

# 2022



## **ROADWAY DESIGN** & CONSTRUCTION STANDARDS

# TABLE OF CONTENTS

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## PART I - POLICY

	<u>Page</u>
<b>SECTION 1.0 GENERAL PROVISIONS .....</b>	<b>I-1</b>
1.1 SCOPE .....	I-1
1.2 AUTHORITY AND JURISDICTION .....	I-1
1.2.1 Home Rule Order .....	I-1
1.2.2 Colorado Statutes .....	I-1
1.2.3 Jurisdiction .....	I-1
1.2.4 Outside Agency Review.....	I-1
1.3 PURPOSE .....	I-1
1.4 AMENDMENT AND REVISIONS.....	I-2
1.5 REVIEW AND APPROVAL .....	I-2
1.6 INTERPRETATION .....	I-2
1.7 ABBREVIATIONS & DEFINITIONS .....	I-2
<b>SECTION 2.0 SUBMITTAL REQUIREMENTS &amp; PROCEDURES .....</b>	<b>I-5</b>
2.1 INTRODUCTION .....	I-5
2.2 ENGINEERING DOCUMENTS RELATED TO A LAND USE CASE .....	I-5
2.2.1 Land Use Applications .....	I-5
2.2.2 Public Improvement Agreement.....	I-5
2.2.3 Engineer’s Cost Estimate.....	I-5
2.2.4 Traffic Impact Study .....	I-6
2.2.5 Construction Documents .....	I-6
2.2.6 Permitting .....	I-8
2.3 CONSTRUCTION DOCUMENTS RELATED TO CAPITAL IMPROVEMENTS.....	I-8
2.3.1 Permitting .....	I-8
2.4 CONSTRUCTION DOCUMENTS – GENERAL INFORMATION .....	I-9
2.4.1 Drafting Standards .....	I-9
2.4.2 Plan Revisions.....	I-9
2.4.3 Field Changes .....	I-9
2.5 Variances.....	I-9
2.5.1 General.....	I-9

## TABLE OF CONTENTS

---

2.5.2	Minimum Standards Variance.....	I-9
2.5.3	Alternate Roadway Section Design Variance.....	I-10
2.5.4	Submission of Request for Variance and Decision of the Director .....	I-10
2.5.5	Variance Appeal Process .....	I-10



# TABLE OF CONTENTS

---

## PART II - DESIGN

	<u>Page</u>
<b>SECTION 3.0 TRAFFIC IMPACT STUDY GUIDELINES.....</b>	<b>II-1</b>
3.1    RESPONSIBILITY FOR TRAFFIC IMPACT STUDIES.....	II-1
3.2    UPDATED TRAFFIC IMPACT STUDY REQUIRED .....	II-1
3.3    TRAFFIC IMPACT STUDY FORMAT.....	II-2
3.3.1    Introduction .....	II-2
3.3.2    Existing Conditions.....	II-3
3.3.3    Proposed Site-Generated Traffic .....	II-3
3.3.4    Future Conditions.....	II-4
3.3.5    Proposed Improvements.....	II-5
3.3.6    Recommendations .....	II-7
3.3.7    Conclusions .....	II-7
3.4    REVISIONS TO TRAFFIC IMPACT STUDY .....	II-7
3.5    TRAFFIC IMPACT STUDY CHECKLIST.....	II-7
<b>SECTION 4.0 ROADWAY DESIGN AND TECHNICAL CRITERIA.....</b>	<b>II-10</b>
4.1    ROADWAY CLASSIFICATIONS .....	II-10
4.1.1    Six-lane Arterial.....	II-10
4.1.2    Four-lane Arterial with Bike Lanes .....	II-11
4.1.3    Major Collector .....	II-12
4.1.4    Minor Collector .....	II-13
4.1.5    Local – Commercial.....	II-14
4.1.6    Local – Detached Walk/Attached Walk .....	II-15
4.1.7    Private Streets.....	II-16
4.2    HORIZONTAL DESIGN.....	II-17
4.2.1    General.....	II-17
4.2.2    Connectivity .....	II-21
4.2.3    Horizontal Curves.....	II-22
4.2.4    Intersections .....	II-23
4.2.5    Off-site Design.....	II-24
4.2.6    Sidewalks, Curb Ramps, and Driveways.....	II-24

## TABLE OF CONTENTS

---

4.2.7	Cul-de-sacs .....	II-24
4.2.8	Auxiliary Lanes (Acceleration and Deceleration Lanes) .....	II-25
4.3	VERTICAL DESIGN .....	II-25
4.3.1	Permissible Roadway Grade .....	II-26
4.3.2	Vertical Curves .....	II-26
4.3.3	Changing Grades .....	II-26
4.3.4	Intersections .....	II-26
4.3.5	Connections with Existing Roadways .....	II-28
4.3.6	Roadway Crown Cross-Slope .....	II-28
4.3.7	UNPAVED SURFACES .....	II-28
4.4	SIGHT DISTANCE DESIGN .....	II-28
4.4.1	Stopping Sight Distance .....	II-28
4.4.2	Intersection and Driveway Sight Distances .....	II-28
4.5	ACCESS MANAGEMENT AND DESIGN .....	II-29
4.5.1	General .....	II-29
4.5.2	Criteria for Speed Change Lanes .....	II-31
4.5.3	Design of Median Islands .....	II-33
4.5.4	Design of Radii and Widths .....	II-33
4.5.5	Vehicle Storage .....	II-34
4.6	BICYCLE FACILITIES .....	II-35
4.7	TRAFFIC CONTROL DEVICES .....	II-35
4.7.1	General .....	II-35
4.7.2	Traffic Signing and Markings .....	II-36
4.7.3	Traffic Signals .....	II-36
4.8	LIGHTING AND UTILITIES .....	II-38
4.8.1	General .....	II-38
<b>SECTION 5.0 PAVEMENT DESIGN .....</b>		<b>II-43</b>
5.1	GENERAL .....	II-43
5.2	PAVEMENT DESIGN REPORT SUBMITTAL REQUIREMENTS .....	II-43
5.3	FIELD INVESTIGATION .....	II-43
5.3.1	Preliminary Design and Final Design Reports .....	II-43
5.3.2	Design Confirmation Report .....	II-43

## TABLE OF CONTENTS

---

5.4	LABORATORY TESTING .....	II-43
5.4.1	Preliminary Design Report and Final Design Report .....	II-43
5.4.2	Design Confirmation Report .....	II-43
5.5	DESIGN REQUIREMENTS .....	II-44
5.6	REPORT REQUIREMENTS .....	II-44
5.6.1	Reports .....	II-44
5.6.2	Private Streets .....	II-44

## LIST OF TABLES

Table 1: Arterial Roadways .....	II-18
Table 2: Collector Roadways .....	II-19
Table 3: Local Roadways .....	II-20
Table 4: Redirect Tapers for Transitions .....	II-21
Table 5: Design Vehicle per Roadway Classification .....	II-23
Table 6: Vertical Design Criteria .....	II-25
Table 7: Maximum Grades and Length of Grades at Intersection Approaches .....	II-27
Table 8: Minimum Curb Return Fall .....	II-27
Table 9: Design Sight Distance for Access Spacing .....	II-31
Table 10: Curb Radii Access Design .....	II-34

# TABLE OF CONTENTS

---

## PART III - CONSTRUCTION

	<u>Page</u>
<b>SECTION 6.0 CONSTRUCTION PROCEDURES AND PRACTICES .....</b>	<b>III-1</b>
6.1 GENERAL .....	III-1
6.2 DEMOLITION .....	III-1
6.2.1 Demolition General.....	III-1
6.2.2 Local Laws, Ordinances and Code.....	III-1
6.2.3 Protection of Public, Onsite and Project Adjacent Improvements .....	III-1
6.2.4 Disconnection of Existing Utilities.....	III-2
6.2.5 Equipment Operated On Streets .....	III-2
6.2.6 Protection of Survey Monuments.....	III-2
6.2.7 Fences .....	III-2
6.2.8 Trees and Shrubs.....	III-2
6.2.9 Cesspools, Privies, Buried Fuel, and Septic Tanks.....	III-3
6.2.10 Wells.....	III-3
6.2.11 Buildings.....	III-3
6.2.12 Slabs On Grade.....	III-3
6.2.13 Walls.....	III-3
6.2.14 Salvage .....	III-3
6.2.15 Filling and Grading .....	III-3
6.2.16 Topsoil.....	III-3
6.3 HOUSEKEEPING, RESTORATION, AND CLEANUP.....	III-4
6.3.1 Surplus Excavation .....	III-4
6.3.2 Concrete Curb, Gutter, Valley Gutter, and Sidewalk .....	III-4
6.3.3 Surface Restoration.....	III-4
6.4 SOILS AND EARTHWORK .....	III-5
6.4.1 Excavation, Embankment, and Compaction .....	III-5
6.4.2 Utility Trenching, Backfill, and Bedding .....	III-5
6.5 PAVEMENT .....	III-6
6.5.1 General.....	III-6
6.5.2 Procedure for Material Source Approval .....	III-6

## TABLE OF CONTENTS

---

6.5.3	Violations of Approval Conditions .....	III-7
6.5.4	Material Specifications.....	III-7
6.5.5	Use of Materials not Listed in Section 6.5.4 .....	III-9
6.6	TRAFFIC CONTROL.....	III-9
6.6.1	Traffic Control Devices .....	III-9
6.6.2	After-Hours Traffic Controls.....	III-9
6.6.3	Damage to Permanent Traffic Control.....	III-9
6.6.4	Specific Requirements.....	III-9
6.6.5	Flagpersons .....	III-10
6.7	TRAFFIC SIGNAGE AND PAVEMENT MARKINGS .....	III-11
6.7.1	General.....	III-11
6.7.2	Traffic Control Devices on Public Property .....	III-11
6.7.3	Traffic Control Devices on Private Property.....	III-11
6.7.4	Pavement Markings .....	III-11
<b>SECTION 7.0 INSPECTION AND TESTING .....</b>		<b>III-12</b>
7.1	QUALITY CONTROL/QUALITY ASSURANCE.....	III-12
7.2	CONSTRUCTION INSPECTION.....	III-12
7.3	CONSTRUCTION TESTING.....	III-12
<b>SECTION 8.0 ACCEPTANCE PROCEDURES AND REQUIREMENTS .....</b>		<b>III-13</b>
8.1	ACCEPTANCE AND WARRANTIES .....	III-13
8.2	RECORD DRAWINGS.....	III-13
8.2.1	Requirements for Construction As-Built Plans.....	III-13

### Appendices

Standard Details



# **PART I**

## **POLICY**

### TABLE OF CONTENTS

	<u>Page</u>
<b>SECTION 1.0 GENERAL PROVISIONS .....</b>	<b>I-1</b>
1.1 SCOPE .....	I-1
1.2 AUTHORITY AND JURISDICTION .....	I-1
1.2.1 Home Rule Order .....	I-1
1.2.2 Colorado Statutes .....	I-1
1.2.3 Jurisdiction.....	I-1
1.2.4 Outside Agency Review .....	I-1
1.3 PURPOSE.....	I-1
1.4 AMENDMENT AND REVISIONS .....	I-2
1.5 REVIEW AND APPROVAL.....	I-2
1.6 INTERPRETATION.....	I-2
1.7 ABBREVIATIONS & DEFINITIONS .....	I-2
<b>SECTION 2.0 SUBMITTAL REQUIREMENTS &amp; PROCEDURES .....</b>	<b>I-5</b>
2.1 INTRODUCTION .....	I-5
2.2 ENGINEERING DOCUMENTS RELATED TO A LAND USE CASE .....	I-5
2.2.1 Land Use Applications .....	I-5
2.2.2 Public Improvement Agreement .....	I-5
2.2.3 Engineer’s Cost Estimate .....	I-5
2.2.4 Traffic Impact Study.....	I-6
2.2.5 Construction Documents.....	I-6
2.2.6 Permitting.....	I-8
2.3 CONSTRUCTION DOCUMENTS RELATED TO CAPITAL IMPROVEMENTS.....	I-8
2.3.1 Permitting .....	I-8
2.4 CONSTRUCTION DOCUMENTS – GENERAL INFORMATION .....	I-9
2.4.1 Drafting Standards.....	I-9
2.4.2 Plan Revisions .....	I-9
2.4.3 Field Changes.....	I-9
2.5 Variances .....	I-9
2.5.1 General .....	I-9

## **PART I – POLICY**

---

2.5.2	Minimum Standards Variance .....	I-9
2.5.3	Alternate Roadway Section Design Variance.....	I-10
2.5.4	Submission of Request for Variance and Decision of the Director .....	I-10
2.5.5	Variance Appeal Process.....	I-10

# PART I – POLICY

---

## SECTION 1.0 GENERAL PROVISIONS

### 1.1 SCOPE

These regulations shall be known as the *City of Centennial Roadway Design and Construction Standards Manual* (hereinafter referred to as the “Manual”). The City of Centennial is hereinafter referred to as the “City.”

### 1.2 AUTHORITY AND JURISDICTION

**1.2.1 Home Rule Charter.** The City is a home rule municipality under Article XX, Section 6 of the Colorado Constitution. As such, the City’s principal authority for adopting this Manual is the Home Rule Charter of the City of Centennial, adopted June 10, 2008, as may be amended from time to time.

**1.2.2 Colorado Statutes.** The provisions in this Manual are also authorized by the Colorado Revised Statutes, including, but not limited to:

- A) Title 31, Article 15, Part 4, *Police Regulations*.
- B) Title 31, Article 15, Part 7, *Public Property and Improvements*.
- C) Title 43, Article 2, *State, County, and Municipal Highways*.

**1.2.3 Jurisdiction.** The standards established in this Manual shall apply to all property under the City’s regulatory authority within the corporate boundaries of the City.

**1.2.4 Outside Agency Review.** The City does not provide water, sanitation, fire protection, and various other utilities and services. The agencies that provide these utilities and services are unaffiliated agencies with independent approval authority. The Developer/Permittee is responsible for contacting all appropriate agencies to obtain their approval for all applications.

The Southeast Metro Stormwater Authority (SEMSWA) provides stormwater and floodplain management services within the City. SEMSWA typically acts as an internal review entity to the City; however, SEMSWA specific approval is required on all applications, whether or not it is received through the City application process. For drainage design and construction standards, refer to SEMSWA standards and manuals.

### 1.3 PURPOSE

This Manual presents the minimum design and technical criteria for analysis, design, and construction of transportation facilities. All proposed construction within the City shall meet or exceed these minimum criteria. Items not specifically addressed by the Manual shall follow the design recommendations in the current editions of the American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets*, the Colorado Department of Transportation (CDOT) *Standard Construction Specifications for Road and Bridge Construction*, the *Manual on Uniform Traffic Control Devices (MUTCD)*, *Municipal Government Pavement Engineers Council (MGPEC) Standards and Construction Specifications*, and other applicable standards approved by the Director.

## **PART I – POLICY**

---

### **1.4 AMENDMENT AND REVISIONS**

The Standard Details may be amended administratively at any time upon approval by the Director. Except for the Standard Details, the Manual may be amended administratively upon approval by the Director and ratification by the City Council.

### **1.5 REVIEW AND APPROVAL**

The City shall review all submittals for general compliance with this Manual and other applicable City standards. Approval by the City does not relieve the Owner, Developer, or their designees from the responsibility of ensuring that the calculations, plans, specifications, construction, and record drawings are in compliance with the Manual. The City makes no warranty and accepts no liability that approved designs are consistent with national and state engineering best practices as this is the responsibility of the Colorado licensed Professional Engineer stamping the plans and reports.

### **1.6 INTERPRETATION**

In the interpretation and application of the provisions contained in this Manual, the following shall govern:

In their interpretation and application, these provisions shall be regarded as the minimum requirements for the protection of the public health, safety, and welfare of the residents of the City and infrastructure users. The Manual shall, therefore, be regarded as remedial and shall be liberally construed to further its underlying purposes.

Whenever a provision of the Manual and any other provisions of the law, ordinance, resolution, rule, or regulation of any kind contain any restrictions covering any of the same subject matter, whichever standards are more restrictive or impose higher standards or requirements shall govern. The Director of Public Works shall have final authority to resolve any conflict in the interpretation of the Manual.

The Manual shall not repeal or annul any public improvement construction plans or permits that have been filed with the City and/or approved before the effective date of the Manual, provided that the improvements will be constructed within one year from the date of plan approval. Public improvement construction plans or permits that have expired approvals (i.e., improvements have not been constructed within one year from the approval date) shall be required to be resubmitted in accordance with the requirements of this Manual.

### **1.7 ABBREVIATIONS & DEFINITIONS**

For the purposes of the Manual, these abbreviations shall have the following meanings:

AASHTO	American Association of State Highway and Transportation Officials
AASHTO Green Book	A Policy on Geometric Design of Highways & Streets
ACI	American Concrete Institute
ADA	Americans with Disabilities Act
ADT	Average Daily Traffic
AADT	Annual Average Daily Traffic
APWA	American Public Works Association

## PART I – POLICY

---

ASA	American Standards Association
ASTM	American Society for Testing and Materials
CD	Site-Civil Construction Document
CDOT	Colorado Department of Transportation
CIP	Capital Improvement Program
ECE	Engineer’s Cost Estimate
ELS	Electronic Locating System
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
HCM	Highway Capacity Manual
IGA	Intergovernmental Agreement
IMSA	International Municipal Signal Association
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System
LDC	City of Centennial Land Development Code
LED	Light Emitting Diode
LOS	Level of Service
MDS	Microwave Data Systems
MTC	Model Traffic Code
MHFD	Mile High Flood District
MGPEC	Municipal Government Pavement Engineers Council
MUTCD	Manual on Uniform Traffic Control Devices
NACTO	National Association of City Transportation Officials
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
OSHA	Occupational Safety and Health Administration
PC	Point of Curvature
PCR	Point of Curb Return
PE	Professional Engineer, Licensed in Colorado
PI	Point of Intersection
PIA	Public Improvement Agreement
PT	Point of Tangency
PW	Centennial Public Works Department
ROW	Right-of-Way
RTD	Regional Transportation District
SEMSWA	Southeast Metro Stormwater Authority
TES	Traffic Engineering Services
THD	Total Harmonic Current Distortion
TIS	Traffic Impact Study
ULI	Urban Land Institute
UPS	Uninterruptible Power Supply
USGS	United States Geological Survey



## PART I – POLICY

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References to external manuals, standards, and guides shall always imply the latest version or edition.

For the purposes of this Manual, these words shall have the following meanings:

**City** – the City of Centennial, a Colorado home rule municipality.

**City Project Manager** – The City of Centennial staff member responsible for the oversight and management of a specific project, as defined at the time of project kickoff, or his or her designee.

**City Traffic Engineer** – The head Traffic Engineer for the City of Centennial or his or her designee.

**Community Development** – The City of Centennial Community Development/Economic Development Department.

**Contractor** – The constructor of project elements acting on behalf of the Developer, Permittee or the City.

**Developer** – The applicant or permittee for development approval by the City. This term shall be inclusive of the Developer, his or her applicant, or his or her designee.

**Director** – Director of Public Works for the City of Centennial, Colorado, or his or her designee.

**Permittee** – The individual or entity applying for permits within the City.

**Public Improvements** – Generally includes improvements on City property or within City right-of-way (ROW). The term also includes similar improvements, being built in connection with a subdivision, intended to be dedicated to the City.

**Public Works** – The City of Centennial Public Works Department.

**Right-of-Way (ROW)** – A general term denoting land, property, or interest therein, usually in a strip, acquired for or devoted to a street, highway, or other public improvement.

**Standard Details** – The drawings, cross-sections, and other details in the Appendix.

**State** – The State of Colorado or Colorado Department of Transportation.

**Street Access Code** – The City of Centennial Street Access Code described in Chapter 11, Article 3 of the Centennial Municipal Code.

### SECTION 2.0 SUBMITTAL REQUIREMENTS & PROCEDURES

#### 2.1 INTRODUCTION

The procedures outlined in the following section are guidance for Developers seeking approval of civil engineering reports and construction plans. Additional guidance on the land development processes and the associated application forms can be found on both the City’s website and the Land Development Code (LDC).

#### 2.2 ENGINEERING DOCUMENTS RELATED TO A LAND USE CASE

##### 2.2.1 LAND USE APPLICATIONS

Community Development conducts pre-submittal meetings for applications related to certain types of land use cases at which time applicants may present their conceptual plan to the Public Works staff for a cursory review. At this meeting, Developer will be advised on the process required to develop in the City, the basic requirements and standards that apply, and the engineering documents that are required. After this meeting, Developer may begin the site plan process based on the information provided. The purpose of the process is typically for the applicant to obtain a development permit to allow construction of horizontal improvements for private development. For more information, refer to the LDC and the City’s website.

##### 2.2.2 PUBLIC IMPROVEMENT AGREEMENT

When public improvements are required as a part of a development, the Developer must enter into a Public Improvement Agreement (PIA) with the City. The PIA identifies the Public Improvements that are required to be constructed, stipulates the timing of the improvements and the warranties that will cover them, and provides the requisite assurances that the Public Improvements will be constructed to the City’s established standards. Details regarding the PIA can be found in Division 14-2 of the LDC.

In some instances, an addendum to the PIA may be required by SEMSWA and will be discussed at the pre-submittal meeting.

##### 2.2.3 ENGINEER’S COST ESTIMATE

The Engineer’s Cost Estimate (ECEs) quantifies the cost of horizontal improvements related to a development, as estimated by the Developer/Permittee’s engineer. Templates can be found on the City’s website. All ECEs must be prepared by a PE. The City may require the Developer to submit the following three types of ECEs as part of a land use case:

**Public ECE:** Consists of the estimated costs of all surfaces, underground utilities, street cut restoration requirements per the ROW regulations, landscaping, lighting, and other improvements located in existing and proposed public ROW and tracts dedicated to the City, and will be used to determine the amount of collateral required to be posted before release of the development permit in conjunction with the City’s PIA.

## PART I – POLICY

---

**Private ECE:** Consists of the estimated costs of all site improvements that will serve the project site exclusively and are located on private property. These costs include all surfaces and underground utilities, landscaping, lighting, and other improvements that are within the private boundary of the property, exclusive of improvements associated with the project's building permit(s) (e.g., foundations, retaining walls, structures, improvements within the building, etc.).

**SEMSWA ECE:** Outlines the costs of improvements that are under the jurisdiction of SEMSWA and may be used by SEMSWA for the PIA addendum. For more information on this document, please refer to SEMSWA's standards.

The Private, Public, and SEMSWA ECEs will be used to determine the amount of use tax associated with the development permit.

### 2.2.4 TRAFFIC IMPACT STUDY

The City requires a Traffic Impact Study (TIS) to adequately assess the impacts of a development proposal on the existing and/or planned street system. The primary responsibility for assessing the traffic impacts associated with a proposed development will rest with the Developer/Permittee, with the City serving in a review capacity. Detailed guidance and requirements for traffic analysis and completion of the traffic study can be found in Section 3.0 of this Manual.

### 2.2.5 CONSTRUCTION DOCUMENTS

Site Civil Construction Documents (CDs) may be submitted once there are no major outstanding issues on the Site Plan (this is up to the discretion of the review engineer). All CDs shall be prepared by or under the direction of a PE and shall be reviewed for the minimum requirements set forth herein and any other applicable City standards. The Developer/Permittee should be aware that additional information and analysis, beyond the minimum requirements, may be required for a proposed project if unusual conditions or construction challenges are anticipated.

The Developer/Permittee or his or her engineer should use the City's CD checklist, general notes, and standard signature block in preparing plans. These can be found on the City's website and must be included with the submittal. Developer/Permittee's should work independently with outside agencies, e.g., utility, fire, water, and sanitary sewer districts. CDs *are not* routed from the City to these agencies, but approvals from these agencies are required before CDs will be approved and development and building permits will be issued.

#### 2.2.5.1 Electronic Submittals

In an effort to achieve greater efficiency in the review process, the City encourages electronic submittal packages for CD review. The Developer/Permittee is responsible for providing an electronic file containing the project CD set. This electronic file should be in PDF format and should be compatible with current software in use by the City; this information is available on the City's website or by contacting Public Works at 303-325-8000. Prior to review, all CD review fees must be paid to the City in a manner approved by Community and Economic Development.

## **PART I – POLICY**

---

### ***2.2.5.2 Engineering Review of Construction Documents***

Public Works staff will review CDs and issue comments to the Developer/Permittee. The Developer/Permittee will be advised of the estimated completion date for review of submitted documents at the pre-submittal meeting. Assuming the City's comments from a previous submittal have been adequately addressed, it is expected that review times will be reduced with each resubmittal of the same plan set. However, the actual time required is a function of the submittal complexity and overall workload of the Public Works staff.

Once the Developer/Permittee or his or her engineer has been notified that Public Works has completed its review of the CD set, the Developer/Permittee shall have six months to address all comments and redlines and resubmit a revised CD set to the City. If Public Works does not receive a revised CD set by the end of this six-month period, the CD application will be closed.

Any submittal received after this six-month period will be required to submit a new CD application and must be accompanied by the CD review fees required by Community Development. At any time before the closing of a CD application, the Developer/Permittee may submit a written request to extend the application's expiration date by six months to the Director of Community Development. Extensions are not guaranteed and only one extension is allowed for any CD application.

### ***2.2.5.3 Submitting Revised Plans***

When submitting revised plans or reports to Public Works, the resubmittal must contain:

1. The revised plans and/or reports;
2. All redlines from previous staff reviews and a point by point response to staff comments;
3. Additional review fees, if applicable; and
4. Any documents or fees required by SEMSWA.

If all the above items are not included, the resubmittal may be returned without further action until such time as they are included. Major changes to CDs after initial submittal may result in additional review times and such changes may be deemed by PW staff to restart the review process and schedule.

### ***2.2.5.4 Construction Document Approval***

City acceptance of the CDs constitutes Public Works review and acceptance of the final design shown on the CDs. Approval of the final CDs shall be completed before the City will issue a development permit. The City will approve CDs before final approvals of the associated land use case, SEMSWA request for approval, and verification of approval from outside agencies (water, sanitary, fire, etc.).

After Public Works has approved the final CDs and so long as the Developer/Permittee has received all other approvals for the associated land use case, the Developer/Permittee shall submit an electronic copy in PDF format to Public Works. The submittal must contain a digital signature and seal of a PE. Public Works will accept CDs by digitally signing all pages of the electronic submittal. The date Public Works digitally signs the CDs is the "approval date. "

## **PART I – POLICY**

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The signed and approved CDs will be distributed to the Developer/Permittee, the Contractor and SEMSWA at or prior to the mandatory pre-construction meeting.

### **2.2.5.5 Plan Expiration**

Approval of CDs related to a land use case expires after one year from the approval date. If a permit has not been applied for within one year of the approval date, the Developer/Permittee must resubmit the CDs as a new application accompanied by the CD review fees required by Community Development. Extensions of time, for up to one additional year, may be granted at the discretion of the Director of Community Development. Requests for extensions of time must be submitted prior to plan expiration.

### **2.2.6 PERMITTING**

Once the land use case process has been completed, all necessary documents have been approved, and outside agency approvals have been verified, the Developer/Permittee can submit an application for a development permit which can be found on the City's website. The Contractor listed on the development permit must be licensed and bonded in the City. More information on City licensing can be found on the City's website or by contacting the City Building Division.

After the development permit application has been reviewed, approved, and it has been verified that the necessary fees, collateral, and documents have been received by the City, the development permit will be ready for issuance. In order to begin construction, the Contractor must hold a pre-construction meeting with the City engineering inspector. At that meeting, the Contractor will obtain the development permit and approved CDs.

## **2.3 CONSTRUCTION DOCUMENTS RELATED TO CAPITAL IMPROVEMENTS**

City projects vary greatly in size, scope, and complexity. The submittal requirements for CIP plans and specifications, including required documents, number of reviews, outside reviewers, etc., will be determined by the City's Project Manager and described within the request for proposals. A general list of plan requirements can be found in the *Public Works Construction Document Checklist*, available on the City's website, along with the Public Works project general notes and signature block.

### **2.3.1 PERMITTING**

All work within City ROW requires a City ROW permit. Information on the ROW permit process can be found in the *Public Works Department Right-of-Way Regulations*, available on the City's website (ROW Regulations).

Work involving utility installation or alteration may require additional permits from the utility owner. Work involving stormwater infrastructure installation or alteration and/or ground disturbance or grading may require additional permits from SEMSWA. Coordination with the applicable agencies is necessary to determine the appropriate permitting process.

## **PART I – POLICY**

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### **2.4 CONSTRUCTION DOCUMENTS – GENERAL INFORMATION**

#### **2.4.1 DRAFTING STANDARDS**

All CDs submitted for approval shall be clear and legible and contain sufficient information so that a Contractor can reasonably be expected to complete construction using the plan set in conjunction with this Manual. Plans shall be submitted in PDF format that will produce 22" x 34" or 11" x 17" sheets at the scale indicated on the drawings. Please refer to the City's website for a CD template and the Public Works CD checklist which identifies the minimum required information to be included in the CD plan set.

#### **2.4.2 PLAN REVISIONS**

Whenever updates or revisions to previously approved construction plans, specifications, or reports are necessary, the Developer/Permittee will submit updates or revisions through the normal document submittal process. After all the comments and revisions have been incorporated, the Developer/Permittee may submit the revised CDs to the City for approval as described in Section 2.2.5.

#### **2.4.3 FIELD CHANGES**

Minor changes to CDs can be made in the field provided that the City approves the changes in writing prior to implementation. Failure to receive approval of field changes from the City may result in non-acceptance of the improvements. All field changes must be accurately depicted on the record drawings as defined in Part III, Section 8.2 of this manual. The Developer/Permittee shall provide to the City a letter, signed and sealed by the PE responsible for the original design, stating that the proposed field change does not deviate from the intent of the original design, when applicable.

### **2.5 VARIANCES**

#### **2.5.1 GENERAL**

Consideration may be given for variances from this Manual when appropriate and as long as the request for a variance complies with the provisions in this section.

Two types of variances may be considered. The first type is a request to vary from the minimum standards described in this Manual (Section 2.5.2, Minimum Standards Variance). The second type is a request to vary from the standard roadway cross-section design (Section 2.5.3, Alternate Roadway Section Design Variance).

#### **2.5.2 MINIMUM STANDARDS VARIANCE**

The Director may authorize a Minimum Standards Variance if the applicant's request establishes that all conditions set forth below are satisfied.

1. The variance will result in a safe and high-quality design.
2. The variance will result in a design with a level of safety, service, and quality equal to or greater than that established by the criteria contained in this Manual.
3. The Developer/Permittee will be able to mitigate all impacts to the City if the variance is granted.
4. The variance will create a benefit to the project that would not be achievable without the variance.



## **PART I – POLICY**

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Satisfying the above-listed criteria does not require or obligate the Director to approve the variance request.

### **2.5.3 ALTERNATE ROADWAY SECTION DESIGN VARIANCE**

Proposed roadway sections should meet or match as closely as possible to the standard roadway sections available in the City Standard Details. The Director may authorize an Alternate Roadway Section Design Variance if the Developer's request for a variance establishes that all the conditions below are satisfied:

1. Existing conditions or restrictions cause use of the applicable standard roadway cross section to be infeasible per staff's recommendation.
2. The proposed roadway cross section will result in a safe and high-quality design that is beneficial to the project and the City and not otherwise feasible using the applicable standard roadway cross section.

An Alternate Roadway Section Design Variance is limited to the typical cross section of the alternate design approved by the Director and will not include any other approvals including, but not limited to, access, roadway connections, or other roadway design or construction issues.

Satisfying the above-listed criteria does not require or obligate the variance request to be approved.

### **2.5.4 SUBMISSION OF REQUEST FOR VARIANCE AND DECISION OF THE DIRECTOR**

It is the sole responsibility of the Developer/Permittee to request variances from this Manual. The request for a variance must be made in writing to the Director and include therewith all supporting documentation necessary for the Director to make a determination. The Director may ask the Developer/Permittee to submit additional material to support the variance request but is not required to seek additional material before making a determination. The Director has 28 days after receiving the request to make a determination, unless such time is extended by the Director, in his or her sole discretion. The Director will issue a determination approving or denying the request for a variance in writing and send such determination to the Developer/Permittee.

If approved, the variance will expire:

- One year after the date on which the variance was granted if CDs are not approved within that time frame; or
- At the time of CD expiration if CDs have been approved.

If denied, the Developer/Permittee may submit an appeal.

### **2.5.5 VARIANCE APPEAL PROCESS**

The City Manager will deliberate appeals according to the same standards that the Director was to apply to the original variance request. Variance appeals shall be submitted to the City Manager in writing no later than 14 days after the date on which the Director denied the variance request. Appeals submitted after that timeframe will not be permitted. The appeal must contain the following:

## **PART I – POLICY**

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- a. The original variance request and supporting documents; and
- b. A brief statement describing how the variance denial violates the intentions of this Manual.

Satisfying the above-listed criteria does not require or obligate the City Manager to approve the appeal request. No new evidence may be submitted to the City Manager. Evidence that was not presented to the Director in the original variance application will be excluded from consideration if presented to the City Manager. The decision of the City Manager is final and not subject to further appeal.

## **PART II**

## **DESIGN**

### TABLE OF CONTENTS

	<u>Page</u>
<b>SECTION 3.0 TRAFFIC IMPACT STUDY GUIDELINES.....</b>	<b>II-1</b>
3.1    RESPONSIBILITY FOR TRAFFIC IMPACT STUDIES .....	II-1
3.2    UPDATED TRAFFIC IMPACT STUDY REQUIRED .....	II-1
3.3    TRAFFIC IMPACT STUDY FORMAT .....	II-2
3.3.1    Introduction .....	II-2
3.3.2    Existing Conditions .....	II-3
3.3.3    Proposed Site-Generated Traffic .....	II-3
3.3.4    Future Conditions .....	II-4
3.3.5    Proposed Improvements .....	II-5
3.3.6    Recommendations.....	II-7
3.3.7    Conclusions.....	II-7
3.4    REVISIONS TO TRAFFIC IMPACT STUDY .....	II-7
3.5    TRAFFIC IMPACT STUDY CHECKLIST .....	II-7
<b>SECTION 4.0 ROADWAY DESIGN AND TECHNICAL CRITERIA.....</b>	<b>II-10</b>
4.1    ROADWAY CLASSIFICATIONS.....	II-10
4.1.1    Six-lane Arterial .....	II-10
4.1.2    Four-lane Arterial with Bike Lanes.....	II-11
4.1.3    Major Collector .....	II-12
4.1.4    Minor Collector.....	II-13
4.1.5    Local – Commercial.....	II-14
4.1.6    Local – Detached Walk/Attached Walk .....	II-15
4.1.7    Private Streets .....	II-16
4.2    HORIZONTAL DESIGN.....	II-17
4.2.1    General .....	II-17
4.2.2    Connectivity .....	II-21
4.2.3    Horizontal Curves .....	II-22
4.2.4    Intersections .....	II-23
4.2.5    Off-site Design .....	II-24
4.2.6    Sidewalks, Curb Ramps, and Driveways .....	II-24

## PART II – DESIGN

---

4.2.7	Cul-de-sacs.....	II-24
4.2.8	Auxiliary Lanes (Acceleration and Deceleration Lanes).....	II-25
4.3	VERTICAL DESIGN .....	II-25
4.3.1	Permissible Roadway Grade .....	II-26
4.3.2	Vertical Curves.....	II-26
4.3.3	Changing Grades.....	II-26
4.3.4	Intersections .....	II-26
4.3.5	Connections with Existing Roadways .....	II-28
4.3.6	Roadway Crown Cross-Slope .....	II-28
4.3.7	UNPAVED SURFACES .....	II-28
4.4	SIGHT DISTANCE DESIGN .....	II-28
4.4.1	Stopping Sight Distance .....	II-28
4.4.2	Intersection and Driveway Sight Distances .....	II-28
4.5	ACCESS MANAGEMENT AND DESIGN.....	II-29
4.5.1	General .....	II-29
4.5.2	Criteria for Speed Change Lanes.....	II-31
4.5.3	Design of Median Islands.....	II-33
4.5.4	Design of Radii and Widths.....	II-33
4.5.5	Vehicle Storage .....	II-34
4.6	BICYCLE FACILITIES.....	II-35
4.7	TRAFFIC CONTROL DEVICES.....	II-35
4.7.1	General .....	II-35
4.7.2	Traffic Signing and Markings .....	II-36
4.7.3	Traffic Signals.....	II-36
4.8	LIGHTING AND UTILITIES .....	II-38
4.8.1	General .....	II-38
<b>SECTION 5.0 PAVEMENT DESIGN .....</b>		<b>II-43</b>
5.1	GENERAL .....	II-43
5.2	PAVEMENT DESIGN REPORT SUBMITTAL REQUIREMENTS .....	II-43
5.3	FIELD INVESTIGATION .....	II-43
5.3.1	Preliminary Design and Final Design Reports.....	II-43
5.3.2	Design Confirmation Report .....	II-43

## PART II – DESIGN

---

5.4	LABORATORY TESTING.....	II-43
5.4.1	Preliminary Design Report and Final Design Report .....	II-43
5.4.2	Design Confirmation Report .....	II-43
5.5	DESIGN REQUIREMENTS.....	II-44
5.6	REPORT REQUIREMENTS .....	II-44
5.6.1	Reports .....	II-44
5.6.2	Private Streets .....	II-44

### LIST OF TABLES

Table 1: Arterial Roadways .....	II-18
Table 2: Collector Roadways .....	II-19
Table 3: Local Roadways .....	II-20
Table 4: Redirect Tapers for Transitions .....	II-21
Table 5: Design Vehicle per Roadway Classification .....	II-23
Table 6: Vertical Design Criteria .....	II-25
Table 7: Maximum Grades and Length of Grades at Intersection Approaches .....	II-27
Table 8: Minimum Curb Return Fall .....	II-27
Table 9: Design Sight Distance for Access Spacing.....	II-31
Table 10: Curb Radii Access Design .....	II-34



### SECTION 3.0 TRAFFIC IMPACT STUDY GUIDELINES

This Section contains guidelines for conducting TIS's for submittal to the City. These guidelines have been established to ensure consistent and proper traffic planning and engineering practices when land development is being considered within the City. These guidelines provide a standard process, set of assumptions, set of analytic techniques, and presentation format to be used in the preparation of all TIS's submitted to the City.

#### 3.1 RESPONSIBILITY FOR TRAFFIC IMPACT STUDIES

The TIS must adequately assess the impact of a development proposal on the existing and/or planned street system.

The TIS may be waived by the City Traffic Engineer if all of the following criteria are met:

1. The average trip generation of the project is less than 250 trips per day;
2. The proposed development's A.M. and P.M. peak hour trip generation will be less than 25 trips;
3. Access is not being requested to either a State highway or City arterial road; and
4. The City has not identified any special circumstances that require further investigation through a TIS.

If these criteria are satisfied, the Developer shall submit a technical memorandum or brief letter report prepared and signed by a PE that includes the following:

1. The trip generation and distribution of the proposed development; and
2. A supported conclusion that no transportation impacts are anticipated as a result of the proposed project.

The City Traffic Engineer will review the technical memorandum or brief letter report. The TIS may be waived if the City agrees that the information provided meets the minimum criteria for a waiver. If not, the City will require that a TIS be completed for the proposed development.

If a TIS is required, the City Traffic Engineer will review the draft study data sources, methods, and findings and provide comments to the Developer in a written form. The Developer and the Developer's engineer shall then have an opportunity to incorporate the necessary revisions before submitting a final report. The City must approve the final TIS before it will be accepted.

#### 3.2 UPDATED TRAFFIC IMPACT STUDY REQUIRED

The Director or City Traffic Engineer may require an update or amendment to a previous TIS or a new TIS if any of the following thresholds are met:

1. Changes to the development proposal increase the expected trip generation for daily or peak hour trips by more than 15 percent from the original study;
3. Previous traffic studies are more than 2 years old, unless the City Traffic Engineer has determined that the conditions have not significantly changed; or
4. The location, types, or number of access points for the development have changed.

## PART II – DESIGN

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If it is determined that an update or amendment is required, the Developer will be informed at the time of the pre-submittal meeting assuming that adequate information has been provided. If information provided at the pre-submittal meeting is inadequate, then the determination for an updated TIS may be made during review of the first submittal of the land use case.

### 3.3 TRAFFIC IMPACT STUDY FORMAT

Traffic consultants are encouraged to discuss projects with the City Traffic Engineer in advance to establish study parameters. Such parameters might include the study area boundary, design years, traffic count locations, directional distribution of traffic, intersections requiring operational analyses, and method for projecting future background traffic volumes. Specific requirements for a TIS may vary depending on the size of the project, the type of project, and the site location. However, every TIS shall contain, at a minimum, the information in this Section 3.3 and shall comprehensively address the potential impacts of a project.

#### 3.3.1 INTRODUCTION

##### 1. Land Use, Site, and Study Area Boundaries

This section briefly describes the size of the land parcel, general terrain features, location within the City, and region. This section should also identify the primary roadways within the study area.

The limits of the study area should be based on engineering judgment and an understanding of existing traffic conditions at the site. In all instances, however, the study area limits shall be mutually agreed upon by the Developer, the Developer's engineer, and City staff. A vicinity map that depicts the site in relation to the surrounding transportation system should be included.

##### 2. Existing and Proposed Site Uses

This section should identify the existing and proposed uses of the site relative to the various zoning categories of the City and include the proposed site plan as a figure in the TIS.

##### 3. Existing and Proposed Uses in the Vicinity of the Site

This section should include a complete description of the existing land uses in the vicinity of the site and their current zoning. The applicant should also identify, if known, any proposed uses for vacant lands adjacent to the site to anticipate any potential transitions in land use. This latter item is especially important where large tracts of undeveloped land are within the prescribed study area and could potentially have an impact on the adjacent transportation system.

##### 4. Existing and Proposed Roadways and Intersections

This section should describe the existing roadways and intersections (laneage, intersection geometrics, and traffic control), as well as any known improvements contemplated by government agencies.

## PART II – DESIGN

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### 3.3.2 EXISTING CONDITIONS

The TIS should discuss and graphically depict the following existing conditions:

1. Existing Average Daily Traffic (ADT) for streets within the established study area based on recent traffic counts. The appendix shall provide all raw traffic count data, including 24-hour ADT counts and peak hour turning movement counts. Daily traffic counts should be actual machine counts rather than factored peak hour counts. Available machine counts from CDOT, the City, and other agencies may be acceptable if not more than two years old.
2. Existing A.M. and P.M. peak hour movements for intersections within the study area based on recent traffic counts. Peak hour counts should include pedestrian movements. All intersection turning movement counts should be less than one year old.
3. A figure depicting the existing study area traffic volumes.
4. Existing A.M. and P.M. peak hour vehicular levels of service (LOS) for all study area intersections. Include a figure summarizing the LOS results.

LOS is a qualitative measure of traffic operational conditions based on roadway capacity and vehicle delay. As defined by the *Highway Capacity Manual* (HCM), LOS ranges from A to F, with LOS A representing generally free-flow traffic and minimal delays, and LOS F representing congested conditions and long delays. LOS C will be the design objective for peak hour intersection operations, with LOS D being the minimum acceptable operational condition for a site plus background traffic. If a development will cause a roadway or an intersection to drop below LOS D, the City may require on-site or off-site improvements to be installed by the Developer. Refer to Section 3.3.5 for more information on possible improvement types.

The TIS shall include vehicular LOS analyses for the study area intersections and proposed site access driveways based on *HCM* methods. The evaluation should also consider pedestrian movements. The TIS appendix shall include LOS worksheets including signal timing information for all signalized intersections. Computer techniques and the associated printouts may be used as part of the report graphics. LOS calculations shall be performed for existing conditions, background conditions, and total traffic scenarios.

### 3.3.3 PROPOSED SITE-GENERATED TRAFFIC

Trips generated by a proposed site must be calculated for the maximum uses allowed under the existing and proposed zoning based on the latest data contained within the most recent Institute of Transportation Engineers (ITE) *Trip Generation Manual*. If published data are unavailable for a proposed land use, the City must approve the estimated rates or trip generation method before acceptance. Traffic volume counts for similar existing uses or additional sources from other jurisdictions may be acceptable to the City. The TIS should address the following, as applicable:

#### 1. Trip Generation

A summary table listing the size and type of each proposed land use, the proposed size, the average trip generation rates that were used (total daily traffic, A.M. peak hours, and P.M. peak hours), and the resultant total site trip generation must be provided.

## PART II – DESIGN

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### 2. Pass-By Trips

Reductions to the site trip generation to account for pass-by traffic may be considered for commercial developments upon approval of the City Traffic Engineer. Data contained in ITE's *Trip Generation Manual* may be used to estimate the pass-by attraction of a proposed development. Pass-by trips would reduce the development's impact on the adjacent roadways, but the site driveway volumes are not reduced. A separate traffic assignment may be needed to demonstrate the pass-by volumes.

### 3. Internal Capture

Internal trip reductions may be considered for mixed-use developments. The methodology presented in ITE's *Trip Generation Manual* shall be used to calculate the internal capture potential. Justification for internal trip reductions shall be provided.

### 4. Transit Oriented Development

Trip reductions may also be considered for developments located along transit corridors or in close proximity to light rail stations. The methodology presented in ITE's *Trip Generation Manual* shall be used to calculate the potential vehicle trip reductions associated with the availability of transit. Justification for transit reductions shall be provided.

### 5. Trip Distribution

The TIS must clearly state the estimated distribution of trips oriented to and from the proposed development by using the north, south, east, and west compass points and by the percent of assignment. Market studies and information concerning the origin of trip attractions to the proposed development may be used to support these assumptions when available. Traffic study graphic materials must include a figure showing the percentage of site traffic on each street.

### 6. Project-Generated Traffic Assignment

This section shall describe the use of the study area roadways by site-generated traffic. The TIS shall include a figure depicting the assignment. This section shall also address each phase of development, if applicable, and include associated figures.

### 3.3.4 FUTURE CONDITIONS

The evaluation of future conditions shall include the short-term, long-range, and any intermediate phases of development. Short-term background volumes include the existing traffic and the traffic projected at the proposed opening year of the development unless the City specifies a later scenario. Long-range background volumes are those volumes projected 20 years from the proposed opening year of the development. Intermediate phases may apply to plans that include more than one phase of build-out or other atypical circumstances, as determined by the Director of Public Works or City Traffic Engineer.

#### 1. Short-Term Background Traffic Volumes

As noted previously, the short-term background volumes include the existing traffic and potential additional traffic projected at the proposed opening year of the development unless the City specifies a later scenario. Growth rates extracted from the regional travel demand model or as

specified by the City may be used. Imminent development of nearby parcels may also be included as determined by the City. The TIS shall include a figure depicting the short-term background volumes (daily, A.M. and P.M. peak hours).

**2. Short-Term Background LOS**

The TIS shall analyze the short-term background traffic operations using *HCM* methods and provide a figure summarizing the LOS results. LOS results for any intermediate future scenarios should also be provided.

**3. Long-Range Background Traffic Volumes**

20-year background traffic volume projections shall consider buildout of major vacant properties around the proposed development as defined by the City. The City may provide projections for background traffic growth or recommend a method for projecting future volumes. The TIS shall include a figure depicting the long-range background volumes (daily, A.M. and P.M. peak hours). The TIS should include intermediate future scenarios corresponding to each phase of development, as applicable.

**4. Long-Term Background LOS**

The TIS shall analyze the 20-year background traffic operations using *HCM* methods and provide a figure summarizing the LOS results. LOS results for any intermediate future scenarios should also be provided.

**5. Site-Generated Traffic Volumes**

The TIS shall analyze the site-generated traffic volumes as described above for the daily, A.M., and P.M. peak hours for the short-term and long-range traffic volumes. Figures depicting these values shall be included in the TIS. Intermediate future horizons reflecting phases of development should also be provided, if applicable.

**6. Total Traffic Volumes**

The total traffic volumes are the sum of the background plus site-generated traffic volumes (daily, A.M. and P.M. peak hours). The TIS shall include figures depicting the short-term (existing plus site) and long-range (20-year background plus site) traffic volumes. Intermediate future horizons reflecting phases of development should also be provided, if applicable.

**7. Total Traffic LOS**

The TIS shall analyze the total traffic operations using *HCM* methods and include figures summarizing the results. Intermediate phases of development shall also be analyzed, and appropriate figures included.

### **3.3.5 PROPOSED IMPROVEMENTS**

This section will describe the location, nature, and extent of proposed improvements to assure sufficient intersection capacity (LOS D or higher). The improvements shall include planned projects by the City, other local jurisdictions, or CDOT for which funds have been appropriated and obligated.

## PART II – DESIGN

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### 1. Roadway Laneage

Potential roadway widening to include additional through or dedicated turn lanes shall be identified.

### 2. Intersection Geometry

Geometric improvements at intersections, such as additional turn lanes or storage modifications to maintain acceptable LOS, shall be identified.

### 3. Traffic Control

Traffic control improvements at site accesses and study area intersections shall be identified. Where the need for traffic signals is identified, a signal warrant and signal progression analysis as described in this Manual must be provided.

### 4. Signal Warrant Analysis and Signal Progression

The need for new traffic signals shall be identified based on warrants specified in the *MUTCD*. Traffic progression along arterials is of paramount importance; therefore, a spacing of one-half mile should be maintained for all signalized intersections along City arterial streets and State highways. This spacing typically provides good speed and optimum signal progression. If the one-half-mile spacing cannot be achieved, the TIS shall include a progression analysis to demonstrate that existing progression levels will be maintained.

The progression analysis shall be based on criteria contained in the *MUTCD*, the *Manual of Traffic Signal Design* (ITE), the *Traffic Control Devices Handbook* (ITE), or other recognized sources approved by the Director. The TIS appendix shall include time-space diagrams.

### 5. Crash Analysis and Safety Improvements

The study may require traffic crash data for affected street corridors. The study period shall normally be three years. Where traffic crash data is necessary, estimates of increased or decreased crash potential shall be evaluated for the development. If the proposed development might impact existing traffic safety conditions in the study area, then safety mitigation recommendations may also be necessary. The City Traffic Engineer will determine whether traffic crash data and/or safety mitigation recommendations are necessary after the initial review of the draft TIS.

### 6. Auxiliary Lanes

The need for acceleration or deceleration lanes at site accesses and affected street intersections shall be evaluated based on CDOT criteria for deceleration and storage. The TIS shall identify auxiliary lane improvements.

### 7. Shared Parking

Traffic studies for mixed-use developments where shared parking is contemplated shall be required to include parking accumulation studies for existing facilities similar to the proposed uses and for the surrounding uses with which parking is being reciprocated. The TIS may use available



## PART II – DESIGN

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shared parking data from the Urban Land Institute (ULI), ITE, or other recognized source, as approved by the Director or City Traffic Engineer.

### 8. Roundabouts

Where existing or future conditions indicate the potential for signalized traffic control, a roundabout may be a feasible alternative. When identified in the TIS or as directed by the City, existing and potential roundabout locations shall be analyzed using *HCM* methods.

### 3.3.6 RECOMMENDATIONS

If the analyses indicate unsatisfactory LOS on study area roadways, recommendations for improvements to mitigate deficiencies shall be identified. In general, the recommendation section should include:

#### 1. Recommended Improvements

This section shall describe the location, nature, and extent of proposed improvements to assure sufficient roadway capacity. A conceptual layout of each improvement should be provided showing the dimensions of the pertinent geometric features of the proposed improvements. The concept sketches shall incorporate recommended signing, striping, traffic signal, and/or other intersection control and operations improvements.

#### 2. Recommendations on Phasing of Improvements

Where long-range improvements are not needed in the short term, a logical phasing plan shall be developed to implement the ultimate configuration. Necessary improvements must be directly tied to construction of a planned phase or a specific year.

#### 3. Traffic Volume Proportions

The City may require the percent share of total traffic volumes to determine the proportion of traffic using various public improvements (both existing and proposed) from several developments within the study area. This will assist the City in determining the appropriate allocation of improvement costs among the area developments.

### 3.3.7 CONCLUSIONS

The last chapter of the report must clearly and concisely summarize the proposed project, the study findings, and its recommendations. It is anticipated that the concluding chapter will serve as an executive summary.

## 3.4 REVISIONS TO TRAFFIC IMPACT STUDY

The City may require revisions to the TIS. The need for revisions will be based on the completeness of the TIS, adherence to City requirements, identification that crash data and/or improvements may be needed, and compatibility of the TIS with the proposed access and development plan.

## 3.5 TRAFFIC IMPACT STUDY CHECKLIST

The traffic consultant conducting the TIS should complete the following checklist to aid in completion of the report. The checklist may be included with TIS submittals to verify completion or to note items that were left out intentionally.

## PART II – DESIGN

TIS Elements		Yes	N/A	Comments
<b>REPORT COVER</b>				
1	Original and revision dates			
2	Dated, sealed, and signature of PE			
<b>INTRODUCTION</b>				
1	Study area boundary map (figure)			
2	Existing and proposed site uses and phasing (Include site plan with access points shown [figure])			
3	Existing and proposed uses in vicinity of site			
4	Existing and proposed roadways and intersections (figure)			
<b>EXISTING CONDITIONS</b>				
1	24-hour roadway counts < 2 years old			
2	Intersection peak hour counts < 1 year old			
3	Existing A.M., P.M., and daily traffic volumes (figure)			
4	Existing A.M. and P.M. peak hour LOS (figure)			
<b>PROPOSED SITE GENERATED TRAFFIC</b>				
1	Trip generation summary (table)			
2	Pass-by trips (provide justification)			
3	Internal trips (provide justification)			
4	Transit trip reductions (provide justification)			
5	Trip distribution (figure)			
6	Trip assignment (figure) – each phase			
<b>FUTURE CONDITIONS</b>				
1	Background traffic volumes (20-year and each phase) – Daily, A.M., and P.M. peak hours (figures)			
2	Background LOS (20-year and each phase) – A.M. and P.M. peak hours (figures)			
3	Site-generated traffic volumes (short-term, long-range, and each phase) – Daily, A.M., and P.M. peak hours (figures)			
4	Total traffic volumes (short-term, long-range, and each phase) – Daily, A.M., and P.M. peak hours (figures)			
5	Total traffic LOS (short-term, long-range, and each phase) – A.M. and P.M. peak hours (figures)			
<b>PROPOSED IMPROVEMENTS</b>				
1	Roadway laneage			

## PART II – DESIGN

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TIS Elements		Yes	N/A	Comments
2	Intersection geometry			
3	Traffic control			
4	Signal warrant analysis and signal progression			
5	Crash analysis and safety mitigations			
6	Auxiliary lanes			
7	Shared parking (provide justification)			
8	Roundabouts			
RECOMMENDATIONS				
1	Recommended improvements (provide sketches)			
2	Recommendations on phasing improvements			
3	Percent share of development traffic volumes			
CONCLUSIONS				
1	Summary of findings			
<p><b>I have reviewed the attached report with this checklist and all the required items have been included except as noted above</b></p> <p>_____ <b>Engineer</b></p>				

### SECTION 4.0 ROADWAY DESIGN AND TECHNICAL CRITERIA

#### 4.1 ROADWAY CLASSIFICATIONS

The City is defined as an urban area and, as such, each of the roadway classifications described in this Section shall accommodate the characteristics of an urban environment. This Section describes the hierarchy of each roadway type, the associated characteristics, and design criteria. The Standard Details include typical sections for each roadway classification. An Alternate Roadway Section Design Variance may be allowed provided that the process outlined in Part I of this Manual has been followed and written approval has been provided by the City.

##### 4.1.1 SIX-LANE ARTERIAL

A six-lane arterial is a roadway designed or operating typically with the following characteristics.

- A. **SPEED LIMIT** – Posted speed limit less than or equal to 55 miles per hour (MPH).
- B. **ACCESS** – Limited access to adjacent parcels of land. When access is allowed, each access should be separated at a minimum distance equal to the design sight distance values found in 31
- C. **TRAFFIC CONTROL** – Provided by traffic signals at major intersections.
- D. **TRAFFIC VOLUMES** – More than 30,000 vehicles per day expected traffic volume when the land served by the arterial is fully developed.
- E. **CONTINUITY** – Several miles, generally connecting with intercity routes.
- F. **FUNCTION** – Permit rapid and relatively unimpeded traffic movement through the City, connecting major land use elements and the City with surrounding communities.
- G. **RIGHT-OF-WAY WIDTH** –144' minimum without bike lanes.
- H. **ACCESS CONDITIONS**
  - 1. Intersections will generally be at-grade.
  - 2. Intersections will normally be located at one-quarter-mile intervals; at one-mile intervals if traffic signalization is projected, minimum.
  - 3. Traffic control devices shall control access from collector and arterial streets.
  - 4. Normally, abutting properties and local streets will not be allowed direct access to the street.
- I. **TRAFFIC CHARACTERISTICS** – Movement of traffic controlled by traffic signals and channelization. Parking shall be prohibited. Roadways should have a raised median that separates traffic. Detached sidewalk is required.
- J. **PLANNING CHARACTERISTICS** – Arterial streets spaced approximately one mile apart and traverse the entire City and/or county. Arterial streets should not bisect neighborhoods but should act as

## PART II – DESIGN

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boundaries between them. Detached sidewalks is required. Other conditions may apply depending on the zone district (see LDC for requirements in the Activity Center and Urban Center districts).

- K. **TYPE OF CURB AND GUTTER** – Vertical curb and gutter with detached 8' sidewalk and 10' landscape area required.
- L. **STREET WIDTHS** – Six 12' travel lanes; 26' median; two 1' median gutter pans, two 2' gutter pans; plus, necessary left turn, acceleration/deceleration lanes, and 4' median at intersections (108'). At intersections the cross section may be modified to accommodate turn lanes. The Developer/Permittee must obtain City approval for any modifications to intersection cross sections.

### 4.1.2 FOUR-LANE ARTERIAL

A four-lane arterial is a street designed or typically operating with the following characteristics.

- A. **SPEED LIMIT** - Posted speed limit less than or equal to 50 MPH.
- B. **ACCESS** – Limited access to adjacent parcels of land. When access is allowed, each access should be separated at a minimum by a distance equal to the design sight distance values found in Table 9.
- C. **TRAFFIC CONTROL** – Provided by traffic signals at major intersections.
- D. **TRAFFIC VOLUMES** – Fewer than 30,000 vehicles per day expected traffic volume when the land served by the arterial is fully developed.
- E. **CONTINUITY** – Several miles, generally connecting with intercity routes.
- F. **FUNCTION** – Permit relatively unimpeded traffic movement and intended for use on routes where four moving lanes and one left turn lane are required but where a 6-lane arterial cross-section would not be warranted.
- G. **RIGHT-OF-WAY WIDTH** – 104' minimum. (114' minimum with bike lanes)
- H. **ACCESS CONDITIONS**
  - 1. Intersections at grade.
  - 2. Intersection with other streets will not be restricted.
  - 3. Access from a street of lower classification will be permitted but, in all cases, will be controlled with traffic control devices.
  - 4. Abutting property will be allowed access to the street if no other access is available.
- I. **TRAFFIC CHARACTERISTICS** – Regulation of traffic accomplished by signs and channelization. Traffic signals may be located at intersections where warrants are met. Parking shall be prohibited.

## PART II – DESIGN

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- J. **PLANNING CHARACTERISTICS** – Arterials should be spaced from one-half to one mile apart and should, where possible, be continuous. Arterials should act as boundaries between neighborhood areas. Arterial cross sections should be used where traffic demands are high and ROW acquisition costs are not prohibitive. Detached sidewalk is required. Other conditions may apply depending on the zone district (see LDC for requirements in the Activity Center and Urban Center districts).
- K. **TYPE OF CURB AND GUTTER** – Vertical curb and gutter with detached 6' sidewalk and 10' landscape area required.
- L. **STREET WIDTHS** – Four 12' travel lanes; one 8' striped median; two 2' gutter pans; two 5' bike lanes plus acceleration/deceleration lanes at intersections (70' flowline – flowline). At intersections the cross section may be modified to accommodate turn lanes. The Developer/Permittee must obtain City approval for any modifications to intersection cross sections .

### 4.1.3 MAJOR COLLECTOR

A major collector is a roadway designed or operated typically with the following characteristics.

- A. **SPEED LIMIT** – Posted speed limit less than or equal to 40 MPH.
- B. **ACCESS** – Access may be granted to adjacent parcels of land. Residential driveways will not be permitted. When access is allowed, each access should be separated at a minimum by a distance equal to the design sight distance values found in Table 9.
- C. **TRAFFIC CONTROL** – Provided by traffic signals or roundabouts; side street control by stop signs.
- D. **TRAFFIC VOLUMES** – Fewer than 15,000 vehicles per day when the land served by the collector is fully developed. Designed to handle traffic volumes loading from and onto local streets, other collectors, and arterial roadways.
- E. **CONTINUITY** – 2 or more miles.
- F. **FUNCTION** – Permit relatively unimpeded traffic movement and intended for use on those routes where two moving lanes are required but where a higher classified street is not warranted.
- G. **RIGHT-OF-WAY WIDTH** – 78' minimum.
- H. **ACCESS CONDITIONS**
  - 1. Intersection at-grade.
  - 2. Intersection with other streets will not be restricted.
  - 3. Access from a street of lower classification will be permitted but, in all cases, will be controlled with traffic control devices.
  - 4. Normally, abutting property will be allowed access to the street and will front (or face) the street but perhaps with increased setback requirements.

## PART II – DESIGN

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### I. TRAFFIC CHARACTERISTICS

1. Regulation of traffic accomplished by signs and channelization.
2. Traffic signals normally located only at intersections with streets of equal or higher classification.
3. Parking shall be prohibited.

### J. PLANNING CHARACTERISTICS

1. Major collector streets should be used where traffic demands are high and ROW acquisition costs are not prohibitive.
2. Detached sidewalk required except at intersections.
3. Design elements (trees, open space, etc.) are recommended and required in some instances (see LDC). Other conditions may apply depending on the zone district (see LDC for requirements in the Activity Center and Urban Center districts).

### K. TYPE OF CURB AND GUTTER – Vertical curb and gutter with detached 6’ sidewalk (except at intersections) and 8’ landscape area required.

### L. STREET WIDTHS – Two 12’ travel lanes, 12’ painted median, two 2’ gutter pans and two 4’ bike lanes (48’ flowline – flowline). At intersections, the cross section may be modified to accommodate turn lanes. The Developer/Permittee must obtain City approval for any modifications to intersection cross sections.

#### 4.1.4 MINOR COLLECTOR

A minor collector is a general term denoting a roadway designed or operating with the following characteristics.

- A. **SPEED LIMIT** – Posted speed limit less than or equal to 35 MPH.
- B. **ACCESS** – Access to adjacent parcels of land. Residential driveways will not be permitted. When access is allowed, each access should be separated at a minimum by a distance equal to the design sight distance values found in Table 9.
- C. **TRAFFIC CONTROL** – Generally provided by roundabouts or stop signs.
- D. **TRAFFIC VOLUMES** – Fewer than 8,000 vehicles per day. Designed to handle traffic volumes loading from and onto local streets, other collectors, and arterial roadways.
- E. **CONTINUITY** – Less than 2 miles.
- F. **FUNCTION** – Collect and distribute traffic between arterial and local streets and serve as main connector routes within communities, linking one neighborhood with another. Traffic carried by collector streets should have an origin or a destination within the community.

## PART II – DESIGN

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G. **RIGHT-OF-WAY WIDTH** – 64' minimum.

H. **ACCESS CONDITIONS**

1. Intersections at-grade with direct access to abutting property permitted.
2. Intersection with other streets permitted, but traffic-control devices should be used when warrants are met.

I. **TRAFFIC CHARACTERISTICS** – Regulation of traffic accomplished through the use of stop signs and channelization. Traffic signals may be used at intersections with major collectors and arterial streets when warranted.

J. **PLANNING CHARACTERISTICS** – Collector streets should have continuity throughout a neighborhood but need not extend beyond the neighborhood. Intersections with minor collectors, major collectors, and arterial streets should be at least one-quarter mile apart. Parking is permitted and will add 6' to each side of the roadway. Other conditions may apply depending on the zone district (see LDC for requirements in the Activity Center and Urban Center districts).

K. **TYPE OF CURB AND GUTTER** – Vertical curb & gutter with detached 5' sidewalk and 8' landscape area required.

L. **STREET WIDTHS** – 24' paved plus two 2' gutter pans and two 4' bike lanes (36' flowline – flowline). At intersections the cross section may be modified to accommodate turn lanes. The Developer/Permittee must obtain City approval for any modifications to intersection cross sections.

### 4.1.5 LOCAL – COMMERCIAL

A local-commercial is a roadway designed or operating typically with the following characteristics.

A. **SPEED LIMIT** – Posted speed limit less than or equal to 30 MPH.

B. **ACCESS** – All adjacent parcels of land. Each access should be separated at a minimum by a distance equal to the design sight distance values found in Table 9.

C. **TRAFFIC CONTROL** – Provided by stop signs where warranted.

D. **TRAFFIC VOLUMES** – Generally, fewer than 3,000 vehicles per day; designed to handle traffic volumes to and from local and collector roadways.

E. **CONTINUITY** – Short distances.

F. **FUNCTION** – Designed for the safety of pedestrians and bicyclists and the ease of access to adjacent parcels of land.

G. **RIGHT-OF-WAY WIDTH** – 60' minimum.



## PART II – DESIGN

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### H. ACCESS CONDITIONS

1. Intersection with other streets will not be restricted, but traffic-control devices should be used when warrants are met.

### I. TRAFFIC CHARACTERISTICS – Regulation of traffic accomplished through the use of stop signs and channelization.

### J. PLANNING CHARACTERISTICS – Local - commercial streets should be used to connect commercial parcels to collectors and arterials. Parking is permitted on the roadway. Other conditions may apply depending on the zone district (see LDC for requirements in the Activity Center and Urban Center districts).

### K. TYPE OF CURB AND GUTTER – Mountable curb and gutter with detached 5' sidewalk and 7.5' landscape area preferred.

### L. STREET WIDTHS – 28' paved plus two 2'-10" mountable curb and gutter (32' flowline – flowline). Sidewalks are required; detached sidewalks are preferred. The cross section may be modified at intersections to accommodate turn lanes. The Developer/Permittee must obtain City approval for any modifications to intersection cross sections.

#### 4.1.6 LOCAL – DETACHED WALK/ATTACHED WALK

A local street is a general term denoting a residential roadway designed or operating with the following characteristics.

### A. SPEED LIMIT – Posted speed limit less than or equal to 30 MPH.

### B. ACCESS – All adjacent parcels of land, specifically residential. Each access should be separated at a minimum by a distance equal to the design sight distance values found in Table 9.

### C. TRAFFIC CONTROL – Provided by stop signs, yield signs, or ROW rules for uncontrolled intersections.

### D. TRAFFIC VOLUMES – Up to 1,000 vehicles per day.

### E. CONTINUITY – Short distances.

### F. FUNCTION – Designed for the safety of pedestrians and bicyclists and the ease of access to adjacent parcels of land.

### G. RIGHT-OF-WAY WIDTH – 50' minimum with attached walk, otherwise 60' minimum with detached walk.

### H. ACCESS CONDITIONS

1. Access to abutting properties shall be at-grade.

## PART II – DESIGN

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2. Intersection with other streets will not be restricted, but traffic-control devices should be used when warrants are met.
- I. **TRAFFIC CHARACTERISTICS** – Regulation of traffic accomplished by using signage where warranted.
- J. **PLANNING CHARACTERISTICS** – Local streets should be used to connect commercial and/or residential parcels to collectors and arterials. Parking is permitted on the roadway. Other conditions may apply depending on the zone district (see LDC for requirements in the Activity Center and Urban Center districts).
- K. **TYPE OF CURB AND GUTTER** – Mountable curb and gutter is permitted. 5' sidewalk with 8' landscape area preferred.
- L. **STREET WIDTHS** – 28' paved with two 2'-10" mountable curb and gutter (32' flowline – flowline).

### 4.1.7 PRIVATE STREETS

The following conditions apply when private streets are constructed.

- A. Private streets may be allowed in certain cases with City approval.
- B. Private streets must meet the same standards for pavement structural section as a public street in an area of comparable density and traffic volume. Concrete sidewalk, curb and gutter, or drainage pans on the edge of streets will be required.
- C. The width of private streets will vary according to the density and traffic impact of each site. Required street widths will be determined after appropriate TIS review through Public Works.
- D. Appropriate signage clearly indicating to the public and private providers that the street is private property must be permanently maintained at the entrances to the private street system.
- E. The Developer of the private street system must submit the portion of the covenant, declaration, and/or by-laws of the homeowner association agreement that clarifies the private responsibilities for the private street system (maintenance, policing, lighting, drainage and signals, maintenance of common open spaces, etc.) for “approval as to form” by the City Attorney’s Office through Public Works. This information may alternatively be indicated as a stipulation on the development plan or the subdivision plat. This information must be approved at the time of the approval of the final plat, rezoning, or site plan, as appropriate.
- F. Any traffic control devices proposed for the private street system, such as signs, signals, markings, speed control mechanisms, etc., will be subject to review and approval by the City.
- G. CDs for private streets will require City approval.
- H. Gating of private streets is discouraged but may be permitted only with prior written approval of the City. Gating of public streets is prohibited.

## PART II – DESIGN

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- I. Private streets must meet the requirements of all applicable State and national standards (*MUTCD*, ADA, etc.).

### 4.2 HORIZONTAL DESIGN

#### 4.2.1 GENERAL

The following criteria for roadway design outlines the minimum requirements; however, exceeding the minimum design criteria should be considered.

## PART II – DESIGN

**Table 1: Arterial Roadways**

Criteria	Six-Lane Arterial	Four-Lane Arterial
Maximum Design Speed	60 MPH	55 MPH
Traffic Volumes	> or = 30,000 vehicles per day	< 30,000 vehicles per day
Minimum ROW	144'	104' *
Total Through Lanes	6	4
Travel Lanes	12'	12'
Bike Lane Width	N/A	5'
Raised Median (including curb and 1' gutter pan)	26'	8' or Painted
Painted Median	N/A	8' or Raised
Curb and Gutter	6" vertical with 2' Gutter	6" vertical with 2' Gutter
Parking Lane	N/A	N/A
Landscape Strip (each side)	9'	10'
Sidewalk	Detached 10' Sidewalk	Detached 6' Sidewalk
Curb Return Minimum Radii		
-Intersect Arterial		
-Intersect Collector	50'	50'
-Intersect Local	40'	40'
	----	----
Maximum Superelevation of Roadway	3%	2%
Minimum Slope of Landscape/Walkways/etc.	1%	1%
Maximum Cross Slope of Walkways	2.0%**	2.0%**
Minimum Radius of Curve at Centerline Per AASHTO	2,200'	1,700'
Min-Max Slope of Intersection		
-Intersect Arterial	1–2%	1–2%
-Intersect Collector	1–3%	1–3%
-Intersect Local	----	----
Min-Max Street Gradient	1–6%	1–6%

\* Four-Lane Arterial with Bike Lanes minimum ROW width shall be 114', additional width with buffers may be considered.

\*\* 1.5% cross slope is recommended to allow for construction tolerances up to 2.0%.

## PART II – DESIGN

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**Table 2: Collector Roadways**

Criteria	Major Collector	Minor Collector
Maximum Design Speed	45 MPH	40 MPH
Traffic Volumes	< 15,000 vehicles per day	< 8,000 vehicles per day
Minimum ROW	78'	64'
Total Through Lanes	2	2
Travel Lanes	12'	12'
Bike Lane Width	4'	4'
Painted Median	12'	N/A
Curb and Gutter	6" vertical with 2' Gutter	6" vertical with 2' Gutter
Landscape Strip (each side)	8'	8'
Sidewalk	Detached 6' Sidewalk	Detached 5' Sidewalk
Curb Return Minimum Radii		
-Intersect Arterial	40'	40'
-Intersect Collector	40'	40'
-Intersect Local	30'	30'
Maximum Superelevation of Roadway	2%	2%
Minimum Slope of Landscape/Walkways/etc.	1%	1%
Maximum Cross Slope of Walkways	2.0%*	2.0%*
Minimum Radius of Curve at Centerline Per AASHTO	1,039'	510'
Min-Max Slope of Intersection		
-Intersect Arterial	1–3%	1–3%
-Intersect Collector	1–3%	1–3%
-Intersect Local	1–4%	1–4%
Min-Max Street Gradient	1–6%	1–6%

\* 1.5% cross slope is recommended to allow for construction tolerances up to 2.0%.

## PART II – DESIGN

**Table 3: Local Roadways**

Criteria	Local – Commercial	Local – Detached Walk/Attached Walk
Maximum Design Speed	35 MPH	35 MPH
Traffic Volumes	< 3,000 vehicles per day	< or = 1,000 vehicles per day
Minimum ROW	60'	50' (attached walk) 60' (detached walk)
Total Through Lanes	2	2
Travel Lanes	28' Drive Lane	20' Drive Lane
Curb and Gutter	Mountable Curb and 2' Gutter	Mountable Curb and 2' Gutter
Parking Lane	6' or N/A	6'
Landscape Strip (each side)	7.5'	8', N/A
Sidewalk	Detached 5' Sidewalk	Detached 5' Sidewalk, Attached 5' Sidewalk
Curb Return Minimum Radii		
-Intersect Arterial	----	----
-Intersect Collector	30'	30'
-Intersect Local	20'	20'
Maximum Superelevation of Roadway	2%	2%
Minimum Slope of Landscape/Walkways/etc.	1%	1%
Maximum Cross Slope of Walkways	2.0%*	2.0%*
Minimum Radius of Curve at Centerline Per AASHTO	510'	510'
Min-Max Slope of Intersection		
-Intersect Arterial	----	----
-Intersect Collector	1–4%	1–4%
-Intersect Local	1–4%	1–4%
Min-Max Street Gradient	1–6%	1–6%

\* 1.5% cross slope is recommended to allow for construction tolerances up to 2.0%.

**NOTE:** All private streets criteria shall be determined at a pre-submittal meeting and approved by the Director or City Traffic Engineer.

## PART II – DESIGN

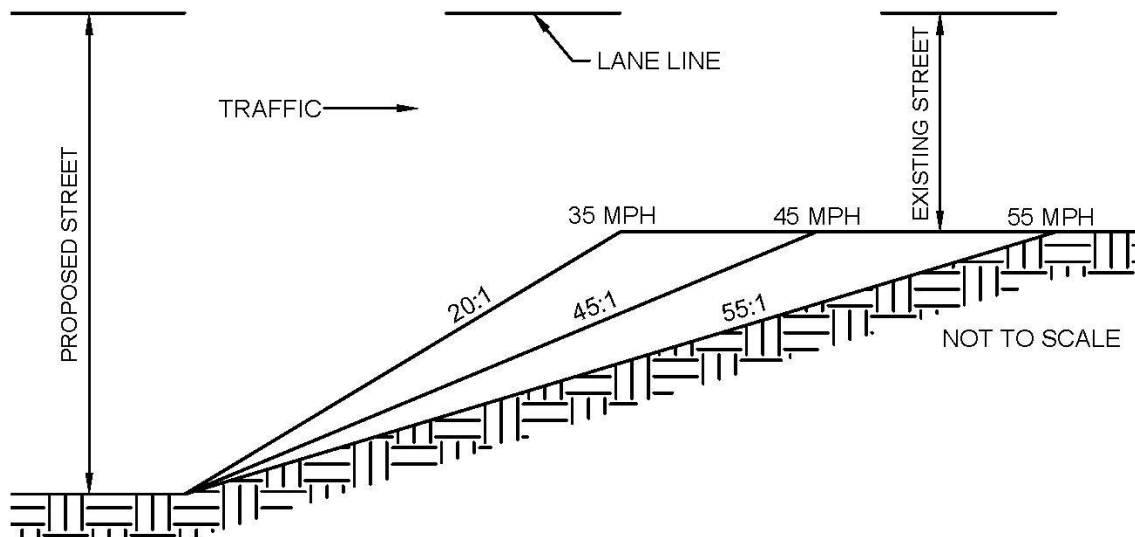
### 4.2.2 CONNECTIVITY

Proposed subdivision streets must be in continuous alignment with existing, planned, or platted streets with which they are to connect. Existing roadways, including planned or platted roadways, in adjoining property shall be continued with equal characteristics and in similar alignment and name with roadways proposed in the subdivision.

Arterial, collector, and local streets (if not ending in a cul-de-sac) must extend to the boundary lines of the land being developed. Proposed streets with widths different from existing streets to which they are being connected must be transitioned using City pavement transition taper standards specified in Table 4. Long, straight residential streets longer than 1,300' are conducive to high-speed traffic and are strongly discouraged.

**Table 4: Redirect Tapers for Transitions**

Posted Speed in MPH	30 or less	35	40	45	50	55
Straight Taper Ratio	15:1	20:1	30:1	45:1	50:1	55:1



At the connection of two local streets with 90° alignments, where the connecting curve is less than the minimum 150-foot radius, the outside flowline may be required to be flared. Additional pavement width may be required on horizontal curves on collector and arterial streets to provide vehicle maneuvers where no superelevation is provided and where the minimum horizontal curve design criteria in Table 1 through Table 3 have not been met. The method of calculation for the widening will be as described in the AASHTO Green Book.

## PART II – DESIGN

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### 4.2.3 HORIZONTAL CURVES

The minimum horizontal curvature for roadway alignment shall be set in accordance with Table 1 through Table 3 located in Section 4.2.1. For unique or unusual circumstances, the AASHTO Green Book design guidelines should be considered, and the City shall approve any variance from the design criteria.

#### 4.2.3.1 *Superelevation*

Superelevation shall be applied to curves on all roadway classifications of arterial designation in which it is required for the roadway to function properly. Horizontal curve radii, superelevation, and superelevation transitions shall be in accordance with the requirements detailed in this Manual and on the recommendations of the AASHTO Green Book.

The use of superelevation shall be avoided on all roadways with a design speed of 35 MPH or less. If superelevation cannot be avoided on a roadway with a design speed of 35 MPH or less, all design criteria within these standards and recommendations of the AASHTO Green Book shall apply.

#### 4.2.3.2 *Roadway End Terminus*

Whenever roadways terminate due to project phasing, subdivision boundaries, etc., barricades are required to indicate and warn users of roadway termination. Design and construction shall comply with the requirements of the *MUTCD*. Details shall be shown on the construction drawings, and installation shall be provided by the Developer.

#### 4.2.3.3 *Small Deflection Angles*

For small deflection angles, curves should be sufficiently long enough to avoid the appearance of a kink. Curves should be at least 500' long for a central angle of 5°, and the minimum length should be increased 100' for each 1° decrease in the central angle. Horizontal curves should not be used when the central angle is 59 minutes or less. This criterion applies to arterial roadway design only.

#### 4.2.3.4 *Compound Curves*

A compound curve on arterials should be avoided, particularly where a simple curve can be obtained at a small extra cost. Where topography makes their use necessary, the radius of the flatter curve should not be more than 50 percent greater than the radius of the sharper curve. When this is not feasible, an intermediate curve or a spiral should be used to provide the necessary transitions. Spiral curves are to be used only upon written approval of the City.

#### 4.2.3.5 *Reversing Curves*

True reversing curves should not be used. In cases of reversing curves, a sufficient tangent should be maintained to avoid overlapping of the required superelevation runoff and tangent runout. The following are the minimum tangent lengths that shall be used for each roadway classification:

1. Local – 100' minimum.
2. Collector – 100' minimum.
3. Arterial – 150' minimum.



## PART II – DESIGN

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### 4.2.3.6 Broken-Back Curves

Broken-back curves are undesirable and should not be used. Alternatively, simple curves, compound curves, or spiral transition should be used to provide some degree of continuous superelevation. Design shall follow the AASHTO Green Book. Spiral curves are to be used only upon written approval of the City.

### 4.2.3.7 Alignment at Bridges

Ending a curve on a bridge is undesirable and adds to the complication of design and construction. Likewise, curves beginning or ending near a bridge should be placed so that no part of the spiral, if allowed, or superelevation transition extends onto the bridge. Compound curves on a bridge are equally undesirable. If curvature is unavoidable, every effort should be made to keep the bridge within the limits of the simple curve.

### 4.2.3.8 Coordination with Vertical Alignment

To avoid the possibility of introducing traffic hazards, coordination is required between horizontal and vertical alignment. Particular care must be exercised to maintain proper sight distance at all times. Sharp horizontal curves introduced at or near the top of pronounced crest or bottom of sag vertical curves should be avoided.

## 4.2.4 INTERSECTIONS

### 4.2.4.1 General

Whenever possible, intersections shall be made at right angles (90°) or radial to a curve. No intersecting angle of less than 80° will be allowed without a variance from the City.

The design vehicle shall be set by the roadway classification. Table 5 identifies design vehicle requirements per roadway classification. Changes to desired design vehicles will be approved by the City Traffic Engineer and may require a traffic analysis justification.

**Table 5: Design Vehicle per Roadway Classification**

Roadway Classification	Desired Design Vehicle
<b>Six-Lane Arterial</b>	WB-67
<b>Four-Lane Arterial</b>	WB-67
<b>Major Collector</b>	WB-62
<b>Minor Collector</b>	WB-62
<b>Local – Commercial</b>	WB-62
<b>Local – Detached Walk / Attached Walk</b>	SU-30

### 4.2.4.2 Minimum Curb Return Radii

Refer to Table 1 through Table 3 for minimum curb return radii per street classification.

## PART II – DESIGN

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### 4.2.5 OFF-SITE DESIGN

The design grade and the existing ground at that design grade of all roadways that dead-end due to project phasing, subdivision boundaries, etc., shall be continued, in the same plan and profile as the proposed design, for at least 500' or to its intersection with an existing roadway. This limit shall be extended to 1,000' when arterial roadways are being designed.

### 4.2.6 SIDEWALKS, CURB RAMPS, AND DRIVEWAYS

Sidewalks and/or bicycle paths shall be constructed on both sides of all roadways as depicted in the Standard Details and required by the LDC unless otherwise approved by the City.

At least one ADA accessible route shall be provided within a site from accessible parking spaces and accessible passenger loading zones; public streets and sidewalks; and public transportation stops to the accessible building or facility entrance they serve.

When widening an existing sidewalk, it shall be completely removed and replaced with a new sidewalk at full width. Existing sidewalks shall not be widened by adding to the back of the walk.

All curb ramp designs shall meet the latest ADA design guidance, and ADA compliance supersedes the Standard Details. Curb ramps shall be constructed in accordance with the drawings found in the Standard Details. Curb ramps shall be shown on all curb returns on the CDs and a minimum of three (3) curb ramps must be shown (located) on all "T" intersections. Whenever referencing a curb ramp, the specific City Standard Detail shall be identified.

Drainage structures shall not be placed in line with curb ramps. The location of curb ramps shall take precedence over the location of drainage structures. Any underground structure set behind the curb that has an access lid shall not have the lid placed within the ramp or landing portion of a curb ramp.

Residential driveways should not be used for commercial/industrial or high-volume residential development access. In general, when the number of parking spaces within a residential development serviced by the driveway exceeds 10, radius returns should be used.

Driveways through sidewalk areas must maintain ADA compliance of the sidewalk. Driveways shall be per the Standard Detail.

### 4.2.7 CUL-DE-SACS

The following criteria shall be used for cul-de-sac horizontal geometry (see the Standard Details).

- A. The minimum property line radius shall be 60'.
- B. The minimum flowline radius shall be 48'.
- C. The maximum length of the cul-de-sac as measured along the center line, from extended property lines on the open end to the farthest side of the circumference of the turnaround, shall be 500'. Length may be increased only with specific approval of the City and applicable fire district for special circumstances.
- D. Vertical alignment shall be in accordance with Section 4.3.

## PART II – DESIGN

### 4.2.8 AUXILIARY LANES (ACCELERATION AND DECELERATION LANES)

The design of street systems depends on the proper control of access to developments. The location and design of access points must minimize traffic hazards and interference to through traffic movements. A technical analysis memorandum or TIS is required to determine the use of auxiliary lanes on non-arterial roads. The Developer/Permittee must obtain approval from the City Traffic Engineer for their use. The following standards for acceleration and deceleration lanes have been established for arterial roadways.

Right and left turn lanes from arterial streets shall have a minimum of 150' of storage length and 150' of transition taper regardless of projected turning movements. Additional storage length may be required depending on the volume of turn movements and should be discussed in the traffic memo or TIS. The *CDOT State Highway Access Code* should be consulted for further details on auxiliary lanes.

### 4.3 VERTICAL DESIGN

Table 6 lists the criteria set forth as the minimum design standards for vertical roadway design. For additional guidance, refer to the AASHTO Green Book.

**Table 6: Vertical Design Criteria**

Roadway Classification	Design Speed (MPH)*	Maximum Grade (%)**	Minimum K Values*** (Length=K times Algebraic Difference in Grades)			
			Crest Vertical Curves		Sag Vertical Curves	
			Calculated	Design	Calculated	Design
	60	6	150.6	151	135.7	136
<b>Six-Lane Arterial</b>	60	6	150.6	151	135.7	136
<b>Four-Lane Arterial</b>	55	6	113.5	114	114.9	115
<b>Major Collector</b>	45	6	60.1	61	78.1	79
<b>Minor Collector</b>	40	6	43.1	44	63.4	64
	35	6	29.0	29	49.0	49
<b>Local – Commercial</b>	35	6	29.0	29	49.0	49
	30	6	18.5	19	36.4	37
<b>Local – Detached Walk / Attached Walk</b>	35	6	29.0	29	49.0	49
	30	6	18.5	19	36.4	37
<b>Notes:</b>						
* The design speed is a minimum of 5 MPH over the posted speed for each classification.						
** The maximum design grades should be used only in extreme topographic conditions. The designer should strive to minimize the use of these grades for considerable lengths and on north-facing slopes.						
*** K Values exceeding 125 on curbed streets should be checked for drainage. Multiple inlets may be required within long sag vertical curves and where the longitudinal slope is less than 0.4 percent.						

## PART II – DESIGN

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### 4.3.1 PERMISSIBLE ROADWAY GRADE

Grades and vertical sight distance are subject to approval by the City to ensure proper drainage and/or safety for vehicles and pedestrians. Grades of streets must not be less than 1.0% and no greater than 6%. Streets must follow the criteria listed in Table 6.

### 4.3.2 VERTICAL CURVES

When the algebraic difference in grade (A) is at, or exceeds, 0.004 ft./ft., a vertical curve is to be used. All vertical curves shall be symmetrical. The minimum gradients into and out of a sag (sump) vertical curve is 0.005 ft./ft. All vertical curves shall be labeled in the profile with length of curve (L),  $K=L/A$  values, vertical points of curvature, tangent and intersection (VPC, VPT, VPI), and stationing and elevation of these components. In addition, the low point or high point of the vertical curve shall be shown. Streets must follow the criteria listed in Table 6.

### 4.3.3 CHANGING GRADES

Using grade breaks in lieu of vertical curves is discouraged. However, if a grade break is necessary and the algebraic difference in grade does not exceed 0.004 ft./ft. along the roadway, the grade break will be permitted. The maximum grade break allowed at the point of tangency at a curb return for local and collector roads shall be 2 percent and a maximum of 1 percent for arterial roadways.

### 4.3.4 INTERSECTIONS

The following criteria shall apply at intersections:

- A. The grade of the “through” or main street shall take precedence at intersections. At the intersection of roadways with the same classification, the more important roadway, as determined by the City Traffic Engineer, shall have this precedence. The design should warp side streets to match through streets with as short a transition as possible.
- B. The key criteria for determining the elevation of the curb return on the side street and the amount of warp needed on a side street transitioning to a through street are:
  - 1. Permissible grade at the stop/start lane. See Section 4.3.4.1 of this Manual.
  - 2. Pavement cross-slope at the point of curve return (PCR) on the side street and permissible warp in pavement cross slope. See Section 4.3.6 of this Manual.
  - 3. Normal vertical curve criteria.
  - 4. Vertical controls within the curb return itself.
  - 5. Drainage considerations.
- C. The elevation at the PCR of the curb return on the through street is always set by the grade of the through street in conjunction with pavement cross-slope.
- D. Carrying the crown at a side street into the through street is permitted only when drainage considerations warrant such a design.

## PART II – DESIGN

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- E. A more detailed review shall be performed for arterial-arterial intersections to maximize drivability. A few arterial intersections will have a uniform 2 percent cross-slope, the majority of them having one or more sides warped.

### 4.3.4.1 Permissible Intersection Grades

Table 7 shows the maximum permissible grade at intersections within Public right-of-way. These grades are maximum instantaneous profile or centerline grades for the stated distances (each side of the street) for the intersecting street. When the cross section varies, the maximum instantaneous grades are based off the centerline.

**Table 7: Maximum Grades and Length of Grades at Intersection Approaches**

Intersection of:	Local	Collector	Arterial	Maximum Grade
<b>Local Street with</b>	35'	100'	100'	4%
<b>Collector Street with</b>	100'	100'	200'	3%
<b>Arterial Street with</b>	125'	200'	200'	2%

The intersection grade of the major (through) street at the intersection may be dictated by design considerations for the street.

All private commercial driveways with curb return radii shall have a maximum grade of 6%, with the length of the maximum grade for the commercial driveway a minimum of 50' measured from the flowline intersection of the public roadway.

### 4.3.4.2 Curb Returns

Minimum fall around curb returns for flow along the curb line shall be as follows:

**Table 8: Minimum Curb Return Fall**

Radius	Minimum Fall
20'	0.3'
30'	0.4'
40'	0.4'
50'	0.5'
All Others	1.2 % Around Return

### 4.3.4.3 Curb Return Profiles

Curb return profiles are required in the CDs for radii equal to or greater than 30' within the public ROW. A mid-point elevation along the arc length of the curb return shall be shown in plan view for all curb returns. All curb return profiles must assure positive drainage.

## PART II – DESIGN

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### 4.3.5 CONNECTIONS WITH EXISTING ROADWAYS

- A. Connections with existing roadways shall be smooth transitions conforming to normal vertical curve criteria if the algebraic difference in grade between the existing and proposed grade exceeds 0.004 ft./ft. When a vertical curve is used to make this transition, it shall be fully accomplished before the connection with the existing roadway and shall also comply with the grade requirements at intersection approaches.
- B. Existing grade shall be shown for at least 300' on the roadway plan and profile within the CDs.
- C. Previously approved designs for the proposed improvement are not an acceptable means of establishing existing grades. However, such designs are to be referenced on the construction plan where they occur.

### 4.3.6 ROADWAY CROWN CROSS-SLOPE

Except at intersections or where superelevation is required, roadways shall be level from top of curb to top of curb (or flowline to flowline) and shall have a minimum 2 percent crown. The cross section shall be standard except where physical geometry does not allow it.

Where cross-slope transitioning at intersections is required, the rate of change in pavement cross slope shall not exceed 1% every 25' horizontally on a local roadway, 1% every 37.5' horizontally on a collector roadway, or 1% percent every 56.5' horizontally on an arterial roadway.

### 4.3.7 UNPAVED SURFACES

Generally, the maximum desirable slope of unpaved surfaces is 4:1, with 3:1 being the maximum allowable (see SEMSWA standards for further guidance). When required slopes cannot be met, a retaining wall is required. Retaining walls 4' or more in height will require a building permit from the City Building Division.

Any drop-off of 30" or more within 3' of a traveled way will require railing. If the traveled way is a roadway, guardrail shall be installed. If the traveled way is a sidewalk, path, or trail, handrail shall be installed. Locations of guardrail and handrail shall be noted on CDs with a detail for rail and installation provided.

## 4.4 SIGHT DISTANCE DESIGN

### 4.4.1 STOPPING SIGHT DISTANCE

Sight distance and stopping sight distance shall be in accordance with the requirements detailed in the AASHTO Green Book.

### 4.4.2 INTERSECTION AND DRIVEWAY SIGHT DISTANCES

#### 4.4.2.1 *Sight Triangle*

At the intersection of two streets, sight distance shall be evaluated across a "sight triangle" where obstructions are restricted according to the following criteria. Within the area of the triangle, there must be no wall, fence, sign, foliage, berming, or other structures that will obscure the driver's view of traffic approaching that intersection. For a structure, foliage, or berm to be allowed within the sight distance

## PART II – DESIGN

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triangle, refer to the LDC for guidance (see Figure 12-11-208A of the LDC). Exceptions to this requirement exist for public facilities such as fire hydrants, utility poles, and traffic control devices. These facilities must be located to minimize visual obstruction and are subject to City approval.

To evaluate the sight distances at an intersection, refer to Standard Detail SD-17. The sight distance triangle in this case is formed by the intersection of two lines plotted along a 10' offset of the flowline of the intersecting streets using the lengths specified in the detail. The diagonal connects the other ends of those lines. Where one or the other of the intersecting streets/driveways has no curb, the lines are plotted along the edge of the traveled way.

Other sight distance lines shall be considered and applied in accordance with the recommendations of the AASHTO Green Book. Sight distance of all types shall be considered in all cases, but where concerns arise lines may be required to be depicted on CDs as per the direction of Public Works.

### 4.5 ACCESS MANAGEMENT AND DESIGN

#### 4.5.1 GENERAL

Access to City roadways is managed in accordance with the Street Access Code. The City must approve the design, number, and location of access points when the use of any property or its access operation is changed. The number of access points must be kept to a minimum. No access points will be approved without a site plan and CDs. The following information is presented as general guidelines for the location of access points to the public street system. If there is any conflict between these guidelines and the Street Access Code, the more stringent provision shall apply.

- A. Access Points: Access Points will not be approved for parking or loading areas that require backing maneuvers in a public street ROW except for single family or duplex residential uses on local-residential streets.
- B. Provision of Access: If a property has frontage on more than one street, access will be permitted to the lower classification of roadway or only on those street frontages where standards contained herein and within the LDC can be met. If a property cannot be served by any access point meeting these standards, the City will approve one or more access point(s) based on traffic safety, operational needs, and conformance to as many of the requirements of these guidelines as possible.
- C. Restriction of Turning Movements: Where necessary for the safe and efficient movement of traffic, the City may require access points to provide only limited turning movements. The restriction of turning movements will not affect the number and location of access points as specified elsewhere.
- D. Number of Access Points: Generally, one access point per property ownership will be permitted, unless a TIS approved by the City shows that additional access points are required to adequately handle driveway volumes, will not be detrimental to traffic flow on adjacent public streets, and is approved by the City Traffic Engineer. Temporary access may be granted to undeveloped property

## PART II – DESIGN

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before development of a final site plan if access is needed for construction or preliminary site access. Temporary accesses are subject to removal, relocation, or redesign after final site plan approval and require a ROW permit before installation or use.

- E. Joint Access: Joint access shared by adjacent properties is encouraged. Joint access must be considered for two adjacent developments where a proposed new access will not meet the spacing requirement set forth in Section 4.1.
- F. Abandoned Accesses: Existing driveways, even if not in use, must not be relocated, altered, or reconstructed without approval from the City.
- G. Spacing and Width: Access spacing and width standards are described in Section 4.1. Each access should be separated by a minimum distance equal to the design sight distance values. Where accesses are in closer proximity than the distances shown, joint access must be considered. Access spacing on State highways is subject to the provisions of Section 4 of the CDOT *State Highway Access Code*.
- H. Alignment: A new or relocated access shall align with an access on the opposite side of the roadway. Where lots are not large enough to allow accesses on opposite sides of the street to be aligned, the center of driveways not in alignment will normally be offset a minimum of 150' on all collector and commercial/multi-family local streets; 300' on all arterials. Greater distances may be required as determined by left turn storage lanes. Minimum sight distance must be provided at all access points as described in Section 4.4, which applies to both public street and private access intersections. Access locations must intersect a public street at 90° or as close to 90° as topography permits (no less than 80°).
- I. Access Classification: The access classification should be determined by using the *City of Centennial Transportation Plan* roadway designations and then determining the corresponding access classifications or by contacting the Public Works Department.

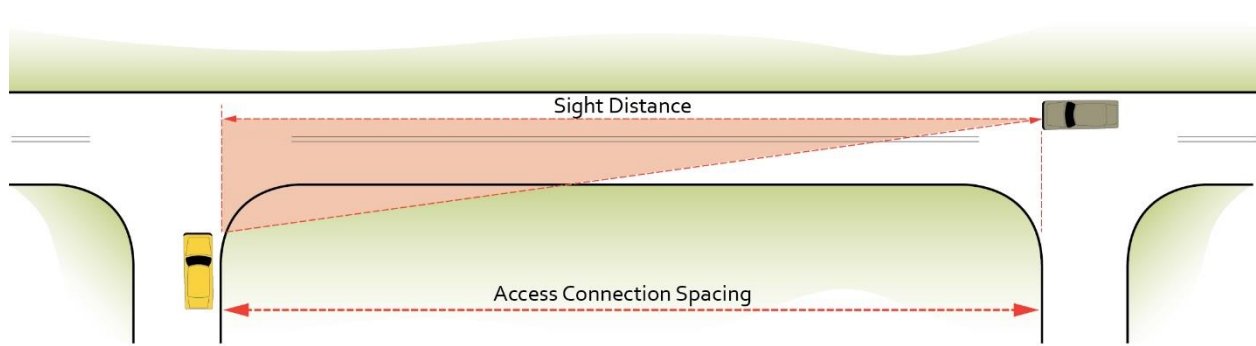


## PART II – DESIGN

**Table 9: Design Sight Distance for Access Spacing\***

Design Speed (MPH)	30	35	40	45	50	55	60
Design sight distance (in feet)	150	200	250	325	400	475	550
Minimum sight distance (in feet)	150	200	225	275	325	400	450

\*Measured from extended flow line



### 4.5.2 CRITERIA FOR SPEED CHANGE LANES

For City streets, speed change lanes may be required according to the following unless a variance is obtained from the City waiving these provisions. The City Traffic Engineer shall review the TIS and make the final determination for speed change lane need in all cases below.

#### 4.5.2.1 Deceleration Lanes for Right Turning Vehicles

A right turn deceleration lane may be required when any one or more of the following criteria is met:

- A. When the access volumes meet or exceed 25 peak hour trips for roadways with speeds of 25 to 40 MPH or 20 peak hour trips for roadways with speeds in excess of 40 MPH.
- B. Where the peak hour volume of the right turn into the access is more than 5 and the outside lane peak hour volume exceeds 250 on 45 to 55 MPH roadways, 450 on 35 to 40 MPH roadways, or 600 on a 25 to 30 MPH roadway a right turn deceleration lane may be required due to high traffic volumes or other unique site-specific safety considerations. The TIS should discuss this, and the City Traffic Engineer will determine final requirements.
- C. Where an access will be frequented by large trucks, a right turn deceleration lane may be required to avoid frequent slowing of traffic. The TIS should discuss this, and the City Traffic Engineer will determine final requirements.

#### 4.5.2.2 Acceleration Lanes for Right Turning Vehicles

A right turn acceleration lane may be required when any one or more of the following criteria is met:

- A. The City may require a right turn acceleration lane for any access where a high traffic volume on the roadway and lack of gaps in traffic makes use of acceleration necessary for vehicles to enter

## PART II – DESIGN

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the roadway traffic flow through the use of merging techniques. This should be discussed in the TIS and final requirements will be determined by the City Traffic Engineer.

- B. A right turn acceleration lane will not normally be required when the posted speed is less than 40 MPH. The City may require an acceleration lane where necessary for public safety and traffic operations based on site-specific conditions. The City Traffic Engineer will determine this requirement.
- C. Where the peak hour volume of the right turn movement out of the access is less than 15 for roadways with speeds of 45 MPH and above or less than 30 for roadways with speeds of 40 MPH, an acceleration lane may not be required unless specifically necessary due to safety considerations. The City Traffic Engineer will determine this requirement.

### 4.5.2.3 *Deceleration Lanes for Left Turning Vehicles*

A left turn deceleration lane may be required when the following is met:

- A. The need for and use of a left turn deceleration lane is site specific. Factors such as highway speed, access volume, nearby access, existing highway auxiliary lanes, traffic control devices, available stopping sight distance, and other topographic and highway design factors are very influential. The TIS should discuss this, and the City Traffic Engineer will determine the final requirements.

### 4.5.2.4 *Acceleration Lanes for Left Turning Vehicles*

A left turn acceleration lane may be required when any one or more of the following criteria is met:

- A. The need for and use of a left turn acceleration lane is site specific. Factors such as highway speed, access volume, nearby access, existing highway auxiliary lanes, traffic control devices, available stopping sight distance, and other topographic and highway design factors are influential. A left turn acceleration lane may be required if the City determines that the lane would benefit roadway safety and operation. The City Traffic Engineer will determine this requirement.
- B. Left turn acceleration lanes may not be required when (1) the posted speed is below 40 MPH unless required for public safety by the City Traffic Engineer, (2) the intersection is signalized, or (3) the acceleration lane would interfere with left turn ingress movement to any other access.

### 4.5.2.5 *General Speed Change Lane Criteria*

- A. Speed change lanes shall be included on public roadways if the access will have a large percentage of vehicles exceeding 30,000 lbs. gross vehicle weight. Speed change lanes are required in the interests of public safety. Refer to the *AASHTO* Green Book for additional design criteria per roadway classification.
- B. When high left turning volumes, safety, or traffic operations necessitate, the City may require double left turn design.
- C. If the design of an access is within two different speed zones, the criteria for the higher speed zone will apply.

## PART II – DESIGN

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- D. Speed change lanes are required if the specific site conditions pose traffic safety concerns.
- E. Where there are three or more through lanes in the direction of travel, the requirement for right turn acceleration and deceleration lanes may be dropped. Each case will be reviewed independently, and a decision made based on site specific conditions. Generally, turn lanes will be required only for a high-volume access or where a specific geometric safety problem exists.
- F. When calculating the roadway single lane design hour volume, it will be assumed that all lanes have equal volumes.
- G. On City arterial streets, accesses will generally require provision of speed change lanes. On collector/commercial local streets, requirement of right turn speed change lanes will be determined on a case-by-case basis. Left turn speed change lanes must be provided on all City streets as required herein.

### 4.5.3 DESIGN OF MEDIAN ISLANDS

The AASHTO Green Book provides design criteria for median islands. Acceleration and deceleration lanes may be required to be incorporated into the design. See Section 4.5.2 for additional requirements on acceleration and deceleration lanes. Islands to be owned and maintained by the City must be provided with vertical curb and cover material per Standard Detail SD-10. Landscaped medians may be permissible if documentation designating the entity to maintain the medians is provided, considered sufficient, and approved by the City.

Additional ROW or easements may be required to accommodate median design. The ends of the islands should typically be provided with 2' flowline radii, minimum. Where conditions do not permit installation of islands on accesses to restrict left turn movements, the City may permit installation of a center median on the adjacent street as an alternative.

Roadway medians shall comply with the widths in Table 1 through Table 3 for each roadway classification. For additional roadway median details see applicable chapters in the AASHTO Green Book.

### 4.5.4 DESIGN OF RADII AND WIDTHS

Generally, all new private property accesses will be designed as drive cuts or with curb returns as noted in Table 10. Residential driveways shall be designed as illustrated in the Standard Details and comply with the most recent ADA standards. All radii are quoted in feet as measured along the flowline or edge of pavement where no flowline exists. These standards apply to accesses on State highways and City streets.

**Table 10: Curb Radii Access Design**

Road Classification	Single Family/Duplex	Commercial/Office/ Multi-Family	Industrial
<b>Residential Local</b>	Driveway <sup>1</sup>	Driveway or 15' Radius	Driveway or 30' Radius
<b>Commercial Local/ Multi-Family/Minor Collector</b>	N/A	20' Radius <sup>3</sup>	30' Radius <sup>3</sup>
<b>Major Collector</b>	N/A <sup>2</sup>	25' Radius <sup>3</sup>	30' Radius <sup>3</sup>
<b>Arterial</b>	N/A <sup>2</sup>	30' Radius <sup>3</sup>	30' Radius <sup>3</sup>
<b>Notes:</b> 1. Mountable curb is required. 2. New single family/duplex accesses shall be to a local-residential public or private streets only. 3. Curb return radii are required on arterial and collector streets unless site constraints prevent their use.			

### 4.5.5 VEHICLE STORAGE

When a development is located adjacent to a public street, the parking facility must have full internal vehicular circulation and storage. Vehicular circulation must be located completely within the property, and vehicles within one portion of the development must have access to all other portions without using the adjacent street system.

Where a proposed development includes a truck loading operation and has access to a public street, adequate space must be provided such that all truck maneuvering and storage/parking is performed off street.

Adequate reservoir capacity must be provided for both inbound and outbound vehicles to facilitate the safe and efficient movement between the street and the development. Inbound vehicle storage areas must be of sufficient size to ensure that vehicles will not obstruct the adjacent street, sidewalk, or circulation within the facility. Outbound vehicle storage areas must be provided to eliminate backup and delay of vehicles within the development.

The following requirements for vehicle storage in parking lots and at drive-up type facilities are based on a typical vehicle length of 20'.

#### 4.5.5.1 For Accesses Serving Off-Street Parking Lots

Recommended distances from the flowline of the street to the first parking stall or aisle for a parking lot design are presented in the LDC and were developed by the City to provide a storage area for outbound vehicles exiting a parking lot. Vehicle storage equivalent to the distances shown in the LDC must be provided at accesses serving the site. The recommended vehicle storage area needed for the entire site may be distributed, proportional to anticipated driver desire and/or among several accesses if more than

## PART II – DESIGN

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one access serves the site. The recommended distance may be further adjusted by the City for accesses with two approach lanes and will be subject to findings in the TIS, roadway geometry, traffic volumes, and site layout.

### 4.5.5.2 *For Various Commercial Uses*

The LDC summarizes the vehicle storage area that must be provided for various commercial uses. These storage areas must be:

1. Based on a vehicle spacing of 12' by 20';
2. Separated from normal parking circulation aisles; and
3. Designed using the appropriate design vehicle turning template.

## 4.6 BICYCLE FACILITIES

All roadways, except those where cyclists are legally prohibited, should be designed and constructed under the assumption that they will be used by cyclists. Therefore, bicycles should be considered in all phases of transportation planning, new roadway design, roadway reconstruction, capacity improvement, and transit projects.

Research continues to provide additional criteria for the design of appropriate bicycle facilities. The selection of a bicycle facility may depend on many factors, including vehicular and bicycle traffic characteristics, adjacent land use, and expected growth patterns. The National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide should be used for general guidance in the design of bicycle facilities. Signs, signals, and pavement markings for bicycle facilities presented in the *MUTCD* should be used in conjunction with the *Guide for the Development of Bicycle Facilities*, by AASHTO, as amended, where an urban design guide may not apply. General striping details can be found in the City Standard Details.

## 4.7 TRAFFIC CONTROL DEVICES

### 4.7.1 GENERAL

#### 4.7.1.1 *Definition*

Traffic control devices shall be defined as documented by Federal Highway Administration (FHWA) in the *MUTCD*. In general, traffic control devices include all signs, object markers, delineators, pavement markings, traffic signals, and other devices that are used to regulate, warn, or guide traffic.

#### 4.7.1.2 *Traffic Control Devices on Public Property*

Unless specifically advised in writing to the contrary, the Developer will install all permanently fixed traffic control devices within a new development at the Developer's expense. The City Traffic Engineer must approve the installation of the traffic control devices, which shall be in conformance with Part III of this Manual.

#### 4.7.1.3 *Traffic Control Devices on Private Property*

The property owner shall install and maintain all traffic control devices on private property.

## PART II – DESIGN

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### 4.7.1.4 *Plan Submittal Requirements*

A traffic design plan that specifies the proposed location, configuration, and type of all proposed traffic control devices shall be submitted to the City with the CDs. The traffic design plan must be on its own sheet(s).

## 4.7.2 TRAFFIC SIGNING AND MARKINGS

### 4.7.2.1 *General Requirement*

The design, placement, size, operation, and uniformity of all traffic signing and markings shall be in conformance with the *MUTCD* and the supplemental *Standard Highway Signs and Pavement Markings* publication by the FHWA.

### 4.7.2.2 *Signs*

The placement and mounting height of all traffic signs shall conform to the City Standard Details. All sign supports and materials shall conform to the Standard Details. The City shall approve the layout for any non-standard (custom) regulatory, warning, or guide signs within public ROW.

### 4.7.2.3 *Markings*

All pavement marking lines, words, and symbols (i.e., color, width, spacing, dimensions and typical layouts) shall conform to the Standard Details and CDOT Standard Plans.

All pavement marking materials shall conform to the latest City specifications.

## 4.7.3 TRAFFIC SIGNALS

### 4.7.3.1 *General Standard*

The design, placement, operation, and uniformity of all traffic signals shall be in conformance with the *MUTCD*.

All traffic signal poles, foundations, heads, controllers, cabinets, detectors, conductors/cables (wiring), conduit, pull boxes and other associated equipment shall conform with the latest City standards and specifications.

### 4.7.3.2 *Signal Poles*

Traffic signal poles with mast arms shall be provided for all new traffic signal installations unless specifically directed otherwise in writing by the City. Traffic signal poles shall conform with the latest City standards and specifications and the latest AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*.

The length of a traffic signal mast arm, at a minimum, shall extend to the center of the leftmost turn lane. The desirable arm length should extend at least 3' beyond the center of the leftmost turn lane.

All new traffic signal poles shall include a luminaire extension arm for roadway lighting per City specifications.

## PART II – DESIGN

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### 4.7.3.3 *Signal Pole and Controller Cabinet Placement*

All traffic signal poles, pedestal poles, and controller cabinets shall be placed as follows:

- A minimum of 3' from the face of curb (if present) to the face of the pole or controller, with a minimum desirable separation of 5'.
- For roads with shoulders and no curbing, poles and cabinets shall be offset with the same minimum separations as curbing but measured from the outside edge of shoulder.
- For roads where only pavement exists without shoulder or curbing, poles and cabinets shall be offset a minimum of 5' from the edge of pavement, with a desirable minimum separation of 7'.

Cabinets shall be placed in a location that avoids any potential line-of-sight conflicts with turning traffic or pedestrians.

Traffic signal poles and cabinets shall not impede pedestrian movements at curb ramps or sidewalk areas.

### 4.7.3.4 *Signal Heads*

Vehicular signal heads shall be provided as follows:

- One signal head shall be centered over each exclusive through lane.
- Signal heads for left turn lanes (with arrow indications) shall be provided as follows:
  - Single Turn Lane – One head shall be centered over the turn lane with a supplemental signal head mounted on the side of the far-left signal pole.
  - Dual Turn Lanes – One head shall be centered over each turn lane. A supplemental signal head shall also be mounted on the side of the far-left signal pole.
- Supplemental signal heads shall be mounted on the side of the pole for each approach, on both the far-left and far-right signal poles.
- The City will determine the need for signal heads for an exclusive right turn lane on a site-specific basis.

In all cases, vehicular signal heads shall have 12-inch diameter indications with tunnel type visors. All overhead signal heads shall have back plates with retroreflective tape per City specifications.

All signal heads shall be mounted vertically.

Pedestrian signal heads shall be provided for all pedestrian crossings at signalized intersections unless specified otherwise by the City. All pedestrian signal heads shall be located within the line-of-sight for crossing pedestrians. Push button detectors, with *MUTCD* standard instructional sign panels, shall also be provided for all protected crossings. Push buttons shall be located per *MUTCD* requirements and shall meet ADA standards for height and horizontal reach. Exclusive pedestrian push button poles shall be provided as necessary.

## PART II – DESIGN

---

All new pedestrian signal indications shall have symbols with countdown type displays. All new pedestrian pushbuttons shall be of the accessible pedestrian signals (APS) type.

### 4.7.3.5 *Vehicle Detection and Signal Preemption*

Vehicle stop line detection shall be provided, per City specifications, for all approaches to the intersection.

Signal preemption detectors shall be provided for emergency vehicle detection for all approaches to the intersection when specified by the City Traffic Engineer, in conjunction with the appropriate fire district.

### 4.7.3.6 *Requirements for Future Traffic Signals*

Any intersection that the City identifies as requiring traffic signalization in the future and that will be modified or constructed as part of a private development or roadway construction project shall include traffic signal conduit with pull boxes and locate wires in conformance with City specifications unless otherwise directed by the City Traffic Engineer. The City shall approve the design for the placement of signal conduit and pull boxes, and this design shall consider future locations of signal poles and associated foundations to avoid conflicts.

## 4.8 LIGHTING AND UTILITIES

### 4.8.1 GENERAL

The provisions of this section apply to City streets by roadway classification.

#### 4.8.1.1 *Street Lighting*

##### *A. Installation of Street Lighting*

At signalized intersections, a minimum of one light pole is required. Additional lighting may be required by the Director of Public Works or City Traffic Engineer based upon the classification of the intersecting roadways and the corresponding traffic and pedestrian volumes, and other factors.

Lighting requirements at unsignalized intersections shall be determined by the Director or City Traffic Engineer.

##### *B. Installation Procedures*

Proposed street lighting along all public ROW must be coordinated with the City and electric provider. The Developer must pay for all costs for new street lighting on public streets when installed for a new development.

##### *C. Design*

Street lighting design elements are shown in the Standard Details. For more information on street lighting also refer to Division 6-7 of the LDC entitled Exterior Lighting Standards.



## PART II – DESIGN

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### 4.8.1.2 *Breakaway Structures and Lateral Clearances*

City approval of the location structures will be placed in the ROW must be received prior to placement. The approved placement location must be in accordance with the Standard Details for the roadway classification to avoid current or future placement of sidewalk.

A. Breakaway Structures. All fixed utility objects installed in the ROW, such as street light poles, fire hydrants, utility cabinets, and telephone junction boxes, shall be of the breakaway type meeting the latest AASHTO construction specifications. It is recommended that satisfactory dynamic performance for breakaway objects be evaluated in accordance with AASHTO specifications. All breakaway structures shall be placed as "far as practical" from the edge of the traveled roadway.

B. Non-Breakaway Structures. This section applies when breakaway type construction cannot be provided.

1. Arterial and Collector Roadways. On arterial and collector roadways a minimum horizontal clearance of 10' should be provided between the flowline of the street (or the edge of the paved traveled way) and any new or relocated non-breakaway structure in excess of 4" in height. If sufficient ROW is not available for the 10' clear zone, all installations are encouraged to be placed "as far as practical" from the edge of the traveled way. The policy is also intended to provide minimum suggested guidelines for the purpose of protecting the public health, safety, and welfare.

2. City Streets. On local City streets, the provision of a 5' horizontal clearance is the recommended minimum between the flowline of the street (or the edge of the paved traveled way) and any new or relocated non-breakaway structures.

C. Utility Cabinets Placement on Residential Streets. On residential streets, utility cabinets should be placed along the rear or side-yard of any residence and not within ten feet (10') of any marked driveway. Contractors must contact adjacent residential landowners prior to the placement of any utility cabinets to ensure that rear or side yard access is not restricted by the placement of the proposed cabinet. Contractors must submit records of communications with adjacent residential landowners, concerning the placement of the utility cabinet, to the City at the time of requesting a ROW permit.

### 4.8.1.3 *Utility Easements*

When available ROW is limited, utility providers may require additional easements for installation. This shall be coordinated with the City, Developer, and applicable utility provider(s). Easement requirements will be discussed on a case-by-case basis due to variations by provider, utility type and size, and available ROW. When possible, shared easements should be used.

### 4.8.1.4 *Undergrounding of New and Existing Utilities*

Except for electric transmission lines, the City requires the installation of underground utilities for initial installation of new utilities and, when funds are available, facilitates the replacement and relocation underground of existing above ground utilities. It is the policy of the City to promote a reduction in the

## PART II – DESIGN

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number of utility poles during the replacement, relocation, upgrade, or maintenance of existing overhead utilities.

### *4.8.1.5 Utility Markers*

Except for high pressure gas lines, underground utilities may not be marked using above ground pole markers. Detectable underground marker systems, such as the 3M™ EMS XR/iD Ball Markers or warning tape, must be used in place of above ground pole markers. All underground marker systems must meet the minimum APWA requirements for detection related to the intended tape burial depth. If detectable tape or marker balls will not be used, Contractor or permittee must identify the type of marker system to be employed to identify underground utilities and receive written approval from the Director.

### *4.8.1.6 Alignment and Depth of Utilities*

#### *A. Utility Alignment*

1. The placement of utility lines and other facilities within landscaped median areas is discouraged unless no other reasonable location is available, or such facilities are used to connect to equipment placed in the median.
2. The utility alignment shall not vary greater than eighteen inches (18") plus ½ of the diameter of the proposed conduit from the approved design vertical alignment without prior approval of the City.

#### *B. Depth of Utilities*

Generally, the minimum allowable depth of utilities shall be as follows:

1. Street Lights – 18"
2. Gas – 36"
3. Telephone – 36"
4. Electric Power – 36"
5. Sanitary Sewer – 60"
6. Cable – 36"
7. Water – 54"
8. Fiber Optic – 36" unless microtrenching is permitted as described below

These requirements may vary based on site conditions and the requirements of individual utility providers.

## PART II – DESIGN

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### *C. Microtrenching*

Microtrenching is allowed by the City for installation of fiber optic cable in certain circumstances and on certain roadways within the City. The following must be met for microtrenching to be allowed:

1. The location for microtrenching is in a local street or minor collector.
2. The microtrench must be placed a minimum of 2 feet from the edge of asphalt and 2 feet away from any other microtrenched utility already in the roadway.
3. The cable must be installed to a minimum depth of:
  - i. 12-16 inches under an asphalt surface;
  - ii. 16 inches under a concrete surface.
4. The depth of the microtrench should be consistent along the installation including all installation elements, i.e., conduits, pea gravel or sand backfill, Corbel Trench Fill, and sealant.
5. Pea gravel shall separate the conduit and trench backfill and shall not exceed 2 inches in depth.
6. A flowable fill will be used as the trench backfill material, ex. Corbel Trench Fill. Contractor must identify the type of flowable fill to be used in execution of microtrenching.
7. The trench must be sealed with Sterling Lloyd sealant or equivalent sealant meeting APWA standards at a minimum of 1/8 inch in depth for the entire width of the trench. Contractor must identify the type of sealant to be used in execution of microtrenching.
8. Contractor and Permittee agree to repair the failure of any element of its microtrench after installation.

## PART II – DESIGN

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### 4.8.1.7 *Utility Providers and Districts*

#### **SANITARY AND WATER PROVIDERS**

Arapahoe County Water & Wastewater Authority  
Arapahoe Estates Water District  
Aurora Water  
Castlewood Water District  
Castlewood Water & Sanitation District A  
Castlewood Water & Sanitation District E  
City of Littleton Water District  
Denver Water  
East Cherry Creek Valley Water District  
East Cherry Creek Valley Water & Sanitation District  
East Valley Water & Sanitation District  
Havana Water & Sanitation District  
Inverness Sanitation District  
Inverness Water & Sanitation District  
South Arapahoe Sanitation District  
South Englewood Sanitation District No. 1A  
Southeast Englewood Water District  
Southgate Water & Sanitation District  
Willows Water District (Master Meter)

Willows Water District (Read & Bill)

#### **FIRE RESCUE DISTRICTS**

South Metro Fire Rescue Authority

#### **STORMWATER AUTHORITIES**

Southeast Metro Stormwater Authority (SEMSWA)  
Cherry Creek Basin Water Quality Authority  
Mile High Flood District

#### **DRY UTILITY PROVIDERS**

Lumen  
CORE Electric Cooperative  
Xcel Energy  
Comcast  
Utility Notification Center of Colorado  
Zayo  
Ting

### **SECTION 5.0 PAVEMENT DESIGN**

#### **5.1 GENERAL**

This section provides the basic criteria and design procedures for roadway pavements. Recommended design methodologies for asphalt and Portland cement concrete are addressed and essentially follow the Metropolitan Governments Pavement Engineers Council (MGPEC) “Pavement Design Standards and Construction Specifications” manual (the most recent revision), hereafter called MGPEC Standards.

The MGPEC Standards apply to all roadway-related public improvements including, but not limited to, new roadways, auxiliary lanes, curb and gutter, sidewalks, and medians. Any construction of roadway improvements shall require a pavement design report(s) and include all detail described in the MGPEC Standards and ROW Regulations.

In an effort to ensure the integrity of all pavement sections, auxiliary lanes shall be designed using the same parameters as adjacent through lanes. Regardless of the results of the pavement design report, a minimum depth of 6” for asphalt and 8” for Portland cement concrete shall be used to construct all public roadways.

#### **5.2 PAVEMENT DESIGN REPORT SUBMITTAL REQUIREMENTS**

Reports for pavement design (includes preliminary design, design confirmation, and final design) shall be prepared per the requirements detailed in the MGPEC Standards and should be submitted along with the ROW permit application. The final pavement design report may be completed after City approval of the associated CDs but prior to or concurrent with issuance of ROW permits.

#### **5.3 FIELD INVESTIGATION**

##### **5.3.1 PRELIMINARY DESIGN AND FINAL DESIGN REPORTS**

Field investigation for the preliminary and final design reports shall conform to MGPEC Standards.

##### **5.3.2 DESIGN CONFIRMATION REPORT**

To confirm the assumptions made in the preliminary design report, the design confirmation report shall conform to the field investigation requirements set forth in the MGPEC Standards.

#### **5.4 LABORATORY TESTING**

##### **5.4.1 PRELIMINARY DESIGN REPORT AND FINAL DESIGN REPORT**

###### **5.4.1.1 Soil Classification, Swell Tests, and Strength Tests**

Soil classification, swell tests, and strength tests shall be prepared per MGPEC Standards.

##### **5.4.2 DESIGN CONFIRMATION REPORT**

Laboratory testing requirements are detailed in the MGPEC Standards for a design confirmation report.

## **PART II – DESIGN**

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### **5.5 DESIGN REQUIREMENTS**

The design, costs, and maintenance recommendations shall conform to requirements of MGPEC Standards.

### **5.6 REPORT REQUIREMENTS**

#### **5.6.1 REPORTS**

The preliminary, design confirmation and final design reports shall include all requirements set forth in the MGPEC Standards.

#### **5.6.2 PRIVATE STREETS**

Life cycle cost analysis shall be completed per MGPEC Standards for all private streets that will be owned and maintained in common ownership.

**PART III**  
**CONSTRUCTION AND INSPECTION**

### TABLE OF CONTENTS

	<u>Page</u>
<b>SECTION 6.0 CONSTRUCTION PROCEDURES AND PRACTICES .....</b>	<b>III-1</b>
6.1 GENERAL .....	III-1
6.2 DEMOLITION .....	III-1
6.2.1 Demolition General .....	III-1
6.2.2 Local Laws, Ordinances and Code .....	III-1
6.2.3 Protection of Public, Onsite and Project Adjacent Improvements.....	III-1
6.2.4 Disconnection of Existing Utilities .....	III-2
6.2.5 Equipment Operated On Streets.....	III-2
6.2.6 Protection of Survey Monuments .....	III-2
6.2.7 Fences .....	III-2
6.2.8 Trees and Shrubs .....	III-2
6.2.9 Cesspools, Privies, Buried Fuel, and Septic Tanks .....	III-3
6.2.10 Wells.....	III-3
6.2.11 Buildings .....	III-3
6.2.12 Slabs On Grade .....	III-3
6.2.13 Walls.....	III-3
6.2.14 Salvage .....	III-3
6.2.15 Filling and Grading .....	III-3
6.2.16 Topsoil .....	III-3
6.3 HOUSEKEEPING, RESTORATION, AND CLEANUP.....	III-4
6.3.1 Surplus Excavation .....	III-4
6.3.2 Concrete Curb, Gutter, Valley Gutter, and Sidewalk.....	III-4
6.3.3 Surface Restoration .....	III-4
6.4 SOILS AND EARTHWORK.....	III-5
6.4.1 Excavation, Embankment, and Compaction.....	III-5
6.4.2 Utility Trenching, Backfill, and Bedding.....	III-5
6.5 PAVEMENT .....	III-6
6.5.1 General.....	III-6
6.5.2 Procedure for Material Source Approval .....	III-6



## **PART III – CONSTRUCTION AND INSPECTION**

---

6.5.3	Violations of Approval Conditions.....	III-7
6.5.4	Material Specifications.....	III-7
6.5.5	Use of Materials not Listed in Section 6.5.4.....	III-9
6.6	TRAFFIC CONTROL .....	III-9
6.6.1	Traffic Control Devices .....	III-9
6.6.2	After-Hours Traffic Controls .....	III-9
6.6.3	Damage to Permanent Traffic Control .....	III-9
6.6.4	Specific Requirements.....	III-9
6.6.5	Flagpersons .....	III-10
6.7	TRAFFIC SIGNAGE AND PAVEMENT MARKINGS .....	III-11
6.7.1	General.....	III-11
6.7.2	Traffic Control Devices on Public Property.....	III-11
6.7.3	Traffic Control Devices on Private Property .....	III-11
6.7.4	Pavement Markings .....	III-11
<b>SECTION 7.0 INSPECTION AND TESTING .....</b>		<b>III-12</b>
7.1	QUALITY CONTROL/QUALITY ASSURANCE .....	III-12
7.2	CONSTRUCTION INSPECTION.....	III-12
7.3	CONSTRUCTION TESTING.....	III-12
<b>SECTION 8.0 ACCEPTANCE PROCEDURES AND REQUIREMENTS.....</b>		<b>III-13</b>
8.1	ACCEPTANCE AND WARRANTIES .....	III-13
8.2	RECORD DRAWINGS .....	III-13
8.2.1	Requirements for Construction As-Built Plans .....	III-13

## **PART III – CONSTRUCTION AND INSPECTION**

---

### **SECTION 6.0 CONSTRUCTION PROCEDURES AND PRACTICES**

#### **6.1 GENERAL**

The information contained within this part of the Manual is intended to supplement the construction requirements found within the City's ROW Regulations. Refer to the ROW Regulations for permitting procedures.

#### **6.2 DEMOLITION**

##### **6.2.1 DEMOLITION GENERAL**

This section contains standards for site (horizontal) demolition. Building and structure demolition requirements are addressed in the City of Centennial Municipal Code or by the City Building Division and will require a separate permit.

Work will often include demolition and removal from the site of all designated slabs on grade, retaining walls, steps, asphalt, rubbish, stumps, trees, shrubs, fencing, buried tanks, pipe, etc. Any depressed areas resulting from removals are to be filled and graded to drain. All items produced by demolition, unless otherwise specified by the City, shall become the property of the Contractor and will be the Contractor's responsibility to remove and dispose of in a responsible and safe manner, including construction debris tracked on ROW. These specifications shall apply to all new construction within the City.

##### **6.2.2 LOCAL LAWS, ORDINANCES AND CODE**

Any Contractor or subcontractor shall be licensed with and bonded with the City before beginning any work within the City and shall comply with all current federal, state, and local laws, codes, and ordinances pertaining to demolition, wrecking, clearing, and grubbing operations.

##### **6.2.3 PROTECTION OF PUBLIC, ONSITE AND PROJECT ADJACENT IMPROVEMENTS**

The Contractor is solely responsible for protecting all existing Public Improvements including, but not limited to, fire hydrants, street lights, traffic signals, traffic signs, pavement markings, other traffic control devices, catch basins, manholes, valves, survey monuments, overhead utility lines and poles, and any existing underground irrigation or utility lines that may be damaged during the execution of the project. It will be the Contractor's responsibility to replace all damaged Public Improvements at the Contractor's expense. Existing manhole rings and covers, valve boxes, and sprinkler heads found defective as a result of the Contractor's work shall be replaced, as directed by the City inspector and/or utility owner inspector, when applicable.

The Contractor shall take proper precautions for the protection of and replacement or restoration of driveway culverts, street intersection culverts or aprons, storm drains or inlets, fences, irrigation ditch crossings and diversion boxes, mailboxes, shrubbery, flowers, trees, driveway approaches, and all other public or private property that may be encountered during the performance of work. The Contractor shall provide each property with access at all times during construction, unless closing such access during construction is authorized by the City in writing. Existing driveways shall be cut, filled, and graded as

## **PART III – CONSTRUCTION AND INSPECTION**

---

required or as directed by the City inspector to provide permanent access. Existing driveways shall be resurfaced with the then existing type of surfacing, whenever surfaces are destroyed.

### **6.2.4 DISCONNECTION OF EXISTING UTILITIES**

Before starting demolition of any structure, the Contractor shall arrange for the disconnection of all utility service connections, such as water, sewer, cable TV, telephone, gas, fiber optic, and electrical power connected thereto. Disconnects shall be made in accordance with the regulations of the utility that controls the supply of service involved.

Underground services are to be cut, capped, and marked (per the utility provider's specifications) at the point of disconnect to facilitate future location of the line. Above ground marking of the utility service point of termination shall also follow the utility provider's specifications.

It shall be the responsibility of the Contractor to backfill all holes to finish grade and install concrete or asphalt surfacing when the holes excavated are in streets or paved areas. The Contractor shall correct any unsatisfactory disconnects at the discretion of City and/or utility owner inspectors.

### **6.2.5 EQUIPMENT OPERATED ON STREETS**

The Contractor shall be permitted to operate only pneumatic-tired equipment over any paved surface and shall be responsible for any damage to street surface resulting from Contractor's operations. Generally, contact of heavy equipment with paved surfaces to remain should be avoided whenever feasible. When unavoidable, the Contractor shall contact the City to investigate the existing condition of Public Improvements and avoid excessive repairs when the project is complete.

### **6.2.6 PROTECTION OF SURVEY MONUMENTS**

Before starting demolition or construction, any public survey monument or range box that may be disturbed during construction shall be referenced to a minimum of two points outside the limits of construction by a Colorado Professional Land Surveyor. Any public survey monument or range box disturbed as a result of construction shall be replaced by a Colorado Professional Land Surveyor as required by law.

### **6.2.7 FENCES**

Where existing fences are to be removed, they shall be replaced with the same or higher quality fencing in locations agreed upon by the City and/or property owner.

### **6.2.8 TREES AND SHRUBS**

Trees not impeding demolition of structures or performance of the work will not be removed except as designated. Trees and shrubbery designated for removal will include stumps and roots to a minimum depth of 3' below existing or finished grade, whichever is lower. Downed trees, brush, and rubble shall be removed from the site.

Trees scheduled to remain shall be carefully protected from damage during performance of the work, with limits of tree protection to be at the drip line. Protection measures should be in place before any demolition or site work begins. Any damage due to the Contractor's operations shall be repaired by

## **PART III – CONSTRUCTION AND INSPECTION**

---

suitable tree surgery methods or replaced to City and/or property owner satisfaction. Damaged trees shall be repaired or replaced, as approved by the City at the Contractor's expense.

### **6.2.9 CESSPOOLS, PRIVIES, BURIED FUEL, AND SEPTIC TANKS**

Tanks that may exist on project sites shall be completely removed and contaminated soils remediated to the standards and by the methods approved by the State. The Contractor shall fill the void created to finished grade.

### **6.2.10 WELLS**

On-site wells and well casings shall be sealed to prevent contamination of groundwater aquifers in accordance with State regulations. The utility that services the location and the State Engineer shall approve all abandonment activities.

### **6.2.11 BUILDINGS**

Building demolition will require separate permitting from the City Building Division.

### **6.2.12 SLABS ON GRADE**

All concrete and asphalt slabs on grade shall be removed from the site. This shall include, but is not limited to, driveways, sidewalks, curbs, cross pans, gutters, etc. Foundations and floor slabs will require demolition permits from the City Building Division.

### **6.2.13 WALLS**

Retaining walls and their footings shall be removed in their entirety from the site.

### **6.2.14 SALVAGE**

Unless otherwise specified in the special conditions on City projects, all materials, salvageable or otherwise, to be removed from the site are considered as being the property of the Contractor performing the work. Disposal of materials shall be completed in a safe and responsible manner in accordance with State and local laws.

### **6.2.15 FILLING AND GRADING**

Depressions resulting from the removal of structures, basement walls, footings, buried tanks etc., shall be filled and compacted with clean fill materials to eliminate hazards of cave-in, accumulation, and ponding of water. Under no circumstances shall organic building material, broken concrete over 6" in diameter, or asphalt be considered as approved fill material.

Immediately following demolition and removal of rubbish from the site, the Contractor shall grade the entire affected area by filling, compacting, and leveling the site to existing adjacent grades.

### **6.2.16 TOPSOIL**

The Contractor shall reclaim within the project limits, or acquire when needed, loose friable loam reasonably free of admixtures of subsoil, refuse, stumps, rocks, roots, brush, weeds, or other material that would be detrimental to the proper development of vegetative growth for use as topsoil.

## **PART III – CONSTRUCTION AND INSPECTION**

---

Topsoil shall be placed and spread at locations and to the thickness shown on the plans, after the areas to be covered have been properly prepared and grading operations in the area have been completed and accepted. Soil so placed shall be keyed to the underlying subgrade by the use of harrows, rollers, or other equipment suitable for the purpose, followed by applying water in a fine spray by nozzles or spray bars in such a manner and extent that eroding will not occur.

### **6.3 HOUSEKEEPING, RESTORATION, AND CLEANUP**

#### **6.3.1 SURPLUS EXCAVATION**

All surplus excavated material shall be removed from the job site by and to locations provided by the Contractor. The Contractor shall obtain written permission before disposing of excess material on private property. If the disposal site is within the City, a GESC permit may be required by SEMSWA; coordination and permitting shall occur prior to disposal. The City relinquishes all right and title to the surplus material unless otherwise specified in the special conditions on City projects or coordinated with City staff. Excess material shall not be wasted on any public ROW without written permission from the City.

#### **6.3.2 CONCRETE CURB, GUTTER, VALLEY GUTTER, AND SIDEWALK**

The Contractor shall replace, in like kind, all curb and gutter, valley gutter, sidewalk, or other concrete infrastructure that is damaged during construction. The replacement shall be of equal or better quality than found and at the original depth with a minimum concrete thickness of 6" regardless of the original depth. Minimum removal length shall be the entire damaged panel, from existing control joint to existing control joint, or as specified by a City inspector.

#### **6.3.3 SURFACE RESTORATION**

The Contractor must secure and pay for all ROW permits required from the City for the execution of work. The Contractor shall assume full responsibility for the consequences of all street cuts or damage that occurs as a result of work and shall comply with all requirements contained therein by the City ROW Regulations.

The replacement of excavated base course, permanent paving, damaged curb and gutter, etc. shall be done in accordance with the City ROW Regulations and requirements contained in the permits.

The Contractor shall replace damaged driveways in like kind to an equal or better condition than existed prior to construction. All cuts necessary for the replacement of damaged concrete shall be made using a concrete saw.

Drainage and ditch facilities shall be maintained per the standards of SEMSWA and necessary permits shall be obtained from the same.

Unsurfaced Areas: The general grade and condition of all unsurfaced areas shall be restored to nearly as practicable to the grade and condition immediately prior to construction. Topsoil shall be removed, saved, and replaced in cultivated and agricultural areas; and any excess earth shall be removed from the ROW. If topsoil is not saved, the Contractor must import additional topsoil to match existing prior to resurfacing.

## **PART III – CONSTRUCTION AND INSPECTION**

---

All previously grassed areas shall be seeded or sodded per the specifications of SEMSWA, and the Contractor shall be responsible for caring for the grass until its growth is established.

Surfaced Areas: See the City ROW Regulations.

Cleanup: Upon completion of the work, the Contractor shall remove from the job site all rubbish, unused materials, concrete forms, and other like material. At all times during construction, the Contractor shall maintain the site, partially finished structures, material stockpiles, and other like areas in a reasonable state of order and cleanliness and in compliance with City and SEMSWA requirements.

If the Contractor fails to perform the above work in a timely manner, the City may perform the work at the Contractor's expense.

### **6.4 SOILS AND EARTHWORK**

#### **6.4.1 EXCAVATION, EMBANKMENT, AND COMPACTION**

Areas to receive embankment and/or structural backfill material and the top of cut areas shall first be stripped of all vegetation, organic material, asphalt, concrete, and materials unsuitable for use in embankments. Topsoil shall be stockpiled for reuse whenever practical and unsuitable material disposed of. Under no circumstances shall organic building material, broken concrete (greater than 6" diameter) or asphalt be considered as approved embankment material.

Embankment and fill material should conform to the material, moisture, compaction, etc., specifications defined in the *Geotechnical/Pavement Design Report*, as well as the City ROW Regulations. In connection with normal grading operations, the Contractor shall use trucks, tractors, bulldozers, and other pieces of equipment in the most effective manner by routing the equipment over the entire embankment or roadway width. Compaction testing shall be performed as per the City ROW Regulations.

#### **6.4.2 UTILITY TRENCHING, BACKFILL, AND BEDDING**

##### **6.4.2.1 General**

Standards and specifications for utility trenching, backfill, and bedding can be found within the City ROW Regulations with further information available from the utility owner. Trench backfill should be completed as shown in the City Standard Details.

Access to private driveways shall be provided to property owners at all times except during working hours when construction operations prohibit provision of such access. Unobstructed access to fire hydrants must be provided at all times. The Contractor shall notify the property owners at least 48 hours in advance of beginning work or in accordance with ROW easements that set forth ingress/egress requirements, prior to any excavation to be made in City easements through private property.

The Contractor shall take precautions to limit the removal of or damage to existing pavements, sidewalks, curbs, lawns, shrubbery, trees, hedges, walls, fences, buildings, or other existing improvements and shall replace or restore such improvements to their original location and condition after the excavation has been backfilled and compacted.

## **PART III – CONSTRUCTION AND INSPECTION**

---

The Contractor shall be familiar with all specific conditions contained in private easements. The Contractor shall perform all of his work in accordance with the stipulations contained therein.

### **6.4.2.2 Backfilling**

The Contractor shall advise the City of the proposed trench backfill date and obtain necessary ROW permits before commencing work. Typically, backfill will take place on the same day as trenching; if this is not the case, the City must be given prior notice as required in the City ROW Regulations. The bottom of the trench shall be prepared to provide a firm foundation for the pipe or facility in accordance with the bedding conditions specified by the geotechnical engineer or utility owner for the type of pipe or facility to be installed. The subgrade of the trench shall be kept free of standing water. Where the trench subgrade material is found to be unsuitable and does not afford a solid foundation, the Contractor shall excavate to such depth as necessary to construct a stable foundation. A stable foundation shall be constructed by placing crushed rock or other CDOT, utility owner, or City approved granular material under the pipe.

Backfill shall be placed so that the pipe will not be displaced or damaged. Bedding requirements for utilities shall meet the minimum requirements of the utility provider and those included in the City ROW Regulations. For trenching within the limits of the roadway, including areas of pavement, curb, gutter, and sidewalks, trenches shall be backfilled with approved materials immediately after the utility authorized by the permit has been placed in the trench.

For trenching outside the roadway, the subgrade shall conform to the lines, grades, and cross sections as shown on the approved plans. The subgrade shall be compacted in successive layers not to exceed 8" thick and shall be finished and maintained in a smooth compacted condition. The compacted surface shall be free from rutting or other objectionable irregularities.

### **6.4.2.3 Base Course**

Base material shall conform to the lines, grades, cross sections, and thickness shown on the approved plans or geotechnical report and shall be finished and maintained in an acceptable condition at least one day in advance of placing prime coat. For more information on base course requirements, refer to the City ROW Regulations.

## **6.5 PAVEMENT**

### **6.5.1 GENERAL**

The Specifications presented in this section are performance oriented. The City's objective in setting forth these Specifications is to achieve an acceptable quality of roadway structures. All sources for the mined or manufactured materials listed in Section 6.5.4 must be annually approved by the City as having met the appropriate materials performance specifications. This approval is a condition of using those material sources for Public Improvement construction.

### **6.5.2 PROCEDURE FOR MATERIAL SOURCE APPROVAL**

A material supplier for any City Public Improvement must supply written documentation and material test results from a competent material-testing laboratory that describes:

## PART III – CONSTRUCTION AND INSPECTION

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- a. Material(s) being tested to meet City specifications;
- b. The test procedures employed;
- c. The supplier's manufacturing, mining, or treating process by which the tested materials were created;
- d. The material test results; and
- e. A signed statement by the material supplier that the materials produced and tested for this certification are truly representative of the materials to be provided for public improvements in Centennial during the coming 365-day period.

### 6.5.3 VIOLATIONS OF APPROVAL CONDITIONS

#### 6.5.3.1 *Random Testing*

The City may order random tests of materials used in City Right of Way to verify compliance with material specifications.

Any and all material used to construct City Public Improvements that is not from a certified source or that is from a certified source and fails one or more random material tests will be subject to complete removal as a condition of City acceptance of that Public Improvement. The extent of the material to be removed will be at the discretion of the City.

### 6.5.4 MATERIAL SPECIFICATIONS

#### 6.5.4.1 *Hot Mix Asphalt Pavement*

The material shall consist of a mixture of aggregate, filler (if required), and asphalt cement. The aggregate mixture shall meet the grading requirements of the job mix formula, submitted to and approved by the City. Tests on the aggregate for cleanliness, abrasion loss, and fractured faces shall meet the aggregate properties and gradation ranges allowed by the MGPEC Standards.

- a. Aggregates shall not contain clay balls, organic matter, or other deleterious substances.
- b. After the job mix formula is established and approved, all mix furnished for the project shall conform to it within the tolerances allowed per the MGPEC Standards.
- c. Hydrated lime shall be added to aggregate per the requirements of the MGPEC Standards.
- d. A mix design, including the job mix formula, shall be submitted to the City for review and approval a minimum of 14 days prior to placing mix on the project. The mix design shall be performed using the standards and procedures detailed in MGPEC Standards.

#### 6.5.4.2 *Portland Cement Concrete Pavement*

This material shall consist of a mixture of coarse and fine aggregates, Portland cement, water and other materials, or admixtures as required per MGPEC Standards, Appendix Item 11 except as described below.

Concrete shall conform to the following requirements:

Min. 28-day Field Compressive Strength	4200 psi
Min. Cementitious Materials	660 lbs./cu. yd.
Max. Water/Cementitious Ratio	0.44 lbs H <sub>2</sub> O/lbs cement



## PART III – CONSTRUCTION AND INSPECTION

---

Air Content % Range	4–8
Maximum Slump	4"
Min. Fine Aggregate % of total Aggregate	55% AASHTO M 43 size No 357 or No. 467 coarse aggregate by weight

- a. Fine aggregates shall meet MGPEC Standards aggregate properties and gradation requirements.
- b. Coarse aggregates shall meet MGPEC Standards aggregate properties and gradation requirements.
- c. Fly ash properties shall comply with MGPEC Standards.
- d. Water shall comply with MGPEC Standards.
- e. Admixtures shall comply with MGPEC Standards.
- f. Curing materials and method of application shall comply with MGPEC Standards.
- g. Reinforcement materials and method of placement shall comply with MGPEC Standards.
- h. Minimum laboratory trial mix strength shall comply with the MGPEC Standards. Per section, the lab trial mix design strength still needs to meet 5,000 psi, but the minimum 1,000 psi over-design requirement can be decreased to 800 psi to still meet 5,000 psi due to the City required strength of 4,200 (i.e., City strength of 4,200 + 800 = 5,000 and still meets that requirement in MGPEC Standards).

### 6.5.4.3 *Aggregate Base Course*

This material shall consist of hard, durable particles or fragments of stone or gravel, crushed to required sizes, containing an appropriate quantity of sand or other finely divided mineral matter, which conform to the requirements or MGPEC Standards.

Only aggregate from City approved sources shall be used unless otherwise approved in writing by the City. Approval of sources will be at the discretion of the City, and submissions will, at a minimum, consist of supplying documented gradation, Atterberg Limits, and CBR/R-Value testing annually. See Section 6.5.2.

The City requires all aggregate base coarse material used for Public Improvements to meet the design properties and gradation requirements detailed in MGPEC Standards.

### 6.5.4.4 *Moisture Treatment*

Equipment and moisture treatment methods shall comply with MGPEC Standards.

### 6.5.4.5 *Stabilized Subgrade*

The materials, mix designs, and methods of placement for stabilizing the subgrade soils before paving shall comply with City ROW Regulations and MGPEC Standards. For detached sidewalks and landscaped medians, the subgrade stabilization shall end at the back of curb. For attached sidewalks and hardscape medians, the subgrade stabilization shall extend to back of walk and under the full width of the median, respectively.

## PART III – CONSTRUCTION AND INSPECTION

---

### 6.5.4.6 Concrete Curbs, Gutters and Sidewalks

Materials, equipment, and methods for placement shall comply with City ROW Regulations, or where otherwise not identified, MGPEC Standards.

### 6.5.5 USE OF MATERIALS NOT LISTED IN SECTION 6.5.4

Materials listed in this section and provided with a set of specifications are those deemed by the City to be the primary structural materials commonly or typically used in Public Improvements. Ancillary Public Improvement materials such as manufactured paints and coatings, bonding agents, sealers, gaskets, insulating materials, etc., should be in compliance with CDOT material specifications for the appropriate material employed. Materials included on the CDOT preapproved materials list may be considered for use. Alternate materials for construction may be proposed for use, and the City will make decisions on acceptability of alternate materials.

## 6.6 TRAFFIC CONTROL

### 6.6.1 TRAFFIC CONTROL DEVICES

Construction activities or maintenance activities that involve vehicles, materials, or equipment that interfere with the movement of vehicular or pedestrian traffic on any public street must have appropriate traffic control during the activity. Traffic control devices and standards shall be in accordance with the *MUTCD*. The Contractor shall provide traffic control plans when applying for a ROW permit for construction activities. Additional information on traffic control requirements can be found in the City ROW Regulations.

### 6.6.2 AFTER-HOURS TRAFFIC CONTROLS

Barricades, cones, signs, or other vehicular or pedestrian traffic controls shall be taken out of service after designated working hours unless their use and application are required to ensure the safety of the traveling public. In that case, those controls shall be noted on the City approved traffic control plan (TCP). For more information, refer to the City ROW Regulations.

### 6.6.3 DAMAGE TO PERMANENT TRAFFIC CONTROL

Any damage to traffic signal poles, lines, and loop detectors shall be immediately reported to the City's 24-hour Call Center at 303-325-8000.

### 6.6.4 SPECIFIC REQUIREMENTS

1. Barricades shall be painted, kept clean, weighted, and the face material shall be retro-reflective.
2. All signs (warning, regulatory, etc.) shall be kept clean and free of graffiti and shall be replaced when the face is damaged. These sign faces shall be retro-reflective. All signs shall be removed or turned away from the roadway immediately after they are no longer applicable, especially when left at the job site overnight.
3. Traffic cones are for daytime use only. Barricading devices with lights shall be used for all work that occurs overnight.
4. When lights are used on barricading devices, steady burn lights shall be used for delineation and channelization. Flashing lights shall be used to denote a specific hazard.

## PART III – CONSTRUCTION AND INSPECTION

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5. Under certain conditions, the use of pavement markings shall be required in addition to the devices used for delineation. Temporary striping shall be shown on the TCP with location and extent verified by City TES. When temporary markings are used, the existing markings shall be removed (not painted black). The Contractor shall install temporary markings and remove them when the construction is completed. The City shall approve the permanent markings, which shall be installed by the Contractor when the construction is completed.
6. Pedestrians shall not be diverted onto the roadway. When pedestrian and cyclist routes are affected by construction, an accessible detour shall be provided unless waived by the City.
7. Open trenches shall not be allowed after work hours without prior approval of the City.
8. Work hours vary by roadway designation and can be found in the City ROW Regulations. The Contractor must submit a written request for approval of work hours beyond the typical limits. The Contractor shall also be responsible for all overtime inspection fees for work completed outside the work hours or as stated in the special conditions of City projects.
9. Measures to prevent spillage and tracking from trucks and equipment onto paved surfaces should be used at all times. If any spillage or tracking occurs, it shall be cleaned up immediately by approved methods.
10. When the normal operation of a traffic signal must be interrupted, uniformed officers shall be used to direct traffic. This shall be coordinated with the City and Arapahoe County Sheriff's Office prior to the work. The Contractor shall bear any expense incurred during this operation.
11. Construction within the ROW will not begin until all traffic control devices are in place, per the approved TCP.
12. The Contractor will notify the Police Department, Fire Department, and Public Works before beginning construction.
13. The Contractor will notify all utility companies, including, but not limited to, the Utility Notification Center of Colorado, a minimum of 48 hours before beginning construction. The Contractor shall be responsible for coordinating with utility companies.
14. The Contractor will keep a signed copy of the TCP at the work area during work hours. This will be available for inspection by City (or State) personnel.
15. In some cases, the City Traffic Engineer may require special, advance notice signs. This will be determined upon review of ROW permits.

### 6.6.5 FLAGPERSONS

Anytime a flagger is required to direct the flow of traffic, that flagger must be visible to traffic. The flagger must wear safety orange or yellow clothing (vest, shirt, or jacket) in accordance with American National Standards Institute (ANSI). For nighttime operations, this clothing must be retroreflective. The flagger must follow the flagging procedures stated in the *MUTCD*.

## **PART III – CONSTRUCTION AND INSPECTION**

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### **6.7 TRAFFIC SIGNAGE AND PAVEMENT MARKINGS**

#### **6.7.1 GENERAL**

The installation of all traffic control devices shall conform to the latest edition of the *MUTCD*, CDOT's *Standard Specifications for Road and Bridge Construction*, and City standards.

#### **6.7.2 TRAFFIC CONTROL DEVICES ON PUBLIC PROPERTY**

Permanently fixed traffic signals will generally be installed by the City but may be partially funded by the Developer/Permittee. For more information, refer to Section 2.2. Additions of or alterations to signage and striping within the Public ROW will generally be the responsibility of the Developer/Permittee at the time of development construction. Prior to installation of these Public Improvements, CDs must be approved by the City and applicable permits obtained (Section 2.2).

#### **6.7.3 TRAFFIC CONTROL DEVICES ON PRIVATE PROPERTY**

The property owner shall install and maintain all traffic control devices on private property; including, by way of example and not limitation, pavement markings, regulatory signs, fire lane signs, and handicapped parking signs.

A signage and striping plan specifying the various types and combinations of traffic control devices shall be submitted to the City for approval, per Sections 2.2 and 4.7 of this Manual.

#### **6.7.4 PAVEMENT MARKINGS**

All permanent pavement markings installed within the Public ROW shall have final determination made by the City Traffic Engineer or TES. Allowable materials are acrylic, epoxy, and thermoplastic as per CDOT Specification 627, with the exception of crosswalk markings, which shall be pre-formed pavement marking tape, 3M, or approved equal. Temporary pavement markings necessary to facilitate construction (i.e., detours) may be installed using paint but must be maintained by the Contractor until permanent markings are installed.

All pavement markings shall meet the requirements of the latest edition of the *MUTCD*. The City Traffic Engineer must approve all pavement marking materials.

## **PART III – CONSTRUCTION AND INSPECTION**

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### **SECTION 7.0 INSPECTION AND TESTING**

#### **7.1 QUALITY CONTROL/QUALITY ASSURANCE**

The Contractor will be responsible for daily quality control operations during the construction of the public and private improvements. The Contractor shall be fully responsible for the acts and omissions of their subcontractors and of any persons either directly or indirectly employed by the Contractor or their subcontractors.

The City may also perform additional tasks for quality assurance including, but not limited to, parallel testing, document review, field technician interviews, certificate reviews, calibration reports, and periodic sample testing.

#### **7.2 CONSTRUCTION INSPECTION**

All work sites, materials, and equipment used in the construction of projects within the City shall be subject to inspection and testing in accordance with this Manual, the City ROW Regulations, and MGPEC. The City shall have access to the work site at all times, and the Contractor shall provide proper facilities for access and inspection. The City shall have the right to reject materials and workmanship that are defective or that do not meet the City requirements. Rejected workmanship shall be corrected to the City's satisfaction. Rejected materials shall be removed from the premises and properly disposed of at the Contractor's expense.

If any work is covered contrary to the instructions or without approval or consent from the City, it shall be uncovered for inspection by the City if and when requested by the City. Uncovered work areas shall be properly restored at the Contractor's expense.

Unacceptable work shall be repaired by the Contractor at Contractor's expense. The City's failure to identify a defect during inspection shall in no way release Contractor for defective materials or workmanship.

Inspections shall be scheduled as per the requirements of the City ROW Regulations and as determined at the pre-construction meeting.

#### **7.3 CONSTRUCTION TESTING**

Construction testing and submittals shall be performed in accordance with the ROW Regulations.

## **PART III – CONSTRUCTION AND INSPECTION**

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### **SECTION 8.0 ACCEPTANCE PROCEDURES AND REQUIREMENTS**

#### **8.1 ACCEPTANCE AND WARRANTIES**

Acceptance procedures and required warranties shall be in accordance with the ROW Regulations, and if applicable, the Public Improvement Agreement (PIA).

#### **8.2 RECORD DRAWINGS**

A complete set of as-built drawings of the Public Improvements shall be submitted to and approved by the City prior to probationary acceptance (land use cases) or substantial completion (City projects).

##### **8.2.1 REQUIREMENTS FOR CONSTRUCTION AS-BUILT PLANS**

The Developer/Contractor will be required to first submit a certified set of the 22" x 34" or 11" x 17" sheets as-built plans in PDF format for review. The applicable sheets from the approved CDs shall be used in preparing the as-built plans. The original design information shall be presented as shown on the approved CDs and struck through with a single line if the as-built information is different from that of the original design. The as-built information shall be provided directly next to the original design information, and "AB" shall be provided next to the as-built information to denote it as such.

At a minimum, record drawings shall indicate the horizontal layout of all underground storm sewer infrastructure (see SEMSWA as-built requirements for more information), roadway plan and profiles, signage and striping plans, roadway intersection grading details, as-built details of special or unusual installations, and changes from the proposed site plan (when applicable). The as-built plans shall clearly depict all revisions to the CDs, including field changes.

Upon review, the City may request additional clarification and/or information.

Once reviewed, the Developer/Contractor will be instructed to submit the final as-builts. The final submittal of as-builts shall be made on 22" x 34" or 11" x 17" PDF sheets. Each sheet of the approved as-builts shall be signed and sealed by a Professional Land Surveyor who is responsible for the land survey and signed and sealed by a PE who is responsible for the preparation of the record drawings as follows:

- Professional Land Surveyor:

"I, \_\_\_\_\_, a Professional Land Surveyor licensed in the State of Colorado, do hereby certify that this as-built survey of \_\_\_\_\_ represents an actual survey made on the ground in accordance with the laws of the State of Colorado under my direct supervision on \_\_\_\_\_ in the State of Colorado."

- Professional Engineer:

"I, \_\_\_\_\_, a Professional Engineer licensed in the State of Colorado, do hereby certify that the site improvements were inspected and, to the best of my knowledge, belief, and opinion, the site improvements were constructed in accordance with the design intent of the approved construction drawings."