

Title 13

ENGINEERING DESIGN STANDARDS AND SPECIFICATIONS FOR NEW INFRASTRUCTURE

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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 Rights-of-Way**

13-01-001

Administrative Enactments

Sections:

13-01-001-0001	Adoption
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13-01-001 Administrative Enactments

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.

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, waterlines, sewerlines, 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.

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.

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.

13-01-002

Agency Controls and Reviews

Sections:

13-01-002-0001	City
13-01-002-0002	County
13-01-003-0003	State
13-01-002-0004	Federal
13-01-002-0005	Utility Companies

13-01-002 Agency Controls and Reviews

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.
 2. The current Maricopa Association of Governments Uniform Standard Specifications for Public Works Construction (MAG Specs - latest revisions) and the current Maricopa Association of Governments Uniform Standard Details for Public Works Construction (MAG Details - latest revisions).
- B. Other standards that will apply when applicable shall include but are not limited to:
1. City of Flagstaff Zoning Code.
 2. Current Arizona Department of Transportation (A.D.O.T.) Standards and Specifications.
 3. City of Flagstaff codes and ordinances.
 4. The current American Society for Testing of Materials (ASTM) standards and specifications.
 5. The current Arizona Department of Environmental Quality (ADEQ) standards.
 6. The current Occupational Safety and Health Administration (OSHA) standards.
 7. The current Federal Highway Administration Manual on Uniform Traffic Control Devices.
 8. The current Arizona Supplement to the Manual on Uniform Traffic Control Devices.
 9. The current American Water Works Association Standards (AWWA).
 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.
 13. The currently adopted International Building Codes.
 14. The currently adopted International Building Code Standards.
 15. The current City of Flagstaff Stormwater Management Design Manual.
 165. Flagstaff City Code, Title 12, Floodplains.

17. Flagstaff City Code, Title 11, Subdivision Regulations.

18. [Arizona Administrative Code \(AAC\) R4-30-301\(13\) \(Arizona Boundary Survey Minimum Standards\).](#)

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 year from the date they are accepted by the City Engineer.

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 waste water disposal systems.

13-01-002-0003 State

A. The Arizona Department of Transportation (A.D.O.T.) 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 travelling 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.

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.

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.
2. UniSource Energy Services
3. CenturyLink
4. Suddenlink

5. City of Flagstaff Utilities Division.
6. Others when applicable.

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

13-01-003 Work in Public Ways

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.

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.

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.

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.

CHAPTER 13-02

MAPPING

Sections:

- 13-02-001 Conceptual Plats, ~~Site Plans, and~~ Preliminary Plats, ~~Final Plats~~
- 13-02-001-0001 Mapping
- 13-02-001-0002 Topographic Precision

13-02-001

Specific requirements for the Conceptual Plat, the Preliminary Plat and the Final Plat are per Flagstaff City Cod, Title 11, Subdivision Regulations.

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13-02-001-0001 Survey Requirements for Mapping

~~A. A. — A complete BOUNDARY SURVEY based upon field work shall be performed prior to submittal of the Preliminary Plat, and documentation of said survey shall be included with that submittal. If the boundary survey information is made a part of the preliminary plat, then the surveyor who performed the boundary survey and the engineer who prepared the preliminary plat shall both seal and sign the plat.~~

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~~If the boundary survey shall meet the requirements of 13-03-002 and is a separate document, then it 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.~~

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~~A SURVEY REPORT, per 13-03-002-0005 shall be submitted, summarizing the results of the survey and explaining the resolution of any problems encountered. A cogo printout of the subdivision boundary shall be included in the Survey Report.~~

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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 13-03-003. Topographic results may be obtained by photogrammetric means.

~~Topography is subdivided into hypsography (the relief features), hydrography (the water and drainage features), and culture (man-made features). A single feature such as a mountain or valley is termed a topographic feature. All of the above are topography.~~

C. Contour interval shall be one foot or two feet, depending on the slope of the ground and the judgment of the Engineer or Land Surveyor.

D. All vertical datum shall be ~~based upon a City approved benchmark (in on NAVD 88). The said Benchmarks shall meet the requirements of 13-03-003-0003, and along with all pertinent information,~~ shall be noted on the preliminary plat.

E. The topographic survey shall identify the Surveyor and the date performed.

~~EF. USGS 7.5 minute quadrangles will not be accepted as topographic data for most projects. The City of Flagstaff Geographic Information System (GIS) model Existing City maps 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 is accurate, complies with the precision tolerances of 13-03-003.~~

13-02-001-0002 Topographic Precision Shall Be

~~A. — Horizontal: Ninety percent of all planimetric features shall be within 1/40 inch of their true relative position and none shall be in error by more than 1/20 inch.~~

~~B. — Vertical — Contour: Ninety percent of any spot elevations as determined from the contours shall be correct within 1/2 the contour interval and none shall exceed one contour interval.~~

CHAPTER 13-03
SURVEY

Divisions:

- 13-03-001 Applied Standards
 - 13-03-002 Boundary Survey
 - 13-03-003 Topographic Survey
 - 13-03-004 Construction Survey
 - 13-03-005 As-built Survey
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13-03-001

Applied Standards

Sections:

13-03-001 Applied Standards

13-03-001 Applied Standards

A. The Arizona Administrative Code (AAC) R4-30-301(13) that adopts the APLS "ARIZONA BOUNDARY SURVES MINIMUM STANDARDS".

B. MAG STANDARD SPECIFICATIONS

C. The National Map Accuracy Standards (NMAS) and the ASPRS (American Society for Photogrammetry and Remote Sensing) Class 1 Standards.

13-03-002

Boundary Survey

Sections:

<u>13-03-002</u>	<u>Boundary Survey</u>
<u>13-03-002-0001</u>	<u>Definitions</u>
<u>13-03-002-0002</u>	<u>Qualifications</u>
<u>13-03-002-0003</u>	<u>Basis of Bearings</u>
<u>13-03-002-0004</u>	<u>Coordinates</u>
<u>13-03-002-0005</u>	<u>Survey Report</u>
<u>13-03-002-0006</u>	<u>Legal Descriptions</u>
<u>13-03-002-0007</u>	<u>Conveyances</u>
<u>13-03-002-0008</u>	<u>Monuments</u>

13-03-002 Boundary Survey

13-03-002-0001 Definition

AAC R4-30-301(13) adopts the "ARIZONA BOUNDARY SURVEY MINIMUM STANDARDS" April 12, 2001 by the Arizona Professional Land Surveyor's Association (APLS MS). Per APLS MS, "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 the purpose of identifying the location of real property.

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.

13-03-002-0003 Basis of Bearing

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.

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:

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

- 2) 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).
- 3) 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).
- 4) Define the Scale Factor on central meridian to no more than six decimal places (e.g. SF = 1.000318).

13-03-002-0005 Survey Report

A SURVEY REPORT shall be submitted summarizing the results of the survey and explaining the resolution of any problems encountered. A cogo printout of the subdivision or parcel boundary shall be included in the Survey Report.

13-03-002-0006 Legal Description

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 parts: text as EXHIBIT 'A' and an 8-1/2" x 11" drawing as EXHIBIT 'B'.

Exhibit 'A' shall conform to the requirements of AAC R4-30-301-13 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 8-1/2" x 11" 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.

13-03-002-0007 Conveyances

Conveyances are regulated as follows:

- A. DEDICATIONS TO CITY (EASEMENTS and RIGHT OF WAY) is per 13-04.
- B. RIGHT OF WAY PLANS are per COFES 13-06-002-0006.
- C. MINOR LAND DIVISIONS, Land Split/Combinations are per Title 11-20.100

13-03-002-0008 Monuments

A. The subdivider/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.

1. Survey monuments shall conform to City Engineering Detail No. 11-01-010.
 - a. An identifying marker, conforming to AAC R4-30-301-13 ~~State Board of Technical Registration~~ requirements, shall be placed at all original tract corners, subdivision boundary control points, ~~bench marks, 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.~~
 - b. All survey monuments shall be described on the final plat.
 - c. ~~All lot corners shall be permanently located; 1/2 inch minimum diameter steel pins, and 18 inch minimum length. They shall be placed in a manner satisfactory to the City Engineer.~~
3. 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 offsite improvements.

City of Flagstaff vertical datum shall be utilized.

B. Existing monuments that define the control/monument line shall be preserved and continue to be used as the right-of-way control line. New monuments shall be established by utilizing record data where existing control cannot be found.

C. 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.

13-11-001-002 Monument Location

A.D. Frame and cover monuments shall be used at section corners, 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 successive street monuments of sufficient distance on a common tangent to establish a base line for future surveys, under a frame and cover. Future surveys in the area will be able to use this established line for a basis of bearing.

~~BE. Survey monuments that define the right-of-way in (of) streets and easements shall be placed on the right-of-way. 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.~~

The surveyor shall provide reference marks and dimensions to the centerline monuments, existing and new. A minimum of two "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 reference marks shall be approximately 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.

F. Refer to COFES DETAIL 11-01-010 "Installation of Survey Monument". 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 13-03-004-0004.

G. 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 8-1/2" x 11" in .pdf format for each point per ARS 33-106(C). Monument data for sectional land corners shall be accompanied by a Corner Record Survey that complies with ARS 33-106 inclusive of the County Instrument Number.

13-03-003

Topographic Survey

Sections:

13-03-003 Topographic Survey

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

13-03-003 Topographic Survey

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 man-made characteristics.

The topographic survey shall be referenced to at least two monumented property lines as indicated by a ROS per 13-03-002.

Topography shall be shown at least 25 feet outside of the project limits depending on the engineering design requirements.

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 refistration. The topographic survey shall be identified as to completed by whom, what means, and date of survey.

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 0.01 feet.

Benchmarks for the project shall be shown on one 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 per site) and at least every 400 linear feet on alignment plans (e.g. Roads, Waterlines, Drainage Channels).

13-03-003-0004 Contours

Contour interval shall be one foot or two feet, depending on the slope of the ground and the judgement of the Engineer or Land Surveyor.

13-03-003-0005 Positional Accuracy

All mapping performed by other than photogrammetric methods shall meet the NMAS with 90% of horizontal features at 1/40th of map scale, 90% of spot elevations with one-quarter of the contour interval and 90% of the contours within one-half 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 1/100 of map scale, the spot elevation RMSE at one-sixth of the contour interval and the contour RMSE at one-third of the contour interval.

13-03-004

Construction Survey

Sections:

13-03-004 Construction Survey

13-03-004-0001 Construction Survey Definition

13-03-004-0002 Qualifications

13-03-004-0003 Coordinates

13-03-004-0004 Monument Protection

13-03-004 Construction Survey

13-03-004-0001 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).

13-03-004-0002 Qualifications

The contractor shall be responsible for retaining, at his expens, 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.

13-03-004-0003 Coordinates

If coordinates are used by the approved Plans to define locations of improvements per 13-06-002-0007(6), then the construction staking shall utilize the same system.

13-03-004-0004 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 13-03-002-0008(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.

13-03-005

As-built Survey

Sections:

13-03-005 As-built Survey

13-03-005-0001 Survey Criteria

13-03-005-0002 Qualifications

13-03-005 As-built Survey

As-built Plans shall meet the requirements of 13-06-002-0008 and the City of Flagstaff Engineering Sections' "As-built plans/Record Drawings Checklist". Survey data shall meet the following requirements:

13-03-005-0001 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 horizontal cross-ties shall be provided for each water valve box. The cross-tie is defined as an un-obstructed horizontal measurement to the nearest 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.

13-03-005-0002 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.

CHAPTER 13-04
EASEMENTS AND RIGHTS-OF-WAY

DivisionsSections:

- 13-04-001 Easements**
- 13-04-002 Rights-of-Way**

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

13-04-001 Easements

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.

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 drainage-ways. Streets, roads and some drainage-ways require warranty deeds.

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. But 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 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 non edifice, a gate, 4' – 0" 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 non-permanent 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 non-permanent structure has been constructed over the easement, the City may require the property owner to remove the non-permanent 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 non-permanent, 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 8' gates are permitted across drainage easements with underground stormdrains.

D. An easement does not become void or non-existent 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 example would be a construction easement adjoining a permanent easement or a turn-around to be abandoned when the street is extended.

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 3 ft. 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 20/26-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.

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 [per 13-03-002-0006](#) 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.

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

13-04-002 Public Right-of-Way

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.

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.

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 [per 13-03-002-0006](#) 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.

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 13-03-002-0008\(A\) prior to final project closeout.](#)
- B. Legal descriptions and exhibit drawings [per 13-03-002-0006](#) must be prepared and sealed by a registered land surveyor and accepted by the City Engineer.

CHAPTER 13-05
ENGINEERING DESIGN REPORTS

DivisionsSections:

- 13-05-001 Engineering Design Reports
- 13-05-002 ~~Water~~ Impact Analysisesis

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

13-05-001 Engineering Design Reports

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 the "Water System Design" section of these standards. The engineer should investigate ~~both~~ 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. Waterlines shall be sized to maintain water pressure as required in Chapter 13-09 of this title 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 the "Sewer System Design" Chapter 13-09 of these Standards, 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.

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 is required.

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 Flagstaff City Code 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 ~~is-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.

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-are~~ 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.

13-05-002

Water Impact Analysis

Sections:

13-05-002-0001	Water Impact Analysis
13-05-002-0002	Sewer Impact Analysis
13-05-002-0003	Traffic Impact Analysis
13-05-002-0003.1	General Introduction
13-05-002-0003.2	Process Proposed Development
13-05-002-0003.3	Requirement Existing Area Conditions and Planning Environment
13-05-002-0003.4	Analysis Approach and Methods Site Traffic Forecasting and Traffic Projections
13-05-002-0003.5	Study and Report Format Traffic Analysis
13-05-002-0003.6	Site Specific Traffic Analysis
13-05-002-0003.7	Public Improvements Analysis
13-05-002-0003.8	Developing Conclusions & Recommendations
13-05-002-0003.9	TIA Report Outline
13-05-002-0004	Stormwater Impact Analysis

13-05-002 Water Impact Analysis

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 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 the "Water System Design", Flagstaff City Code, Title 13, Section 13-09-003 of these regulations.
1. The analysis shall evaluate ~~both~~ 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.

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 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 the "Sewer System Design" section of these regulations, shall be adhered to.

1. The developer must provide adequate information regarding the projects 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: 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 9 of these regulations (the loadings and patterns may be modified at the discretion of the Utility 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 offsite 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.

[13-05-002-0003 Traffic Impact Analysis](#)

[13-05-002-0003.1 Introduction](#)

[A. Purpose](#)

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Transportation Impact Analysis reports (TIA's) are also sometimes referred to as Traffic Impact Studies. For the purposes of this document, the City of Flagstaff refers to them as Transportation Impact Analysis reports, or TIA's, related to policy emphasis on multimodal transportation. TIA's are required for Site Plans, Rezoning's, General Plan Amendments, and Preliminary Plats. This section presents the analysis process and requirements for completing a TIA to determine the transportation needs of the development and the necessary modifications to the existing transportation system.

One of the City of Flagstaff's primary objectives is to operate and maintain a safe and efficient roadway system. The review and management of development-generated traffic is an integral part of that objective. The TIA procedures, as outlined in this document, have been established for this purpose. The TIA Procedures establish a range of transportation impact study categories based on the characteristics of development and estimated peak hour traffic volumes.

A TIA identifies existing traffic volumes and conditions, development traffic volumes and conditions, and their combined impacts on the existing and future roadway system. The TIA is a useful tool for early identification of potential traffic problems and can play an important role in the success of a development. When insufficient attention is given to the assessment of traffic impacts at the beginning of the development process, then limited flexibility to modify the development to eliminate problems or adjust to changed conditions may occur.

The TIA provides an opportunity for the City and the applicant to share information and jointly address traffic related problems. It provides a means of balancing development needs with the functional integrity of the roadways that serve both the development and the surrounding transportation system. The need of a TIA and its scope should be assessed as early as possible in the development process when there is maximum flexibility for mitigating traffic-related problems. The results of the TIA can affect development proposal, so it is important to begin the traffic analysis early and incorporate the TIA recommendations into the development plans.

The procedures contained herein are provided to:

- assist applicants through the approval process by outlining the requirements and level of detail of traffic analysis that is required of them during the approval process
- standardize the types and details of analysis required in the assessment of traffic impacts for developments with similar levels of size and intensity
- ensure consistency in the preparation and review of a TIA through standardization of the reports

These procedures are presented in a sequence that reflects the expected report outline – this introduction is a substitute for the executive summary.

B. General Information

A TIA is required of all new developments, additions, or expansions to existing developments. For development projects generating less than 100 peak hour trips, a Traffic Statement may be submitted in lieu of a full TIA. In some cases, where there are less than 100 peak hour trips, a TIA may be required when:

- current traffic problems or concerns exist; or
- the public may perceive an adverse impact on the adjacent neighborhoods or other areas; or
- the proximity of site drives to other drives or intersections could create traffic concerns; or
- other specific problems or concerns may be aggravated by the proposed development

Should such conditions arise, the City Traffic Engineer will evaluate the need for the study based on technical merit. Developments processed under previously approved Development Master Plans, site plans, subdivision plats, or rezoning cases with current approvals will not be required to provide a new or revised TIA during the platting or site planning process unless:

- the level of development changes significantly to warrant a new study;
- the adjacent roadway system changes significantly to warrant a new study;
- detailed information for commercial access analysis was not available during the initial development process;
- the access drives or openings are proposed to change;
- there is an increase in intensity of or change in land uses;
- there is an addition of drive-through facilities;
- there is an addition of schools

The need for a revised TIA will be determined by the City Traffic Engineer in accordance with the intent of these guidelines.

The TIA is required to be prepared by a registered professional engineer in the State of Arizona with professional traffic engineering experience. The report shall be bound, signed, and sealed by the registered professional engineer. The TIA is required to be submitted (3-paper copies and 1-electronic copy) with the Development Application package to the Planning and Development Services Section. Additional copies may be required if needed for distribution to other involved agencies impacted by the proposed development. Reviews and comments on TIA reports will follow procedures and standards set as part of the standard Development Review process with the application submittal. Review fees must be submitted at the time of application. Schedules and timelines may be found on the City's webpage under Planning and Development Services. Current review fees can be found in the Flagstaff City Code under section 3-10-001-0002 Engineering User Fees.

When the TIA is approved, it is imperative that the recommendations or requirements of the report are incorporated into the Development application. This will help not only reduce the number of review comments, but also reduce review times, number of reviews, necessary revisions, and resubmittals.

Major Issues Addressed in the TIA

The TIA document will address such issues as:

- the current transportation system and operational characteristics in the site vicinity;
- on-site circulation system and the adjacent circulation system, including collector systems;
- the intensity and character of the development;
- trip generation;
- distribution and assignment estimates; and
- impacts of the development on the existing and planned transportation systems

It is the City of Flagstaff's intent to have an open discussion between staff, the applicant, and the traffic engineering consultant, but prior to the Scoping Meeting it is recommended to have submitted a Pre-Scoping Form. This form can be found on the City of Flagstaff's Transportation Engineering webpage.

Once the Pre-Scoping Form has been received, if needed, the City will run the TransCAD model to determine the trip distribution. A scoping meeting will then be scheduled. At the meeting the model results will be discussed, along with any comments or concerns with the Pre-Scoping Form. The Pre-Scoping Form may need to be revised until a final agreement can be made. Figure 1 is a detailed flow chart of the TIA review process, while Figure 2 is a detailed flow chart of the Traffic Statement review process. The need for and extent of the study shall be based on the criteria described in these procedures. It is the City's intention to be available to answer questions during the analysis process to minimize the review time and the number of comments. For more information on the preparation of a TIA see Chapter 2 "Site Planning" of the Institute of Transportation Engineers publication "Transportation and Land Development."

It is extremely important that the traffic engineering consultant explain the results and recommendations of the TIA in detail to the applicant prior to submittal of the development package to the City. The TIA includes recommendations that affect the development and could possibly impact its design. The TIA is not meant to be a report submitted to the City simply to meet requirements, but rather a tool used by the applicant to guide the design of a safe and efficient project. Projects submitted to the City that fail to include the results of the TIA on the plan may be returned as incomplete, to be revised and resubmitted for staff review.

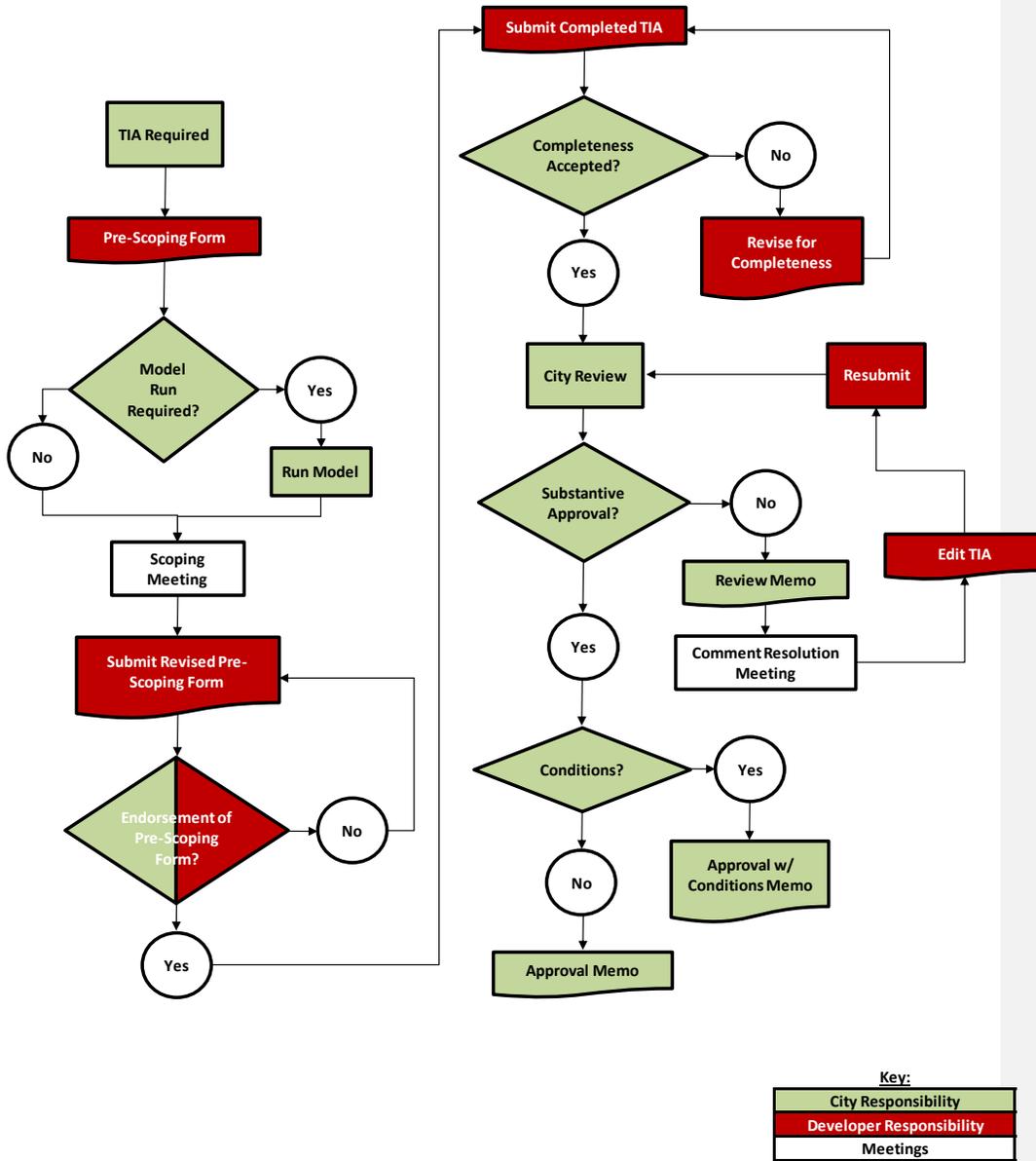


Figure 1. TIA Review Process

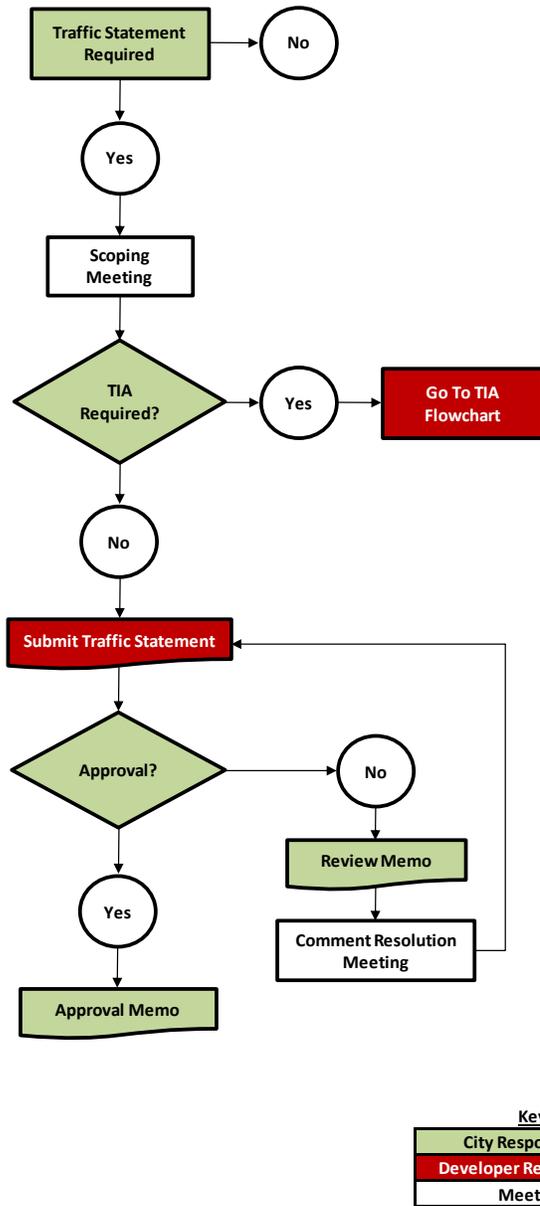


Figure 2. Traffic Statement Review Process

C. Scope of Analysis

This section describes what size of development or minimum square footages of land uses that warrants the need for a TIA, the levels of categories, and the requirements that must be included in the TIA.

1. Levels of Study

A TIA is required for all projects which generate 100 or more peak hour trips. To quickly estimate if a proposed project will generate enough peak hour trips to require a TIA, please see Table 1. The most recent version of the ITE Trip Generation Manual shall be used for all trip generation calculations in the TIA or Traffic Statement. Rates for additional land uses not listed in Table 1 are found in the ITE Trip Generation Manual. Please be advised that verification of the land use and size, and number of peak hour trips generated, will be required prior to submittal.

This table should be used only to estimate if a TIA may be required and not as the basis for actual trip generation calculations.

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Table 1. Traffic Statement and TIA Requirement Thresholds

ITE LUC	Land Use	Trip Rate/Unit	Maximum Units For Less Than 100 Trips
<i>Residential</i>			
<u>210</u>	Single Family	1.02/DU	98 DU
<u>230</u>	Townhomes	0.52/DU	192 DU
<u>220</u>	Apartments	0.67/DU	149 DU
<u>240</u>	Mobile Homes	0.60/DU	166 DU
<u>254</u>	Assisted Living	0.37/Bed	270 Beds
<u>310</u>	Hotel*	0.87/Room	114 Rooms
<i>Commercial</i>			
<u>911</u>	Walk-in Bank	24.15/1,000 SF	4,140 SF
<u>912</u>	Drive-in Bank	26.70/1,000 SF	3,740 SF
<u>820</u>	Shopping Center*	4.82/1,000 SF	20,740 SF
<u>850</u>	Grocery Store*	18.93/1,000 SF	5,280 SF
<u>851</u>	24-Hour Convenience Store	77.10/1,000 SF	1,290 SF
<u>815</u>	Discount Store*	7.39/1,000 SF	13,530 SF
<u>890</u>	Furniture Store*	0.95/1,000 SF	105,250 SF
<u>812</u>	Lumber Store*	9.58/1,000 SF	10,430 SF
<u>816</u>	Hardware/Paint Store*	11.80/1,000 SF	8,470 SF
<u>841</u>	Auto-Sales*	4.02/1,000 SF	24,870 SF
<u>817</u>	Nursery/Garden Store*	23.39/Acre	4.27 Acres
<u>565</u>	Day Care	0.84/Student	119 Students
<u>843</u>	Auto Part Sales	6.44/1,000 SF	15,520 SF
<u>942</u>	Automobile Care Center	3.51/1,000 SF	28,480 SF
<u>944</u>	Gas Station	15.65/Pump	6 Pumps
<u>491</u>	Racquet Club	4.38/Court	22 Courts
<u>492</u>	Health Club	4.06/1,000 SF	24,620 SF
<u>931</u>	Quality Restaurant*	10.82/1,000 SF	9,240 SF
<u>932</u>	Sit Down High Turnover Restaurant	18.49/1,000 SF	5,400 SF
<u>934</u>	Fast Food with Drive Thru*	72.74/1,000 SF	1,370 SF
<i>Offices</i>			
<u>710</u>	Office	1.56/1,000 SF	64,090 SF
<u>720</u>	Medical-Dental Office	4.27/1,000 SF	23,410 SF
<u>750</u>	Office Park	1.71/1,000 SF	58,470 SF
<u>770</u>	Business Parks	1.40/1,000 SF	71,420 SF
<u>760</u>	Research & Development	1.90/1,000 SF	52,620 SF

* Weekend peak hour generator.

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Proposed projects will fall into one of five categories for purposes of TIA's.

LEVEL 1 / TRAFFIC STATEMENT:

If the proposed project generates less than 100 peak hour trips, a traffic statement that addresses trip generation and any site specific issues may be submitted in lieu of a full TIA. These projects are assumed to have impacts only to the adjacent localized transportation system.

LEVEL 2:

The second level includes projects that are deemed to have minor or minimal traffic impacts.

LEVEL 3:

The third level includes projects that have localized and possibly extended impacts to the city's transportation system.

LEVEL 4:

The fourth level includes proposed developments that have significant impacts to the transportation system that extend beyond the vicinity of the site.

LEVEL 5:

The fifth level includes proposed developments that have regional impacts to the transportation system that extend beyond the vicinity of the site, and/or cross jurisdictional boundaries.

These levels are further described below. The study horizon years and study areas are listed in Table 2 and are further described following the table. For those situations where it is questionable as to which level is appropriate, the City Traffic Engineer will make the final determination in writing. The City Traffic Engineer also has the authority to waive the requirement for a TIA for unusual situations that fall outside of the following guidelines, or where the analysis is deemed to be unnecessary based on previous studies or current traffic conditions.

Other issues required to be analyzed in the TIA when applicable include:

- Driveway spacing and design
- Transit – route accommodation, site circulation, and stops
- Pedestrian circulation and/or trail connectivity
- School traffic circulation
- Proximity and potential impacts to nearby residential areas
- Neighborhood connectivity and traffic calming

Other special conditions and circumstances particular to the development or the transportation system

Table 2. TIA Categories and Study Horizon and Area

<u>TIA Level</u>	<u>Development Characteristic</u>	<u>Study Horizon*</u>	<u>Minimum Study Area</u>
<u>1/</u> <u>Traffic Statement</u>	<u>Development less than 100 peak hour trips</u>	<u>- Opening Year</u>	<u>- Site access drives, if applicable</u>
<u>2</u>	<u>Small development less than 500 peak hour trips</u>	<u>- Opening Year</u>	<u>- Site access drives</u> <u>- Adjacent signal controlled intersections and/or major street intersections without signal control</u>
<u>3</u>	<u>Moderate development 500 - 1000 peak hour trips</u>	<u>- Opening Year</u> <u>- 5 Years after opening</u>	<u>- Site access drives</u> <u>- All signal controlled intersections within 1/2 mile and/or major street intersections without signal control and major driveways within 1/2 mile</u>
<u>4</u>	<u>Large development 1,000 -1,500 peak hour trips</u>	<u>- Opening Year</u> <u>- 20 Years after opening</u>	<u>- Site access drives</u> <u>- All signal controlled intersections within 1 mile and/or major street intersections without signal control and major driveways within 1 mile</u>
<u>5</u>	<u>Regional development greater than 1,500 peak hour trips</u>	<u>- Opening Year</u> <u>- 20 Years after opening</u>	<u>- Site access drives</u> <u>- All signal controlled intersections within 2 mile and/or major street intersections without signal control and major driveways within 1 mile</u>

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*Includes developments with multiple phases

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A NOTE ABOUT TRAFFIC STATEMENTS

A Traffic Statement shall be written and prepared by a registered professional engineer in the State of Arizona with professional traffic engineering experience. The statement can be submitted in letter format, stapled with attachments, and shall be sealed by the registered professional engineer. The statement is required to be submitted with the Development Application package to the Development Services Department and should include the following:

- description of proposed land uses and sizes
- trip generation, daily and peak hour(s)
- driveway design; including location, spacing, access, number of driveways, width, throat length, deceleration lane requirements, number of ingress and egress lanes, etc.
- street description and classification of adjacent streets
- on-site traffic circulation issues and any other traffic safety issues
- impact to traffic signals, if any
- transit, bike and pedestrian facilities and requirements, if applicable

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D. Study Area

The study area will be the roadway segments, intersections, and major driveways as described in Table 2 above. An enlarged study area may be required when the minimum study areas identified in Table 2 do not provide sufficient information to meet the intent of the TIA procedures.

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For a Level 4 Regional Development study, the intersections to be analyzed greater than a 1-mile radius within the study area, as described above in Table 2, shall be pre-approved and documented in the Pre-Scoping Form prior to beginning the TIA.

E. Study Horizon Years

For the Study Horizon Year, the Opening Year shall mean build-out for single-phase developments. Multi-phase developments may require assessment of horizon year's corresponding to each phase of the proposed project.

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For a Level 1, Traffic Statement, the development is assumed to be built out in its opening year, so no horizon year applies.

For a Level 2 study, the traffic analysis will be based on traffic conditions for the build-out or completion year of the development. In some cases, staff may require an additional horizon year if there are significant changes anticipated to the surrounding infrastructure or traffic volumes.

For a Level 3 study, the traffic analysis will be based on traffic conditions for the build-out or completion year of the development, and a minimum 5-year projection from the anticipated build-out date. If the project is a large, multi-phased development, the initial horizon year will be the date that corresponds to the opening of the first major phase of development. In some cases, staff may require an additional horizon year for multi-phase projects or projects with significant changes anticipated to the surrounding infrastructure or traffic volumes.

Level 4 and 5 studies may require that additional years be analyzed for interim phases in addition to the 20-year horizon year.

The study will provide morning and evening peak hour turning movement volumes for each intersection in the study area for the required horizon years. Level-of-service analyses for these peak hour conditions, with and without the site traffic, shall be included in the report.

13-05-002-0003.2 Proposed Development

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A. Introduction

The proposed development should be adequately described so that direct associations with the analysis may be made. The description should “stand alone” from similar descriptions required elsewhere in the development application. As it is anticipated that the evolution of the development proposal and transportation analysis are somewhat iterative, it may be useful to describe some of the site plan adaptations in land use and circulation that have taken place up to the time of submittal.

B. Description of Development

Generally, describe the location of the property including parcel numbers and addresses and support this with a vicinity map and site plan/preliminary plat. The vicinity map will show the location of the site within the City. Describe the project in terms of the existing and desired regional plan designation, including area type and place type and/or existing and desired zoning. Provide a table of the expected land uses and intensity and be sure they are in line with the policy and regulatory documents previously described. To conclude this section, describe the different phases and their anticipated timing. Phases should also be illustrated on the site plan/preliminary plat.

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C. Description of Study Area Development

Describe the adjacent properties in the same terms. If development proposals are approved but not yet built, site plans/preliminary plats and circulation should be illustrated or referenced.

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13-05-002-0003.3 Existing Area Conditions and Planning Environment

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A. Introduction

The applicant is responsible for demonstrating an understanding of the planning and regulatory context in which the development will take place. Further, the applicant will show that development is compliant with those plans and regulations. The applicant will be responsible for obtaining copies of the current Circulation (or Transportation) Element of the Regional Plan for the City of Flagstaff, the City of Flagstaff Engineering Standards, the ADOT Traffic Safety in School Areas manual (as applicable), and any other applicable, governing documents, and report on how the project adheres to the policies and guidelines contained in them.

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B. Study Area

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1. Area of Influence

Refer to Table 2, as modeling may be required by the Engineer. Describe and illustrate the study area. This should include the area of influence as indicated by preliminary expectations for high distribution proportions and large changes in volume on select roadway segments and intersections.

2. Area of Significant Impact

Area of significant impact should be identified. These include road segments and intersections anticipated to fall below level of service standards and require mitigation, and those segments and intersections that will drop in level of service but require no mitigation. Also, identify areas where accommodation of any mode is particularly challenging.

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C. Study Area Land Use

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This is similar in nature to the Site and Adjacent Area descriptions, but takes a more general look at the entire study area.

1. Existing Land Uses

Describe land uses within the area of significant impact in terms of ITE categories, regional plan categories, area types, and place types.

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2. Existing Zoning

Provide a map and general description of the zoning categories that apply to the property.

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3. Anticipated Future Development, Land Uses, & Zoning

Provide land use and zoning descriptions for future developments proposed within the area of influence.

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D. Transportation Systems and Site Access

Descriptions of transportation systems should be adequate so that the attributes are properly represented in any regional transportation modeling or off-model analysis.

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1. Area Roadway System

Describe existing and future roadway systems and their relevant attributes such as classification, number of lanes, and posted speed limit. Provide a general description of the adequacy of the right-of-way to accommodate anticipated improvements. Anticipated improvements should account for pedestrian, bicycle and transit facilities, and any on-street parking. Dedicated public roads that are present on-site, and especially through-site circulation, should be noted.

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The TIA will provide current approach volumes for 48 hours of a typical weekday, and turning movement volumes in 15 minute intervals for the time periods of 7:00 to 9:00 a.m. and 4:00 to 6:00 p.m. for all intersections of streets that are classified as collectors (major or minor) or arterials (major or minor), in the study area. Midday counts may also be required by the City Engineering Department.

The report will analyze the peak traffic periods as they occur on the adjacent street system during the morning and evening peak hours. The report will also analyze the peak traffic periods for the development, should these periods occur at different times or on different days from the peak periods of the adjacent street system. Examples include, school impacted sites, sites that have Saturday or Sunday peak hours, etc.

Availability of Background Data: The City of Flagstaff Traffic Engineering Section and Flagstaff MPO conduct annual traffic volume counts and make them available on a state-sponsored website at <http://fmco.ms2soft.com>. The applicant will use the most current data, at a minimum. The applicant may not use traffic volume data older than 12 months as current information. If traffic volume data more recent than 12 months is not available, then the applicant is responsible for obtaining the information directly. If data from earlier years is deemed pertinent, the applicant may utilize it to supplement the most recent data.

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The City Traffic Engineer will determine the locations of counts. All data will be provided to the City in digital format and is subject to a quality review.

- Peak hour turning movement volumes shall be conducted on Tuesdays, Wednesdays, or Thursdays during weeks not containing a holiday. Counts shall be conducted in favorable weather conditions.
- Counts shall be collected when schools and colleges are in session, but not during the first or last two weeks that the schools and colleges are in session. Counts collected when schools and colleges are not in session shall be approved by the Traffic Engineer, including a methodology for adding historical school traffic volumes to the analysis.
- Turning movement counts shall be collected during AM (7:00 a.m. to 9:00 a.m.) and PM (4:00 p.m. to 6:00 p.m.) peak hours, unless otherwise specified (such as midday or weekend peak periods).
- Counts will include the peak hour factor calculation.
- Roadway volume counts shall be at least 48-hours in duration and include speed and class data.
- A Traffic Consultant shall observe each study intersection during peak hours of analysis and document their observations such as lane utilization, delay, queue lengths in the field, adjacent intersection queues affecting study intersection capacity, etc.

The City has prepared traffic volume projections and can produce interpolations for 5-year increments as needed. This information will be available to the applicant. However, the information will need to be reviewed by the applicant for applicability to the TIA. Adjustment and recalculation may be necessary. In the event that the proposed development is very large (Level 5, in most cases Level 4, and some cases Level 3) in terms of anticipated traffic generation or in terms of deviation from the Flagstaff Regional Plan land use or zoning designations, comprehensive traffic projection modeling may be necessary.

The City of Flagstaff, based upon a public records request, will provide copies of approved TIA's prepared for previous proposed developments that may be pertinent to a current analysis. The City will also provide other transportation related reports that may be of assistance. The applicant will be responsible for reviewing these reports and incorporating their data, conclusions, and recommendations where appropriate.

2. Transit and Other Relevant Transportation Systems

Applicant should reference Northern Arizona Intergovernmental Public Transportation Authority (NAIPTA) 5-Year and Long Range Transit Plans, Flagstaff Urban Trail System (FUTS) Masterplan (or latest Regional Plan Map) and expected modal levels of service for the Area and Place Type as they appear in the latest regional plan.

Existing bicycle and pedestrian facilities including crosswalks, shall be discussed/illustrated in this section.

13-05-002-0003.4 Site Traffic Forecasting and Traffic Projections

A. Introduction

This section of the report establishes the estimated and projected traffic volumes created by background traffic and the site. It evaluates which roads the traffic will use and its impact upon them. Site volumes may be adjusted by mode share and other reasons such as anticipated 2nd homes. Mode share is estimated using factors including modal level of service and land use.

B. Site Traffic (Each Horizon Year)

1. Trip Generation

The applicant shall follow the guidelines contained in the most recent edition of the ITE "Trip Generation Handbook: An ITE Recommended Practice." Proposals for deviations from the ITE Recommended Practice should be presented and pre-approved by the City Traffic Engineer prior to conducting the TIA analysis. Generally:

- Rates should be calculated using the flowchart labeled *Recommended Procedure for Selecting Between Trip Generation Average Rates and Equations* in the ITE Trip Generation Manual. Progressing through this flowchart will determine whether to use the average rate or the regression equation.
- Special consideration should be given for ITE rates based on antiquated data or a small sample and may require additional data collection to determine the appropriate trip generation.
- New rates should be generated using community examples for uses not updated or included in the ITE Trip Generation Manual.
- Trip generation rates, other than those included in the ITE Handbook, will be required to be studied at three equivalent sites, and compared to similar rates in ITE. Worst case trip generation rates may be required to be used for the TIA analysis.
- All assumptions shall have proper citation and justification for their use in the TIA.
- The City has studied multiple local apartment buildings, and trip generation rates for similar developments are to utilize this study for calculations.

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- The use of the 3D's (density, diversity, design) model is allowed to inform project trip generation (and appropriate reductions) from projects in the downtown area, at large TOD's, large activity centers, and at large mixed-use developments.

Occasionally, a development proposal will consist of special or unusual land uses for which typical trip generation rates or equations are not available, or do not apply. Judgment must be applied to identify a land use or combination of land uses that best represent the trip-making characteristics of the site. For any trip generation calculations based on rates not included in the ITE Trip Generation Manual, the reasoning and data used by the applicant in developing a trip generation estimate for a special or unusual generator must be pre-approved by the City Traffic Engineer and explained in the report.

Table 3. Example Trip Generation Table

Land Use	ITE LU	Variable	AM Peak Hour			PM Peak Hour			Saturday Peak Hour		
			In	Out	TOT	In	Out	TOT	In	Out	TOT
Retail	820 – Shopping Center	60,000 SF	44	27	71	137	149	285	214	198	412
Supermarket	820 – Shopping Center	140,000 SF	104	63	167	320	347	657	499	461	960
Total Site Generated Trips			148	90	238	457	496	953	713	659	1372
Pass-By Trip Rate			0%	0%	0%	34%	34%	34%	26%	26%	26%
Pass-By Trips			0	0	0	155	169	324	186	171	357
Total Primary Trips			148	90	238	302	327	629	528	488	1015

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Pass-By Trips: No pass-by trip reductions are allowed unless justified to and approved by the City Traffic Engineer during scoping. It is usually assumed that all trips entering and exiting a new development are new trips that were not made to or through the area prior to the development being completed. However, for some non-residential developments, a portion of these trips may be "captured" from trips already being made to other existing developments on the adjacent street system, or they may be merely passing by on the way from one place to another. The driveway volume for a new development may, therefore, be significantly different from the amount of traffic added to the adjacent street system. For example, retail establishments, restaurants, banks, service stations, and convenience markets attract people from the passing stream of traffic; these are known as pass-by trips.

ITE's Trip Generation Handbook contains discussions and references on the issue of pass-by trips. Because of the limited data available, adjustments for pass-by trips should be applied carefully. If pass-by trips are a major consideration, studies and interviews at similar land uses must be conducted or referenced.

Internal Capture: Internal trip capture is the portion of trips generated by a mixed-use development that both begin and end within the development. The importance of internal trip capture is that those trips satisfy a portion of the total development's trip generation and they do so without using the external road system. Mixed-use developments—single projects that include different integrated, complementary, and interacting land uses such as office, retail, restaurants, entertainment, and/or hotels are a growing trend in land use development. Many mixed-use developments also have increased levels of internal connectivity—walkways or internal streets or drives, and the sharing of parking—use of the same on-site parking lots by users of different buildings. As a result, it is important to know for a mixed-use development how much of the trip generation uses the public street system to reach off-site destinations and how much stays within the development without using external roads. The Institute of Transportation Engineers (ITE) produced its *Trip*

Generation Handbook (1) in part to aid analysts in estimating trip generation for mixed- and multi-use developments. It is important to note that a single development must contain distinct ITE land uses to qualify for internal capture. Shopping centers and malls have a single ITE code despite multiple uses, so do not qualify.

2. Trip Distribution and Assignment

The directions from which traffic will access the site can vary depending on many factors, including:

1. The type of proposed development and the area from which it will attract traffic
2. The presence or absence of competing developments within the same market area
3. The size of the proposed development, and
4. The conditions on the surrounding street system

The influence area of the development needs to be identified for the site. Ideally, the influence area should contain approximately 80% of the trip ends that will be attracted to the site. If a market study is available, it should be used in establishing the influence area. Otherwise, an influence area should be established based on a reasonable documented estimate. See Section III.A Study Area. The influence area will almost always be larger than the Study Area.

The three most common methods for estimating trip distribution are by analogy, model, and surrogate data. In most cases, a surrogate data method can be utilized for developing the trip distribution. Utilizing this procedure involves using socioeconomic and demographic data to establish population or employment land use distributions around the site. In most cases, population can be used as the basis for estimating distribution of office, retail, and entertainment trips; employment is a reasonable surrogate for residential trips, and other trips can be similarly distributed using logical surrogates. For horizon years, land use estimates based on the city's General Plan should be utilized.

For some large-scale developments, a trip distribution model should be utilized to estimate site trip distribution. The gravity model portion of the regional transportation forecasting model is available for this purpose. In the event that the applicant's consulting engineer believes that the specifics of the project will materially change the distribution, then these changes should be justified to and approved by the City Traffic Engineer and documented in the report. A consequence of failing to bring these changes to the attention of the City early in the process may be a delay due to possible rejection of the distribution changes and any work done by the applicant based on those rejected changes.

Assignment of trips to specific roadways can be performed through use of the regional traffic forecasting model or by surrogate data. The latter should consider posted speed limit, current and projected levels of congestion that will influence travel time, and ease of access to the projected distribution areas.

The City in partnership with the Flagstaff MPO maintains a regional traffic model for base year and future forecast conditions. After the project land uses and network changes have been submitted to the City several model runs will be produced. The following describes the models and how, after consultation with the City Traffic Engineer, they may be used to develop the TIA:

- Existing Conditions (base year) – Calibrated against current year traffic volumes, together with traffic and turn movement counts used to assess peak hour LOS analysis and available capacity.
 - Applicable to all TIA categories
 - Off model or after model adjustments may be necessary where model calibration is weak within the Study Area
- Existing plus Project Conditions – The land uses for project build out and network changes will be added to the existing conditions (base year) model. One or more traffic analysis zones unique to the project will likely be added to the model to isolate impacts. Trip generation using rates coded in the

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model will be applied and trip distribution reported out of the model. When compared to the previous scenario the link level LOS analysis will assist in defining facilities particularly sensitive to the impacts of the project and will be used in defining the Study Area limits.

- Applicable to TIA categories 2 and above
- Near Term Analysis (Previous scenario plus Approved and Pending Development and Public Capital Projects). Other development projects for which a complete application has been received or which have been reasonably scoped and analyzed plus public capital projects programmed in the next 3-5 years will be added to the model. The results will be used to evaluate changes in trip distribution patterns and cumulative impacts to LOS. Together with the previous analysis proportional shares can be evaluated.
 - Applicable to TIA categories 3 and above
- Horizon Year Conditions – Background Traffic – (Interpolated growth to Horizon Year from base year to Regional Build Out without Project). This will be used to determine the level of background traffic projected to be present at the time of build out of the applicant’s project.
 - Applicable to TIA categories 3 and above
- Horizon Year plus Proposed Project Conditions – Project traffic added to the previous scenario and LOS analysis. This will be used to help in the assessment of when capacity poses limits to the proposed development and how and when capacity will be addressed.
 - Applicable to TIA categories 3 and above
 - If any phasing is to take place, then such phasing should be studied at the appropriate build out year in addition to the above scenarios.
 - Trip distribution to affected ADOT freeway interchanges identified in the regional plan shall be evaluated for the proposed project.
- Regional Build Out Model – This model will reflect land use and transportation systems build out in the adopted regional plan including assumptions about external trips. This model serves two primary purposes. First, as the basis for interpolation of Horizon Year background traffic and; second, to aid in determining ultimate system right-of-way needs in, and adjacent to, the project.
 - Applicable to TIA categories 3 and above

Redevelopment Projects: Since the purpose of the impact study is to evaluate a development proposal’s impact on the transportation system, redevelopment projects require some special analysis. In the case of redevelopment projects, existing site-generated trips should be subtracted from existing and horizon year off-site traffic. The traffic generated by the proposed development is then added to the adjusted off-site traffic according to the above procedures to determine the impacts on the transportation system.

The applicant will establish the existing site generated trips through the collection of driveway counts. If the redevelopment area is substantial, or for some other reason does not lend itself to the collection of driveway counts for this purpose, trip generation rates may be applied to establish the existing site generated trips.

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3. Bicycle / Pedestrian Reduction

Bicycle/pedestrian reduction may be used if approved by the Traffic Engineer. According to the Institute of Transportation Engineers (ITE), the recommended practice is a reduction of no more than 10%.

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C. Background Traffic (Each Horizon Year)

Estimates of non-site traffic are required for a complete analysis of horizon-year conditions. These estimates represent the “base” conditions, that is, without the site development. There are two principle methods of projecting offsite traffic that are acceptable: use of area-wide modeled data and trends or growth rates. Each method has its appropriate use depending on the availability of data and the size of the proposed development.

Growth rates can be determined from historical data. Annual traffic count data in the City of Flagstaff from previous years is available on the state-sponsored website. Modeled data for 20-year projections are available from

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the Flagstaff Metropolitan Planning Organization (FMPO). In those cases, where this data is not available, the City will determine if the data needs to be produced for an adequate analysis, or if a trends analysis will suffice.

Future traffic demand estimates are developed by adding the estimated site generated traffic, all approved (or potential) development in the area, and current traffic volumes adjusted for general growth in the area. The applicant will determine the levels of service in the study area based on the non-site traffic for the horizon year.

The FMPO has traffic volume projections available to the applicant. However, the information will need to be reviewed by the applicant for applicability to the TIA. Adjustment and recalculation may be necessary. In the event that the proposed development is very large (Level 5, in most cases Level 4, and some Level 3) in terms of anticipated traffic generation or in terms of deviation from the Flagstaff Regional Plan, comprehensive traffic projection modeling may be necessary. All such adjustments should be made in consultation with the City Traffic Engineer or his designee and documented.

13-05-002-0003.5 Traffic Analysis

A. Introduction

This section describes the analytical techniques used to derive the study findings, conclusion, and recommendations. Capacity analysis must be performed at each of the major street and site access intersection locations (signalized and unsignalized), as well as roadway segments located within the study area. In some cases, there may be a need to analyze additional critical intersections or segments located outside the study area. These will be identified in the scoping letter.

B. Level of Service Goals

The City of Flagstaff set a minimum standard level of service (LOS) D as defined by the current edition of the Highway Capacity Manual for intersections and segments. For intersections already performing at LOS D or LOS E development impacts may not reduce the LOS whatsoever. For example, if the existing LOS is E, the development must keep it the same or make it better, but never make it worse. Same with an LOS of D, it either needs to stay at D or be made better by improvements.

C. Level of Service and Capacity Analysis Guidance

1. Guidelines

The evaluation of traffic operating conditions is referred to as level of service (LOS). The assessment of LOS is based on the quantitative effect of factors, such as speed and volume of traffic, geometric features of the roadway or intersection, traffic interruptions and delay, and freedom to maneuver.

The total traffic estimate from the preceding section will serve as the foundation for this analysis. For each analysis period being studied, a projected total traffic volume must be estimated for each segment of the roadway system being analyzed. These projected total traffic volumes will be used in the capacity analyses. The TIA must clearly depict the total traffic estimate and its site and non-site traffic components. Projected daily traffic volumes must be determined for all major streets within the study area as well.

Once the total traffic volume estimate has been established, capacity analyses will be performed. The analysis is intended to show the relationship between operations and geometry and to assess deficiencies, as well as to identify alternatives for further consideration. This requires the identification of impacts, needs, and deficiencies. Capacity Analysis Software that accurately replicates the current HCM computations may be used in lieu of manual computations. Assumptions should be verified, as well as checking default values. Synchro software is also acceptable where appropriate. In the appendix include the full HCM-style report with all input and output values.

The Flagstaff City Charter and City Code are current through Ordinance 2016-02, passed January 19, 2016.

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D. Signal and Unsignalized Intersections Capacity Analysis

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1. Signalized Intersections

Signalized intersection level of service will be determined utilizing the methods contained in the most recent edition of the Highway Capacity Manual (HCM). Two methods (operational and planning) are used for the analysis of signalized intersections.

a. Operational Analysis

The operational analysis requires detailed information on all prevailing traffic, roadway, and signalization characteristics. It provides for a full analysis of capacity and level of service and can be used to evaluate alternative traffic demands, geometric designs, signal plans, or all three. This analysis should start with the use of existing signal timing plans if available.

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If not available, then:

- Minimum split time for protected left-turn phase shall not be less than 12 seconds if volumes warrant the need.
- Minimum pedestrian times should be satisfied on all phases with a pedestrian phase for signals modeled as coordinated signals.
- For study intersections modeled as actuated, uncoordinated signals, the intersections shall be evaluated with at-least 10 pedestrian calls per hour in the Existing + Project and Future Conditions, if pedestrian projections are not available.
- LOS calculations should be conducted using the natural cycle lengths. The cycle lengths should remain constant for comparison purposes unless the project is changing the character of the intersection and it is noted in the report.
- In instances where signalized intersections are coordinated, coordinated cycle lengths should be determined based on the natural cycle lengths of the coordinated signals, and shall be used for evaluation purposes.
- All-Red time(s) shall equal 1.0 second or greater.
- Yellow time shall equal 3.5 seconds or greater based upon the approach speeds.

LOS calculations for Existing Condition scenarios, and the near-term scenario, should use existing traffic volumes and peak hour factors, when available. All data that has been referred to in the report shall be included in the Appendix. For all cumulative scenarios and existing conditions where peak hour factors are not available, factors as per the HCM shall be used and shall be consistent throughout the cumulative scenarios and peak hours. All assumptions and defaults used shall have proper citation and justification for their use in the TIA.

Existing storage lengths shall be entered as input data if LOS calculations are conducted using Synchro. When generating reports, include the 95th percentile queue length report as an appendix. Summarize all turn lane storages at each of the analyzed intersections in a table within the report. This table shall include existing, required, and recommended storage lengths.

When more distant horizon years are studied or critical variables are missing, such as when anticipating upcoming planned or assumed development, it may be necessary to conduct a planning analysis.

b. Planning Analysis

The planning analysis only addresses capacity because it is not necessary or practical to perform detailed calculations of delay given the accuracy of the data that are generally available for planning purposes. The planning method generates important products:

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- a projection of the status of the intersection with respect to its capacity.
- an approximation of a signal timing plan.

- segment capacity including number of through and auxiliary lanes

Combining this approximation with appropriate values for other parameters used in the operational analysis, it is possible to extend the planning analysis into the level of the operational analysis.

2. Unsignalized Intersections

Unsignalized intersection level of service will be determined utilizing the methods contained in the most current Highway Capacity Manual (HCM). Procedures have been developed to analyze both 2-way stop controlled intersections and all-way stop controlled intersections. Each of these analysis methods is further divided into analysis of 4-way intersections and T-intersections.

The need for the construction or improvement of turn lanes, including an analysis of storage capacities, will be determined for all intersections in the study area.

E. Arterial Level of Service

In most cases, the capacity of an arterial street is dictated by the signalized intersections operating along its length. The analysis procedures described in the HCM rely on the results of the analysis methods above as a part of the input. Planning applications may use the entire arterial methodology, in a straightforward, but somewhat simplified way, by computing stopped delay using certain default values, as outlined in the signalized intersection analysis section. A reasonable estimation of the intended signal timing and quality of progression is vital to this process.

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F. Traffic Safety

The applicant will work with the Arizona Department of Transportation Traffic Data Records to obtain the crash data in the study area for the past three-years. The TIA will identify high accident areas, whether development traffic aggravates existing or creates new conditions, and, if so, the means by which the development will address them.

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13-05-002-0003.6 Site Specific Traffic Analysis

A. Introduction

An integral part of an overall traffic impact study relates to basic site planning principles. It is extremely important that off-site roadway improvements be fully integrated with on-site recommendations. In addition to capacity analysis, several other transportation service-related factors shall be considered, including:

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- Safety
- Parking needs and circulation patterns
- Traffic control needs
- Turn lanes (left, right, dual, deceleration, etc.)
- Driveways, including spacing, location, and design
- Access management strategies
- Transportation demand management
- Neighborhood impacts
- Pedestrian and bicycle circulation, including access to transit
- Service and delivery vehicle access and circulation

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Approach to Site Planning: Internal design will have a direct effect on the adequacy of site access points. The identification of access points between the site and the external roadway system, and subsequent recommendations concerning the design of those access points, is directly related to both the directional distribution of site traffic and the internal circulation system configuration. It is clear that driveway traffic volumes of varying sizes need to be accommodated on the site in terms of both providing sufficient capacity and queuing space, and of distributing

vehicles to and from parking spaces, pick-up/drop-off points, drive through lanes, and adjoining properties where appropriate. An integrated system should deliver vehicles from the external roadway system in a manner that is easily understood by drivers, maximizes efficiency, accommodates anticipated traffic patterns, and ensures public safety. Pedestrian linkages should conveniently and safely connect transit stops, roadway intersections and parking facilities with building entrances. Similar linkages should be provided between buildings.

B. Site Access & Design

Requirements for access to the public street system are detailed in the City of Flagstaff Engineering Standards. Modifications will only be granted according to the process outlined in the Engineering Standards. The Engineering Standards provide requirements for driveway and side street spacing, appropriate sight distances, location, median openings, signal spacing and other access management principles.

Joint access (the sharing of a driveway by two or more properties) is desirable. Such driveways should be located on joint property lines and be accessible via cross-access easements on the private property being served by the joint driveway. Joint driveways may be required to provide two or more parcels appropriate access to the adjacent street system that would otherwise be restricted when full or safe connections to adjacent roadways cannot be provided to an individual parcel.

1. Driveway Design

Analysis should review spacing between driveways, distance to nearest driveways adjacent to and across the street from the site, and spacing of off-set driveways across the street from the site and location with respect to intersections (signalized and non-signalized). Driveway locations should be reviewed for appropriateness and alignment with parking lot layout and intersecting drive aisles. Driveway width should be analyzed for necessary turning radii, truck turning movements, and ingress and egress lanes. Driveway length should be reviewed for minimum throat length needed to accommodate all inbound traffic safely on-site without backups of traffic onto the intersecting street, and to accommodate all outbound traffic queued at driveway to exit without blocking intersecting drive aisles, median openings or parking spaces. The effective length of a vehicle shall be measured in increments of 25-feet.

2. Vehicular Queuing Storage

Adequate internal and external vehicle queuing storage is essential to providing safe and efficient access and circulation. Queuing analyses must be included to demonstrate the adequacy of the proposed storage lanes, for all turn lanes, drive-throughs, and drop-off/pick-up zones. The effective length of a vehicle shall be measured in increments of 25-feet. For all right and left turn lanes, a table shall be provided in the TIA that summarizes the existing (if applicable), required (as calculated per the TIA), and proposed storage lengths for all driveways and intersections analyzed.

C. Drive - Through Queuing

Drive-in and drive-through establishments must be provided with adequate queue storage capacity to accommodate normal peak queues. Since many of these businesses have major daily or seasonal variations in activity, peaking characteristics should be carefully evaluated.

D. Turn Lane Analysis

At driveways on arterial and collector roadways, deceleration lanes may be required. Additional right-of-way may also be required to accommodate the turn lanes. To determine the need for a turn lane please refer to Chapter 10 of the Engineering Standards.

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At the discretion of the Traffic Engineer, a turn lane may be required regardless of the minimum criteria if site specific conditions warrant the addition of such a lane. In no event shall adjacent driveways be located within the area of the turn lane and the required taper lengths unless specifically approved by the Traffic Engineer.

1. Turn Lane Length Design

For turn lane lengths at unsignalized intersections use the Arizona Department of Transportation (ADOT) Traffic Guidelines and Processes (TGP) 430. For speeds under 40 mph modify ADOT TGP 430 to only include the queue length plus the taper (remove breaking distance and gap). The turn lane length at signalized intersections shall have a queue length that is based on the Synchro 95th percentile plus the taper length.

The type of vehicles used in the calculation shall depend solely on the type of facility being studied accounting for 10% truck traffic (minimum of one) where applicable.

E. Site Circulation

Internal circulation is the means by which vehicular traffic is delivered between entry points and parking areas, pick-up/drop-off points, and service areas. Internal circulation should permit access between all areas. This circulation should be designed to safely and efficiently deliver vehicles and pedestrians to their respective destinations. Parking lot layouts and on-site traffic control should be reviewed for safe circulation. Recommendations for traffic control should be made as appropriate.

1. Emergency, Service, and Delivery Vehicles

Emergency, service, and delivery vehicles require separate criteria for movement to and from the site. The applicant will identify the design vehicle. Of particular interest is that adequate turning paths are provided for large emergency and delivery vehicles to allow entry and exit without encroaching upon opposing lanes or curbed areas. In addition, sufficient storage areas and loading zones must be provided so that delivery vehicles do not hinder the use of parking and circulation routes for other visitors to the site. Detail design is not required as part of the TIA, but will be required during site plan development.

A minimum of one driveway for all proposed projects with commercial or industrial uses shall be designated as truck delivery access drives and shall meet the minimum turning path needed for the development. Additional driveways may be required in order to meet this criterion and will be determined by the Traffic Engineer based on local conditions.

2. Pedestrian, Transit, Bicycles, and Accessible Facilities

Overall site plans must consider public transportation, pedestrians, bicyclists, and those with disabilities. Adequate facilities for parking bicycles shall be included. Transit facilities, park-and-ride, and shuttle bus staging areas should be provided as appropriate for the development. Where provided, these facilities should be located adjacent to the service drive and entrance locations, at key locations along circulation drives, or at major pedestrian focal points along the external roadway system.

Pedestrian connections between these facilities and the site's buildings must be integrated into the overall project design and provide maximum accessibility through the use of sidewalk ramps, etc. These connections must also be provided to the public sidewalk and path or trail systems surrounding the site. Pedestrian connections to nearby trail systems will also be required. Pedestrian circulation should be comprehensive and provide connections between all buildings, and from all streets, signals and transit stops into the site.

Pedestrians and Bicycles: The site plan should be reviewed to ensure that the internal circulation system and external access points are designed for pedestrian safety and to minimize vehicle/pedestrian conflicts.

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Locations for transit stops, and their associated pedestrian flows to building access points, require thorough assessment to ensure safety. Similarly, pedestrian flows to and from parking facilities need careful consideration during site planning, which often requires detailed information on the project's use and layout.

These considerations should also be addressed for projects expected to generate significant bicycle traffic.

Transit: Transit standards are provided in the City of Flagstaff's Engineering Standards. There are two types of transit stops: bus pull-out bays, typically on the departure side of signalized intersections, and bus stop pads, where no pull-out bay is required. Specific standards and design details for bus pull-outs are found in the Flagstaff Engineering Standard Details.

F. Schools

For locations where schools are proposed, site specific analysis of the school site plan will be required, which includes the following:

- Safe Walking Routes to School
- Crossing Locations
- Traffic Control
- Traffic Calming
- Driveway Locations
- On-Site Drop-off/Pick-up—to maximize effectiveness of on-site queuing and eliminate back-ups onto public streets
- Pedestrian & Bicycle Circulation
- Bus Circulation
- Conformance with the ADOT "Traffic Safety for School Areas" Manual.

These items will be summarized in a separate *School Traffic Management Plan* signed by the school administration and that will remain on file at the City.

G. Traffic Calming

The City of Flagstaff Engineering Standards incorporates traffic calming into the street design elements of residential local streets. When appropriate, however, other traffic calming features may be necessary as a result of physical, property rights, or other constraints. Chapter 10 of the Standards includes a list of traffic calming features that may be used in those instances.

13-05-002-0003.7 Public Improvements Analysis

A. Introduction

In this section the applicant will provide an overview of the general capital improvements program environment within which the required site-generated improvements will take place. This section will also include a discussion of publicly funded improvements scheduled within the horizon years and reasonably anticipated privately funded improvements within the Study Area. In effect, details on project funding and timing will be provided here that go beyond the "Existing Conditions" section. In addition, the applicant will briefly describe alternative mitigation strategies considered.

B. Improvements to Accommodate Horizon Year Background Traffic

1. Status of Improvements Already Funded, Programmed, or Planned

Provide a description of projects relevant to serving background traffic as they are reported in state and local capital improvement programs and plans. Assess their delivery schedule within the context of the

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application's phasing. Relevant improvements to be delivered by private development projects may be listed if bonds or other means exist to guarantee their delivery.

2. Additional Improvements to Accommodate Background Traffic

Identify system improvements needed to address background traffic levels beyond those already programmed. If projects are planned, but not programmed, and are relevant to addressing background traffic or other transportation needs, list those and any information related to anticipated funding sources.

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NOTE: Applicants may not utilize capacity created by planned, but unfunded improvements, or improvements outside the first year of the city capital improvement program, unless cost-sharing arrangements by the applicant are agreed to.

C. Additional Improvements to Accommodate Site Traffic

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1. Localized Improvements consist of modification, expansion, and in some cases addition of roadway facilities in the immediate vicinity of the proposed development. The scope of these improvements will be consistent with the LOS criteria established above. They will address specific site and through traffic needs, and will be compatible with the city's long-term improvement plans.

2. Network (Off site) Improvements recognize that individual developments and increasing traffic volumes are part of the long-term growth of an area. Roadway improvements associated strictly with any given development may not necessarily address the long-term needs of the rest of the region on a systematic basis, and thus not address overall transportation system needs. Therefore, a section of the TIA will address compatibility with the existing and planned infrastructure.

D. Evaluation of Alternative Improvements

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Briefly describe alternate solutions considered and the reasons for their rejection. Examples might include intersection solutions, like roundabouts versus signalization, pedestrian connectivity treatments such as mid-block, signalized, or grade-separated facilities, a variety of access management solutions, or other network connections considered.

E. Travel Demand Management Strategies

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If adequate transportation improvements cannot be reasonably recommended, consideration should be given to reducing trip generation during problem periods by reducing the project magnitude or altering the land use mix or mode share. For some projects, redevelopment projects in particular, mitigation alternatives may include transportation demand management measures, including, but not limited to transit, bicycle, and pedestrian improvements.

F. Implementation Schedule

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Within the final phase of the study, all analyses are reviewed and re-assessed to best respond to the actual transportation needs of the project and the adjacent area. Results must be placed in logical perspective and sequence. It is important to make recommendations for improvements within the appropriate time perspectives. Recommendations should be sensitive to the following issues:

- Timing of short-term and long-term network improvements that are already planned, scheduled, and/or funded.
- Time schedules of adjacent developments.
- Size and timing of individual phases of development (see notes on "Phased Developments" below).
- Right-of-way needs and availability of additional rights-of-way within appropriate time frames.
- City priorities for transportation improvements and funding.

1. Phased Development

In high-growth areas, particularly when large developments are being analyzed, it is important to determine the impact of individual phases of the development. This procedure becomes necessary in situations requiring applicant provision of, or contribution to, improvements. In such cases, the following analyses should be completed:

- Levels of service under existing conditions.
- Levels of service for future horizon dates, with anticipated background traffic growth. Committed City improvements should be included for each horizon year in the analyses. Additional improvements necessary to attain minimum LOS D for base conditions should be identified (by others or by City).
- Levels of service including site generated traffic for horizon years with, or without proposed additional improvements to local and regional roadways beyond those identified in step 2.

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13-05-002-0003.8 Developing Conclusions & Recommendations

A. Introduction

Purpose and End Uses: The purpose of the TIA is to identify and measure the effects of a proposed development (subdivisions, zoning changes, site plans, building permits, or other development reviews) on the surrounding transportation system, and determine appropriate measures necessary to mitigate those impacts. The applicant will also be able to utilize the report to evaluate their development proposal and site plan design.

The results and recommendations of the TIA should be reviewed by the owner and applicant prior to submitting to the City of Flagstaff with the development package, and ensure that the recommendations and improvements are included in the proposed project and the site plan. In most cases, results of the TIA will impact the design of the development, and are required to be incorporated as an integral part of the site development.

This conclusion and recommendations section is a summation of the previous sections and follows this outline:

B. Summary of Findings

Summarize how trip generation and trip distributions were calculated/determined, and include a summary of reductions, if any were taken. Include each study intersection and segment analysis. Describe the existing conditions, the calculated/analyzed conditions, and lastly, the recommended conditions. Include pertinent tables, such as, intersection LOS, segment LOS, queue lengths, etc.

C. Site Accessibility / Circulation Plan

Summarize all site accesses and any turn lanes, if necessary. Discuss the circulation plan that was developed, including all assumptions that were made.

D. Recommended Roadway Improvements

Discuss all improvements that were highlighted in the report, for example, additional lanes, longer queue lengths, addition of a signalized intersection, addition of a roundabout, new bus stop, wider sidewalks, crosswalk improvements, etc. These improvements do not necessarily need to be mitigated in the TIA, but they all need to be stated. The mitigation process will be left for the Development Agreement (DA).

E. Other Considerations

Sample Report Outline: A sample outline structure may be found at the end of the document. It provides the framework for a Transportation Impact Analysis Report. Studies that follow this outline will be easily documented; however, additional sections may be warranted because of specific issues to be addressed and/or the results of the

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study. Likewise, inapplicable sections listed in the outline may be noted as “not applicable” in the report, but the outline format should be retained.

Please follow the sample report outline at the end of this document and any instructions provided by the Transportation Engineering Program staff when completing the analysis and report. Incomplete reports will be returned to the applicant for completion prior to a full review of the analysis.

Appendices: All appendices and attachments must be included as hard copies with the report. Appendices should be separated by labeled tabs.

13-05-002-0003.9 TIA Report Outline

I. EXECUTIVE SUMMARY

II. PROPOSED DEVELOPMENT

A. Description of On-Site Development

1. Location
2. Site Plan/Vicinity Map
3. Zoning
4. Land Use and Intensity
5. Phasing and Timing

B. Study Area Development

III. EXISTING AREA CONDITIONS AND PLANNING ENVIRONMENT

A. Study Area *NOTE: Clearly state what Level TIA*

1. Area of Influence
2. Area of Significant Impact

B. Study Area Land Use

1. Existing Land Uses
2. Existing Zoning
3. Anticipated Future Development, Land Uses & Zoning

C. Transportation Systems and Site Access

1. Area Roadway System, both Existing & Future
 - a. Roadway classifications & Posted Speed Limits
 - b. Right-of-Way, existing and required
 - c. Traffic Volumes and Conditions
2. Transit and Other Relevant Transportation Systems, both Existing & Future
 - a. Transit facilities and services
 - b. Flagstaff Urban Trails facilities
 - c. Bicycle facilities
 - d. Other pedestrian facilities, including crosswalks

IV. SITE TRAFFIC FORECASTING AND TRAFFIC PROJECTIONS

A. Site Traffic (each Horizon Year)

1. Trip Generation
2. Trip Distribution and Assignment
3. Modal Split

B. Through (or Background) Traffic (each Horizon Year)

1. Method of Projections
2. Non-Site Traffic for Anticipated Development in Study Area
 - a. Method of Projections
 - b. Trip Generation
 - c. Trip Distribution
 - d. Modal Split
 - e. Trip Assignment
3. Through Traffic
4. Estimated Volumes

V. TRAFFIC ANALYSIS

A. Level of Service Goals

B. Arterial Level of Service and Capacity Analysis Guidance

C. Traffic Signals and Unsignalized Intersections

1. Turn Lanes, both Right and Left Turn Lanes—Include Table of Existing, Required, and Proposed

D. Arterial Level of Service

E. Traffic Safety

VI. SITE SPECIFIC TRAFFIC ANALYSIS

A. Site Access & Design

B. Drive-through Queuing and Stacking Requirements—Include Table if needed

C. Deceleration Lane Analysis—Include Table of Required and Proposed Lanes

D. Site Circulation, On-Site Traffic Control, Parking

E. Schools

F. Traffic Calming

VII. PUBLIC IMPROVEMENTS ANALYSIS

A. Improvements to Accommodate Horizon Year Background Traffic

B. Additional Improvements to Accommodate Site Traffic

C. Evaluation of Alternative Improvements

D. Travel Demand Management Strategies

E. Implementation Schedule

VIII. CONCLUSIONS & RECOMMENDATIONS

A. Summary of Findings

1. Traffic Impacts

2. Need for Improvements

3. Compliance with Applicable City of Flagstaff Requirements and Codes

B. Site Accessibility/Circulation Plan

C. Roadway Improvements

1. On-Site

2. Off-Site

3. Phasing, if Applicable

4. Summary of Improvements Based on Background Traffic vs. Based on Site Generated Traffic

D. Other Transportation Mode Systems

~~A. —The impact of traffic generated by new developments and re-developments on the City's transportation network shall be considered in the approval process for all developments. The purpose for this consideration will be to:~~

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 1 ft. (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.

CHAPTER 13-06
CONSTRUCTION PLANS

Divisions:

- 13-06-001** **General**
- 13-06-002** **Plans**
- 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**

13-06-001

General

Sections:

13-06-001-0001 General

13-06-001 General

13-06-001-0001 General

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

At the time of submittal of plans for private development projects, all plan check fees per current adopted fee schedules shall be paid.

13-06-002

Plans Required

Sections:

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

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 of a minor nature, such as driveway cuts and sidewalk replacement. Plans shall be prepared by a registered professional engineer licensed in Arizona.

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 plans, 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-year period, subsequent to the date of approval.

13-06-002-0001.1 Modifications and Appeals

13-06-002-0001.1.1 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 shall not be used as a justification.
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 to 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 paragraph A above shall be utilized in a case where a project manager seeks to implement a promising 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.

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 13-06-002-0001.1.1.A. 1 thru 5 above. 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 (i.e. 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 all the provided materials and provide follow-up questions to both parties for clarification. The parties will exchange responses, and subsequently provide rebuttals. All responses and rebuttals will then be submitted to the City Manager for final review and decision.
- D. The City Manager may, at his discretion, hire a third-party professional engineer to assist him with his decision.

13-06-002-0002 Content of Plans

Plans are to meet the minimum requirements set forth in Title 13 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).

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 1" = 40' (1:500) scale horizontal (1" = 20' may be required if necessary to meet the appearance of objectives), and 1" = 4', (1:50) vertical, or larger. Overall drawing size shall be 24" x 36" 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 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.

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 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 4 mil. reverse double matte.
- F. Stick-on materials, other than Standard Blue-Stake stickers, will not be allowed on plan originals.

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.
- G. Signature block for City Utilities Director.
- H. Block for Arizona Department of Environmental Quality approval (file number and date) if applicable.
- I. Signature block for the Arizona Department of Transportation including permit number (if applicable).
- J. Completed signature blocks for representatives from all utility and cable television companies.
- K. Applicable Notes.
- L. Index of the sheets.
- M. City of Flagstaff project number in the lower right hand corner.
- N. Utility Conflict Note: "Summary of Utility Conflicts": Information to be provided under this note shall include a brief description of conflicts and the sheet number(s) where they appear.

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 bearing [per 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.

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 bench marks (T.B.M.'s) and elevations per 13-03-003-0003, relative to City datum (in NAVD-88). Plans shall also indicate the City bench mark and elevation utilized in establishing the T.B.M.
4. Property lines, easement lines, and right-of-way limits. Survey monuments identified per 13-03-002-0008(G).
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. Then coordinate tables shall be shown for points on at least one sheet of the construction/improvement drawings which depict right-of-way, easements, or property boundaries. All angle points, survey control points, and curve PC's, PT's and PI's 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 and right-of-way and easement limits located relative to the proposed improvements.
14. Basis of bearing per 13-03-002-0003, including location and description of monuments used to establish basis of bearing.
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.

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 to be 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 re-submittal 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 per 13-03-005-0001, tie into the same site benchmarks as those used for the construction plans.~~

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 13-05-005-0002 for the requirements of a registered land surveyor.](#)

13-06-002-0009 Final Plan Submittal

Upon approval of the construction plans, but prior to the issuance of a permit for construction, 1 complete set of plan originals (which shall be a 4 mil reverse double matte mylar of legible quality) and 1 additional cover sheet shall be submitted to the City for signatures. One 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 blue-line 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).

13-06-004
Drainage Plans

Sections:

13-06-004-0001 Drainage Plans

13-06-004 Drainage Plans

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 Flagstaff City Code, Title 13, Section 13-06-002-0007 of these regulations.

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

13-06-005 Water and Sewer Plans

13-06-005-0001 ADEQ Approval

All water and sewer plans must have received ADEQ approval prior to City approval.

13-06-005-0002 Plan Presentation

- A. A bench mark ~~per 13-03-003-0003 shall be referenced location (temporary bench marks may be acceptable) and elevation is to be established in the field and included~~ 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 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 1"=100' (1:1000) 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.

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.

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. Waterline crossings shall be shown in the sewer profile.

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. Waterline profiles shall be included wherever waterline depth is different than the typical standard depth and wherever necessary to clarify clearances to existing or proposed facilities. Water lines of larger than 12" 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.

13-06-006

Street Plans

Sections:

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

13-06-006 Street Plans

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.

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. Bench marks ~~per 13-03-003-0003 used.~~
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 ~~per 13-03-002-0008(A) indicated on the plans. Appropriate places are street intersections, P.C.'s, P.L.'s, P.T.'s, section corners, sixteenth corners, and subdivision corners if applicable in the streets. Please note Section 3-11-001-0001 or survey monuments.~~
12. Additional information needed to clarify plans or deal with specific conditions.
13. All plans shall meet requirements of Section 13-06-003 if separate grading plans are not included.
14. Blue Stake sticker on all sheets.
15. Resource protection areas.
16. Flagstaff Urban Trails System.
17. Erosion protection measures for roadway slopes (cut and fill).

18. All areas disturbed by grading shall be seeded per Title 17 of these standards.

B. Profiles

1. Bench marks ~~per 13-03-003-0003 shall be shown, including description of location and elevation. Source of vertical datum shall be a City accepted benchmark (in NAVD 88). This source benchmark shall be noted on plans.~~
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 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

25 ft. 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.

13-06-007 General Notes

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

13-06-007 General Notes**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-year period, subsequent to the date of approval. If construction work is not started within the one-year period, or has been discontinued for any reason for longer than one 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 24 hours prior to beginning different phases of construction so that City inspectors may be scheduled.
5. All materials and workmanship shall comply with Flagstaff City Code, Title 13, "Engineering Design and Construction 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 21 of these Standards 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 which meets Section 13-13-004-0001, fire hydrants, water mains, and street name signs 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.

13-06-007 General Notes

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 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 ARS 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 Permashield, Sacrificial Graffiti Control System (or approved equal).
20. All areas disturbed during construction shall be stabilized reseeded in accordance with Chapter 13-17 of this Title. In the event that the construction activity disturbs more than one acre, a stormwater pollution prevention plan (SWPPP) shall be prepared in order to obtain a construction general permit from ADEQ.

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 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

13-06-007 General Notes

elastomeric gaskets and couplings. All ductile iron pipe ~~lines~~ 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 feet, horizontal distance, and less than two 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 inches of concrete for at least ten feet beyond the area covered by this paragraph.
 - b. Within two feet horizontally and two 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 feet, measured from the center of the manhole.
3. The minimum separation between force mains or pressure sewers and water mains shall be two feet vertically and six feet horizontally under all conditions. Where a sewer force main crosses above or less than six feet below a water line, the sewer mains shall be encased in at least six inches of concrete or constructed using mechanical joint ductile iron pipe for ten 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 foot (1').
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 per 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 0.001 of the total manhole volume in one 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 C1244-93.

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 2 inches at termination of the service).

13-06-007 General Notes

- O. Water valves shall be adjusted per C.O.F Detail No. 9-03-060 and manholes shall be adjusted per C.O.F 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.

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: a) all curbs, pavements, sidewalks, catch basins, storm drains, and manholes have been cleaned of all dirt and debris; b) survey monuments are installed and stamped; and c) 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.
- 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. ~~A chip seal is required on all public paving projects.~~ On projects where the contractor causes excessive damage to an existing paved street or there are multiple street cuts (maximum of four in 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 3 inches of aggregate base course (ABC). The ABC shall be constructed per MAG Section 310, and shall be compacted to 95% relative density. All precast structures such as manhole bases, catch basins, and box culverts shall be constructed on a minimum of 3 inches of ABC.
- L. Permanent pavement markings.

13-06-007 General Notes

1. ~~Longitudinal pavement markings shall be installed per Section 13-16-006-0001 ADOT Standard Specification 708 and shall be applied in two coats.~~

~~Transverse pavement markings such as stop bars, crosswalks, arrows, and legends shall be installed per ADOT Standard Specification 705, Type 1.~~

2. Transverse pavement markings such as stop bars, crosswalks, arrows, and legends shall be installed per ADOT Standard Specification 705, Type 1 Section 13-16-006-0002.

M. Temporary pavement markings.

1. Temporary pavement markings, when approved, shall be installed per ~~ADOT Standard Specification 701-3.05~~ Section 13-16-006-0001 and Section 13-16-006-0002.

NOTES:

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

2. ~~NOTE-~~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 4 inches.

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 1 and September 30.

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 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 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 to three inches of specified mulch shall be placed in the area disturbed by excavation of the planting well.

B. Groundcover Installation

1. Prior to planting activities, completely remove existing weeds, including roots. Immediately prior to installation, cultivate groundcover areas to a depth of six (6) inches and grade smoothly and uniformly. Plant groundcover so the root crown is at or slightly above the bed's finish grade. After planting of groundcover and

13-06-007 General Notes

prior to mulching, spread pre-emergent weed control over planting bed soil surface per manufacturer's written directions. Install the specified mulch to a depth of two (2) inches over the entire groundcover 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.

13-06-008

Construction Traffic Control Plans

Sections:

- 13-06-008-0001 General
- 13-06-008-0002 Plan Presentation
- 13-06-008-0003 Traffic Control Device Maintenance Requirements

13-06-008 Construction Traffic Control Plans

13-06-008-0001 General

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.

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 1"=20'(1:200), for construction zones under three hundred feet (300') in length and 1"=40'(1:500) or 1"=50'(1:500) for construction zones greater than three hundred feet (300') 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 No. 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.

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.
3. Performance of flaggers.
4. Placement 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.

13-06-009

Franchise Utility Plans

Sections:

13-06-009-0001 Construction Plans

13-06-009 Franchise Utility Plans

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 locations(s), for all City of Flagstaff permitted projects for review and approval along with the first submittal of the 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.

CHAPTER 13-07

GRADING

Sections:

- 13-07-001 Design Criteria
- 13-07-002 Soils Analysis

13-07-001 Grading

13-07-001-0001 Design Criteria

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

1. The City of Flagstaff Stormwater Management Design Manual.
2. The currently adopted International Building Codes.
3. The City of Flagstaff Zoning Code.
4. The Engineered soils report (if applicable).

13-07-002
Soils Analysis

Sections:

13-07-002-0001 Soils Analysis

13-07-002 Soils Analysis

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.

CHAPTER 13-08
STORMWATER MANAGEMENT

Sections:

- 13-08-001 Stormwater Management
- 13-08-001-0001 Stormwater Management

13-08-001 Stormwater Management

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.

CHAPTER 13-09

WATER, SEWER, AND OTHER UNDERGROUND UTILITIES

Sections:

- 13-09-001 Underground Utilities**
- 13-09-002 Sewer System Design**
- 13-09-003 Water System Design**
- 13-09-004 City Participation In Utility Extension**
- 13-09-005 Recapture Agreement**
- 13-09-006 Sewer And Water Line Materials And Construction**
- 13-09-007 Reclaimed Wastewater System Design**

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

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 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 10 feet north or east of centerline and sewer on the centerline.

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 locations(s), for all City of Flagstaff permitted projects 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.

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 and fire lines and water services (strip wire 2 inches at termination).
- B. The tracer wire shall be taped to the top of water, sewer, and reclaimed wastewater mains with 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.
- B. An approved type, five pound magnesium anode shall be installed for each 1,000 linear feet of tracer wire or at least one anode at each end of the project.
1. The anodes for waterline tracer wires shall be installed near the curb and next to a water service, (but at a minimum of 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 station for each 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 waterlines 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 500 feet to the north or east side of the waterline.
6. For long lengths of reclaimed wastewater main without intersections, the connection station shall be installed to a valve box every 500 feet on the south or west side of the reclaimed wastewater line.
7. Eight 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 6-inch wide plastic warning tape, 12 inches to 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 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.

13-09-001-0003 Water 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.

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:

1. When a water main is below a sewer main, the minimum separation is two (2) feet and extra protection is always required per MAG specifications.
2. 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 per 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 parallel water mains are required, there shall be a six (6) foot minimum horizontal separation between the two 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.

2. Reclaimed wastewater mains shall be considered the same as water mains for the purpose of minimum cover and separation.

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 ARS requirements and per 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 6 inches above the sewer service even if the sewer service connection is constructed with ductile iron pipe in accordance with ~~Note 3B~~ of 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 ~~Note 3B~~ of MAG Standard Detail 404-1.

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

Water and sewer mains shall maintain six (6) feet horizontal and one foot vertical separation from storm drains and culverts.

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

Water and sewer mains shall be separated from other utilities per Engineering Detail 9-01-010 for joint trench utilities.

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.

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 10 ft. 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 feet (3 ft.) 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) ft. 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 10 feet and shall be constructed per the structural section in Standard Detail No. 14-01-010 (unpaved). The access road shall connect to a public or private road.

13-09-002
Sewer System Design

Sections:

13-09-002	Sewer System Design
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 Sizes
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 Systems
13-09-002-0013	On-Site Disposal Systems

13-09-002 Sewer System Design

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:

1. Bulletin #11 - Minimum Requirements for Design, Submission of Plans and Specification of Sewage works.
2. Bulletin #12 - The Septic Tank.
3. Bulletin #15 - Package Aeration Plants.

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.

13-09-002-0002 Wastewater Design Flows

A. Design flows utilized in the preparation of engineering design reports, plans and specifications shall, as a minimum, conform to the criteria set forth in this section.

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 100 gallons per person per day shall be used.

Table 9-1 Average Daily Flows by Land Use

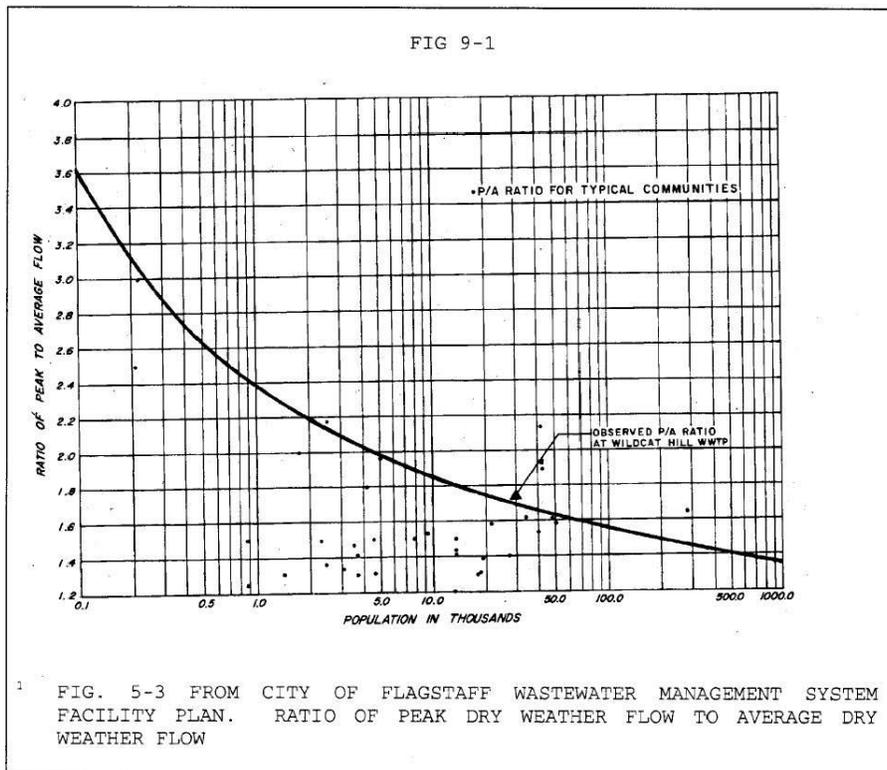
LAND USE		AVERAGE DAILY FLOW
Type		Average dry weather flow (ADWF)
Residential Single Family, Townhouses	Use 3.5 persons per dwelling unit	75 gallons per capita per day (gpcd)

LAND USE		AVERAGE DAILY FLOW
Residential Manufactured Homes, Mobile Homes	Use 3.0 persons per dwelling unit	75 gallons per capita per day (gpcd)
Residential Condos, Apartments	Use 2.5 persons per dwelling per unit	75 gallons per capita per day (gpcd)
Hotel, Motel Tourist	Use 2.0 persons per hotel/motel room	75 gallons per capita per day (gpcd)
Commercial	Use number of acres	1000 gallons per acre per day (gad) 3000 gad PEAK
Industrial	Domestic flows only	1000 gallons per acre per day (gad) 3000 gad PEAK
Schools, Colleges	Use enrollment per building	90 gallons per capita per day (gpcd)

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

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.



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 70%.

13-09-002-0004 Minimum Pipe

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

1. The d/D ratio for gravity sewer pipes shall be no greater than 0.7 at the peak flow condition.
2. Minimum pipe size shall be 8-inches in diameter.
3. A maximum of 120 acres of combined commercial and residential development shall drain into an 8-inch diameter line.

13-09-002-0005 Velocities of Flow

A. Velocities in sewer lines shall be determined for design capacities using Mannings formula $V = (u/n) (R)^{2/3} (S)^{1/2}$ where V is the average velocity (fps, m/s), u is 1.49 for English units and 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 2 fps to 10 fps flowing full.

a. A minimum velocity of 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.

Pipe Size (inches)	Min. Slope (%) 2 fps		Max. Slope (%) 10 fps	
	n=.010	n=.013	n=.010	n=.013
8	0.20	0.34	4.91	8.29
10	0.15	0.26	3.65	6.16
12	0.11	0.20	2.86	4.83
15	0.085	0.15	2.12	3.59

Note: PVC (n = .010) DIP (n= .013)

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.

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 6 inches in diameter; and at distances not greater than 400 feet for sewers 12 inches or less, and 500 feet for sewers greater than 12 inches.

Table 9-02-001

Maximum Manhole Spacing

PIPE SIZE (INCHES)	MAXIMUM MANHOLE SPACING (FEET)
Less than < 12"	400
Greater than > 12"	500

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

Table 9-02-002

Minimum Manhole Diameter

PIPE SIZE (INCHES)	MANHOLE DEPTH (FT)	MANHOLE DIAMETER (INCHES)	FRAME AND COVER DIAMETER (INCHES)
Less than < 12"	12 and less	48	24
Greater than > 12"	Greater than 12	60	30
15" and larger	Any	60	30
Drop Manholes	Any	60	30

C. A drop manhole is to be used when a sewer enters a manhole 2.5 feet or more above the manhole invert per MAG detail #426.

1. If there is less than 2.5' of fall, redesign of sewer grades is required to result in a maximum of 0.5' above the flow line of the outlet.
2. Sewer grades shall be normally designed to provide 0.1 feet fall from the flowline inlet to the flowline outlet within the manhole.
3. When a sewer main joins a 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 8" main shall be 90 degrees.
 - b. For mains 10 inches and larger the maximum deflection angle shall be 60 degrees.
 - c. The minimum flow line radius shall be 2 feet.

D. Concrete caps on manholes located outside roadways or parking lots shall have a continuous #3 rebar centered in the cap.

E. One adjustment ring or one 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.
 - a. 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. Water-tight 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.

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

When the depth of a sewer line exceeds 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 20 feet may be required. Sewer lines deeper than 25 feet will not be allowed.

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.

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 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 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 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 5 feet, and there shall be one connection per length of VCP and two 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).

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 preventative 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 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 100-year storm scouring.

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. Offsite 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 A.A.C. 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 24 hour response and mitigation by qualified personnel.
4. Per A.A.C. R18-9-E301, sewer collection, force mains, and lift stations having the design flow of 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.

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

On-site disposal systems will be permitted only as outlined in Arizona Administrative Code3 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.

13-09-003

Water System Design

Sections:

- 13-09-003 Water System Design
- 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
- 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.

13-09-003 Water System Design

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:

- A. Bulletin #10 - Minimum Basic Design Criteria for Construction of Water Distribution and Water Treatment Systems.
- B. Bulletin #8 - Disinfection of Water Systems.

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 (per Chapter 13-13, Fire Safety Requirements) and peak hour flows (per this Chapter) simultaneously with no

residual pressures in the system dropping below 20 psi. In order to assure that a 20 psi residual pressure within the public system is maintained, a minimum static pressure of 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 20 psi.
2. System analysis is required and shall include anticipated future expansions.

B. Water mains shall be designed to maintain between 40 and 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 20 psi at a point of maximum fire flow, at a flow velocity of less than or equal to 10 fps.

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

C. The maximum allowable head loss for transmission lines is eight (8) feet per 1,000 feet (8 ft. / 1,000 ft.) and 10 feet per 1,000 feet (10. ft. / 1,000 ft.) 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 8-inch diameter be permitted (in connection with a grid network).

1. A new minimum 8-inch main is required if the existing main is less than 6 inches and a new or larger service (even a 3/4 inch) is required.
 - a. A 6-inch diameter pipe may be permitted only in special cases (such as dead-end stubs-outs less than 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 1000 feet or with more than three fire hydrants shall have two or more connections to an existing main and the main shall have at least one valve between the connections.

3. Fire hydrants shall be served from an 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.

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 40 to 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 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.

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.

13-09-003-0004.1 General

Minimum pipe sizes shall meet the criteria established in Title 13, 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.

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

Type of dwelling units	Number of persons/unit
Mobile home	3.0
Single family	3.5
Multi-family	2.5
Hotel/Motel	2.0

Table 9-4 Water Demand Criteria

LAND USE	AVERAGE	PEAK
Residential Single Family, Low Density	120 gpcd	300 gpcd
Residential Single Family, TH Medium Density	100 gpcd	250 gpcd
Residential Apartments, Condos, High Density	75 gpcd	250 gpcd
Hotel, Motel Tourist	75 gpcd	200 gpcd
Commercial	2000 gad	5000 gad
Industrial	2000 gad	5000 gad
gpcd = gallons per capita per day		
gad = gallons per acre per day		
FROM CITY OF FLAGSTAFF "WATER SYSTEM IMPROVEMENT PROGRAM"		

NOTE: If a proposed development does not fit within the categories listed above, a maximum daily consumption of 200 gallons per person per day shall be used. For clarification, the following example characterizes the calculations performed to determine the design flows and quantities involved in a hypothetical system design.

The Flagstaff City Charter and City Code are current through Ordinance 2016-02, passed January 19, 2016.

EXAMPLE: Hypothetical water demand/flow evaluation
ASSUME: A 120-dwelling unit, medium density, residential subdivision development
CRITERIA: From Table 13-09-03, and Table 13-09-04, "Water Demand Criteria" population density = 3.5 persons per dwelling unit
Maximum daily consumption = 250 gallons per capita per day (gcpd)
Design population = 120 x 3.5 = 420 people
Maximum total daily consumption = 250 x 420 = 105,000 gallons per day (gpd)
Peak day flow rate = 105,000 gpd/1440 mpd = 72.92 gpm

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.

13-09-003-0004.3 Fire Flow Demand

A. 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 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 2-10 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 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 9-5

MINIMUM FIRE FLOW REQUIREMENTS

1000 gpm for single family residential
1500 gpm for multi-family residential
1500 gpm for commercial and industrial areas

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 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.

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] ft.).
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 4-way cross, ~~one (1)~~ two (2) valves minimum ~~is~~ are required on all 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 waterline between temporary blow-off valves and the plug.

13-09-003-0006 Valve Box Assembly

- A. All valve boxes shall be DOMESTIC (non-import), Tyler Series #6855 or East Jordan Iron Works Model #8555 or equivalent, having a minimum shaft diameter of 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 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 95%.
- F. Fill material shall be compacted to 95% around valve and valve boxes up to finished grade in 1 foot lifts.
- G. If a valve nut, whether existing or new, ends up to be 16 inches or less from finish grade, one top section box, w/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 sub-standard 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. 2-piece valve box assemblies are preferred as shown in Engineering Detail 9-03-060, Figure A. Bottoms come in lengths of up to 60 inches. Tops come in lengths of up to 26 inches.
- K. Another option is adjusting with one 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, 2 1/2 inch x 72 inch "Carsonite" valve marker with concrete ring.

13-09-003-0007 Water Services

- A. All pipe and fittings for water services shall have a minimum pressure rating of 200 psi.

1. Where not otherwise noted on the plans, all water services shall be at least 3/4 inch I.D. and shall have a minimum cover of 30 inches and a maximum depth of 48 inches except for the last 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 4 feet from the water service including no crossings near the curb stop.
- D. Installation of 3/4 inch and 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 16 inches or larger, fire sprinkler lines or on the 6-inch lead line between the 6-inch valve and the fire hydrant on fire hydrant assemblies.
 2. Only one meter per lot, 3/4 inch maximum, is allowed on existing 2-inch water lines.
 3. No multifamily or commercial connections may be made on a 2-inch line. No more than 16-3/4" meters will be allowed on any 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 3 feet to allow a minimum separation of 2 feet between curb stop and gas line; or the PE gas line must be sleeved inside a pipe Schedule 40 or greater.

13-09-003-0007.1 Copper Tubing and Fittings

- A. Copper tubing for 3/4 inch and 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 1 1/2-inch and 2 inch shall be Type L or better rigid copper.
- B. All fittings used in connection with 3/4-inch and 1-inch Type K soft copper tubing shall be Mueller or Ford Quick Joint couplings (type K cooper). No other pack joint couplings will be accepted.
- C. All fittings used in connection with 1 1/2-inch and 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 90,000 P.S.I. (621 MPa) self-fluxing, lead-free, manufactured by turbo-torch.

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 P.V.C. C-900 or approved main, a P.V.C. 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 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 #393.

13-09-003-0007.3 Corporation Stops

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

B. All 1 1/2-inch and 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 3/4 inch and 1 inch shall be I.P. thread inlet. 1 1/2 inch and 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 3/4-inch and 1-inch corporation stops only (no pack-joint couplings will be accepted).

D. All corporation stops shall be installed at a 45 degree angle toward the lot to be served.

E. Corporation stops of 1 1/2 inch and 2 inch shall include a swing type connection consisting of two 90 degree brass ells and one 1 1/2-inch x 2 1/2 inches or 2-inch x 2 1/2 inch brass nipple between the 90 degree ells.

13-09-003-0007.4 Curb Stops

A. All 3/4-inch and 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, 6 inches under and up to 6 inches below finished grade.

1. No oriseal type curb stops are allowed.

B. All 1 1/2-inch and 2-inch meter valve connections shall be IPx IP 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 1-1/2-inch or 2-inch meter valve connection.

C. Angle stop valves for 3/4-inch shall meet or exceed those manufactured by the Mueller B-2427, or Ford BA41-333WQ or approved equal. For 1" angle stop valves, use Mueller #B24274 or Ford #BA41-444WQ or equal.

D. Angle stop valves for 1 1/2-inch and 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 1 1/2-inch and 2-inch.

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 or 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 12 ga. (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.

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 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 1/2 CY of cinder sand within 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 2 inches from the inside of the inlet side of the box and 20 inches below finished grade. (See Detail No. 9-03-070.)
 - b. The curb stop shall be located per Detail 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 6 inches beneath the bottom of the box (minimum) and up to 6 inches beneath the finished grade around boxes (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 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 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, per the International Plumbing Code, Section ~~606.4005~~.
 - a. The valve must have its own acceptable valve box.

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 3/4 inch branches off a single 1-inch service.
2. U branches shall be straight line with 3/4-inch iron pipe outlets and a minimum of 13 1/2-inch center to center separation.
3. U branches shall meet or exceed those manufactured by the Mueller, Jones, and Ford companies, FORD UVB23-42W-13, MUELLER H-15362-13.

B. Multiple Meters: Manifolds

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

Table 9-03-001

MAXIMUM NUMBER OF METERS ON ONE SERVICE				
Service Size	Meter Size			
	3/4 inch	1 inch	1-1/2 inch	2 inch
3/4 inch	1	0	0	0
1 inch	2	1	0	0
1-1/2 inch	4	2	1	0
2 inch	8	4	2	1

2. Each manifold of 3 or more meters shall be constructed of copper sweat fittings (with City of Flagstaff approved silver flow brazing) with a separation of 13 1/2-inches. Each service curb stop shall have a minimum of 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 per City of Flagstaff Detail No. 9-03-081.

3. All 1 1/2-inch and 2-inch service connections with manifolds shall have a control valve within 18 inches to 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 C.O.F. Detail 9-03-081.

4. All 1 1/2 inch and 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.

13-09-003-0008.2 Compound Meters

A. Compound meters shall be installed per City of Flagstaff Detail No. 9-03-082 and fire service meters shall be installed per City of Flagstaff Detail No. 9-03-083.

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.

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 per City of Flagstaff Detail [No. 9-03-101 for pipes as large as 12" in diameter, and Detail No. 9-03-100 for larger sizes.](#)

13-09-003-0011 Thrust Block Design

Engineer's design must fit [the main size and design](#) & 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.

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 which 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 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 years of operation. Replacement capital costs shall be based on a ten year life of pumps and motors.
 - b. Capital with a life of greater than ten 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 5% rate of inflation and then discounted back to their present value using a factor equal to the previous average six 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 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 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 250,000 gallons.

D. Pump stations for residential, industrial and commercial areas shall be designed by the developer's engineer with due regard for 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 24 hours with one pump out of service while under normal demand conditions.

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

13-09-003-0013 Wells

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.

13-09-003-0013.2 Construction Materials

A. The acceptable materials for well casings are:

1. Single-ply carbon steel conforming to ANSI/AWWA C305, API Specification
2. Single-ply high strength, low alloy steel conforming to ASTM A714.

3. Single-ply stainless steel conforming to ASTM A409.

B. Acceptable joint types for casing materials are welded or threaded AWWA C206. All screens and fittings shall be stainless steel including 20 ft. blank pump chambers. Spacers shall be of the same material as the blank casing and well screen.

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) ft. wide double drive access gate with at least twelve (12) ft. clear space.
3. The station shall have a paved access road at least twelve (12) ft. wide with a maximum slope not to exceed 12%.
 - a. A 45-foot radius turnaround shall be provided if the access road exceeds 50 ft. in length.
4. The interior of the compound shall be surfaced with 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 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.
19. Pump base concrete slab.
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 6 inches thick and slope away from the well head a minimum of 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 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.

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.

13-09-003-0014 Water Storage Facilities

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 due regard for 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.

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.

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 250,000 gallons.

13-09-003-0014.4 Design Considerations

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

1. A 6-ft. 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 16 feet clear space.
3. The station shall have a paved access road at least 12 ft. wide with a maximum slope not to exceed 12%.
4. The interior of the compound shall be surfaced with a 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 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 non-elevated storage, a backup power supply capable of operating the pump station for eight 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.
13. Outside ladder safety cage with locking security gate at base.
14. Water level indicator.
15. Tank vent housing.
16. Two (2) separate 36-inch, square-hinged roof access openings (one 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.

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.

13-09-004

City Participation in Utility Extensions

Sections:

13-09-004 City Participation in Utility Extensions

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

13-09-004 City Participation in Utility Extensions

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.

13-09-005

Recapture Agreement

Sections:

13-09-005 Recapture Agreement

13-09-005-0001 Recapture Agreement

13-09-005 Recapture Agreement

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 pro-rated 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 years.

13-09-006

Sewer and Water Line Materials

Sections:

13-09-006	Sewer and Water Line Materials
13-09-006-0001	Sewer and Water Line Materials and Construction
13-09-006-0002	General Requirements
13-09-006-0003	Pipe Bedding
13-09-006-0004	PVC Pipe for Sanitary Sewers
13-09-006-0005	PVC Pipe for Water Lines
13-09-006-0005.1	General
13-09-006-0005.2	Specifications
13-09-006-0005.3	Affidavit of Compliance
13-09-006-0005.4	Approved Manufacturer and Model
13-09-006-0006	Fire Hydrants
13-09-006-0006.1	Fire Hydrant Testing
13-09-006-0006.2	Fire Hydrant Specifications
13-09-006-0006.3	Fire Hydrant Installation Notes
13-09-006-0006.4	Fire Lines
13-09-006-0007	Back Flow Prevention Devices

13-09-006 Sewer and Water Line Materials

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 15 inches and less. For pipe diameters greater than 15 inches, ductile iron pipe (DIP) shall be used as specified in Subsection 2 below.
2. Class 150 dD Ductile iron pipe (DIP) conforming to the appropriate MAG section. DIP may be used for sewer lines, 8 inches through 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 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) 4-inch to 10-inch diameter, and Class 250 DIP for 12-inch and larger, conforming to MAG section 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 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 250 psi rating shall be used on water mains that are twelve (12) inches and smaller in diameter. Gate valves with non-rising stems shall be used for all locations and be resilient seat and epoxy coated inside and out. Butterfly valves with C504 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 per manufacturer recommendations). The casing ends shall ~~be grouted with light flyash cement and sealed in a manner acceptable to the Utilities Department with end seals by Advanced Products & Systems, or approved equal.~~ (See Detail 9-06-010.)

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

C. The design engineer may submit a carefully documented and considered written proposal for alternate pipe line materials and construction methods. The City Engineer and the Utilities Director will review this proposal for use of alternate pipe line 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.

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.

13-09-006-0003 Pipe Bedding

- A. The City of Flagstaff will accept back filling of trenches with a non-shrink backfill as an alternative to standard trench backfill material. The non-shrink backfill shall be proportioned as follows: 2600 lbs. of 3/8-inch minus aggregate, 800 lbs. sand, 94 lbs. cement and 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).

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

- A. The pipe material used shall be SDR35.
- B. The pipe shall be installed per 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.

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

13-09-006-0005.1 General

A. PVC waterline, in conformance with AWWA C-900 standards and the City of Flagstaff requirements, will be allowed for water distribution mains, 8 inch to 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 12 inches unless written approval is obtained from the City Engineer for each individual situation.

B. All other standards applying to waterline 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.

13-09-006-0005.2 Specifications

A. All poly vinyl 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 1/2 the maximum as recommended by the manufacturer, horizontally and vertically.

D. The type of pipe furnished shall be marked per AWWA C-900 specifications, Section 2.5 and to 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 20 foot (plus or minus 1 inch) laying lengths for all sizes. Short lengths may be field cut for making required horizontal or vertical deflections. At least 85% of the total footage of pipe in any class and size shall be furnished in standard lengths, the remaining 15% in random lengths. Random lengths shall not be less than 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 per 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 per ADEQ Bulletin 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 2 inches) and drilling tools (3/4 inch to 2 inches). All tapping with sleeves and/or service connections shall be accomplished per 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 ~~cast-iron-or~~ ductile iron and polyethylene encased in accordance with applicable City specifications and AWWA C-110 (minimum pressure rating is ~~250200~~ psi).

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

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

Nominal Pipe Size Inches	Allowable Leakage (gph) (per 1,000 feet or 50 Joints)
6	0.57
8	0.76
10	0.96
12	1.15

Formula English Units

$$L = \frac{7400}{ND \times P^{1/2}}$$

Design Basis

WHERE: L = Allowable Leakage (gph).
 N = Number of Joints in the Tested Line (pipe and fittings).
 D = Nominal Diameter of Pipe (inch)
 P = Average Test Pressure (psi).

WARNING: WATER PRESSURE TESTING ONLY. AIR TESTING IS NOT ALLOWABLE.

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.

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.

The Flagstaff City Charter and City Code are current through Ordinance 2016-02, passed January 19, 2016.

- a. Vinyltech.
- b. Johns-Manville.
- c. Certainteed.
- d. PW Pipe by Pacific Western Extruded Plastics Co.
- e. Uponor ETI
- f. North American Pipe Corporation
- g. Diamond Plastics

13-09-006-0006 Fire Hydrants

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 following paragraph). 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 5 fl. oz. per min) through the drains; per the current AWWA Standards for Testing.

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 2 inches above ground level, 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 5-1/4 inches to assure optimum flow.

F. Standpipe (hydrant barrel) inside diameter shall not be less than 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 1-1/2 inches point to flat (National Standard).

J. Hydrants shall have a 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 drain ports in the shoe of the hydrants. These drain ports shall be brass lined to prevent rusting.

L. Hydrants shall have two 2-1/2 inch nozzles and one 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 primer coat and two coats of epoxy enamel yellow paint.

P. The center of the lowest nozzle shall have a ground clearance of not less than 15 inches.

Q. All fire hydrants, when installed, shall have a clear, level working area extending not less than 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 3 feet-foot area of a hydrant. Banks shall be excavated to obtain such clearance and an approved retaining wall with footing shall be constructed where the excavated bank exceeds 18 inches in height, as shown in the Engineering Standard Detail 13-03-011.

R. A class "A" concrete pad 4-6 inches thick and 3 feet x 3 feet square, shall be placed around a fire hydrant barrel a minimum of 3 inches below the bottom of a traffic flange; 6 inches maximum.

S. Fire hydrant types shall be limited to Waterous Pacer Model WB-67-250 w/18" upper standpipe, Mueller Super Centurion Model 250, & A423 and Clow Medallion Model F-2545.

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 3/4 of the way up the back of the shoe and "V" shaped to solid ground. Thrust blocks shall be a minimum of 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 8 inches and reduced to 6 inches, there shall be two valves; one flanged X MJ at the main and one MJ X MJ by the fire hydrant a minimum of 2 feet from the fire hydrant with the valve meg-lugged to the hydrant lead run.
5. Fire hydrants shall also be strategically located so as to avoid conflicts with vehicular traffic as follows:
 - (a) When a hydrant is located near the intersection of two streets, it should be located no less than ~~10~~³⁰ ft. 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 10 ft. from the edge of the driveway.
6. Fire hydrants installed within curbed islands shall be located a minimum of 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 300 feet of all parts of a commercial building. Hydrants shall also be placed within 100 feet of Fire Department connection to sprinkler and standpipe systems.
8. Offsite spacing shall be 300 feet between hydrants for commercial areas and 500 fee spacing for one and two-family subdivisions.
9. Fire hydrants will have a maximum 6 ft. bury.
10. Where a fire hydrant is located in a concrete section (sidewalk, slab, or other concrete structure) a 4' x 4' 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 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.

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 4-inch (FLANGE X MJ) valve at the main. The 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 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 – 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.

13-09-006-0007 Back Flow Prevention Devices

Backflow preventers shall be installed as required by the City of Flagstaff Code, Chapter 7-03, City Water System Regulations, Section 7-03-001-0015, Cross-Connection Control, and shall be installed per City of Flagstaff Details 9-06-071 through 9-06-075.

13-09-007

Reclaimed Wastewater System Design

Sections:

- 13-09-007 Reclaimed Wastewater System Design
- 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

13-09-007 Reclaimed Wastewater System Design

13-09-007-0001 Guide For Design

Reclaimed water shall be used for non-potable 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.

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 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 4-way cross, one (1) valve minimum is required on all 3-way Tee fittings.

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

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 13-09-01-0002.

13-09-007-0004 Thrust Block Design

Engineer's design must fit main size, design, and soil conditions.

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 7000 ft. 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 of the pumps out of service.

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.

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.

13-09-007-0007.1 General Requirements

See construction of public water lines.

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.

CHAPTER 13-10
STREETS

Sections:

- 13-10-001 Street Layout**
- 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**

13-10-001

General

Sections:

13-10-001 General

13-10-001-0001 General

13-10-001 General

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 Section 13-10-012. The City Engineer shall approve all such design.

Functional classifications are defined in ~~the Circulation Element of the Regional Land Use and Transportation Plan (Regional Plan) Section 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 nature of the predominant vehicle trips, i.e., mobility vs. access, the percentages of local delivery vehicles and 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 ~~Section 13-10-014~~ ~~the Regional Plan~~.

Sections 13-10-001 through 13-10-011 of these Standards 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 Section 13-10-012 of these Standards.

13-10-002
Street Design

Sections:

13-10-002 Street Design
13-10-002-0001 Street Design

13-10-002 Street Design
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 Section 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 500 ADT. When the traffic volumes on a given street exceed 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 660 ft. A speed control point is defined as any one 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 300 ft. and a corresponding delta of 30° 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 10-2 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.

13-10-003

Street Naming and Addressing

Sections:

- 13-10-003 Street Naming and Addressing
- 13-10-003-0001 Street Naming and Addressing
- 13-10-003-0002 Street Name Policy

13-10-003 Street Naming and Addressing

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.

13-10-003-0002 Street Name Policy

A. The Engineering Section has established the overarching standards for street name extensions:

Type	Extension Name
Misc. arterial/collector street	Boulevard (Blvd./Road (Rd.))
East/west arterial/collector	Avenue (Ave.)
North/south arterial/collector	Street (St.)
East/west local	Drive (Dr.)
North/south local	Lane (Ln.)
Miscellaneous local	Way/Circle (Cir./Loop (Lp.))

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 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.

13-10-004
Dead End Streets

Sections:

- 13-10-004 Dead End Streets
- 13-10-004-0001 Dead End Streets
- 13-10-004-0002 Warning Devices

13-10-004-0001 Dead End Streets

A. No dead end street of a permanent nature shall be longer than 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 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 will be 40-foot radius.~~ The temporary turn-around shall be per 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.

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.

13-10-005

Alleys

Sections:

13-10-005 Alleys

13-10-005-0001 Alleys

13-10-005 Alleys

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 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.

13-10-006

Intersection Design

Sections:

- 13-10-006 Intersection Design
- 13-10-006-0001 Intersection Design
- 13-10-006-0002 Intersection Sight Triangles, Clear View Zones

13-10-006 Intersection Design

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 follow: arterial – 100 feet, major collector – 75 feet, minor collector – 50 feet, and local – 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 75 degrees. Where two residential local streets intersect, the minimum angle shall be 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 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 center-lines. Consult Section 11 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 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 $\pm 2\%$ for a distance of 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

Minimum Spacing of Driveways to Intersections	
SIGNALIZED	
Posted Speed (mph)	Minimum Spacing to Intersection (ft)
< or =30	230
35	275
40	320
45	365
UNSIGNALIZED	
30	115
35	135
40	155
45	180

13-10-006-0002 Intersection Sight Triangles, Clear View Zones

A. 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.

~~B. The clear view zone is the triangular volume defined by the intersection sight triangle and sight lines between the driver's eye on each leg of the intersection and a vehicle approaching on the other leg. Driver's eye height is the range of 3.5 ft. to 8 ft. above the roadway, and the approaching vehicle is a point which is 3.0 ft. above the surface of the roadway at the center line of the nearest through approach lane.~~

13-10-007

Horizontal Alignment

Sections:

- 13-10-007 Horizontal Alignment
- 13-10-007-0001 Horizontal Alignment
- 13-10-007-0002 Other Design Considerations

13-10-007 Horizontal Alignment

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.

13-10-007-0002 Other Design Considerations

- A. Tangents from centerline deflection shall be connected by a curve per 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 500 feet to discourage high speeds.

13-10-008
Vertical Alignment

Sections:

- 13-10-008 Vertical Alignment
- 13-10-008-0001 Vertical Alignment
- 13-10-008-0002 Other Design Considerations Shall Be Based On the Following

13-10-008 Vertical Alignment

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.

13-10-008-0002 Other Design Considerations Shall Be Based As Follows:

- A. Grades. Maximum grade for any street varies from 6-10% depending on street classification (Table 10-1). Minimum flow line tangent grades shall be 0.4% (the preferred minimum is 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 2%.
- C. Vertical Curves. All straight grades which deflect by more than 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 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:

$L = K \times A$ (where: L = minimum curve length (ft.)

K = rate of vertical curvature (ft./%)

A = algebraic difference in grades (%)

TABLE 10-08-01

MINIMUM VERTICAL CURVE LENGTH			
DESIGN SPEED	MINIMUM LENGTH	RATE OF VERTICAL CURVATURE K (ft. per % grade change)	
		CREST	SAG
mph	ft.		
20	60	7	17
25	75	12	26
30	90	19	37
35	105	29	49
40	120	44	64
45	135	61	79

MINIMUM VERTICAL CURVE LENGTH			
DESIGN SPEED	MINIMUM LENGTH	RATE OF VERTICAL CURVATURE K (ft. per % grade change)	
mph	ft.	CREST	SAG
50	150	84	96

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 25 foot stations.

DB. Curb Returns. Data shall be given which will include curb elevations at 1/2 delta, (1/4 delta preferred) around the return, tangent slopes, P.I. elevations, and other related features

ED. Bench Mark. Permanent bench marks shall be established in projects having no bench mark in the immediate area. The City of Flagstaff datum shall be the one used. ~~Consult Section K for the type of monument to be used.~~ The City source datum shall be noted on the plans.

13-10-009
Structural Section

Sections:

13-10-009 Structural Section
13-10-009-0001 Structural 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 every 500 ft., or as determined by the engineer. The pavement shall be designed for a 20~~7~~ 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 10-9-010, 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 in 500 ft.), 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 2% or less than 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 2-horizontal to 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 2-horizontal to 1-vertical exceeding 6 feet in height shall use rigid or semi-rigid erosion protection products including, when appropriate, reseeded pursuant to Flagstaff City Code, Title 13, Chapter 17, Erosion Control/Seeding. All slopes of 3-horizontal to 1-vertical slopes or greater, including 2-horizontal to 1-vertical slopes of less than 6' in height, shall be reseeded pursuant to Flagstaff City Code, Title 13, Chapter 17, Erosion Control/Seeding. 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 City Code Title 3, Section 10-001-0002. The fee shall be paid at the time of the applicable construction permit.

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13-10-010

Driveways

Sections:

13-10-010 Driveways

13-10-010-0001 Driveways

13-10-010-0002 Right Turn Deceleration Lane Warrants

13-10-010 Driveways

13-10-010-0001 Driveways

- A. Driveways shall be designed and constructed in accordance with the current M.A.G. 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.

Table 13-10-010-0001

Minimum Drive Spacing (Measured Edge to Edge) on Arterials and Collector Streets	
Street Type	Minimum Spacing (ft.)
Major Arterial	230
Minor Arterial and Major Collector	150
Minor Collector	125

- b. Mitigation of problems created by such access points may also be required such as raised medians, turn restrictions, or right turn lanes.
 - c. When a property fronts on more than one 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 dwelling units are classed as commercial driveways. Residential driveways shall be located a minimum of 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 through lanes shall be either lined up directly opposite each other or separated, center to center by 120 ft. along the street.

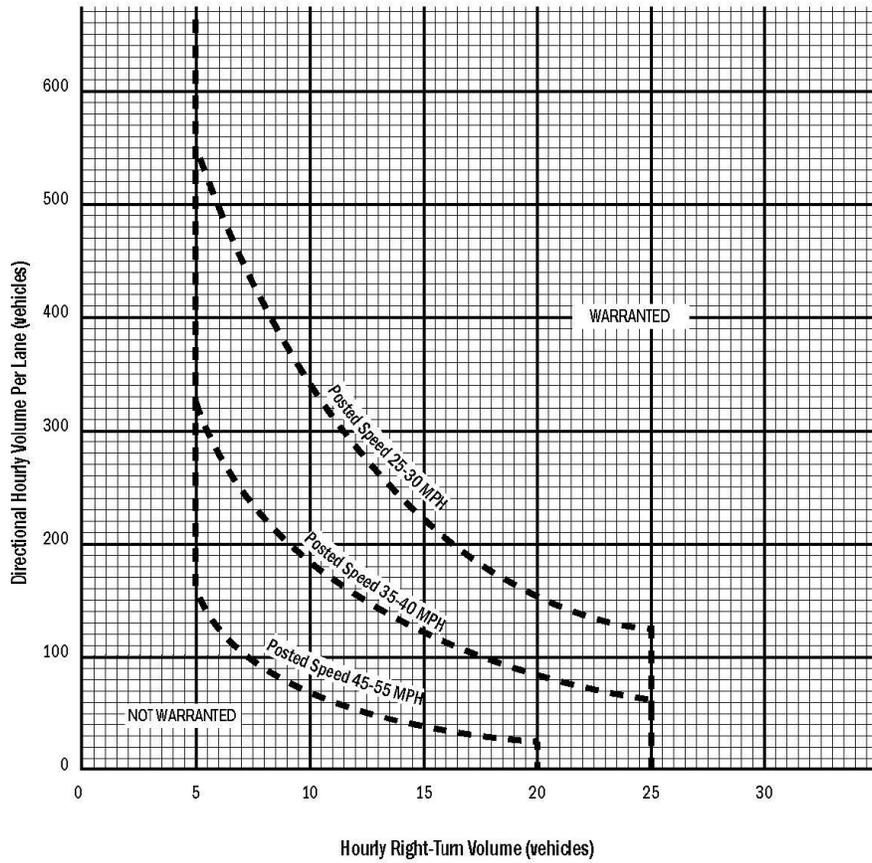
- E. Parking areas shall not be designed to require backing maneuvers out of driveways onto arterial or ~~major~~ collector streets, or any commercial driveway on any street.
- F. Docking, loading, and parking areas shall be designed so that no portion of a circulation or approach maneuver is accomplished by using a public street.
- G. Maximum commercial driveway slope shall be 10%, with a minimum of 20 feet of tangent at a maximum grade of 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 M.A.G. 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.

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



Sources: Idaho Transportation Department "Traffic Manual";
Transportation Research Board, NCHRP Report 348, Access Management Guidelines for Activity Centers.

Figure 5-2

13-10-011

Resource and Slope Design Criteria

Sections:

13-10-011 Resource and Slope Design Criteria

13-10-011-0001 Resource and Slope Design Criteria

13-10-011 Resource and Slope Design Criteria

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 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 3-feet.

Table 10-10-01

Functional Classification/Design Criteria

URBAN								
Functional Classification(*)	Major Arterial	Minor Arterial	Major Collector	Minor Collector	Commercial Local	Residential Local "Wide"	Residential Local	Residential Local "Narrow"
Max. Through Lanes	4	4	4	2	2	2	2	2
Maximum Average Daily Traffic						1000	500	250
On Street Parking	Not allowed	Not allowed	Not allowed	Not allowed	Not allowed	Not striped	Not striped	Not striped
Bicycle Provision	4.5'	4.5'	4.5'	4.5'	In travel lane	In travel lane	In travel lane	In travel lane
Total A.C. Width	68'	68'	**68'/64'	42'	24'	33'	29'	23'
Width (B.C. to B.C.)	72'	72'	**72'/68'	46'	28'	37'	33'	27'
Minimum R.O.W. (See Note #2)	98'	98'	**96'/92'	70'	52'	61'	57'	54'
Through Lane Width	12'	12'	12'>=40 mph 11'<40 mph	11'	12'	NA 10.5'	NA Total A.C. = 27'	Total A.C. = 23'
Auxiliary Lane Widths	11'	11'	11'	11'	NA	NA	NA	NA
Edge Treatments	Vertical C/G	Vert. C/G	Vert. C/G	Vert. C/G	Vert. C/G	Vert. C/G	Vert. C/G ***	Vert. C/G ***
Min. Sidewalks (See Note #3)	6'	6'	5'	5'	5'	5'	5'	5'
Min. Parkway (See Note #8)	5'	5'	5'	5'	5'	5'	5'	5'
Offset	2'	2'	2'	2'	2'	2'	2'	2'
Parking Lane	Not allowed	Not allowed	Not allowed	Not allowed	Not allowed	Not striped	Not striped	Not striped
Minimum median width (See Note #7)	15'	15'	15'	NA	NA	NA	NA	NA
Max. A.C. Width @ Signal w/o Median	68'	68'	68'	68'	NA	NA	NA	NA

The Flagstaff City Charter and City Code are current through Ordinance 2016-02, passed January 19, 2016.

URBAN								
Functional Classification(*)	Major Arterial	Minor Arterial	Major Collector	Minor Collector	Commercial Local	Residential Local "Wide"	Residential Local	Residential Local "Narrow"
Max. A.C. Width at Non-Signalized Inters. w/o Median	48'	48'	48'	48'	NA	NA	NA	NA

* Functional classifications are further defined in [Section 13-10-014 the Regional Land Use and Transportation Plan](#)

** 1. For travel lanes adjacent to a raised median, increase travel lane width by 1'.

2. All truck routes – min. through lane width of 12' and a 30' curb return radius at intersections.

* Functional classifications are further defined in the [Regional Land Use and Transportation Plan](#)

** All truck routes – min. through lane width of 12' and a 30' 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 40'. This is limited to those streets within the development that front the houses.

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Table 10-10-01 (Continued)

Functional Classification/Design Criteria

URBAN								
Functional Classification (*)	Major Arterial	Minor Arterial	Major Collector	Minor Collector	Commercial Local	Residential Local "Wide"	Residential Local	Residential Local "Narrow"
Corner Cut-Off (see note #4)	25'	25'	20'	15'	15'	15'	15'	15'
Curb Ret. Radius	30'	30'	25' **	20' **	20'	15'	15'	15'
Design Speed	45 MPH	40 MPH	40-35 MPH	30 MPH	25 MPH	20 MPH	20 MPH	20 MPH
Superelevation (See Note #5)	4% Max.	4% Max.	4% Max.	None	None	None	None	None
Min. Curve Radius (See Note #5)	1,000 900'	600 667'	600 667' (40mph) 454' (35 mph)	300'	150 181'	100'	100'	100'
Maximum Grade	6%	6%	6%/7%	8%	10%	10%	10%	10%
Property Access	Major D/W Only	Major D/W Only	Major or Combined D/W Only	Individual D/W Head Out	Individual D/W Head Out	Individual D/W Back Out	Individual D/W Back Out	Individual D/W Back Out

* Functional classifications are further defined in [Section 13-10-014 the Regional Land Use and Transportation Plan](#)

** 1. For travel lanes adjacent to a raised median, increase travel lane width by 1'.

2. All truck routes – min. through lane width of 12' and a 30' curb return radius at intersections
* Functional classifications are further defined in the Regional Land Use and Transportation Plan

Table 10-10-01 (Continued)

Functional Classification/Design Criteria

URBAN					
COMMERCIAL CENTER STREETS					
Functional Classification (*)	Major Arterial	Minor Arterial	Major Collector	Minor Collector	Local
Max. Through Lanes	4	4	4	2	2
On Street Parking	6'	6'	6'	6'	6'
Bicycle Provision	5'	5'	5'	5'	In travel lane
Total A.C. Width	81'	81'	81'/77'	55'	36'
Width (B.C. to B.C.)	85'	85'	85'/81'	59'	40'
Minimum R.O.W. (See Note #2)	117'	113'	113'/109'	87'	68'
Through Lane Width (**)	12'	12'	12'>=40mph 11'<40mph	11'	12'
Auxiliary Lane Widths	11'	11'	11'	11'	11'
Edge Treatment	Vert. C/G	Vert. C/G	Vert. C/G	Vert. C/G	Vert. C/G
Min. Sidewalks	10'	10'	10'	10'	10'
Furnishing Strip	5'	3'	3'	3'	3'
Offset	1'	1'	1'	1'	1'
Parking Lane	6'	6'	6'	6'	6'
Minimum Median Width (See Note #7)	15'=11' lane + 4' median	15'	15'	NA	NA
Max. number of lanes at a signal w/o Median	6	6	6	6	NA

The Flagstaff City Charter and City Code are current through Ordinance 2016-02, passed January 19, 2016.

URBAN					
COMMERCIAL CENTER STREETS					
Functional Classification (*)	Major Arterial	Minor Arterial	Major Collector	Minor Collector	Local
Max. number of lanes at a non-signalized intersection w/o Median	4	4	4	4	NA

* Functional classifications are further defined in [Section 13-10-014 the Regional Land Use and Transportation Plan](#)

** 1. For travel lanes adjacent to a raised median, increase travel lane width by 1'.

2. All truck routes – min. through lane width of 12' and a 30' curb return radius at intersections.

* Functional classifications are further defined in the [Regional Land Use and Transportation Plan](#)

** All truck routes (as defined in the [Regional Land Use and Transportation Plan](#)) – min. through lane width of 12' and a 30' curb return radius at intersections

Table 10-10-01 (Continued)

Functional Classification/Design Criteria

URBAN					
COMMERCIAL CENTER STREETS					
Functional Classification (*)	Major Arterial	Minor Arterial	Major Collector	Minor Collector	Local
Corner Cut-Off (see Note #4)	25'	25'	25'	15'	15'
Curb Ret. Radius	30'	30'	20' **	20' **	25'
Design Speed	45 MPH	40 MPH	40-35 MPH	30 MPH	25 MPH
Superelevation (See Note #5)	4% Max.	4% Max.	4% Max.	None	None
Min. Curve Radius (See Note #5)	1,000' 900'	600' 667'	600' 667' (40 mph) 454' (35 mph)	300'	450' 181'
Maximum Grade	6%	6%	6%/7%	8%	10%
Property Access	Major D/W Only	Major D/W Only	Major or Combined D/W Only	Individual D/W Head Out	Individual D/W Back Out

* Functional classifications are further defined in [Section 13-10-014 the Regional Land Use and Transportation Plan](#)

** 1. For travel lanes adjacent to a raised median, increase travel lane width by 1'.

2. All truck routes – min. through lane width of 12' and a 30' curb return radius at intersections

* Functional classifications are further defined in the Regional Land Use and Transportation Plan

Table 10-10-01 (Continued)

Functional Classification/Design Criteria

RURAL						
Functional Classification (*)	Major Arterial (See Note #3)	Minor Arterial (See Note #3)	Major Collector (See Note #1)	Minor Collector (See Note #1)	Local	Local Narrow
Max. Through Lanes	2	2	2	2	2	2
On Street Parking	Not allowed	Not allowed	Not allowed	Not allowed	Not striped	Not striped
Bicycle Provision	4'	4'	4'	4'	In travel lane	In travel lane
Total A.C. Width	32'	32'	32'	30'	26'	20'
Minimum R.O.W. (See Note #2)	60'	60'	60'	60'	60' 50'	60' 44'
Through Lane Width (**)	12'	12'	12'	12'	13'	10'
Edge Treatment	6 foot Compacted Shoulders and Drainage Swales/Curb and Gutter is Optional (See Note #9)					
Sidewalks	No Sidewalks or Parkway Section					
Parking Lane	Not allowed	Not allowed	Not allowed	Not allowed	N/A	N/A
Corner Cut-Off	30'	30'	20'	20'	20'	20'
Fillet Radius	30'	30'	20' **	20' **	20'	20'
Design Speed	45 MPH	40 MPH	35-40 MPH	30 MPH	20 MPH	20 MPH
Superelevation (See Note #5)	4% Max.	4% Max.	4% Max.	None	None	None
Min. Curve Radius (See Note #5)	1,000' 900'	600' 667'	600' 667' (40 mph) 454' (35 mph)	300'	100'	100'
Maximum Grade	6%	6%	7%	8%	10%	10%
Property Access	Major D/W Only	Major or Combined D/W Only	Major or Combined D/W	Individual D/W Head Out	Individual Back Out	Individual Back Out

RURAL						
Functional Classification (*)	Major Arterial (See Note #3)	Minor Arterial (See Note #3)	Major Collector (See Note #1)	Minor Collector (See Note #1)	Local	Local Narrow
Min. D/W to Intersection	(See Note #10)	(See Note #10)	(See Note #10)	(See Note #10)	10'	10'

* Functional classifications are further defined in [Section 13-10-014 the Regional Land Use and Transportation Plan](#)

** -1. For travel lanes adjacent to a raised median, increase travel lane width by 1'

2. All truck routes – min. through lane width of 12' and a 30' curb return radius at intersections

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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 which 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 25,000 sq. ft. The rural residential local "narrow" street shall be used where the minimum lot size is 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 5 ft. 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.

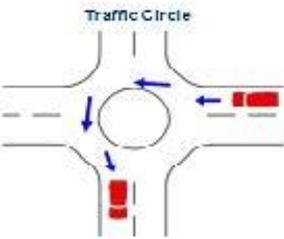
At the intersection of two streets of different classifications, the corner cut-off dimension and the curb return or fillet radius of the higher classification street shall be used.

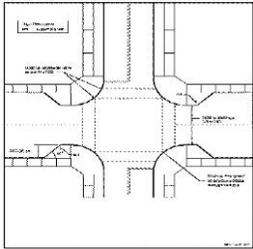
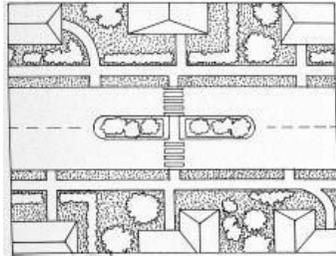
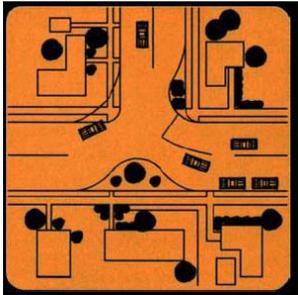
5. For arterial and major collector streets, the relationship between super-elevation rate, runoff, and curve radius shall be determined from AASHTO tables for e-max = 4.0%. For local streets, the minimum delta angle (D) must be greater than 30°. Minimum curve radii in the table are based on no superelevation.
6. Pavement edge tapers shall be designed per C.O.F. Detail No. 10-10-031.
7. Medians shall be ~~required~~ required as outlined in Table 13-10-01 or as required on all arterials and major collectors and as outlined in Table ~~13-10-01~~ or as required by the City Engineer. ~~Medians shall be designed per Standard Detail No. 10-06-014.~~
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 local residential "narrow" streets do not intersect at a right angle, the radius of curb returns on the acute angles shall be 20 ft.
10. See Section 10-06-010 for location of driveways adjacent to intersections.

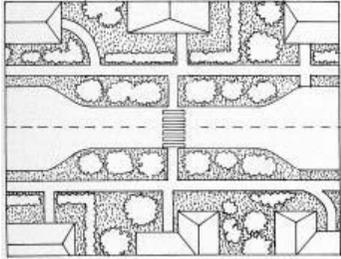
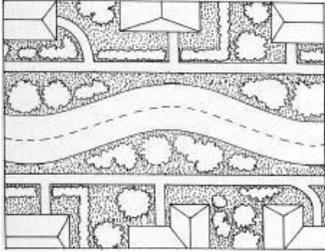
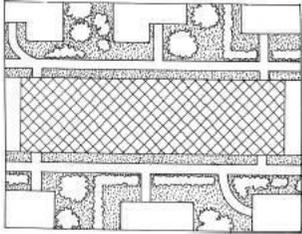
11 For design criteria not addressed in this table, refer to AASHTO.

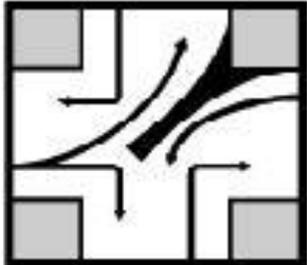
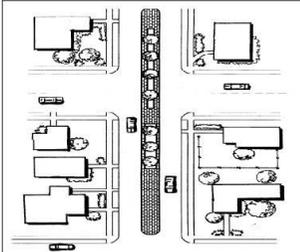
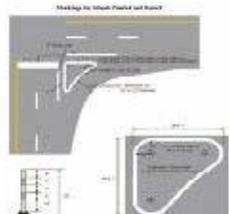
Table 1042-10-02– New Design and Retrofit of Existing Streets

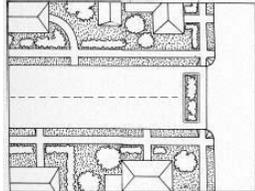
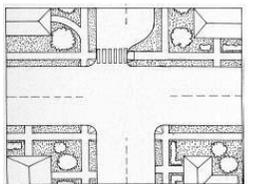
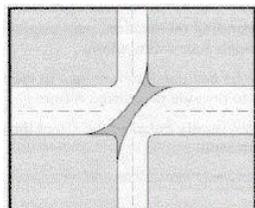
Traffic Calming Design Features For Local Residential Streets

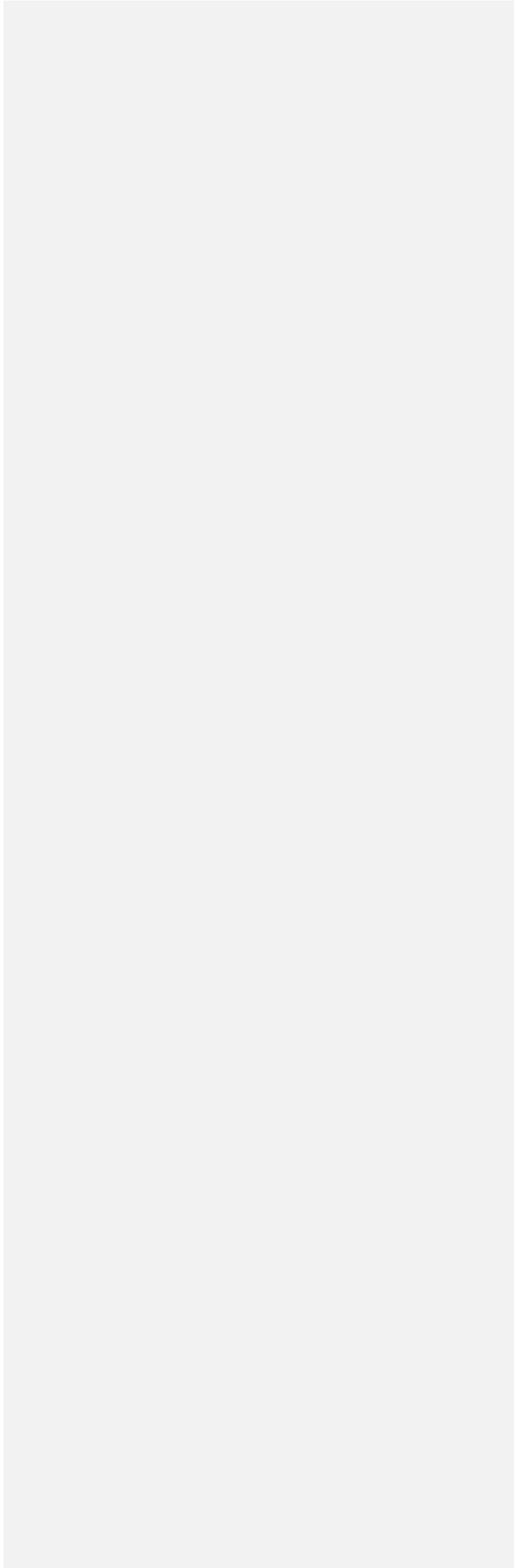
Design Option	Description	Diagram	Advantages	Disadvantages
Neighborhood Traffic Circle	Raised circular islands placed in intersections, around which traffic circulates. Typically, min. 14' diameter & includes 2-foot wide mountable truck apron and landscaping		<ul style="list-style-type: none"> a. Effective 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 	<ul style="list-style-type: none"> a. Difficult for large trucks to circumnavigate b. Designed such that the travel lane doesn't encroach upon cross-walks 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 28' from center with 2' truck apron. The inscribed diameter should be 88' and 200'. Circulating roadway has a width of 14' to 19'		<ul style="list-style-type: none"> a. Moderates traffic speeds on arterials b. Enhanced safety as compared to signalization c. Less operating expenses as compared to signalization 	<ul style="list-style-type: none"> a. May be difficult to navigate with large trucks b. Designed such that the travel lanes don't encroach into cross-walks c. Eliminates some on-street parking

Design Option	Description	Diagram	Advantages	Disadvantages
<p>Curb Extension</p> <ul style="list-style-type: none"> a. Swells b. Elephant ears c. Located at intersections only 	<p>Comprises an angled narrowing of the roadway and widening of the sidewalk</p>		<ul style="list-style-type: none"> a. Improves pedestrian circulation and space b. Through and left-turn movements are easily negotiable by large vehicles c. Creates protected on-street parking bays d. Reduces speeds, especially for right-turning vehicles 	<ul style="list-style-type: none"> 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
<p>Center Island Narrowing</p>	<p>A raised island located along the centerline of a street that narrow the travel lanes at that location. A min. of 6' X 20' and landscaped with pedestrian cut-through</p>		<ul style="list-style-type: none"> a. Increase pedestrian safety b. Reduces traffic volume 	<ul style="list-style-type: none"> 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
<p>Realigned Intersection</p>	<p>Changes in alignment that convert T-intersections with straight approaches into curving streets that meet at right-angles</p>		<ul style="list-style-type: none"> a. Effective <u>at</u> reducing speeds and improving safety at T-intersections that have been ignored by motorist b. <u>Eats-up-on-used</u>Eliminates unnecessary pavement 	<ul style="list-style-type: none"> a. Curb realignment could be costly b. May require additional right of way

Design Option	Description	Diagram	Advantages	Disadvantages
Choker	Midblock curb extensions that narrow the street by expanding the sidewalk or adding a planting strip and often are installed at midblock crossings		<ul style="list-style-type: none"> a. Easily negotiated by large vehicles b. Reduces speed and volume 	<ul style="list-style-type: none"> 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
Chicane	Literal shifts that alternate on both sides of the street creating a S-shaped path of travel		<ul style="list-style-type: none"> a. Reduces speed through horizontal deflection b. Larger vehicles can easily negotiate 	<ul style="list-style-type: none"> 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.		<ul style="list-style-type: none"> a. Reduces speed over an extended length b. Located at intersection, can reduce speeds on two streets 	<ul style="list-style-type: none"> a. Generally expensive due to material b. Cross-walk application may cause difficulties for those with disabilities and cyclist to traverse c. Less effective

Design Option	Description	Diagram	Advantages	Disadvantages
Truncated Diagonal Diverter	A diagonal diverter with one end open to allow for additional turning movements		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		a. Limited, rarely used	a. Limited, rarely used
Median Barriers (Applied at intersections in special circumstances)	Intersection island blocking movement of a through street		a. Improves safety at an intersection of a local street and a major street by prohibiting dangerous turning movements b. Reduce 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
Pavement Markings Note: Applies only to retrofit of existing streets.	Painted striping or channelization to guide traffic		a. Modestly effects speed	a. Extreme unacceptable aesthetic

Design Option	Description	Diagram	Advantages	Disadvantages
<p>Full Closures Note: Applies only to retrofit of existing streets.</p>	<p>Full closures divert traffic off the street, creating pedestrian and bicycle friendly areas</p>		<p>a. Maintains pedestrian and bicycle access b. Effective in reducing traffic volume</p>	<p>a. Cause circuitous routes for local residents and emergency service vehicles b. May be expensive c. May limit access to businesses d. May increase volumes remaining routes</p>
<p>Half Closures Note: Applies only to retrofit of existing streets.</p>	<p>Similar to full closures, are barricades located in the street and constructed of landscaped walls, gates, side-bollards, or other obstructions</p>		<p>a. Maintains pedestrian and bicycle access b. Effective in reducing traffic volume</p>	<p>a. Cause circuitous routes for local residents and emergency service vehicles b. May limit access to businesses c. Depending on the design, drivers may be able to circumvent the barrier</p>
<p>Diagonal Diverters Note: Applies only to retrofit of existing streets.</p>	<p>A barrier placed diagonally across an intersections disconnecting the legs of the intersection</p>		<p>a. Does not require a closure per se, only a redirection of existing streets b. Able to maintain full pedestrian and bicycle access c. Reduce traffic volumes</p>	<p>a. Cause circuitous routes for local residents and emergency service vehicles b. May be expensive c. May require reconstruction of corner curbs</p>



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 [Section 13-10-014the Regional Plan](#)
- 13-10-012-0002 Bicycle Facilities in a Traditional Neighborhood
- 13-10-012-0003 Special Districts
- 13-10-012-0004 Tables—Thoroughfare Standards in Traditional Neighborhoods
- 13-10-012-0005 Utility Placement in Thoroughfares
 - 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

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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 C of the Zoning Code. Specific terms used throughout this chapter that are capitalized may refer to Section 10-14-005-0001, Definitions, of terms for traditional neighborhood districts in the Zoning Code.

13-10-012-0001 Applying a Thoroughfare Type in a Traditional Neighborhood

Transect zones, speed/movement type, functions of thoroughfares, arterials as described in [Section 13-10-014the Regional Plan](#), and other considerations should be taken into account in determining the correct application of a thoroughfare type in a Traditional Neighborhood

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 or more of the six normative Transect Zones.

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 20 mph 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 20 mph.
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 25 mph.
4. **SPEED:** Drivers can expect travel similar to conventional suburban street design, but with continued emphasis on pedestrian safety and comfort. Design speed of 30 mph.
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 35 mph.

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.

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 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 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.

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.

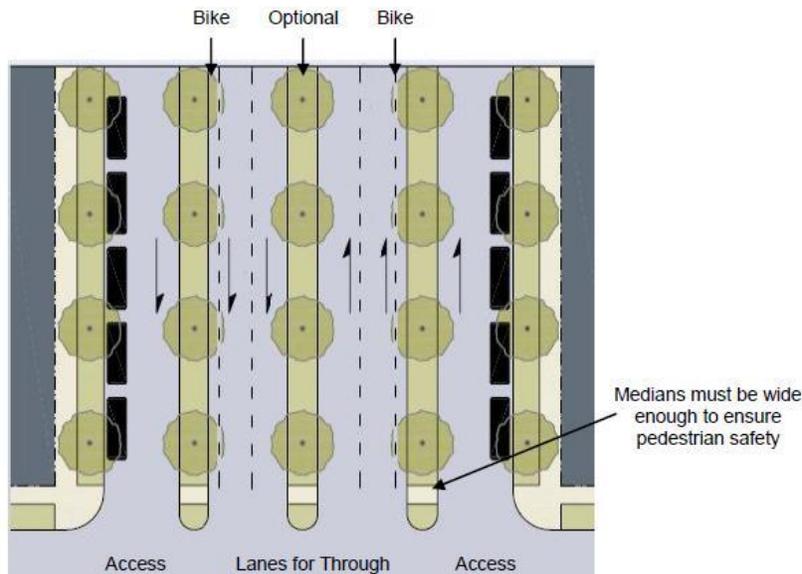
13-10-012-0001.5 Arterials and Major Collectors as described in ~~Section 13-10-014 the Regional Plan~~

A. Major and minor arterial roads and major collector roads as described and mapped in ~~Section 13-10-014 the Regional Plan~~ 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 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



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 transect zones, 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 13-10-01.
- D. In transect zones T1, T2, and T3 (as shown in Table 13-10-01), bike lanes may be provided based on vehicular speed in the thoroughfare, and on the uphill side of thoroughfares where grades exceed 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 ~~which-~~ 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 13-10-01.

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.

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.

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.

Table 13-10-01 – Vehicular/Parking/Right-of-Way Assemblies

Vehicular Lane Assemblies, (located in Title 10, Flagstaff Zoning Code)

Thoroughfare Assemblies, (located in Title 10, Flagstaff Zoning Code)

Public Frontages – General, (located in Title 10, Flagstaff Zoning Code)

Public Frontages – Specific, (located in Title 10, Flagstaff Zoning Code)

Public Lighting, (located in Title 10, Flagstaff Zoning Code)

Public Planting, (located in Title 10, Flagstaff Zoning Code)

13-10-012-0005 Utilities in Traditional Neighborhood Districts

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 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.

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.

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 of the Zoning Code, 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 were used for selecting thoroughfare types. See Table 13-10-01 below.

TABLE 13-10-01: 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.

T1 & T2 Movement Type	SPEED	TRAVEL Lane	BIKE Lane	PARKING	EDGE	PARKWAY	PATH
SLOW	20 mph	10'8"			R	5'-10'	8-10'
FREE	25 mph	10'9"			R or C	5'-10'	8-10'
SPEED	30 mph	10'	RequiredP		R or C	5'-10'	8-10'
RURAL	35 mph	11'	RequiredP		R or C	5'-10'	8-10'
T3 Movement Type	SPEED	TRAVEL Lane	BIKE Lane	PARKING	EDGE	PARKWAY	PATH
YIELD	20 mph	12'±	-	±	C	5'-10'	5'min.
(Lots > 1 acre)	20 mph	10'9"			R or C	5'-10'	5'min.
SLOW	20 mph	9'		76.5'	C	5'-10'	5'min.
FREE	25 mph	10'		6.58'	C	5'-10'	5'min.
SPEED	30 mph	10'	RequiredP	6.58'	C	5'-10'	5'min.
REAR LANE	n/a	12'				4'	5'min-NA
T4 Movement Type	SPEED	TRAVEL Lane	BIKE Lane	PARKING	EDGE	PARKWAY	PATH
YIELD	20 mph	12'±	-	±	C	5' min.	6' min.
SLOW	20 mph	119'		6.57'	C	5' min.	6' min.
SLOW (w/45° parking)	20 mph	12'		18.5'	C	7' min.	6' min.
FREE	25 mph	110'	S	6.58'	C	5' min.	6' min.
FREE (w/45° parking)	25 mph	12'		18.5'	C	7' min.	6' min.
SPEED	30 mph	110'	S	6.58'	C	5' min.	6' min.
ALLEY	n/a	21'			Ribbon		

T1 & T2 Movement Type	SPEED	TRAVEL Lane	BIKE Lane	PARKING	EDGE	PARKWAY	PATH
T5 & T6 Movement Type	SPEED	TRAVEL Lane	BIKE Lane	PARKING	EDGE	PARKWAY	PATH
SLOW	20 mph	11'		6.57'	C	5' min.	8'min.
SLOW (w/45° parking)	20 mph	12'		18.5'	C	5'-7'	8'min.
FREE	25 mph	11'	S	6.5'	C	5' min.	8'min.
FREE (w/45° parking)	25 mph	12'		18.5'	C	5'-7'	8'min.
SPEED	30 mph	11'	S	6.58'	C	5' min.	8'min.
ALLEY	n/a	21'			Ribbon		
Curb Radius (assumes 90 degree intersections)							
MOVEMENT TYPE	SPEED	Curb Radius w/Parking	R = Rural edge treatment				
YIELD	20 mph	40'	C = Curb edge treatment				
SLOW	20 mph	5-10'	Ribbon = Ribbon Curb (18 inches)				
FREE	25 mph	10-15'	S = When authorized by staff P = Permitted				
SPEED	30 mph	15-20'	S = When authorized by staff				
RURAL	35 mph	25'					

TABLE 13-10-01 NOTES:

1. ~~Parking Lanes are measured from the edge of pavement to the edge of the adjacent travel lane. *A Yield Street is 23' in width measured from the lip of gutters. Parking is allowed on both sides and the remaining travel lane is approximately 12' when vehicles are parked on both sides.~~
2. Bike Lanes shall be 4' for rural edge streets, 4 1/2' for curbed streets, and 5' 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 10-12-012 in these Standards. Bike lanes may also be required where uphill grades exceed 7% or to provide continuity between neighborhoods. Where a bike lane is provided adjacent to a Path, the Path width may be reduced to 5'.
3. Right-of way shall be located 2' from back of sidewalk or at the back of sidewalk when adjacent to buildings.
4. Arterial and Major Collector Roads, as identified in ~~Section 13-10-014 the Regional Plan~~ shall be designed as Boulevards (see section 10-12-011.5) of these Standards.
5. Thoroughfares shall be designed according to the type of vehicle expected to use each thoroughfares on a daily basis recognizing that occasionally, large vehicles may cross the centerline when making turning movements.

13-10-013

Use of Uncompleted Streets within a Subdivision

Sections:

13-10-013 Use of Uncompleted Streets within a Subdivision

13-10-013-0001 Use of Uncompleted Streets within a Subdivision

13-10-013 Use of Uncompleted Streets within a Subdivision

13-10-013-0001 Use of Uncompleted Streets within a Subdivision

Use of uncompleted streets within a subdivision by construction or residential traffic will be allowed provided that:

- A. All on-site and offsite 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 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.

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

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. 2015-12, Enacted, 07/21/2015)

13-10-014-0001.1 Definitions

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.

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.

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 (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 site, and institutional sites.

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 affect neighborhood form.

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.

Commercial-local refers 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 refers 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

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~~commercial areas, open space, public lands, industrial sites and institutional sites. Residential property will not abut major arterials unless separated by adequate buffering.~~

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. 2015-12, Enacted, 07/21/2015)

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." (Ord. 2015-12, Enacted, 07/21/2015)

[Functional Classifications Map Placeholder](#)

CHAPTER 13-11

SURVEY

Sections:

13-11-001 — Surveys

13-11-001-0001 — Monuments

13-11-001-0002 — Monument Location

13-11-001 Surveys

13-11-001-0001 Monuments

~~A. — The subdivider 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.~~

~~1. — Survey monuments shall conform to City Engineering Detail No. 11-01-010:~~

~~a. — An identifying marker, conforming to State Board of Technical Registration requirements, shall be placed at all original tract corners, subdivision boundary control points, bench marks, 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.~~

~~b. — All survey monuments shall be described on the final plat.~~

~~c. — All lot corners shall be permanently located; 1/2-inch minimum diameter steel pins, and 18-inch minimum length. They shall be placed in a manner satisfactory to the City Engineer.~~

~~2. — Boundary 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.~~

~~3. — Street centerline monuments shall be set and vertical control established upon completion of street improvements and prior to acceptance of the offsite improvements.~~

~~City of Flagstaff vertical datum shall be utilized.~~

~~B. — Existing monuments that define the control/monument line shall be preserved and continue to be used as the right of way control line. New monuments shall be established by utilizing record data where existing control cannot be found.~~

~~C. — 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.~~

13-11-001-0002 Monument Location

~~A. — Frame and cover monuments shall be used at section corners, 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 successive street monuments of sufficient distance on a common tangent to establish a base line under a frame and cover. Future surveys in the area will be able to use this established line for a basis of bearing.~~

~~B. — Survey monuments shall be placed on the right-of-way survey line (usually centerline). Some situations could warrant placement of monumentation at the right-of-way limits. 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.~~

CHAPTER 13-12
STREET LIGHTING

Sections:

- 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
- 13-12-001 General
 - 13-12-001-0001 General
 - 13-12-002 Lighting Required
 - 13-12-002-0001 Lighting Required
 - 13-12-003 Lighting Layout
 - 13-12-003-0001 Lighting Layout
 - 13-12-003-0002 Streetlights at Intersections
 - 13-12-003-0002.1 General
 - 13-12-003-0002.2 Streetlights at Non-Signalized Intersections
 - 13-12-003-0002.3 Streetlights at Signalized Intersections
 - 13-12-003-0003 Spacing of Street Lights
 - 13-12-003-0004 Location and Placement of Equipment
 - 13-12-004 Pedestrian Lighting
 - 13-12-004-0001 Pedestrian Lighting.
 - 13-12-005 Street Light Equipment
 - 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
 - 13-12-006 Plan Submittals
 - 13-12-006-0001 Plan Submittals
 - 13-12-007 Modifications to the Existing System
 - 13-12-007-0001 Modifications to the Existing System
 - 13-12-008 Repair and Replacement
 - 13-12-008-0001 Repair and Replacement

13-12-001

General

Sections:

13-12-001 General

13-12-001-0001 General

13-12-001 General

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 offsite 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.

13-12-002

Lighting Required

Sections:

13-12-002 Lighting Required

13-12-002-0001 Lighting Required

13-12-002 Lighting Required

13-12-002-0001 Lighting Required

Streetlights shall be installed on all public and private streets in accordance with [this section Flagstaff City Code, Title 13](#). 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 offsite 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 offsite 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.

13-12-003
Lighting Layout

Sections:

- 13-12-003 Lighting Layout
- 13-12-003-0001 Lighting Layout
- 13-12-003-0002 Streetlights at Intersections
- 13-12-003-0002.1 General
- 13-12-003-0002.2 Streetlights at Non-Signalized Intersections
- 13-12-003-0002.3 Streetlights at Signalized Intersections
- 13-12-003-0003 Spacing of Street Lights
- 13-12-003-0004 Location and Placement of Equipment

13-12-003 Lighting Layout

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.

13-12-003-0002 Streetlights at Intersections

13-12-003-0002.1 General

A. Luminaire Wattage – Single Installation. The size (wattage) of a streetlight at an intersection where only one 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 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.

13-12-003-0002.2 Streetlights at Non –Signalized Intersections

A. A streetlight shall be installed at each non-signalized public street intersection with the following exceptions:

1. Street Width. At intersections where the width of one or more of the approaches is greater than or equal to fifty feet (50') as measured to the back of curb (on urban street sections) or edge of pavement (on rural street sections), two streetlights shall be installed on diagonally opposite corners.
2. Urban Local Streets. At the intersection of two Urban Local Streets, a street light may be omitted if its installation would violate the spacing and uniformity criteria of Section 12-03-030 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-way intersection.

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 streetlights shall be installed, one 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 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.

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

FUNCTIONAL CLASSIFICATION	SIZE (watts)	TYPE	LUMENS	SPACING
MAJOR ARTERIAL	180	LPS	33K	300'
	135	LPS	22.5K	250'
MINOR ARTERIAL	180	LPS	33K	300'
	135	LPS	22.5K	250'
MAJOR COLLECTOR	135	LPS	22.5K	300'
	90	LPS	13.5K	250'
MINOR COLLECTOR	90	LPS	13.5K	350'
	55	LPS	8K	300'
COMM. LOCAL	55	LPS	8K	350'
LOCAL 37'	55	LPS	8K	350' (400')
LOCAL 31'	55	LPS	8K	350'
LOCAL 27'	55	LPS	8K	350'

Note: When streetlights are constructed along an existing street, the wattage and corresponding spacing shall match ~~that of existing lights on the street— the table above.~~ 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.

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 10% , with a maximum of 300'. For uniformity of appearance, the variance in spacing between adjacent spans should not be more than 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 feet wide, one foot from back of sidewalk.

- b. When the sidewalk is separated from the curb by a parkway greater than or equal to four feet in width, two feet back of curb.
 - c. When there is curbing but no sidewalk, two feet from back of curb.
 - d. On a rural street, eight 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 70 feet (back of curb) the required streetlights shall alternate on either side of the street.

13-12-004

Pedestrian Lighting

Sections:

13-12-004 Pedestrian Lighting

13-12-004-0001 Pedestrian Lighting

13-12-004 Pedestrian Lighting

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 undercrossings 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 night-time 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.

**13-12-005
Street Light Equipment**

Sections:

- 13-12-005 Street Light Equipment
- 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

13-12-005 Street Light Equipment

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

Luminaire Wattage	Maximum Weight including Ballast, Slipfitter, Lamp and Photo Cell (Pounds)	Maximum EPA (Square Feet)
55 LPS	30	1.4
90 LPS	35	1.6
135 LPS	50	2.0
180 LPS	65	2.6 2.0

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.

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 ~~per the~~ AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic signals (2001 Design Criteria), to withstand a wind speed of 90 m.p.h.

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 12-05-02

NOMINAL MOUNTING HEIGHT

LUMINAIRE (Watts)	MOUNTING HEIGHT (ft)	POLE (ft)	MAST ARM
55 LPS	26	30	20" X 6'
90 LPS	26	30	20" X 6'

LUMINAIRE (Watts)	MOUNTING HEIGHT (ft)	POLE (ft)	MAST ARM
135 LPS	34	38	3' X 8'
180 LPS	39	38	8' X 8'

Mast arms of different rise and length may be required when existing utility poles are utilized. The design 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.

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.

13-12-005-0004 Streetlight Equipment and Service Line Ownership

- 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.

13-12-006
Plan Submittals

Sections:

13-12-006 Plan Submittals
13-12-006-0001 Plan Submittals

13-12-006 Plan Submittals
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 and auxiliary equipment and 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.

13-12-007

Modifications to the Existing System

Sections:

13-12-007 Modifications to the Existing System

13-12-007-0001 Modifications to the Existing System

13-12-007 Modifications to the Existing System

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.

13-12-008

Repair and Replacement

Sections:

13-12-008 Repair and Replacement

13-12-008-0001 Repair and Replacement

13-12-008 Repair and Replacement

13-12-008-0001 Repair and Replacement

If an existing streetlight installation which is not in conformance with these standards suffers damage to such an extent that the cost of repairing the damage is greater than 50% of the cost of replacing the non-conforming 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 50% of the replacement cost then the installation shall be repaired in accordance with these Standards whenever possible.

**CHAPTER 13-13
FIRE SAFETY REQUIREMENTS**

Sections/Divisions:

- 13-13-001 Fire Safety Requirements**
- 13-13-002 Fire Flow**
- 13-13-003 Fire Hydrants/Protection Water Supplies**
- 13-13-004 Access**
- 13-13-005 Addressing**
- 13-13-006 Reservoir Capacity**
- ~~13-13-007 Mains~~
- ~~13-13-008 Power Supply and Pumps~~
- ~~13-13-009 Fire Sprinkler Lines~~
- ~~13-13-001 Fire Safety Requirements~~
- ~~13-13-001-0001 Fire Safety Requirements~~
- ~~13-13-002 Fire Flow~~
- ~~13-13-002-0001 Fire Flow~~
- ~~13-13-003 Fire Hydrants~~
- ~~13-13-003-0001 Fire Hydrants~~
- ~~13-13-004 Access~~
- ~~13-13-004-0001 Fire Access~~
- ~~13-13-004-0002 Dead-end Fire Access~~
- ~~13-13-004-0003 Technical Reports~~
- ~~13-13-005 Addressing~~
- ~~13-13-005-0001 Addressing~~
- ~~13-13-006 Reservoir Capacity~~
- ~~13-13-006-0001 Reservoir Capacity~~
- ~~13-13-007 Mains~~
- ~~13-13-007-0001 Mains~~
- ~~13-13-008 Power Supply and Pumps~~
- ~~13-13-008-0001 Power Supply and Pumps~~
- ~~13-13-009 Fire Sprinkler Lines~~
- ~~13-13-009-0001 Fire Sprinkler Lines~~

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13-13-001

Fire Safety Requirements

Sections:

- 13-13-001 Fire Safety Requirements
- 13-13-001-0001 Fire Safety Requirements

13-13-001 Fire Safety Requirements

13-13-001-0001 Fire Safety Requirements

When applicable, these requirements shall conform to the currently 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 conflict with these standards, the more restrictive requirement shall apply.

13-13-002

Fire Flow

Sections:

13-13-002 Fire Flow

13-13-002-0001 Fire Flow

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13-13-002 Fire Flow

13-13-002-0001 Fire Flow

A. ~~For minimum fire flow demands please refer to Section 13-09-003-0004.3 of these standards. All fire hydrants and water systems shall be designed to deliver water at a minimum rate of 1000 GPM for one and two family residences and 1500 GPM for commercial occupancies (other than one and two family residences). Higher rates of flow may be required.~~

~~1. The basis of determining required rates of flow is The Uniform Fire Code (latest adopted edition).~~

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.

13-13-003

Fire HydrantsProtection Water Supplies

Sections:

- 13-13-003 Fire HydrantsProtection Water Supplies
- 13-13-003-0001 Fire Hydrants
- 13-13-003-0002 Fire Lines
- 13-13-003-0003 Mains

13-13-003 Fire HydrantsProtection Water Supplies

For Fire Protection Water Supplies refer to Section 507 of the International Fire code

13-13-003-0001 Fire Hydrants

For fire hydrant construction specifications and design requirements refer to Section 13-09-006-0006 of these standards. Fire hydrant types shall be limited to Waterous Paecer Model WB 67-250 w/18" upper standpipe, Mueller Super-Centurion Model 250, & A423 and Clow Medallion Model F-2545. Fire hydrants shall be installed within 300 feet of all parts of a commercial building. Hydrants shall also be placed within 100 feet of Fire Department connections to sprinkler and standpipe systems. Offsite spacing shall be 300 feet between hydrants for commercial areas and 500 feet (spacing for one and two family subdivisions).

A. All fire hydrants, when installed, shall have a clear, level working area extending not less than 3 feet around the hydrant. Typical location shall be one foot (1 ft.) behind the sidewalk. Banks shall be excavated to obtain such clearance and an approved retaining wall with footing shall be constructed where the excavated bank exceeds 18 inches in height, as shown in the Engineering Standard Detail 13-03-011.

B. Consideration shall be given to fire truck access and hose line laying techniques in the spacing of hydrants. Fire Department approval of fire hydrant location shall be required prior to plan approval. All subdivisions or planned residential developments shall have fire hydrants located at, or very near, the entrance to the development.

C. Fire hydrants shall also be strategically located to avoid conflicts of vehicular traffic as follows:

1. When a hydrant is located near the intersection of two streets, it shall be located no less than 130 ft. from the curb returns of the intersection.
2. When a hydrant is located adjacent to a driveway of a private property, it shall be located behind the sidewalk and no less than 10 ft. from the edge of the driveway.
3. Fire hydrants installed within curbed islands shall be located a minimum of 6 ft. 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).

D. Every fire hydrant shall have a valve on the lead line. Blow-off valves shall be required at the ends of dead-end lines whether temporary or permanent. 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. No fire hydrant or water services will be allowed on the water line between temporary blow-off valves and the plug.

E. If a developer is required to move an existing fire hydrant, the existing hydrant must be salvaged and provided to the City, and the Developer shall install a new hydrant at the Developer's cost.

See Title 13, Section 13-09-006-0006.3 for additional requirements of fire hydrant installation.

13-13-003-0002 Fire Lines

For fire line construction specifications and design requirements refer to Section 13-09-006-0006.4 of these standards.

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For Water Main construction specifications and design requirements refer to Section 13-09-003 of these standards.

13-13-004

Access

Sections:

- 13-13-004 Access
- 13-13-004-0001 Fire Access Drives
- 13-13-004-0002 Dead-end Fire Access
- 13-13-004-0003 Technical Reports

13-13-004 Access

13-13-004-0001 Fire Access

A. ~~For fire access requirements refer to Section 503 and Appendix D, both titled Fire Apparatus Access Roads, of the International Fire Code. A fire access drive 20 feet in width minimum, with 13 feet 6 inches of overhead clearance will be required within 150 feet of all buildings.~~

1. ~~Fire access drives 26 feet in width minimum (measured from the eave or flat roof parapet) will be required for structures 20 feet high or greater.~~

2. ~~Access for up to two single-family dwelling units may be supplied by a 10-foot wide driveway meeting all Fire Department requirements.~~

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. If the access drive exceeds 150 feet in length and is not looped, an approved turn-around shall be supplied.~~

1. ~~Turn-arounds shall meet road requirements and have a minimum of an 80-foot diameter.~~

a. ~~No parking is allowed in turn-arounds with 80-foot diameter.~~

(1) ~~If parking is desired, additional size shall be required for the turn-around.~~

b. ~~An acceptable access route is required, to be installed prior to, and maintained during, combustible construction.~~

2. ~~The owner shall provide a means for permanent maintenance of the access drive that is satisfactory to the City Fire Department.~~

C. ~~The maximum length of any dead-end access road shall be 1200 feet. The dimensions of any median proposed for a turn-around or cul-de-sac shall be as indicated by the appropriate Engineering Detail.~~

D. ~~The maximum allowable grade on all Fire Department access drives shall conform to the current Fire Code.~~

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. When a fire access drive exceeds 150 feet, an approved turn-around must be provided.~~

B. ~~For Dead End Streets construction specifications and design requirements refer to Section 13-10-004, and Cul-De-Sac details 10-04-010 and 10-04-011 of these standards. When a fire access drive exceeds 1,200 feet, a second remotely located access road is required. Spacing between access drives shall be in remote locations at least 100 feet from other access.~~

C. ~~A separate, remotely located access drive will also be required when any development exceeds 50 units/lots; regardless of the access length.~~

D. ~~Interior fire access drives must be 26 feet wide when the development exceeds 100 units/lots.~~

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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.

13-13-005
Addressing

Sections:

13-13-005 Addressing
13-13-005-0001 Addressing

13-13-005 Addressing
13-13-005-0001 Addressing

~~Address numbers are required on each residential or multi-family unit and shall be addressed with minimum sized 4-inch numbers. All other addresses require minimum sized 6-inch numbers. All addressing shall be visible from the street and have a contrasting background. Letters are not allowed for 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 Section 13-10-003 of these standards.

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13-13-006

Reservoir Capacity

Sections:

- 13-13-006 Reservoir Capacity
- 13-13-006-0001 Reservoir Capacity

13-13-006 Reservoir Capacity

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 of these standards. 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 120 minutes. Reservoir supplement shall meet Fire Department approval.~~

~~13-13-007~~

~~Mains~~

~~Sections:~~

~~13-13-007 Mains~~

~~13-13-007-0001 Mains~~

~~13-13-007 Mains~~

~~13-13-007-0001 Mains~~

~~Hydrants shall be served from an 8-inch or larger water line and, depending on distance, may be required to be off a looped line.~~

~~Mains are required to be looped if they are greater than 1000 feet in length or have more than three fire hydrants coming from them.~~

~~Existing and proposed hydrants and mains shall be shown on the site plan or concept and preliminary plat. The hydrant systems shall be installed, approved, and maintained prior to any combustible construction.~~

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~~13-13-0087~~

~~Power Supply and Pumps~~

~~Sections:~~

~~13-13-0087 Power Supply and Pumps~~

~~13-13-0087-0001 Power Supply and Pumps~~

~~13-13-008 Power Supply and Pumps~~

~~13-13-008-0001 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. When power supply and pumps are necessary, redundant systems shall be provided.~~

13-13-008~~7~~

Power Supply and Pumps

Sections:

13-13-008~~7~~ Power Supply and Pumps

13-13-008~~7~~-0001 Power Supply and Pumps

13-13-008 Power Supply and Pumps

13-13-008-0001 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. ~~When power supply and pumps are necessary, redundant systems shall be provided.~~

13-13-009
Fire Sprinkler Lines

Sections:

13-13-009 — Fire Sprinkler Lines

13-13-009-0001 — Fire Sprinkler Lines

13-13-009 Fire Sprinkler Lines

13-13-009-0001 Fire Sprinkler Lines

All commercial fire sprinkler lines shall have a minimum 4 inch (FLANGE X M.J) valve at the main. The 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 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. A y-strainer shall be installed upstream of the backflow prevention assembly as approved by the manufacturer.

All commercial fire sprinkler lines shall be separate from domestic lines unless approved by the Fire Chief and the Utilities Division.

Firelines may not exceed 100' in length from the water main to the backflow assembly inside the fire riser room.

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CHAPTER 13-14

Bicycle Facilities

Sections:

13-14-001 Bicycle Facilities

13-14-001-0001 Bicycle Facilities

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."

CHAPTER 13-15

WORK IN PUBLIC RIGHTS-OF-WAY AND EASEMENTS

Sections:

- 13-15-001 Permit Requirements
- 13-15-001-0001 Permit Requirements
- 13-15-002 Project Clean-Up Requirements
- 13-15-002-0001 Project Clean-up Requirements

13-15-001 Permit Requirements

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 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 again 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 related 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 Construction Standards and Specifications, 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 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 UPMTM (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 2 inches of the finish trench grade with non-Shrink Slurry backfill conforming to Flagstaff City Code, Title 13, Engineering Design and Construction Standards and Specifications, Section 13-09-006-0003. The final 2 inches shall be MAG Class C concrete.

G. Permittees shall submit to the City for approval: 1) ~~for small private development projects,~~ two 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 ~~Flagstaff City Code, Title 13, Engineering Design and Construction Standards and Specifications, Sections 13-06-003 "Review", 13-06-005 "Format", and 13-06-006 "Drafting Standards Format". The plan shall depict the control of public traffic through the work area. All barricades, lights and other traffic control devices shall be in accordance with~~ the MUTCD. The City Engineer may suspend this requirement for minor work.

H. Streets or alley shall not be closed without written authorization of the City Engineer.

J. Should blasting be required, an additional permit shall be obtained from the City of Flagstaff Fire Department.

K. 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.

L. 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).

M. The permittee shall fully conform to the requirements of A.R.S. § 40-360.21, restrictions for working near over power lines.

N. The permittee shall be fully responsible for all work performed under this permit, including, but not limited to, workmanship and worksite cleanup as specified in Title 13, City of Flagstaff Engineering Design and Construction Standards and Specifications, Section 13-15-002.

O. All work permitted herein shall be guaranteed against all defects in material and workmanship for one year from the date it is accepted by the City Engineer.

P. 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.

Q. The permittee may be required to perform special requirements as determined by the City Engineer.

13-15-002

Project Clean-up Requirements

Sections:

13-15-002-0001 Project Clean-up Requirements

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 per City Code, Chapter 7-03, City Water System Regulations, Section 7-03-001-001⁴⁵, 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 cleanup 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 cleanup 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 right-of-ways 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.

CHAPTER 13-16

TRAFFIC SIGNALS, SIGNING, AND PAVEMENT MARKINGS

Sections:

- 13-16-001 General
- 13-16-001-0001 Standards and Applicable Documents
- 13-16-001-0002 Professional Certification
- 13-16-002 Signal Design Elements
- 13-16-002-0001 Plan Set
- 13-16-002-0002 Intersection Design Requirements
- 13-16-003 Signal Equipment
- 13-16-003-0001 Required/Approved Product List
- 13-16-003-0002 Controller Cabinets
- 13-16-003-0003 Electrical Service Cabinet
- 13-16-003-0004 Uninterruptible 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
- 13-16-004 Signal Construction
- 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 Warrants
- 13-16-005 Traffic Signing
- 13-16-005-0001 Traffic Signs
- 13-16-005-0002 Sign Installation
- 13-16-006 Pavement Markings
- 13-16-006-0001 Longitudinal Pavement Markings
- 13-16-006-0002 Transverse Markings, Symbols, and Legends

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.

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.
4. National Electrical Manufacturers Association, Traffic Control Systems, Standards Publication: TS2-1992.
5. International Municipal Signal Association, Inc., Wire and Cable Specifications.

CHAPTER 13-16 TRAFFIC SIGNALS, SIGNING, AND
PAVEMENT MARKINGS

6. Institute of Transportation Engineers, Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Circular Signal Supplement.
7. Manual on Uniform Traffic Control Devices for Streets and Highways: USDOT/FHWA.
8. American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Structural Supports for Highway Signs, Luminaire and Traffic Signals.
9. The City of Flagstaff Traffic Signal Standard Drawings.
10. The City of Flagstaff Traffic Signal Approved Products List.

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.

13-16-002

Signal Design Elements

Sections:

13-16-002 Signal Design Elements
13-16-002-0001 Plan Set

13-16-002-0002 Intersection Design Requirements

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 larger construction project.

1. The cover sheet shall meet the requirements of City of Flagstaff Engineering Design and Construction Standards (Standards) Chapter 6-07, Cover Sheet.
2. The traffic signal plan sheet, (1" = 20') 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.

13-16-002-0002 Intersection Design Requirements

Refer to the Flagstaff City Code, Title 13, Section 13-10-006, Intersection Design, for geometric standards.

- A. Curb returns shall be constructed or reconstructed to provide dual ramps and minimum ten-foot spacing between signal poles per Standard Drawings 10-10-34 through 10-10-39.

- 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, pre-existing 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, 4" thick, 4 ft. 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 2" above adjacent curb for positive drainage. The cabinet foundation shall be 4" higher than the technician's maintenance pad.

- E. Signals shall be designed with an "8-pole" design; that is, two signal poles on each corner of the intersecting streets.
 - 1. The minimum distance between the two poles shall be 10 ft. 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 street light poles.
 - 1. The number and location of luminaries varies with the size of the intersection, per Flagstaff City Code, Title 13, Chapter 12, "Street Lighting," of these standards.

2. Luminaire shall be installed on 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 Disability Act. Reach distance to push button stations shall not exceed 10 inches.
- H. Each pole foundation shall be provided with a 1/2" 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 other signal head.
- L. Mast arm mounted signal heads shall be centered vertically over traffic lanes.
- M. Seven conductor IMSA cable shall be run to each outboard signal head.
- N. The intersection will be 'boxed' with two 3-inch diameter conduits.
1. One conduit shall contain higher voltage signal and lighting conductors.
 2. The second conduit shall contain lower voltage detection, pre-emption 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 additional 3-inch conduits, each with a #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.
1. Interconnect pull boxes shall be installed no more than 660 feet apart and shall be polymer fiberglass ADOT Type 7 traffic signal boxes with a 12-inch extension. The lids shall have a legend with 1-inch minimum letters that read "Interconnect".
 2. Dedicated interconnected pull boxes shall be installed adjacent to the traffic signal pull boxes at intersections.
 3. A 3-inch conduit shall be installed to the traffic signal cabinet from the closest interconnect pull box.
- Q. All trenches in existing pavement shall be slurry back-filled and T-topped.
- R. A minimum of one #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.

13-16-003
Signal Equipment

Sections:

13-16-003	Signal Equipment
13-16-003-0001	Required/Approved Product List
13-16-003-0002	Controller Cabinets
13-16-003-0003	Electrical Service
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

13-16-003 Signal Equipment

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.

13-16-003-0002 Controller Cabinet

- A. Cabinet shall be NEMA TS2, Type One design will all inputs and outputs through BIU interface. The back panel shall include 16 load switch bays.
- B. The signal cabinet shall be unpainted aluminum, and provided with and mounted on a 16-inch high aluminum elevator base.
- C. The cabinet shall include a vehicle detection rack to accommodate 16 channels of detection.
- D. The cabinet shall include a telemetry interface.
- E. The cabinet shall provide mounting for four channels of 3M Opticom pre-emption.
- 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-hour of the day.

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 100 amp main disconnect for all underground service conductors.
 4. Shall provide space for a minimum of eight one-inch circuit breakers.
 5. Shall be of sufficient size to permit three two-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.

13-16-003-0004 Uninterruptible Power Supply System

A traffic signal UPS system shall be supplied. The UPS system shall include four batteries of sufficient amp-hour rating to support the continuous full operation of a traffic signal drawing 1000-watts for a minimum of four (4) hours; the UPS shall not operate the street lighting. The transfer switch shall be manually operated and shall 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 NEWA Type L14-30R cord inlet with a walkable cover.

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."

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.

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 piece of anodized flat black 16-gauge aluminum sheet having a non-louvered, five-inched border.
- C. All vehicle signals indications shall be light emitting diode (LED) modules, which meet the requirements of ITE VTCSH Standards.

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 BTCSH Standards.

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, luminare mast arms and luminare 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. Luminare housings shall be painted in accordance with ADOT Standard Specifications, Section 610 and 1002.

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-Type1 controller, and a 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 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 PC's 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 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 non-volatile 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 5 to 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: 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 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-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 6 X 40 front loop and a 6 X 20 rear loop separated by 12 feet.
 - b. Through and right turn lanes require a 6x50 loop.
 - c. Bike lanes require a 3 X 10 loop.
 - d. High-speed approaches may require one more 6 X 6 square advance extension loops per lane.
 4. Loop detector amplifiers shall be two 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.

13-16-004

Signal Construction

Sections:

13-16-004	Signal Construction
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

13-16-004 Signal Construction

13-16-004-0001 General

- A. The location of utilities shown on plans is approximate and all utilities may not be shown. The contractor is responsible, per 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 'bluestake' location of underground signal utilities until final acceptance.
- C. The contractor shall maintain a safe and secure worksite during working and non-working hours.

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 hour.
 - 2. A signal cannot remain in flash for more than four hours.
 - 3. Damaged detection loops shall be replaced within two weeks unless the City agrees in writing to a longer period.
 - 4. Video detection and pedestrian detection shall be repaired within twenty-four hours.
 - 5. A loss of communications shall be repaired within twenty-four 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-person crew with service truck for two 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.

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 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.

13-16-004-0004 Construction Procedure, Scheduling, and Inspection

A. At least one 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 offsite inspector regarding inspections, material and other project-related issues. A city traffic signal technician will provide technical support to the offsite inspector.

C. Contractor requests for inspection shall be submitted 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.
9. Before above-ground construction begins.
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 stopsign-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 pushbuttons, 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.

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 30 days after turn on, unless directed otherwise by the city Traffic Engineering Section. Signs may be pre-placed 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 24 hours prior to signal turn on, but must be installed within one hour after turn on, unless otherwise directed by the City Traffic Engineer.

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 – 1 copy in digital format (.dwg).
2. Signal cabinet plans – 3 printed copies, one mylar copy, and 1 copy in digital format (.dwg).

3. As-built plans - 3 printed copies and one 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 years for the traffic signal controller and traffic signal LED modules.
 2. One year for all other equipment, materials, and labor, including settlement of trenches.

13-16-005

Traffic Signs

Sections:

- 13-16-005 Traffic Signs
- 13-16-005-0001 Traffic Signs
- 13-16-005-0002 Sign Installation

13-16-005-0001 Traffic Signs

A. Pedestrian push button signs shall be ~~R10-eb, or~~ R10-3e [AZ \(Arizona Manual of Approved Signs\)](#) to match the pedestrian signal display.

B. City of Flagstaff Engineering Standard Details ~~160-053~~-010 and ~~160-035~~-020, Street Name Signs, shall be mounted on each pole mast arm per ADOT Standard Drawing S-9.

13-16-005-0002 Sign Installation

A. Traffic signs shall be installed on square tube post per ADOT Signing and Marking Standard Drawings Detail S-1. Materials shall meet the requirements of ADOT SS 607. [All sign blanks shall be 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.](#)

13-16-006
Pavement Markings

Sections:

- 13-16-006 Pavement Markings
- 13-16-006-0001 Longitudinal Pavement Markings
- 13-16-006-0002 Transverse Markings, Symbols, and Legends

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: ~~C.~~—This item of work shall apply to all longitudinal pavement markings and other pavement markings not specified to be pre-formed plastic.

13-16-006-0002 Transverse Markings, Symbols, and Legends

~~A.~~ ~~A.~~—~~Transverse Permanent Pavement Markings shall be either (two options are):~~

- ~~1. Applied thermoplastic in accordance with ADOT SS 704, minimum 90 mil applied thickness, or Dual Component Markings (Epoxy) shall be installed in accordance with ADOT Standard Specification 709, or~~
- ~~2. Preformed markings in accordance with ADOT SS 705 Standard Specification 705 Type I (may only be used if total project is less than 300 sq. ft.).~~

~~3B.~~ Temporary Markings: ~~Temporary transverse pavement markings, when approved, shall be installed in accordance with ADOT Standard Specification 701-3.05.~~

~~4.~~—~~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.~~

~~(two options are):~~

- ~~1. Preformed markings, when approved, shall be in accordance with ADOT Standard Specification 705 Type II, or~~
- ~~2. Preformed markings, when approved, shall be 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.~~

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CHAPTER 13-17
EROSION CONTROL

Divisions

13-17-001 General

13-17-002 Native Seeding

13-17-003 Temporary Seeding

Section 13-17-001 General

Erosion control applies to improvements within the city and as part of the erosion control section of a Storm Water 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 Storm Water Pollution Prevention Plan (SWPPP) for the site is required per 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>)

13-17-002 Native Seeding

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

13-17-002-0005.6 Watering

13-17-002-0005.7 Establishment Period

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.

13-17-002-0002 Definitions

13-17-002-0002 Seeding, Broadcast

Sowing seeds using a mechanical means often a cyclone spreader driven by a power take off or hand operation.

Seeding, Grassland Drill

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 action.

Seeding, Hydraulic (Hydroseeding)

More commonly known as hydroseeding, distributes seed and mulch in one operation through a water-based slurry system with a tacking agent.

Pure Live Seed (PLS)

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 & 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, 1000SF) =
Recommended Seeding Rate PLS in Lbs. per Unit Area/Percent PLS

13-17-002-0003 Materials

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.

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 pre-inoculated seed with protective coating may be used. Contractor inoculated seed that is not sown within eight hours shall be inoculated again. Seed rates are expressed as ounces of pure live seed (PLS) per thousand square feet. The seed mix shall consist of the following species mix of all grasses plus five flowers plus one nurse crop:

<u>Grasses</u>	<u>Percentage of Total Mix</u>	<u>25# Total / Acre</u>
<u>Bouteloua curtipendula</u>	Sideoats Grama Grass 12%	3# PLS/ Acre
<u>Bouteloua dactyloides</u>	Buffalo Grass 36%	9# PLS/ Acre
<u>Bouteloua gracilis</u>	Blue Grama Grass 20%	5# PLS/ Acre
<u>Festuca arizonica</u>	Arizona Fescue 16%	4# PLS/ Acre
<u>Festuca ovina</u>	Sheep Fescue 16%	4# PLS/ Acre
<u>Flowers</u>		<u>16# Total / Acre</u>
<u>Achillea millefolium occidentaleis</u>	Western Yarrow	1.5# PLS/ Acre
<u>Aster bigloveii</u>	Purple Aster	1.5# PLS/ Acre
<u>Coreopsis tinctoria</u>	Plains Coreopsis	1# PLS/ Acre
<u>Echinacea purpurea</u>	Purple Coneflower	.5# PLS/ Acre
<u>Eriqeron speciosus</u>	Fleabane	.5# PLS/ Acre
<u>Eschscholzia californica</u>	California Poppy	1.5# PLS/ Acre
<u>Gaillardia aristata</u>	Blanket Flower	.5# PLS/ Acre
<u>Gaillardia pinnatifida</u>	Adobe Blanket Flower	.5# PLS/ Acre
<u>Gaillardia pulchella</u>	Fire Wheel	.5# PLS/ Acre
<u>Linum perenne lewisii</u>	Blue Flax	1# PLS/ Acre
<u>Penstemon palmeri</u>	Palmer Penstemon	1# PLS/ Acre
<u>Penstemon strictus</u>	Rocky Mountain Penstemon	2# PLS/ Acre
<u>Ratibida pinnata columnifera</u>	Prairie Coneflower	1# PLS/ Acre
<u>Ratibida columnifera pulcherrima</u>	Mexican Hat	1.5# PLS/ Acre
<u>Rudbeckia fulgida</u>	Black Eyed Susan	1.5# PLS/ Acre
<u>Nurse Crop</u> (added to native	<u>grass + wild flower mix</u>)	

<u><i>Avena sativa</i></u>	<u>Oats</u>	<u>20 lbs/acre</u>
<u><i>Lolium multiflorum</i></u>	<u>Annual Ryegrass</u>	<u>20 lbs/acre</u>
<u><i>Trifolium pretence</i></u>	<u>Red Clover</u>	<u>20 lbs/acre</u>

Alternative species may be acceptable but are subject to prior approval from the City Engineer or duly authorized representative.

Fertilizer

No fertilizer is required for native seeding.

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.

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: 4.5 to 6.5.

Tacking Agent

Tacking agent shall be an organic muciloid liquid concentrate diluted with water, containing no agents toxic to seed germination. When applied, the tacking agent shall form a transparent crust permeable by water and air.

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.

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.

Soil Amendments

Soil amendments shall be well-composted animal manure, plant compost or materials as approved by the City Engineer or duly appointed representative.

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 pass of a cultipacker or drag harrow to insure seed to soil contact.

13-17-002-0005 Execution

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 non-irrigated permanent seed application dates are between April 1 and June 15 and between August 15 and September 20. 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.

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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 25% more than the rate specified in the seed mixes identified in the appendix.

Broadcast seeding shall be performed in a two-pass operation with half of the seed distributed in one 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 complete rolling with a cultipacker or light drag harrow.

A. Mulching for Broadcast Seeding

Mulch 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 1-1/2 to 2 tons per acre with the goal of 1/2 inch depth and <70% coverage. Operations shall minimize displacement of the soil and disturbance of the design cross 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.

13-17-002-0005.5 Hydraulic Seeding (Hydroseeding)

Seed application shall follow the preparation of the seedbed as described in **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 homogenous and applied uniformly resulting in an even distribution of material.

Per acre application rates are as follows;

<u>Tacking Agent</u>	<u>40#</u>
<u>Wood Fiber</u>	<u>200#</u>
<u>Seed</u>	<u>50% more than the rate indicated in 432.3</u>

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 Section 432.2.
- Wood fiber mulch shall be applied at a rate of five (5) pounds per 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 thousand (1,000) square feet.
- Tackifier application rate shall be two (2) pounds per thousand (1,000) square feet.

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 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 1/2-inch. Watering for the remainder of the Establishment Period shall be once a week to a ground moisture depth of 1/2-inch.

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 45 calendar day period. During the establishment period, the contractor shall repair and restore eroded or damaged areas.

Within the one-year warranty period, the contractor shall perform two 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.

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 of the following:

<u>Annual ryegrass</u>	<u>(<i>Lolium multiflorum</i>)</u>	<u>30 lbs/acre</u>
<u>Oats</u>	<u>(<i>Avena sativa</i>)</u>	<u>30 lbs/acre</u>
<u>Red Clover</u>	<u>(<i>Trifolium pretense</i>)</u>	<u>30 lbs/acre</u>
<u>Regreen®</u>	<u>(<i>Triticum aestivum</i> x <i>Elytrigia elongata</i>)</u>	<u>30 lbs/acre</u>

Alternative species may be acceptable but are subject to prior approval from the City Engineer or duly authorized representative.

Sections:

CHAPTER 13-18

LANDSCAPING STANDARDS FOR RIGHTS-OF-WAY

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- 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
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- 13-18-001 Intent, Purpose, Application, and Enforcement/Waiver
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13-18-001 Intent, Purpose, Application, and Enforcement/Waivers

13-18-001-0001 Intent, Purpose, Application, and Enforcement/Waiver

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 per 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-Ways 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, Modifications and Appeals.

13-18-002 Landscape Design

13-18-002-0001 Preface

This section identifies and quantifies desired "landscape design concept" or "theme" for rights-of-ways 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-ways.

B. Landscaping is context specific. The contexts through which rights-of-ways 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-ways pass.

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 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 one through six, are classified as "special districts".

Greater detail in the descriptions of transects is provided in Title 10, Flagstaff Zoning Code.

13-18-002-0003 General Design Goals

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 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 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 course 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 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 21 inches of precipitation during the year, including an average of 86 inches of snow. However, these amounts are quite variable from one year to the next.

Flagstaff enjoys over 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 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 90 to 120 day growing season.

Fire is a natural and frequent occurrence with roughly 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-ways 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.

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-ways 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-ways.

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 of the Flagstaff City Code.

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 2 to 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.

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 groundcover is provided in the Zoning Code found in Title 10 of the Flagstaff City Code.

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 per 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 15% of shrubs indicated in the table may be replaced by native boulders on an "area covered" basis. One third of the boulder's height should be buried.

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.

Clusters – The natural forest density is not monolithic and varies from meadows to clusters of trees and shrubs. In emulating the natural surrounds per the table, the table indicates when clustering is expected to be appropriate.

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 18-2, Landscape Design).

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.

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

Trees			
	Type	Density	Placement
T-1: The most rural, undisturbed, natural land.			
Parkways, Medians, and Other Areas	Match Surrounds	Match Surrounds including Clusters (Max. 100 per acre)	Match Surrounds including Clusters
T-2: Rural, but modified lands.			
Parkways, Medians, and Other Areas	Match Surrounds	per T-1 and Add 15% (Max. 100 per acre)	Match Surrounds Clusters
T-3: The edge areas of a town or city, suburban areas - Large lot subdivisions and substantially forested lands.			
Parkways, Medians, and Other Areas	Match Surrounds	per T-1 and Add 30% (Max. 100 per acre)	Match Surrounds Clusters
T-3: The edge areas of a town or city, suburban areas - Small lot subdivisions and/or substantially denuded lands.			
Parkways	Max. Two Types per Road Segment	(1) per 45 FT	45 FT O.C. (As Practical)
Medians	Max. Two Types per Road Segment	(1) per 45 FT	45 FT O.C. (As Practical)
Other Areas	Match Surrounds	per T-1 and Add 30% (Max. 100 per acre)	Match Surrounds including Clusters
T-4: Higher density mixed-use area - residential prevalent.			
Parkways	Max. Three Types per Road Segment	(1) per 45 FT	45 FT O.C. (As Practical)
Medians	Max. Three Types per Road Segment	(1) per 45 FT	45 FT O.C. (As Practical)
Other Areas	Match Surrounds	per T-1 Add 15% (Max. 100 per acre)	Match Surrounds Clusters
T-5: Higher density mixed-use area - Commercial prevalent.			
Parkways, Tree Wells	Max. Two Types per Road Segment	(1) per 45 FT	45 FT O.C. (As Practical)
Medians	Max. Two Types per Road Segment	(1) per 45 FT	45 FT O.C. (As Practical)
Other Areas	Should not occur in urban area; where occurs, see Special District.		
T-6: Downtown Flagstaff			
Parkways, Tree Wells	One Type per Road Segment	(1) per 45 FT	45 FT O.C. (As Practical)
Medians	One Type per Road Segment	(1) per 45 FT	45 FT O.C. (As Practical)
Other Areas	Should not occur in urban area; where occurs, see Special District.		
Special Districts			
Parkways	Max. Three Types per Road Segment	(1) per 45 FT	45 FT O.C. (As Practical)
Medians	Max. Three Types per Road Segment	(1) per 45 FT	45 FT O.C. (As Practical)
Other Areas	Match Surrounds	per T-1 and Add 30% Max. 100 per acre)	Match Surrounds

Table 13-18-01b - Quantitative Landscape Design Parameters

	Shrubs		
	Type	Density	Placement
T-1: The most rural, undisturbed, natural land.			
Parkways, Medians, and Other Areas	Match Surrounds	Match Surrounds including Clusters	Match Surrounds including Clusters
T-2: Rural, but modified lands.			
Parkways, Medians, and Other Areas	Match Surrounds	Match Surrounds including Clusters	Match Surrounds including Clusters
T-3: The edge areas of a town or city, suburban areas - Large lot subdivisions and substantially forested lands.			
Parkways, Medians, and Other Areas	Match Surrounds	Match Surrounds including Clusters	Match Surrounds including Clusters
T-3: The edge areas of a town or city, suburban areas - Small lot subdivisions and/or substantially denuded lands.			
Parkways	Where Occurs – per Medians	None or per Medians	Where Occurs - per Medians
Medians	(1) per (50) Plants to Max. (5) Types Min. 15% per Type	Min. 25% Coverage at Maturity less Groundcover	Species Appropriate Spacing with Diamond Pattern
Other Areas	Match Surrounds	per T-1 and Add 30%.	Match Surrounds including Clusters
T-4: Higher density mixed-use area - residential prevalent.			
Parkways	Where Occurs – per Medians	None or per Medians	Where Occurs – per Medians
Medians	(1) per (50) Plants to Max. (5) Types Min. 15% per Type	Min. 50% Coverage at Maturity less Groundcover	Species Appropriate Spacing with Diamond Pattern
Other Areas	Match Surrounds	per T-1 and Add 15%.	Match Surrounds including Clusters
T-5: Higher density mixed-use area - Commercial prevalent.			
Parkways, Tree Wells	None	None	None
Medians	(1) per (50) Plants to Max. (5) Types Min. 15% per Type	Min. 75% Coverage at Maturity less Groundcover	Species Appropriate Spacing with Diamond Pattern
Other Areas	Should not occur in urban area; where occurs, see Special District.		
T-6: Downtown Flagstaff			
Parkways, Tree Wells	None	None	None
Medians	(1) per (50) Plants to Max. (5) Types Min. 15% per Type	Min. 75% Coverage at Maturity less Groundcover	Species Appropriate Spacing with Diamond Pattern
Other Areas	Should not occur in urban area; where occurs, see Special District.		
T-6: Downtown Flagstaff			
Parkways	Where Occurs – per Medians	None or per Medians	Where Occurs – per Medians
Medians	(1) per (50) Plants to Max. (5) Types Min. 15% per Type	Min. 25% Coverage at Maturity less Groundcover	Species Appropriate Spacing with Diamond Pattern
Other Areas	Match Surrounds	per T-1 and Add 30%.	Match Surrounds

Table 13-18-01c - Quantitative Landscape Design Parameters

Living Groundcover			
	Type	Density	Placement
T-1: The most rural, undisturbed, natural land.			
Parkways, Medians, and Other Areas	Native Grass and Wildflower Seed Mix	100% Coverage of Disturbed Areas	Hydroseed
T-2: Rural, but modified lands.			
Parkways, Medians, and Other Areas	Native Grass and Wildflower Seed Mix	100% Coverage of Disturbed Areas	Hydroseed
T-3: The edge areas of a town or city, suburban areas - Large lot subdivisions and substantially forested lands.			
Parkways, Medians, and Other Areas	Native Grass and Wildflower Seed Mix	100% Coverage of Disturbed Areas	Hydroseed
T-3: The edge areas of a town or city, suburban areas - Small lot subdivisions and/or substantially denuded lands.			
+Parkways	Where Occurs - per Medians	None or per Medians	Where Occurs - per Medians
Medians	(1) per (500) Plants to Max. (5) Types Min. 15% per Type	Min. 25% Coverage at Maturity less Shrubs	Species Appropriate Spacing with Diamond Pattern
Other Areas	Native Grass and Wildflower Seed Mix	100% Coverage of Disturbed Areas	Hydroseed
T-4: Higher density mixed-use area - residential prevalent.			
Parkways	Where Occurs - per Medians	None or per Medians	Where Occurs - Medians
Medians	(1) per (500) Plants to Max. (5) Types Min. 15% per Type	Min. 50% Coverage at Maturity less Shrubs	Species Appropriate Spacing with Diamond Pattern
Other Areas	Native Grass and Wildflower Seed Mix	100% Coverage of Disturbed Areas	Hydroseed
T-5: Higher density mixed-use area - Commercial prevalent.			
Parkways, Tree Wells	per T-4 (Tree Wells per Medians)	per T-4 (Tree Wells per Medians)	per T-4 (Tree Wells per Medians)
Medians	(1) per (500) Plants to Max. (5) Types Min. 15% per Type	Min. 75% Coverage at Maturity less Shrubs	Species Appropriate Spacing with Diamond Pattern
Other Areas	Should not occur in urban area; where occurs, see Special District.		
T-6: Downtown Flagstaff			
Parkways, Tree Wells	per T-4 (Tree Wells per Medians)	per T-4 (Tree Wells per Medians)	per T-4 (Tree Wells per Medians)
Medians	(1) per (500) Plants to Max. (5) Types Min. 15% per Type	Min. 75% Coverage at Maturity less Shrubs	Species Appropriate Spacing with Diamond Pattern
Other Areas	Should not occur in urban area; where occurs, see Special District.		
Special Districts			
Parkways	Where Occurs - per Medians	None or per Medians	Where Occurs - per Medians
Medians	(1) per (500) Plants to Max. (5) Types Min. 15% per Type	Min. 25% Coverage at Maturity less Shrubs	Species Appropriate Spacing with Diamond Pattern
Other Areas	Native Grass and Wildflower Seed Mix	100% Coverage of Disturbed Areas	Hydroseed

13-18-003 Material Selection

See Table 13-18-02.

13-18-003-0001 General Requirements

A list of pre-approved trees, shrubs, and groundcover is provided in the Zoning Code found in Title 10 of the Flagstaff City Code.

Selection and use of native and drought tolerant plant species is preferred. All plant species shall be cottonless, non-fruiting, and, except for groundcover, 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 non-availability 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 groundcovers 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 in filled 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.

13-18-003-0002 Irrigation (See City Code, Chapter 13-19)

Irrigation system technical specifications are contained in Chapter 13-19 of the Flagstaff City Code.

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.

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-ways.

13-18-003-0003.1 Pre-approved Trees

A list of pre-approved trees is provided in the Zoning Code found in Title 10 of the Flagstaff City Code.

13-18-003-0003.2 Prohibited Trees

Specifically prohibited for landscape use in rights-of-way are the following plant materials:

Botanical Name	Common Name
Acer negundo	Box Elder
Elaeagnus angustifolia	Russian Olive
Populus acuminata	Lance Leaf Cottonwood
Populus alba	White Poplar
Populus angustifolia	Narrow Leaf Cottonwood
Populus fremontii	Fremont Cottonwood
Populus nigra	Black Poplar
Salix species	Willows
Ulmus parvifolia	Chinese Elm
Ulmus pumila	Siberian Elm

13-18-003-0004 Shrubs

Shrubs shall be well rooted container stock and shall have a minimum size of three gallons.

13-18-003-0004.1 Pre-approved Shrubs

Shrub species selected from the list of pre-approved shrubs found in Title 10 of the Flagstaff City Code are acceptable. Other species may be acceptable but are subject to approval by the City Engineer and the Public Works Division.

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 groundcover is provided in the Zoning Code found in Title 10 of the Flagstaff City Code.

13-18-003-0005.1 Pre-approved Groundcover

Groundcover species selected from the pre-approved list found in Title 10 of the Flagstaff City Code are acceptable. Other species may be acceptable but are subject to approval by the City Engineer and the Public Works Division.

13-18-003-0006 Landscape Materials

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.

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.

13-18-003-0006.3 Root Barrier

A. Root barriers shall be one 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.

13-18-003-0006.4 Pre-emergent Weed Control

A. Pre-emergent weed control shall be Dactal or equal and shall be used prior to the installation of wood and rock mulch materials. Installation shall be per the manufacturer's written instructions.

13-18-003-0006.5 Weed Barrier

Weed barrier shall be a synthetic, non-woven, water permeable geotextile. Manufacturer's technical information and a nominal 4-inch square sample shall be submitted for City of Flagstaff's prior approval.

13-18-003-0006.6 Tree Wrap

Tree wrap shall be heavy, crinkle crepe paper, 4 to 10 inches wide and manufactured specifically as tree wrap.

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 4% to 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 part mix consisting of a 5:1 ratio of crushed stone to clay loam, by weight, with .03% hydrogel added. Total moisture at mixing shall be 10% per AASHTO T-99 (optimum moisture).

The stone shall be clean, angular, gap graded, 3/4 to 1-1/2 inch crushed stone with no fines. Volcanic rock is explicitly excluded.

The clay loam shall consist of <5% gravel, 25-30% sand, 20-40% silt and 25-40% clay with 2-5% organic matter per the USDA soil classification system.

Hydrogel shall be A1000C Hydro-Gel as manufactured by Finn Corporation, Fairfield, Ohio or an approved equal.

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-ounce weight. Plastic products are prohibited.

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.

TABLE 13-18-02

MATERIAL SELECTION

Symbol Scale @ 2/3 Maturity	Genus & Species	Common Name	Qty.	Planting Size	Estimated Mature Size Height x Width	Design Spacing O.C.
	Overstory / Canopy Trees					
	Fraxinus pennsylvanica	Green Ash	12	2.5" Cal.	65' x 40'	35'
	Populus tremuloides	Quaking Aspen	25	2.5" Cal. Multi Stem	28' x 18'	24'
	Ornamental Trees					
	Malus sargentii	Sargent Crabapple	30	1.5" Cal.	10' x 16'	14'
	Prunus padus	Common Birdcherry	15	1.5" Cal.	24' x 20'	18'
	Evergreen Trees					
	Pinus ponderosa	Ponderosa Pine	5	6' B&B	80' x 30'	30'
	Shrubs					
	Potentilla fruticosa 'Gold Drop'	Gold Drop Bush Cinquefoil	200	2 Gallon	2' x 2'	2'
	Pinus mugo mughus	Dwf. Mugho Pine	50	3 Gallon	2.5' x 3'	2.5'
	Groundcovers & Perennials					
	Vinca minor	Periwinkle	300	3" Pot	Groundcover	1'

13-18-004 Installation, Placement, and Planting

13-18-004-0001 General Requirements

- A. Except for groundcover, 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, cinder operations, and vehicular traffic.
- B. All landscape materials shall be placed, including the quantity and spacing of plant materials, per 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 is 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.

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 at 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. Groundcover Installation
 - 1. Immediately prior to installation, groundcover areas are to be cultivated to a depth of six (6) inches and grade smooth and uniform.
 - 2. Groundcover shall be planted to within eighteen (18) inches of tree trunks or shrubs planted within the area. Groundcover is to be planted so that the root crown is at or slightly above the prepared bed's finish grade.
 - 3. After planting of groundcover and prior to mulching, pre-emergent weed control shall be spread over planting bed soil surface per manufacturer's written directions.
 - 4. Specified mulch shall be installed to a depth of two (2) inches over the entire groundcover bed.
- C. Container and balled and burlapped (B&B) plant material installation
 - 1. Non-plantable 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 non-plantable 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 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 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 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 to three inches in the area disturbed by excavation of the planting well or in planting bed areas as designated on the plans(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 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 lines spaced evenly about the tree.

a. Line shall attach to the tree trunk about 2/3 of the tree height and be anchored at the ground to the specified earth anchors at a 30 to 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.

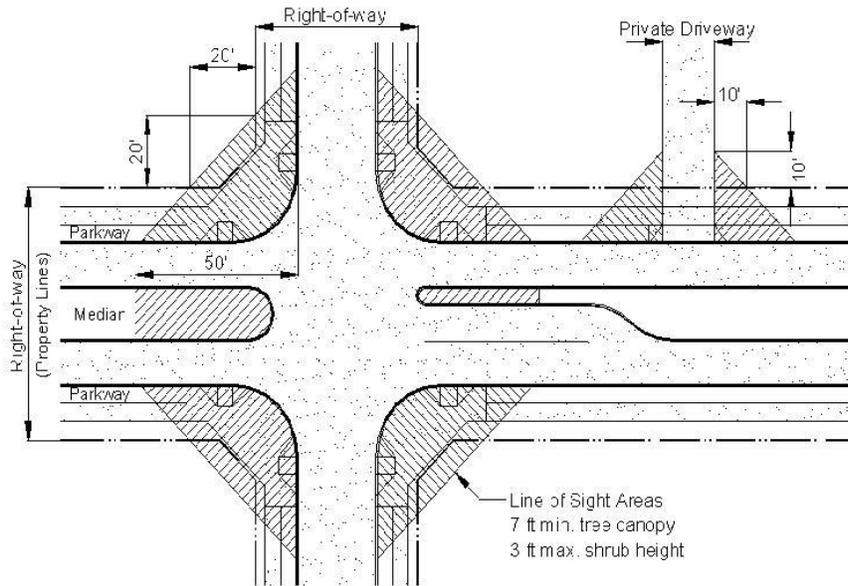
5. If planting work is performed after lawn preparation is finished, the Contractor shall provide protection to the lawn areas and immediately repair any damage resulting from planting operations at no cost to the City.

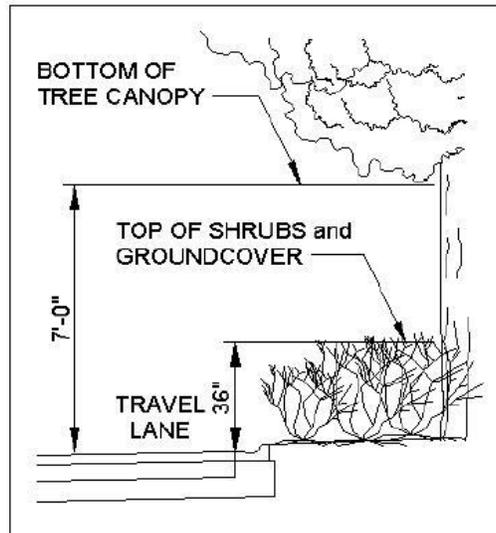
6. Maintenance of plants shall commence immediately and continue until acceptance of the work. A written recommended maintenance program is to be provided to the City prior to acceptance of the work.

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.

13-18-004-0001.2 Safety

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 feet along both street side property lines from their intersection, or ten 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 inch top height. Trees located within or overhanging these triangular areas shall have canopies selected for and maintained at seven feet above street level. The end fifty 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 feet of emergency apparatus.
2. Trees and shrubs shall not be placed within ten 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.

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 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.

13-18-004-0003 Finish Grading

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.

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.

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.

13-18-004-0005 Trees

A list of pre-approved trees, shrubs, and groundcover is provided in the Zoning Code found in Title 10 of the Flagstaff City Code.

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 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 per Standard Detail 18-04-050.)

13-18-004-0005.2 Urban Street Trees

Urban street trees shall typically be placed per the following schedule:

Tree Size	Spacing
Small	10 to 15 feet
Medium	15 to 20 feet
Large	20 to 25 feet

A list of pre-approved trees is provided in the Zoning Code found in Title 10 of the Flagstaff City Code.

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 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 per 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 24 square feet. Circular tree grates shall have a nominal minimum grate area of 23.75 square feet (5.5-foot diameter).
4. Tree grate and frame shall be installed per 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 guying.

13-18-004-0005.3 Root Control

Trees planted within four feet of buildings, roads, walkways, and similar situations, shall be provided with root control system specified in Section 13-18-004-0005.5.

13-18-004-0005.4 Structural Soils

Structural soil mixes are two-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.

13-18-004-0005.5 Root Barriers

Root barriers shall be one continuous piece (not interlocking), shall be a minimum of 24" in depth, and installed such that the top is even with the top of pavement.

13-18-004-0005.6 Staking

A. Staking and strapping shall be provided for all tree installations. Stakes are to be driven 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 2 inches and under - one stake oriented northwest
2. deciduous trees larger than 2 inches but less than 3 inches and evergreen trees less than 5 feet in height - two stakes oriented northwest and southeast;
3. deciduous trees 3 inches and larger and evergreen trees 5 feet and larger - three stakes with one oriented northwest and the other two oriented 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 grommet in the strap, the strap wrapped around trunk at no more than one-third 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.

13-18-004-0005.7 Wrapping

A. All deciduous trees shall be wrapped between October 15 and November 30 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 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 places.

B. Tree wrap should be removed between April 1-15 of the following spring.

13-18-004-0006 Hardscape

Flagstaff City Code, Title 13, Engineering and Construction Standards provides standards for the design and construction of medians and parkways, sidewalks, and similar hardscape elements, and is incorporated herein by reference.

13-18-004-0007 Landscape Boulders and Rock Work

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 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.

13-18-004-0008 Hydroseeding

Hydroseeding means, materials and methods is described and specified under Chapter 13-17, Erosion Control.

13-18-005 Maintenance

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.

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 per the approved streetscape plan, or in the absence thereof, per 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 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.

13-18-005-0003 Irrigation

- A. Newly planted trees should be watered daily for the first two 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.

13-18-006 Tree Protection Measures

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 Flagstaff City Code, Title 10, 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.

13-18-007 City of Flagstaff Rights

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.

13-18-008 Enforcement

13-18-008-0001 Enforcement

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 (1) interferes with the proper spread of light along the street from a street light, (2) interferes with the visibility of any traffic control device or sign, or (3) 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.

13-18-009 Definitions

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 non-plant materials used in landscaping.

"Landscape" refers collectively to the plants and hardscape in a prescribed area, and may include non-living 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 non-driving surface within a street, between the two 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 groundcovers.

"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 non-chemical 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.

CHAPTER 13-19
Irrigation Systems

Sections:

13-19-001	Criteria
13-19-002	Irrigation Plans
13-19-003	System Flushing and Testing
13-19-004	Products, Material, and Equipment
13-19-001-0001	General Design Criteria
13-19-001-0002	General System Criteria
13-19-002-0001	Irrigation Plans
13-19-003-0001	System Flushing and Testing
13-19-004-0001	Supplemental Products, Materials, and Equipment
13-19-004-0002	Products, Materials and Equipment

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 10% and shall be designed to provide for a maximum pressure of 85psi.
2. Design irrigation system lateral piping to limit pressure drops to less than 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 alternation. 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 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.

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 piece and shall not exceed twenty four (24) inches.
- D. Provide two 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 per manufacturer's written instructions.
- F. Provide a three 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 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 amp breaker is required in the back flow 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.

13-19-002-0001 Irrigation Plans

Minimum plan requirements include a schematic utility connection detail, irrigation legend, piping diagrams, pipe diameter and design calculations.

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.
- D. Irrigation systems shall be warranted against defects in materials and workmanship for one year from date of acceptance.

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 additional quick coupling valve, quick coupling valve operating key and quick coupling valve hose swivel.
 - 2. Provide one additional controller key pad for each type of irrigation controller installed.
 - 3. Provide one additional controller programming/access key per project for the solar irrigation controller.
 - 4. Provide one ProMax remote controller and adapter cord with plug at each end.
 - 5. Provide an additional 10% of the installed quantity of sprinkler heads, emitters and irrigation control valves.

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:

Backflow Prevention Device

Febco 825 YA

Backflow Enclosure	Lok Box or Hot Box Shall be an insulated box. Cage is not acceptable.
Pressure Regulator	Watts or Febco
Quick Coupling Valves	Rainbird 44 LRC, 44K (1") valve key & hose swivel Rainbird 7, 1 piece body, 7K (1-1/2") valve key & hose swivel
Control Valves	Weathermatic 11000 Series
Irrigation Valve Boxes	Carson #1 & #2, Model 1220 Reclaim shall be purple. Potable shall be green.
Strainers	Watts or Febco
Drip System Pressure Regulator	Watts or Febco
Drip System Emitters	Quadra Bubbler Octa Bubbler System Bowsmith ML 200 Multi-emitter Bowsmith SL 206 Single Emitter
Electric Irrigation Controllers	Rainbird MaxiCom Central Control System - ProMax remote control required Rainsafe Control System - preassembled with controller unit, master valve flow sensor Rainbird ESP-SAT Series Controller (when required)
Spray Heads	Hunter: I-40/PGP/I-25 Stainless Steel Riser/PS Series 2"&6" Toro: Series 300 or 570 or 640 or Super 600 or V-1550 Rainbird: 1800 Series – 6", 8" & 12"
Piping	PVC pipes and fittings shall be schedule 40 PVC Cement: medium bodied, primer required Copper tubing shall be K copper Poly drip tubing: allowed only after emitters
Manual Valves	Shall be resilient seated ball valve
Master Valves – required on main line of irrigation system	Less than 2": Griswold Master Valve - a pressure reducing valve is required 2" or larger: Singer Model #106-PR-SC24V
Flow Sensor	Compatible with MaxiCom System. Required on main line of irrigation system.

CHAPTER 13-21

REVISIONS TO M.A.G. UNIFORM STANDARDS SPECIFICATIONS AND M.A.G. UNIFORM

STANDARD DETAILS

Sections:

- 13-21-001 Revisions to M.A.G. Uniform Standard Specifications
- 13-21-002 Revisions to M.A.G. Uniform Standard Details
- 13-21-001-0010 Flagstaff Addendum to M.A.G. Uniform Standard Specifications for Public Works Construction
- [13-21-001-104.1.3 M.A.G. Spec 104.1.3-Cleanup and Dust Control](#)
- 13-21-001-106.2 M.A.G. Spec. 106.2 – Control of Materials – Samples and Tests of Materials
- 13-21-001-0107.7 M.A.G. Spec. 107.7 – Barricades and Warning Signs
- 13-21-001-0108.5 M.A.G. Spec 108.5 - Limitations of Operations
- 13-21-001-0211.2 M.A.G. Spec. 211.2 – Fill Construction – Placing
- 13-21-001-0211.3 M.A.G. Spec 211.3 – Fill Construction – Compacting
- 13-21-001-0301.3 M.A.G. Spec. 301.3 – Sub-grade preparation – Relative Compaction
- 13-21-001-0310.2 M.A.G. Spec. 310.2 – Untreated Base – Placing
- 13-21-001-0311.2 M.A.G. Spec. 311.2 – Soil Cement Base Course – Materials
- 13-21-001-0311.4 M.A.G. Spec. 311.4 – Soil Cement Base Course – Construction Methods
- 13-21-001-0321.5 M.A.G. Spec. 321.5 – Asphaltic Concrete Paving – Placing, Spreading, and Finishing
- 13-21-001-0321.5.3 M.A.G. Spec. 321.5.3 – Asphaltic Concrete Pavement – Leveling Course
- 13-21-001-0321.5.4 M.A.G. Spec. 321.5.4 – Asphaltic Concrete Pavement – Asphalt Base and Surface Course
- 13-21-001-0321.6 M.A.G. Spec. 321.6 – Asphaltic Concrete Pavement – Corrective Requirements for Deficiencies
- 13-21-001-0330.2.1 M.A.G. Spec. 330.2.1 – Asphalt Chip Seal – Materials – Asphalt
- 13-21-001-0330.3 M.A.G. Spec 330.3 – Asphalt Chip Seal – Time of Application and Weather Conditions
- 13-21-001-0330.4.8 M.A.G. Spec. 330.4.8 – Asphalt Chip Seal – Protection to Adjacent Property
- [13-21-001-0336.2.1 M.A.G. Spec. 336.2.1 – Pavement Widening or Extensions](#)
- 13-21-001-0336.2.3 M.A.G. Spec. 336.2.3 – Temporary Pavement Replacement
- 13-21-001-0336.2.4 M.A.G. Spec. 336.2.4 – Pavement Matching and Surface Replacement – Permanent Pavement Replacement
- 13-21-001-0340.2 M.A.G. Spec. 340.2 – Concrete Curb, Gutter, Sidewalk, Driveway and Alley Entrance – Materials
- 13-21-001-0340.3 M.A.G. Spec. 340.3 – Concrete Curb, Gutter, Sidewalk, Driveway and Alley Entrance – Construction Methods
- 13-21-001-0342.2.1 M.A.G. Spec. 342.2.1 – Decorative Pavement – Sand Aggregate Base Course
- 13-21-001-0342.2.4 M.A.G. Spec. 342.2.4 – Decorative Pavement – Brick
- 13-21-001-0342.3.3 M.A.G. Spec. 342.3.3 – Decorative Pavement – Header
- 13-21-001-0342.3.4 M.A.G. Spec. 342.3.4 – Decorative Pavement – Concrete Paving Stones
- 13-21-001-0342.3.6 M.A.G. Spec. 342.3.6 – Decorative Pavement – Sand Laying Course
- 13-21-001-0345.2 M.A.G. Spec. 345.2 – Adjusting Frames, Covers, Valve Boxes, and Water Meter Boxes – Adjusting Frames
- 13-21-001-0345.3 M.A.G. Spec. 345.3 – Adjusting Frames, Covers, Valve Boxes, and Water Meter Boxes – Adjusting Valve Boxes
- 13-21-001-0401.5 M.A.G. Spec. 401.5 – Right-of-Way and Traffic Control General Traffic Regulations
- 13-21-001-0505.3 M.A.G. Spec. 505.3 – Concrete Structures – Forms
- 13-21-001-0505.6 M.A.G. Spec. 505.6 – Concrete Structures – Placing Concrete
- 13-21-001-0505.6.2 M.A.G. Spec. 505.6.2 – Concrete Structures – Adverse Weather Concreting
- 13-21-001-0601.2.3 M.A.G. Spec. 601.2.3 – Water and Sewer – Trench Grade
- 13-21-001-0601.2.9 M.A.G. Spec. 601.2.9 – Water and Sewer – Trench Excavation, Backfill and Compaction – Shoring and Sheeting
- 13-21-001-0601.4.3 M.A.G. Spec. 601.4.3 – Trench Excavation, Backfill and Compaction – Backfill

CHAPTER 13-21 REVISIONS TO M.A.G. UNIFORM
STANDARDS SPECIFICATIONS AND
M.A.G. UNIFORM STANDARD DETAILS

- 13-21-001-0601.4.4 M.A.G. Spec. 601.4.4 – Water and Sewer – Trench Excavation, Backfill and Compaction –
Compaction Densities
- 13-21-001-0610.10 M.A.G. Spec. 610.10 – Connection to Existing Mains
- 13-21-001-0625.3 M.A.G. Spec. 625.3 – Manhole Construction and Drop Sewer Connections – Construction
Methods
- 13-21-001-0702.1 M.A.G. Spec. 702.1 – Base Materials – General
- 13-21-001-0702.2.2 M.A.G. Spec 702.2.2 – Base Materials – Crush Aggregate – Grading
- 13-21-001-0710.2.1 M.A.G. Spec. 710.2.1 – Asphaltic Concrete – Material – Asphalt Cement
- 13-21-001-0710.2.2 M.A.G. Spec. 710.2.2 – Asphalt Concrete – Material - Aggregate
- 13-21-001-0710.3.1 M.A.G. Spec 710.3.1 – Asphalt Concrete – Mixed Design Requirements – General
- 13-21-001-0710.3.2.1 M.A.G. Spec 710.3.2.1 – Asphalt Concrete – Mixed Design Requirements – Marshall Mix
Design
- 13-21-001-0710.4.2 M.A.G. Spec 710.4.2 – Asphalt Cement Content
- 13-21-001-0713.1 M.A.G. Spec. 713.1 – Emulsified Asphalts - General
- 13-21-001-0716.2.1 M.A.G. Spec. 716.2.1 – Cover Material – Stone Chips - General
- 13-21-001-0716.2.3 M.A.G. Spec. 716.2.3 – Cover Material – Gradation
- 13-21-001-0725.1 M.A.G. Spec. 725.1.1 – Portland Cement Concrete – Classes of Concrete
- 13-21-001-0725.3 M.A.G. Spec. 725.3 – Portland Cement Concrete Aggregates
- 13-21-001-0725.5 M.A.G. Spec. 725.5 – Portland Cement Concrete – Water
- 13-21-001-0750.2 M.A.G. Spec. 750.2 – Iron Water Pipe and Fittings, Ductile Iron Water Pipe
- 13-21-001-0750.3 M.A.G. Spec 750.3 – Iron Water Pipe and Fittings, Joint Requirements
- 13-21-001-0760.1 M.A.G. Spec. 760.1 – Coating Corrugated Metal Pipe and Arches – General

**13-21-001-0010 FLAGSTAFF ADDENDUM TO M.A.G. 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
(M.A.G. SPECS AND DETAILS) LATEST REVISIONS.

EACH CHAPTER NUMBER INDICATES THE SECTION OF M.A.G. SPECIFICATIONS ON WHICH THE
CHANGE IS MADE.

PARAGRAPH NUMBER REFERENCES ARE COUNTED FROM THE BEGINNING OF THE RESPECTIVE
TITLE.

13-21-001-104.1.3 M.A.G. Spec 104.1.3- Cleanup 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 per City
Code, Chapter 7-03

13-21-001-0106.2 M.A.G. Spec. 106.2 – Control of Materials – Samples and Tests of Materials

Third paragraph; revised 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.

13-21-001-0107.7 M.A.G. Spec. 107.7 – Barricades and Warning Signs

Revised 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).

13-21-001-0108.5 M.A.G. Spec. 108.5 – Limitations of Operations

Add new 5th and 6th paragraph:

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.

13-21-001-0211.2 M.A.G. 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.*

13-21-001-0211.3 M.A.G. Spec 211.3 – Fill Construction – Compacting

Fifth paragraph; revised 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.

13-21-001-0301.3 M.A.G. 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 #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

13-21-001-0310.20 M.A.G. 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.

13-21-001-0311.2 M.A.G. 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, revised 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.

13-21-001-0311.4 M.A.G. 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.

13-21-001-0321.5 M.A.G. 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.

13-21-001-0321.5.3 M.A.G. Spec. 321.5.3 – Asphaltic 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.

13-21-001-0321.5.4 M.A.G. Spec. 321.5.4 – Asphaltic 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 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.

13-21-001-0321.6 M.A.G. Spec. 321.6 – Asphaltic 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.

13-21-001-0330.2.1 M.A.G. 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.

13-21-001-0330.3 M.A.G. 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 ~~not~~ be performed between ~~October 1~~ and ~~May 31~~ unless specifically permitted by the City Engineer.

13-21-001-0330.4.8 NEW SUB-TITLE: M.A.G. 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.

13-21-001-0336.2.1 M.A.G. 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.

13-21-001-0336.2.3 M.A.G. 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 2 inches and shall conform to the following requirements:

1. The paving material shall be composed of an aggregate, as specified herewith, and plant mixed with Unique Paving Material (U.P.M.tn) 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:

Sieve Size	% Passing
3/8 inch	100
No. 4	85-100
No. 8	10-40
No. 16	10
No. 50	0-5
No. 200	2 maximum

2. The aggregate shall also meet the following criteria:

Sand equivalent	45 min.
Crushed faces	70% min.
Flakiness index	25 max.
Absorption	1.0 – 2.5%
Specific gravity	2.55 – 2.75%

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.
Kinematic Viscosity @	140°F (60°C) 1000 – 4000 cSt
Water	0.2% max.

Distillate Test

(volume of original sample)

To 437°F	0%
To 500°F	0 – 55%
To 600°F	0 – 20%
Residue from Distillate @ 680°F	78 – 95%

Residue Test:

Absolute Viscosity @ 140°F	125 poises
Penetration	200 min.
Ductility @ 39°F	100 min.
Solubility in Trichloroethylene	99% min.

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.

13-21-001-0336.2.4 M.A.G. Spec. 336.2.4 – Pavement Matching and Surface Replacement – Permanent Pavement Replacement

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, revised 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.

13-21-001-0340.2 M.A.G. Spec. 340.2 – Concrete Curb, Gutter, Sidewalk, Driveway and Alley Entrance – Materials

First paragraph, revised to read as follows:

Concrete shall be Class A, containing 5 to 7% air entrainment, and conforming to applicable requirements of Section 725.

13-21-001-0340.3 M.A.G. Spec. 340.3 – Concrete Curb, Gutter, Sidewalk, Driveway and Alley Entrance – Construction Methods

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.

13-021-001-0342.2.1 M.A.G. 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 per M.A.G. Section 702.

13-21-001-0342.2.4 M.A.G. Spec. 342.2.4– Decorative Pavement – Brick
Revised paragraph to read as follows:

Brick shall not be used for decorative pavement.

13-21-001-0342.3.3 M.A.G. Spec. 342.3.3 – Decorative Pavement – Header
Revised paragraph to read as follows:

The header shall be a Class A concrete with 5 to 7% air entrainment, and per Section 725.

13-21-001-0342.3.44 M.A.G. 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.

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.

13-21-001-0342.3.6 M.A.G. 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.

13-21-001-0345.2 M.A.G. 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".

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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.

13-21-001-0345.3 M.A.G. 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, per 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.

13-21-001-0401.5 M.A.G. 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, revised 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.

13-21-001-0405.2 M.A.G. Spec. 405.2 – Monuments – Materials

Second paragraph, revise to read as follows:

All concrete shall be Class A with 5 to 7% air entrainment.

13-21-001-0505.3 M.A.G. 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.

13-21-001-0505.6 M.A.G. 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.

13-21-001-0505.6.2 M.A.G. Spec. 505.6.2 – Concrete Structures – Adverse Weather Concreting

Subsection (B), revised 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,

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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.

13-21-001-0601.2.3 M.A.G. 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.

13-21-001-0601.2.9 M.A.G. 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.

13-21-001-0601.4.3 M.A.G. 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.

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.

13-21-001-0601.4.4 M.A.G. Spec. 601.4.4 – Water and Sewer - Trench Excavation, Backfill and Compaction – Compaction Densities

Table 601-2, revise to read as follows:

TABLE 601-2

MINIMUM DENSITY REQUIRED

Backfill Type	Location	From Subgrade to 2' Below Subgrade	From 2' Below Subgrade to 1' Above Top of Pipe	From 1' Above Top of Pipe to Bottom of Trench
I	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.	100% for Granular 95% for Non-Granular	95%	95%

Backfill Type	Location	From Subgrade to 2' Below Subgrade	From 2' Below Subgrade to 1' Above Top of Pipe	From 1' Above Top of Pipe to Bottom of Trench
II	On any utility easement, street, road or alley right-of-way outside limits of (I)	90%	90%	95%
III	Around any structures or exposed utilities.	95%	In all cases	

13-21-001-0610.10 M.A.G. Spec. 610.10 – Connection to Existing Mains

Revised 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 to 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.

13-21-001-0625.3 M.A.G. 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.

13-21-001-0702.1 M.A.G. 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.

13-21-001-0702.2.2 M.A.G. Spec. 702.2.2 – Base Materials – Crushed Aggregate –Grading
Table 702, revised 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.

13-21-001-0710.2.1 M.A.G. 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.

13-21-001-0710.2.2 M.A.G. Spec. 710.2.2 – Asphalt Concrete - Aggregate
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.

13-21-001-0710.3.1 M.A.G. Spec. 710.3.1 – Asphalt Concrete – Mixed Design Requirements - General
(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:

TEST	ACCEPTABLE TEST RESULTS
Loss on Abrasion (ASTM C0131 and/or ASSHTO 96) after 500 revolutions	40 Max.
Absorbed Asphalt Range (ASSHTO T-245)	0 – 1%
Combine Water Absorption (ASSHTO T-84)	0 – 2.25%

All asphaltic concrete shall contain a minimum of 1% Portland Cement or dry hydrated lime by weight of total mixture.

13-21-001-0710.3.2.1 M.A.G. Spec 710.3.2.1 – Asphalt Concrete – Mix Design Requirements – Marshall Mix Design

Revise the percent of asphalt range for B-1 and 3/4 inch asphaltic concrete from 5.0 to 6.0% to 5.3 to 6.0%.

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 2500 to 2000

13-21-001-0710.4.2 M.A.G. 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.

13-21-001-0713.1 M.A.G. 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

Test Description	Test Method	Min	Max
TEST OF EMULSION			
Viscosity, SFS @ 122 F	D244	125	400
Settlement, 5 days, %	D244		5
Storage Stability 1 Day, %	A244		1
Class, Un-coated Par	A502	60	
Particle Charge Test	D244		+
Sieve Test, %	D244		0.30
Oil Distillate, % V of Emulsion	D244		3
Residue by Distillation, %	D244	66	
Tests on Residue by VACUUM RECOVERY A512			
Viscosity, ABS, Poise @ 140 F	D2171	1800	2800
Pen @ 77F, 100g/5 sec, Dmm	D5	40	90
Ductility, 77F, 5 cm/min, Cm	D113	40	

Test Description	Test Method	Min	Max
Solubility in TCE, %	D2042	97.5	
Toughness, inch-pounds	(1)	150	
Elastic Recovery by means of Ductilometer, %	T301	58	
Tenacity, inch-pounds	(1)	110	
Polymer Content (by wt. Of solids) %	CAL-401	2.5	
TEST ON RTFO RESIDUE			
Aging Ratio, ABS viscosities	D2171		2.5
POLYMER REQUIREMENTS			
Melt flow rate, dg/min 190 C	D1238		45

- 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.

13-21-001-0716.2.1 M.A.G. 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.

13-21-001-0716.2.3 M.A.G. Spec. 716.2.3 – Cover Material – Stone Chips – Gradation

Tables 716-1 and 716-2, revise to read as follows:

GRADATION CM-11

	% passing sieve
3/8 inch	100
No. 4	0-40
No. 8	0-5

	% passing sieve
No. 200	0-2.0

13-21-001-0725.1 M.A.G. 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 non-reinforced. 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.

13-21-001-0725.3 M.A.G. 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.

13-21-001-0725.5 M.A.G. 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.

13-21-001-0750.2 M.A.G. 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.

13-21-001-0750.3 M.A.G. Spec 750.3 – Iron Water and Pipe Fittings, Joint Requirements

Only Megalug or Bell joint are acceptable types of joint restraints.

13-21-001-0760.1 M.A.G. 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.

13-21-002

Addendum to M.A.G. Uniform Standard Details for Public Works Construction

Sections:

- 13-21-002 Addendum to M.A.G. Uniform Standard Details for Public Works Construction
- 13-21-002-0010 Portland Concrete Exposed to Weather13-21-002-0120.1M.A.G. Detail No. 120-1 and 120-2 – Survey Marker
- 13-21-002-0120.1 M.A.G. Detail No. 120-1 and 120-2 – Survey Marker
- 13-21-002-0120.2 M.A.G. Detail No. 120-1 and 120-2 – Survey Marker
- 13-21-002-0202 M.A.G. Detail No. 202 – Alley Details (Paved and Unpaved)
- 13-21-002-0212 M.A.G. Detail No. 212 – Utility Pothole Repair
- 13-21-002-0220 M.A.G. Detail No. 220 – Curb and Gutter – Types A, B, C, and D
- 13-21-002-0230 M.A.G. Detail No. 230 - Sidewalks
- 13-21-002-0240 M.A.G. Detail No. 240 – Valley Gutter
- 13-21-002-0250 M.A.G. Detail No. 250 and 251 – Driveway Entrances/ Return Type Driveways
- 13-21-002-0380 M.A.G. Detail No. 380 – Thrust Blocks for Water Lines
- 13-21-002-0390 M.A.G. Detail No. 390 – Curb Stop with Flushing Pipe
- 13-21-002-0420 M.A.G. Detail No. 420 – Pre-Cast Concrete Sewer Manhole
- 13-21-002-0421 M.A.G. Detail No. 421 – Offset Manhole for 8" to 30" Pipe
- 13-21-002-0422 M.A.G. Detail No. 422 – Sewer Manhole and Cover Frame Adjustment
- 13-21-002-0424 M.A.G. Detail No. 424 and 425 – Manhole Frame and Cover
- 13-21-002-0425 M.A.G. Detail No. 424 and 425 – Manhole Frame and Cover
- 13-21-002-0426 M.A.G. Detail No. 426 – Drop Sewer Connections
- 13-21-002-0427 M.A.G. Detail No. 427 – Stub-Out and Plugs
- 13-21-002-0440.1 M.A.G. Detail No. 440-1 – Type "A" Sewer Building Connection
- 13-21-002-0440.3 M.A.G. Detail No. 440-3 – Type "C" Sewer Building Connection
- 13-21-002-0441 M.A.G. Detail No. 441 – Sewer Cleanout
- 13-21-002-0533 M.A.G. Detail Nos. 533-540 – Catch Basins
- 13-21-002-0534 M.A.G. Detail Nos. 533-540 – Catch Basins
- 13-21-002-0535 M.A.G. Detail Nos. 533-540 – Catch Basins
- 13-21-002-0536 M.A.G. Detail Nos. 533-540 – Catch Basins
- 13-21-002-0537 M.A.G. Detail Nos. 533-540 – Catch Basins
- 13-21-002-0538 M.A.G. Detail Nos. 533-540 – Catch Basins
- 13-21-002-0539 M.A.G. Detail Nos. 533-540 – Catch Basins
- 13-21-002-0540 M.A.G. Detail Nos. 533-540 – Catch Basins

13-21-002-0001 Portland Cement Concrete Exposed to Weather

M.A. G. Uniform Standard Details for Public Works Construction shall be modified as follows:

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 M.A.G. 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, 501-3, 501-4, 501-5, 502-1, 502-2, 530, 531, 532, 533-1, 533-2, 534-1, 535, 550, and 552.

13-21-002-0120.1 and 13-21-002-01210.2 M.A.G. Detail No. 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.

13-21-002-0202 M.A.G. 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".

13-21-002-0212 M.A.G. Detail No. 212 – Utility Pothole Repair

Disallow Type "B" pavement repair.

13-21-002-0220 M.A.G. 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.

13-21-002-0230 M.A.G. Detail No. 230 – Sidewalks

Change the length of the sidewalk from 10 feet to 12 feet on 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. Revised the class of concrete from Class B to Class A.

13-21-002-0240 M.A.G. Detail No. 240 – Valley Gutter

Detail No. 240 shall not be used. Use City of Flagstaff Detail 8-06-010.

13-21-002-0250 M.A.G. Detail No. 250 and 251 – Driveway Entrances/ Return Type Driveways

Revise to include the following notes:

~~The revised depth of concrete for commercial and industrial driveways shall be 8" 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".

13-21-002-0380 M.A.G. Detail No. 380 – Thrust Blocks for Water Lines

Replace the table with the following table:

TYPE OF FITTING	Pipe Size (Inches)	MINIMUM THRUST BLOCK BEARING AREA (SQ. FT.) REQUIRED (Y x W)				
		SOFT CLAY	SAND	SAND & GRAVEL	SAND & GRAVEL WITH CLAY	ROCK
TEES & DEAD ENDS	8	4 <u>3</u> 2	9 <u>1</u> 6	6 <u>1</u> 1	5 <u>8</u>	2 <u>4</u>
	10	3 <u>2</u> 8	4 <u>6</u> 4	4 <u>1</u> 6	8 <u>1</u> 2	4 <u>6</u>
	12	DESIGN <u>6</u> 8	2 <u>4</u> 4	4 <u>6</u> 3	4 <u>2</u> 7	6 <u>9</u>
	16	DESIGN <u>1</u> 19	DESIGN <u>5</u> 9	2 <u>3</u> 4	4 <u>7</u> 3	9 <u>1</u> 5

TYPE OF FITTING	Pipe Size (Inches)	MINIMUM THRUST BLOCK BEARING AREA (SQ. FT.) REQUIRED (Y x W)				
		SOFT CLAY	SAND	SAND & GRAVEL	SAND & GRAVEL WITH CLAY	ROCK
90° BENDS	8	2645	4323	915	711	36
	10	DESIGN68	2334	4523	4417	69
	12	DESIGN97	DESIGN48	2332	4724	912
	16	DESIGN168	DESIGN84	DESIGN56	2442	4221
45° BENDS	8	4425	712	58	46	23
	10	2537	4219	812	69	35
	12	DESIGN52	4826	4217	913	57
	16	DESIGN91	DESIGN45	4730	4323	711
22 1/2° BENDS	8	713	46	24	23	42
	10	4319	69	46	35	292
	12	4927	913	69	57	23
	16	2746	4323	915	712	36

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 (1000 PSF), SAND AND GRAVEL (1500 PSF), SAND AND GRAVEL WITH CLAY (2000 PSF), AND ROCK (4000 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 NON-BEARING VERTICAL SURFACES

13-21-002-0390 M.A.G. 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.

13-21-02-0420 M.A.G. 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 per 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.

13-21-02-0421 M.A.G. 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.

13-21-002-0422 M.A.G. 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 per 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 9-03-06~~5~~2.

13-21-002-0424 and 13-21-002-0425 M.A.G. Detail No. 424 and 425 – Manhole Frame and Cover

All manhole frames and covers shall be aluminum.

The agency name is not required on manhole covers.

13-21-002-0426 M.A.G. Detail No. 426 – Drop Sewer Connections

Delete all references to "V.C.P." and replace with "P.V.C." or "D.I.P."

13-21-002-0427 M.A.G. Detail No. 427 – Stub-Out and Plugs

Delete all references to "V.C.P." and replace with "P.V.C." or "D.I.P."

13-21-002-0440.1 M.A.G. 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 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.

13-21-002-0440.3 M.A.G. 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 of the notes in profile view as follows:

1. Revise the one-way cleanout to read:

Two-way cleanout with single riser.

2. Revise the Number 1 meter box per Detail 320 to read:

Frame and cover per Detail 270 (Concrete Required in Paved Areas Only)

13-21-002-0441 M.A.G. 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.

13-21-002-0533-0540 M.A.G. Detail No. 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%.

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

13-22-001-0001 Purpose

The purpose of this Glossary is to define words, terms, and phrases within these Standards.

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 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.

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
ARS	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

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 storm water 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 change of being flooded in any given year. For the purposes of these Standards, floodplain areas shall be considered as one of the following two 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 which 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 per City Ordinance or voluntary by a private party. These improvements include those offsite improvements defined in the City’s public improvement ordinance.

Public Right-of-way. Property used to obtain transportation 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 which 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.

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.

Streets:

Arterial. A road which 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 non-residential 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.)

Sedimentation. The deposition of soil transported from its site of origin by water, ice, wind, gravity, or other means as a result of erosion.

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.

Surveyor. A surveyor who is registered by the Arizona State Board of Technical Registration.

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.

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.

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.

CHAPTER 13-23

STANDARD DRAWINGS; CITY OF FLAGSTAFF

8-02-010	Storm Drain Trench
8-06-010	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 Services
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 for Mains 12" and Smaller
9-03-056	In Line Blow Off for Mains 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	3/4 and 1 inch Water Service Connection
9-03-071	1 1/2 and 2 inch Water Service Connection
9-03-080	Concrete Water Meter Box Assembly
9-03-081	Multiple Meter Manifolds
9-03-082	3", 4", 6" Compound Meter
9-03-083	4", 6", 8", 10" Fire Service Meter
9-03-100	2" Combination Air Release Valve.
9-06-010	Water/Sewer Line Casing
9-06-030	Non-Shrink Slurry Backfill
9-06-071	Double Check Valve Assembly
9-06-072	Reduced Pressure Assembly
9-06-073	Pressure Vacuum Breaker Assembly
9-06-074	Air Gap Backflow Protection for Water Tanks
9-06-075	Fire Hydrant Meter Backflow Protection
10-03-010	Street Name Sign
10-03-020	Traffic Signal Street Sign (where names change)
10-03-030	Traffic Signal Street Sign
10-04-010	Urban Cul-de-sac
10-04-011	Rural Cul-de-sac
10-06-010	Intersection Striping
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	Asphalt Pavement Structural Section
10-09-032	Major or Minor Arterial
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
10-09-039	Residential Local "Narrow"
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 Driveways
10-10-021	Turn Lane Pavement Marking
10-10-031	Paved Turnouts
10-10-034	Sidewalk Ramp Detail (15' or 20' radius curb return)
10-10-035	Sidewalk Ramp Detail (25' or 30' radius curb return)
10-10-036	Sidewalk Ramp Detail (30' radius curb return)
10-10-037	Sidewalk Ramp Detail (curb return with limited R/W)
10-10-038	Apron Joints
10-10-039	Driveway – Pedestrian Ramp Combination (for use at T-type intersections)
10-10-040	Driveway Entrance – Retrofit
10-10-041	Return Type Driveways with Attached Sidewalk
10-10-042	Pavement Edge Tapers
10-10-043	Detectable Warning Strip
11-01-010	Installation of Survey Monuments
13-03-011	Fire Hydrant Assembly
13-03-012	Fire Hydrant Protection Post
13-03-013	Shoulder Widening at Fire Hydrants for Uncurbed Roads
13-03-014	Removable Bollard
14-01-010	Flagstaff Urban Trails Details
14-01-011	Pedestrian and Shared Use Path Underpass Dimensions
14-01-012	Bicycle Parking Rack
16-01-240	Concrete Paving Stone or Brick Sidewalk
16-01-241	Concrete Paving Stone or Brick Driveway
16-06-010	Crosswalk Markings Layout
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 & Pressure Regulator
19-02-005	Emitter Flush Cap Assembly
19-02-006	Quick Coupler Assembly
19-02-007	1-1/2" & Smaller Mainline Ball Valve
19-02-008	Ball Valve Detail
19-02-009	3" & Larger Mainline Isolation Gate Valve
19-02-010	3" & Larger Master Valve/Flow Meter
19-02-011	Irrigation Remote Control Valve
19-02-012	Single & Multi-Outlet Emitters
19-02-013	Irrigation Emitter Layout
19-02-014	End Line Flush
19-02-015	2" or Smaller Master Valve/Flow Sensor Assembly
19-02-016	Maxicom PE-Cable Pull Box
19-02-017	Maxicom PE-Cable Splices

19-02-019	Drip Irrigation Remote Control Valve Assembly
19-02-021	Irrigation Wire Connection
19-02-022	Irrigation Wire Sleeving Chart
19-02-023	Schematic Layout
19-02-024	Solar Controller
19-02-025	Solar Controller and Backflow Preventer Enclosure
19-02-026	Maxicom CCU (6 or 28)- Wall Mount
19-02-027	Maxicom Esp-Sat Field Satellite Controller – Wall Mount
19-02-028	Maxicom Esp-Sat Field Satellite Controller S.S. Pedestal
19-02-029	Maxicom Flow Sensor (PT1502)
19-02-030	Controller Enclosure
19-02-031	Grounding Rod Grid
19-02-032	Grounding Plate Design Layout
19-02-033	Weather Station External Wire Connection
19-02-034	Maxicom Variable Wind Speed Detection
19-02-035	Sleeve Trenching Detail
19-02-036	Irrigation Trenching
19-02-037	Irrigation Thrust Block
PW 50.10	Dumpster Enclosure

8-02-010 Storm Drain Trench