td>95%</td>
<td>95%</td>
</tr>
<tr>
<td>II</td>
<td>On any utility easement, street, road or alley right-of-way outside limits of (I)</td>
<td>90%</td>
<td>90%</td>
<td>95%</td>
</tr>
<tr>
<td>III</td>
<td>Around any structures or exposed utilities.</td>
<td>95%</td>
<td>In all cases</td>
<td></td>
</tr>
</tbody>
</table>

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0610.10 MAG Spec. 610.10 – Connection to Existing Mains

Revise second-to-last paragraph to read:

When a shutdown of an existing water main is necessary in order to connect the new lines, the contractor shall make application and pay the required charges to the contracting agency (City of Flagstaff Utilities Division). A conference between the contractor’s representative, Public Works inspection, and water
distribution personnel shall establish the timeline and procedures to ensure that the shutdown will be the shortest possible time (8 hours maximum). If necessary to minimize the inconvenience to customers, shutdowns may be scheduled during other than normal working hours. The water supply to some customers, such as hospitals, may not be shut off at any time. Provisions to furnish a continuous supply of water to such establishments will be required. After the procedures and time for a shutdown are agreed upon, it shall be the contractor’s responsibility to notify all affected customers, in advance, that the water will be turned off. Customers shall be notified no less than forty-eight (48) hours in advance except for emergency situations. Notification shall be in writing giving the reason for the shutdown and the time and duration the water services will be shut off. All shutdown notifications to the customers must be approved by Public Works inspection and water distribution personnel.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0625.3 MAG Spec. 625.3 – Manhole Construction and Drop Sewer Connections – Construction Methods

First sentence, revise to read:

Manholes shall be constructed of precast concrete sections with frames and covers in accordance with the standard details; bricks will be allowed only when authorization has been granted to repair rather than replace an existing brick manhole.

Add the following supplemental text:

Flow channel

Flow channels straight through a manhole shall be made to conform as closely as possible in shape and slope to that of the connecting sewers. The channel wall shall be formed or shaped to the full height of the crown of the outlet sewer in such a manner to not obstruct maintenance, inspection, or flow in the sewers. When curved flow channels are specified in manholes, including branch inlets, slopes shall be increased to maintain acceptable velocities.

Bench

A bench shall be provided on each side of any manhole channel when the pipe diameter(s) are less than the manhole diameter. The bench shall be sloped to provide a minimum 3" fall from the top of the
bench to the crown of the pipe or 1/2" per foot, whichever is
greater. No lateral sewer service connections or drop manhole
pipe shall discharge onto the surface of the bench.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0702.1 MAG Spec. 702.1 – Base Materials – General

Revise to include the following:

The aggregate base course will be clean, free of organic matter,
and be of such a nature to be compacted to a dense, firm layer
capable of supporting loaded trucks and self-propelled pavers
without rutting. Volcanic cinders shall not be used for base
materials.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0702.2 MAG Spec. 702.2 – Base Materials – Crushed Aggregate – Grading

Table 702, revise to read as follows:

For aggregate base, the percentage by weight passing the No. 200
sieve shall be limited to no more than 10 percent.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0710.2.1 MAG Spec. 710.2.1 – Asphaltic Concrete – Material – Asphalt Binder

Revise paragraph to read as follows:

The asphalt to be mixed with the mineral aggregate shall be paving
grade asphalt conforming to AASHTO Designation MP1, Standard
Specification for Performance Grade Asphalt Binder and shall be
58-28 unless otherwise specified in the special provisions. AC 20
conforming to Section 711 may be used if PG 58-28 is not
available.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
Add the following sentence to the end of the first paragraph:

Volcanic cinders or materials containing clay balls, coated rock or other deleterious materials shall not be used.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

Revise to include the following:

The contractor shall furnish the engineer with a job-mix formula for asphalt concrete not less than ten (10) days in advance of actual placement of the material. The job-mix formula, upon approval of the Engineer, shall be used to establish the standards to which field test results will be compared and to determine compliance of the materials furnished with all physical properties of the composite mix and its individual components as shown on the approved job-mix formula. The job-mix formula, with the allowable tolerances for a single test shall be used for monitoring compliance with the specifications.

The maximum permissible variation in the daily Marshall Plug unit weight from the unit weight shown in the approved job-mix shall be +/- 3%. If the unit weight of the Marshall Plug deviates from the permissible variation by more than 1%, payment will be reduced in accordance with Table 321-2.

The aggregate and mix to be incorporated into the work shall also meet the following requirements:

<table>
<thead>
<tr>
<th>TEST</th>
<th>ACCEPTABLE TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss on Abrasion (ASTM C0131 and/or AASHTO 96) after 500 revolutions</td>
<td>40 Max.</td>
</tr>
<tr>
<td>Absorbed Asphalt Range (AASHTO T-245)</td>
<td>0 – 1%</td>
</tr>
<tr>
<td>Combine Water Absorption (AASHTO T-84)</td>
<td>0 – 2.25%</td>
</tr>
</tbody>
</table>

All asphaltic concrete shall contain a minimum of 1% Portland Cement or dry hydrated lime by weight of total mixture.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
REVISED 10/17

SECTION 13-21-001-0710.3.2.1  MAG Spec 710.3.2.1. - Asphalt Concrete
- Mix Design Requirements - Marshall Mix Design

Revise the percent of asphalt range for B-1 and three-quarter (3/4) inch asphaltic concrete from five percent (5%) to six percent (6%) to five and three-tenths percent (5.3%) to six percent (6%).

Revise Table 710-3 as follows:

6. Dry Tensile Strength: psi, Min. from 100 to 65 for all mixes

7. Stability: pounds, Min. 1/2" and 3/4" mixes, from 2,500 to 2,000

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0710.4.2  MAG Spec 710.4.2 - Asphalt Cement Content

Revise the first sentence of the second paragraph to read:

The asphalt cement content shall be considered acceptable if it is within -0.30% or +0.40% of the mix design target value.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0713.1  MAG Spec. 713.1 - Emulsified Asphalts - General

Revise to include the following:

REQUIREMENTS FOR ANIONIC/CATIONIC EMULSIFIED ASPHALT CATIONIC RAPID-SETTING POLYMER-MODIFIED ASPHALTIC EMULSION, CRS-2P

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Test Method</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST OF EMULSION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, SFS @ 122 F</td>
<td>D244</td>
<td>125</td>
<td>400</td>
</tr>
<tr>
<td>Settlement, 5 days, %</td>
<td>D244</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Storage Stability 1 Day, %</td>
<td>A244</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Class, Un-coated Par</td>
<td>A502</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Particle Charge Test</td>
<td>D244</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Sieve Test, %</td>
<td>D244</td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td>Oil Distillate, % V of Emulsion</td>
<td>D244</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

(Revised 10/17)
1) Benson method of toughness and tenacity: Scott tester, inch-pounds @ 77°F, 20 inches per minute pull. Tension head 7/8" diameter.

2) Upon standing undisturbed for a period of 24 hours, the emulsion shall show no white milky film upon the surface.

3) The base asphalt shall be modified prior to emulsification.

4) The emulsion shall be precertified prior to use. A one-quart sample each of the base asphalt and polymer shall be supplied to the agency 10 days in advance to the project start.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0716.2.1 MAG Spec 716.2.1 – Cover Material – Stone Chips – General

First paragraph, revise to include the following:

No volcanic cinders will be acceptable for cover material.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-21-001-0716.2.3 MAG Spec. 716.2.3 – Cover Material – Stone Chips – Gradation

Tables 716-1 and 716-2, revise to read as follows:

<table>
<thead>
<tr>
<th>% passing sieve</th>
<th>3/8 inch</th>
<th>No. 4</th>
<th>No. 8</th>
<th>No. 200</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0-40</td>
<td>0-5</td>
<td>0-2.0</td>
</tr>
</tbody>
</table>

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0725.1 MAG Spec. 725.1 – Portland Cement Concrete – Classes of Concrete

Revise to read as follows:

As tested in accordance with ASTM C-39, the maximum slump shall be 4 inches, or as specified in the special provisions, when tested in accordance with ASTM C-143.

Class AA concrete, with 5 to 7% entrained air, shall be used for all valley gutters and as specified.

Class A concrete shall be used for concrete structures, either reinforced or nonreinforced. Additionally, Class A concrete with 5 to 7% entrained air shall be used for all curbs, gutters, sidewalks, and exposed structures except as may be specified otherwise.

Class B concrete shall be used as specified, except 5 to 7% entrained air shall be included for all exposed structures.

Class C concrete may be used for thrust blocks, encasements, fill or over excavation, and/or other purposes as approved.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-21-001-0725.3 MAG Spec. 725.3 – Portland Cement Concrete – Aggregates

First paragraph, after the second sentence, revise to include the following:

Aggregates must be subjected to five cycles of the sodium sulfate soundness test in accordance with the requirements of AASHTO T-104. The total loss shall not exceed ten percent by weight of the aggregate as a result of the test.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0725.5 MAG Spec. 725.5 – Portland Cement Concrete – Water

Last paragraph, revise to include the following:

Water shall be sampled and tested in accordance with AASHTO T-26.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0750.2 MAG Spec 750.2 – Iron Water and Pipe Fittings, Ductile Iron Water Pipe

Revise the second paragraph to read:

Pipe shall be lined with Protecto 401 ceramic epoxy.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-001-0750.3 MAG Spec 750.3 – Iron Water and Pipe Fittings, Joint Requirements

Only Megalug or Bell joint are acceptable types of joint restraints.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-21-001-0760.1 MAG Spec. 760.1 – Coating Corrugated Metal Pipe and Arches - General

Revise to include the following:

    All corrugated metal, spiral rib, and helical pipe and arches shall be a minimum of 14 Ga. aluminized steel Type II.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
All Portland cement concrete exposed to weather shall be a minimum of Class A with 5 to 7% air entrainment. This requirement shall apply to all sidewalk, curb and gutter driveways, and adjustment collars (e.g., water valves, manholes, and survey monuments), as well as all other construction items exposed to weather. This change includes, but is not limited to, concrete specified on the following MAG Standard Details: 120-1, 120-2, 200, 202, 203, 206, 206-1, 206-2, 220, 221, 222, 230, 231, 232, 233, 234, 250, 251, 260, 261, 262, 263, 270, 321, 346, 391-1, 391-2, 501-1, 501-2,

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-002-0120.1 MAG Detail Nos. 120-1 and 120-2 – Survey Marker

Revise to include the following notes to both details:

All survey caps shall be stamped with the registration number of the surveyor responsible for placing the monument.

The top of all survey caps placed in paved areas shall be at least 1/2" below pavement grade.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-002-0202 MAG Detail No. 202 – Alley Details (Paved and Unpaved)

Change the paved alley detail to read: Concrete gutter required where longitudinal grade is less than 0.50% and change the minimum asphalt thickness to 3". (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-002-0212 MAG Detail No. 212 – Utility Pothole Repair

Disallow Type "B" pavement repair. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-002-0220 MAG Detail No. 220 – Curb and Gutter – Types A, B, C, and D

Revise all curb types to show that roadway widths are measured to the back of the curb. Revise the class of concrete from Class B to Class A. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-002-0230 MAG Detail No. 230 – Sidewalks

Change the length of the sidewalk from ten (10) feet to twelve (12) feet on four (4) foot wide S/W between contraction joint.
Change the score mark note to read:

Score mark (1/2 inch minimum depth) every 5 feet for 5 foot S/W and 4 foot S/W. Revise the class of concrete from Class B to Class A.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-002-0240 MAG Detail No. 240 – Valley Gutter

Detail No. 240 shall not be used. Use City of Flagstaff Detail No. 8-06-010. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-002-0250 MAG Detail Nos. 250 and 251 – Driveway Entrances/Return Type Driveways

Revise to include the following notes:

The revised depth of concrete for residential driveways shall be 6" minimum.

Class of concrete on all driveways shall be Class A.

The radius on Detail 251 shall be 5 feet or designed to complement the adjoining parkway and sidewalk.

Revise Note No. 5 by deleting "or score mark."

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
Replace the table with the following table:

<table>
<thead>
<tr>
<th>TYPE OF FITTING</th>
<th>Pipe Size (Inches)</th>
<th>MINIMUM THRUST BLOCK BEARING AREA (SQ. FT.) REQUIRED (Y x W)</th>
<th>SOFT CLAY</th>
<th>SAND</th>
<th>SAND AND GRAVEL</th>
<th>SAND AND GRAVEL WITH CLAY</th>
<th>ROCK</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>TEES AND DEAD ENDS</td>
<td>8</td>
<td></td>
<td>32</td>
<td>16</td>
<td>11</td>
<td>8</td>
<td>4</td>
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<td>10</td>
<td></td>
<td>48</td>
<td>24</td>
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<td>119</td>
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<td>90° BENDS</td>
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<td>23</td>
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<td>168</td>
<td>84</td>
<td>56</td>
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<td>21</td>
</tr>
<tr>
<td>45° BENDS</td>
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<td></td>
<td>25</td>
<td>12</td>
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<td>3</td>
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<td>10</td>
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<td>12</td>
<td>9</td>
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<td>91</td>
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<td>30</td>
<td>23</td>
<td>11</td>
</tr>
<tr>
<td>22 1/2° BENDS</td>
<td>8</td>
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<td>13</td>
<td>6</td>
<td>4</td>
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<td>2</td>
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<td>10</td>
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<td>19</td>
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<td>46</td>
<td>23</td>
<td>15</td>
<td>12</td>
<td>6</td>
</tr>
</tbody>
</table>

NOTES:

1. THE BEARING AREAS ARE BASED UPON A TEST PRESSURE OF 200 PSI WITH A FACTOR OF SAFETY OF 1.25 = 250 PSI AND SOIL BEARING CAPACITIES OF SOFT CLAY (500 PSF), SAND (1,000 PSF), SAND AND GRAVEL (1,500 PSF), SAND AND GRAVEL WITH CLAY (2,000 PSF), AND ROCK (4,000 PSF). ADJUSTMENTS MAY BE MADE BY ENGINEERS WITH SPECIFIC DATA ON SOIL CONDITIONS.

2. AREAS FOR PIPE EQUAL TO AND LARGER THAN 18" IN DIAMETER SHALL BE CALCULATED FOR EACH PROJECT.

3. FORM ALL NONBEARING VERTICAL SURFACES.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-21-002-0390  MAG Detail No. 390 – Curb Stop with Flushing Pipe

Revise the detail to include the following note:

A 3/16" drain hole shall be drilled in the bottom ell of all flushing pipes.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-02-0420  MAG Detail No. 420 – Pre-Cast Concrete Sewer Manhole

Delete the Note "steps not required in 60" M.H."

Revise to include the following:

Manholes that have either two or more inlets or inlet/outlet pipes ranging between 12" and 18" in diameter shall be constructed using 60" inside diameter manhole material. Manholes having inlet/outlet pipes 24" to 36" in diameter shall be constructed using 72" inside diameter manhole material. Manholes for pipes greater than 36" in diameter shall be specially designed.

Steps shall be installed in 60" manhole in accordance with 48" manhole standard.

Steps in all manholes shall be placed so that climber faces traffic and the steps are on the same side of the manhole the sewer pipe enters or exits the manhole.

For new manholes, the maximum dimension from the top of the lid to the top of the cone shall be 22". The maximum dimension from the top of the lid to the bottom of the flat top shall be 24".

The manhole base of all manholes shall be reinforced with #4 rebar 8" on center both ways and placed 4" above subgrade elevation.

A 1" vertical clearance shall be provided between the top of the sewer pipe and the bottom edge of all manhole barrel sections. A suitable radius shall be provided where the manhole floor joins the vertical edge of the invert channel.

Precast manhole bases may be allowed if sufficient design information is provided to enable a thorough review of the design for a recommendation of approval by the City Engineer.

Manhole bases shall be placed on a minimum 8" aggregate base course compacted to 100%.
See COF Standard Detail 9-02-092 for additional requirements of the manhole base geometry.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

**SECTION 13-21-02-0421 MAG Detail No. 421 – Offset Manhole for 8” to 30” Pipe**

Remove the Note beginning "1:3 Cement . . .."

Revise to include the following notes:

- The manhole base shall be reinforced with #4 rebar 8" on center both ways and placed 4" above subgrade.
- Manhole bases shall be placed on a minimum 8" aggregate base course compacted to 100%.
- See COF Standard Detail 9-02-092 for additional requirements of the manhole base geometry.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

**SECTION 13-21-002-0422 MAG Detail No. 422 – Sewer Manhole and Cover Frame Adjustment**

Remove the notes beginning "1:3 Cement . . .." and "M.H. step in 48" . . .."

Revise to include the following notes:

- Steps shall be installed in 60" manholes in accordance with 48" manhole standard.
- The manhole base shall be reinforced with #4 rebar 8" on center, placed 4" both ways above subgrade.
- All manhole frame and cover adjustments shall be made in accordance with City of Flagstaff Detail 9-03-062.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

**SECTION 13-21-002-0424 MAG Detail Nos. 424 and 425 – Manhole Frame and Cover**

All manhole frames and covers shall be aluminum.
The agency name is not required on manhole covers. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-002-0426  MAG Detail No. 426 – Drop Sewer Connections

Delete all references to "V.C.P." and replace with "P.V.C." or "D.I.P." (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-002-0427  MAG Detail No. 427 – Stub-Out and Plugs

Delete all references to "V.C.P." and replace with "P.V.C." or "D.I.P." (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-002-0440.1  MAG Detail No. 440-1 – Type A Sewer Building Connection

Delete all references to "V.C.P." and replace with "P.V.C." or "D.I.P." 

Delete the two (2) unnumbered notes beginning "2"x4" _stake . . ." and replace each with the following note:

Using the appropriate fittings as required (i.e., 45°, 22.5°) extend the service vertically at the property line or back of P.U.E. to within 36" min. to 42" max. of finished grade. Cover the end with a (no-glue) cap and mark with a brick and wire. The brick shall be placed on the surface and connected to the service with 12 ga. (min.) galvanized steel or a 12 ga. (min.) copper wire with green insulation.

Exclude the electronic ball markers. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-002-0440.3  MAG Detail No. 440-3 – Type C Sewer Building Connection

The clean-out assembly shall be located behind the sidewalk and may be located on either side of the property line.

Exclude the electronic ball markers.

Revise two (2) of the notes in profile view as follows:

1. Revise the one (1) way cleanout to read:

   Two-way cleanout with single riser.
2. Revise the Number 1 meter box in accordance with Detail 320 to read:

Frame and cover in accordance with Detail 270 (Concrete Required in Paved Areas Only)

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-002-0441    MAG Detail No. 441 – Sewer Cleanout

Delete references to "vitrified clay pipe" ("V.C.P.") and replace with "P.V.C." or "D.I.P."

Revise to include the following note:

Sewer cleanouts shall be used on public sewers only when specifically allowed by the City Engineer.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-21-002-0533    MAG Detail Nos. 530-540 – Catch Basin Details

Clarifications – The dimensions of the angle iron on the frame details are given in order of height, width, and thickness. Clarification is given to insure that the frame height is not manufactured less than the thickness of the grate.

Section C-C of Detail 536-1 as noted below the section applies to Details 531, 532, and 533.

Revise to include the following:

Catch basins shall be placed on a minimum 8" aggregate base course compacted to 100%.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13-22
GLOSSARY

Sections:
13-22-001-0001 Purpose
13-22-001-0002 Word Usage
13-22-001-0003 Abbreviations
13-22-001-0004 Definitions

SECTION 13-22-001-0001 Purpose

The purpose of this glossary is to define words, terms, and phrases within these standards. (Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-22-001-0002 Word Usage

In the interpretation of these standards, the provisions and rules of this section shall be observed and applied, except when the context clearly requires otherwise:

A. Words used or defined in one (1) tense or form shall include other tenses and derivative forms.

B. Words in the singular number shall include the plural number, and words in the plural number shall include the singular number.

C. The masculine gender shall include the feminine, and the feminine gender shall include the masculine.

D. The word "shall" is mandatory.

E. The word "may" is permissive.

F. The word "person" includes individuals, firms, corporations, associations, trusts, and any other similar entities.

G. The word "City" shall mean the City of Flagstaff, Arizona.

H. The word "Council" shall mean the City Council of the City of Flagstaff.

I. In case of any difference of meaning or implication between the text of these standards and any caption, illustration, or table, the text shall control. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION 13-22-001-0003   Abbreviations

The following abbreviations are used in these standards and are intended to have the following meanings:

AASHTO  American Association of State Highways and Transportation Officials
ABC  Aggregate Base Course
AC  Asphaltic Concrete
ADEQ  Arizona Department of Environmental Quality
ADOT  Arizona Department of Transportation
ADT  Average Daily Traffic
A.R.S.  Arizona Revised Statutes
ASTM  American Society of Testing and Materials
AWWA  American Water Works Association
COE  Corps of Engineers
DIP  Ductile Iron Pipe
FEMA  Federal Emergency Management Agency
MAG  Maricopa Association of Governments
MUTCD  Manual on Uniform Traffic Control Devices
OSHA  Occupational Safety and Health Administration
PC  Point of Curvature
PE  Professional Engineer
PI  Point of Intersection
PT  Point of Tangent
PVC  Polyvinyl Chloride
RLS  Registered Land Surveyor
ROW  Right-of-way
SCS  Soil Conservation Service

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

SECTION 13-22-001-0004   Definitions

When used in these standards, the following terms shall have the meanings herein ascribed to them:

Access. A means of vehicular approach or entry to or exit from property, from a street, or highway.
City. The City of Flagstaff.

City Engineer. The head of the City of Flagstaff Engineering Section or his authorized representative.

City Standards. Title 13, Engineering Design Standards and Specifications for New Infrastructure.

Community Development Director. The Director of Community Development for the City of Flagstaff, Arizona.

Council. The City Council of the City.

Dedication. The transfer of property interests from private to public ownership for a public purpose. The transfer may be of fee simple interest or of a less than fee simple interest, including an easement.

Drainage. The removal of surface water or groundwater from land by pipes, grading, or other means. Drainage includes the control of runoff to minimize erosion and sedimentation during and after development and includes the means necessary for water supply preservation, prevention, or alleviation of flooding.

Drainage Channel. Any depression into which stormwater flows along a defined course.

Drainageway. Watercourses defined by the presence of intermittent or perennial streams or topography which indicates a swale where surface sheet flows join or by physical drainage improvements.

Dry Utilities. Gas, electric, cable, and telephone, in the City’s right-of-way, also known as franchise utilities.

Easement. Authorization by a property owner for the use by another and for a specified purpose of any designated part of his property.

Engineer. Registered professional engineer in the State of Arizona.

Engineering Plans. Maps, plats, profiles, cross-sections and other required details for the construction of public improvements, prepared by a registered engineer in accordance with these standards. These plans are distinguished from the preliminary submittals, which should also be prepared by a registered engineer and other appropriate professionals.

Erosion. The process of removal and transport of soil particles or land surface by the action of wind, water, ice, gravity, or any combination thereof.
Final Plat. A map of a land subdivision prepared in a form suitable for filing a record with necessary affidavits, dedications, and acceptances; and with complete bearings and dimensions of all lines defining lots and blocks, streets and alleys, public areas, and other dimensions.

Flood or Flooding. A general and temporary condition of partial or complete inundation of any land areas from the unusual and rapid accumulation or runoff of surface waters of any source and/or the overflow of flood waters.

Floodplain. Any normally dry land area that is susceptible to being inundated by water from any source and is the maximum area of land that has a one (1) percent chance of being flooded in any given year. For the purposes of these standards, floodplain areas shall be considered as one (1) of the following two (2) types based upon the adopted City of Flagstaff Zoning Map:

1. Urban Floodplains. Those delineated floodplain areas, which are located in developed urban areas of the City of Flagstaff.

2. Rural Floodplains. Those delineated floodplain areas, which are essentially open space and natural land uses, and are unsuitable for urban development purposes due to poor natural soil conditions and periodic flood inundation.

Horizon Year. (City planning horizon) – The horizon year of the City’s current general plan at the time of the development application, initially the year 2020.

Impervious Surface. Impervious surfaces are those which do not absorb water. They consist of all buildings, parking areas, driveways, roads, sidewalks, and any other areas of concrete or asphalt.

Improvements. All types of roadway construction, street lights, street and traffic signs, sidewalks, pedestrian ways, bicycle ways, water lines, sanitary sewers, storm drainage structures, grading, parking, and other community facilities of like nature.

On-Site Improvements. Improvements made by public or private parties on public or private property that are a condition of development required by the City of Flagstaff or other authority and that require final approval by the City or other authority.

One Hundred (100) Year Flood. A flood event having a one (1) percent chance of occurrence in any given year.
Peak Hour Trip Generation. The greater of the number of trip ends either arriving or departing a site during the highest hour of total trip generation for the site under normal conditions.

Plat. A map of a subdivision.

Preliminary Plat. A map and other submittals, including a site capacity analysis and a map showing resources on the site, as required by the subdivision regulations of the City, of a proposed subdivision showing the character and proposed layout of the tract in sufficient detail to indicate the suitability of the proposed subdivision of land.

Private Improvements. Improvements made by public or private parties on public or private property done under no requirements of the City or other authority, and possibly not requiring a permit.

Public Improvements. Improvements made by public or private parties within public ways or easements that shall, upon acceptance by the City Engineer, become and remain the property of the City of Flagstaff. These improvements are a requirement of development in accordance with City ordinance or voluntary by a private party. These improvements include those off-site improvements defined in the City’s public improvement ordinance.

Public Right-of-Way. Property used to obtain transportational passage for the public with the implied power to permit other persons and public uses to use the right-of-way for public purposes other than transportation, i.e., water, power, drainage and other utilities. (Implies fee simple ownership.)

Public Sanitary Sewer. Includes sanitary sewer systems other than individual on-site systems approved by the State or County and maintained by a public agency authorized to operate such systems.

Public Service Access Easement. An easement that gives public service vehicles, such as Fire and Sanitation, access to private property.

Public Works. Improvements made by a public agency or public utility within public ways or easements that shall, upon acceptance by the City Engineer, remain the property of the City of Flagstaff or the responsible agency or utility. These improvements are not a condition or requirement of development per the public improvements ordinance.

Record Plat. A final plat bearing all the certificates of approval required and recorded in the Coconino County Recorder’s Office.

Sedimentation. The deposition of soil transported from its site of origin by water, ice, wind, gravity, or other means as a result of erosion.
Site Plan. A graphic depiction of features on a site such as existing and proposed structures, paved areas, ingress/egress points, and landscaped areas along with certain information as required in the City zoning code.

Specifications. Title 13, Engineering Design Standards and Specifications for New Infrastructure.

Standards. Title 13, Engineering Design Standards and Specifications for New Infrastructure.

Street. Any existing or proposed public or private street, avenue, boulevard, road, lane, parkway, place, bridge, viaduct or easement for public vehicular access, or a street shown in a plat duly filed and recorded in the County Recorder’s Office. A street includes all land within the street right-of-way, whether improved or unimproved, and includes such improvements as pavement, shoulders, curbs, gutters, sidewalks, parking space, bridges, and viaducts.

Streets:

Arterial. A road that is intended to provide for high-speed travel between or within communities, or to and from collectors. Access is controlled so that only regionally significant land uses may take direct access to these streets. (Arterial classification includes urban, urban commercial, and rural, both major and minor.)

Collector. A road which is intended to connect residential streets to arterial roads or provide access to nonresidential uses and arterial streets. (Collector classification includes urban, urban commercial center, and rural collector, both major and minor.)

Freeway. An arterial road (such as an Interstate Highway) with restricted or limited access.

Local. A road which is intended to provide access to abutting residential properties. (Local classification includes urban commercial, urban residential, urban commercial center, rural, and rural narrow.)

Surveyor. A surveyor who is registered by the Arizona State Board of Technical Registration.

Threshold Level Traffic. One hundred (100) or more peak direction trips to or from the site during either the peak hour of traffic on the adjacent roadway or the peak hour of traffic generation of the site itself.
Transect 1 (T1). Natural Zone consists of lands approximating or reverting to a wilderness condition, including lands unsuitable for settlement due to topography, hydrology or vegetation.

Transect 2 (T2). Rural Zone consists of sparsely settled lands in open or cultivated state. These include woodland, grasslands, parks and open space areas. Typical buildings are farmhouses, agricultural buildings or cabins.

Transect 3 (T3). Sub-Urban Zone consists of low-density residential areas, adjacent to higher density zones that include some mixed use. Home occupations and outbuildings are allowed. Planting is naturalistic and setbacks are relatively deep. Blocks may be large and the roads irregular to accommodate natural conditions.

Transect 4 (T4). General Urban Zone consists of mixed-use but primarily residential urban fabric. It may have a wide range of building types, such as single-family, sideyard buildings, and rowhouses. Setbacks and landscaping are variable. Streets with curbs and sidewalks define medium-sized blocks.

Transect 5 (T5). Urban Center Zone consists of higher density mixed-use buildings that accommodate retail, offices, rowhouses and apartments. It has a tight network of streets and small blocks, with wide sidewalks, regularly spaced street planting, and buildings set close to the sidewalks.

Transect 6 (T6). Urban Core Zone consists of the highest density and height, with the greatest variety of uses, and civic buildings of regional importance. It may have larger blocks, and streets have regularly spaced tree planting with buildings set close to the wide sidewalks. The T6 urban core is typically associated with downtown Flagstaff, thus this transect would not be applied in other locations within the City.

Utilities. Installations or facilities furnishing, for the use of the public: electricity, gas, steam, communication, water, drainage, sewage disposal, or flood control; utilities may be owned and operated by any person, firm, corporation, municipal department/division, or board, duly appointed by State or municipal regulations. Utility or utilities as used herein may also refer to such persons, firms, corporations, department/division, or boards. All utility lines associated with development or redevelopment shall be underground in accordance with the provisions of the City Code.

Watercourse. Any lake, river, creek, stream, wash, arroyo, channel, or other topographic feature on or over which waters flow, at least periodically. (Ord. 2017-22, Rep&ReEn, 07/05/2017)
CHAPTER 13-23
STANDARD DRAWINGS; CITY OF FLAGSTAFF

Sections:

3-02-070 Installation of Survey Monument
8-06-010 Standard Valley Gutter
9-01-010 Underground Utilities in Streets Typical Location
 and Trench Detail
9-01-011 Service Location
9-01-020 Tracer Wire
9-01-030 Trenching and Backfill (Existing Paved Street)
9-01-031 Trenching and Backfill (New Paved Street)
9-01-032 Trenching and Backfill (Unpaved Easement or Street)
9-01-033 Trenching and Backfill (Existing Paved Parking Lot)
9-02-080 Deep Sewer Service
9-02-092 Manhole Base Geometry
9-03-053 End-of-Line Temporary Blow-Off
9-03-054 End-of-Line Permanent Blow-Off
9-03-055 In-Line Blow-Off on Water Line 12" and Smaller
9-03-056 In-Line Blow-Off on Water Line Larger than 12"
9-03-060 Valve Box Adjustment
9-03-061 Valve Extension Stem
9-03-062 Ring, Frame or Cover Installation
9-03-070 Water Service Connection 3/4" and 1"
9-03-071 Water Service Connection 1-1/2" and 2"
9-03-080 Polymer Water Meter Box
9-03-080A Traffic Rated Water Meter Box
9-03-081 Multiple Meter Manifolds
9-03-082 Compound Meter 3", 4", 6"
9-03-083 Fire Service Meter 6", 8", 10"
9-03-100 Combination Air Release Valve 2"
9-03-101 Air Release Valve 1"
9-06-010 Water/Sewer Line Casing
9-06-030 Non-Shrink Slurry Backfill
9-06-071 Double Check Valve Assembly Installation
9-06-072 Reduced Pressure Assembly (RPA) Installation
9-06-073 Pressure Vacuum Breaker Assembly (PVBA) Installation
9-06-074 Air Gap Backflow Protection for Water Tanks
9-06-075 Fire Hydrant Meter Backflow Protection
10-04-010 Urban Cul-de-sac
10-04-011 Rural Cul-de-sac
10-06-011 Standard Delineator
10-06-012 Stop Ramp Parameters
10-06-013 Detector Loops for Traffic Counters
10-06-014 Median with 90' or 60' Taper
10-09-010 Pavement Structural Section for Streets and Off-
Street Parking Lots
10-09-032 Arterial (Major or Minor)
10-09-034 Major Collector
10-09-035 Minor Collector
10-09-036 Commercial Local
10-09-037 Residential Local "Wide"
10-09-038 Residential Local
10-09-040 Major Arterial "Commercial Center"
10-09-041 Minor Arterial "Commercial Center"
10-09-042 Major Collector "Commercial Center"
10-09-043 Minor Collector "Commercial Center"
10-09-044 Commercial Local "Commercial Center"
10-09-045 Rural Arterial
10-09-046 Rural Collector
10-09-047 Rural Local
10-09-048 Rural Local "Narrow"
10-09-049 Shoulder Section
10-09-050 Residential Alley Cross-Section
10-10-010 Parking, Driveway and Aisle Slope Parameters
10-10-019 Bus Pullout
10-10-020 Right Turn Lane for Urban Driveway
10-10-031 Paved Turnouts
10-10-034 Sidewalk Ramp Detail (15' Radius Curb Return)
10-10-038 Apron Joints
10-10-039 Driveway-Pedestrian Ramp Combination (For Use at T-Type Intersection)
10-10-040 Driveway Entrance – Retrofit
10-10-041 Return Type Driveways with Attached Sidewalk
10-10-042 Pavement Edge Tapers for Isolated Street Widening
10-10-043 Detectable Warning Strip
13-03-011 Fire Hydrant Assembly
13-03-012 Fire Hydrant Protection Post in Paved or Concrete Surface
13-03-013 Shoulder Widening at Fire Hydrants for Uncurbed Roads
13-03-014 Removable Bollard
14-01-010 Flagstaff Urban Trails System Details
14-01-011 Pedestrian and Shared Use Path Underpass Dimensions
16-01-240 Concrete Paving Stone or Brick Sidewalk
16-01-241 Concrete Paving Stone or Brick Driveway
16-04-010 Typical Layout of Pedestrian CRFB
16-05-010 Street Name Signs
16-05-020 Traffic Signal Street Name Signs
16-06-010 Intersection Striping
18-03-050 Landscape Details
18-04-050 Conifer Tree Planting
19-01-020 Febco Backflow Assembly
19-02-001 Rotor Sprinkler Assembly
19-02-002 Pop-Up Sprinkler Assembly
19-02-003 Shrub Pop-Up Sprinkler Assembly
19-02-004 Drip Filter and Pressure Regulator
19-02-005 Emitter Flush Cap Assembly
19-02-006 Quick Coupler Assembly
<table>
<thead>
<tr>
<th>Document Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-02-007</td>
<td>Mainline Ball Valve 1-1/2&quot; and Smaller</td>
</tr>
<tr>
<td>19-02-008</td>
<td>Ball Valve Detail</td>
</tr>
<tr>
<td>19-02-009</td>
<td>Mainline Isolation Gate Valve 3&quot; and Larger</td>
</tr>
<tr>
<td>19-02-010</td>
<td>Master Valve/Flow Meter 3&quot; and Larger</td>
</tr>
<tr>
<td>19-02-011</td>
<td>Irrigation Remote Control Valve</td>
</tr>
<tr>
<td>19-02-012</td>
<td>Single Outlet Emitters All Shrubs and Ground Covers</td>
</tr>
<tr>
<td>19-02-013</td>
<td>Irrigation Emitter Layout</td>
</tr>
<tr>
<td>19-02-014</td>
<td>End Line Flush</td>
</tr>
<tr>
<td>19-02-015</td>
<td>Master Valve/Flow Sensor Assembly 2&quot; or Smaller</td>
</tr>
<tr>
<td>19-02-016</td>
<td>Maxicom Cable Pull Box</td>
</tr>
<tr>
<td>19-02-017</td>
<td>Maxicom Cable Splices</td>
</tr>
<tr>
<td>19-02-019</td>
<td>Drip Irrigation Remote Control Valve Assembly</td>
</tr>
<tr>
<td>19-02-021</td>
<td>Irrigation Wire Connection</td>
</tr>
<tr>
<td>19-02-022</td>
<td>Irrigation Wire Sleeving Chart</td>
</tr>
<tr>
<td>19-02-023</td>
<td>Schematic Layout</td>
</tr>
<tr>
<td>19-02-024</td>
<td>Solar Controller</td>
</tr>
<tr>
<td>19-02-025</td>
<td>Solar Controller and Backflow Preventer Enclosure</td>
</tr>
<tr>
<td>19-02-026</td>
<td>Maxicom CCU (6 or 28) - Wall Mount</td>
</tr>
<tr>
<td>19-02-027</td>
<td>Maxicom Esp-Sat Field Satellite Controller - Wall Mount</td>
</tr>
<tr>
<td>19-02-028</td>
<td>Maxicom Esp-Sat Field Satellite Controller Stainless Steel Pedestal</td>
</tr>
<tr>
<td>19-02-029</td>
<td>Maxicom Flow Sensor (PT1502)</td>
</tr>
<tr>
<td>19-02-030</td>
<td>Controller Enclosure</td>
</tr>
<tr>
<td>19-02-031</td>
<td>Grounding Rod Grid</td>
</tr>
<tr>
<td>19-02-032</td>
<td>Grounding Plate Design Layout</td>
</tr>
<tr>
<td>19-02-033</td>
<td>Weather Station External Wire Connection</td>
</tr>
<tr>
<td>19-02-034</td>
<td>Maxicom Variable Wind Speed Detection</td>
</tr>
<tr>
<td>19-02-035</td>
<td>Sleeve Trenching Detail</td>
</tr>
<tr>
<td>19-02-036</td>
<td>Irrigation Trenching</td>
</tr>
<tr>
<td>19-02-037</td>
<td>Irrigation Thrust Block</td>
</tr>
<tr>
<td>PW 50.10</td>
<td>Single and Double Trash Enclosure</td>
</tr>
</tbody>
</table>
3-02-070  Installation of Survey Monument

NOTES:
1. RIGHT-OF-WAY CONTROL MONUMENT SHALL BE FACTORY STAMPED "CITY OF FLAGSTAFF" AND BEAR THE REGISTRATION NUMBER OF THE LAND SURVEYOR RESPONSIBLE FOR THE WORK.
2. A MONUMENT EXAMPLE ACCEPTABLE TO THE CITY: 2" LIETZ BRASS CAP PRESS-FITTED ON TO AN I.P.
3. USE TYPE C UNLESS SPECIFIED OTHERWISE ON THE PLANS, SEE SPECIFICATION 13-03-002-0007.H

City of Flagstaff

INSTALLATION OF SURVEY MONUMENT

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
8-06-010  Standard Valley Gutter

1. CONCRETE SHALL BE CLASS "AA" (WITH 5-7% ENTRAINED AIR)
2. NO CONCRETE SHALL BE PLACED PRIOR TO FORM INSPECTION BY THE CITY ENGINEER OR HIS REPRESENTATIVE.
3. ASPHALTIC CONCRETE SHALL BE HELD 1/4" HIGH AT EDGE OF CONCRETE.

City of Flagstaff
ENGINEERING DETAIL

STANDARD VALLEY GUTTER

DETAIL NO. 8-06-010

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
9-01-010 Underground Utilities in Streets Typical Location and Trench Detail

NOTES:
1. Where possible sewer should be located at the centerline.
2. Water should be 10' north or east of centerline (min. 6' separation from sewer).
3. Storm drain should be 10' from sewer (min. 6') on the opposite side of where water is located.
4. No utility shall be less than 4' from lip of gutter.

Plan View

Subgrade

Profile View

Notes:
1. The dimensions given in these trench details are minimum. Depending on the number and size of utilities in a trench, additional cover and/or clearances may be required.
2. Minimum cover shall be measured from the top of the pipe to the subgrade under existing or proposed pavement. In areas that are not to be paved, minimum cover shall be measured from finished grade.
3. Minimum horizontal distance between water and sewer pipes is 6 feet.
4. When sewer and water lines cross, refer to Arizona Department of Environmental Quality (A.D.E.Q.) Guidelines, and other city standards.
5. While power and communication cables may be installed in sanitary sewer trenches, a separate trench may be required when deemed necessary by utility companies.
6. Water and electric power lines are not allowed in the same trench.
7. Gas and sewer lines are not allowed in the same trench.
8. Two working days before you dig, call for the blue staked 1-800-stake-it.
9. Tracer wires shall be installed in accordance with standard 9-01-020.
10. When power and communication cables are not in the same trench, they shall have a minimum horizontal separation of 36" from water lines and 24" from sewer lines, and shall maintain a minimum of 24" above sewer lines. When gas lines are not in the same trench, a minimum horizontal separation of 36" from sewer lines and 18" from water lines shall be maintained; gas lines shall also be a minimum of 18" above water lines. All measurements shall be made from the outside edge of pipe or cable.
11. Minimum depths for power, gas, television, and communication are measured from finished grade.
12. All waterline (fire hydrant lead lines, fire lines and service lines shall have a minimum horizontal separation of 3")
9-01-011  Service Location

NOTES:
1. LARGE TRANSFORMER AND SWITCHING CABINETS SHALL BE LOCATED SO THAT THEY DO NOT INTRUDE INTO THE CLEAR VIEW ZONES OF ADJACENT INTERSECTIONS AND DRIVEWAYS.
2. DUE TO SAFETY CONSIDERATIONS, E.G. DIGGING AROUND TRANSFORMER, AND TO PRECLUDE DAMAGE TO CABLES BY OTHERS, CABLE TELEVISION REQUIRE SEPARATING AWAY FROM THE APS TRANSFORMER LOCATION. IT IS SUGGESTED THAT TRENCHING SIMILAR TO THE "Y" TRENCH AS SHOWN BE PROVIDED, ALTHOUGH ANY ALTERNATIVE THAT PROVIDES SIMILAR SEPARATION WILL BE CONSIDERED. PLEASE CHECK WITH OTHER UTILITIES FOR THEIR SPECIFIC REQUIREMENTS.
3. WATER AND GAS SERVICES SHALL BE CENTERED ON THE OPPOSITE PROPERTY LINE FROM THE SEWER SERVICE PER SPECIFICATION 13-09-003-0007.

City of Flagstaff

ENGINEERING DETAIL

SERVICE LOCATION

DETAIL NO. 09-01-011

11/22/16

1

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
9-01-020 Tracer Wire

NOTES:
1. THE UF-600 TRACER WIRE SHALL BE A MINIMUM 8 FOOT OUTSIDE OF BOX WHEN EXTENDED, IN A CAST IRON VALVE BOX WITHOUT A VALVE.
2. THE TRACER WIRE EXTENDS FROM THE MAIN ON THE FIRE HYDRANT OR METER SERVICE RUNS. THE END COIL MUST BE SET IN A SEPARATE VALVE BOX.
3. COVER SHALL BE LABELED WATER, SEWER OR RECLAIM WASTEWATER.
4. LOCATE VALVE BOX 1 FOOT BEHIND SIDEWALK WITHIN RIGHT OF WAY.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
9-01-030  Trenching and Backfill (Existing Paved Street)

NOTES:
1. BACKFILL MATERIAL SHALL BE PER MAG SPECS.
2. THE DEPTH OF THE AC SHALL MATCH EXISTING OR TYPICAL MIN. PAVEMENT DEPTH FOR THE TYPE OF ROADWAY, WHICHEVER IS GREATER. THE TYPICAL MINIMUM PAVEMENT DEPTHS ARE AS FOLLOWS: ARTERIAL = 5", COLLECTOR = 4", LOCAL = 3".
3. NON-SHRINK BACKFILL IN ACCORDANCE WITH COF STD. 9-6-030 AND MAY BE USED FOR BACKFILL UP TO EXISTING SUBGRADE. THE NON-SHRINK BACKFILL SHALL BE PROPORTIONED AS FOLLOWS: 2600 LBS OF 3/8" MINUS AGGREGATE, 800 LBS SAND, 94 LBS CEMENT AND 11 GALLONS WATER.
4. A MIN. 2" OF UPM™ MAY BE USED FOR TEMPORARY TRENCH PAVING IF HOT MIX IS NOT AVAILABLE. UPM™ TEMPORARY PAVEMENT SHALL NOT REMAIN IN PLACE LONGER THAN 5 WORKING DAYS OR UNTIL HOT MIX ASPHALT IS AVAILABLE. AFTER 5 WORKING DAYS, THE CITY MAY PERFORM THE PERMANENT TRENCH PAVEMENT AT THE CONTRACTORS EXPENSE. IN LIEU OF PLACING UPM™ THOUGH STILL TEMPORARY, THE CONTRACTOR MAY ELECT TO COMPLETELY BACKFILL THE TRENCH TO WITHIN 2" OF THE FINISH TRENCH GRADE WITH NON-SHRINK BACKFILL; THE FINAL 2" SHALL BE MAG CLASS "C" CONCRETE.

* TRACER WIRE TAPE TO TOP CENTER OF MAIN WITH 10MIL PVC TAPE ON 4' CENTERS, SEE COF STD 9-01-020.

** WARNING TAPE

City of Flagstaff
ENGINEERING DETAIL

TRENCHING & BACKFILL' EXISTING PAVED STREET

DETAIL NO. 9-01-030

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
9-01-031  Trenching and Backfill (New Paved Street)

NOTES:
1. NATIVE BACKFILL SHALL BE PER MAG SPECS AND MAY BE SELECTED FROM THE EXCAVATION MATERIAL OR FROM A SOURCE SELECTED BY THE CONTRACTOR AND APPROVED BY THE CITY ENGINEER.
2. NON-SHRINK BACKFILL IN ACCORDANCE WITH COF STD. 9-6-030 AND MAY BE USED FOR BACKFILL UP TO EXISTING SUBGRADE. THE NON-SHRINK BACKFILL SHALL BE PROPORTIONED AS FOLLOWS: 2600 LBS OF 3/8" MINUS AGGREGATE, 800 LBS SAND, 94 LBS CEMENT AND 11 GALLONS WATER.
   * TRACER WIRE TAPED TO TOP CENTER OF MAIN WITH 10MIL PVC TAPE ON 4' CENTERS, SEE COF STD 9-01-020.
   ** WARNING TAPE

City of Flagstaff
ENGINEERING DETAIL

TRENCHING AND BACKFILL
NEW PAVED STREET

DETAIL NO. 9-01-031
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
NOTES:
1. NATIVE BACKFILL SHALL BE PER MAG SPECS AND MAY BE SELECTED FROM THE EXCAVATION MATERIAL OR FROM A SOURCE SELECTED BY THE CONTRACTOR AND APPROVED BY THE CITY ENGINEER.
2. IF THE UNPAVED STREET HAS A SURFACE MATERIAL (ABG, CINDERS, ETC) OTHER THAN NATIVE, THE SURFACE MATERIAL SHALL BE REPLACED TO ITS EXISTING DEPTH.
3. NON-SHRINK BACKFILL IN ACCORDANCE WITH COF STD. 9-5-030 AND MAY BE USED FOR BACKFILL UP TO 6" BELOW FINISH GRADE. THE FINAL 6" SHALL BE NATIVE MATERIAL 8" MAX. THE NON-SHRINK BACKFILL SHALL BE PROPORTIONED AS FOLLOWS: 2600 LBS OF 3/8" MINUS AGGREGATE, 800 LBS SAND, 94 LBS CEMENT AND 11 GALLONS WATER

* TRACER WIRE TAPE TO TOP CENTER OF MAIN WITH 10MIL PVC TAPE ON 4' CENTERS, SEE COF STD 9-01-020.

** WARNING TAPE

City of Flagstaff
ENGINEERING DETAIL
TRENCHING AND BACKFILL
UNPAVED EASEMENT OR STREET

DETAIL NO. 9-01-032
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
9-01-033 Trenching and Backfill (Existing Paved Parking Lot)

NOTES:
1. NATIVE BACKFILL SHALL BE PER MAG Specs AND MAY BE SELECTED FROM THE EXCAVATION MATERIAL OR FROM A SOURCE SELECTED BY THE CONTRACTOR AND APPROVED BY THE CITY ENGINEER.
2. NEW PAVEMENT SHALL BE 2 1/2" AC OVER 4" ABC, OR 4" PORTLAND CEMENT CONCRETE, OR DEPTH OF EXISTING PAVEMENT, WHICHEVER IS GREATER.
3. NON-SHRINK BACKFILL IN ACCORDANCE WITH COF STD. 9-6-030 AND MAY BE USED FOR BACKFILL UP TO EXISTING SUBGRADE. THE NON-SHRINK BACKFILL SHALL BE PROPORTIONED AS FOLLOWS: 2600 LBS OF 3/8" MINUS AGGREGATE, 800 LBS SAND, 94 LBS CEMENT AND 11 GALLONS WATER.

* TRACER WIRE TAPE TO TOP CENTER OF MAIN WITH 10 MIL PVC TAPE ON 4' CENTERS, SEE COF STD 9-01-020.

** WARNING TAPE

City of Flagstaff
ENGINEERING DETAIL

TRENCHING AND BACKFILL
EXISTING PAVED PARKING LOT

DETAIL NO. 9-01-033

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
9-02-080 Deep Sewer Service

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
NOTES:
1. PIPE SIZE AND ELEVATION AS SHOWN ON PLANS
2. MIN. FLOW LINE RADIUS ON 8" PIPE IS 2 FEET

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
End-of-Line Temporary Blow-Off

NOTES:
1. PIPE FITTINGS BEDDED IN GRANULAR MATERIAL 3/4" MAX. AND COMPACTION PER MAG SPEC (95% COMPACTION) WHERE DRAINAGE GRAVEL NOT REQUIRED.
2. ALL MATERIAL COMPACTED TO 95% UNDER VALVE BOXES.

City of Flagstaff

END-OF-LINE TEMPORARY BLOW-OFF

DETAIL NO. 9-03-053

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
NOTES:
1. PIPE FITTINGS BEDDED IN GRANULAR MATERIAL 3/4" MAX. AND COMPACTION PER MAG SPEC (95% COMPACTION) WHERE DRAINAGE GRAVEL NOT REQUIRED.
2. ALL MATERIAL COMPACTED TO 95% UNDER VALVE BOXES.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
9-03-055 In-Line Blow-Off on Water Line 12" and Smaller

NOTES:
1. ALL SWEAT FITTINGS PER COF DETAIL 9-3-070
2. PIPE FITTINGS BEDDED IN GRANULAR MATERIAL 3/4" MAX AND COMPACTION PER MAG SPECS. (95% COMPACTION) WHERE DRAINAGE GRAVEL NOT REQUIRED
3. ALL MATERIALS COMPACTED TO 95% UNDER VALVE BOXES.

City of Flagstaff
ENGINEERING DETAIL

IN-LINE BLOW-OFF
ON WATER LINE 12" and SMALLER

DETAIL NO. 9-03-055
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
IN-LINE BLOW-OFF
ON WATER LINE LARGER THAN 12"

9-03-056

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
9-03-060 Valve Box Adjustment

NOTES:
1. See COF STD. DETAIL 9-03-062 FOR NOTES RELATING TO THIS DETAIL

City of Flagstaff
ENGINEERING DETAIL

VALVE BOX ADJUSTMENT

DETAIL NO. 9-03-060

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
9-03-061 Valve Extension Stem

NOTES:
1. EXTENSION STEM: WITH SQ. SOCKET ON BOTTOM TO FIT 2" SQ. VALVE NUT. EXTENSION TO VALVE STEMS REQUIRED ON ALL VALVES INSTALLED WHERE OPERATING NUT IS OVER 7" BELOW SURFACE. LENGTH TO FIT EACH INSTALLATION OPERATING NUT TO BE HELD ON TOP OF EXTENSION WITH STOP NUT.
2. STEM PAINTING: ALL STEEL TO HAVE PRIME COAT OF PAINT NO. 1-D AND ONE HEAVY APPLICATION (FINISH COAT) OF PAINT NO. 9 AS PER MAG SECTION 790.

NTS

City of Flagstaff

ENGINEERING DETAIL

DETAIL NO. 9-03-061

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
NOTE:

1. TOP OF VALVE BOX AND CONCRETE RING MUST BE 1/4" BELOW FINISHED GRADE.
2. CONCRETE RING FOR VALVES AND MANHOLES SHALL HAVE FOUR (4) STRESS JOINTS AT 90º ANGLES.
3. DEPTH OF CONCRETE SHALL BE A MIN. 6" OR SAME AS AC AND ABC SECTION, NOT TO EXCEED 8".
4. VALVES AND MANHOLES LOCATED UNDER CONCRETE PAVING SHALL HAVE A COLD JOINT OR EXPANSION JOINT CONCRETE COLLAR.
9-03-070 Water Service Connection 3/4" and 1"

- Finished Grade
- Existing or Future Sidewalk
- UF-600 Direct Bury 12 GA. Min. Or Copper Wire w/Blue Insulation
- Brick
- 3/4" Or 1" Copper Water Line Type 'K'
- 19" - 20" To Top Of Curb Stop
- Ford Curb Stop Or Equal B41 - 333WQ Or B41-444WQ Ball Valve
- 110 Or Quick Compression Unit
- Copp. Stop With Tapered Or Iron Pipe Inlet Threads Per Ford F9000/F9700 Or Equal
- Double Strap Or Double Band For PVC Service Clamp
- Water Main

See Section 13-09-003-0007 For Notes Relating To This Detail.
TYPE 'A'
IN AREAS WHERE SIDEWALK IS TO BE INSTALLED WITH OR WITHOUT PARKWAY, USE THIS CONFIGURATION

TYPE 'B'
IN AREAS WHERE NO SIDEWALK IS REQUIRED, USE THIS CONFIGURATION

TYPE 'C'
IN AREAS WHERE NO CURB, GUTTER OR SIDEWALK IS REQUIRED THE FOLLOWING REQUIREMENTS SHALL BE MET:

1. METER BOX SHALL BE SET ON FRONT PROPERTY LINE.
2. 3/4" AND 1" CURB STOP SHALL BE 24" OUTSIDE PROPERTY LINE.
3. 1 1/2" AND 2" CURB STOP SHALL BE 36" OUTSIDE PROPERTY LINE.
4. CURB STOP SHALL BE 2" FROM INSIDE OF BOX TO ALLOW FOR EASY ACCESS TO BOTH COUPLINGS

City of Flagstaff
ENGINEERING DETAIL

WATER SERVICE CONNECTION
1 1/2" AND 2"

DETAIL NO. REVISION DATE: 09-03-070 11/22/16 2 2

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
9-03-071 Water Service Connection 1-1/2" and 2"

NOTE:
1. ALL FITTINGS USED IN CONNECTIONS WITH 1 1/2" AND 2" TYPE K RIGID COPPER SHALL BE NEW MUELLER OR FORD QUICK JOINT COUPLINGS PER SECTION 9-3-070.1
2. ALL 1 1/2" AND 2" SHALL ENTAIL A SWING TYPE CONNECTION CONSISTING OF TWO 90 DEGREE ELLS AND ONE 1 1/2" X 2 1/2" OR 2" X 2 1/2" BRASS NIPPLE BETWEEN THE 90 DEGREE ELLS.
3. ALL 1 1/2" AND 2" METER VALVE CONNECTIONS SHALL BE IPxIP BALL VALVE TYPE THAT ARE EQUAL OR EXCEED THOSE MANUFACTURED FORD, 811-666; OR JONES 3-1900.
4. THE CURB STOP SHALL BE INSTALLED 19-20" BELOW FINISHED GRADE.

City of Flagstaff
ENGINEERING DETAIL

WATER SERVICE CONNECTION
1 1/2" AND 2"

DETAIL NO. 09-03-071
REVISION DATE 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
NOTES:
1. THE METER BOXES SHALL CONFORM TO THE DIMENSIONS AS SHOWN AND SHALL BE MADE OF LLDPE POLYMER.
2. MINIMUM 3/8" WALL THICKNESS.
3. THE METER BOXES SHALL BE BLACK EXCEPT FOR THE LID THROUGHOUT USING POLYETHYLENE MATERIALS AND SHALL NOT HAVE FOAMING OR BLOWING AGENTS.
4. LIDS SHALL BE OF THE LOCATABLE TYPE, COLORED AS FOLLOWS: BLUE ( POTABLE WATER USE ) PURPLE ( RECLAIM WATER USE )
5. BOXES & LIDS SHALL BE MADE IN THE U.S.A. BY DFW OR APPROVED EQUAL

City of Flagstaff

POLYMER WATER METER BOX

ENGINEERING DETAIL

DETAIL NO. 9-03-080

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
9-03-080A  Traffic Rated Water Meter Box

METER BOX DIMENSIONS

<table>
<thead>
<tr>
<th>DIM</th>
<th>BOX NUMBER</th>
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<tbody>
<tr>
<td>A</td>
<td>22 1/4&quot;</td>
</tr>
<tr>
<td>B</td>
<td>15 5/8&quot;</td>
</tr>
<tr>
<td>C</td>
<td>12&quot; TYP</td>
</tr>
<tr>
<td>D</td>
<td>20&quot;</td>
</tr>
<tr>
<td>E</td>
<td>13 3/8&quot;</td>
</tr>
</tbody>
</table>

WEIGHT: 130 LBS  166 LBS  268 LBS

NOTES:
1. THE METER BOXES SHALL CONFORM TO THE DIMENSIONS AS SHOWN AND SHALL BE MADE OF HIGH DENSITY REINFORCED CONCRETE.
2. BOXES & LIDS SHALL BE MADE IN THE U.S.A. BY OLDCASTLE PRECAST OR APPROVED EQUAL.

City of Flagstaff  TRAFFIC RATED WATER METER BOX

ENGINEERING DETAIL  DETAIL NO.  REVISION DATE: 11/22/16 1

9-03-080A

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
9-03-081  Multiple Meter Manifolds

OPTION 'A'

1 1/2" or 2" BALL VALVE CURB STOP

NOTE:
1. MULTIPLE WATER METER MANIFOLDS DESIGN CONFIGURATION MAY VARY
2. ALL MULTIPLE WATER METER MANIFOLDS DESIGNS MUST BE APPROVED BY THE WATER DISTRIBUTION DIVISION OF THE UTILITIES DEPARTMENT
3. USE COPPER BRAZING ALLOY PER ASTM

City of Flagstaff

MULTIPLE METER MANIFOLDS

ENGINEERING DETAIL

DETAIL NO. 09-03-081

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
KEYNOTE:
1. FLANGED TEE FOR BY-PASS
2. CURBSTOP 2" BALL TYPE
3. ADAPTER, FLANGED TO MECH JOINT FOR ACP
4. GATE VALVE, FLANGED WITH HAND WHEEL, OPEN LEFT WITH PIPE SUPPORT
5. COMPOUND METER (CONTACT COF UTILITIES FOR CURRENT STYLE AND LAY LENGTH)
6. FLANGED SWING CHECK VALVE WITH EXTERNAL LEVER AND WEIGHT
7. 2" BRONZE CHECK VALVE
8. FLANGED SPOOL 12" MIN. LENGTH
9. STRAINER 3", 4", 6" MANUFACTURER APPROVED FOR THE METER INSTALLED
10. FLANGED SPOOL (3 PIPE DIAMETERS IN LENGTH)
11. 2" TYPE "K" RIGID COPPER BY-PASS (USE SILVER FLOW BRAZING ALLOY FOR JOINTS)
12. COMPANION FLANGED WITH 2" TAP FOR BY-PASS
13. 2" ADJUSTABLE PIPE SUPPORT (2 MIN.)
14. 2" BRASS UNION
15. FORM AND FILL PIPE OPENING WITH CLASS "B" CONCRETE AFTER PIPE IS INSTALLED

NOTE:
1. FOR LARGER METERS SPECIAL VAULT DESIGN IS REQUIRED.
2. USE OF REMOTE READING DEVICE AT OPTION OF UTILITY.
3. PRECAST CONCRETE VAULTS - WITH DOUBLE TORSION DOORS - SPRING ASSISTED. (CONTACT COF UTILITIES FOR APPROVED VAULT BEFORE INSTALLATION).
4. INLET AND OUTLET PIPES MUST BE JOINT RESTRAINED TO PERMIT REMOVAL OF FITTINGS OR METER.
5. WATER METER VAULT MUST BE A UTILITY VAULT CO/COF SPEC. VAULT (4484-WA)
   (5106-WA)
   (512-WA)
6. 8" & LONGER CONTACT COF UTILITIES FOR SPECIAL APPLICATION
KEYNOTE:

1. Flanged Tee for by-pass - same size as the fire service meter.
2. Flanged 90° bend size same as the fire service meter.
3. Gate valve, flanged with hand wheel, open left with pipe support same size as the fire service meter.
4. Fire service meter (contact COF Utilities for current style and lay length).
5. Strainer, manufacturer approved for the meter assembly UL/FM approved.
6. By-pass must match the size of the fire service meter (flanged dip).
7. Flanged spool (3 pipe diameters in length).
8. Adjustable pipe support match pipe support to size of meter.
9. Linkseal (or approved equal) are to be used in pipe through concrete walls.
10. Flanged spool.
11. Ductile iron mechanical joint solid sleeve - restrained.

NOTE:

1. Use of remote reading device at option of utility.
2. Precast concrete vaults - with double torsion doors - spring assisted. (Contact COF Utilities for approved vault before installation).
3. Inlet and outlet pipes must be joint restrained to permit removal of fittings or meter.
4. Water meter vault must be a utility vault co./cof spec. vault 6": (G12-VA) 8" & larger contact COF Utilities for special application.

City of Flagstaff
ENGINEERING DETAIL

FIRE SERVICE METER
6", 8", 10"

DETAIL NO. 09-03-083
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
KEYNOTE:

1. SWING JOINT ASSEMBLY:
   SERVICE SADDLE, DOUBLE STRAP:
   2" CORR (1) IP x IP
   2" 90° BRASS ELLS (2)
   2" BRASS NIPPLE, 2 1/2" TO 6" LONG

2. 2" IP x SWEAT COPPER ADAPTOR IP THREADS, SWEAT WITH BRAZING ROD AS PER COF STD FOR SWEAT FITTINGS, 110 or QUICK

3. 2" TYPE "L" RIGID COPPER

4. 2" BRASS UNION

5. 2" BRASS NIPPLE

6. 2" BALL CURB STOP, LOCATE CURB STOP ON IT'S SIDE SO THAT IT IS ACCESSIBLE FROM MH OPENING

7. 2" BRASS 90° ELL

8. ADJUSTABLE PIPE SUPPORT - - - ELGEN NO. 48, 50 AND 268 FLOOR FLANGE BOLT TO SLAB WITH WEDGE ANCHOR BOLTS

9. 2" COMBINATION AIR RELEASE VALVE

10. 2" 90° ELL - - - GALVANIZED STEEL STANDARD WEIGHT

11. 2" GALVANIZED UNION

12. 2" x 1/2" GALVANIZED TEE

13. 1/2" GALVANIZED DRAIN TUBE

14. 2" SCHEDULE 40 GALVANIZED STEEL PIPE

15. 2" AWWA CLASS "B" FLANGES (THREADED) WITH MINIMUM 2 THREADED BOLTS

16. 2" AWWA CLASS "B" FLANGES (THREADED) W/NO. 18 STAINLESS STEEL WIRE MESH BETWEEN FLANGES

17. 1/2" CHECK VALVE

18. STANDARD DELINEATOR PER COF STD DETAIL 10-06-011 SET IN A 12" x 24" BASE FACING ONCOMING TRAFFIC (2 EA)

NOTE:

1. ALL BELOW GROUND PIPE & FITTINGS SHALL BE WRAPPED W/2 LAYERS (50% LAP EACH) OF 10 MIL PVC TAPE W/PRIMER PER MANUFACTURER'S RECOMMENDATIONS.

2. ALL COPPER FITTINGS OUTSIDE OF MANHOLE TO BE BEDDED IN FINE CINDER.
NOTE:

1. SHOP DRAWINGS REQUIRED ON ALL COMPONENTS OF AIR RELEASE VALVE ASSEMBLY VAULT.
2. SERVICE SADDLE AND CORP STOP PER CDF STANDARD DETAIL 9-03-070-1

City of Flagstaff

AIR RELEASE VALVE

1"

DETAIL NO. 09-03-101

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
**NOTES:**

1. THE END OF THE DIP PIPE IS RESTRAINED MECHANICALLY JOINT AND NOT TO REST ON THE CASING.
2. ALL CASING SPACERS SHALL RUN THE LENGTH OF THE M/J DIP PIPE.
3. CASING SPACERS TO BE BY ADVANCE PRODUCTS & SYSTEMS, INC. OR APPROVED EQUAL.
4. SEAL ENDS OF CASING W/END SEALS BY ADVANCE PRODUCTS & SYSTEM, INC. OR APPROVED EQUAL

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**City of Flagstaff**  
**ENGINEERING DETAIL**  
**WATER/SEWER LINE CASING**  
**DETAIL NO.** 09-06-010  
**REVISION DATE:** 11/22/16  
**1/1**

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
9-06-030  Non-Shrink Slurry Backfill

NOTES:
1. COLD MIX ASPHALT MAY BE USED FOR TEMPORARY PATCH IF HOT MIX ASPHALT IS NOT AVAILABLE.
2. A MINIMUM OF 2" OF UPN™ MAY BE USED FOR TEMPORARY TRENCH PAVING IF HOT MIX IS NOT AVAILABLE. UPN™ TEMPORARY PAVEMENT SHALL NOT REMAIN IN PLACE LONGER THAN 5 WORKING DAYS OR UNTIL HOT ASPHALT IS AVAILABLE. AFTER 5 WORKING DAYS, THE CITY MAY PERFORM THE PERMANENT TRENCH PAVING AT THE CONTRACTOR’S EXPENSE. IN LIEU OF PLACING UPN™ THROUGH STILL TEMPORARY, THE CONTRACTOR MAY ELECT TO COMPLETELY BACKFILL THE TRENCH TO WITHIN 2" OF THE FINISHED TRENCH GRADE WITH NON-SHRINK BACKFILL, THE FINAL 2" SHALL BE MAG CLASS “C” CONCRETE.
3. WHEN PIPE IS ENCASED IN NON-SHRINK BACKFILL, THE PIPE SHALL BE WRAPPED PER MAG SPECIFICATION 610.6.2

City of Flagstaff
NON-SHRINK SLURRY BACKFILL

DETAIL NO. 09-06-030
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
9-06-071 Double Check Valve Assembly Installation

NOTES:
1. A correct reduced pressure backflow assembly (RPA) installation is shown above. There must not be any connections on the service line between the RPA and the water meter.
2. Protective cages are optional, and when installed must meet clearance requirements in addition to providing side and top access.
3. Cages must not retain water.
4. The assembly must be accessible at all times.
5. The RPA must be installed above ground and as close to the water meter as possible.
6. The assembly must be protected from freezing.
7. Distance from the bottom of pressure relief valve to the drain opening must be a minimum of twice the diameter of the assembly piping.
8. Installation must meet uniform plumbing codes in addition to Flagstaff water standard details.
9. Installation must be left exposed until inspected and approved by Flagstaff City Utilities.
10. In cases where water supply may not be interrupted during normal working hours, two assemblies installed in parallel are required.
11. The assembly must be approved by the City Utilities prior to installation.
12. For an updated list of approved assembles or additional questions contact the city utilities department at (928) 213-2117.

City of Flagstaff
ENGINEERING DETAIL

DOUBLE CHECK VALVE ASSEMBLY INSTALLATION

DETAIL NO. 09-06-071 REVISION DATE: 11/22/16 1

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
Reduced Pressure Assembly (RPA) Installation

1. A CORRECT REDUCED PRESSURE BACKFLOW ASSEMBLY (RPA) INSTALLATION IS SHOWN ABOVE. THERE MUST NOT BE ANY CONNECTIONS ON THE SERVICE LINE BETWEEN THE RPA AND THE WATER METER.
2. PROTECTIVE CAGES ARE OPTIONAL, AND WHEN INSTALLED MUST MEET CLEARANCE REQUIREMENTS IN ADDITION TO PROVIDING SIDE AND TOP ACCESS.
3. CAGES MUST NOT RETAIN WATER.
4. THE ASSEMBLY MUST BE ACCESSIBLE AT ALL TIMES.
5. THE RPA MUST BE INSTALLED ABOVE GROUND AND AS CLOSE TO THE WATER METER AS POSSIBLE.
6. THE ASSEMBLY MUST BE PROTECTED FROM FREEZING.
7. DISTANCE FROM THE BOTTOM OF PRESSURE RELIEF VALVE TO THE DRAIN OPENING MUST BE A MINIMUM OF TWICE THE DIAMETER OF THE ASSEMBLY PIPING.
8. INSTALLATION MUST MEET UNIFORM PLUMBING CODES IN ADDITION TO FLAGSTAFF WATER STANDARD DETAILS.
9. INSTALLATION MUST BE LEFT EXPOSED UNTIL INSPECTED AND APPROVED BY FLAGSTAFF CITY UTILITIES.
10. IN CASES WHERE WATER SUPPLY MAY NOT BE INTERRUPTED DURING NORMAL WORKING HOURS, TWO ASSEMBLIES INSTALLED IN PARALLEL ARE REQUIRED.
11. THE ASSEMBLY MUST BE APPROVED BY THE CITY UTILITIES PRIOR TO INSTALLATION.
12. FOR AN UPDATED LIST OF APPROVED ASSEMBLIES OR ADDITIONAL QUESTIONS CONTACT THE CITY UTILITIES DEPARTMENT AT (928) 213-2117.
13. THREE SETS OF PLANS SHALL BE SUBMITTED TO CITY UTILITIES DEPARTMENT FOR APPROVAL BY SIGNATURE PRIOR TO INSTALLATION.

City of Flagstaff

ENGINEERING DETAIL

REDUCED PRESSURE ASSEMBLY (RPA) INSTALLATION

DETAIL NO. 09-06-072

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
NOTES:

1. CONTACT CITY OF FLAGSTAFF UTILITIES DEPARTMENT FOR LATEST APPROVED LIST OF BACKFLOW PREVENTOR ASSEMBLIES.
2. TWO TEST COCKS SHALL BE INSTALLED PER U.S.C.*
3. ASSEMBLY MUST BE INSTALLED 12 INCHES ABOVE THE HIGHEST OUTLET ON THE SYSTEM. IF THIS DISTANCE EXCEEDS 36 INCHES A REDUCED PRESSURE BACKFLOW PREVENTION ASSEMBLY MUST BE UTILIZED.
4. ASSEMBLY MUST BE PROTECTED FROM FREEZING.
5. 3 SETS OF PLANS SHALL BE SUBMITTED TO THE CITY UTILITIES DEPARTMENT FOR APPROVAL BY SIGNATURE PRIOR TO INSTALLATION.
6. ALL SHUT OFF VALVES MUST BE RESILIENT SEATED.
7. FLANGES OR UNIONS TO BE AS CLOSE TO THE ASSEMBLY AS POSSIBLE.
8. DEVICE MAY BE REMOVED FOR WINTER THEN REINSTALLED AND TESTED IN THE SPRING.


City of Flagstaff
ENGINEERING DETAIL

PRESSURE VACUUM BREAKER ASSEMBLY (PVBA) INSTALLATION

DETAIL NO. 09-06-073
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
Fire Hydrant Meter Backflow Protection

(Water Tank Truck) REDUCED PRESSURE BACKFLOW ASSEMBLY PER DET. 9-06-072

FIRE HYDRANT METER

(Water Tank) REDUCED PRESSURE BACKFLOW ASSEMBLY PER DET. 9-06-072

FIRE HYDRANT METER

(Water Tank) REDUCED PRESSURE BACKFLOW ASSEMBLY PER DET. 9-06-072

FIRE HYDRANT METER

(Elevated Tank) REDUCED PRESSURE BACKFLOW ASSEMBLY PER DET. 9-06-072

FIRE HYDRANT METER

City of Flagstaff
ENGINEERING DETAIL
DETAIL NO. 09-06-075
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
10-04-010 Urban Cul-de-sac

City of Flagstaff
URBAN CUL-DE-SAC

DETAIL NO. 10-04-010
REVISION DATE: 5/22/17

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
10-04-011 Rural Cul-de-sac

SLOPE OR DRAINAGE EASEMENT

5% MAX GRADE

R=50'

R=56'

R=62'

R=30'

R=24'

ROW

SHOULDER

ROW

SHOULDER

City of Flagstaff

RURAL CUL-DE-SAC

ENGINEERING DETAIL

DETAIL NO. 10-04-011

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
10-06-011 Standard Delineator

**NOTES:**
1. ROADSIDE DELINEATOR SHALL BE PLACED AT THE DIRECTION OF THE TRAFFIC ENGINEER OR IN ACCORDANCE WITH THE GUIDELINES PRESENTED IN THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES.
2. ON DEAD END STREET, DELINEATORS SHALL BE PLACED AT THE END OF PAVING ON PAVED STREET AND AT THE END OF THE TRAVELED WAY ON UNPAVED STREETS. USE MAG STD 130 Type 'A' or 'B' ON TEMPORARY DEAD ENDS.

**City of Flagstaff**

<table>
<thead>
<tr>
<th>ENGINEERING DETAIL</th>
<th>STANDARD DELINEATOR</th>
</tr>
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<tr>
<td>DETAIL NO.</td>
<td>10-06-011</td>
</tr>
<tr>
<td>REVISION DATE</td>
<td>11/22/16</td>
</tr>
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(Ord. 2017-22, Rep&ReEn, 07/05/2017)
10-06-012 Stop Ramp Parameters

NOTES:
1. THIS STANDARD SHALL BE APPLIED TO EACH MINOR LEG OF AN INTERSECTION AS DETERMINED BY THE CITY ENGINEER.
2. GRADES SHOWN ARE AT MINOR STREET CENTERLINE. INDIVIDUAL CONSIDERATION SHALL BE GIVEN AT THE CURB LINE TO ENSURE POSITIVE DRAINAGE AT THE VALLEY GUTTER. SUITABLE MEASURES SHALL BE TAKEN WHERE NECESSARY TO ENSURE THAT PROPER DRAINAGE PATTERN IS OBTAINED AT THE INTERSECTION. LARGER SCALE INTERSECTION DETAILS MAY BE REQUIRED.

City of Flagstaff

ENGINEERING DETAIL

STOP RAMP PARAMETERS

DETAIL NO. 10-06-012

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
NOTES:

1. ONE DETECTOR LOOP PER LANE SHALL BE INSTALLED AND CENTERED IN THE TRAVEL LANE.

2. SPEED MONITORING AND VEHICLE CLASSIFICATION SYSTEMS REQUIRE 2 LOOPS PER LANE, CENTERED IN THE LANE, WITH 16 FEET FROM LEADING EDGE TO LEADING EDGE. THE LEADING EDGE OF BOTH LOOPS MUST BE PARALLEL TO EACH OTHER WITH NO MORE THAN 1 INCH OF VARIATION ACROSS THE FACE OF THE LOOPS.

3. LOOPS OF 6 FT. X 6 FT. ARE STANDARD FOR LANES UP TO 12 FEET WIDE. FOR WIDER LANES, ADJUST THE WIDTH OF THE LOOP TO MAINTAIN 3 FEET FROM THE CENTER STRIPE AND 3 FEET FROM THE EDGE OF PAVEMENT, EDGE LINE, OR THE LIP OF GUTTER. FOR LANES NARROWER THAN 12 FEET, ADJUST THE WIDTH TO MAINTAIN 3 FEET FROM THE CENTER STRIPE AND AT LEAST 1 FT. FROM EDGE OF PAVEMENT, EDGE LINE, OR THE LIP OF GUTTER WHILE MAINTAINING 6 FT. LENGTH OF LOOP.

4. THREE TURNS OF SKEW SHEATHES, THHN STRANDED 14 AWG SINGLE CONDUCTOR COPPER WIRE (IN PVC TUBING) IS THE STANDARD FOR COUNTER AND CLASSIFICATION / SPEED LOOPS.

5. BACKFILL PULL BOX WITH EXCAVATED MATERIAL AND THOROUGHLY TAMPER.

6. PULL BOXES INSTALLED IN CONCRETE AREAS SHALL USE 1 INCH FELT AS AN EXPANSION JOINT.

7. ALL UNUSED EXCAVATION MATERIAL SHALL BE PROPERLY DISPOSED.

8. SAW CUTS SHALL BE SEALED WITH AN APPROVED SEALER AS PER THE CURRENT ARIZONA DEPARTMENT OF TRANSPORTATION STANDARDS AND SPECIFICATIONS FOR ROADWAY AND BRIDGE CONSTRUCTION.

9. EMULSIFIED CRACK FILLER (CRF OR APPROVED EQUIVALENT) AND SILICA SAND MIXTURE ARE TO BE USED ON ALL INSTALLATIONS IN ASPHALTIC CONCRETE, WITH OR WITHOUT AN OVERLAY.

10. WHEN A PULL BOX IS INSTALLED IN SIDEWALK, INSTALL PULL BOX FLUSH WITH THE TOP OF SIDEWALK.
10-06-014 Median with 90' or 60' Taper

10.0-90'
USE 60' REVERSE CURVE FOR SPEEDS UP TO 40 MPH
USE 90' REVERSE CURVE FOR SPEED GREATER THAN 40 MPH

POINT OF REVERSE CURVE

11'

3'

VERTICAL CURB MAG 222 TYPE A (TYP.)
USE MAG 220 TYPE 'A' WHEN NECESSARY TO ACCOMMODATE DRAINAGE

MEDIAN NOSE TRANSITION
PER MAG STD. DTL 223

City of Flagstaff
ENGINEERING DETAIL

MEDIAN WITH 90' or 60' TAPER

DETAIL NO. 10-06-014

(Ord. 2017-22, Rep & ReEn, 07/05/2017)

(Revised 10/17)
10-09-010 Pavement Structural Section for Streets and Off-Street Parking Lots

SECTION

CHIP SEAL FEE TO BE PAID TO THE CITY PER 13-10-009

AC (ASPHALTIC CONCRETE) (95% COMPACTED)

PRIME COAT (OPTIONAL)

ABC (AGGREGATE BASE COURSE) (100% COMPACTED)

SUB-BASE (SELECT MATERIAL OPTIONAL) (95% COMPACTED)

NATIVE MATERIAL (95% COMPACTED)

* THE MINIMUM DEPTH OF THE AC VARIES, DEPENDING ON THE TYPE OF ROADWAY. THE TYPICAL MINIMUM PAVEMENT DEPTHS ARE AS FOLLOWS, OR MATCH EXISTING, WHICHEVER IS GREATER.

ARTERIALS = 5"
COLLECTORS = 4"
LOCALS & ALLEYS = 3"

OFF-STREET PARKING MINIMUM DEPTH OF AC IS 2 1/2"
PARKING LOTS MAY BE PAVED WITH 4" PORTLAND CEMENT CONCRETE UPON COMPACTED SUBGRADE.

ALTERNATIVE SECTIONS:
1. FOR PARKING LOTS, ALTERNATIVE SECTIONS OF PAVEMENT WILL BE CONSIDERED
   (i.e. PAVERS, POROUS ASPHALT AND CONCRETE, GRASS CRETE, GRAVEL PAVE, ETC.)

NOTES:
1. ALTERNATIVE SECTIONS SHALL BE LIMITED TO THE PARKING AREAS AND DRIVE AISLES THAT DO NOT SERVE AS FIRE ACCESS AISLES.
2. THE PROFESSIONAL ENGINEER MAY RECOMMEND PAVEMENT STRUCTURAL SECTION THAT ARE EQUIVALENT TO THE MINIMUM SECTIONS ABOVE.

City of Flagstaff
ENGINEERING DETAIL

PAVEMENT STRUCTURAL SECTIONS for STREETS & OFF-STREET PARKING LOTS

DETAIL NO. 10-09-010

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
10-09-032  Arterial (Major or Minor)

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
10-09-035 Minor Collector

City of Flagstaff

MINOR COLLECTOR

DETAIL NO. 10-09-035

ENG. DATE: 11/22/16

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
10-09-036  Commercial Local

(Slope and Drainage Easement)

ROW

5' SIDEWALK

5' MAX. WALK

2'

12' TRAVEL LANE

26'

12' ROADWAY & ROW

1% - 2%

5' MAX. WALK

2'

5' SIDEWALK

SLOPE AND DRAINAGE EASEMENT

ROW

26'

52' MIN.

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

City of Flagstaff

ENGINEERING DETAIL

COMMERCIAL LOCAL

DETAIL NO. 10-09-036

REVISION DATE: 11/22/16

1/1

(Revised 10/17)
10-09-037 Residential Local "Wide"

City of Flagstaff

RESIDENTIAL LOCAL "WIDE"

DETAIL NO. 10-09-037

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
10-09-038 Residential Local

(city) 10-09-038

City of Flagstaff
ENGINEERING DETAIL

RESIDENTIAL LOCAL

DETAIL NO. 10-09-038

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(REvised 10/17)
(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
10-09-041 Minor Arterial "Commercial Center"

City of Flagstaff

MINOR ARTERIAL "COMMERCIAL CENTER"

DETAIL NO. 10-09-041

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
10-09-043  Minor Collector "Commercial Center"

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
10-09-044  Commercial Local "Commercial Center"

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
10-09-047 Rural Local

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
10-09-048 Rural Local "Narrow"

NOTE: CURB, GUTTER, AND SIDEWALK ARE OPTIONAL

City of Flagstaff

RURAL LOCAL "NARROW"

ENGINEERING DETAIL

DETAIL NO. 10-09-048

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
10-09-049 Shoulder Section

NOTES:
1. ON FILL SECTIONS WHERE COLLECTION AND TRANSPORTATION OF SURFACE RUNOFF IS NOT REQUIRED, THE MAXIMUM SLOPE IS 2:1.
2. IN RURAL SHOULDER SECTIONS, GUARD RAILS OR OTHER PROTECTIONS WILL BE REQUIRED ON FILL SECTIONS OF SLOPES GREATER THAN 4:1, OR PER AASHO REQUIREMENTS.
3. DRAINAGE CALCULATIONS MAY SHOW SUCH INCREASED DRAINAGE AS TO REQUIRE ADDITIONAL RIGHT-OF-WAY.
4. RIGHT-OF-WAY TOTAL VARIES WITH COMBINATIONS OF STREET AND SHOULDER SECTIONS.
5. SLOPE EASEMENTS WILL BE REQUIRED WHERE SLOPES ARE OUT OF THE RIGHT-OF-WAY.

City of Flagstaff

ENGINEERING DETAIL

DETAIL NO. 10-09-049

REVISION DATE: 11/22/16 1

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
Revised 10/17

10-09-050 Residential Alley Cross-Section

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
10-10-010 Parking, Driveway and Aisle Slope Parameters

NOTES:

1. DRIVeway - NO DIRECT PARKING ACCESS.
2. AISLE - DIRECT PARKING ACCESS.
3. THIS DETAIL DOES NOT APPLY FOR SINGLE FAMILY RESIDENCE.
4. PARKING - THE MAXIMUM SLOPES SHOWN FOR AISLES AND SPACES MAY BE EXCEEDED FOR UP TO 30% OF THE TOTAL NUMBER OF SPACES FOR A SINGLE PROJECT. THIS 30% SHOULD BE IN 3 OR MORE LOCATIONS AROUND THE PROJECT AND SHOULD BE IN OUTLYING AREAS THAT WILL BE USED LEAST. IN THE 30% AREAS, THE AISLES SLOPES SHALL NOT EXCEED 8%, THE SPACES SLOPE SHALL NOT EXCEED 6% LONGITUDINALLY OR 8% LATERALLY.
5. ACCORDING TO THE FEDERAL REGISTER/VOL. 56, NO. 144/FRIDAY, JULY 26, 1991/RULES AND REGULATIONS: HANDICAPPED PARKING SPACES AND ACCESS AISLES SHALL BE LEVEL WITH SURFACE SLOPES NOT EXCEEDING 1:50 (2%) IN ALL DIRECTIONS.

City of Flagstaff
ENGINEERING DETAIL

PARKING, DRIVEWAY & AISLE SLOPE PARAMETERS

DETAIL NO. 10-10-010

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
(Ord. 2017-22, Rep&ReEn, 07/05/2017)
10-10-020  Right Turn Lane for Urban Driveway

Refer to 16-06-010 for bike lane striping.

Refer to 16-06-010 for turn arrow spacing. See Table 1 below.

Taper = 4W (3W if row is limited).

R4-4 at beginning of taper when bike lane exists.

Design right turn lane yields to bikes R4-4.

Table 1

<table>
<thead>
<tr>
<th>Design Speed (MPH)</th>
<th>Deceleration Lane Length, L (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>90</td>
</tr>
<tr>
<td>35</td>
<td>120</td>
</tr>
</tbody>
</table>

Per 2010 AASHTO:
Stopping Sight Distance on Level Roadways

Notes:
1. Refer to 16-06-010 for pavement marking details.
2. This detail applies only with speeds of 35 MPH or less.
3. Where the speed limit exceeds 35 MPH, refer to ADOT standards for turn lane detail (the design speed is the greater of the posted speed or the 85th percentile speed).

City of Flagstaff
Engineering Detail

Right Turn Lane for Urban Driveway

Detail No. 10-10-020
Revision Date: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
SECTION A-A'

TYPICAL STRAIGHT DRIVEWAY FOR USE WITH CULVERTS

NOTES:
1. W - INDICATES WIDTH OF PAVED SURFACE OF DRIVEWAY
   L - INDICATES LENGTH OF PAVED SURFACE DRIVEWAY P.L. to E.P.
   R - RADIUS 10' MIN., 20' DESIRABLE
   EOP - EDGE OF EXISTING PAVEMENT
   PL - PROPERTY LINE
2. SIZE AND TYPE OF DRIVEWAY SHALL BE NOTED ON PLANS
3. DRIVEWAYS SHALL BE PERPENDICULAR TO THE STREET WITHIN THE RIGHT OF WAY
4. A.C. AND BASE MATERIAL THICKNESS FOR DRIVEWAYS SHALL BE
   2.5" A.C. 4" A.B.C. or 6" CLASS "A" P.C.C. ON 3" A.B.C. FOR RESIDENTIAL and 6" CLASS "A" P.C.C. ON 3" A.B.C. FOR COMMERCIAL
5. DRIVEWAYS ARE TO BE PLACED WHERE SHOWN ON PLANS OR AS DIRECTED BY THE CITY ENGINEER
6. DRAINAGE STRUCTURES SHALL BE PROVIDED UNDER DRIVEWAYS WHERE NECESSARY 12" MIN. COVER TO FINISH GRADE REQUIRED UNLESS OTHERWISE NOTED ON PLANS

City of Flagstaff

ENGINEERING DETAIL

PAVED TURNOUTS

DETAIL NO. 10-10-031

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
10-10-034  Sidewalk Ramp Detail (15' Radius Curb Return)

**NOTES:**

1. CONTROL ELEVATIONS SHOWN ARE IN RELATION TO THE GUTTER AND ARE LOCATED RADIALY. GUTTER ELEVATION = 0'
2. RAMP CURBS MAY BE POURED MONOLITHIC WITH A CONSTRUCTION JOINT. CLASS "A" CONCRETE TO BE USED AS PER SECTION 725
3. EXPANSION JOINT FILLERS SHALL BE PREFORMED 1/2" BITUMINOUS TYPE PER A.S.T.M. D-1751
4. THE MAXIMUM CROSS SLOPE MAY BE GREATER THAN 2% WHEN THE TOPOGRAPHY IS EXTREME
5. SEE 10-10-043 FOR DETECTABLE WARNING DETAIL

<table>
<thead>
<tr>
<th>City of Flagstaff</th>
<th>SIDEWALK RAMP DETAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGGINEERING DETAIL</td>
<td>15' RADIUS CURB RETURN</td>
</tr>
</tbody>
</table>

**DETAIL NO.** 10-10-034  **REVISION DATE:** 11/22/16

(Revised 10/17)  

TITLE 13 - PAGE 424
SIDEWALK RAMP DETAIL
WITH LANDSCAPE PARKWAY

SIDEWALK RAMP DETAIL
WITH NO LANDSCAPE PARKWAY

GROOVE SLOPING RAMP FACE PER MAG
SEE MAG 234 (DETAILS)

SECTION A-A'
City of Flagstaff

ENG. DET. NO. 10-10-034

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
NOTES:
1. CONSTRUCT THE CONTRACTION JOINTS AS SHOWN ON CONCRETE APRON FOR THE RADIUS REQUIRED.
2. WHEN PLANS CALL FOR A CLASS "A" CONCRETE VALLEY GUTTER THE CONTRACTION JOINTS SHALL BE SPACED SYMMETRICAL WITH AT LEAST ONE JOINT EVERY 10 FEET.
3. WHEN PLANS CALL FOR A 7" VALLEY GUTTER, MAKE A 7" SQUARE INSTEAD OF A 3" SQUARE
10-10-039  Driveway-Pedestrian Ramp Combination (For Use at T-Type Intersection)
KEYNOTES:

1. ROUGH BROOM FINISH - USE A RIPPLE SURFACE PATTERN
2. SIDEWALK MAG DETAIL 230
3. CONTRACTION JOINT
4. WHEN WIDTH EXCEEDS 22’ PROVIDE A CONTRACTION JOINT ON DRIVEWAY CENTERLINE
5. FULL DEPTH EXPANSION JOINT THROUGH DRIVEWAY, CURB & GUTTER. EXPANSION JOINT FILLER SHALL BE 1/2” BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751

NOTES:

1. DEPRESSED CURB SHALL BE PAID FOR AS COMBINED CURB & GUTTER.
2. EXPANSION JOINT MATERIAL SHALL BE SECURED IN PLACE PRIOR TO POURING CONCRETE AND SHALL COMPLETELY SEPARATE THE DRIVEWAY SLAB FROM THE SIDEWALK, EXTENDING FROM THE SURFACE TO THE SUBGRADE.
3. CONTROL ELEVATIONS SHOWN ARE IN RELATION TO GUTTER. GUTTER ELEVATION = 0’
10-10-041  Return Type Driveways with Attached Sidewalk

**NOTES:**

1. CONTROL ELEVATIONS ARE IN RELATION TO THE GUTTER AND ARE LOCATED RADICALLY. GUTTER ELEVATION = 0".
2. RAMP CURBS MAY BE Poured MONOLITHIC WITH A CONSTRUCTION JOINT. CLASS "A" CONCRETE TO BE USED AS PER SECTION 725.
3. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER A.S.T.M. D-1751.
4. MEASUREMENT AND PAYMENT FOR CONCRETE DRIVEWAY SHALL BE BY THE SQUARE FOOT OF 9" CLASS "A" CONCRETE PLACED.
   MEASUREMENT AND PAYMENT FOR THE CURB RETURNS AND THE SIDEWALK AT THE RETURNS SHALL BE MADE UNDER THEIR
   SEPARATE PAY ITEMS.
5. SEE MAG 251 FOR DETACHED CONDITION.

**City of Flagstaff**

**ENGINEERING DETAIL**

**RETURN TYPE DRIVEWAYS WITH ATTACHED SIDEWALK**

**DETAIL NO.** 10-10-041  **REVISION DATE:** 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
Pavement Edge Tapers for Isolated Street Widenings

<table>
<thead>
<tr>
<th>CASE 1</th>
<th>CASE 2</th>
<th>CASE 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONDITION</td>
<td>$W + P \geq 20'$</td>
<td>$W \geq 8'$</td>
</tr>
<tr>
<td>$L \geq 250'$</td>
<td>$L \geq 250'$</td>
<td></td>
</tr>
<tr>
<td>$T_o$</td>
<td>$W^{1/2}$</td>
<td>$W^{1/2}$</td>
</tr>
<tr>
<td>$120$</td>
<td>$310$</td>
<td>$4W$</td>
</tr>
<tr>
<td>$T_d$ (NOTE 3)</td>
<td>$W^{1/2}$</td>
<td>$W^{1/2}$</td>
</tr>
<tr>
<td>$60$</td>
<td>$155$</td>
<td>$10W$</td>
</tr>
</tbody>
</table>

**NOTES:**

1. IF A PAVEMENT EDGE TAPER OVERLAPS THE TAPER FROM ANOTHER WIDENING, OR EXTENDS INTO A STREET INTERSECTION, THEN THE NEW PAVEMENT EDGE SHALL BE CONSTRUCTED TO MATCH THE FULL WIDTH OF THE WIDENING, OR TO MATCH THE CURB RETURN OF THE INTERSECTION.

2. TAPERS ARE CONSTRUCTED OFF THE FRONTAGE OF THE DEVELOPING PARCEL UNLESS ADEQUATE RIGHT-OF-WAY IS NOT AVAILABLE.

3. WIDENING AND DEPARTURE TAPER FOR CASE 1 MAY REQUIRE LANE MARKINGS AND WARNING SIGNS. ALL CURBED DEPARTURE TAPERS REQUIRE TYPE 2 OBJECT MARKERS (TRIPLE VERTICAL).

4. SAWCUT MAYBE REQUIRED.
IN THE CASE OF WIDENING WITHOUT A CURB THE DIMENSION ‘W’ IS TO THE NEW EDGE OF PAVEMENT. IN THE CASE OF WIDENING AN ALREADY CURBED SECTION THE TAPER LENGTHS ARE THE SAME BUT THE EDGE OF THE TAPER IS THE EXTENSION OF A TYPE ‘A’ CURB.

**CASE 1**

W + P ≥ 26’

L ≥ 250’

THREE WIDENING IS LONG ENOUGH AND WIDE ENOUGH THAT IT CREATES or APPEARS TO BE AN ADDITIONAL TRAFFIC LANE WHICH COULD BE USED BY THROUGH TRAFFIC FOR DECELERATION, OR PASSING. THE SPEED OF THE TRAFFIC IS A CRITICAL FACTOR AND SAFE TAPER LENGTHS ARE DERIVED FROM THE MUTCD AND ASHTO FOR THE DIVERGING AND MERGING MANEUVERS AT EACH END.

**CASE 2**

W ≥ 8’

L ≥ 250’

THE WIDENED AREA IS NOT A FULL ADDITIONAL TRAFFIC LANE, BUT CAN SERVE FOR PASSING AT REDUCED SPEED, MANEUVERING INTO ON-STREET PARKING OR IN AND OUT OF DRIVEWAYS ALONG THE WIDENED SECTION. TAPERS SERVE TO PROTECT THE EDGE OF PAVEMENT BEYOND THE WIDENING. THE DEPARTURE TAPER IS LONG ENOUGH TO ACCOMMODATE SWEEPING TURNS OUT OF DRIVEWAYS.

**CASE 3**

W < 8’

THE WIDENED AREA IS NOT USED BY TRAFFIC EXCEPT TO ENTER AND EXIT DRIVEWAYS ALONG THE WIDENED SECTIONS. THE TAPERS PROTECT THE EDGE OF THE PAVEMENT.

**NOTES:**

1. COVERS THE COMMON SITUATION WHERE A WIDENING IS NEAR BY NOT ADJACENT TO ANOTHER WIDENING OR AN INTERSECTION RETURN. THE MATCH ACROSS THE INTERVENING PROPERTY ELIMINATES THE RAGGED/RANDOM APPEARANCE OF THE EDGE OF PAVEMENT AND MAKES PLowing AND SWEEPING MUCH EASIER.

2. CLARIFIES AND STANDARDIZES THE CITY RESPONSE TO THE QUESTION OF HOW MUCH WIDENING IS NECESSARY. IT ALSO PRECLUDES THE CASES WE HAVE HAD IN THE PAST WHERE THE TAPER IS ACCOMPLISHED WITHIN THE WIDENING USING EDGE LINE STRIPING AND DELINERATORS INSTALLED IN THE PAVEMENT.

3. REQUIRES TRAFFIC CONTROL DEVICES TO WARN DRIVERS AND MAINTENANCE OPERATORS IN CASES WHERE THE DEPARTURE TAPES COULD BE A HAZARD TO TRAFFIC OR CURBED TAPERS COULD BE DAMAGED DURING PLowing.

4. THIS STANDARD DOES NOT COVER THE SITUATIONS WHERE THERE IS NOT ENOUGH RIGHT OF WAY IN FRONT OF THE PROPERTIES NEXT TO THE DEVELOPMENT TO ACCOMMODATE THE REQUIRED TAPER. THESE AND OTHER UNUSUAL CONDITIONS NEED TO BE REVIEWED ON A CASE BY CASE BASIS.

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**City of Flagstaff**

**ENGINEERING DETAIL**

**PAVEMENT EDGE TAPERS FOR ISOLATED STREET WIDENINGS**

**DETAIL NO.** 10-10-042

**REVOLUTION DATE:** 11/22/16

**ORD. 2017-22, Rep&ReEn, 07/05/2017**

(Revised 10/17)
10-10-043 Detectable Warning Strip

NOTES:

1. DETECTABLE WARNING STRIPS SHALL BE USED ON ALL NEW AND RETRO-FIT RAMPS, PEDESTRIAN REFUGES AND OTHER LOCATIONS AS OUTLINED IN THE CURRENT ACCESS BOARD GUIDELINES FOR RIGHT OF WAY DEVELOPMENT.
2. DETECTABLE WARNING STRIPS SHALL BE MECHANICALLY ATTACHED FOR NEW RAMP INSTALLATIONS.
3. DIMENSIONS ARE SUBJECT TO SITE CONDITIONS AND ADA REGULATIONS.

KEYNOTES:

A  11/16" MINIMUM (TYP.) (0.65" MINIMUM ADA ACTUAL)
B  1-5/8" to 2-3/8" (TYP.) (1.6" to 2.4" ADA ACTUAL)
C  7/8" to 1-3/8" (TYP.) (0.9" to 1.4" ADA ACTUAL)
D  50% to 65% of "C"

MATERIALS:

CAST GRAY IRON CONFORMING TO ASTM A-48 CLASS 30A MINIMUM

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
SEE DETAIL NO. 13-03-012 FOR PROTECTION POST INSTALLATION
NOTE: MIN. 3' CLEAR LEVEL AREA AROUND HYDRANT

CLASS A' CONCRETE PAD AROUND HYDRANT BARREL
4'-6" THICK 3'X3' WIDE

1' TO BACK OF SIDEWALK

2" MIN.
6" MAX.

1" MAX. FROM TOP OF PAD TO TOP OF CURB OR SIDEWALK

COMPLETE VALVE BOX ASSEMBLY PER COF STD. 9-03-060

DRAIN HOLES MUST BE KEPT CLEAR

FLANGED X MJ 6" GATE VALVE

1/4 CUBIC YARD GRAVEL (3/4") AROUND DRAIN HOLES

THRUST BLOCKS PER MAG DETAIL NO. 380 (TYP.)

MJ DIP WATERLINE

FLANGED TEE

TAPPING SLEEVE AND VALVE PER MAG DET. No. 340

FOR SPECIFICATIONS, INSTALLATION, AND TESTING REFER TO SECTION 13-09-006-0006 (FIRE HYDRANTS).
13-03-012  Fire Hydrant Protection Post in Paved or Concrete Surface

NOTES:
1. GROUT SHALL CONFORM TO MAG SECTION 776
2. * COLOR SHALL BE OSHA SAFETY YELLOW (WITH YELLOW REFLECTIVE TAPE) WHEN SPECIFIED ON THE PLANS

City of Flagstaff
ENGINEERING DETAIL
Detail No. 13-03-012
Revision Date: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
Shoulder Widening at Fire Hydrants for Uncurbed Roads

NOTE:
BOLLARDS SHALL NOT BE PLACED IN THE WAY OF VEHICULAR TRAFFIC

FIRE HYDRANT PROTECTION POST
PER DETAIL 13-03-012

City of Flagstaff
ENGINEERING DETAIL

SHOULDER WIDENING AT FIRE HYDRANTS FOR UNCURBED ROADS

DETAIL NO. 13-03-013
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
Removable Bollard

NOTES:
1. BOLLARD IS TO BE PAINTED AS FOLLOWS:
   1.1. PRIMER: TWO (2) COATS - COMPONENT ETCHING WASH PRIMER
   1.2. INTERMEDIATE: TWO (2) COATS - COMPONENT EPOXY PRIMER
   1.3. FINISH: ONE (1) COAT - "FRAZEE - 7636N LUSH VERANDA" HEAVY DUTY ENAMEL (ALKYD BASED) OR EQUAL
2. FOOTINGS AND BOLLARDS TO BE INSTALLED PRIOR TO POURING CONCRETE
3. BOLLARDS SHALL NOT BE IN THE WAY OF VEHICULAR TRAFFIC

City of Flagstaff
ENGINEERING DETAIL

DETAIL NO. 13-03-014
REVISION DATE: 11/22/16
1

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
NOTES:
1. 50' MAX DISTANCE BETWEEN EXPANSION JOINTS per ADOT DETAIL C-07.01 (E JOINT)
2. 10' MAX DISTANCE BETWEEN CONTRACTION JOINT (SAW CUT TO 1 1/2" DEPTH AND FILL JOINT per ADOT DETAIL C-07.01)

* PER ANTICIPATED MIX USES, AREA TYPE AND ENVIRONMENT, LANE STRIPING WILL BE REQUIRED ON 14 FT WIDTHS AND MAY BE REQUIRED ON 10' AND 12' WIDTHS TO INDICATE CENTERLINE OR USER SEPARATION. IF IT IS DETERMINED THAT THE CITY WILL UTILIZE THE FUTS TRAIL AS ACCESS FOR MAINTENANCE VEHICLES, THE DESIGN ENGINEER MAY BE REQUIRED TO DESIGN A THICKER PAVEMENT SECTION THAT WILL SUPPORT MAINTENANCE VEHICLES THAT ARE ANTICIPATED TO USE THE FUTS FOR ACCESS. WHEN A FUTS TRAIL IS CONSTRUCTED ADJACENT TO A PUBLIC STREET (IN LIEU OF A SIDEWALK) IT SHALL BE CONSTRUCTED OF PCC

NOTES:
1. 6" CLASS "A" PCC OVER 4" ABC WITH MAG STD 201 "A" TURN DOWN AT THE END OF THE TRAIL OR 3" AC OVER 6" ABC WITH MAG STD 201 TYPE "A" TURN DOWN WHEN APPROVED BY CITY ENGINEER.
VEHICLE CROSSINGS TO MEET COF DRIVEWAY STDS WHEN TRAIL IS USED FOR VEHICLE TRAFFIC, A GREATER SECTION MAY BE REQUIRED.
2. SEED ALL DISTURBED AREAS per COF STD. 13-17-002
TYPICAL TRAIL PLAN VIEW

NOTES:
1. 50' MAX DISTANCE BETWEEN EXPANSION JOINTS per ADOT DETAIL C-07.01 (E JOINT)
2. 10' MAX DISTANCE BETWEEN CONTRACTION JOINT (SAW CUT TO 1 1/2" DEPTH AND FILL JOINT per ADOT DETAIL C-07.01

* PER ANTICIPATED MIX USES, AREA TYPE AND ENVIRONMENT, LANE STRIPING WILL BE REQUIRED ON 14 FT WIDTHS AND MAY BE REQUIRED ON 10' AND 12' WIDTHS TO INDICATE CENTERLINE OR USER SEPARATION. IF IT IS DETERMINED THAT THE CITY WILL UTILIZE THE FUITS TRAIL AS ACCESS FOR MAINTENANCE VEHICLES, THE DESIGN ENGINEER MAY BE REQUIRED TO DESIGN A THICKER PAVEMENT SECTION THAT WILL SUPPORT MAINTENANCE VEHICLES THAT ARE ANTICIPATED TO USE THE FUITS FOR ACCESS. WHEN A FUITS TRAIL IS CONSTRUCTED ADJACENT TO A PUBLIC STREET (IN LIEU OF A SIDEWALK) IT SHALL BE CONSTRUCTED OF PCC.

TYPICAL UNPAVED TRAIL CROSS SECTION

NOTES:
1. WHERE THE SLOPE OF THE TRAIL EXCEEDS 10% THE STRUCTURAL SECTION SHALL BE PCC OR AC PER SHEET 1/4
2. SEED ALL DISTURBED AREAS PER COF STD. 13-17-002
NOTES:
1. USE ONE OR TWO SECTIONS OF 5" x 5" POSTS AND 3" x 3" RAILS FOR ENTRY FEATURES.
2. USE 56.5" POSTS AND 4" RAILS IN HIGH HAZARD AREAS
3. SET POST 3' DEEP ON SLOPES GREATER THAN 2:1

4" x 4" x 4.5" ABOVE GRADE, 3/16" UNPAINTED STEEL SQUARE TUBING, PEAKED CAP TO DRAIN
AGGREGATE SURFACE MATERIAL (FOR UNPAVED SECTION):

1. HERBICIDE SHALL BE SURFLAN® OR EQUAL FOR PRE-EMERGENT CONTROL AND ROUNDUP® FOR POST EMERGENT CONTROL.
2. AGGREGATE SURFACE MATERIAL SHALL BE A COLOR COMPATIBLE WITH NATURAL SURROUNDINGS AND ACCEPTABLE TO THE CITY OR COUNTY. WHITE, LIGHT GREY OR OTHER VISUALLY INCOMPATIBLE COLORED AGGREGATES WILL NOT BE ACCEPTED.
3. AGGREGATE SURFACE MATERIAL SHALL CONFORM TO THE REQUIREMENTS OF MAG SECTION 702, EXCEPT THAT THE GRADATION SHALL BE AS FOLLOWS:

<table>
<thead>
<tr>
<th>SIEVE SIZE (SQUARE OPENINGS)</th>
<th>PERCENT BY WEIGHT PASSING SIEVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>96-100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>85-99</td>
</tr>
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<td>3/8&quot;</td>
<td>79-98</td>
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<tr>
<td>No. 4</td>
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<td>No. 30</td>
<td>27-50</td>
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<tr>
<td>No. 100</td>
<td>16-33</td>
</tr>
<tr>
<td>No. 200</td>
<td>13-27</td>
</tr>
</tbody>
</table>

4. HERBICIDES SHALL BE MIXED IN ACCORDANCE WITH THE MANUFACTURER’S INSTRUCTIONS FOR NON-CROP LAND USE. PRE-EMERGENT HERBICIDE SHALL BE APPLIED TO THE SUBGRADE SURFACE AT A RATIO OF 1.5 GALLONS TO 100 GALLONS OF WATER PER ACRE. CARE SHALL BE GIVEN TO CONTAINING THE HERBICIDES TO THE FUTS TRAIL LIMITS ONLY. THE AGGREGATE SURFACE MATERIAL SHALL BE TREATED WITH LIGNIN SULFONATE IN ACCORDANCE WITH MAG SPECIFICATION 792.2.

5. HERBICIDES SHALL BE MIXED IN ACCORDANCE WITH THE MANUFACTURER’S INSTRUCTIONS FOR NON-CROP LAND USE. POST EMERGENT HERBICIDES SHALL BE APPLIED TO FUTS TRAIL AFTER THE SUBGRADE HAS BEEN SCARIFIED AND BEFORE SHAPING AND COMPACTION THE BASE. THE POST EMERGENT HERBICIDE SHALL BE APPLIED AT A RATIO OF 1.5 GALLONS OF WATER PER ACRE. CARE SHALL BE GIVEN TO CONTAINING HERBICIDES TO THE FUTS TRAIL LIMITS ONLY.

6. LIGNIN SULFONATE SHALL BE DELIVERED TO THE CONTRACTOR IN A CONCENTRATED FORM WITH 50% SPENT SULFIDE LIQUOR (SSL). THE CONTRACTOR SHALL FURTHER DILUTE THE LIGNIN SULFONATE WITH AN EQUAL PART OF WATER PRIOR TO SPREADING.

7. PLACEMENT OF AGGREGATE SURFACE MATERIAL WITH DILUTED LIGNIN SULFONATE SHALL BE IN ACCORDANCE WITH THE MANUFACTURER’S SPECIFICATIONS IN OTHER APPROVED METHODS, INCLUDING APPLICATION OF WATER TO THE SUBGRADE AS REQUIRED BY THE MANUFACTURER. THE FUTS TRAIL SHALL RECEIVE A TOTAL APPLICATION OF 0.7 GALLONS PER SQUARE YARD OF 50% SSL AND SHALL BE APPLIED IN THE FOLLOWING MANNER:

   a. THE AGGREGATE SURFACE MATERIAL SHALL BE THOROUGHLY MIXED WITH DILUTED LIGNIN SULFONATE AT A RATE OF 0.5 TO 0.6 GALLONS PER SQUARE YARD OF TRAIL.

   b. THE CONTRACTOR SHALL APPLY A “TOP SHOT” TO THE FINISHED TRAIL SURFACE BY SURFACE SPRAYING 0.1 TO 0.2 GALLONS OF DILUTED LIGNIN SULFONATE PER SQUARE YARD OF TRAIL NO SOONER THAN 2 DAYS AND NO LATER THAN 3 DAYS AFTER THE PLACEMENT OF THE TREATED AGGREGATE SURFACE COURSE.

DIRTY CINDER GRADATION SPECIFICATION

<table>
<thead>
<tr>
<th>SIEVE SIZE (SQUARE OPENINGS)</th>
<th>PERCENT BY WEIGHT PASSING SIEVE</th>
</tr>
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<tbody>
<tr>
<td>3/4&quot;</td>
<td>90-100</td>
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<tr>
<td>No. 4</td>
<td>58-78</td>
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<td>No. 8</td>
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<td>No. 30</td>
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<tr>
<td>No. 100</td>
<td>4-15</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-12</td>
</tr>
</tbody>
</table>
14-01-011 Pedestrian and Shared Use Path Underpass Dimensions

WIDTH OF UNDERPASS SHOULD BE INFLUENCED IN PART BY LENGTH. FOR TUNNEL STRUCTURES UP TO 50' LONG, THE WIDTH SHOULD BE EITHER:

a) 14' or

b) THE WIDTH OF THE APPROACH PATHWAY PLUS A 24" "SHY ZONE" ON EITHER SIDE (i.e., 10' + 2' + 2' = 14'), whichever is greater.

FOR TUNNEL STRUCTURES LONGER THAN 50', THE WIDTH SHOULD BE INCREASED BY ONE FOOT (1') FOR ANY PORTION OF EACH 10' BEYOND 50'. (FOR 51' TO 60', USE 15' WIDTH; FOR 61' TO 70', USE 16'; AND SO FORTH)

THE HEIGHT/CLEARANCE OF THE UNDERPASS SHOULD BE A MINIMUM OF 9' WITH THE PREFERRED HEIGHT OF 10' (ESPECIALLY FOR LONGER UNDERPASSES)

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
16-01-240 Concrete Paving Stone or Brick Sidewalk

**TYPICAL CROSS SECTION**

- Construct appropriate edge retention curb as shown (below)
- 1.5% slope
- 3" ABC Min.
- 1" Sand
- 8" Base at driveway cuts
- Compacted subgrade; 95%

**TYPICAL LAYOUT**

- EX. LINE OF BUILDING or property row
- 6" TYP.
- Edge retention curb
- Remove existing sidewalk
- Full width or as shown
- Concrete pavers (if visible)
- 6" TYP.
- Sawcut existing sidewalk
- Concrete curb & gutter

**EDGE RETENTION CURB DETAILS**

- Existing building or structure line
- 1/4" Fiber expansion joint
- Edge retention curb
- Concrete pavers

**TYPE "A"**

- 3" ABC Min.
- 6"
- 1" Sand

**TYPE "B"**

- Existing ground or paving
- Edge retention curb
- Concrete pavers

**TYPE "C"**

- Edge retention curb
- Concrete pavers

---

**City of Flagstaff**

**ENGINEERING DETAIL**

**CONCRETE PAVING STONE or BRICK SIDEWALK**

**DETAIL NO.** 16-01-240

**REVISION DATE:** 11/22/16

**(Ord. 2017-22, Rep&ReEn, 07/05/2017)**

**(Revised 10/17)**
16-01-241  Concrete Paving Stone or Brick Driveway

NOTE:
THIS WORK SHALL MEET ALL REQUIREMENTS OF MAG SECTION 342 "DECORATIVE PAVEMENT CONCRETE PAVING STONE OR BRICK".

City of Flagstaff
ENGINEERING DETAIL

CONCRETE PAVING STONE  or  BRICK DRIVEWAY

DETAIL NO.  16-01-241  REVISION DATE:  11/22/16  1

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
**16-04-010  Typical Layout of Pedestrian CRFB**

**LEGEND:**
- TWO (2) CIRCULAR RAPID FLASHING BEACONS (CRFB)
- POLE WITH MAST ARM (MORE INFORMATION ON PAGE 3/3)
- FIFTEEN (15) FOOT POLE (MORE INFORMATION ON PAGE 2/3)
- PULL BOX
- LED INDICATOR LIGHT
- PUSH BUTTON

**NOTES:**
1. EACH LOCATION (CROSSING 1 AND CROSSING 2) IS AN INDEPENDENT CROSSING AND SHALL HAVE ITS OWN ACTUATED CONTROLLER.
2. EACH CROSSING SHALL HAVE TWO (2) PUSH BUTTONS, SIX (6) 12" LED CIRCULAR RAPID FLASHING BEACON SIGNAL HEADS, AND TWO (2) LED INDICATOR LIGHTS.
3. ALL INDICATORS AND DETECTORS ARE TO BE HARDWIRED TO THE CONTROLLERS.

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City of Flagstaff  
ENGINEERING DETAIL  
TYPICAL LAYOUT OF PEDESTRIAN CRFB  
DETAIL NO. 16-04-010  
REVISION DATE: 11/22/16  
NTS
NOTES:

1. ADVANCED WARNING SIGNS (MUTCD W11-2 AND W16-9P) ARE TO BE PLACED IN ACCORDANCE WITH SECTION 2C.05 OF THE MUTCD.
NOTES:
1. FOR ALL TRAFFIC SIGNAL CONSTRUCTION WORK REFER TO SECTION 13-16-004-0064.
2. FOR POLE, FOUNDATION, AND BOLTS REFER TO ADOT STANDARD DRAWINGS T.S. 4-1 AND 4-23 AND ADOT STANDARD SPECIFICATIONS SECTION 731-1.
3. FOR MOUNTING ASSEMBLY REFER TO ADOT TYPE VII MOUNTING ASSEMBLY STANDARD DRAWING.
4. FOR SIGNAL FACE REFER TO ADOT FLASHING BEACON SIGNAL FACE ASSEMBLY; TYPE "D" STANDARD DRAWING; ALSO INCLUDE 2" FLUORESCENT YELLOW PRISMATIC RETROREFLECTIVE RODDER AROUND THE ENTIRE PERIMETER OF THE BACKPLATE.
5. FOR BREAKAWAY BASE REFER TO ADOT TYPE 2 BREAKAWAY BASE STANDARD DRAWINGS.
6. A 25" COIL OF #4 AWG BARE COPPER CONDUCTOR OR 14" SQUARE COPPER GROUND PLATE SHALL BE INSTALLED BEFORE THE CONCRETE IS Poured AND CONNECTED TO POLE GROUNDING LUG IN THE HAND HOLE. THE GROUND OR COIL SHALL BE COVERED WITH 6" OF FILL.

DETAIL A
MUTCD R10-25
(modified to include directional arrow)

DETAIL B
Typical Pedestrian Push Button

DETAIL C
Base Plate

DETAIL D
Top View of Break Away Base

DETAIL E
Bottom View of Break Away Base

DETAIL F
Foundation Section
NOTES:
1. FOR ALL TRAFFIC SIGNAL CONSTRUCTION WORK REFER TO SECTION 13-16-004-0004.
2. SIZE OF THE FOUNDATION, POLE, AND MAST ARM ARE DEPENDENT ON THE NUMBER AND LAYOUT OF LANES AND SHALL BE DETERMINED USING ADOT STANDARD SPECIFICATIONS AND DRAWINGS.
3. FOR SIGNAL MOUNTING ASSEMBLY REFER TO ADOT TYPE VII MOUNTING ASSEMBLY STANDARD DRAWING.
4. FOR SIGNAL FACE REFER TO ADOT FLASHING BEACON SIGNAL FACE ASSEMBLY; TYPE "D" STANDARD DRAWING; ALSO INCLUDE 2" FLUORESCENT YELLOW PRISMATIC RETROREFLECTIVE BORDER AROUND THE ENTIRE PERIMETER OF THE BACKPLATE.
5. FOR OVERHEAD SIGNAL MOUNTING ASSEMBLY REFER TO PELCO ASTRO-BRAC AS-0124 (DUAL SIGNAL SECTION).
6. A 25' COIL OF #4 AWG BARE COPPER CONDUCTOR OR 14" SQUARE COPPER GROUND PLATE SHALL BE INSTALLED BEFORE THE CONCRETE IS POURED AND CONNECTED TO POLE GROUNDING LUG IN THE HAND HOLE. THE GROUND OR COIL SHALL BE COVERED WITH 6" OF FILL.

City of Flagstaff
ENGINEERING DETAIL
TYPICAL MAST ARM DETAIL
OF PEDESTRIAN CRFB
DETAIL NO. 16-04-010
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
16-05-010  Street Name Signs

DETAIL A: STREET NAME SIGN FOR SPEEDS OF 40 MPH OR LESS

DETAIL B: STREET NAME SIGN FOR SPEEDS GREATER THAN 40 MPH

NOTES:
1. FOR PUBLIC ROADWAYS SIGNS ARE TO BE A GREEN BACKGROUND WITH WHITE RETRO-REFLECTIVE (TYPE XI SHEETING) LETTERS.
2. FOR PRIVATE ROADWAYS SIGNS ARE TO BE A BLUE BACKGROUND WITH WHITE RETRO-REFLECTIVE (TYPE XI SHEETING) LETTERS.
3. THE ARROW SHALL POINT IN THE DIRECTION OF INCREASING ADDRESSES FOR A GIVEN STREET.
4. SIGNS SHALL MEET 2009 MUTCD SECTION 2D.43.
5. LETTER FONT SHALL BE HIGHWAY C.
6. FOR POST DESIGN, REFER TO SECTION 13-16-005-0002.

City of Flagstaff

ENGINEERING DETAIL

STREET NAME SIGNS

DETAIL NO. 16-05-010  REVISION DATE: 11/22/16  1/1

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
16-05-020 Traffic Signal Street Name Signs

**DETAIL C: TRAFFIC SIGNAL STREET NAME SIGN**

Huntington Ave

**DETAIL D: TRAFFIC SIGNAL STREET NAME SIGN**

Lockett Rd → Cedar Ave

**NOTES:**

1. FOR PUBLIC ROADWAYS SIGNS ARE TO BE A GREEN BACKGROUND WITH WHITE RETRO-REFLECTIVE (TYPE XI SHEETING) LETTERS.
2. FOR PRIVATE ROADWAYS SIGNS ARE TO BE A BLUE BACKGROUND WITH WHITE RETRO-REFLECTIVE (TYPE XI SHEETING) LETTERS.
3. SIGNS SHALL MEET 2009 MUTCD SECTION 2D.45.
4. LETTER FONT SHALL BE HIGHWAY C.
5. TRAFFIC SIGNAL STREET NAME SIGNS SHALL BE INSTALLED ON TRAFFIC SIGNAL POLES WITH A MINIMUM OF 3 STEEL CLAMP BRACKETS WITH PERFORATED SQUARE TUBING, AS SHOWN ON ADOT STANDARD DRAWINGS.

City of Flagstaff

TRAFFIC SIGNAL STREET NAME SIGNS

DETAIL NO. 16-05-020 REVISION DATE: 11/22/16 1 1

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
NOTES:
1. FOR PAVEMENT MARKING MATERIAL TYPES, SEE CHAPTER 13-16-006.
2. 8" WIDE STRIPING IS TO BE A MINIMUM LENGTH OF 100 FEET, OR MATCH EXISTING TURN LANE.
3. LAYOUT OF MINI SKIPS THROUGH INTERSECTION AND SETBACK OF LEFT TURN LANE STOP BAR SHALL BE APPROVED BY TRANSPORTATION ENGINEERING STAFF.

City of Flagstaff

INTERSECTION STRIPING

DETAIL NO. 16-06-010

REVISION DATE: 11/22/16

(Revised 10/17)
NOTES:
1. USED WHEN A BIKE LANE APPROACHES AN INTERSECTION, STRIPE A SKIP SECTION OF 50 FEET ENDING AT CURB RETURN.
2. SOLID BIKE STRIPE SHALL CONTINUE ACROSS DRIVES.
3. WHEN PARKING APPROACHES AN INTERSECTION, STRIPE A SKIP SECTION OF 50 FEET ON THE TRAVEL LANE SIDE OF THE BIKE LANE AND A 25 FOOT SECTION ON THE PARKING SIDE OF THE BIKE LANE.
4. DOUBLE YELLOW STRIPE SHALL BE A 4" WIDE STRIPE, A 6" WIDE GAP, AND A 4" WIDE STRIPE.
5. BIKE LANE SYMBOLS SHALL BE 15 FEET FROM THE CURB RETURN ON THE DOWNSTREAM LEG OF ALL INTERSECTIONS.
6. THE GAPS BETWEEN BIKE SYMBOLS SHALL BE RELATIVELY STANDARD SPACING OF NO MORE THAN 1/2 MILE LONG.
7. TYPICAL BIKE LANE WIDTH = 4.5', EXCEPT WHEN ADJACENT TO ON-STREET PARKING AND/OR WHEN BIKE LANE TRAVERSES BETWEEN TURN LANES, THEN WIDTH = 5'.

City of Flagstaff
INTERSECTION STRIPE

DETAIL NO. 16-06-010
REVISION DATE: 11/22/16

NTS
NOTES:

1. FOR ROADWAYS WITH MORE OR LESS LANES, SAME CONFIGURATION APPLIES. KEEP CROSSWALK BARS CENTERED ON LANE LINES, IN CENTER OF TRAVELED PORTION OF LANE TO MINIMIZE WEAR ON CROSSWALK STRIPES, AND PARALLEL TO WHEEL PATHS. DETAIL IS INTENDED TO BE REPRESENTATIVE ONLY. FINAL LAYOUT OF PAVEMENT MARKINGS IS DEPENDENT ON SPECIFIC LANE CONFIGURATION OF STREET.

2. CITY INSPECTOR SHALL INVOLVE TRAFFIC ENGINEERING SECTION FOR REVIEWING NONSTANDARD LAYOUTS PRIOR TO INSTALLING MARKINGS, FOR WHICH AT LEAST 24-HOURS NOTICE IS REQUIRED.

3. FOR MORE THAN TWO (2) 20 FOOT PARALLEL PARKING STALLS, ONE (1) PARKING MANEUVERING BOX IS REQUIRED BETWEEN THE SECOND AND THIRD STALL.

INTERSECTION STRIPING

DETAIL NO. 16-06-010

REVISION DATE: 11/22/16

NTS
TURN LANE LINE STARTS AT STOP BAR, BUT IF STOP BAR DOES NOT EXIST, THEN START AT CURB RETURN

STEP 1:
PLACE FIRST ARROW FLUSH WITH THE END OF THE TURN LANE LINE, AS SHOWN

STEP 2:
WHEN STORAGE LENGTH IS 76' OR GREATER, PLACE ANOTHER ARROW 20' FROM THE STOP BAR, OR IF NO STOP BAR EXISTS 20' FROM BEGINNING OF THE TURN LANE LINE

STEP 3:
PLACE SUPPLEMENTAL ARROW CENTERED FOR STORAGE LENGTHS OF 200' OR GREATER.

NOTES:
1. FOR STORAGE LENGTHS OF 400' OR GREATER, ADD A 4TH ARROW EQUALLY SPACED.
2. ARROWS SHALL BE EVEN WITH ADJACENT TURN LANE ARROWS WHEN APPLICABLE.

TURN LANE PAVEMENT MARKINGS

City of Flagstaff
INTERSECTION STRIPING

ENGINEERING DETAIL

DETAIL NO. 16-06-010

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
18-03-050 Landscape Details

DECOMPOSED GRANITE FINISH GRADE TO BE RAKED SMOOTH
PROVIDE FINAL APPLICATION OF WEED CONTROL UPON FINAL RAKING.
FINE GRADED SUBGRADE
APPLY PRE-EMERGENT HERBICIDE AS PER MANUFACTURERS RECOMMENDATIONS.
(SURFAN or EQUAL APPROVED BY COP).

NOTES:
Refer to COS Detail 2210 for finish grade height of decomposed granite in relation to top of curbs & sidewalks.

FORM TEMPORARY IRRIGATION BORDER JUST OUTSIDE OF ROOT BALL. USE WATER TO SETTLE BACKFILL. DO NOT PACK BACKFILL.
BACKFILL WITH NATIVE SOIL (NO ROCKS GREATER THAN 1”) APPLY SLOW-RELEASE FERTILIZER TO SURFACE AWAY FROM TRUNK PER MANUFACTURER’S SPECIFICATIONS.

GROUNDCOVERS
PREPARE SOIL PER SPECIFICATIONS AND ROTOTILL TO A DEPTH OF 6” PRIOR TO ANY SPRINKLER WORK.
SET TOP OF ROOT BALL AT SOIL SURFACE
PLANTING HOLE SHALL BE 2-2 1/2 TIMES DIAMETER OF ROOT BALL AND NO DEEPER THAN HEIGHT OF ROOT BALL. SCARIFY SIDES AND BOTTOM OF PLANTING HOLE
SCARIFY SIDES OF ROOT BALL PRIOR TO PLANTING

SHRUB PLANTING
SUFFICIENT CLEARANCE SHALL BE MAINTAINED BETWEEN SHRUBS AND UTILITY FACILITIES SO AS TO NOT HINDER USE OF THESE FACILITIES.
PLANT PIT BASINS WITHIN SLOPED PLANTING AREAS SHALL BE CONSTRUCTED WITH A MAX. 2:1 SLOPE. PROVIDE SMOOTH TRANSITION TO SURROUNDING FINISH GRADE.

PRUNE TREE AT TIME OF STAKE REMOVAL
(2) 2” DIAMETER x 10’ LONG LODGEPOLE PINE TREE STAKES BURY 3” IN GROUND AND CUT OFF STAKE 12” ABOVE TIE WIRE. STAKES SHALL REMAIN IN PLACE FOR 2 YEARS UNLESS REMOVAL IS APPROVED BY MAINTENANCE DIRECTOR
SET TOP OF ROOT BALL AT SOIL SURFACE
BACKFILL WITH NATIVE SOIL (NO ROCKS GREATER THAN 1”) APPLY SLOW-RELEASE FERTILIZER TO SURFACE AWAY FROM TRUNK PER MANUFACTURER’S SPECIFICATIONS.
SCARIFY SIDES OF ROOT BALL PRIOR TO PLANTING

TREE PLANTING AND STAKING
≤ 36” BOX OR 2” CALIPER
TWO STRAND-12 GA. GALV. WIRE WITH NYLON MESH STRAP WITH END OF WIRE TWISTED AROUND POLE. TIES SHALL BE 2 OPPOSING LOOPS, NOT TO BE A SINGLE LOOP.
FORM TEMPORARY IRRIGATION BORDER JUST OUTSIDE OF ROOT BALL. USE WATER TO SETTLE BACKFILL. DO NOT PACK BACKFILL.
PLANTING HOLE SHALL BE 3 TIMES DIAMETER OF ROOT BALL AND NO DEEPER THAN HEIGHT OF ROOT BALL. SCARIFY SIDES AND BOTTOM OF PLANTING HOLE.

NOTES:
SUFFICIENT CLEARANCE SHALL BE MAINTAINED BETWEEN SHRUBS AND UTILITY FACILITIES SO AS TO NOT HINDER USE OF THESE FACILITIES.
PLANT PIT BASINS WITHIN SLOPED PLANTING AREAS SHALL BE CONSTRUCTED WITH A MAX. 2:1 SLOPE. PROVIDE SMOOTH TRANSITION TO SURROUNDING FINISH GRADE.
SEE DETAIL 18-04-050 FOR CONIFER TREE PLANTING.

City of Flagstaff

LANDSCAPE DETAILS

ENGINEERING DETAIL
DETAIL NO. 18-03-050
REVISION DATE: 11/22/16
1/1

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
FEBCO MODEL 825YA
REDUCED PRESSURE ASSEMBLY
STANDARD CONFIGURATION
OUTSIDE INSTALLATION

NOTES
1. IF WYE STRAINER OR PRESSURE REGULATOR IS SPECIFIED, INSTALL ON EITHER THE HORIZONTAL Piping OR ON THE DOWNSTREAM LEG AS SPACE PERMITS.
2. ALL PIPE & FITTINGS TO BE TYPE "L" COPPER.
3. ASSEMBLY SHALL BE APPROVED BY U.S.C. FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH.
4. INSTALL BACKFLOW PREVENTION ASSEMBLY W/ RELIEF PORT FACING TOWARD THE GROUND.
5. BACKFLOW PREVENTION ASSEMBLY MUST BE LEVEL AND INSTALLED A MIN. OF 12" FROM RELIEF PORT TO GRADE.
6. TEST COCKS (4) SHALL BE FITTED W/ BRASS PLUGS AND INSTALLED W/ TEFLEX TAPE.
7. SHUTOFF CALCS TO BE RESILIENT BALL TYPE W/ REMOVABLE HANDLES.
8. COMPRESSION TYPE FITTINGS ARE NOT ALLOWED.
9. STAKE LOCATION OF ASSEMBLY FOR APPROVAL BY THE ENGINEER BEFORE INSTALLATION BEGINS.
10. ALL PIPES AND FITTINGS SHALL BE COPPER.
11. PROVIDE TEST CERTIFICATE FROM CITY APPROVED TESTING COMPANY PRIOR TO APPROVAL.
12. COPPER FITTINGS SHALL BE INSTALLED W/ LEAD FREE SOLDER JOINTS.

City of Flagstaff
ENGINEERING DETAIL

FEBCO BACKFLOW ASSEMBLY

DETAIL NO. 19-01-020
REVISION DATE 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-001 Rotor Sprinkler Assembly

SWING JOINT ASSEMBLY ELEVATION

SWING JOINT ASSEMBLY PLAN

NOTES:
1. SWING JOINT TO BE THE SAME SIZE AS SPRINKLER HEAD INLET.
2. NO PRE-FAB SWING JOINTS.
3. NO MARLEX FITTINGS.

City of Flagstaff

ENGINEERING DETAIL

DETAIL NO. 19-02-001

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-002 Pop-Up Sprinkler Assembly

SWING JOINT ASSEMBLY ELEVATION

SWING JOINT ASSEMBLY PLAN

NOTES:
1. SWING JOINT TO BE THE SAME SIZE AS SPRINKLER HEAD INLET.
2. NO PRE-FAB SWING JOINTS.
3. NO MARLEX FITTINGS.

City of Flagstaff

POP-UP SPRINKLER ASSEMBLY

DETAIL NO. 19-02-002

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-003 Shrub Pop-Up Sprinkler Assembly

SWING JOINT ASSEMBLY ELEVATION

SWING JOINT ASSEMBLY PLAN

NOTES:
1. SWING JOINT TO BE THE SAME SIZE AS SPRINKLER HEAD INLET.
2. SWING JOINT SHALL BE CONNECTED TO BOTTOM OUTLET.
3. NO PRE-FAB SWING JOINTS.
4. NO MALEX FITTINGS.

City of Flagstaff

SHRUB POP-UP SPRINKLER ASSEMBLY

DETAIL NO. 19-02-003

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
CARSON/BROOKS VALVE BOX WITH LOCKING "T" STYLE COVER (SUPPLY WITH STAINLESS STEEL BOLTS). INSTALL H-20 TRAFFIC RATED BOX IN HIGH TRAFFIC AREAS AS DETERMINED BY THE CONS.

INLINE WYE FILTER W/200 MESH STAINLESS STEEL SCREEN AND FLUSHING CAP, PROVIDE ROOM FOR SCREEN REMOVAL. AGRICULTURAL PRODUCTS INC. "SPIN CLEAN" MODEL OR APPROVED EQUAL.

SCH. 40 PVC FEMALE ADAPTER (SLIP x THREAD)

SCH. 40 PVC DRIP LATERAL LINE FROM CONTROL VALVE, CLASS 315 FOR 1/2" LINE

PVC Emitter Lateral Line

SCH. 40 COUPLER

BRICK PAVER (TYP. 4)

6" MIN. DEPTH PEA GRAVEL

City of Flagstaff

DRIP FILTER & PRESSURE REGULATOR

ENGINEERING DETAIL

DETAIL NO. 19-02-004

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-005  Emitter Flush Cap Assembly

CARSON/BROOKS
6" ROUND VALVE BOX

3/4" SCH. 40 PVC
MALE ADAPTER (MHTXSLIP)

4" MIN. DEPTH OF PEA
GRAVEL

3/4" SCH. 40 PVC PIPE
(LENGTH AS REQUIRED)

BALL VALVE

PVC EMMITTER LATERAL PIPE

SCH. 40 PVC 90ELL

FINISH GRADE

3"
19-02-006  Quick Coupler Assembly

NOTE:
1. EACH QUICK COUPLER SHALL BE IN A SEPARATE VALVE BOX.
2. SWING JOINT SHALL BE THE SAME SIZE AS QUICK COUPLER VALVE.
3. NO PRE-FAB SWING JOINTS.
4. U-BOLT TO BE SECURED WITH LOCK WASHERS AND BACK-UP LOCKING NUT.
5. VALVE BOX Lid EMBOSSED WITH "QC" OR AS DIRECTED.

City of Flagstaff
ENGINNEERING DETAIL

DETAIL NO.  REVISION DATE:  11/22/16  1
19-02-006  1

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
1. BALL VALVE SHALL MATCH NOMINAL SIZE OF MAINLINE PIPE.
KEYNOTE:
1. CARSON/BROOKS STANDARD BOX WITH LOCKING "T" STYLE COVER. SUPPLY WITH STAINLESS STEEL BOLTS.
2. FINISH GRADE
3. BRONZE FULL PORT BALL VALVE
4. SCH 80 PVC 45° ELBOW
5. BRICK PAVER
6. 2" LAYER OF PEA GRAVEL
7. LANDSCAPE FABRIC
8. MALE ADAPTER
9. PRESSURE SUPPLY LINE. DEPTH AS PER SPECS.

NOTE:
1. BALL VALVE SHALL MATCH NOMINAL SIZE OF MAINLINE PIPE.
2. BOX TO BE INSTALLED AS TO ALLOW FOR PROPER OPERATION OF BALL VALVE INSTALL AT RIGHT ANGLE TO HARDSCAPE EDGE, INSTALL VALVE OFF-CENTER IN BOX.
3. INSTALL VALVE BOX EXTENSIONS AS REQUIRED TO ACHIEVE PROPER VALVE INSTALLATION AT MAIN LINE DEPTH.
4. EMBOSSED COVER WITH "TV" IN 1-INCH HIGH STENCIL LETTERS USING STYLIUS TIP TORCH.

City of Flagstaff

ENGINEERING DETAIL

BALL VALVE DETAIL

DETAIL NO. 19-02-008

REVISED DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
NOTE:

1. GATE VALVE SHALL MATCH NOMINAL SIZE OF MAINLINE PIPE.
2. PROTECT VALVE BODY WITH 10MIL PLASTIC PRIOR TO INSTALLATION OF REBAR & SUPPORT BLOCK.
3. RESILIENT WEDGE GATE VALVE MAY HAVE EITHER MECHANICAL JOINT, PUSH-ON ENDS, OR FLANGE ENDS. THE OPERATOR IS A WRENCH NUT.
4. EMBOSSED COVER WITH "ILV." IN 1" HIGH STENCIL LETTERS USING STYLUS TIP TORCH.
5. SET VALVE BOX FLUSH WITH FINISH GRADE IN NATIVE AREAS. 1/2 INCH ABOVE FINISH GRADE IN TURF AREAS.
6. SUPPLY 2" KEY HANDLE FOR VALVE OPERATION.

City of Flagstaff

ENGINEERING DETAIL

MAINLINE ISOLATION GATE VALVE

3" & LARGER

DETAIL NO. 19-02-009

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
19-02-010 Master Valve/Flow Meter 3" and Larger

19-02-010 Master Valve/Flow Meter 3" & Larger

NOTES:
1. PROVIDE 30" SLACK WIRE IN 3/4" COILS FOR EACH WIRE ENTERING VALVE BOX.
2. INSTALL VALVE I.D. TAG WITH CONTROLLER IDENTIFICATION AND STATION NUMBER WHICH CORRESPONDS TO THE PLANS.
3. MAINTAIN 2" MIN. -4" MAX. DISTANCE BETWEEN TOP OF CONTROL VALVE AND BOTTOM OF BOX LID.
4. CONTROL AND SIGNAL WIRE FROM MASTER VALVE TO CONTROLLER TO BE SEPARATE COLOR FROM OTHER VALVE WIRE. (CONTROL AND SIGNAL COMMONS TO BE SEPARATE FROM ANY OTHERS COMMONS IN THE SYSTEM.)
5. EACH MASTER VALVE REQUIRES A TOTAL OF EIGHT WIRES - FOUR CONTROL WIRES (TWO OF WHICH ARE SPARES) AND FOUR COMMON WIRES (TWO OF WHICH ARE SPARES).
6. ALL WIRES SHALL BE IN CONDUIT.
7. DO NOT REST VALVE BOX ON MAIN LINE, PROVIDE CUTOUTS AS NECESSARY.
8. 6 MIN / 24" MAX BETWEEN TOP OF MASTER VALVE AND BOTTOM OF VALVE BOX LID.
19-02-011 Irrigation Remote Control Valve

KEYNOTES
1. CARSON/BROOKS VALVE BOX WITH LOCKING "T" STYLE COVER (SUPPLY WITH STAINLESS STEEL BOLTS). INSTALL H-20 TRAFFIC RATED BOX IN HIGH TRAFFIC AREAS AS DETERMINED BY THE COS.
2. EPOXY FILLED TWO PIECE CYLINDER WIRE CONNECTOR (TYP. 1 of 2)
3. ID TAG
4. 3" MIN CLEARANCE BETWEEN BOTTOM OF LID AND VALVE FLOW STEM
5. FINISH GRADE
6. NO. 12 COMMON WIRE
7. NO. 12 CONTROL WIRE
8. NO. 12 SPARE WIRES LOOPED INTO EACH VALVE BOX (BLUEx2)
9. ELECTRIC REMOTE CONTROL VALVE
10. BRONZE BALL VALVE (FULL PORT) SAME SIZE AS CONTROL VALVE
11. SCH. 80 PVC 45 (SxSxS) (TYP 1 of 2)
12. SCH. 80 PVC PIPE SAME SIZE AS CONTROL VALVE
13. SCH. 80 PVC PIPE (SCH. 80 PVC TEE CONNECTION - SxSxS) SCH. 80 TOE NIPPLE (DUCTILE TEE CONNECTION)
14. PVC MAINLINE PIPE WITH SCH 80 PVC OR DUCTILE IRON SERVICE TEE
15. BRICK PAVER (TYP 1 of 4)
16. 6" MIN DEPTH OF PEA GRAVEL (BELOW VALVE BODY)
17. 3" SCH. 80 PVC TEE NIPPLE (PLASTIC VALVE ONLY) 3" BRASS NIPPLE FOR BRASS VALVES
18. PVC LATERAL PIPE

NOTES
1. PROVIDE 30" SLACK WIRE IN 3/4" COILS FOR EACH WIRE ENTERING VALVE BOX.
2. INSTALL VALVE ID TAG WITH CONTROLLER IDENTIFICATION AND STATION NUMBER WHICH CORRESPONDS TO THE PLANS.
3. MAINTAIN 2" MIN - 4" MAX DISTANCE BETWEEN TOP OF CONTROL VALVE AND BOTTOM OF BOX LTD.
4. INSTALL D.C. LATCHING SOLENOIDS W/ DC CONTROLLERS.
5. FOR BRASS CONTROL VALVES, INSTALL 3" BRASS TEE NIPPLE BETWEEN BALL VALVE AND CONTROL VALVE.
6. LOWER LATERAL PIPE TO PROPER DEPTH OUTSIDE OF VALVE BOX USING SCH 40 PVC 45° ELBOWS.
7. INSTALL WITHIN PURPLE VALVE BOX WITH LID MARKED "CAUTION - RECLAIMED WATER - DO NOT DRINK"

City of Flagstaff
ENGINEERING DETAIL

IRRIGATION REMOTE CONTROL VALVE

DETAIL NO. 19-02-011
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-012  Single Outlet Emitters All Shrubs and Ground Covers

KEYNOTES

LIST OF MATERIALS

1. BOWSMITH SL - SERIES SINGLE PORT EMITTER OR APPROVED EQUAL. LOCATE ON UPHILL SIDE OF PLANT CENTERLINE
2. 1/4" POLY FLEX HOSE EMITTER TUBING (6' MAX)
3. 1/2" PVC SCH 40 MALE ADAPTOR
4. AG. PRODUCTS - 1/2" I.P.S. FLEXIBLE VINYL PVC PIPE OR APPROVED EQUAL
5. 1/2" PVC SCH 40 90° ELBOW
6. 1/2" PVC SCH 40 PIPE
7. 1/2" PVC SCH 40 FITTING
8. ALL PVC SHALL BE SCH 40
9. INSTALL BUSHING AS REQUIRED.

NOTES

1. PIPE CEMENT & PRIMER SHALL BE USED FOR FLEXIBLE AND RIGID PIPE CONNECTIONS.
2. Emitter tubing emission points shall be equally spaced and located to direct water flow to the perimeter of the drip line.
3. NUMBER OF OPENINGS AND Emitter TUBES REQUIRED IS BASED ON PLANT SIZE. SEE COF DET. 19-02-013
4. MAXIMUM Emitter TUBING LENGTH = 6 FEET.
5. NO Emitter LATERALS OR PIPING SHALL BE INSTALLED THROUGH OR BELOW PLANT PITS. MINIMUM DISTANCE BETWEEN PLANT PIT PERIMITER AND PIPING SHALL BE 12''.

City of Flagstaff
ENGINEERING DETAIL

SINGLE OUTLET EMITTERS
ALL SHRUBS & GROUND COVERS

DETAIL NO. 19-02-012
REVISION DATE: 11/22/16

(Revised 10/17)
KEYNOTES

LIST OF MATERIALS

1. SWIVEL OUTLET 90° ELBOW
2. 1/4" POLY FLEX HOSE EMISSOR TUBING (6' MAX.)
3. BOWSMITH ML 200 SERIES MULTI-PORT EMISSOR OR APPROVED EQUAL. LOCATE ON UPHILL SIDE OF PLANT Q.
4. 1/2" PVC SCH 40 MALE ADAPTER
5. AG. PRODUCTS 1/2" I.P.S. FLEXIBLE VINYL PVC PIPE OR APPROVED EQUAL.
6. 1/2" PVC SCH 40 FITTING

NOTES

1. PIPE CEMENT & PRIMER SHALL BE USED FOR FLEXIBLE AND RIGID PIPE CONNECTIONS.
2. EMISSOR TUBING EMISSION POINTS SHALL BE EQUALLY SPACED AND LOCATED TO DIRECT WATER FLOW TO THE PERIMETER OF THE DRIP LINE.
3. NUMBER OF OPENINGS AND EMISSOR TUBES REQUIRED IS BASED ON PLANT SIZE. SEE COF DET. 19-02-013
4. MAXIMUM EMISSOR TUBING LENGTH = 6 FEET.
5. NO EMISSOR LATERALS OR PIPING SHALL BE INSTALLED THROUGH OR BENEATH PLANT PITS. MINIMUM DISTANCE BETWEEN PLANT PIT PERIMETER AND PIPING SHALL BE 12".

City of Flagstaff

MULTI-OUTLET EMITTERS
TREES ONLY

DETAIL NO. 19-02-012
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
City of Flagstaff

IRRIGATION EMITTER LAYOUT

ENGINEERING DETAIL

DETAIL NO. 19-02-013

REVISED DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-014  End Line Flush

DECOMPOSED GRANITE
SEE SPECS.

VALVE BOX SEE SPECS.

1/2" MAX.

1 1/2" MAX.

SCHEDULE 80 90° SLIP FIPT
ELBOW AND NIPPLE

COMPRESSON
x 3/4" MHT ADAPTOR

TURF

FINISH GRADE

WASHED GRAVEL FILL
6" DEEP x 15" SQUARE

3/4" FHT x FHT BALL VALVE

1/2" MIN.
19-02-015  Master Valve/Flow Sensor Assembly 2" or Smaller

City of Flagstaff

MASTER VALVE/FLOW SENSOR ASSEMBLY
2" OR SMALLER

DETAIL NO. 19-02-015  REVISION DATE: 11/22/16

(Needed 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
19-02-016 Maxicom Cable Pull Box

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
KEYNOTES

1. PE-CABLE (36-INCH LOOP)
2. PREFORMED SUPER SERVISEAL WATERPROOF WIRE SPLICE KIT
3. 3M UAL CONNECTIONS (SPlice ALL WIRE PAIRS)
4. ALL WIRE MUST BE PLACED IN CONDUIT 3' ABOVE ¾' ROCK

City of Flagstaff
MAXICOM CABLE SPLICES

DETAIL NO. 19-02-017
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-019  Drip Irrigation Remote Control Valve Assembly

KEYNOTES
1. VALVE BOX
2. EPOXY FILLED TWO PIECE CYLINDER WIRE CONNECTOR
3. ID TAG
4. ELECTRIC REMOTE CONTROL VALVE AS NOTED ON PLANS.
5. SCH 80 PVC LATERAL
6. BRICK PAVER (TYP.)
7. 6" MIN. DEPTH PEA GRAVEL (BELOW VALVE BODY)
8. 3" SCH 80 PVC NIPPLE (PLASTIC VALVE ONLY).
9. SCH 80 PVC MAINLINE PIPE WITH HDPE SERVICE TEE
10. SCH 80 PVC PIPE SAME SIZE AS CONTROL VALVE
11. 24-VOLT WIRES FROM CONTROLLER
12. BRONZE BALL VALVE (FULL PORT), SAME SIZE AS
13. SPARE WIRES LOOPED INTO EACH VALVE BOX (BLUE) (2)
14. CONTROL WIRE
15. COMMON WIRE

NOTES
1. PROVIDE 30" SLACK WIRE IN 3/4" COILS FOR EACH WIRE ENTERING VALVE BOX.
2. INSTALL VALVE I.D. TAG WITH CONTROLLER IDENTIFICATION AND STATION NUMBER THAT CORRESPONDS TO THE PLANS.
3. MAINTAIN 2" MIN.-4" MAX. DISTANCE BETWEEN TOP OF CONTROL VALVE AND BOTTOM OF BOX LID.
4. INSTALL D.C. LATCHING SOLENOIDS W/ D.C. CONTROLLERS.
5. FOR BRASS CONTROL VALVES, INSTALL 3" BRASS TEE NIPPLE BETWEEN BALL VALVE AND CONTROL VALVE
6. INSTALL CONTROL VALVES A MINIMUM OF 1' APART IN SHRUB AREAS UNLESS OTHERWISE NOTED.
7. USE Teflon TAPS ON ALL THREADED FITTINGS.
8. VALVE BOX SHALL BE SET PARALLEL W/ GRADE.  

City of Flagstaff  
ENGINEERING DETAIL  

DRIP IRRIGATION REMOTE CONTROL VALVE ASSEMBLY  
DETAIL NO. 19-02-019  REVISION DATE: 11/22/16  

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-021  Irrigation Wire Connection

STEP 1
SLIP BASE SOCKET OVER END OF WIRES

STEP 2
STRIP WIRES APPROX. 5/8" FROM ENDS
- TWIST ENDS TOGETHER

APPLY SEALER TO OUTSIDE OF SEALING PLUG
- FILL CAVITY WITH SEALER

PUT CRIMP SLEEVE OVER WIRE ENDS
- CRIMP SLEEVE AND CUT OFF EXCESS WIRE

STEP 3
PULL BASE SOCKET OVER WIRE END AS FAR AS POSSIBLE

PUSH SEALING PLUG INTO BASE SOCKET

STEP 4
PUSH WIRES TO END OF BASE SOCKET TO ASSURE COMPLETE SEALING OF CONNECTION

DRI-SPLICE TYPE WIRE CONNECTOR

NOTES
1. FOR WIRE SIZES NO. 14, 12 AND 10, ALL CONNECTIONS IN VALVE BOXES ONLY.
2. INSTALL SPEARS DS-100 DRI-SPLICE CONNECTORS WITH DS-300 SEALANT.
## Irrigation Wire Sleeving Chart

**MAXIMUM NUMBER OF WIRES TO BE INSTALLED IN A SCHEDULE 40 PVC SLEEVE**

<table>
<thead>
<tr>
<th>WIRE SIZE (AWG)</th>
<th>2&quot;</th>
<th>2-1/2&quot;</th>
<th>3&quot;</th>
<th>WIRE SIZE (AWG)</th>
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<tbody>
<tr>
<td>14</td>
<td>25</td>
<td>40</td>
<td>56</td>
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<tr>
<td>12</td>
<td>20</td>
<td>33</td>
<td>50</td>
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</table>

**NOTES**

ALL WIRE SLEEVES TO BE SHC. 40 PVC AND SHALL BE INSTALLED WITH A MINIMUM OFFSET AT THE JOINTS TO PERMIT EASY INSTALLATION AND REMOVAL OF CONTROL AND COMMON WIRES. ALL WIRES SHALL BE INSTALLED IN SLEEVES UNDER THE PAVED AREAS. SLEEVES SHALL EXTEND AT LEAST 12" BEYOND THE EDGES OF THE PAVEMENT. SIZE OF SLEEVES SHALL BE AS SHOWN.

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**City of Flagstaff**

**IRRIGATION WIRE SLEEving CHART**

<table>
<thead>
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<th>DETAIL NO.</th>
<th>REVISION DATE</th>
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<tbody>
<tr>
<td>19-02-022</td>
<td>11/22/16</td>
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(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-023 Schematic Layout

City of Flagstaff

ENGINEERING DETAIL

DETAIL NO. 19-02-023

REVISION DATE: 11/22/16

NTS

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
NOTES
1. INSTALL WIRE OF APPROPRIATE GAUGE, CONNECTORS, SEALANT, AND ADAPTORS PER MANUFACTURERS INSTRUCTIONS.
2. D.C. LATCHING SOLENOIDS ON REMOTE CONTROL Valves TO BE COMPATIBLE WITH CONTROLLER.
3. MASTER VALVE TO BE INSTALLED AND WIRED TO CONTROLLER WITH DC LATCHING SOLENOID COMPATIBLE WITH CONTROLLER (IF REQUIRED).
4. PROGRAMMING/ACCESS KEY TO BE SUPPLIED WITH CONTROLLER.
5. INSTALL MANUFACTURERS STAINLESS STEEL ENCLOSURE FOR CONTROLLER.
6. PROVIDE 12" EXPANSION COIL FOR EACH WIRE SPLICE INSIDE SPLICE BOX WHEN SPLICES ARE REQUIRED BY MANUFACTURER.
7. THE CONTROLLER SHALL BE SECURED INSIDE THE MANUFACTURES STAINLESS STEEL ENCLOSURE IF NOT INSTALLED INSIDE THE BACKFLOW PREVENTER ENCLOSURE.
8. ALL WIRES ARE TO BE IN CONDUIT.

City of Flagstaff
ENGINEERING DETAIL

SOLAR CONTROLLER

DETAIL NO. 19-02-024
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-025 Solar Controller and Backflow Preventer Enclosure

NOTES
1. INSTALL WIRING OF APPROPRIATE GAUGE, CONNECTORS, SEALANT, AND ADAPTORS PER MANUFACTURERS INSTRUCTIONS.
2. INSTALL CONTROL WIRES, SPLICES, AND MOUNTING COLUMN AS FURNISHED/SPECIFIED BY THE CONTROLLER MANUFACTURER.
3. LABEL ALL WIRES IN CONTROLLER.
4. D.C. LATCHING SOLENOIDS ON REMOTE CONTROLS VALVES TO BE COMPATIBLE WITH CONTROLLER.
5. MASTER VALVE TO BE INSTALLED AND WIRED TO CONTROLLER, WITH D.C. LATCHING SOLENOID COMPATIBLE WITH CONTROLLER.
6. ALL WIRES TO BE IN CONDUIT.
7. PROGRAMMING/ACCESS KEY TO BE PROVIDED WITH CONTROLLER.
8. PROVIDE 12" EXPANSION COIL FOR EACH WIRE SPlice INSIDE SPlice BOX WHEN SPLICES ARE REQUIRED BY MANUFACTURER.

City of Flagstaff
ENGINEERING DETAIL

SOLAR CONTROLLER AND BACKFLOW PREVENTER ENCLOSURE

DETAIL NO. 19-02-025

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
KEYNOTES

1. FINISH GRADE
2. RAIN BIRD WALL MOUNT CLUSTER CONTROL UNIT (CCU)
3. 25 PIN CONNECTOR (USE RS232 CABLE)
4. INTERFACE BOARD
5. COMPUTER COMPORT
6. COMMON WIRE (BLACK) FROM MAXICABLE TO MSP-1 SURGE ARRESTER AND FROM MSP-1 SURGE ARRESTER TO CCU COMMON WIRE TERMINAL POST
7. GROUND WIRE (GREEN) TO GROUNDING BUSS BAR
8. HOT WIRE (RED) FROM MAXICABLE TO MSP-1 SURGE ARRESTER AND FROM MSP-1 SURGE ARRESTER TO CCU HOT WIRE TERMINAL POST
9. 120 VOLT 60 CYCLE POWER SUPPLY
10. RAIN BIRD MSP-1 RECOMMENDED SURGE ARRESTER
11. RS232 SERIAL CABLE (TO MODEM). MAXIMUM 50 FEET
12. JUNCTION BOX - SIZE AS REQUIRED
13. CONDUIT (SIZE AS REQUIRED)
14. SET SWITCH AS NEEDED
15. REFER TO LOCAL ELECTRIC CODE FOR CONNECTIONS
16. RAIN BIRD WARRANTY REQUIRES PROPER SURGE PROTECTION. USE INTERMATIC AG2401 OR TRIPPLITE ISOBAR
17. CCU GROUNDING BUSS BAR
18. #10 COPPER GROUND WIRE FROM CCU GROUNDING BUSS BAR TO GROUNING GRID

NOTE:
CONTRACTOR MUST CONFER WITH MAXICOM REPRESENTATIVE FOR PROPER INSTALLATION.

City of Flagstaff
MAXICOM CCU (6 or 28)
WALL MOUNT

ENGINEERING DETAIL

DETAIL NO. 19-02-026
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-027 Maxicom Esp-Sat Field Satellite Controller – Wall Mount

KEYNOTES

1. FINISH GRADE
2. RAIN BIRD ESP-SAT WALL MOUNT (METAL) FIELD SATELLITE CONTROLLER
3. RAINSAFE STRONGBOX VANDAL-RESISTANT ENCLOSURE
4. WIRE TERMINAL CONNECTORS TO REMOTE CONTROL VALVES
5. COMMUNICATION CABLE CONDUIT - SIZE AS REQUIRED
6. COMMON WIRE (BLACK) FROM MSP-1 SURGE ARRESTER TO MAXICOM INTERFACE BOARD (MIB)
7. ALL GROUND WIRES (GREEN) TO GROUNDING BUSS BAR
8. #10 COPPER GROUND WIRE FROM ESP FIELD SATELLITE CONTROLLER GROUNDING BUSS BAR TO GROUNDING GRID
9. HOT WIRE (DASHED/RED) FROM MSP-1 SURGE ARRESTER TO MAXICOM INTERFACE BOARD (MIB)
10. ESP FIELD SATELLITE CONTROLLER GROUNDING BUSS BAR
11. JUNCTION BOX - SIZE AS REQUIRED
12. 120 VOLT POWER SUPPLY
13. REFER TO LOCAL ELECTRIC CODE FOR CONNECTIONS
14. RAIN BIRD MSP-1 RECOMMENDED SURGE ARRESTER
15. TO TWO WIRE PATH WHEN REQUIRED.
16. RAIN BIRD WARRANTY REQUIRES PROPER SURGE PROTECTION. USE INTELMATIC AG2401 OR TRUPLITE ISOBAR

City of Flagstaff
ENGINEERING DETAIL

MAXICOM ESP-SAT FIELD SATELLITE CONTROLLER - WALL MOUNT

DETAIL NO. 19-02-027

REVISED DATE: 11/22/16

1

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-028 Maxicom Esp-Sat Field Satellite Controller Stainless Steel Pedestal

KEYNOTES
1. FINISH GRADE
2. RAIN BIRD ESP-SAT STAINLESS STEEL PEDESTAL FIELD SATELLITE CONTROLLER
3. ESP-SAT MAXILINK MAXICOM INTERFACE BOARD (MIB)
4. WIRE TERMINAL CONNECTORS FOR CONTROL AND COMMON WIRES TO REMOTE CONTROL VALVES
5. PVC CONDUIT FOR CONTROL AND COMMON WIRES - SIZE AS REQUIRED.
6. 3/4" PVC CONDUIT FOR 120 VAC POWER SUPPLY
7. RAIN BIRD WARRANTY REQUIRES PROPER SURGE PROTECTION. USE INTERMATIC AG2401 OR TRIPPILITE ISOBAR
8. REFER TO LOCAL ELECTRIC CODE FOR CONNECTIONS
9. #10 COPPER GROUND WIRE FROM ESP FIELD SATELLITE CONTROLLER GROUNDING BUSS BAR TO GROUNDING GRID
10. ESP FIELD SATELLITE CONTROLLER GROUNDING BUSS BAR
11. MAXILINK ANTENNA. CONNECT TO RAIN BIRD RADIO MODEM KIT (RMK) (IF REQUIRED) NOT SHOWN. USE PROPER ANTENNA SURGE PROTECTION POLYPHASE MODEL IS-IE50LN-C1
12. 9-PIN CABLE CONNECTION TO RAIN BIRD RAIDIO MODEM KIT (RMK) NOT SHOWN
13. POURRED CONCRETE BASE

City of Flagstaff
ENGINEERING DETAIL
MAXICOM ESP-SAT FIELD SATELLITE CONTROLLER STAINLESS STEEL PEDESTAL

DETAIL NO. 19-02-028
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-029 Maxicom Flow Sensor (PT1502)

KEYNOTES
1. TO RAIN BIRD ESP-SAT OR ESP-SITE-SAT SENSOR INPUT
2. RAIN BIRD FS SERIES FLOW SENSOR
3. RAIN BIRD MODEL PT1502 TRANSMITTER
4. RAIN BIRD PTWRSU PP POWER SUPPLY
5. RAIN BIRD FSSURKIT SURGE PROTECTOR
6. TO RAIN BIRD FSSURKIT
7. TO RAIN BIRD PTWRSU PP POWER SUPPLY
8. GREEN WIRE TO GROUND

NOTES:
1. IF THE FLOW SENSOR IS LOCATED MORE THAN 150 FEET FROM THE FLOW TRANSMITTER, INCLUDE AN ADDITIONAL FSSURKIT AND GROUND ROD AT THE FLOW SENSOR LOCATION.

City of Flagstaff

ENGINEERING DETAIL

MAXICOM FLOW SENSOR (PT1502)

DETAIL NO. 19-02-029

REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-030 Controller Enclosure

KEYNOTES
1. VENTS W/ BAFFLE
2. 3 POINT LATCH W/ LOCKABLE HANDLE
3. 2" MALE ADAPTER W/ LOCK RING
4. 2" PEX/30B SDR 9 SLEEVE W/ 2" SWEEP FOR 24 VOLT CONTROL WIRE. SECURE TO WALL W/ CONDUIT STRAP, TOP AND BOTTOM
5. CONTROL WIRES IN MAINLINE TRENCH
6. FINISH GRADE
7. 8' COPPER CLAD GROUND ROD W/ 10 GAUGE NON-INSULATED GROUND WIRE CONNECTED TO GROUND TERMINAL BLOCK
8. 1/2" E.M.T. CONDUIT FOR 110-V POWER SUPPLY
9. LOCKABLE STAINLESS STEEL CABINET (OR APPROVED EQUAL)
10. 4" x 4" ELECTRICAL JUNCTION BOX W/ 120 VOLT POWER SURGE ARRESTER
11. ELECTRICAL JUNCTION BOX AS REQUIRED
12. STAINLESS "J" BOLTS (OPTION: ZINC-PLATED STEEL EMBEDDED BASE)
13. RAINSAFE™ STRONGBOX VANDAL-RESISTANT ENCLOSURE

NOTES:
1. POWER SOURCE FOR CONTROLLER TO BE HARD WIRED FROM CIRCUIT BREAKER
2. MOUNTED INSIDE CABINET TO CONTROLLER
3. LOCATION OF POWER SOURCE TO BE NOTED ON CIRCUIT BREAKER PANEL
4. REMOTE CONTROL VALVES FOR D.C. APPLICATIONS MUST HAVE D.C.
5. LATCHING SOLENOIDS AND APPROVED SOLAR PANEL FOR POWER SOURCE.

City of Flagstaff
ENGINEERING DETAIL

DETAIL NO. 19-02-030
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
19-02-031  Grounding Rod Grid

KEYNOTES

1. MAXICOM FIELD SATELLITE, WEATHER STATION OR CCU ASSEMBLY
2. SOLID BARE COPPER WIRE (#10 AWG) FROM GROUNDING ROD TO SATELLITE OR CCU. MAKE WIRE AS SHORT AND STRAIGHT AS POSSIBLE
3. COVER GROUNDING ROD WITH #10 ROUND VALVE BOX AS SHOWN
4. 5/8-INCH X 8 FT COPPER CLAD GROUNDING ROD OR GROUNDING PLATE. INSTALL RODS IN SOIL IN A TRIANGULAR PATTERN SPACED A MINIMUM OF 16 FT APART FROM EACH OTHER. GROUNDING GRID TO HAVE A RESISTANCE OF TEN (10) OHMS OR LESS TO MEET MANUFACTURERS SPECIFICATIONS.
5. BARE COPPER WIRE (#10 AWG MIN.) BETWEEN GROUNDING RODS
6. GROUND ROD CLAMP OR WELDS
7. FINISH GRADE

NOTES:
REFER TO RAIN BIRD CENTRAL CONTROL TECHNICAL BULLETIN TB-9001-MULTI FOR INSTALLATION GUIDELINES.

City of Flagstaff

GROUNDING ROD GRID

DETAIL NO. 19-02-031  REVISION DATE: 09/28/17 1

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-032  Grounding Plate Design Layout

KEYNOTES
1  MAXICOM FIELD SATELLITE, WEATHER STATION OR CCU ASSEMBLY
2  SOLID BARE COPPER WIRE (#10 AWG) FROM GROUNDING ROD TO SATELLITE OR CCU. MAKE WIRE AS SHORT AND STRAIGHT AS POSSIBLE
3  COVER GROUNDING ROD WITH #10 ROUND VALVE BOX AS SHOWN
4  5/8-INCH X 10 FT COPPER CLAD GROUNDING ROD OR GROUNDING PLATE. INSTALL RODS IN SOIL IN A TRIANGULAR PATTERN SPACED A MINIMUM OF 16 FT APART FROM EACH OTHER. GROUNDING GRID TO HAVE A RESISTANCE OF TEN (10) OHMS OR LESS
5  BARE COPPER WIRE (#6 AWG MIN.) BETWEEN GROUNDING ROD AND GROUNDING PLATE
6  GROUND ROD CLAMP OR WELDS
7  COPPER GROUNDING PLATE
8  GROUND ENHANCEMENT MATERIAL (IF REQUIRED)
9  FINISH GRADE

NOTES:
1. REFER TO RAIN BIRD CENTRAL CONTROL TECHNICAL BULLETIN TB-9001MULTI FOR INSTALLATION GUIDELINES.

City of Flagstaff
ENGINEERING DETAIL

GROUNDING PLATE DESIGN LAYOUT

DETAIL NO. 19-02-032
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-033 Weather Station External Wire Connection

KEYNOTES

1. 12-INCH X 12-INCH ENCLOSURE (NEMA 3)
2. 120/16 VAC TRANSFORMER
3. WIRE NUT CONNECTORS
4. FINISH GRADE
5. TWO (2) LONG SWEEP ELBOWS (ONE HIDDEN WITH COMMUNICATION WIRE). ORIENT PROPERLY FOR WIRING (SIZE AS REQUIRED)
6. TELEPHONE LINE OR DIRECT CONNECT CABLE TO HIDDEN LONG SWEEP ELBOW
7. 16 VAC TO WEATHER STATION THROUGH LONG SWEEP ELBOW
8. GROUND WIRE TO GROUND RODS. SEE MAXICOM DETAIL 305
9. CONDUITS
10. 120 VAC POWER SUPPLY
11. WEATHER STATION TEMPLATE
12. 4-INCH X 4-INCH POST (TREATED)
13. WEATHER STATION ANCHOR BOLTS
14. CONCRETE PAD. REFER TO MAXICOM DETAIL 300
15. CONCRETE

City of Flagstaff
ENGINEERING DETAIL

WEATHER STATION EXTERNAL WIRE CONNECTION

DETAIL NO. 19-02-033
REVISION DATE: 9/28/17

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
KEYNOTES

1. TO RAIN BIRD ESP-SAT OR ESP-SITE-SAT SENSOR INPUT
2. RAIN BIRD ANEMOMETER WIND SPEED SENSOR ON POLE IN UNOBSERVED AREA
3. RAIN BIRD MODEL PT1502 PULSE TRANSMITTER
4. RAIN BIRD PTPWRSUPP POWER SUPPLY
5. TO WIND SENSOR
6. TO RAIN BIRD PTPWRSUPP POWER SUPPLY

City of Flagstaff
ENGINEERING DETAIL

MAXICOM VARIABLE WIND SPEED DETECTION

DETAIL NO. 19-02-034
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-035  Sleeve Trenching Detail

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<td>DIMENSION</td>
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<td>PAVED AREA/DRIVEWAY</td>
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<td>PUBLIC ROADS</td>
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</tbody>
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SECTION VIEW

KEYNOTES

1. PAVING
2. LATERAL LINES IN HDPE SLEEVE
3. SAND BACKFILL COMPACTED TO THE DENSITY OF EXISTING SOIL
4. UNDISTURBED SOIL
5. CONTROL WIRES IN HDPE SLEEVE
6. PRESSURE MAINLINE IN HDPE SLEEVE. HOPE SLEEVES TO BE TWICE THE DIAMETER OF THE PIPE OR WIRE BUNDLE CARRIED.

NOTES:
1. BUNDLE WIRING AND WRAP W/ ELECTRICAL TAPE @ 10' INTERVALS.
2. ALL MAINLINE PIPING TO BE INSTALLED IN ACCORDANCE W/ MANUFACTURER’S INSTALLATION SPECIFICATIONS.
3. ALL MAINLINE, LATERAL LINES AND CONTROL WIRES SHALL BE SLEEVED BELOW ALL HARDSCAPE ELEMENTS WITH HDPE PE 3408, SDR 11 PIPE, 2.5 TIMES THE DIAMETER OF THE PIPE OR WIRE BUNDLE WITHIN.
4. ALL CURBS SHALL BE MARKED W/ A "SCORE" MARK TO DESIGNATE SLEEVE LOCATION, TYPICAL.

City of Flagstaff

ENGINEERING DETAIL

SLEEVE TRENCHING DETAIL

DETAIL NO. 19-02-035
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)
19-02-036 Irrigation Trenching

NOTES
1. BEDDING SHALL BE PLACED AND LEVELED PRIOR TO INSTALLATION OF BURY ITEM.
2. BACKFILL SHALL BE PLACED IN MAXIMUM 6" LIFTS.
3. SLEEVE ALL PIPE AND WIRE SEPARATELY. SLEEVE 2 X DIA. OF PIPE (MIN 2"). ONE PIPE PER SLEEVE. SLEEVES TO BE PRIMED AND SOLVENT WELDED.
4. ALL PIPE TO BE INSTALLED PER MANUFACTURES SPECIFICATIONS WITH PIPE LABELING FACING UP FOR INSPECTION PURPOSES. PROVIDE A MINIMUM OF 2" CLEARANCE TO SIDE OF TRENCH AND BETWEEN PIPES.
5. ALL 120 V. WIRING SHALL BE INSTALLED IN ACCORDANCE WITH LOCAL CODE REQUIREMENTS.
6. TAPE AND BUNDLE IRRIGATION CONTROL WIRES EVERY 10', PROVIDE LOOSE 20' LOOP AT ALL CHANGES OF DIRECTION OVER 30°.
7. ALL REMOTE CONTROL VALVE WIRING SHALL BE INSTALLED IN A MINIMUM 2" SCHEDULE 40 GREY ELECTRICAL CONDUIT OR AS APPROVED.
8. "NON-TOXIC" WARNING TAPE TO BE INSTALLED ON ALL PRESSURIZED MAINLINES 12" ABOVE THE PIPE.
9. INSTALL ONE ADDITIONAL SLEEVE SIZED TO MATCH THE LARGEST REQUIRED SLEEVE WITH ENDS TAPED FOR FUTURE USE.
10. SLEEVES TO EXTEND A MINIMUM OF 12" PAST HARDSCAPE PLANTERS, CURBS, SIDEWALKS, ETC. SLEEVES TO BE STAGGERED/OFFSET SO THAT SLEEVE USE IS NOT OBSTRUCTED BY OTHER PIPES.
11. WHERE PRESSURE SUPPLY PIPING IS INSTALLED WITHOUT CONTROL WIRING, A 14 GA. TRACKING WIRE SHALL BE INSTALLED.

City of Flagstaff
ENGINEERING DETAIL

DETAIL NO. 19-02-036
REVISION DATE: 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)
19-02-037  Irrigation Thrust Block

<table>
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<th>MINIMUM THRUST BLOCK AREA (YxW)</th>
<th>IRRIGATION PIPE</th>
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<tr>
<td>PIPE SIZE</td>
<td>TEE, DEAD END 90° BEND</td>
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<tr>
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<td>1 SF</td>
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<tr>
<td>4&quot;</td>
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<td>5&quot; &amp; LARGER</td>
<td>2 SF</td>
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<tr>
<td></td>
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</table>

**NOTES**

1. **MINIMUM THRUST BLOCK AREAS ARE BASED ON A SOIL BEARING CAPACITY OF 3000 LBS/SF**

2. **THRUST BLOCK SHALL EXTEND INTO UNDISTURBED SOIL.**

3. **THRUST BLOCK SHALL BE MAG SECT. 725-CLASS C.**

4. **MAINLINE PIPING 4" AND LARGER SHALL HAVE MEGA/IG JOINT RESTRAINTS INSTALLED AT ALL FLOW DIRECTION CHANGES (CONCRETE THRUST BLOCK NOT REQUIRED).**

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**City of Flagstaff**

**ENGINEERING DETAIL**

**IRRIGATION THRUST BLOCK**

**DETAIL NO.** 19-02-037  **REVISION DATE:** 11/22/16

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17) 

TITLE 13 - PAGE 494
PW 50.10 Single and Double Trash Enclosure

DOUBLE ENCLOSURE

SOLID GROUT WALL and CROWN TOP

8"x8"x16" CMU WALL WITH #4 HORIZ. REINF. @ 16" O.C.
and #4 VERT. @ 48" O.C. TO FOOTINGS

#4 HORIZ. TOP and BOTTOM COURSE

6" STL. BOLLARD 4" FROM WALL (TYP)

6" SCH. 40 GALV. STEEL POST

TYP. WALL SECTION

TYP. STEEL BOLLARD

NOTES:
WHEN THE ENCLOSURE INCLUDES GATES, THE PLANS SHALL PROVIDE A WAY TO SECURE THE GATES OPEN AND CLOSED.

City of Flagstaff
ENGINEERING DETAIL

SINGLE and DOUBLE TRASH ENCLOSURE

DETAIL NO. PW-50-10

REVISION DATE: 11/22/16

NTS
GATE HINGE DETAIL

DETAIL NO. PW-50-10

(Ord. 2017-22, Rep&ReEn, 07/05/2017)

(Revised 10/17)