City of Greenwood Village

Public Infrastructure

Design and Construction Standards

Version 1.0

November 16, 2017

Table of Contents

Introduction

0.1 PURPOSE

The Roadway Design and Construction Standards (hereinafter referred to as "Standards") are intended to protect the public health, safety, and welfare of the City of Greenwood Village (hereinafter referred to as "Village") by regulating the design and construction of public improvements within the Village.

The Department of Public Works is authorized to establish standards and specifications for the construction of all public improvements in the Village. The Standards shall be designed to assure long life, good performance and minimum maintenance. The general high-quality image, appearance, and identity of Greenwood Village shall be maintained. It shall be unlawful for any person to construct, reconstruct or demolish any public improvement in the Village except in compliance with Department of Public Works standards and specifications. Any deviation from the Standards must first be approved by the Public Works Director or designee. A copy of the Standards shall be maintained by the Village and available for public inspection during regular business hours.

0.2 JURISDICTION

These Standards shall apply to all public improvements within the City of Greenwood Village, except where the Village's jurisdiction is superseded by the State, the County, or by another jurisdiction.

0.3 AMENDMENTS

These Standards may be amended from time to time as new technologies and practices are developed and/or the experience gained in the use of these Standards indicates a need for revision. The Public Works Department shall evaluate the effectiveness of the Standards and recommend amendments, as needed. The effective date of any amendments to the Standards shall be the date of publication. Any construction projects with a final approved bid design before the effective date of publication shall be grandfathered into the previous version of the Standards, provided that the improvements have been constructed within two years from the date of approval. If the improvements have not been constructed within two years, the applicant will be required to resubmit the application in accordance with the requirements of the most recent version of the Standards.

0.4 REVIEW AND APPROVAL

All projects will be subject to review by a variety of public agencies and departments within the City of Greenwood Village prior to final approval. An approval by the Village does not relieve the applicant from ensuring that all applicable aspects of the project comply with the Standards.

These Standards should be interpreted as the minimum requirements (unless otherwise stated) for the protection of the public safety, health, convenience and welfare of the residents of the Village. Whenever a provision of these Standards conflicts with another provision in any other law, ordinance, resolution, rule, or regulation covering any of the same subject matter, the more restrictive provision shall take precedence.

The Director shall have the final authority to resolve any conflict in the interpretation of these Standards.

0.5 RELATIONSHIP TO OTHER STANDARDS

The Standards do not address development requirements outside of roadway design and construction. For required documents such as permits, transportation impact studies, storm water/drainage requirements, etc., please contact the appropriate department.

Many standards are incorporated by reference throughout the document. Where there are references to outside documents, applicants should refer directly to the latest version of those original documents for specifications.

The following standards (the latest editions, unless otherwise stated) shall be used as the presumptive standard when specific design and construction methods, materials, or procedures are not specifically addressed in these Standards:

- American Disability Act (ADA) "2010 ADA Standards for Accessible Design"
- American Disability Act and American Association State Highway and Transportation Officials (AASHTO) "A Policy on Geometric Design of Highway and Streets" and "Guide for Development of Bicycle Facilities"
- Colorado Department of Transportation (CDOT) "M&S Standards Plans"
- Colorado Department of Transportation (CDOT) "Standard Specification for Road and Bridge Construction," or "CDOT Construction Manual"
- Federal Highway Administration (FHWA) "Manual on Uniform Traffic Control Devices" (MUTCD)
- Greenwood Village "Drainage Criteria Manual" (DCM)
- Metropolitan Government Pavement Engineering Council (MGPEC) "Pavement Design Standards and Construction Specification Manual"
- Occupational Safety and Health Administration (OSHA)

0.6 ENVIRONMENTAL STANDARD OPERATING PROCEDURES (SOPS)

The intent of the SOPs is to ensure that all applicable municipal, state, and federal codes, laws, and regulations are being followed by contractors performing work within the City of Greenwood Village. The procedures are general and can be applied to varying types of municipal construction. These SOPs can be found in the DCM.

0.7 GENERAL APPLICATION SUBMITTAL REQUIREMENTS

The Village has varying submittal requirements for each application. Please refer to the following list of applications and contact the appropriate Department to receive the general requirements for each:

- Access Permit application – Public Works
- Land Development application – Community Development
- ROW Permit application – Public Works

0.8 DEFINITIONS

As used in these Standards, the following definitions shall apply:

AASHTO
American Disability Act and American Association State Highway and Transportation Officials

ADA
American Disability Act

CDOT
Colorado Department of Transportation

CLSM
Controlled low strength material

DCM
Drainage Criteria Manual

FOOT-CANDLE
The unit of measure expressing the quantity of light received on a surface

FULL-CUT OFF LUMINAIRE
A luminaire having a light distribution in which zero (0) candela intensity occurs at or above an angle of ninety (90) degrees above nadir, and the candela per one thousand (1,000) lamp lumens does not numerically exceed one hundred (100) (ten percent (10%)) at or above a vertical angle of eighty (80) degrees above nadir. This applies to all lateral angles around the luminaire.

LIGHT STANDARD
A structure constructed for or serving as an upright supporting base for a streetlight

LUMEN
The unit of measure used to quantify the amount of light produced by a lamp or emitted from a luminaire

LUMINAIRE
A complete lighting unit consisting of a lamp or lamps and the parts designed to distribute the light

to position and protect the lamps and to connect the lamps to the power supply. Luminaires may be attached, via a mast arm, to a light standard or to a traffic signal.

MAST ARM
The part of a streetlight which projects from the light standard to which the luminaire is attached

MGPEC
Metropolitan Government Pavement Engineering Council

MOVING LANE
Lanes used for continuous travel throughout the entire length of the street segment. Bicycle lanes, parking lanes, turn lanes do not constitute moving lanes.

MPH
Miles per hour

PCR
Point of curb return/radius

ROW
Right-of-way (ROW) is the public space between property lines that may include sidewalks, curbs, moving lanes, bicycle lanes, parking lanes, medians, public utilities, street furniture, and landscaping.

SOP
Standard Operating Procedures

STREETLIGHT
A structure consisting of a light standard, mast arm and luminaire, which is located adjacent to a public roadway. A luminaire attached to a traffic signal is considered a streetlight.

TCP
Traffic control plan

Chapter 1: Soils and Pavement Design

1.1 GENERAL

All applicants must refer to the most recent version of the MGPEC "Pavement Design Standards and Construction Specifications" for further requirements.

Chapter 2: Roadway and Sidewalk

2.1 GENERAL

The Standards in this section are largely based off the AASHTO Roadside Design Guide. Certain requirements have been amended to suit the unique characteristics of the City of Greenwood Village. The Village reserves the right to modify any of the requirements in this section for individual applications, based on surrounding roadway geometries.

This chapter refers to the design specifications for roadways and sidewalks. For construction specifications of roadways and sidewalks, refer to Chapters 7 - 13.

2.2 STREET CLASSIFICATIONS

The City of Greenwood Village has adopted a street classification system together with respective Standards for ROW and street design. The Standards are to be used in the design and construction of new streets and as guides in the improvement of the existing street system.

The classification system was applied to existing streets. It was recognized while classifying streets that existing streets do not always comply with the Standards, and in these instances the function being performed by existing streets was used as the primary basis for classification. The design of new streets and highways and the improvement of existing streets and highways can now be directly related to a classification system. The ROW width for all streets shall be consistent for the length of the street.

These Standards shall apply to all roads within the City of Greenwood Village, except where the Village's jurisdiction is superseded by the State, the County, or by another jurisdiction.

2.3 ACCESS

Any access to a public roadway requires the approval by the City of Greenwood Village Department of Public Works. If the proposed access borders or falls within another jurisdiction, approval may require coordination with other agencies. More information is available in the Greenwood Village Municipal Code, Chapter 16, Section 2-565. Special information regarding access can be found under each roadway classification in this chapter. In general, when considering new or revised access, the City of Greenwood Village will evaluate the following factors:

(1) Whether the street to which access is sought is residential or commercial in character;

(2) Whether the proposed access approach, driveway or curb cut would cross a sidewalk;

(3) Whether drivers of vehicles using the proposed access approach, driveway or curb cut would have difficulty in seeing pedestrians or other vehicles in the vicinity;

(4) Whether pedestrians or the drivers of other vehicles would have difficulty in seeing vehicles using the proposed access approach, driveway or curb cut;

(5) Whether the proposed access approach, driveway or curb cut would result in increased noise, dirt, smoke or fumes in the vicinity of the proposed access approach, driveway or curb cut;

(6) Whether the property for which an access approach, driveway or curb cut is proposed is already served by an existing access approach, driveway or curb cut;

(7) Whether parking is permitted on the street to which access is proposed;

(8) The width of the street to which access is sought;

(9) The posted speed limit on the street to which access is sought;

(10) The distance of the proposed access approach, driveway or curb cut from the curb line of the nearest street which intersects the street to which access is proposed; and

(11) The proximity of the proposed access approach, driveway or curb cut to residential neighborhoods and schools.

2.4 REGIONAL ROADS

2.4.1 Function

(1) Principal roadway system that is designed to carry high volumes of traffic and longer trips, including roads designated in Denver regional transportation plans as freeways, major regional arterials, and principal arterials.

(2) Movement of traffic will be controlled by signals and channelization.

(3) Regional roads shall be spaced approximately one mile apart and shall traverse the entire city and/or county. Regional roads shall not bisect neighborhoods but shall act as boundaries between them.

2.4.2 Access requirements

(1) Intersections will generally be at grade. Access from collector and arterial streets shall be controlled by traffic control devices. Normally, abutting properties and local streets will not be allowed direct access to the street. Abutting residential properties shall not face on the roadway unless separated from it by a frontage road.

2.4.3 Roadway design

(1) Target speed – 40 MPH

(2) Moving lanes – Four or six, each a minimum of 12’ wide

(3) Turn lanes – 1-2 dedicated, each a minimum of 11’ wide

(4) Medians – Required – raised and landscaped.

(5) On-street parking – Not permitted

(6) Bicycle facilities – Not advised

(7) Sidewalks – detached, minimum of 8’ with a minimum 4’ wide landscaped area

(8) Curb and gutter – Vertical

(9) Minimum radius of curvature on center line (horizontal) – 600 feet

(10) Minimum length of tangents between curves – 300 feet

(11) Minimum length of vertical curves (per AASHTO) – see the following table:

Algebraic Difference in Grades (%)			Minimum Length Vertical Curve (feet)
0	-	2-3/4	160
2-3/4	-	3-1/2	180
3-1/2	-	4	190
4	-	4-3/4	200
4-3/4	-	5-1/2	220
5-1/2	-	6	230

(12) Street grades – Minimum grade 0.75% - maximum grade (see table below):

Terrain Type	Maximum Grade for 40 MPH Design Speed
Level	7%
Rolling	8%

(13) Cross-slope –2.0%; for cross-slope requirements at intersections, refer to guidelines in the most recent version of the AASHTO “A Policy on Geometric Design of Highway and Streets” publication

(14) Curb radii – Thirty-five (35) feet minimum at street intersections

2.5 CITY AND COUNTY LEVEL STREETS, COMMERCIAL STREETS

2.5.1 Function

(1) Network of city and county level streets that are not designed to carry traffic volumes as great as regional facilities, but which are intended to serve a significant mobility function. Commercial streets that are not regional facilities are included in this category.

(2) Regulation of traffic accomplished by signs and channelization. Unless otherwise warranted, traffic signals shall be located only at intersections with streets of higher classification. Parking shall be prohibited.

(3) City and county level streets shall be spaced from ½ mile to 1 mile apart and shall, where possible, be continuous. Arterials shall act as boundaries between

neighborhood areas. Detached sidewalks shall be required. City and county level streets may separate major land uses.

2.5.2 Access requirements

(1) Intersection at grade. Intersection with other streets will not be restricted. Access from street of lower classification will be permitted but in all cases, will be controlled by traffic control devices. Normally, all abutting property will not be allowed access to the street and will face the street but increased setbacks may be required.

2.5.3 Roadway design

(1) Target speed – 35 MPH

(2) Moving lanes – Four, each a minimum of 12' wide

(3) Turn lanes – One, minimum 11' wide

(4) Medians – Required – raised and landscaped.

(5) On-street parking – Not permitted. Any parking along the street will require a parking area within private property

(6) Bicycle facilities – Minimum of 5', preferred 6' width

(7) Sidewalks – Detached, minimum of 8' with a minimum 4' wide landscaped area

(8) Curb and gutter – Vertical

(9) Minimum radius of curvature on center line (horizontal) – 350 feet

(10) Minimum length of tangents between curves – 200 feet

(11) Minimum length of vertical curves (per AASHTO) – see the following table:

Algebraic Difference in Grades (%)			Minimum Length Vertical Curve (feet)
0	-	2-1/2	150
2-1/2	-	4	160
4	-	5	180
5	-	6-1/2	190
6-1/2	-	8	220
8	-	9	240
9	-	10	250
10	-	11	260

(12) Street grades – Minimum grade 0.75% - maximum grade (see table below):

Terrain Type	Maximum Grade for 40 MPH Design Speed
Level	7%
Rolling	8%

(13) Cross-slope – 2.0%; for cross-slope requirements at intersections, refer to guidelines in the most recent version of the AASHTO "A Policy on Geometric Design of Highway and Streets" publication

(14) Curb radii – Thirty (30) feet minimum at street intersections

2.6 INTER-NEIGHBORHOOD/COLLECTOR STREETS

2.6.1 Function

(1) Inter-neighborhood streets that connect local neighborhood streets with the city and county and regional systems. While these streets serve a mobility function for adjacent neighborhoods, the function of these streets needs to be balanced with impacts that high traffic volumes and speeds on them may create for adjacent neighborhoods.

(2) Regulation of traffic accomplished using stop signs and channelization. Traffic signals normally used only at intersections with collectors and arterial streets.

(3) Collector streets shall have continuity throughout a neighborhood but need not extend beyond the neighborhood. Intersections with collectors and arterial streets shall be at least one-quarter mile apart. Sidewalks shall be detached and a minimum of 6' wide.

2.6.2 Access requirements

(1) Intersections at grade with direct access to abutting property permitted.

2.6.3 Roadway design

(1) Target speed – 30 MPH

(2) Moving lanes – Two, each a minimum of 12' wide

(3) Turn lanes – Center turn lane, minimum of 11' wide

(4) Medians – Preferred – raised and landscaped.

(5) On-street parking – Permitted. The minimum size of a parking space shall be 9' x 18'

(6) Bicycle facilities – Minimum of 5', preferred 6' width. Requires a minimum 3' ridable surface outside of 2' gutter pan. If no gutter pan is present, the minimum width is 5'

(7) Sidewalks – Detached, minimum 6' width with a minimum 4' wide landscaped area and a maximum cross slope of 2%.

(8) Curb and gutter – Vertical

(9) Minimum radius of curvature on center line (horizontal) – 275 feet

(10) Minimum length of tangents between curves (reverse curves permissible) – 50 feet

(11) Minimum length of vertical curves (per AASHTO) – see the following table:

Algebraic Difference in Grades (%)			Minimum Length Vertical Curve (feet)
0	-	4-3/4	150
4-3/4	-	7	170
7	-	9	190
9	-	11	220

(12) Street grades – Minimum grade 0.75% - maximum grade 5.0%

(13) Cross slope – 2.0%; for cross-slope requirements at intersections, refer to guidelines in the most recent version of the AASHTO "A Policy on Geometric Design of Highway and Streets" publication

(14) Curb radii – Twenty (20) feet minimum at street intersections

2.7 LOCAL STREETS – DIRECT AND INDIRECT

2.7.1 Function

(1) Provide connectivity to higher street classifications and access to adjacent properties.

(2) Traffic requirements in other than residential areas may require special design consideration by the Engineer.

(3) Local streets shall be designed to discourage through traffic from moving through the neighborhood. Local streets shall not intersect regional roads. Attached sidewalks are permissible.

2.7.2 Access requirements

(1) Intersections at grade with direct access to abutting property permitted.

2.7.3 Roadway design

(1) Target speed – 25 MPH

(2) Moving lanes – Two, each a minimum of 12' wide

(3) Turn lanes – Not required

(4) Medians – Optional – raised, landscaped

(5) On-street parking – Parallel parking, 7' width. Parking is permitted on both sides of the street if the street width is greater than 30'

(6) Bicycle facilities – Minimum 5', preferred 6'. Requires a minimum 3' ridable surface outside of 2' gutter pan. If no gutter pan is present, the minimum width is 5'. If both parking and a bike lane are provided, the total minimum width should be 13'

(7) Sidewalks – Attached or detached – 5' minimum, 6' preferred. If a detached sidewalk is installed, there shall be a minimum 4' wide landscaped area provided

(8) Curb and gutter – Vertical or valley pan

(9) Cul-de-sacs – All cul-de-sacs shall have a curb diameter of seventy (70) feet

(10) Minimum radius of curvature on center line (horizontal) – 100 feet

(11) Minimum length of tangents between curves (reverse curves permissible) – 50 feet

(12) Minimum length of vertical curves (per AASHTO) – see the following table:

Algebraic Difference in Grades (%)			Minimum Length Vertical Curve (feet)
0	-	7	135
7	-	9	150
9	-	11	170

(13) Street grades – Minimum grade 0.75% - maximum grade (see table below):

Terrain Type	Maximum Grade for 25 MPH Design Speed
Level	7%
Rolling	10%

(14) Cross-slope – 2.0%; for cross-slope requirements at intersections, refer to guidelines in the most recent version of the AASHTO "A Policy on Geometric Design of Highway and Streets" publication

(15) Curb radii – Fifteen (15) feet minimum at street intersections

2.8 UNPAVED STREETS

2.8.1 General

(1) Per the Greenwood Village Municipal Code, new subdivisions with gravel streets are prohibited. Any repair or alteration to existing gravel roads must be approved by the City of Greenwood Village Public Works Department.

2.9 INTERSECTIONS

Appropriate traffic control devices should be installed at each intersection in accordance with the MUTCD, as determined by the Director of Public Works.

2.9.1 Sight distance

(1) Refer to figures 2.1 – 2.4 for appropriate sight distance geometries.

2.10 MEDIANS

Where raised medians are required with new construction or median replacement, the following standards shall apply:

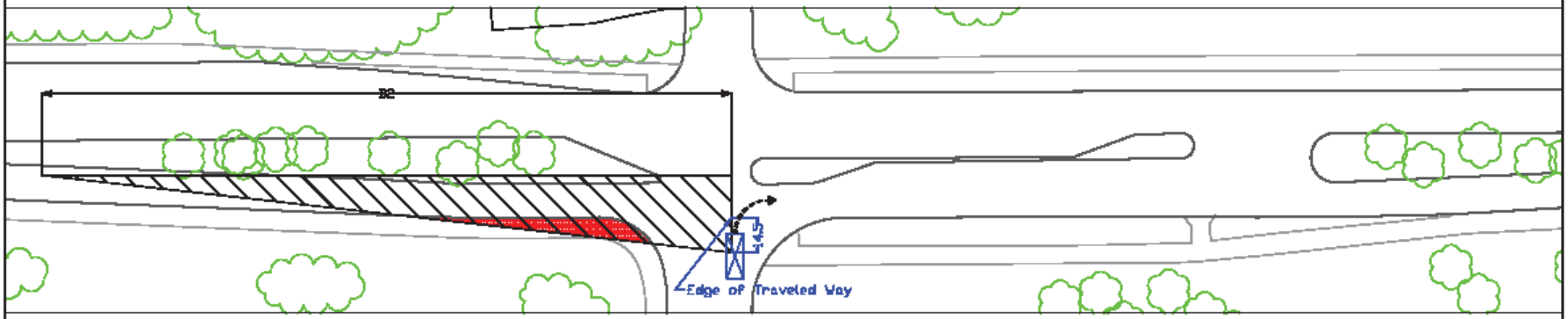
(1) No permanent structures (trees, poles, large boulders, etc.) shall be placed in any location that would obstruct sight distance.

(2) Median planters shall be spaced to provide safe sight distance. Mature vegetation growth shall not extend over back of curb into adjacent lanes. Mature height shall facilitate adequate sight distance. If irrigation is planned in a median island, a trench drain shall be provided to protect the subgrade under the pavement from being saturated.

(3) Median cover shall be consistent with and/or complement existing median cover along the adjacent mainline corridor and accepted by Greenwood Village Public Works.

(4) The nose of the median island shall not extend past the PCR for the curb return at any intersection.

AASHTO Recommended Sight Triangles: Right Turn from Stop on Minor Road



Case B2	
Design Speed	*Length of Leg*
MPH	*Feet*
15	145
20	195
25	240
30	290
35	335
40	385
45	430

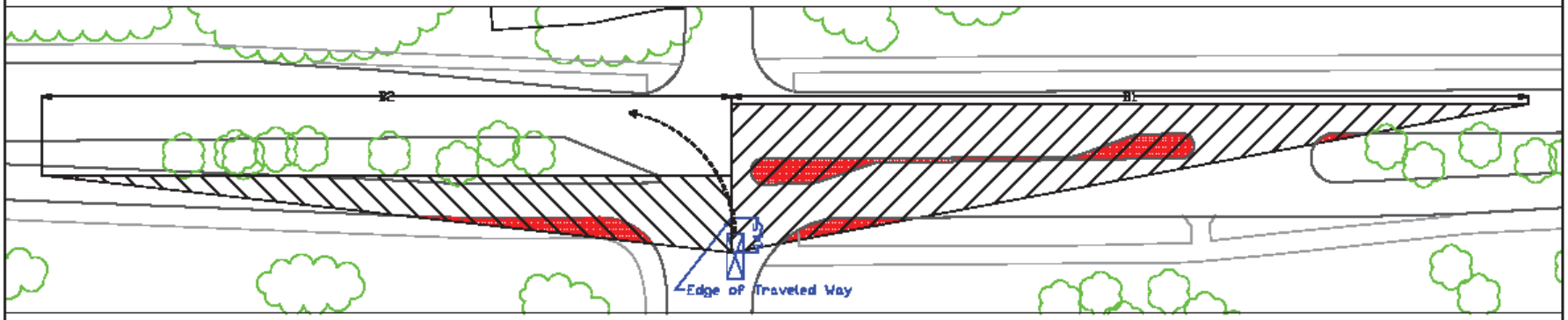
Sight Triangle Area

Landscaping may not be planted within the sight triangle if foliage is between 36 and 84 inches in height from the roadway

For 3-legged or 4-legged intersections with stop control on the minor leg. Signal controlled, yield controlled, all-way stop controlled and non-controlled intersections have additional tables that should be referenced. Adjustments should be made for crossing or entering into multi-lane facilities, crossing roads with wide medians and for grades in excess of 3 %. Adjustments should also be made for intersections facilitating substantial heavy-vehicle (truck) traffic.

Figure 2.1 – Right Turn from Stop on Minor Road (AASHTO)

AASHTO Recommended Sight Triangles: Left Turn from Stop on Minor Road



Case B1	
Design Speed	*Length of Leg*
MPH	*Feet*
15	170
20	225
25	280
30	335
35	390
40	445
45	500

Case B2	
Design Speed	*Length of Leg*
MPH	*Feet*
15	145
20	195
25	240
30	290
35	335
40	385
45	430

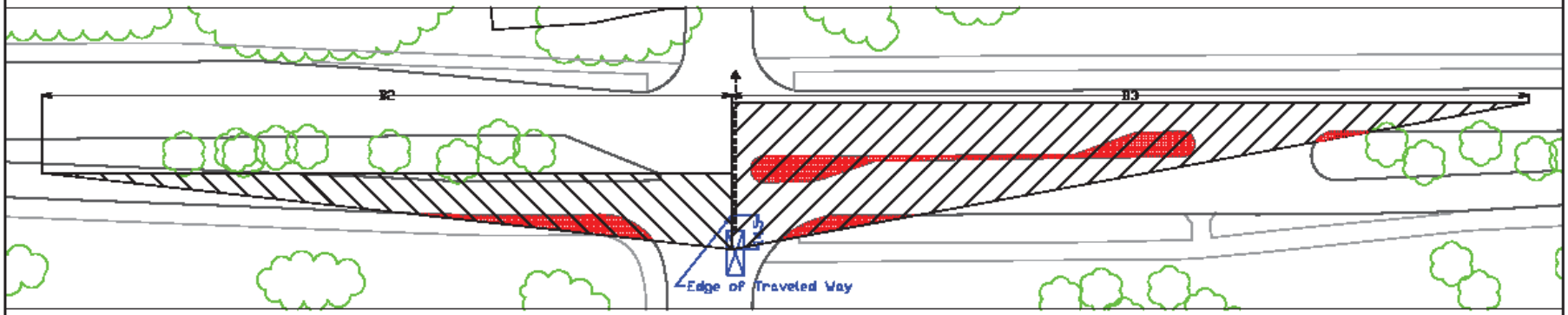
Sight Triangle Area

Landscaping may not be planted within the sight triangle if foliage is between 36 and 84 inches in height from the roadway

For 3-legged or 4-legged intersections with stop control on the minor leg. Signal controlled, yield controlled, all-way stop controlled and non-controlled intersections have additional tables that should be referenced. Adjustments should be made for crossing or entering into multi-lane facilities, crossing roads with wide medians and for grades in excess of 3 %. Adjustments should also be made for intersections facilitating substantial heavy-vehicle (truck) traffic.

Figure 2.2 – Left Turn from Stop on Minor Road (AASHTO)

AASHTO Recommended Sight Triangles: Through Movement from Stop on Minor Road



Case B2 and B3	
Design Speed	*Length of Leg*
MPH	*Feet*
15	145
20	195
25	240
30	290
35	335
40	385
45	430

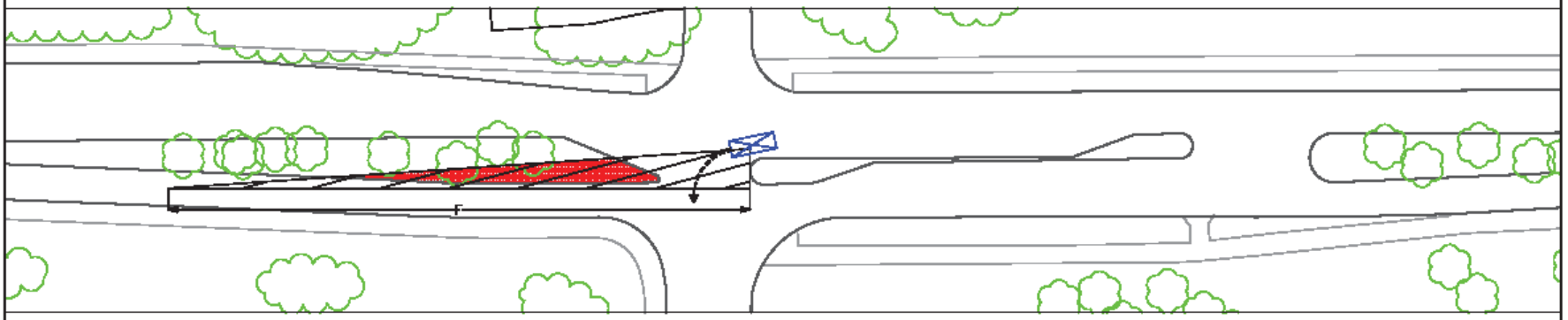
Sight Triangle Area

Landscaping may not be planted within the sight triangle if foliage is between 36 and 84 inches in height from the roadway

For 3-legged or 4-legged intersections with stop control on the minor leg. Signal controlled, yield controlled, all-way stop controlled and non-controlled intersections have additional tables that should be referenced. Adjustments should be made for crossing or entering into multi-lane facilities, crossing roads with wide medians and for grades in excess of 3 %. Adjustments should also be made for intersections facilitating substantial heavy-vehicle (truck) traffic.

Figure 2.3 – Through Movement from Stop on Minor Road (AASHTO)

AASHTO Recommended Sight Triangles: Left Turn from Major Road



Case F	
Design Speed MPH	*Length of Leg Feet*
15	125
20	165
25	205
30	245
35	285
40	325
45	365

Sight Triangle Area

Landscaping may not be planted within the sight triangle if foliage is between 36 and 84 inches in height from the roadway

For 3-legged or 4-legged intersections with stop control on the minor leg. Signal controlled, yield controlled, all-way stop controlled and non-controlled intersections have additional tables that should be referenced. Adjustments should be made for crossing or entering into multi-lane facilities, crossing roads with wide medians and for grades in excess of 3 %. Adjustments should also be made for intersections facilitating substantial heavy-vehicle (truck) traffic.

Figure 2.4 – Left Turn from Major Road (AASHTO)

Chapter 3: Utilities

3.1 GENERAL

This chapter refers to the placement of utilities within the Village ROW. For specific design guidelines of the specific utility facility, refer to the owner's requirements.

This chapter refers to the design specifications for placing utilities. For construction specifications of utilities, refer to Chapters 7 - 14.

3.2 UTILITY LOCATION

3.2.1 Utility separation

See Figure 3.1, Utility Boundary Area Cross Section, below for minimum separation requirements for utilities

(1) Utilities must be placed a minimum 30" under the roadway and sidewalk surfaces.

(2) For utility projects longer than 500', the Village requires plan and profile plan sets of the proposed running line based on field locates prior to construction.

3.2.2 Alignment

(1) The placement of utility lines and other facilities within landscaped median areas is discouraged unless there is no other reasonable location.

(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 Village approval (see Figure 3.1 below).

(3) If the designed alignment conflicts with other facilities not shown on the approved plans, the permittee shall submit an alignment modification request and the change shall be approved by the Village prior to proceeding.

(4) All underground cables and wires, excluding electrical, shall be placed within a conduit sleeve, with a locator tracer.

(5) The permittee's proposed facilities shall be located outside the restricted areas, as shown in Figure 3.1. Wet utilities include water, sewer, and gas.

3.2.3 Utility access

(1) Access structures shall be placed in line with the utility alignment.

(a) Horizontal adjustments to accommodate underground access structures are discouraged and shall only be permitted when conditions warrant at the Village's sole discretion.

(b) Field approval shall be required prior to the placement of each access structure.

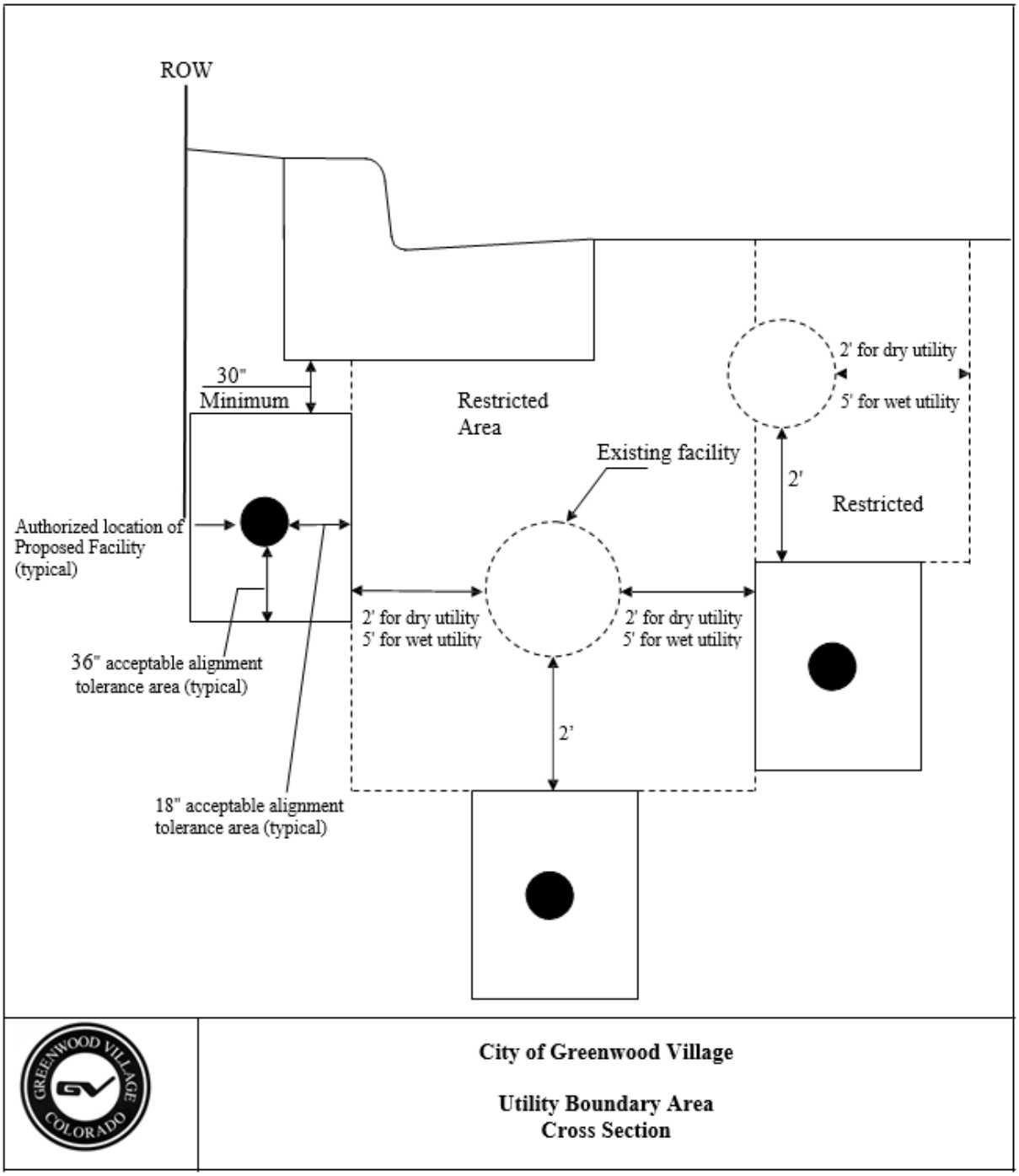


Figure 3.1 – Utility Boundary Area Cross Section

(2) The minimum separation between access structures shall be five hundred feet (500'). An exemption to this provision shall be granted by the Village if the following criteria are met:

(a) The access structure is required to provide service to a building or a customer within a building.

(b) The width of the property frontage does not allow the permittee to meet the minimum separation requirement while still providing service at a reasonable cost.

(c) The permittee has no access structure already located within one hundred feet (100') of the boundaries of the property to be served.

(d) Other conduit owned or leased is not available for the use.

(e) Options to provide service to the building from other directions are not reasonably available.

(3) In no case shall an exemption granted, pursuant to this section, authorize access structures to be separated by less than two hundred fifty feet (250').

(4) Access structures shall be placed a minimum of one hundred fifty feet (150') from any intersection, unless approved by the Village.

(5) The maximum size of an access structure and access lid shall be the minimum necessary for the facility being installed, as previously determined by the Village. In making its determination, the Village shall consider any information submitted to justify the size of the access structure or access lid.

(6) Access lids located in landscaped areas shall be buried in mulch, rock beds, or sod, unless otherwise approved by the Village.

(7) Access lids located in sidewalks shall be flush with the existing surface and capable of being filled with like material.

(8) All access lids within travel lanes shall be placed outside of the wheel track.

3.2.4 Above ground utilities

(1) A detailed plan shall be required for all above ground structures placed in the public ROW. The plan shall show dimensions of the cabinet, base, and proposed location.

(2) Best efforts shall be applied to locate above ground structures outside the public ROW within a private easement on the property being served.

(3) Shall be screened with landscaping, as approved by the Village.

(4) Shall not interfere with sight distance requirements for intersecting streets and access drives (see Chapter 2 for sight distance requirements).

(5) Shall be located to minimize the aesthetic impact to landscaping within the public ROW.

3.3 UTILITY POTHOLE RESTORATION

3.3.1 General conditions

(1) Locate potholes shall be located outside of the wheel track of a travel lane.

(a) When possible, potholes shall be located under existing pavement marking and such marking replaced in kind at the completion of the repair to camouflage the pavement disturbance.

(2) All locate potholes in the pavement section shall be cored with a circular coring saw with a maximum diameter of ten inches (10”). The plug shall be carefully removed without causing damage.

(3) Excavations for potholes shall be backfilled with squeegee or controlled low strength material (flowable fill) only. Native material removed shall not be used to backfill the hole.

(4) The removed pavement shall be replaced by one of the following methods as directed by the Village.

(a) The full depth section or the top three inches (3”) of pavement of the removed original core shall be replaced and grouted with a high strength, quick set epoxy or mortar, as approved by the Village, such that the surface is flush with the surrounding pavement.

(b) The pavement shall be patched with hot mix asphalt of similar aggregate size to the surrounding pavement and compacted in maximum three inch (3”) lifts with a “pogo stick” compactor capable of fitting into the core hole such that the surface is flush with the surrounding pavement. At the Village’s discretion, localized infrared treatment may be required to blend the top mat of the asphalt together.

Chapter 4: Drainage

4.1 GENERAL

All applicants must refer to the Drainage Criteria Manual (DCM) for further requirements.

Chapter 5: Roadway Lighting

5.1 GENERAL

The purpose of this chapter is to ensure that street lighting in the Village's public ROW is designed to complement the surrounding area while promoting and protecting the public health, safety and welfare by assisting motorists and pedestrians with the detection of obstacles.

These Standards apply only to land within the public ROW. For lighting requirements for parking lots and other private development, refer to the Greenwood Village Municipal Code, Chapter 16, Article 21.

5.2 ROADWAY LIGHTING - GENERAL

5.2.1 Height

(1) A streetlight shall not exceed eighteen (18) feet in height in residential zone districts and forty (40) feet in all other zone districts.

(2) In residential zone districts, luminaires on traffic signals may exceed eighteen (18) feet in height, but shall not exceed forty (40) feet in height.

5.2.2 Style

(1) The style shall be consistent throughout the development and consistent with surrounding streetlights and the master plan of the metropolitan district, if applicable.

(2) Poles shall be painted or otherwise coated.

5.2.3 Location

(1) A streetlight shall not project into any roadway so as to obstruct traffic.

(2) A streetlight located on a sidewalk shall not obstruct the passage of pedestrians and shall comply with the Americans with Disabilities Act, as amended.

5.2.4 Luminaires

(1) Except as otherwise provided in these Standards, every luminaire other than a luminaire on a residential neighborhood entrance light shall comply with the following:

(a) The luminaire shall be a full-cutoff type;

(b) The luminaire shall be designed to direct light downward and to minimize up-light, spill light, glare and unnecessary diffusion on adjacent property;

(c) The lamp shall be recessed within the luminaire and shall not be visible below the luminaire; and

(d) No lamp in a luminaire shall exceed the limits set forth in these Standards.

5.2.5 Positioning at intersections

(1) Generally, the nighttime visibility of a pedestrian or hazardous object within an intersection is enhanced by increased contrast between the object and the surrounding street area. The optimum contrast (safety) is achieved when the streetlights are situated to silhouette (backlight) objects in the intersection. Therefore, streetlights at intersections shall be placed on the downstream side of the intersecting street, as viewed by a motorist approaching the intersection.

(2) If streetlights cannot be located on the downstream side of the intersection, a variance may be granted by the City Manager to allow for the upstream location of streetlights. In reviewing a request for such a variance, the City Manager shall consider safety and impact to the surrounding area.

(3) At signalized intersections, luminaires on traffic signals shall be mounted to be perpendicular to the flowline.

5.2.6 Underpass and tunnel lighting

(1) Underpasses, undercrossings and tunnels where vehicles, pedestrians, bicyclists and equestrians may be present shall be lighted at levels approved by the City Manager.

(2) The objectives for lighting these facilities are to improve public safety, security and nighttime visibility and function. Design and placement shall take into consideration the aesthetics of the neighborhood and environmental sensitivity.

5.2.7 Underground electric service

(1) On new public roadways, all streetlights shall be installed with underground electric service.

5.2.8 Neighborhood entrance lights

(1) Each entrance into a residential neighborhood may be lighted with up to two (2) lantern-style streetlights, one (1) on each side of the street.

(2) The luminaires shall be the Village's standard lantern style, constructed of cast aluminum, painted verde green with a white cap, fifteen (15) feet in height and shall not exceed two thousand (2,000) lumens.

(3) The correlated color temperature shall be in a range to produce a warm white emission of light, in the range of 2500K to 3500K conducive to the aesthetic character of the neighborhood environment.

5.2.9 Other streetlights - In addition to the applicable provisions of City Code Chapter 11, Article 2, streetlights other than entrance lights in residential neighborhoods shall meet the following:

(1) Style - The style shall be consistent throughout the neighborhood. Poles shall be anodized, painted or otherwise coated.

(2) Luminaire - On residential streets, lamps shall not exceed illumination levels set forth in these standards.

5.3 STREET ILLUMINATION LEVELS

Street illumination levels shall comply with the following table unless the City Manager determines that different lighting levels are appropriate, based on the lighting levels and other features of the surrounding area.

Road Classification	**Area Classification**	**Minimum Illuminance (foot-candles)**	**Uniformity Ratio (Average/minimum)**
Regional Arterial	Commercial & Industrial	0.9	3:1
Regional Arterial	Residential	0.6	3:1
Collector	Commercial & Industrial	0.7	4:1
Collector	Residential	0.4	4:1
Local	Commercial & Industrial	0.6	4:1
Local	Residential	0.2	6:1

Chapter 6: Traffic Control Devices

6.1 GENERAL

The intent of this chapter is to ensure that the traffic control devices including but not limited to signs, signals and markings in the Village are designed to complement the surrounding area while promoting and protecting the public health, safety, and welfare.

All applicants must refer to the most recent version of the following standards for further requirements, or when specific design and construction methods, materials or procedures are not specifically addressed in these Standards:

- FHWA "Manual on Uniform Traffic Control Devices" (MUTCD)
- CDOT "Standard Specifications for Road and Bridge Construction"

6.2 SIGNS

6.2.1 Sign posts (revision of section 614 of CDOT)

(1) Greenwood Village does not permit galvanized sign posts. Any new sign posts should be consistent with existing posts in the surrounding area. Refer to constuction details in Chapter 11.

6.2.2 Traffic control at mid-block crossings

(1) Shall be placed at all pedestrian crossings

(2) Shall be pedestrian push-button activated

(3) Shall be LED with two beacons per pole, one per direction of vehicle traffic, and programmable with multiple flashing patterns

(4) Shall be solar powered and wirelessly linked

6.3 PAVEMENT MARKINGS – MAINLINE LONGITUDINAL LINES

6.3.1 Center line

(1) The center line shall be a longitudinal line that consists of two 4-inch-wide solid yellow lines separated by a 3-inch gap.

6.3.2 Channelization line

(1) The channelizing line shall be solid white 8-inch-wide longitudinal lines to separate exclusive turn lanes from adjacent turn or through lanes or to identify channelization medians by outlining the median.

(2) For identifying turn lanes, the channelization line shall begin at such a point as to clearly designate the start of the bay, while minimizing wear due to vehicle wheel tracks.

6.3.3 Lane line (broken line)

(1) The lane line shall be 4-inch-wide longitudinal lines consisting of 10-foot-long line segments and 30 foot gaps.

(2) White markings shall be used to separate adjacent through lanes for traffic in the same direction.

6.3.4 Dotted line

(1) Dotted lines are longitudinal lines that shall be white for the extension of lane lines and channelizing lines, and yellow for centerline extensions through an intersection.

(2) The dotted lines shall be the same width as the line that they are extending.

(3) A white dotted line, used to alert motorists they are approaching a trap lane, shall consist of 3-foot-long line segments and 9 foot gaps.

(4) Dotted lines used as an extension of an edge line shall consist of 2-foot-long line segments with 4 foot gaps.

(5) Dotted lines used as extensions lines within an intersection shall consist of 2-foot-long line segments with 6 foot gaps.

(6) The gaps in the striping shall be placed outside of the wheel tracks of cross traffic where possible.

6.3.5 Two-way center left-turn lane lines

(1) Two-way center left-turn markings shall include a 4-inch-wide solid yellow line and a 4-inch-wide broken yellow line separated by a 3-inch gap.

(2) The broken line shall be placed towards the two-way left turn lane and the solid line towards the adjacent traffic.

6.3.6 Edge lines

(1) These longitudinal lines shall be 4 inches wide solid white lines.

(2) Edge lines shall not be continued through intersections (broken at the curb returns) and not be broken at driveways.

6.3.7 Bike lane lines

(1) These longitudinal lines shall be a 4-inch-wide solid white line.

(2) Bike lane lines shall not be continued through intersections (broken at the curb returns) and not be broken at driveways.

6.4 PERPENDICULAR/TRANSVERSE LINES

6.4.1 Crosswalks

(1) When marking crosswalks with pavement markings, a zebra crossing pattern shall be applied. These transverse lines shall be 24 inches wide and 8 feet long.

(2) Crosswalk lines shall be separated by gaps of 12 to 60 inches to avoid vehicular wheel paths, where possible. Gaps shall be uniform per leg of an intersection.

(3) Crosswalk markings shall be located so that they are in alignment with the existing curb ramps.

6.4.2 Stop line

(1) The stop line shall consist of a solid white line extending across the approach lane(s).

(2) The stop line shall be 24 inches wide on arterial and collector streets and 12 inches wide on residential streets.

(3) Stop lines shall be placed only in the absence of a marked crosswalk, in which case the stop line should be placed at the desired stopping point but should not be placed more than 30 feet or less than 4 feet from the opposing traveled way.

6.4.3 Yield lines

(1) Yield lines shall be comprised of a series of triangles aligned to designate the point behind which vehicles are required to yield in compliance with a yield sign.

(2) The individual triangles comprising of the yield line shall have a base of 12 to 24 inches wide and a height equal to 1.5 times the base.

(3) The space between the triangles shall be 3 to 12 inches.

(4) If used, yield lines shall be placed a minimum of 4 feet in advance of the nearest crosswalk line at yield controlled approaches to intersections.

(5) In absence of a marked crosswalk, the yield line shall be placed at the desired yielding point, but should not be placed more than 30 feet or less than 4 feet from the nearest edge of the intersecting traveled way, and positioned perpendicular to the direction of traffic.

6.5 SPECIALTY MARKINGS

6.5.1 Arrows

(1) Arrow symbols shall be white in color and shall be the narrow, elongated arrows 12 feet in length by 3 feet wide for a single turn arrow and 20 feet in length and 3 feet-7 inches wide for a shared turn and through lane arrow.

(2) For turn lane storage lengths less than 150 feet, only one arrow shall be installed and shall be centered in the turn lane storage area.

(3) For storage lengths between 150 feet and 300 feet, one arrow shall be installed 25 feet from the stop line (measured from the closest point of the arrow marking to the stop line) and a second arrow will be placed 25 feet from the start of the turn lane channelizing line (measured to the base of the arrow marking). In the absence of a stop line, measurements shall be made from the end of the adjacent channelization line identifying the turn lane.

(4) For storage lengths greater than 300 feet a third arrow shall be installed at the midpoint between the first arrow and last arrow, as required for the storage lengths of 150 feet to 300 feet.

(5) For drop lanes, the appropriate turn arrow shall be placed within the drop lane 25 feet from the start of the dotted line designating the change in lane utilization.

(6) Use of arrows in adjacent lanes shall be determined by the City of Greenwood Village Public Works Department on a case-by-case basis.

6.5.2 "Keep clear" (previously "do not block") message markings

(1) Previously applied "DO NOT BLOCK" messages will no longer be maintained. This previous message shall be replaced by the "KEEP CLEAR" message, which will consist of a solid white word message "KEEP CLEAR" within the intersection area where vehicles are not to block.

(2) Letters shall be 8 feet in height.

(3) Each word shall be on a separate line and read in the direction of travel.

(4) The longitudinal space between each word should be at least four (4) times the height of the characters for low speed roads (i.e., roads with a speed limit less than 40 MPH), but not more than ten (10) times the height of the characters under any conditions.

6.5.3 Bike lane symbol markings

(1) While such symbols exist currently on the roadway, such markings or any identification of bike lanes by use of symbols are not being maintained within Greenwood Village at this time, nor are any such symbols anticipated to be required in the near future. If at such time the need arises, installation of bike symbols shall be at the discretion of the City of Greenwood Village Public Works Department.

6.5.4 Speed hump markings

(1) Speed hump markings shall be 12-inch-wide white chevron symbols that are 6 feet at the base and 6 foot tall.

(2) Inside the chevron shall be a small 18-inch equilateral triangle separated by a 12-inch gap from the chevron.

(3) One speed hump marking shall be installed in each lane of the approach side of the speed hump. The speed hump marking should be placed with the point of the chevron at the base of the hump.

6.5.5 Other specialty messages

(1) Use of any other specialty symbols or messages shall be at the discretion and direction of the City of Greenwood Village.

6.5.6 Parking lines

(1) The lines between parking stalls shall be 4-inch-wide white lines.

6.6 SIGNALS

6.6.1 General

(1) All signal design plans require a Professional Engineer stamp

(2) Low and high voltage shall be located in a separate conduit

(3) Each traffic signal head shall be centered over the lane it is meant to serve

(4) This section refers to the design specifications for traffic signals. For equipment specifications of traffic signals, refer to Chapter 11.

6.6.2 Style

(1) When a new traffic signal is placed, or an existing signal is replaced, the type of signal shall match the surrounding conditions. There are three traffic signal design types that are allowed in the City of Greenwood Village:

- Modular
- Standard pole and mast arm
- Pole only

(2) When a new traffic signal is placed, or an existing signal is replaced, the color of the signal shall match the surrounding conditions. Acceptable colors for traffic signals in the City of Greenwood Village are:

- RAL 8019 – Bronze
- Tnemec Blackwater

6.7 GUARD RAIL

(1) "W" Beam Guardrail and Guardrail hardware shall be Corrosion Resistant Corten Steel that conform to the requirements in CDOT Standard Specifications.

(2) All other materials and tubes, anchor bolts and miscellaneous bolts, nuts, and washers shall be painted in accordance with section 708. Structural steel elements shall conform to the requirements in DCOT Standard Specifications. Color shall be Federal No. 20040.

Chapter 7: Pavements, Subgrade, and Surface Treatments

7.1 GENERAL

All applicants must refer to the most recent version of the following standards for further requirements, or when specific design and construction methods, materials or procedures are not specifically addressed in these Standards:

- MGPEC "Pavement Design Standards and Construction Specification Manual"

7.2 MATERIAL SPECIFICATION

7.2.1 General

The specifications presented in this section are performance oriented. The Village's objective in setting forth these specifications is to achieve an acceptable quality of roadway structures. For the purpose of these Standards, public improvements are all roadway improvements, sidewalks, curbs and gutters, appurtenant drainage basins or structures, storm sewers and their access ways, other public works within Village ROW and Village mandated storm water detention structures built on private property and maintained by the property owner.

7.2.2 Hot mix asphalt pavements

(1) The material shall consist of a mixture of aggregate, filler (if required) and asphalt cement.

(2) The aggregate mixture shall meet the grading requirements of the job mix formula.

(3) Tests on the aggregate for cleanliness, abrasion loss and fractured faces shall meet the aggregate properties and gradation ranges allowed by the MGPEC Standards.

(4) Aggregates shall not contain clay balls, organic matter or other deleterious substances.

(5) After the job mix formula is established, all mix furnished for the project shall conform to it within the tolerances allowed per the MGPEC Standards.

(6) Hydrated Lime shall be added to aggregate per the requirements of the MGPEC Standards.

(7) A mix design, including the job mix formula, shall be submitted for review and approval a minimum of seven (7) days prior to placing mix on the project. The mix design shall be performed using the standards and procedures detailed in the MGPEC Standards.

7.2.3 Portland cement concrete pavement

(1) 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, except as described below.

(2) Portland cement shall comply with MGPEC Standards, except as described below:

Concrete shall conform to the following requirements:

Min. 28-day Field Compressive Strength	4200 Psi
Min. Cementitious Materials	610 lbs./cu. yd.
Max. Water/Cement Ratio	0.45 lbs H2O/lbs cement
Air Content % Range	7 - 10
Maximum Slump	4"
Max. Fine Aggregate % of total Aggregate	50%

7.2.4 Aggregate base course

(1) 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 of MGPEC Standards.

(2) Only aggregate from Village-approved sources shall be used. Unless otherwise approved in writing by the Department of Public Works. Approval of sources will be at the discretion of the Department of Public Works and submissions will, at a minimum, consist of supplying documented gradation, Atterburg limits and CBR/R-value testing on an annual basis.

(3) The City of Greenwood Village requires all aggregate base coarse material used for public improvements to meet the design properties and gradation requirements detailed in the MGPEC standards.

7.2.5 Moisture treatment

(1) Equipment and moisture treatment methods shall comply with MGPEC Standards.

7.2.6 Stabilized subgrade

(1) The materials, mix designs and methods of placement for stabilizing the subgrade soils before paving shall comply with MGPEC Standards.

(2) For detached sidewalks and landscaped medians, the subgrade stabilization shall end at the back of curb.

(3) For attached sidewalks and hardscape medians the subgrade stabilization shall extend to back of walk and under the full width of the median respectively.

7.2.7 Stabilization fabric

(1) Where required by design, stabilization fabric materials and method of placement shall comply with MGPEC Standards.

7.2.8 Paving fabric

(1) Where required by design or Village recommendation, paving fabric materials and method of placement shall comply with MGPEC Standards.

7.3 METHODS

7.3.1 Subgrade

7.3.2 Base course

7.3.3 Asphalt paving

(1) Removals

(a) All asphalt pavement cuts shall be straight lines. Irregular shaped cuts with more than four (4) sides or cuts within existing patches shall not be allowed. All cuts shall be rectangular in shape, and edges shall be parallel or perpendicular to the flow of traffic.

(b) In order to provide straight edges, all asphalt pavement cuts shall be cut by saw cutting, rotomilling, or another approved method which assures a straight edge for the required depth of the cut.

(c) Asphalt pavement cuts shall be such that no longitudinal joints lie within the wheel path.

(2) Asphalt Patching

(a) The minimum patch dimensions shall be three feet (3') beyond each side of the trench or excavation but shall not extend into an adjacent undisturbed lane.

(b) The longitudinal edges of the patch shall not fall within the existing wheel tracks.

(c) A tack oil shall be applied to all edges of the existing pavement prior to placing the patch.

(d) Patch back areas greater than one hundred twenty square feet (120 SF) require the submittal and approval of a mix design to the Village prior to placement.

(e) Hot bituminous patches shall be placed in maximum three-inch (3") compacted lifts to a depth of the existing pavement plus two inches (2").

(f) A cold mix asphaltic material may only be used as a temporary patch and the cold mix material shall be approved by the Village.

(g) A permanent hot patch shall be made within five (5) days after the area is open to traffic, weather permitting.

(h) Whenever permanent patches are not constructed immediately following trench backfilling operations, temporary pavement patches consisting of a minimum of three inches (3") of hot or cold plant mix or steel plates must be utilized to provide the required number of paved travel lanes. Plates may be left for the duration previously approved by the Village. Temporary pavement patches may be left in place for a maximum of five (5) working days unless otherwise approved by the Village.

7.3.4 Concrete paving

(1) Removals

(a) Concrete pavement shall be removed and replaced from existing panel joints only.

Chapter 8: Embankment and Excavation

8.1 GENERAL

All applicants must refer to the most recent version of the following standards for further requirements, or when specific design and construction methods, materials or procedures are not specifically addressed in these Standards:

- CDOT "Standard Specification for Road and Bridge Construction"
- Occupational Safety and Health Administration (OSHA)

8.2 EXCAVATION

8.2.1 General conditions

(1) All trench excavations shall be made by open cut to the depth required to construct the facility and provide adequate bracing of trench walls. All excavation, trenching, shoring, and stockpiling of excavated materials shall be in strict compliance with the applicable OSHA rules and regulations. The contractor shall furnish, place, and maintain all supports and shoring required for the sides of the excavation, as to prevent damage to the work or adjoining property. If the contractor is not expected to fully complete the work within any excavated area in a reasonable length of time as determined by the Village, the Village may require the contractor to backfill the excavation and re-excavate when the work can be completed expeditiously.

(2) The length of an open trench shall be limited to the amount of pip or conduit that can be placed and backfilling in a single day. however, in no case shall the length of the open trench exceed three hundred feet (300') unless otherwise previously approved by the Village.

(3) No trench shall be left unprotected overnight.

(4) A maximum of two (2) excavations shall be open at any time for access structure installation and conduit splicing, unless otherwise approved by the Village.

(5) Only material that will be hauled or backfilled within one (1) day shall be stockpiled in the public ROW. The Village shall approve all proposed construction staging areas.

8.3 BACKFILLING

8.3.1 Controlled low strength material (CLSM)

(1) All excavation of less than one hundred cubic yard (100 CY) within the roadway pavement shall be backfilled with controlled low strength material (flowable fill) unless otherwise approved by the Village.

(2) CLSM shall consist of a controlled low strength, self-leveling materials composed of various combinations of cement, fly ash, aggregate, water, and chemical admixtures. It shall have a design compressive strength between 50 to 150 psi at twenty-eight (28)

days when tested. The mix shall result in a product having a slump in the range of seven inches (7”) to ten inches (10”) at the time of placement. The mix design shall be submitted for approval by the Village.

(3) The maximum layer thickness for CLSM shall be three feet (3’). Additional layers shall not be placed until the backfill has lost sufficient moisture to be walked on without indenting more than two inches (2”).

8.3.2 Native backfill

(1) In cases where CLSM in not required, backfill of a suitable material shall be placed in maximum eight inch (8”) loose lifts.

(2) Compaction testing shall be provided for all backfill work. Each lift not tested in accordance with the testing frequency (see Figure 13.1), may be rejected by the Village.

(3) Excavation and backfill shall be completed on the same day to minimize impact to the public ROW, unless otherwise approved by the Village.

8.3.3 Bridging plates

(1) The bridging plate shall be secured to the pavement with anchored pins so that it does not slip. The bridging plates shall extend over the supporting pavement by a minimum of one foot (1’) on all sides. Cold mixed asphalt shall be ramped a minimum of two feet (2’) in the travel direction.

(2) The use of bridging plates shall not be allowed from September through April. Use of bridging plates shall only be allowed with the prior approval of the Village.

(3) A design engineer shall certify in writing the suitability of the plates for the specific use.

Chapter 9: Curb and Gutter, Sidewalks, and Flatwork

9.1 GENERAL

All applicants must refer to the most recent version of the following standards for further requirements, or when specific design and construction methods, materials or procedures are not specifically addressed in these Standards:

- CDOT "Standard Specification for Road and Bridge Construction"

9.2 MATERIALS

9.2.1 Concrete mix design

(1) Mix shall be CDOT Class B 4500 psi with 20% Class C fly ash included in the mix (4000 psi compressive breaks permitted due to increased entrained air spec).

(2) Mix shall have entrained air content of 7%-10% at delivery from truck. Mixes that arrive that do not meet the air content minimum shall be supplemented with "air packs" and remixed for a minimum of 20 revolutions and retested (loss of 1%-2% air is predicted after placement and consolidation).

9.2.2 ADA domes

(1) Cast Iron Domes shall be used unless equivalent product is previously authorized by the Village.

9.3 METHODS

9.3.1 General methods

(1) Consolidation of the concrete shall be performed with a mechanical pencil vibrator; other methods such as pounding the forms is not acceptable (excessive vibration to move the concrete or sink the aggregate is not permitted).

(2) Evidence of honeycombing of the concrete after the forms are stripped will be subject to rejection.

(3) The use of steel trowels shall not be permitted in finishing the surface as it can lead to compromising the entrained air structure at the surface.

(4) Plastering or adding water to the surface shall not be permitted.

(5) The use of evaporative retardant products shall not be used unless specifically approved by the inspector for the day of use and in strict conformance with the manufacturer's recommendation. In no instance shall it be used as a finishing aid.

(6) Tolerances for the straightness or trueness of the alignment and shape geometry of the curb and gutter shall be less than ¼" variance in 10 feet.

(7) Curb head geometry (corner radii, face slope and gutter slope) shall be per CDOT Standard Specifications (variance may be allowed if matching adjacent curb shape).

(8) White pigmented, liquid membrane-forming curing compound per CDOT 711 shall be applied immediately after finishing. In no instance shall concrete be left exposed for more than 30 minutes after finishing before cure is applied.

(9) The compound shall be placed in two directions to achieve 100% coverage in a total application rate that achieves the appearance of ponding on the surface.

(10) Diluting or watering down the curing compound shall not be permitted.

(11) Concrete placed between September 15 and April 15 will be sealed with a combination seal-cure conforming with ASTM C-1315 Type 1, Class A as approved by the Village.

(12) The Village may approve the use of evaporation retardant products when specific conditions warrant its use. These products shall only be approved for use for hot weather concrete placement conditions (ambient temperatures in excess of 85 degrees Fahrenheit) and shall only be applied to reduce moisture loss.

(13) Per ACI 305R-15, 4.3.3: "Finishing of flatwork should commence after the surface sheen of the (monomolecular) film has disappeared. These products should not be used as finishing aids or worked into the surface, as concrete durability may be reduced."

(14) The contractor is required to obtain authorization from the Village Inspector prior to use of the product. Use of these products for other than their intended use will be grounds for rejection of the associated concrete and the discontinuation of the use of the product in the Village. Additionally, the application method and maximum application rates shall be per the manufacturer's specifications. The following products have been approved with the conditions noted above:

- ChemRex Confilm
- Dayton Superior Sure Film (J 74)

(15) The use of water and/or any evaporative retardant product to aid in finishing will result in rejection of the concrete placed for that day. If such practice is witnesses again by the Village after the initial infraction, the Village will reject that day's concrete and assign adequate inspection personnel to witness the placement and finishing of subsequent concrete pours until such time that the Village determines the abuse will not continue. The cost of the additional inspection personnel will be borne solely by the contractor from the concrete pay item billed for work done with the additional inspection personnel.

(16) Admixtures approved by the Village may be used to extend the working time of concrete in hot weather conditions. Products such as Delvo Hydration Stabilizer, HS-30 or equivalent may be used in approved conditions.

(17) Concrete shall not be left exposed for more than 1/2 hour between the time finishing is completed and commencement of curing treatment unless approved by the Village.

(18) It shall be the contractor's responsibility to protect the concrete from the elements, vandalism, and physical damage. Any concrete showing any signs of exposure to precipitation, flowing water or freezing, or showing any signs of physical damage, shall be removed and replaced by the contractor at their expense.

(19) The contractor shall protect freshly poured concrete from drainage running across the surface for a period of 12 hours from the time of placement. The Village may reject any concrete that has been exposed to direct runoff within this 12-hour period.

9.3.2 Curb and gutter

(1) Sections of curb and gutter which develop random cracking, or shrinkage cracking at locations other than the designated tooled control joints, shall be removed and replaced, or repaired in a satisfactory manner approved by the Village, by the contractor at his expense.

9.3.3 Sidewalks and flat work

(1) Surface tolerances shall be similar to CDOT Standard Specifications.

9.3.4 Medians

Where raised medians are required with new construction or median replacement, the following standards shall apply:

(1) Median cover shall be constructed at a minimum width of 1.5', with 4" thick, integrally colored concrete, patterned/colored concrete and/or flagstone.

Median cover/splash block control joints shall align with adjacent curb and gutter joint. Should patterned concrete be utilized, control joints shall follow the path of the pattern and align with adjacent curb and gutter joint. Install 1/2" x 4" expansion material (zip strip) and sealant at median noses, fixed objects and at transverse joints at 50 ft intervals along the median.

Should integrally colored concrete, patterned/colored concrete be utilized, a Type I curing compound with a matte finish shall be applied immediately after stripping forms and/or acceptance of the concrete finish. The rate of application of curing compound shall be in accordance with the manufacturer's recommendation.

For weed control prior to median paving, apply a pre-emergent herbicide to median subgrade area per manufacturer's specification for paving under the barrier.

Chapter 10: Traffic Control Devices

10.1 GENERAL

The intent of this chapter is to ensure that the traffic control devices including but not limited to signs, signals and markings in the Village are designed to complement the surrounding area while promoting and protecting the public health, safety, and welfare.

All applicants must refer to the most recent version of the following standards for further requirements, or when specific design and construction methods, materials or procedures are not specifically addressed in these Standards:

- CDOT "Standard Specification for Road and Bridge Construction"
- FHWA "Manual on Uniform Traffic Control Devices" (MUTCD)

10.2 MATERIALS

10.2.1 Preformed plastic pavement markings

(1) Preformed plastic pavement markings material shall conform to ASTM D 4505 for one of the following requirements.

(a) Type I shall not be permitted.

(b) Type II shall be used for lane lines, crosswalks, stop lines, and edge lines.

(c) Type III shall be used for legends and symbols.

(2) Unless otherwise stated in the contract, preform plastic pavement markings for long line markings shall be performed plastic marking, Type 1 (3m 380-ES or approved equal) and conform to the following:

Property	Type I	Type II+	Type III
Minimum Thickness (mils)	75	75	60
Minimum Width (in)	4	7	4
Initial Retroreflectivity	Retroreflectivity level I in accordance to ASTM D 4505	Retroreflectivity level I in accordance to ASTM D 4505	Retroreflectivity level II in accordance to ASTM D 4505
Adhesion (degree F)*	Roadway surface temperature range of 50 F – 115 F** in accordance with ASTM Test Method 1000	Roadway surface temperature range of 50 F – 115 F** in accordance with ASTM Test Method 1000	Roadway surface temperature range of 50 F – 115 F in accordance with ASTM Test Method 1000
Beads	Ceramic or combination of glass and ceramic	Ceramic or combination of glass and ceramic	Glass
Minimum Refractive Index	1.7	1.7	1.5
Surface Pattern	Minimum of 31 mils and in accordance with ASSTM D 4505	Minimum of 31 mils and in accordance with ASSTM D 4505	N/A

* The adhesion temperature is identical to both the application and test temperatures

** Application at lower temperature may be permitted as approved by the Engineer

+ Contrast pavement marking to be used for skip lines, lane lines and gore markings

10.2.2 Preformed thermoplastic markings

(1) The material shall be supplied at a minimum thickness of 90 mils.

10.2.3 Painted markings

(1) Product data must be submitted to certify that the pavement marking used complies with CDOT Standard Specifications.

10.2.4 Sign posts and anchors

(1) Sign posts shall be square tubing with a 14-gauge wall thickness. The tubular material shall have 7/16" diameter holes punched on all four sides at 1" intervals. Holes on the adjacent side shall align on the 1" interval.

(2) Sign posts shall consist of a 1.75" x 1.75" post and a 2" x 2" anchor.

(3) The sign post and anchor shall be power coated "Interstate Green".

10.2.5 Traffic signal equipment

(1) Conduit

(a) All underground conduit shall be PVC, schedule 80 or heavier and shall contain pull rope.

(b) All external metal conduit and pipe supports shall be rigid pip made of ductile steel, galvanized and painted to match the signal pole.

(2) Pull boxes

(a) Shall be Quazite, PG/LG style (Design load: 22,500 lbs).

(b) All pull boxes shall be 18" deep (minimum) and shall be sized as: Pull Box "C" = 24" x 36".

(3) Traffic signal equipment

(a) Traffic signal cabinet shall be model 332.

(b) Controller shall be Econolite Cobalt rack-mount or equal.

(c) Camera detection video image processor shall be Econolite Autoscope Vision or equal.

(d) Pedestrian push button controller shall be Polara iCCU-C or equal. Pedestrian buttons shall be Polara iN2 PBS or equal.

(e) Conflict monitor enhanced monitor shall be model 2010 ECLIP EDI and shall be Ethernet capable.

(f) UPS battery backup – Cabinet Base – Tesco.

(g) The video detection camera shall be Econolite Vision or equal, painted to match signal pole.

(h) Traffic signal indications shall be 12" LED (Dailight 15XL or equal) untinted.

(i) Pedestrian signal shall be count-down type (Dailight Countdown Pedestrian or equal) contained within a clamshell black housing.

(j) Signal heads shall be black.

10.3 METHODS

10.3.1 Pavement marking

(1) Conditions and tolerances

(a) The contractor shall furnish all necessary flag persons, advance warning signs, barricades (cones), lights/signs on vehicles in the painting train, and sufficient safeguards for the safety of all motor vehicle and pedestrian traffic.

(b) The barricade placement/spacing shall be phased as to allow pavement markings to dry prior to permitting vehicles to cross. At a minimum, the contractor shall provide barricade spacing at adequate intervals to protect the freshly placed markings.

(c) Any tire-tracking of markings or over spraying shall be eradicated at the cost of the contractor in a method approved by the Village within 72 hours of notification.

(d) Applied striping shall not vary more than one half inch (1/2”) from the true designated width.

(e) The striping edge shall be clean and well defined (no over spraying due to windblown paint or improper equipment operation will be permitted).

(f) The striping shall not vary more than one quarter inch (1/4") over ten feet (10’) from the true designated alignment.

(g) Replacement of existing markings shall match existing alignment unless requested by the Village to place layout marking lines. Accuracy of final marking placement from the approved alignment shall be +/- 3/8”.

10.3.2 Pre-application

(1) The contractor shall be required to ensure that areas to be striped or marked are free of sand, dirt, and oil, prior to applying pavement markings. The contractor shall have to sweep or perform other necessary tasks to ensure proper surface preparation.

(2) The contractor shall comply with all local ordinances which include vehicle weight limit, noise, work hours, day of operation, etc.

10.3.3 Stripe eradication (grinding or blasting)

(1) The contractor shall comply with CDOT Standard Specifications and submit for approval the specific method and equipment to be used for each type of stripe eradication.

(2) The contractor shall be required to perform a test to demonstrate the proposed method will not adversely affect the pavement.

10.3.4 Preformed plastic pavement marking

(1) Grooved/recessed marking

(a) Groove depth for preformed plastic and thermoplastic marking shall be 30 mils greater than thickness of marking, groove width shall be no greater than 1/2" wider than marking.

(b) Transverse grooving terminations shall be no greater than 2" beyond the end of the marking.

(c) Multiple pass grooving for wider applications shall be done such that each transverse termination aligns within +/- ½" of the adjacent groove termination.

(2) Double left track lines

(a) The contractor shall mark the proposed dashed line extensions through the intersection by establishing the correct radius point and using a string line to create a uniform arc which is tangent to the associated lines being extended.

(b) The proposed layout shall be tabbed on the pavement with spray paint and approved by the inspector prior to proceeding with the grooving and applying marking.

10.3.5 Preformed thermoplastic markings

(1) Grooved/recessed marking

(a) Groove depth for preformed plastic and thermoplastic marking shall be 30 mils greater than thickness of marking, groove width shall be no greater than 1/2" wider than marking.

(b) Transverse grooving terminations shall be no greater than 2" beyond the end of the marking.

(c) Multiple pass grooving for wider applications shall be done such that each transverse termination aligns within +/- ½" of the adjacent groove termination.

10.3.6 Painted markings

(1) Application over existing visible markings

(a) Striping shall be placed over the existing pavement markings without varying longitudinally (width) one half inch (1/2") along the edge of the existing marking or two inches (2”) transversely (length).

(b) At tight radius terminations of double yellow and solid white lines, or when cars are present during parking stall striping, the contractor may be required to apply marking by hand operated equipment to accurately match existing striping.

(c) Contractor may be required to eradicate, in a method approved by the Village, any over spraying outside the allowable tolerances at the direction of the Village. In lieu of eradication, the Village may elect at its discretion to accept the application, however, the contractor will not be paid for the striping out of compliance.

(d) Any out of tolerance segment shall be measured at a minimum 100’ length for contract price adjustments.

(1) Application over existing nonvisible markings

(a) The contractor shall be required to mark control points along sections where the existing striping has been worn away and is no longer visible.

(b) The control points shall be applied such that the permanent striping is consistent with adjacent visible markings. The inspector shall inspect and approve such control points prior to application of the final permanent striping.

10.3.7 Sign post and anchor

(1) Shall be installed according to MUTCD Standards

10.3.8 Traffic signal

(1) Conduits shall be loaded at 50% capacity

(2) Home run pull box shall be installed next to the traffic control cabinet unless authorized by the Village to alter final location

Chapter 11: Construction Traffic Control

11.1 GENERAL

All applicants must refer to the most recent version of the following standards for further requirements, or when specific design and construction methods, materials or procedures are not specifically addressed in these Standards:

- CDOT "M&S Standards Plans"
- CDOT "Standard Specification for Road and Bridge Construction"
- FHWA "Manual on Uniform Traffic Control Devices" (MUTCD)

11.2 CONSTRUCTION TRAFFIC CONTROL

11.2.1 General conditions

(1) When it is necessary to obstruct roadways or pedestrian ways, a traffic control plan (TCP) shall be submitted, in compliance with the above standards.

(2) All TCPs shall be prepared under the supervision of a certified work site traffic control supervisor. Documentation of certification shall be submitted with the TCPs.

(3) Lane closures shall be permitted only between 8:30 AM and 3:30 PM on weekdays, 8:00 AM and 7:00 PM on Saturdays, and 10:00 AM and 7:00 PM on Sundays, unless otherwise directed by the Village.

(4) Lane closures within three hundred feet (300') of signalized intersections shall not be allowed on weekdays unless authorized by the Village.

Chapter 12: Inspection, Testing Procedures, and Tolerances

12.1 GENERAL

All applicants must refer to the most recent version of the following standards for further requirements, or when specific design and construction methods, materials or procedures are not specifically addressed in these Standards:

- CDOT "Standard Specification for Road and Bridge Construction"
- CDOT "M&S Standards Plans"

12.2 INSPECTIONS

12.2.1 General conditions

(1) Testing shall be performed by an independent testing company acceptable to the Village, and results shall be provided to the Village within two (2) working days of completion of testing and prior to the next phase of construction.

(2) Any damage not documented during the pre-construction inspection shall be repaired by the permittee at the permittee's sole expense.

(3) Utility markings shall be limited to the boundaries of the construction area and shall be removed by a method approved by the Village within forty-five (45) days of the completion of work, pursuant to the Greenwood Village Municipal Code, Chapter 11, Article 3, Section 420.

(4) The Village shall be advised at least forty-eight (48) hours in advance of the date work will be started and shall notify the Village at least twenty-four (24) hours in advance if this date is changed or cancelled. Inspections required on the permit shall be scheduled by permittee at least twenty-four (24) hours in advance.

(5) For blanket maintenance permits, a permittee shall notify the Village at least twenty-four (24) hours prior to commencing any maintenance operations under the blanket maintenance permit. The notice shall include the location and duration of the maintenance operations, and the name of the person(s) performing the maintenance operations.

(6) Erosion control measures shall be used to prevent erosion and degradation of water quality.

(7) The Village may restrict any work that causes pavement disturbance from November 1 to April 1.

(8) All work sites shall be maintained so that:

(a) Trash and construction materials are contained and not blown off the work site.

(b) Trash is removed from a work site often enough so that it does not become a health, fire, or safety hazard.

(c) Trash dumpsters and storage or construction trailers are not placed in the street without specific prior approval of the Village.

(9) Each permittee shall utilize its best efforts to eliminate the tracking of mud or debris upon any street or sidewalk. Streets and sidewalks shall be cleaned of mud and debris at the end of each day. All equipment and trucks tracking mud and debris into a public ROW shall be cleaned of mud and debris at the end of each day or as otherwise directed by the Village.

(10) Backhoe equipment outriggers shall be fitted with rubber pads or other like protective material whenever outriggers are placed on any paved surface. Tracked vehicles that may damage pavement surfaces shall not be permitted on paved surfaces unless specific precautions are taken to protect the surface. The permittee shall be responsible for any damage caused to the pavement by the operation of such equipment. Should the permittee fail to make such repairs to the satisfaction of the Village, the Village may repair any damage and charge the permittee pursuant to section 11-3-260 of the Greenwood Village Code.

(11) As the work progresses, all public ROWs and other property shall be cleaned of all rubbish, excess dirt, rock, and other debris, at the sole expense of the permittee.

(12) No permittee shall disturb any surface monuments, property marks or survey hubs and points found on the line of work unless prior approval is obtained from the Village. Any monument, hub, or point which is disturbed by a permittee shall be replaced by a Colorado Registered Land Surveyor at the permittee's sole expense.

(13) Each permittee shall provide employee and construction vehicle parking so that there is no parking in the neighborhood adjacent to the work site. There shall be no unauthorized parking on sidewalks.

(14) Each permittee shall provide necessary sanitary facilities for workers, the location of which shall be approved by the Village and set forth in the permit.

(15) For major installations, a permittee shall locate all parallel dry facilities within forty-two inches (42") plus ½ of the diameter of the proposed conduit and all parallel wet facilities within seventy-eight inches (78") plus ½ of the diameter of the proposed conduit. The location of parallel facilities shall be field verified by locate potholes, unless the locate potholing causes pavement disturbance in an adjacent travel lane that otherwise would be undisturbed. The location of existing facilities, including lateral crossings, which may affect the proposed facility alignment shall also be field verified by locate potholes. Wet facilities include water, sewer, and gas; and all other facilities shall be considered dry facilities.

(16) For major installations, the permittee shall provide "as-built" information to the inspector on a daily basis or upon completion of every five hundred feet (500') of

work, whichever is less frequent. It shall be the permittee's responsibility to immediately notify the Village of any variance from the approved alignment.

(17) All "as-built" information shall be provided by the permittee to the Village in a format acceptable to the Village, and approved by the Village prior to use of the facility.

(18) For any work performed in the public ROW between 10:00 PM and 6:00 AM, if the required restoration cannot be performed at night, or if performing the required restoration at night is economically unfeasible for the permittee because of the cost of materials or equipment, the Village may allow the restoration to be performed during business hours. The Village shall consider the impact of the proposed restoration work on users of the public ROWs. The timing of all required restoration work shall be set by the Village in the permit.

12.3 TESTING PROCEDURES

12.3.1 General conditions

12.4 TOLERANCES

12.4.1 General conditions

All testing to be performed per current CDOT standards

Item	Type of Test	Minimum Frequency
All excavation backfill – gas, elec., water, storm & san. Sewer, cable TV, telephone, etc.	Moisture/Density (Compaction Test)	One per 150 lineal ft., per vertical foot of fill, and within 2 ft. of all structures; minimum 2 tests per lift
Inlets/Structures		
Concrete testing	Rebar Inspection Air and Slump Cylinders	Visual/Documentation First 3 loads, every 5th load thereafter One set of 4 per 100 yds^3, or fraction thereof
Soil testing	Moisture/Density (Compaction)	One test per vertical foot, min. 2 tests per lift
Sidewalk, curb and gutter		
Soil testing	Moisture/Density (Compaction) Proof-roll	One per 150 lineal ft., per 2 vertical feet of fill Min. 2 tests per lift All subgrade
Concrete testing	Air and Slump Cylinders	One per day min. – machine placed Two per day min. – hand placed plus one per 500 square yards One set of 4 per 100 yds^3, or fraction thereof
Roadway		
Subgrade testing	Moisture/Density (Compaction) Proof Roll	One per 300 lane feet, min. 2 tests per lift All subgrade
Base course testing	Moisture/Density (Compaction) Gradation/Atterberg limits Proof-roll	One per 300 lane feet, min. 2 tests per lift One per 500 tons All base course
Concrete testing – full time	Air and Slump Slump Cylinders	First 3 loads, if pass, 1 per 100yds^3 Every load One set of 4 per 100 yds^3 or fraction thereof
Asphalt testing – full time	Density Extraction/Gradation, Marshall	One per 300 lane feet, min. 2 tests per lift One per 500 tons

Figure 12.1 – Testing Requirement