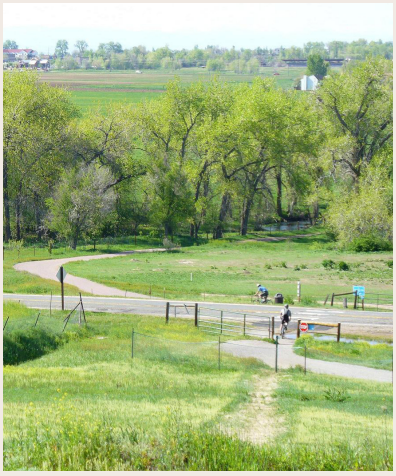
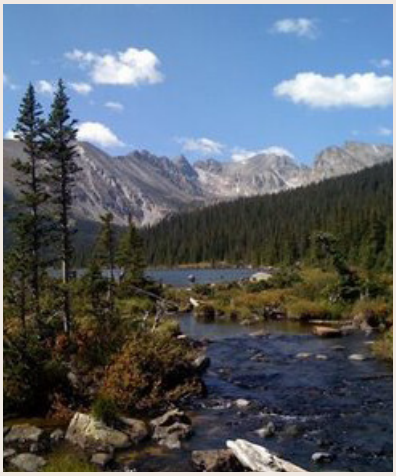
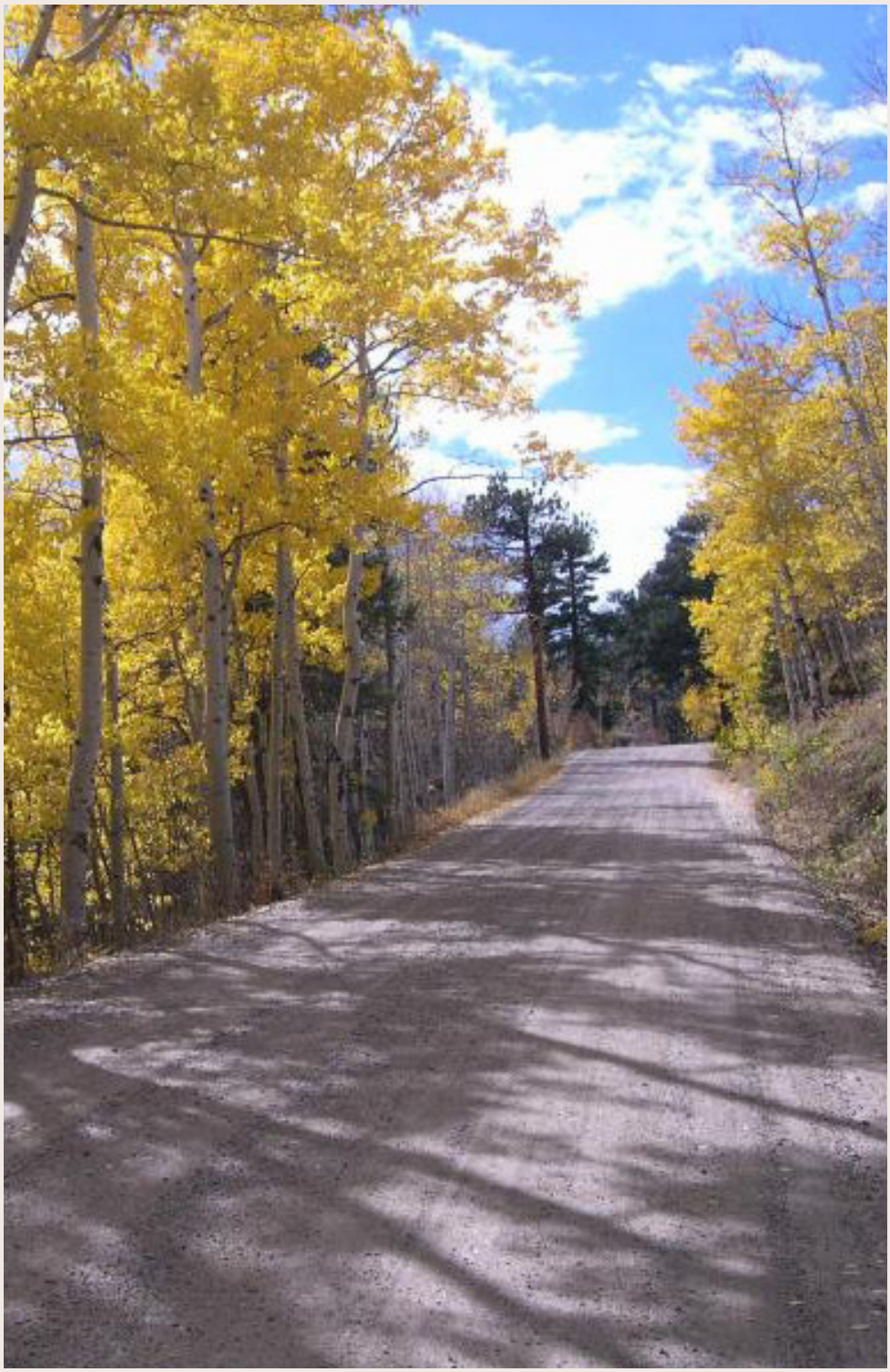
Boulder County Multimodal Transportation Standards







July 1, 2012

Article 1 - General Provisions

1.0 Introduction

These Multimodal Transportation Standards plan for and implement the goals of the Boulder County Comprehensive Plan, referred to herein as the Comprehensive Plan, which supports the provision of high quality transportation facilities and services across all modes to meet the mobility and access needs of all users. The Standards provide direction to effectively and sustainably manage the existing and future transportation infrastructure, both public and private, within unincorporated Boulder County.

1.1 Title

These Standards, together with all future amendments, shall be known as the Boulder County Multimodal Transportation Standards, and will be referred to herein as the Standards. Boulder County, Colorado, will be referred to herein as the County.

1.2 Purpose

The purpose of these Standards is twofold. First, the Standards govern the planning, design, and construction of transportation facilities within unincorporated Boulder County, whether the County, other governmental agencies, or private parties developing land carry out these activities. Second, the Standards provide for the administration of the County transportation system consistent with State law and applicable County resolutions or ordinances, including road system regulation, right-of-way management, and regulation of access to local highway and transportation systems.

1.3 Applicability

These Standards apply to (1) facilities planned, designed, and constructed by the County; (2) facilities planned, designed, and constructed by private parties that provide access from public right-of-way to property proposed for private development; and (3) all other facilities required through the development review process outlined in the Boulder County Land Use Code, referenced herein as the Land Use Code, and these Standards. It is unlawful to undertake any transportation project in unincorporated Boulder County that does not comply with these Standards, unless these Standards are not applicable as specified herein.

These Standards are legally adopted in their entirety into the Land Use Code, which regulates parcel and project-specific decisions. All new transportation facilities and improvements to existing transportation facilities must be consistent with these Standards and applicable provisions of the Land Use Code, with two exceptions. First, if the law of another jurisdiction preempts these Standards, then the County will work in good faith with that entity to ensure compliance to the extent necessary with these Standards through Memorandums of Understanding, Intergovernmental Agreements, or other methods. Second, County projects approved as part of a previous public process such as the Capital Improvement Program (CIP) must be consistent with these Standards, but are not subject to further review under the Land Use Code, with the exception of those projects subject to regulations concerning areas and activities of state interest.

1.4 Authority

The following statutes (among other legal authority as applicable) provide the authority for the adoption of these Standards by the Board of County Commissioners:

Article 11 of Title 30, C.R.S., as amended (County Powers and Functions)
Article 2 of Title 43, C.R.S., as amended (State, County, and Municipal Highways)
Article 28 of Title 30, C.R.S., as amended (County Planning and Building Codes)
Article 20 of Title 29, C.R.S., as amended (Local Government Regulation of Land Use)

Among other rights and obligations, these state statutes require the Board of County Commissioners to determine the general policies of the County as to County transportation matters. Counties are expressly authorized to adopt a local access code for application to local roads not a part of the state highway system.

1.5 Documents Incorporated by Reference

Appendix IV includes a list of those documents that are incorporated by reference in these Standards.

1.6 Amendments

These Standards may be altered or amended upon recommendation of the County Engineer, review and recommendation by the Boulder County Planning Commission to the Board of County Commissioners, and subsequent approval by the Board of County Commissioners. Public hearings before both the Boulder County Planning Commission and the Board of County Commissioners are required, preceded by a public notice published in a newspaper of general circulation in the County at least 14 days prior to the hearing, as well as all other applicable procedural requirements specified in Section 3-205 of the Land Use Code, as amended.

Public hearings shall be conducted expeditiously while giving due regard to the needs of the public to fully and fairly present their views. Where new technical or other information is made available without reasonable opportunity for review or response, the Boulder County Planning Commission or the Board of County Commissioners may table or delay the opening of the public hearing for a reasonable period of time to provide the public and staff the proper time to review the new information, to obtain additional information necessary to make a decision, or to allow for additional time for Boulder County Planning Commission or Board of County Commissioners deliberation and action.

Any action taken by the Board of County Commissioners will be based on the entire record of proceedings on the matter, as that record is maintained by the Clerk of the Board of County Commissioners, Director of the Boulder County Land Use Department, or Director of the Boulder County Transportation Department, referenced herein as the Clerk and Recorder, Land Use Department, and Transportation Department, respectively.

1.7 Severability

If any section, clause, provision, or portion of these Standards should be found unconstitutional or otherwise invalid by a court of competent jurisdiction, the remainder of these Standards shall not be affected thereby and is hereby declared to be necessary for the public health, safety, and welfare.

Article 2 - Administration

2.0 Introduction

This article describes the authority and processes to administer public rights-of-way within unincorporated Boulder County. It also describes Transportation Department review of development proposals subject to the Land Use Code.

2.1 The County Engineer

Appointed by the Director of the Transportation Department, the County Engineer is a Colorado Registered Professional Engineer charged with protecting the public health, safety, and welfare in the public engineering context.

2.1.1 Role of the County Engineer

The County Engineer is responsible for the administration and enforcement of these Standards, as well as several related duties, in a manner reasonable for regulatory purposes and based on engineering and scientific methods of study. Without limitation, these related duties include traffic engineering; design and construction of all of the County's public transportation projects; evaluation of Floodplain Development Permit applications; and various other engineering-related duties under the Land Use Code, as specified therein.

Nothing in these Standards shall create a liability on the part of, or a cause of action against, the County or any officer or employee thereof for any harm that may result from reliance on these Standards or any administrative decision.

2.1.2 Review of County Engineer Decisions

Actions of the County Engineer made while interpreting and enforcing these Standards involve the considered application of professional engineering and transportation planning judgment and skill in the context of a particular situation and are not appealable, with two exceptions. First, the grant or denial of an Access Permit is appealable to the Boulder County Board of Adjustment, as provided in these Standards. Second, Transportation Department referral responses to the Land Use Department under the Land Use Code are recommendations only. Such recommendations are not themselves appealable, but are subject to final decision through the applicable Land Use Code review process.

2.2 Transportation System

The multimodal transportation system in Boulder County enables travel by motorized and non-motorized means, including travel by vehicle, bicycle, transit, and foot. The County Road System consists of state highways, county roads, and other public and private roads. It provides the foundation infrastructure for the County's multimodal transportation corridors that include on-street bicycle, sidewalk, and transit facilities. Off-street facilities are provided through shared use paths and trails.

2.2.1 The State Highway System

The State highway system in Boulder County is administered by the Colorado Department of Transportation (CDOT) under the direction of the Executive Director and the State Transportation Commission. CDOT has full responsibility for the construction and maintenance of all state highways within the unincorporated areas of Boulder County. Access to the State highway system in Boulder County is administered by CDOT through the State Highway Access Code.

2.2.2 The County Road System

2.2.2.1 County Road System Administration

The State of Colorado, by statute, authorizes the Board of County Commissioners to administer the County Road System, which the board has decided to do through the Transportation Department and the County Engineer. Administration of the County Road System includes, but is not limited to, planning, design, construction, operation, and maintenance of maintained roads, and regulation of the County rights-of-way.

2.2.2.2 The County Road Map

The Board of County Commissioners has adopted a Boulder County Road Map, referred to herein as the Road Map, per State Statute 43-2-109 and 110. The Road Map includes the official name, location, surface, road type (classification), and mileage for County roads. It also indicates maintenance and snow removal priority for roads the County has accepted for routine maintenance.

The Transportation Element of the Comprehensive Plan includes definitions for road maintenance and rehabilitation. Maintenance, as described in the Comprehensive Plan, includes snow removal, sweeping, asphalt patching, crack filling, road grading, cleaning of culverts and roadside drainage, and repair or replacement of traffic signs, and pavement markings. Maintenance also includes repair of concrete sidewalks. Maintenance does not include reconstruction, asphalt overlay, and surface treatments, which are considered rehabilitation activities.

2.2.2.3. Acceptance of Public Roads or other Transportation Facilities for Routine Maintenance

The Board of County Commissioners may accept roads for routine maintenance by resolution only after the following requirements are met:

- The roads have a usable traveled way to provide for the safe flow of travel.
- The County Engineer and Road Maintenance Division Manager or their designees have inspected the roads in accordance with approved plans and specifications.
- Based on the inspection, the County Engineer and Road Maintenance Division Manager have recommended acceptance.
- The roads connect to another transportation facility maintained by a public agency.
- Roads have been constructed and include any abutting intersections and to the end of cul-de-sacs
- All required street signs and traffic control devices have been installed in accordance with these Standards.
- A performance bond or cash for 15% of the total cost of the improvements has been submitted to the County to warranty the road construction for two years after the date of acceptance.
- All required subsurface utilities have been installed prior to finishing subgrade.
- All survey monuments, as required by Section 5.11.2, in roadways and rights-of-way have been properly installed.
- As-built plans certified by a qualified Professional Engineer registered in the State of Colorado have been submitted to the Transportation Department.

Roads do not officially become accepted for routine maintenance and part of the County Road System until they are constructed according to these Standards, and specifically accepted by recording an Acceptance Resolution of the Board of County Commissioners with the Clerk and Recorder.

2.2.2.4. Maintenance and Rehabilitation Responsibilities

Maintenance levels for public roads can be found on the Road Map. Per longstanding County policy, the County gives first priority to the rehabilitation of the County's arterial and collector transportation corridors. As a secondary priority, the County rehabilitates a limited number of local roads as resources permit.

The responsibility for road maintenance and rehabilitation within the jurisdiction of the County is outlined in the following chart for various categories of roads:

Road Type	Maintenance Responsibility	Rehabilitation Responsibility
Arterial and Collector roads accepted for maintenance	Boulder County	Boulder County
Local roads accepted for maintenance with no specially benefited parties*	Boulder County	Boulder County
Local roads accepted for maintenance with specially benefited parties**	Boulder County	Benefited Parties
Public Roads not accepted for maintenance	Benefited Parties	Benefited Parties
Private Roads**	Owner	Owner

* Refer to Appendix III.

** Refer to Section 2.3.3, the Land Use Code, and the Building Code for permits that may be required for road maintenance or rehabilitation activities performed by benefited parties or owners.

2.2.3 Other Public Roads

The County has authority to regulate uses of non-maintained public roads in unincorporated Boulder County that are not part of the County Road System. C.R.S. § 43-2-201 declares the following to be public highways:

(a) All roads over private lands dedicated to the public use by deed to that effect, filed with the county clerk and recorder of the county in which such roads are situate, when such dedication has been accepted by the board of county commissioners. A certificate of the county clerk and recorder with whom such deed is filed, showing the date of the dedication and the lands so dedicated, shall be filed with the county assessor of the county in which such roads are situate.

(b) All roads over private or other lands dedicated to public uses by due process of law and not heretofore vacated by an order of the board of county commissioners duly entered of record in the proceedings of said board;

(c) All roads over private lands that have been used adversely without interruption or objection on the part of the owners of such lands for twenty consecutive years;

(d) All toll roads or portions thereof which may be purchased by the board of county commissioners of any county from the incorporators or charter holders thereof and thrown open to the public;

(e) All roads over the public domain, whether agricultural or mineral.

2.2.4 Municipal Streets

These Standards apply to unincorporated Boulder County only. Each municipality has full responsibility for the construction and maintenance of all streets within their jurisdiction. The municipal street systems in Boulder County are administered by the Transportation and/or Public Works directors and City Council or Town Board members of each respective municipality. Access to municipal streets is administered through the respective access codes for each municipal system.

2.2.5 Private Access

Private access roads or driveways may be established by prescriptive use, recorded deed or easement, plat notation, court order, or other legal means. The County regulates the development, improvement, and use of private accesses, including for vehicular, emergency, and other appropriate purposes, through the development review process in these Standards and the Land Use Code.

The County assumes no maintenance responsibility for private accesses, roads or drives, or other private, transportation-related facilities. Where appropriate, a corporation, perpetual association, or other suitable means must be established for maintenance of a private access.

2.3 Road System Regulations

2.3.1 Legislative Authority

State statute authorizes the Board of County Commissioners to regulate traffic on County roads. State statute also authorizes local governments to regulate vehicular access to or from any public highway under their respective jurisdiction from or to property adjoining a public highway in order to protect the public health, safety, and welfare, to maintain smooth traffic flow, to maintain highway right-of-way drainage, and to protect the functional level of public highways. State statute further authorizes the County to regulate transportation facility development and use as well as road access improvements and use.

2.3.2 Traffic Control Devices

All traffic control devices installed on County roads shall conform to the Manual on Uniform Traffic Control Devices (MUTCD).

The Transportation Department shall be responsible for conducting or managing any accident studies, traffic analyses, traffic control studies, or any other engineering studies required by state law or by the MUTCD, which are prerequisite for the installation of traffic control devices on County roads. The Transportation Department shall keep records of all roads or parts of roads where the Board of County Commissioners has authorized traffic regulations.

The County installs and maintains traffic control devices on County public maintained roads. Property owners on County public unmaintained roads may apply for permission to install and maintain traffic control devices on those roads through the Transportation department. The responsibility for installation and maintenance of traffic control devices on private roads belongs to the owners of that road.

2.3.3 Issuance of Permits

The Transportation Department issues permits that regulate activities in the right-of-way to ensure that the integrity of the road system is maintained and to protect the health, safety, and welfare of the traveling public and citizens of the County. This includes permits for utility construction, access, construction, oversize and overweight vehicles, and special events. The Transportation Department also issues Floodplain Development Permits through the Land Use Code.

2.3.3.1 Utility Construction Permits

The County regulates utility and other construction in the County rights-of-way to ensure the integrity of the road system is maintained and to minimize negative impacts to the traveling public during the construction process. No individual, company, corporation, or public agency shall modify, install, or otherwise change any utility located within a County right-of-way without first obtaining a Utility Construction Permit from the Transportation Department. Requirements for such installations are found in the Boulder County Utility Construction Permit Requirements as adopted under separate cover.

2.3.3.2 Access Permits

The County regulates access to the right-of-way through the access permit process to maintain safe traffic flow; to maintain road drainage facilities; and to protect the functional level of the County's roads. Pursuant to state statute no person shall construct any driveway providing vehicular access to or from any County right-of-way without an Access Permit. Requirements for access permits are found in Boulder County Access Permit Requirements as adopted under separate cover.

For access design standards, refer to Sections 5.4 and 5.5. Pursuant to the provisions of Section 4-1200 of the Land Use Code, any person aggrieved by an inability to obtain an Access Permit may appeal to the Boulder County Board of Adjustment.

2.3.3.3 Construction Permits

No person shall construct or improve any road, drainage, or other infrastructure within County right-of-way without a Construction Permit issued by the Transportation Department. Construction Permits shall also be required for private accesses serving more than one parcel. Requirements for obtaining construction permits are found in the Boulder County Construction Permit Documents as adopted under separate cover.

2.3.3.4 Oversize/Overweight Permits

Pursuant to state statute, the Transportation Department may, upon application in writing and good cause being shown therefor, issue an Oversize/Overweight Permit to operate or move a vehicle or combination of vehicles of a size or weight of vehicle or load exceeding the maximum specified in the Colorado Vehicle Code upon any County road.

The Transportation Department may limit the number of trips, the hours of operation, or otherwise prescribe conditions of operation of such vehicles to prevent undue damage to road foundations, surfaces or structures, or disruption of traffic and may require the applicant to provide such security as is deemed necessary to compensate for any injury to any roadway or structure. Liability for damage to the public highway or highway structures shall remain with the overweight vehicles operator, regardless of authorization by special permit. Requirements for obtaining oversize/overweight permits are found in the Oversize/Overweight Permit Requirements.

2.3.3.5 Special Event Permits

The County issues Special Event Permits to ensure that any changes, restrictions, or adaptations resulting from events are managed in a safe, prudent, and legal manner. Special events are activities that change, restrict, or adapt the normal use of a County road or other facility or require a temporary road closure. Requirements for obtaining special event permits are found in the Special Events Permits Requirements for Boulder County Roads as adopted under separate cover.

2.4 Enforcement

It is the responsibility of the Colorado State Patrol and the Boulder County Sheriff's Office to enforce applicable provisions of Colorado traffic laws on the County Road System and insofar as possible to cooperate with the Transportation Department and other officials of the County in administering the provisions contained herein and in developing ways and means to improve traffic conditions. In its discretion, the Transportation Department is authorized to work in conjunction with the County Attorney or the District Attorney to prevent obstruction of or damage to public roads. The Transportation Department may pursue all remedies authorized by law, including criminal penalties, civil fines, and injunctive relief.

2.5 Right-of-Way Management

The County is given authority by state statute to regulate the right-of-way and has a duty to use its right-of-way responsibly and in the best interest of the general public.

2.5.1 Right-of-Way Preservation

The County may hold unimproved right-of-way for trails or other potential community benefits.

2.5.2 Right-of-Way Additions

Right-of-way may be added to the County Road System by dedication and acceptance, by acquisition, by adverse use, and by any other legal means. No such addition shall be made unless approved by the Board of County Commissioners.

2.5.2.1 Right-of-Way Dedication/Acceptance of Right-of-Way

New development or re-development approved through the Land Use Code, which reasonably necessitates the provision of transportation facilities, shall have the following right-of-way requirements:

- All roads, streets, alleys, or other public transportation ways located within the subject property, the benefit of which is to the current or future residents of the subject property, shall be dedicated as public rights-of-way unless specifically approved as private rights-of-way and so designated on the plat or exemption documents.
- In addition to any other dedication requirements of this section, land shall be dedicated to the County for rights-of-way for perimeter streets and roads.

Furthermore the following shall apply:

- New perimeter street systems for new subdivisions shall be laid out so as to eliminate or avoid new perimeter half-streets. Where an existing half-street is adjacent to a new subdivision, the other half of the street shall be improved and dedicated by the subdivision. The Board of County Commissioners may authorize a new perimeter street where the subdivision improves and dedicates the entire required street right-of-way width entirely within the subdivision boundaries.
- When, due to topography, hazards, or other design constraints, additional road width is necessary to provide for the public safety by cut and/or fill area, drainage area, or other road appurtenances along roads, then dedication or right-or-way in excess of the minimum standards shall be required.

Acceptance of the plat by the County constitutes acceptance of the right-of-way. Refer to Section 2.2.2.3 for the standards governing acceptance of roads by the County for maintenance.

2.5.2.2 Acquisition

The Board of County Commissioners is authorized by state statute to layout, widen, alter, or change any County road and to acquire land for County programs or projects.

2.5.3 Right-of-Way Deletions

2.5.3.1 Abandonment

When a portion of the County transportation system is relocated and because of such relocation a portion of the route as it existed before such relocation is in the opinion of the Board of County Commissioners no longer necessary as part of the County transportation system or of no benefit to current or future county residents, such portion shall by resolution of the Board of County Commissioners be considered as abandoned, and title to it shall revert to the owner(s) of the land through which such abandoned portion may lie, pursuant to C.R.S. 43-2-301, et seq ("Vacation Proceedings: Roads, Streets, and Highways").

2.5.3.2 Right-of-way and Easement Vacations

The Board of County Commissioners may vacate any public right-of-way or any portion thereof subject to the provisions of C.R.S. 43-2-301, et seq ("Vacation Proceedings: Roads, Streets, and Highways").

Any vacation of rights-of-way or easement that is not an abandonment as defined above must follow requirements of the Land Use Code.

2.5.3.3 Annexations

County roads can be transferred to incorporated areas through annexations. At such time annexation occurs the County will review the annexation and generally request the annexing municipality to annex the full width of the right-of-way.

2.5.4 Right-of-Way Improvements

2.5.4.1 Special Assessment Authority

The County allows for special assessments or other appropriate revenue-generating programs to fund rehabilitation and other transportation improvements. State statute provides for the establishment of Local or Public Improvement Districts (LIDs, PIDs), which are funding mechanisms for building or upgrading infrastructure.

2.5.4.2 Special Assessment

The Board of County Commissioners is empowered to set special assessments according to benefits received. An election is required to allow the Board of County Commissioners to incur indebtedness on behalf of the County.

2.6 Parcel Access

Both legal and physical access is required for the purpose of developing a property. Legal access is the legal right vested in an owner to enter and return from a parcel to a public road without obstruction. Adjacency to the following facilities is considered to be adequate legal access: Public Road -Maintained, Public Road – Non-maintained, Private access with legal right to cross.

The physical improvements to a parcel by road or driveway that meet these Standards constitute physical access. Physical access does not ensure legal access and legal access does not ensure physical access.

The review of and requirements for Parcel Access depends on the functional classification of the road to which the parcel connects. See Section 5.4 Access Control.

2.6.1 Access by Maintained Public Road

Where access from private property to the County road system is via public, maintained road, an applicant wishing to develop that private property will need an Access Permit. The Transportation Department will review existing and proposed accesses for private development as part of the development review process. A new or revised Access Permit may be required to address any changes in intensity of use or modifications to the access design to improve safety. See Section 2.3.3.2 Access Permits.

2.6.2. Access by Unmaintained Public or Private Road

Where access from private property to the County road system is via public, unmaintained road, a private road, or some combination of the two, an applicant wishing to develop that private property will be required to execute an Access Improvement and Maintenance Agreement (AIMA) either in addition to or instead of an Access Permit. The Transportation Department will develop the agreement, including companion exhibits. Once signed by the applicant, the AIMA is recorded and runs with the land (i.e., it binds successor owners of the property). Development of the AIMA generally occurs during the development review process.

The AIMA identifies the following for the proposed development: 1) the type of road that provides access to the parcel; 2) on parcel and off parcel construction improvements and limitations; and 3) on parcel and off parcel ongoing maintenance responsibilities, practices, and limitations. These requirements will be included in the AIMA when they are necessary and reasonable to mitigate project impacts and assure safe and adequate access to the parcel without negatively affecting other County goals. The AIMA specifies that any improvements must be constructed in accordance with these Standards. No other improvements are to be made without the written consent of the County.

2.6.3. Types of Access

Access types include but are not limited to new or existing primary, secondary, temporary, or relocated accesses. Refer to Access Permit Requirements under separate cover.

2.7 Road Name Changes

The Road Name Change Process was established to accommodate a desired change when an existing road name causes confusion or inconvenience to residents, service providers, and/or public agencies. No road names shall be used which will duplicate or may be confused with the names of existing city streets in the immediate vicinity or with other County roads. Applicants shall follow requirements in the Land Use Code.

Road naming shall conform to the Boulder County Roadway Naming and Housing Numbering Guide as adopted under separate cover, and shall be subject to the approval of the Board of County Commissioners.

If the road in question has been accepted by the County for routine maintenance, the County will be responsible for changing the applicable road name signs. When the road name change is for a road that has not been accepted by the County for routine maintenance, the applicant (or the developer of the affected subdivision) is responsible for changing the road name signs.

2.8 Transportation Review of Development Proposals Subject to the Land Use Code

The Transportation Department serves as a referral agency in the development review process. These Standards guide the County Engineer and designees in reviewing proposals subject to the Land Use Code.

2.8.1 General Process Outline

The following is a general outline of the steps required under these Standards. Where circumstances warrant for a specific application, these steps may be supplemented or altered at the discretion of the County Engineer. In submitting any application to which these Standards apply, the applicant is deemed to agree to and be bound by the applicable provisions herein.

1. A pre-application conference between County staff and the applicant is recommended and may be required in order to develop submittal requirements for the docket in question, including the level of Transportation System Impact Analysis, as described in Article 4.
2. Filing of all required submittal materials, as specified in Section 2.8.3 below
3. County Engineer (or designee) review of how well the proposal complies with these Standards
4. Further discussion as needed between the County Engineer (or designee) and the applicant to obtain additional information or discuss potential necessary Design Exceptions
5. Written referral response from the County Engineer (or designee) to the Land Use Department with recommendations on granting or denying requested Design Exceptions, if needed, and appropriate mitigation for impacts
6. Land use process continues as specified in the Land Use Code

2.8.2 Pre-application Conference

Unless expressly provided otherwise in these Standards or the Land Use Code, a Transportation Department pre-application conference may be required of any land use permit applicants whose projects involve floodplain, road, access, traffic concerns, parking design and engineering, vehicular movement patterns and volumes, or any other transportation-related concern.

Any comments or commitments made by any member of County staff during this pre-application conference are only preliminary in nature and should not be relied upon by the applicant. All prospective applicants should be informed that formal comments cannot be made by staff until after the application is submitted and adjacent and/or nearby property owners and referral agencies have had an opportunity to respond.

2.8.3 Submittal Requirements

As part of the transportation and engineering portion of the Land Use Code application, Land Use Code applicants shall provide information that describes how well the proposal comports with the Overall Design Principles identified in Section 5.1. The information shall be identified on the Submittal requirement checklist provided by the County Engineer and shall include all of the following information to constitute a complete application, unless waived by the Transportation Department as inapplicable in the particular context:

1. A survey which shows all utilities (underground and above ground) and all significant topographical features;
2. A Transportation System Impact Analysis, where applicable;
3. Description of how any safety concerns will be resolved, including access for emergency vehicles or other concerns expressed by the Fire Protection District, if appropriate;
4. Description of how the project promotes multi-modal mobility (e.g., location of existing and proposed transit, bicycle, and pedestrian facilities);

5. Technical reports evaluating drainage, geotechnical, hydrological, structural, and pavement design and any other pertinent engineering issues deemed necessary by the County Engineer given the context;
6. Grading calculations;
7. Description of impacts on environmental and natural resources as follows:
    i. percentage of the total disturbance out of the entire parcel area calculated for the project;
    ii. percentage of the wetlands out of the total parcel area;
    iii. percentage of the affected parcel(s) which is forested and percentage of trees and other vegetation proposed to be removed from the affected parcel(s);
    iv. anticipated water quality impacts, given upstream drainage area and historic drainage patterns;
    v. a soils report describing anticipated soil stability impacts, given soil type, average existing grade of topography, extent of new grading (cubic yards), extent of new cut and fill (width, depth, height), proposed new grades on cut/fill slopes, and proposed new sustained grades on access and surface drainage facilities;
    vi. air quality impacts and fugitive dust plan;
    vii. impacts on wildland & natural communities, including both plant and wildlife impacts on publicly-owned open space and significant agricultural lands;
    viii. impacts on ditches to include any ditch crossings; and
    ix. visual impacts.
8. Description of proposed mitigation for all significant negative impacts to environmental and natural resources. For example, some impacts may be mitigated through an erosion control plan, a stormwater management plan, or the use of sustainable materials and construction methods, including without limitation minimization of materials quantity and use of local and recycled materials.
9. Identification of the party or parties responsible for maintaining all transportation facilities, including any existing or proposed agreements to manage maintenance of the facilities through a perpetual association, corporation, or other suitable means.
10. A complete set of signed and sealed plans as defined by the County Engineer in the particular context, which may include without limitation:
    i. title sheet and general notes
    ii. summary of approximate quantities
    iii. sections for roadways, trails, fencing, or other facilities
    iv. plans and profiles for roadways, trails, fencing or other facilities
    v. signing, striping, and traffic control plans showing existing and proposed facilities
    vi. bridge or other structure plan and profile
    vii. utility plans for storm sewer, sanitary sewer, water, light, and power
    viii. drainage plan
    ix. grading plan
    x. stormwater management plan
    xi. erosion control plan demonstrating temporary and permanent best management practices
    xii. site plan showing without limitation topography, property lines, setbacks, easements, buffers and open spaces, proposed grading, surface waters, delineated wetland areas, structures and building envelope locations, well locations, septic locations, storm and surface water drainage, and roads, accesses, parking areas, and sidewalks
11. Any other submittal requirements for design considerations requested by other County departments.

2.8.4 County Engineer Review

Once an applicant has submitted all required materials, the County Engineer will review the engineering-related aspects of the proposal with respect to the potential impacts on the transportation system and the surrounding environment, and necessary mitigation measures to offset the impacts attributable to the proposal. The guiding documents and transportation corridor concepts listed in Article 3 of these Standards guide the County Engineer's assessment, as well as the Overall Design Principles listed in Section 5.1. The policy of the Transportation Department is for the County Engineer and designees to work cooperatively with applicants to find solutions that work for all parties, unless it appears that safety, access, maintenance, or other fundamental transportation principles simply cannot be met.

2.8.5 Design Exceptions

The County recognizes that in certain limited instances, such as in the County's historic townsites, environmentally significant areas, or areas with significant view sheds, it may be exceptionally difficult to both conform to these Standards and maintain the special character and environmental values associated with such areas. In these instances, the applicant will document in writing, good and sufficient cause for a requested Design Exception on the most recent Boulder County Design Exception Request Form, which is to be signed by a Colorado Professional Engineer. The rationale for the Design Exception Request shall demonstrate the following:

1. is not likely to unacceptably compromise public safety;
2. is not contrary to best engineering practices, as reflected by the approach outlined in the American Association of State Highway and Transportation Officials' (AASHTO) Guide for Achieving Flexibility in Highway Design (May 2004), hereby incorporated into these Standards by reference;
3. is not contrary to the intent and general purpose of these Standards, including without limitation an appropriate balancing of safety, multimodal mobility, and pursuit of the environmental, community, and sustainability goals outlined in the Comprehensive Plan;
4. does not result in a significant impact to the public due to maintenance of the improvements;
5. is the minimum exception from the Standards necessary to afford relief, given the context;
6. reflects special conditions or exceptional characteristics of the proposal, not created by the applicant, that justify an exception from strict and literal interpretation of the Standards to avoid unusual difficulties or unnecessary hardship; and
7. is reasonably necessary for the health, safety, and welfare of the public.

Upon receipt of a written request for a Design Exception from a particular provision of Article 5 of these Standards, the County Engineer may issue a determination on whether a Design Exception should be granted or denied given the context. The County Engineer will provide a copy of the determination to the applicant and to the Land Use Department.

The Board of County Commissioners acknowledges that some judgments ought be made by technical experts, particularly those involving public safety and prevailing engineering practice. Therefore, the Board of County Commissioners typically defers to the professional judgment of the County Engineer. However, the Board of County Commissioners retains its discretion to make the final decision on whether a Design Exception is appropriate in light of the context of a land use application and the applicable Land Use Code criteria.

2.8.6 Transportation Referrals

The County Engineer provides a Transportation Referral to the Land Use Department that summarizes the extent to which the proposed development complies with these Standards. In developing the referral, Transportation Department staff may request the applicant submit additional information necessary for complete review of the proposal or request to meet with the applicant in order to discuss particular issues. A referral will address one or more of the following statements:

1. As presented, the development proposal meets the requirements of these Standards
2. The development proposal does not meet the requirements of these Standards as presented, but could meet the Standards with certain enumerated modifications to the design:
    i. Where modifications to the proposed design would not require a Design Exception, no discussion of the Design Exception is necessary;
    ii. Where modifications to the proposed design would require one or more Design Exceptions, the referral will include written findings on the factors listed in 2.8.5 above
3. As presented, the development proposal meets the requirements of these Standards by including the recommended conditions of approval, including without limitation:
    i. Adequate legal description on the final plat of all easements or rights-of-way necessary for all transportation facilities (e.g., a pedestrian, equestrian, or bicycle facility);
    ii. Identification of the party or parties responsible for maintaining all transportation facilities through a perpetual association, corporation, or other suitable means;
    iii. Any permits or agreements the applicant must obtain before building permit issuance; and
    iv. Any other additional documentation the applicant must provide before building permit issuance.
4. The development proposal does not meet the requirements of these Standards as presented, and no design modification (regardless of whether requiring a Design Exception or not) would remedy the problems with the proposal.

Once submitted to the Land Use Department, the Transportation referral becomes part of the permanent record -- along with all other referral responses from other applicable agencies -- and is incorporated into the Land Use Department's determination letter or, where applicable, the Land Use Department staff recommendation to the Boulder County Planning Commission and the Boulder County Board of Commissioners.

2.8.7 Result of Review of Development Proposals Subject to the Land Use Code

Where development review results in an approval with conditions, those conditions and support therefor shall be reflected in the determination letter issued by the Land Use Department, the AIMA described above in Section 2.6.2, the resolution of approval signed by the Board of County Commissioners, the subdivision and other development agreements, or other documents associated with the approval. Taken together, these documents memorialize how the County's conditions of approval are roughly proportional in nature and extent to the impact of the proposed use or development of the property.

Article 3 - Transportation Planning

3.0 Introduction

Transportation planning provides the context and direction for the development of the multimodal transportation system. While the Design Standards in Article 5 specify how a facility is designed and performs, transportation planning factors described in this article specify where, when, and for what purpose transportation facilities and infrastructure are designed and constructed.

3.1 Guiding Documents

Adopted plans give direction to the County for the use of public resources to make improvements to the transportation system. They provide policy guidance and direction on facility improvements for the County to implement over time. The transportation standards apply to the design and construction of individual facilities as identified in these plans.

3.1.1 Boulder County Road Map

The Boulder County Road Map is the official document identifying the primary and secondary system of County roads, including each road's functional classification and which entity (the County or others) bears responsibility for maintenance. The Board of County Commissioners adopted the original Road Map in 1953 and has since periodically updated it as needed.

3.1.2 Boulder County Comprehensive Plan

The County, pursuant to C.R.S. § 30-28-106, as amended, has adopted and periodically updates a comprehensive plan for the physical development of the County's unincorporated territory. The Comprehensive Plan is used by residents, staff, and other public and private sector stakeholders to provide a vision and policy guidance for decisions concerning the future types, locations, design, mix, and character of land uses in unincorporated Boulder County. The Comprehensive Plan links future development and redevelopment to environmental, economic, community, and other planning goals.

One component of the Comprehensive Plan is the Transportation Element, which includes policy direction for existing and planned transportation facilities and mobility choices in Boulder County. The Comprehensive Plan maps depict the County's plans for developing its multimodal transportation network.

While the Comprehensive Plan is periodically amended and updated, the Transportation Element provides enduring value in its framework for how personal mobility will be planned and provided for over time in concert with the County's land use planning and growth management policies.

3.1.2.1 Regional Trail Plan

The County Trails Map identifies existing and future Regional Trail connections throughout Boulder County and is an adopted map in the Comprehensive Plan. Regional Trail Priorities are adopted periodically by the Board of County Commissioners.

3.1.2.2 On-Street Bikeways Plan

The Boulder County On-Street Bikeways Plan identifies the location of existing and future bikeways throughout Boulder County and is an adopted map in the Comprehensive Plan. The Bikeway Plan consists primarily of on-street bikeways, which are streets that include road shoulders wide enough to safely accommodate bicycle travel.

3.1.3 Transit Plans

With other jurisdictions, the County cooperatively plans for, funds, and constructs infrastructure and facilities for public transportation service, both within Boulder County and to connect to the regional transit network. The Regional Transportation District (RTD) is the primary agency responsible for providing public transportation service within Boulder County. The County may construct bus pullouts, bus stop pads, and other transit facilities in cooperation with RTD and other stakeholders.

3.1.4 Transportation Master Plan

The Boulder County Transportation Master Plan (TMP) is currently under development (as of June 2010). When complete, it will provide a link between the policies of the Comprehensive Plan and the programs and projects that are planned, funded, and implemented by the Transportation Department and associated agencies. The TMP will integrate existing adopted plans and guidance for development of the multimodal transportation system in unincorporated Boulder County into a single comprehensive document. This document, along with other adopted plans, shall be used to identify the specific facility needs within unincorporated Boulder County. TMP completion is anticipated in 2011.

3.2 Transportation Corridors

In concert with federal, state, and municipal transportation agencies, the County plans for the development, design, funding, and implementation of the transportation network. This network supports travel by vehicular traffic (including freight movement), transit, bicycle, and foot. Planning efforts for the County's transportation corridors integrate private and public rights-of-way and balance various elements, including safety and mobility for all travel modes, traffic flow, congestion, access, positive and negative impacts on community character, cost, and others.

3.2.1 Functional Classifications

A hierarchy of functional classifications categorizes transportation corridors based on their role in connecting and providing access between "origin" and "destination" land uses. Higher functional classifications are devoted primarily to moving larger numbers of people longer distances, while the lower classifications primarily provide access to and serve adjacent land uses. These different purposes are categorized as follows:

- Regional Travel: The ability to move over large distances to connect regions.
- Local Circulation: The ability to move within areas and to connect land uses.
- Local Access: The ability to enter and make use of specific land uses and sites.

The following are descriptions of functional classifications for County roadways. State and federal highways are classified by the responsible agency and may include Freeways, Expressways, or Toll Roads.

Principal Arterial (PA)

Provides for the movement of through travel between major population and employment centers and across urban areas. While the primary purpose is the movement of people between major population and employment centers, some access to abutting land uses may be permitted. A principal arterial is usually a divided multi-lane facility.

Minor Arterial (MA)

Provides for the movement of through travel between minor population and employment centers and across urban areas. While the primary purpose is the movement of people between minor population and employment centers, some access to abutting land use is a normal secondary function. A minor arterial is a two-lane facility.

Collector (C)
Connects adjacent land uses to the arterial network and provides some access to adjacent land uses. A collector is a two-lane facility.

Residential Collector (RC)
Provides for internal movement within a residential area connecting local access to collector roads and/or minor arterials, and provides some access to adjacent land uses. A residential collector is a two-lane facility.

Local (L), Local Secondary (LS)
Provides access to specific land uses, particularly residential. Roads of these classifications are two-lane facilities, although in isolated cases, one-lane roads may exist (townsites, forest access, etc.).

The purpose of the transportation corridor and roadway classifications helps determine the types of transportation facilities:

Purpose	Roadway Classification	Modal Features
Regional Travel Corridor	Principal Arterial Minor Arterial	Vehicle travel, fixed route and frequent transit service, regional multiuse paths, marked bicycle lanes
Local Circulation Corridor	Collector Residential Collector	Vehicle travel, fixed route and frequent transit service, non-fixed route/demand response transit, multiuse paths, marked bicycle lanes, sidewalks
Local Access Corridor	Local Local Secondary	Vehicle travel, on street parking, fixed route transit service (infrequent), non-fixed route/demand response transit, sidewalks, signed bicycle routes, shared roadways

3.2.2 Transportation System Features
Where there is an approved transportation facility alignment, such as a trail or other corridor, new development shall provide for this alignment.

3.2.2.1 Roadway Shoulders
Roadway shoulders are the portion of the roadway contiguous with the traveled way that accommodate stopped vehicles and emergency use, and provide structural support for roadway components. Shoulders are often surfaced with gravel, crushed rock, asphalt, or concrete pavement to provide better all-weather load support.

Paved (asphalt or concrete) shoulders can decrease roadway maintenance costs and run-off-the-road vehicular crashes. Paved shoulders are also an appropriate facility for accommodating bicycle travel. Bikeable shoulders on these roadways can reduce passing conflicts between motor vehicles and bicycles and provide increased separation in locations where speed differentials are high.

Shoulder Width

Road shoulder widths are based on facility classification and whether or not the facility is considered a bicycle corridor as defined by the County's On-Street Bikeways Plan. Shoulder width determinations for given facility types are based on the following factors, without limitation:

- Vehicle volumes
- Vehicle speeds
- Percentage truck or bus traffic
- Environmental constraints
- Geologic or physical constraints
- Land ownership

3.2.2.2 Bicycling

The County develops non-motorized transportation facilities for both transportation and for active, outdoor recreational pursuits.

Bicycle User Groups

The County's bicycle facility design standards are structured to accommodate the needs of multiple types of bicyclists using County bikeway facilities including commuters, competitive riders, and recreationalists.

Bicycle Facility Types

Boulder County's bicycle network includes both off-street and on-street facilities. Off-street facilities such as shared-use soft surface trails and paved pathways along arterial roadways offer a more comfortable environment for cyclists who do not wish to ride in traffic for recreation or short utilitarian trips. On-street facilities such as road shoulders and bicycle lanes offer more direct connections between destinations.

Shared Use Paths or Multiuse Trail (off-street)

There are two types of off-street shared-use facilities available for bicycle use-- soft-surface trails and shared use paths. The Regional Trail system provides soft-surface trails to connect Boulder County communities. Shared use paths are often in or adjacent to Boulder County Community Service Areas (see Land Use Code § 18-126). These off-street concrete pathways are physically separated from motorized vehicular traffic by buffer space within the road right-of-way.

Bicycle Lane (on-street)

Bicycle lanes are a portion of a roadway designated by striping, signing, and pavement markings for preferential use by bicyclists. Bicycle lanes are usually one-way facilities located on both sides of streets, and are particularly well suited to circulation and travel corridors such as collectors and minor arterials.

3.2.2.3 Pedestrian

Pedestrian facilities are prioritized in areas with the highest potential for walking (e.g., near or in Community Service Areas and transit stop connections), areas with vulnerable populations (e.g., school zones), and in areas with demonstrated safety issues.

Article 5 of these Standards outlines requirements for the location, design, accessibility, drainage, and maintenance of sidewalks and other pedestrian facilities along County roadways. Refer to Section 5.3.7.

3.2.2.4 Transportation Demand Management (TDM)

The County's Transportation Demand Management (TDM) program includes a comprehensive set of strategies to influence travel behavior with respect to mode, time, frequency, route, and distance, with the aim of reducing single occupant vehicle demand on the transportation network, particularly in peak travel periods (rush hour). TDM measures used by the County in cooperation with other transit partner agencies include transit education; discounted transit passes and an annual pass program; a guaranteed ride home program; carpool, vanpool, bicycle, and pedestrian programs; and other efforts that maximize travel choices as competitive options to driving alone for all trip purposes, particularly work trips.

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Article 4 - Transportation System Impact Analysis

4.0 Introduction

A Transportation System Impact Analysis (TSIA) is required of all new development and redevelopment projects that forecast future trip-making of 30 or more trips per day. It is an evaluative tool that informs staff and decision makers on a proposed development's impacts on the transportation system as well as potential ways to mitigate those impacts. The completion of a TSIA does not guarantee approval of the development proposal.

While this article defines the requirements of TSIAs for development, other articles provide direction on the planning, design, and construction of multimodal transportation facilities that also apply during the Land Use Code development review process.

4.1 TSIA Policy Intent and Priorities

The County's TSIA policy intent is to maximize personal travel choices and mobility through traffic impact mitigation by creating a balanced transportation network. Where applicable, a TSIA shall address traffic mitigation investments (facilities, services, and strategies) as follows:

- Facilities: streets, sidewalks, paths, bus stops, and other multimodal transportation infrastructure components
- Services: public transit and other transportation services provided by public or private entities
- Strategies: transportation demand management, signal timing, context sensitive solutions, and other transportation planning, design, and operation strategies

Thus, development shall address transportation system impact mitigation investments based on the following criteria:

- Ensure safety for users of all travel modes in facility design and travel/movement.
- Provide multimodal transportation investments (facilities, services, and strategies) as required by these Standards.
- Maximize convenient and competitive travel choices for personal mobility within and to/from the project.
- Minimize single-occupant vehicle trips as a means to minimize the project's congestion, noise, air pollution, other community and environmental impacts, and greenhouse gas emissions.
- Prioritize non single-occupant vehicle travel mode share, mode shift to alternative modes, transportation demand management, and efficient traffic operations strategies first as methods to mitigate a project's traffic impacts. Roadway and intersection capacity additions must be the lowest priority mitigation strategies except as necessary to improve mobility for alternative modes and for safety purposes.

While individual project, location, and other specific contextual circumstances may result in policy priority conflicts or otherwise call for flexibility in approach, this framework provides the foundation for the TSIA approach and application review.

4.2 TSIA Objectives

At a minimum, a project TSIA should address the following specific objectives:

- Identify the potential net traffic (trip) generation, particularly vehicle trips and person trips, of proposed development, redevelopment, or land use changes;
- Quantify the potential multimodal traffic impacts on the adjacent transportation network, and the adequacy of existing transportation facilities and services to absorb the net traffic increases;
- Assess the project's safety impacts on the transportation network and subject property;
- Determine the project's ability to minimize single-occupant vehicle trips;
- Specify the nature, location, timing, and cost of multimodal transportation facilities, services, and strategies needed to mitigate the project's traffic impacts; and
- Allocate the project's responsibilities for funding or otherwise providing such transportation investments to address its traffic impacts.

4.3 Analysis Levels

Proposed development projects or other land use changes range in size, complexity, and location. Therefore, the scope of a TSIA for a particular project will vary. The thresholds for different analysis levels below (sections 4.3.1, 4.3.2, and 4.3.3) have been established as general guidelines to determine the necessary elements in a TSIA in relation to major project characteristics. The Transportation Department may either waive certain TSIA requirements or ask for elements of a "higher level" analysis where circumstances warrant.

The Transportation Department will determine and inform the applicant of the level of TSIA required during or subsequent to the pre-application meeting, if held, or after reviewing the applicant's pre-application methodology statement. Some of the factors that may determine the appropriate analysis level in addition to daily vehicle trips include, but are not limited to:

- High traffic volumes on surrounding roads that may affect movement to and from the proposed development.
- Inadequate sight distance at access points.
- The proximity of the proposed access to other existing drives or intersections.
- Impacts to the surface quality of the road.
- A development that includes a drive-through facility.
- A situation where a previous analysis adequately addresses all required items.

TSIAs are categorized into the following three analysis levels: 1) Transportation System Impact Letter; 2) Transportation System Impact Review; and 3) Transportation System Impact Study.

4.3.1 Transportation System Impact Letter

A Transportation System Impact Letter is an acceptable level of analysis for developments considered to have a minimal traffic impact (at least 30 and less than 50 daily vehicle trips) and limited opportunities for improving the immediate transportation network. Transportation System Impact Letters involve a limited analysis of conditions for very small developments. The study area is in the immediate vicinity of that development. Safety, access, and basic facility provision are emphasized at this level of analysis.

4.3.2 Transportation System Impact Review

Transportation System Impact Reviews involve a limited analysis of conditions for small developments generating at least 50 and less than 150 daily vehicle trips. Examples of impacts include higher traffic volume to and from the site and on the adjacent road. This level of analysis investigates traffic impacts and mitigation for proposed developments in the general vicinity of that development. Safety, access, Level of Service (LOS), transit service, bike and pedestrian facilities, and limited off-site traffic impact mitigation are emphasized at this level of analysis.

4.3.3 Transportation System Impact Study

Transportation System Impact Studies involve the most detailed analysis of transportation system conditions, impacts, and mitigation. These are intended for large or complex projects generating 150 or more daily vehicle trips that may have significant traffic or safety impacts and opportunity through site design, mode shift, or other strategies to expand personal and regional travel choices. This level of analysis investigates traffic impacts and mitigation for proposed developments in the larger region around the proposed development. Safety, access, Level of Service (LOS), transit service, bike and pedestrian facilities, and off-site traffic impact mitigation are emphasized at this level of analysis.

4.4 Submittal Requirements

All TSIAs shall conform to the following submittal requirements. The applicant shall submit electronically the initial TSIA and any subsequent revisions. The TSIA may also be submitted via hard copy at the Transportation Department's request.

4.4.1 Responsibility

Applications for proposed land use development, redevelopment, or changes to an approved land use application shall include a TSIA in accordance with this article as part of the project's submittal. Applicants are responsible for addressing and mitigating the transportation system impacts associated with their projects as necessary to provide safe, efficient access to the proposed development. This includes providing reasonable improvements to public facilities made necessary by the development.

In those incidences where a trip rate for an unusual or seasonal land use is not readily available from the Institute of Transportation Engineers (ITE) Trip Generation Manual the applicant may submit trip rate data (Average Daily Traffic and or Peak Hour) for a similar use within Boulder County. Where neither is available, the applicant shall retain a Traffic Engineer to establish the trip rate for the site.

4.4.2 Preparation

Registered, accredited, or certified engineers or planners, including (but not limited to) American Institute of Certified Planners (AICP), Professional Engineers (PE), or Professional Traffic Operations Engineers (PTOE), with a documented professional background in transportation/traffic planning or engineering may prepare TSIAs. A Professional Engineer, registered in the State of Colorado, qualified in traffic engineering, shall approve and sign all studies. Where circumstances warrant, the County Engineer may waive this requirement for TSIA Letters.

4.4.3 Timing

Applicants must meet with the Transportation Department prior to initiation of the TSIA to coincide with the submittal of the pre-application methodology statement.

4.4.4 Pre-Application Methodology Statement

TSIAs must be preceded by a methodology statement to be submitted to and approved by the Transportation Department.

The methodology statement shall explain the TSIA's proposed methodology and address the TSIA Objectives in Section 4.2. It shall include the following for the project:

- Impact area: description and graphic/map of project impact area for analysis purposes and list of study area intersections to be included
- Project components, phasing, and timing: project site plan, the project's land uses (type, size, density) and their proposed phasing and timing (year) for development
- Trip generation rates: source and initial calculations for gross vehicle trips and total person trips
- Mode share: methodology and justification for allocating person trips by mode. Background traffic and adjacent development: methodology and justification for background traffic growth rate; traffic data for adjacent new/approved projects
- Trip distribution: methodology and justification of allocation of project trips on the study area network by percent of total trips

The purpose of the methodology statement is for the Transportation Department and applicant to agree on analysis level, methodology, allocations, and other calculations before the full TSIA is undertaken. Any requested deviations from the requirements of this Article must be clearly noted and justified in the TSIA methodology statement.

4.4.5 Review

All TSIA Letters, Reviews and Studies must be approved as complete by the Transportation Department before the applicant can complete the Development Review process.

4.5 Requirements – Transportation System Impact Letter

A Transportation System Impact Letter shall include all of the information specified in Sections 4.5.1 through 4.5.4. Where a submitted Letter is found incomplete, revisions may be required.

A pre-application methodology statement is always required at this analysis level.

4.5.1 Project Description

The proposed project and development application should be briefly described. Development timing and phasing should be specified, if applicable.

4.5.2 Study Area

The project's site location and study area should be briefly described and shown on a location map. Unless otherwise requested by the Transportation Department, the study area should include each access point and the greater of 150 feet in each direction from the access, or the project frontage on the adjacent roadway(s), unless additional distance is required to adequately evaluate sight distances. The location map shall include the site, study area limits and transportation facilities, including the project access and parking, adjacent road(s), bikeable shoulders, paths, sidewalks, and transit stops.

4.5.3 Existing & Future Conditions

Existing and project build out transportation conditions should be identified and may include:

- An inventory (can be shown on site map) of existing multimodal transportation facilities and services (roadways, transit, walking, and biking);
- Project average daily traffic (ADT) volumes. Another trip rate may be recommended during the pre-application methodology process for developments that generate seasonal or other unusual traffic;
- Access spacing dimensions, sight distance, accident history; and
- Other issues as requested by the Transportation Department.

4.5.4 Conclusions & Mitigation Recommendations

This section should describe potential multimodal transportation system and safety impacts resulting from the project, needed actions to mitigate the impacts, and the applicant's proposed methods to implement the mitigation measures.

The project's traffic impact mitigation obligations shall address the following:

- Sight distance for project access (in feet)
- Access location (including relocation of existing access) related to adjacent road configuration (in feet)
- Multimodal transportation infrastructure appropriate to the location (e.g., paving the first 3 feet of a gravel access from a paved road, to minimize gravel being carried onto the pavement, or providing pedestrian connections along the project frontage or to nearby development or multimodal facilities)

4.6 Requirements – Transportation System Impact Review

A Transportation System Impact Review shall include all of the information specified in Sections 4.6.1 through 4.6.4. Where a submitted Review is found incomplete, revisions may be required.

A pre-application methodology statement is always required at this analysis level.

4.6.1 Project Description

The proposed project and development application should be briefly described. The project's land uses (type, size, density) and their proposed phasing and timing (year) for development should be specified.

4.6.2 Study Area

The project's site location and study area should be briefly described and shown on a location map. The study area shall include all adjacent streets, intersections, and high-volume driveways; the nearest major intersection; and all streets and roads internal to the project. The location map shall include the site, study area limits, and transportation facilities, including the project access and parking, adjacent roads, bikeable shoulders, paths and trails, sidewalks, and transit stops.

4.6.3 Existing & Future Conditions

Existing and project build out transportation conditions, traffic volumes, impacts, and implications should be stated and discussed. Analysis factors shall include the following issues:

- An inventory (can be shown on map) of existing multimodal transportation facilities and service (roadways, transit, pedestrian, and bicycle)

- Access management/spacing dimensions
- Existing Conditions - Average daily traffic (ADT) and peak hour traffic (PHT) volumes and Level of Service (LOS) performance on adjacent roadway(s)
- Peak hour access point(s) Level of Service
- Trip generation, distribution, and assignment. Another trip rate may be recommended during the pre-application methodology process for developments that generate seasonal or other unusual traffic
- Cumulative conditions (existing conditions plus other approved projects)
- Cumulative conditions plus proposed project
- Safety and accident analysis
- Adjacent neighborhood and stakeholder public input issues
- Other issues as requested by the Transportation Department

4.6.4 Conclusions & Mitigation Recommendations

This section should describe potential multimodal traffic and safety impacts resulting from the project, needed actions to mitigate the impacts, and the applicant's proposed methods to implement the mitigation measures. This section should also detail the anticipated site access configuration (driveways, private roadways, paths, sidewalks, etc.) consistent with the requirements of Article 5 of these Standards.

The project's traffic impact mitigation obligations shall address the following:

- Safety and access management, including turn lanes, acceleration/deceleration lanes (as detailed in Article 5) and traffic control improvements, sight distance at accesses (in feet), and access location (including relocation of existing access) related to adjacent road configuration (in feet)
- Multimodal transportation infrastructure and facilities required through the cross-section design elements of Article 5 for the roadway(s) providing direct project access, and connections to nearby multimodal facilities
- Personal mobility, transportation demand management (TDM), and other measures that may reduce the project's net single-occupant vehicle trips, if applicable
- Internal and external street, bicycle, and pedestrian connectivity and access requirements including connections to nearby development

4.7 Requirements – Transportation System Impact Study

A Transportation System Impact Study shall include all of the information specified in Sections 4.7.1 through 4.7.9. Where a submitted Study is found incomplete, revisions may be required.

A pre-application methodology statement is always required at this analysis level.

4.7.1 Project Description

The applicant should describe the proposed project and types of Land Uses including:

- The project's land uses (type, size, density) and their proposed phasing and timing (year) for development
- The project's site/subdivision plan shall be provided, showing internal, bordering, and immediately adjacent street cross-section details, access points (consistent with the requirements of Article 5), and pedestrian, bicycle, and transit facilities
- A description of how pedestrian, bicycle, and transit travel within ¼ mile of the site will be accommodated within the proposed site/subdivision plan

- A discussion of types of sidewalks (attached/detached), shared-use paths, and connections to existing and planned local and perimeter destinations and facilities, such as transit routes, regional trails, and other multimodal investments

4.7.2 Study Area

The project's site location and study area should be briefly described. The study area shall include all adjacent streets, intersections, and high-volume driveways; the nearest major intersection; and all streets and roads internal to the project. The location map shall include the site, study area limits, and transportation facilities, including the project access and parking, adjacent and nearby roads, bikeable shoulders, paths and trails, sidewalks, and transit stops.

- The study area may encompass at least a one-mile impact radius from the project site. Depending on the project's potential traffic impacts and at the discretion of the Transportation Department, strategic intersections or roadway links beyond the one-mile radius may also be included as appropriate.
- All signalized and key un-signalized intersections (as defined by the Transportation Department) within the one-mile impact radius shall be identified.
- All multimodal services (such as transit) shall also be identified along with school and park locations, and parking locations, type (lot, structure, etc.), and use, as appropriate.

4.7.3 Existing Conditions

Existing multimodal transportation conditions should be stated and discussed, encompassing the following issues:

- An inventory of existing multimodal transportation facilities and services (roadways, transit, pedestrian, and bicycle)
- Access management/spacing dimensions
- Average daily traffic (ADT) and peak hour traffic (PHT) volumes and Level of Service (LOS) performance on roadways and intersections within the one-mile impact area.
- Peak hour access LOS if access is existing
- Trip generation, distribution and assignment. Another trip rate may be recommended during the pre-application methodology process for developments that generate seasonal or other unusual traffic.
- LOS analysis results shall be detailed in tabular form, including seconds of delay and LOS letter grade for each individual turning movement on each intersection approach.
- Intersection signal timings
- Safety and accident analysis (scope shall be determined by the Transportation Department)
- Adjacent neighborhood and stakeholder public input about transportation-related issues
- Other issues as requested by the Transportation Department

The objective of this section is to set a facilities inventory and performance baseline against which to analyze the proposed project.

4.7.4 Trip Generation

Estimate the new vehicle trip generation to and from the site. Show the source and calculations for gross vehicle trips and pass-by trips. Local data from comparable projects are the preferred source; otherwise, trip generation rates from the ITE Trip Generation Manual are acceptable. Provide both peak hour trips and average daily traffic to and from the site. Convert the vehicle trips to person trips. The default rate to convert vehicle trips to person trips is the DRCOG Regional model rate of 1.37 people per vehicle. Other rates for specific uses will be considered if they are justified.

4.7.5 Mode Share

The objective of this section is to calculate the net single-occupant vehicle trips for traffic impact and mitigation analysis, and to maximize and ensure sufficient provisions for personal travel choices within and to/from the proposed project. Use the person trips arrived at in Section 4.7.4 and allocate person trips by travel mode (driving alone, carpool, walking, biking, transit), Person trips allocated to transit should be justified by providing an inventory of the transit routes and current transit schedules that people will use. Similarly, trips made by non-motorized modes (biking and walking) should be justified through the sidewalks, trails and paths, and bicycle facilities identified earlier.

4.7.6 Background Traffic & Adjacent Development

Background traffic is the natural growth in traffic over time not directly attributable to the project. Background traffic should be estimated through the entire project's horizon build out year and for interim phases, as applicable, and for a 20-year planning horizon. Background traffic can be based on recent historical traffic counts and growth rates, regional traffic model outputs, or another method approved by the Transportation Department. Background traffic calculations should specifically include traffic from all approved but not constructed projects, approved projects, and other significant development anticipated within the one-mile impact area that are not yet reflected in current traffic counts.

4.7.7 Trip Distribution & Assignment

Based on the trip generation rates found in Section 4.7.4, distribute and assign all single-occupant vehicle trips to the transportation network within the one-mile impact area and other streets/intersections as required by the Transportation Department. Calculations should be shown in graphic/map format as a percentage of total project single-occupant trips by roadway link and the number of existing, background, project, and total trips by link. Intersection turning movements and traffic assignments should be similarly shown.

4.7.8 Future Conditions Analysis

Based upon the trip distribution and assignment found in Section 4.7.7 calculate the vehicular Level of Service (LOS) at all intersections within the study. The LOS analysis results shall be detailed in tabular form, including seconds of delay and LOS letter grade for each individual turning movement on each intersection approach. In addition to the vehicle LOS analysis, include an analysis of other modes to identify:

- New pedestrian or bicycle safety concerns
- Pedestrian access to transit stops

Other components that should be included in the future conditions analyses are:

- Cumulative conditions (existing conditions plus other approved projects that fall within the study area)
- Cumulative conditions plus proposed project
- Traffic signal and stop sign warrants as appropriate
- Progression analysis for signalized intersections if appropriate (per the Transportation Department)
- Safety and accident analysis
- Adjacent and nearby neighborhood and stakeholder public input issues
- Other issues as requested by the Transportation Department

4.7.9 Conclusions & Mitigation Recommendations

This section should describe potential multimodal traffic and safety impacts resulting from the project, needed actions to mitigate the impacts (both immediately adjacent to the site as well as off-site mitigation measures needed as a direct result of the project), and the applicant's proposed methods to implement the mitigation measures.

This section should also detail the anticipated site access configuration (driveways, private roadways, paths, sidewalks, etc.) consistent with the requirements of Article 5 of these Standards.

The project's traffic impact mitigation obligations shall address the following:

- Safety issues across all modes
- Multimodal transportation infrastructure and facilities required through the cross-section design elements of Article 5 for internal streets, project access points, and external roadways within the one-mile impact area and connections to nearby multimodal facilities, such as transit routes and regional trails
- Proposed mode share, transportation demand management (TDM) and other measures required to reduce the project's single-occupant vehicle trips, if applicable, particularly if these measures have been included in the technical analysis
- Internal and external street, bicycle and pedestrian connectivity and access requirements
- Access infrastructure including turn lanes, acceleration/deceleration lanes, and traffic control improvements. This includes recommendations for new infrastructure as well as relocation of existing access points.
- The cost of all off-site infrastructure improvements, the percentage contribution of this project to those off-site improvements, and the anticipated source/timing of the remaining percentage of off-site improvements.

The objective of this section is to specify the nature, location, timing/triggers, cost, and responsibility of transportation investments needed to mitigate the project's traffic impacts. Consistent with Sections 4.1, mitigation strategies shall be structured as follows:

- Mode share and TDM: Strategies include transportation allowances, carpool incentives, transit passes, parking cash out and fee-in-lieu, and others.
- Vehicular travel: These strategies include access management, traffic flow, signal timing, transportation system management, and other related efforts.

Roadway or intersection capacity additions should be considered only after all other mitigation strategies noted above have been considered.

4.8 Result of Transportation System Impact Analysis

Satisfactory completion of the TSIA includes County Engineer review of how well the identified mitigation recommendations in the TSIA comply with these Standards. Refer to Section 2.8.1.

Study Parameters *For comparative purposes only. See appropriate sections for full descriptions.*			
	Transportation System Impact Letter ***Section 4.5***	Transportation System Impact Review ***Section 4.6***	Transportation System Impact Study ***Section 4.7***
Study Thresholds (ADT)	30-49	50-149	150+
Project Description	Proposal and development application Development timing and phasing	Proposal and development application Development timing and phasing Land Uses	Proposal and development application Development timing and phasing Land Uses Site/subdivision plan Pedestrian, bicycle, and transit travel within ¼ mile of the site Type of sidewalks, shared-use paths and connections to existing and planned destinations
Study Area	Each access point plus 150 feet in each direction on the adjacent roadway OR Project frontage on the adjacent roadway(s)	All adjacent streets, intersections, and high-volume driveways Nearest major intersection All streets and roads internal to the project	One-mile impact radius from project site All signalized and key un-signalized intersections All multimodal facilities, infrastructure, & services School and park locations Parking locations, type (lot, structure, etc.), & use
Evaluation Elements Existing/ Future Conditions	Inventory of existing multimodal transportation facilities and service Project average daily traffic (ADT) volume Access spacing dimensions Sight distance Accident history Other issues as requested	Inventory of existing multimodal transportation facilities & service Access management/spacing dimensions Average daily traffic (ADT) or peak hour traffic (PHT) volumes on adjacent roadway(s) LOS on adjacent roadway Peak hour access point(s) LOS Trip generation, distribution and assignment Cumulative conditions Cumulative conditions plus proposed project Safety and accident analysis Public input issues Other issues as requested	Inventory of existing multimodal transportation facilities and service Access management/spacing dimensions Average daily traffic or peak hour traffic volumes LOS performance on roadways & intersections Peak hour access LOS Trip generation, distribution and assignment Intersection signal timings Safety and accident analysis Mode share Pedestrian and bicycle hazards Pedestrian access to transit stops New barriers to non-motorized facilities Cumulative conditions Cumulative conditions plus proposed project Signal and stop sign warrants Progression analysis for signalized intersections Public input issues, and other issues as requested
Conclusions & Mitigation Recommendations	Sight distance for project access Access location Multimodal transportation infrastructure appropriate to location	Safety and access management Multimodal transportation infrastructure and facilities Personal mobility, transportation demand management (TDM) and other measures that may reduce project's net external single-occupant vehicle trips Internal and external street, bicycle and pedestrian connectivity and access requirements Access infrastructure	Safety issues across modes Multimodal transportation infrastructure and facilities required Proposed mode share, transportation demand management (TDM) & other measures that may reduce project's net external single-occupant vehicle trips Internal and external street, bicycle and pedestrian connectivity and access requirements Access infrastructure Cost of all off-site infrastructure improvements Percentage contribution of the project to off-site improvements Anticipated source/timing of the remaining percentage of off-site improvements Mode share and TDM strategies Vehicular travel strategies

Article 5 - Design Standards

5.0 Introduction - Application of Design Standards

The planning, design, and construction of all Multimodal Transportation facilities shall follow the Overall Design Principles while meeting the design standards contained in this article. The design of private development shall incorporate these principles and standards.

5.1 Overall Design Principles - General

The design principles described below and the design standards following are intended to ensure a consistent baseline level of safety, functionality, and environmental sensitivity throughout all transportation facilities in Boulder County.

5.1.1 Safety

Transportation facilities shall be designed and constructed in a manner that ensures adequate safety for multiple user types. Adequate emergency vehicle access shall be ensured through consultation with the appropriate Fire Protection District.

5.1.2 Multimodal Mobility

Transportation facilities shall be designed and constructed so as to maximize the mobility of people, goods, and services by multiple transportation modes, including motorized vehicles, bicycles, pedestrians, and transit.

5.1.3 Natural Environment and Surrounding Community

Transportation facilities shall be designed and constructed to minimize impacts to the natural environment and surrounding community. These include impacts to trees and vegetation; air, noise, and water pollution; green house gas emissions (GHG), visual and aesthetic impacts; plant and animal species impacts; riparian area and wetlands impacts; wildlife corridor and habitat fragmentation; impacts to community character; and impacts to historic and cultural resources.

5.1.4 Maintenance

Transportation facilities shall be designed to allow for maintenance operations by Boulder County or other entities responsible for maintenance activities.

5.1.5 Sustainability

Transportation facilities shall be designed and constructed to minimize the quantity of materials needed, utilize recycled materials, use local materials, reduce water use, and minimize energy consumption (initial and ongoing).

5.1.6 Cost

Public transportation facilities shall be designed to be cost-efficient and cost-effective for construction and maintenance.

5.1.7 Other Considerations and Public Agencies

Transportation facilities shall meet all applicable local, state, regional, and federal design requirements. Whenever a provision of these Standards and a provision of any other law, ordinance, resolution, rule, or regulation of any kind, including another provision of these Standards, contain any restrictions covering the same subject matter, the more restrictive shall govern.

5.2 Design Elements

5.2.0 Introduction

The Standards presented herein represent the engineering design standards. Deviations from these Standards to balance the different objectives and policies in the Boulder County Comprehensive Plan may be requested of the County Engineer.

The following design factors shall be considered in the application of these Standards. In general, documents from the American Association of State Highway and Transportation Officials (AASHTO), Manual on Uniform Traffic Control Devices (MUTCD), and Colorado Department of Transportation (CDOT) are used in the County and these documents and standards are referenced throughout. Unless specifically stated otherwise, the most current version of all referenced items shall be utilized. See Appendix IV for referenced documents and their abbreviations used throughout the Standards.

5.2.1 Terrain Classification

Standards for facility construction are dependent on project location, which falls in to one of two general categories:

- Flat or Rolling Terrain: Average cross slope is less than 15 percent and the ridges and draws are not well defined. Most of the land east of US 36 (the foothills) falls into this category.
- Mountainous Terrain: Average cross slope is greater than 15 percent and the ridges and draws are steep and well defined. Most of the land west of US 36 (the foothills) falls into this category.

5.2.2 Road Classification

The functional classifications are defined in Section 3.2.1 and illustrated in the Boulder County Road Map. The County Engineer shall also determine the correct functional classification for a given roadway when the sources noted in this section differ or are otherwise inconsistent.

5.2.3 Design Speed

Design speed is the speed selected for a given transportation facility for use in determining the appropriate geometric design features. These features influence vehicle operations and the interaction between vehicles of different travel modes and the interaction with pedestrians. The Corridor type, Functional Classification of the facility, terrain, adjacent land uses, mix of travel modes, and the desired vehicle operating speed combine to influence the design speed. On higher-level facilities (Collector and above) the design speed may be higher than the intended posted speed limit to support safe vehicle operations. On lower level facilities the design speed may be at the intended posted speed limit so that the design of the facility itself supports the desired travel speed.

5.2.3.1 Roadway Design Speed

The initial recommended design speed for roadways is included in the following table, depending on the terrain and Functional Classification. The County Engineer will make the final determination as to roadway design speed by considering the specific character of the roadway and its context in the overall transportation system.

The design speed for a roadway of a given Classification may change along its length even in cases where the Functional Classification of the roadway does not change due to changes in land use, terrain, and multi-modal travel considerations that may exist in a corridor.

Table 4. Roadway Design Speed (miles per hour)

Classification Label	Functional Classification (consistent with Boulder County Road Map)	Terrain Classification	
		Flat or Rolling	Mountainous
PA	Principal Arterial	60	50
MA	Minor Arterial	50 - 55	40 - 45
C	Collector	25 - 50	20 - 45
RC	Residential Collector	up to 30	up to 25
L	Local	up to 45	up to 30
LS	Local Secondary	up to 25	up to 25
J	Jeep Road (Not Maintained for access by passenger cars)	N/A	N/A

NOTE: There is a range of design speeds shown in the table above. The design speed for a particular road or road-way section shall be context sensitive and include consideration of factors such as, but not limited to, neighborhood character, accident history, traffic volumes, adjacent land use character, access, transit, pedestrian and bicycle facility use, topography, sight distance, and other roadway geometric constraints. The design speed listed above does not necessarily indicate the appropriate posted speed limit. In some cases, the County may install a posted speed limit that is lower than the design speed of the roadway. The posted speed limit shall not exceed the design speed for the roadway.

5.3 Facility Design

The intent of Boulder County multimodal corridors is to provide for the safe movement of people and goods. Because these corridors define the public landscape, it is important that they remain consistent with the topography, local character, and values of the County. The County roads shall fit within the landscape with low impact.

5.3.1 Cross Section Elements

The Cross Sections provided in Appendix I and summarized in Table A-1 include the standard dimensions for roadway facilities including vehicle travel lanes, turn lanes, parking lanes, bicycle lanes, shoulders, sidewalk buffers, sidewalks or shared paths, and overall right-of-way width requirements by corridor type and functional classification. Cross sections are included for the following roadway classifications:

- Principal Arterial – pg. A-2
- Minor Arterial – pg. A-3
- Collector – pg. A-3
- Residential Collector – pg. A-3
- Local, Local Secondary– pg. A-4

And in addition, while there is no Classification for historic townsite facilities they are occasionally improved per the following:

- Townsite Road – pg. A-4

5.3.1.1 Right-of-Way Width

The minimum right-of-way width for each typical cross section has been identified as sufficient to accommodate the specific cross-sectional elements depicted in Appendix I and Table A-1. Additional right-of-way may be required for additional through lanes or auxiliary lanes, curb returns, drainage improvements, transit facilities, or separated bikeways or regional trails.

5.3.1.2 Roadway Width

The County maintains reasonable pavement width and right-of-way requirements by avoiding excessively wide vehicular travel lanes, parking lanes, and turn lanes and by widening roadways and intersections only after exhausting multimodal and Transportation Demand Management (TDM) alternatives. Additional considerations influencing roadway width shall include the need or desire to provide:

- The addition of paved shoulders to accommodate bicycling
- A designated lane or pull-off area for transit boardings and alightings
- Adequate pavement width and clear space to accommodate maintenance (e.g. snow removal and storage)
- Adequate pavement width and clear space to accommodate emergency vehicles
- Community character
- Visual and environmental impacts

5.3.1.3 Vehicular Travel Lane Width

Wider lanes than those shown in the standard cross sections should be considered on arterials where a significant amount of heavy truck traffic or transit vehicle traffic is anticipated or on roads that do not have separate paved shoulders, to allow for bicycle travel.

5.3.1.4 Shoulder Width

Section 3.2.2.1 provides an explanation of roadway shoulder functions and related considerations. Specific design considerations are outlined below:

a. Eastern / Plains – In the eastern or plains portion of the County, paved roads classified as Arterials (Principal or Minor) or Collectors, shall be designed with paved shoulders to facilitate bicycle travel where included in adopted plans (Article 3) or for connectivity to the bicycle network. See Table A-1 for dimensions. In some cases, the width of the vehicular travel lanes may be narrowed to 10 or 11 feet to provide adequate shoulder width for safe bicycle travel.
b. Western / Mountainous – Shoulders on paved arterial and collector roadways in the western or mountainous portion of the County should be constructed as wide as practical to facilitate bicycle travel. In cases where it is not practical to construct 4-foot wide shoulders on both sides of the roadway, then a minimum 4-foot wide shoulder should be added to the roadway in the direction of uphill travel to accommodate slower moving bicycles.

5.3.1.5 On-Street Parking

See Section 5.6.3 for a discussion of on-street parking design criteria.

5.3.1.6 Curbs and Gutters

Curbs and gutters shall be used where required by drainage, traffic or public safety considerations, or to support the local land use character.

Curb and gutter shall be concrete. Temporary curb installations may be constructed with asphalt with prior approval of the County Engineer.

5.3.1.7 Sidewalks

See Section 5.3.7 for a discussion of sidewalk and other pedestrian facility design considerations.

5.3.2 Typical Cross Section Design

The major factors in roadway design should include, but are not limited to, the following technical requirements: Functional Classification, design speed, safety, multimodal user mix, vehicle type and mix, land use type and character, residential density, environmental impacts, available right-of-way, and construction costs. Cross-sectional elements may provide for additional facilities within the right-of-way, including utilities and maintenance operations.

5.3.2.1 Crown Slope

On undivided roads in tangent alignment, the high point of the crown shall be at the centerline of the pavement and the pavement sloped toward the edges on a uniform grade. In mountainous terrain, local and local secondary roads should be sloped toward the cut side of the road on a constant two percent grade to alleviate surface erosion due to runoff, provided safe speed requirements are met. On divided multi-lane standard roads on tangent alignment, each pavement should have a uniform cross slope with the high point at the edge of the inside shoulder. At intersections, or in unusual situations, the crown position may vary depending upon drainage or other controls.

Standard crown slopes to be used on the traveled way for different pavement and surface types are as follows:

Crown Slopes	
Type of Surface	Crown Slope (%)
Bituminous Mix and Concrete Pavements	2.0
Gravel Surfacing	2.0

These slopes are considered to be optimal, but may vary depending on existing topography and other design factors, such as superelevated roadway sections. The County Engineer shall approve crown slopes varying +/- 0.5 percent of the optimal design slope for a typical crowned roadway.

5.3.2.2 Cut & Fill Slopes

All slopes shall be designed for functional effectiveness, ease of maintenance, and pleasing appearance and shall be revegetated with low growing, erosion resistant grasses (native where possible and always non-invasive). Grades of roads should conform as much as possible to the original topography. 3:1 slopes or flatter are preferred. Stable cut and fill slopes shall be provided no steeper than 2:1 on the plains and 1.5:1 in mountainous areas. A geotechnical report may be required for slopes greater than 2:1.

The tops of all cut slopes shall be rounded with a minimum of 10-foot radius where the material is other than solid rock and shall be revegetated.

The County Engineer shall approve the revegetation-seeding plan or if project received approval through a Land Use Code process the Land Use Department will review with consultation from Parks and Open Space. For detailed, technical information regarding cut and fill slopes adjacent to roadways, refer to the CDOT Roadway Design Guide and AASHTO publications.

Flatter slopes shall be required in unstable soils. Cut slopes steeper than the CDOT standard may be considered in special situations such as in solid material but require prior approval by the County Engineer.

The backslopes at ends of all cuts, except rock, shall be flattened. The ditch at the lower end of cuts shall be widened gradually to discharge side ditch drainage away from the base of adjacent fill slopes in order to avoid erosion and improve appearance.

In areas where right-of-way width is fairly constant, a pleasing appearance can be obtained by keeping the catch points for a given cut a fixed distance from the centerline. This constant distance catch point will:

- Provide a smooth transition from cut to fill
- Allow smooth rounding at ends of cuts and fills
- Permit the flattest possible slopes within the right-of-way limitations, thus encouraging better revegetation and erosion control

The necessity of benches, their width and vertical spacing shall be established only after an adequate materials investigation of the site. Since greater traffic benefits are realized from widening a cut than from benching the slope, benches should be used sparingly and only where they are justified by sound engineering principles.

When benches are allowed, for ease of maintenance, a 12-foot bench width is satisfactory. Benches should be sloped to form a valley of at least one-foot deep with the low point, a minimum of 4 feet from the toe of the upper slope. Access for maintenance equipment should be provided to the lowest bench and, if feasible, to the higher benches.

5.3.2.3 Horizontal & Vertical Clearances

Minimum clearances to structures or other roadside obstructions, including cut and fill slopes, shall be designed per the AASHTO Roadside Guide.

5.3.3 Geometric Standards

Horizontal and vertical design includes evaluating the following: existing topography, design speed, grade profile, subsurface conditions, safety, sight distance, available rights-of-way, and construction costs.

For specific design parameters as well as procedures for determining geometric performance for urban and rural roads that are not covered within these Standards, refer to the latest versions of the AASHTO Green Book, AASHTO Roadside Guide, AASHTO Pedestrian Guide, AASHTO Bicycle Guide, AASHTO Flexibility Guide, and AASHTO Low-Volume Guide.

5.3.3.1 Horizontal Alignment

Factors utilized for horizontal design should include, but not be limited to, the following:

a. Design Speed

Refer to Section 5.2.3 for Design Speed definitions and criteria.

b. Sight Distance

The horizontal alignment shall provide at least the minimum stopping sight distance for the design speed at all points as defined by AASHTO. This includes visibility at intersections as well as around curves and roadside appurtenances.

In some cases, passing sight distance may be required on Residential Collectors, major Collectors, or Arterials. Passing sight distance design criteria are defined by AASHTO.

Where an object off the pavement such as a bridge pier, cut slope, or natural growth restricts sight distance, the stopping sight distance determines the minimum radius of curvature.

c. Curvature

The minimum curve radii and the maximum allowable rate of superelevation for County public roadway design shall be as outlined in the AASHTO Green Book. The tables are based on design speed, friction factors, and superelevation and do not consider sight distance. Minimum radii should be used only when the cost of realizing the higher standard is inconsistent with the benefit and is approved by the County Engineer.

Sudden reductions in standards introduce the element of surprise to the driver and should be avoided. Where physical restrictions cannot be overcome and it becomes necessary to introduce curvature of a lower standard than the design speed for the project, the design speed between successive curves shall not change by more than 10 mph increments. It is desirable that a curve for a design speed lower than the design speed of the project not be introduced at the end of a long tangent or at other locations where high approach speeds may be anticipated. Combinations of steep grades and curves should be avoided. Use of lower standard curve radii must be fully justified and is subject to approval by the County Engineer.

Design Speed (mph)	Minimum Curve Length (feet)
≤ 30	200
30 - 40	300
≥ 40	400

Angle points less than one degree require no curve radius. Compound curves are not permitted.

Ending a curve on a bridge is undesirable and adds to the complications of design and construction. If curvature is unavoidable, the bridge must be kept within the limits of a simple curve.

Reversing curves without an intervening tangent will not be permitted. Existing physical restrictions may dictate the use of curves in opposite directions with a short intervening tangent. In such cases, the minimum length of tangent shall be as shown in Section 5.3.3.1d. A broken-back curve is two curves in the same direction joined by a short tangent. Broken-back curves are not permitted.

d. Tangents

Minimum tangent lengths between curves shall be 400 feet for all Principal Arterial, Minor Arterial, and Collector roads. For Residential Collectors, Local and Local Secondary road classifications, the tangents between curves shall be as shown on the following table:

Residential Collectors, Local and Local Secondary	
Design Speed (mph)	Minimum Tangent (feet)
15	50
20	75
25	100
30	150
35	200
40 & above	250

5.3.3.2 Vertical Alignment

The centerline profile is a reference line by which the elevation or grades of the pavement and other features of the roadway are established. It is controlled by topography, structure clearances, horizontal alignment, safety, sight distance, design speed, available rights-of-way, construction costs, and the performance of heavy vehicles on a grade.

a. Centerline Profile Position

The centerline profile should be positioned with relation to the cross-section as follows:

- It shall coincide with the road centerline on two-lane and multi-lane undivided roads.
- On multi-lane divided roads, the grade lines shall be placed at the edge of the travel lane nearest the median.

b. Minimum & Maximum Grades

Minimum sustained grades shall be no less than 0.5 percent in curbed areas.

Maximum sustained grades for new roads are related to design speed as follows:

Maximum Sustained Grades (%)							
	Design Speed (mph)						
Terrain Classification	**15**	**20**	**25**	**30**	**40**	**50**	**60**
Plains	6	6	6	6	6	5	4
Mountains	12	10	9	9	8	6	N/A

The maximum design grade should be used infrequently rather than as a value to be used in most cases. At the other extreme, for short grades less than 500 feet, the maximum gradient may be increased by 1 percent.

In the plains, all grades shall flatten to 4.0 percent or less for at least 100 feet approaching intersections and for at least 50 feet entering and leaving turnarounds or cul-de-sacs. In the mountains, all grades shall flatten to 6 percent or less for at least 50 feet approaching intersections and entering switchbacks on cul-de-sacs.

c. Vertical Curves

Properly designed vertical curves shall provide adequate stopping and passing sight distance, headlight sight distance, comfortable driving, good drainage, and pleasing appearance.

Vertical curves shall be parabolic, and the vertical curves shall be designed based upon discussions provided by AASHTO. Unequal tangent vertical curves are permitted only in special circumstances as approved by the County Engineer.

d. Sight Distance

Stopping sight distance requirements as outlined in the ASSHTO Green Book controls minimum lengths of crest vertical curves.

e. Superelevation

For undivided roads, the axis of rotation for superelevation should be at the centerline. Where long relatively level tangents precede curves, however, the plane of superelevation may be rotated about the edge of pavement to improve perception of the curve. Drainage pockets may also cause the axis of rotation to move from the centerline to the inside edge of pavement. Superelevations greater than 4.0 percent require County Engineer approval.

A superelevation transition is variable in length depending upon the amount of superelevation. With respect to the beginning and end of the curve, two-thirds of the transition is in the tangent approach and one-third within the curve. This results in two-thirds of the full superelevation at the beginning and at the end of the curve. Curve transitions shall be designed using the CDOT Roadway Design Guide.

For further discussion on superelevated roadways and for superelevation design standards, refer to the AASHTO Green Book.

5.3.4 Non-Connective Road Alignments

5.3.4.1 Connectivity

Roadway connections shall be made to adjacent developments whenever possible to facilitate emergency access, minimize trip distances and ultimately reduce the need for roadway widening. Pedestrian and/or bicycle connections shall be made, even (and especially) when roadway connections are not feasible. Creating non-motorized connections in new developments and formalizing existing social trails promotes walking and bicycling trips and minimizes potential trespassing/property line disputes.

5.3.4.2 Cul-de-sacs

Cul-de-sac radii for County Maintained roads shall meet the following criteria:
Areas served by single axle plows:

a. 40 foot minimum radius to edge of pavement
b. If a one-way road is proposed within a cul-de-sac the width shall be 16 feet
c. If parking is allowed within the cul-de-sac the radius shall be 55 feet

Areas served by tandem axle plows:

a. 55 foot minimum radius to edge of pavement
b. If a one-way road is proposed within a cul-de-sac the width shall be 16 feet
c. If parking is allowed within the cul-de-sac the radius shall be 55 feet

Cul-de-sac radii not maintained by the County shall meet the smaller of the requirements of the serving fire district or the County standard.

Cul-de-sac grades shall be maximum 4 percent in flat and rolling terrain and 6 percent in mountainous terrain. In situations where adequate right-of-way is not available or in cases where the construction of a cul-de-sac will create undue scarring, a “T” or “Y” turnaround design may be used if approved by the County Engineer.

5.3.4.3 Stub Roads

Roadway facilities within a new development that are designed to provide future connectivity to adjacent properties shall be constructed according to the applicable roadway classification cross -section to the project boundary or as directed by the County Engineer. Maintenance on stub roads would begin once a connection through to an adjacent road is complete.

5.3.5 Intersections at Grade

At grade roadway intersections shall be designed to safely and efficiently accommodate anticipated automobile, truck, bus, bicycle, and pedestrian traffic. Once the appropriate multimodal travel mix has been determined, the intersection shall be designed using the criteria contained in these Standards and the AASHTO Green Book.

5.3.5.1 Horizontal and Vertical Curves at Intersections

Intersections occurring on horizontal and/or crest vertical curves are undesirable due to the potential for limited sight distance and problems with roadway profile design. To the extent possible, intersections should be located to avoid horizontal and crest vertical curves.

5.3.5.2 Intersection or Access Approach Width

The width of a roadway, driveway, or access approaching an intersection shall be measured exclusive of any flares or radii on the approach. The width of an access approach shall be as required in Section 5-5. Where pedestrian traffic is anticipated, the width of the roadway intersection approach shall be as narrow as practical to minimize pedestrian exposure while crossing the path of vehicular traffic.

5.3.5.3 Intersection or Access Approach Radii

The following shall apply:

- Where pedestrian traffic is anticipated, the corner radii shall be as small as practical to minimize the size of the intersection and the associated pedestrian crossings.
- The designer shall not only consider the corner radii to be provided, but shall also consider other factors that affect the vehicle equivalent inside turning paths, such as on-street parking and available shoulder width, presence of a median which limits the available width, etc. For example, a corner with a curb (or edge of pavement) radius of 10 or 15 feet may provide an equivalent inside turning radius of more than 20 feet as illustrated in Standard Drawing 7.
- A minimum of 50 foot equivalent inside turning radii shall be used for driveways when multi-unit vehicles are intended to use the access on a daily basis.
- The equivalent turning radii shall not be less than that necessary to accommodate the turning radius of the largest vehicle for which the access approach is intended to be used on a regular basis.
- Local or Local Secondary approach on to Local or Local Secondary roads shall have an equivalent inside turning radius not less than 15 feet.
- A Local or Local Secondary approach onto a Residential Collector or higher classification shall typically have a 25-foot equivalent inside turning radius.
- Any Residential Collector approach onto a higher classification shall have a 30-foot equivalent inside turning radius.
- Intersections involving Collector and Arterial roads are to be designed individually with design criteria subject to approval by the County Engineer.

5.3.5.4 Channelization Principles and Additional Lanes on Intersection Approaches

Channelization typically involves some type of left and/or right turn treatment and can result in efficiency to traffic flow. In addition, areas can be provided for pedestrian refuge. The need for additional lanes on an intersection approach shall be documented in an approved traffic study, using procedures detailed in the Highway Capacity Manual (HCM) and turn lane warrant considerations in the National Cooperative Highway Research Program (NCHRP) 279. However, the need for additional vehicle lanes on intersection approaches shall also consider their impact on pedestrian and bicycle traffic at the intersection, and the decision to allow or require additional lanes should not be based solely on vehicle traffic volume and/or operations.

The addition of left and right turn lanes widens the crossing distance and increase the distance for pedestrians traversing the intersection. Intersection design shall provide for the needs of pedestrians, bicyclists, and transit vehicles where appropriate on their approaches to and departures from an intersection. Pedestrian activity may result in the need for pedestrian refuge islands in a median or the creation of right turn islands to shorten and simplify pedestrian crossings.

The geometric design of intersection turn lanes shall be consistent with guidelines in the AASHTO Green Book and storage length requirements detailed in the approved traffic study. Transition or bay taper ratios on side street approaches may typically be designed at 8:1.

Turn lane widths should typically be 10 feet wide unless wider widths are warranted by the roadway classification, turning vehicle volume, or design vehicle. The installation of additional traffic lanes on an intersection approach, and the design of said lanes, shall be approved by the County Engineer.

At larger signalized intersections where right turn islands (raised or striped) exist and transit service is provided, the County will determine the need to accommodate transit vehicles and/or bicycles through the intersection area. In some cases a right turn deceleration lane may become a “bus and bike only” lane through the intersection area adjacent to the islands. See Standard Drawing 6.

See Section 5.3.6 for additional considerations for bicyclists on intersection approaches.

See Section 5.3.7 for additional considerations for pedestrians at intersections.

See Section 5.8 for additional considerations for transit users and buses at intersections.

5.3.5.5 Speed Change Lanes

Speed change lanes can improve the safety and efficiency of an intersection by allowing exiting and/or entering vehicles to decelerate or accelerate outside of the through vehicle lanes. Speed change lanes are typically only installed on County roadways classified as Arterials or higher. Since speed change lanes can increase the crossing distance for pedestrians and affect transit and bicycle facilities their use shall be evaluated in the context of the corridor. The provisions of the State of Colorado State Highway Access Code shall be used to evaluate the need for a speed change lane, with the following considerations, using CDOT definitions of rural and non-rural:

- If rural, the arterial should be assumed to be a Rural Highway (R-B)
- If non-rural, the arterial should be assumed to be a Non-Rural Arterial (NR-B)

When it has been determined that a speed change lane is warranted, the geometric requirements of the State Highway Access Code shall be used with these Standards.

5.3.5.6 Intersection Sight Distance Considerations

Intersection sight distance shall be determined according to the AASHTO Green Book.

In addition to the stopping sight distance necessary for vehicles traveling on the highway to see objects in the traveled way, it is also necessary to provide the vehicle entering the intersection adequate sight distance in order to enter or cross the highway. The AASHTO Green Book shall be used to determine the appropriate minimum sight distance necessary for entering vehicles. For most intersections with stop sign control on the minor street approach, Cases B1 – Left turn from the minor road, B2 – Right turn from the minor road, and B3 – Crossing the major road from a minor road approach shall be used.

Access Permits or Building Permits shall not be issued that include any design elements, or allow any turning movements, where the stopping sight distances are not adequate to allow the safe movement of any vehicle using the access approach or vehicle passing the access approach. Any proposed intersections that do not provide intersection sight distance consistent with Cases B1, B2, and B3 in the AASHTO Green Book Intersection Sight Distance criteria shall require special approval by the County Engineer.

Any roadway or access approach to a multi-use path crossing must have clear sight triangles that provide adequate stopping sight distance for both vehicles on the roadway (or access) and bicycles on the multi-use path to avoid collisions in the multi-use path intersection.

5.3.5.7 Other Design Elements

Other intersection or access design elements that shall be considered include:

- Within the right-of-way, maximum grades for low volume residential driveways shall be as specified in Section 5.5.
- The horizontal axis of an approach to the highway shall normally be at a right angle to the centerline of the highway and extend a minimum of 40 feet beyond the traveled way. An angle between 90 and 60 degrees shall be acceptable only if physical constraints require a skew angle less than 90 degrees. An angle less than 60 degrees requires County Engineer approval.
- An access approach that has a gate across it shall be designed so that the longest vehicle using it can completely clear the traveled way when the gate is closed.

5.3.6 On-Street Bicycle Facilities

The design standards in this section help provide safe and efficient facilities for on-street bicycle travel. Off-street bicycle travel along multi-use paths is addressed in Section 5.7.

All on-street bicycle facilities in Boulder County shall be designed and constructed consistent with the latest version of the AASHTO Bicycle Guide. Traffic signing and marking should be consistent with the latest edition of the MUTCD and any Colorado supplement. Additional considerations are detailed in the sections below.

5.3.6.1 Bikeable Shoulders

Shoulder width requirements are described in Section 5.3.1.4. Shoulders shall be delineated with a white line at the outer edge of the outer vehicular travel lane in each direction.

5.3.6.2 Bicycle Considerations for Intersection Approaches

All shoulder edge line striping shall terminate on the approach to an intersection at the point of pavement or curb curvature so that the shoulder edge line does not curve to the right into the intersection. This is necessary so that shoulder edge lines do not imply the need to turn right for bicyclists traveling along the shoulder on an intersection approach. Shoulder edge line striping should be resumed at the far side of the intersection adjacent to the pavement edge or curb line point of tangency. This is illustrated on Standard Drawing 4.

Where a separate right turn lane is created at an intersection on a Collector or Arterial roadway, a 5-foot wide striped bicycle lane shall be striped and marked between the right turn lane and the adjacent through lane to accommodate bicyclists traveling straight through the intersection. The transition area between the shoulder bikeway and the intersection bicycle lane should be signed and marked consistent with recommendations of the MUTCD which provides details of bicycle lane treatment at a right turn only lanes. Use of short dashed lines delineating the transition between the shoulder bikeway and the intersection bicycle lane is recommended. This treatment helps identify the necessary crossing area between the right turning automobile traffic and the through bicycle traffic.

A "Begin Right Turn Lane, Yield to Bikes" sign (MUTCD type R4-4) should be placed at the beginning of the right turn lane taper where it diverges from the shoulder approach. This treatment is illustrated in Standard Drawing 4.

This type of intersection bicycle lane treatment is also recommended on the downstream side of an intersection where there is a right turn acceleration lane merging onto the through roadway as illustrated in Standard Drawing 6.

On Arterial and Collector roadways where there is not adequate width for a bicycle lane between a right turn lane and a through lane on an intersection approach, the bicycle lane shall be incorporated into the left edge of the right turn lane. On the approach to the intersection, the transition of the bicycle lane or bikeable shoulder to the bicycle lane within the right turn lane shall be delineated using dashed bicycle lane striping (through the transition area and along the right edge of the bicycle lane where it overlaps with the right turn lane on the approach to the stop bar). This treatment is illustrated in Standard Drawing 5.

Where there is a bikeable shoulder or a bicycle lane on the approach to an intersection that has right turn islands, a bicycle lane should be striped and marked through the intersection adjacent to the islands as illustrated in Standard Drawing 6.

All intersections with traffic signals shall have adequate detection designed to accommodate bicycle traffic as follows:

Detecting bicycles with loop detectors:

a. Loop Placement - Bicycle-sensitive detectors shall be installed at all traffic-actuated signals, and shall be installed where bicyclists are likely to travel (i.e. the right side of through travel lanes or the center of bicycle lanes).
b. Loop Type - Quadrupole loop sensors shall be used in place of dipole sensors to more reliably detect bicycles, motorcycles, and other small vehicles at signalized intersections. This loop configuration minimizes the false positive detections (due to large vehicles in adjacent lanes) common with dipole loop sensors adjusted to detect smaller vehicles.
c. Pavement Markings - The Bicycle Detector Symbol recommended in the latest version of the MUTCD shall be used to indicate the location of traffic-actuated signal detectors.

Detecting bicycles with alternative detection:

d. Push Buttons - In some situations, the use of pedestrian- or bicyclist-actuated buttons may be an acceptable alternative to the use of loop detectors provided they do not require bicyclists to dismount or make unsafe leaning movements. Actuated buttons should not be considered a substitute for detectors, particularly where right turn only lanes exist.
e. Video Detection - Where video detection is utilized, care should be taken to ensure that it detects bicyclists and motorcyclists.

See also Section 5.3.5.4 for additional considerations for bicyclists on major intersection approaches.

5.3.6.3 Bicycle Lanes

All bicycle lane markings and signage shall conform to the latest version of the MUTCD.

Bicycle lane pavement marking symbols and legends shall be pre-formed thermoplastic materials.

Bicycle lane requirements are presented by facility type in Appendix I and summarized in Table A-1. Facility design considerations include:

- When striped against the curb and there is a seam or grade break at the edge of the gutter pan, bicycle lanes shall be at least 4 feet in width (exclusive of the gutter pan), striped with a line 6 to 8 inches in width separating the bicycle lane and travel lane. When bicycle lanes are four feet in width, the measured area shall not include the gutter pan or drainage grates.
- Where the bicycle lane and the gutter pan are poured as a single integral surface with no seams or significant lateral grade breaks, a 5-foot total width of the bicycle lane is acceptable.
- When on-street parking is present, bicycle lanes shall be at least 5 feet in width (6 feet preferred to minimize door zone conflicts), striped with a line 4 inches in width separating the bicycle lane and parking lane, and a line 6 inches in width separating the bicycle lane and travel lane.
- When the line separating the bicycle lane and travel lane is dashed (e.g. at an intersection with a right turn lane), the dash shall be 2 feet in length and 6 inches in width, with 6 feet between dashes.

5.3.6.4 On-Street Bicycle Routes

Bicycle Route signs may be used on County roadways where it is desirable to define or emphasize an on-street bicycle corridor or it is necessary to identify a roadway connection between portions of off-street shared use paths. Destination and distance information may be added as appropriate per the MUTCD.

5.3.6.5 Share the Road Signs

"Share the Road" sign installations warn motor vehicle traffic that bicycles will be moving along the roadway and indicate the need to share the roadway with bicyclists. The appropriate signs as defined by the MUTCD should be posted along roadways where the potential for bicycle / vehicle conflict is high, especially on mountain roads with limited shoulders or in other locations where road shoulders narrow requiring bicycles and other vehicles to travel in close proximity.

Where used, "Share the Road" signs should be posted after every major intersection and at an intermediate spacing of between 1 and 2 miles in each direction when no major intersections exist.

5.3.7 Sidewalks / Pedestrian Facilities

5.3.7.1 Location

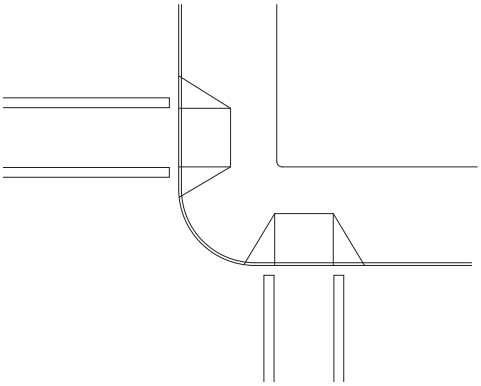
Where sidewalks are needed to support pedestrian travel, sidewalks should be installed along Principal Arterials, Minor Arterials, Collectors and Residential Collectors, and along local access roads. Sidewalks along both sides of these roads should be considered as the standard unless it can be shown to the satisfaction of the County Engineer that a sidewalk along only one side of the road is adequate to provide for pedestrian mobility in the area. See Appendix A-1 for widths.

Shared use paths (facilities other than sidewalks) are discussed in Section 5.7 Shared Use Path Design Standards.

5.3.7.2 Design and Accessibility

Sidewalks shall be constructed in accordance with the M & S Standards, and comply with relevant segments the Americans with Disabilities Act (ADA) B&F Accessibility Guide, and the ADA R/W Accessibility Guide. Guidelines to be noted include, but are not limited to, curb ramps and detectable warnings, cross slopes, width, and clearance. Refer to Appendix I for sidewalk width and buffer requirements by facility and area type.

Separate curb ramps should be installed for every crosswalk at the corner of an intersection, oriented to direct pedestrians into the crosswalk (as illustrated below). When constructed, curb ramps shall match the existing or planned width of the adjoining sidewalk facility. Detectable warnings (truncated domes, shown below) shall be installed across sidewalks and shared use paths where they access roadways, even if there is no curbing along the roadway and no curb ramps installed. The width of detectable warning zone shall match the width of the adjoining facility.



Perpendicular Curb Ramp

5.3.7.3 Pedestrian Crossing Treatments

Pedestrian crossing treatments are usually required at an intersection or at a mid-block location. High traffic volumes and/or speeds, multi-lane crossings, high pedestrian volumes, shared-use path intersections, or proximity to a school, bus stops, or significant pedestrian destination will trigger the need for enhanced pedestrian crossing treatments. See Standard Drawings 9 and 10 for the selection of appropriate pedestrian crossing treatments. These treatments may range from a simple crosswalk, enhanced pedestrian crossing signing, median refuge island, pedestrian traffic signal, to an underpass or overpass.

Possible installations include:

- marked crosswalk
- marked crosswalk with signing on the approaches and at the crossing
- marked and signed crosswalk with a pedestrian refuge median (See Standard Drawing 8)
- pedestrian actuated rapid flash warning signs
- HAWK (High-intensity Activated Cross Walk) pedestrian actuated crossing signal
- conventional traffic signal at a pedestrian crossing
- pedestrian crossing heads and push buttons at a signalized intersection
- grade separated pedestrian crossing (underpasses typically preferred; see Sections 5.10.2 and 5.10.3 for a discussion of pedestrian overpass and underpass design, respectively)

Where crosswalks are installed, they shall comply with the following:

Crosswalk dimensions:

- 24-inch wide crosswalk bars shall be used.
- All crosswalk bars shall be 9 feet in length.
- Crosswalks should be applied with heat fusion pre-formed thermoplastic materials.

5.3.8 Traffic Control Devices and Other Roadway Appurtenances

Roadway design shall incorporate signs, striping, delineators, signals and other traffic control devices designed to guide all transportation system users on roadway segments and through intersections in a safe and efficient manner.

All traffic control devices shall conform to the latest edition of the MUTCD and any Colorado supplement.

5.3.8.1 Street Name Signs

Street names signs shall be green in color with white lettering. Non-standard street name signs will not be allowed.

5.3.8.2 Traffic Signals

The design and installation of a traffic signal shall be consistent with the traffic control guidance contained in the MUTCD and all appropriate CDOT design specifications.

Pedestrian traffic signal heads and push buttons shall be included at any intersection where pedestrian traffic is anticipated, as determined by County Transportation staff. See Section 5.3.7.3.

5.3.8.3 Signal Warrants

Signal warrants are typically based on vehicular and pedestrian volumes and intersection crash history, but may also address school crossings, signal coordination, and other considerations.

When an approved traffic analysis indicates that a particular development impacts a road or roads to a point that a traffic signal is warranted per the Warrants in the MUTCD, the developer shall be responsible for all or a portion of the cost of installation of the intersection and signal improvements. The proportionate share of installation cost shall be as determined by the procedures outlined in Article 4.

5.3.8.4 Stop Signs

The installation of stop signs shall be in accordance with an approved traffic analysis and subject to the approval of the County Engineer. At a minimum, stop signs should be installed on any roadway that intersects a higher-level roadway of the Collector or Arterial category. All-way stop signs will only be allowed when their installation meets the warrant thresholds outlined in the MUTCD, as supported by an approved traffic study.

5.3.8.5 Traffic Control at Local Street Intersections

At intersections of local streets, formal traffic control is not required if vehicular volumes, speeds, and accident potential are at acceptable levels, as determined by the County Engineer. In these instances, clear sight distance must be maintained in accordance with Section 5.3.5.6.

5.3.8.6 Mailboxes

In rural areas, mailboxes must be located to be accessible to postal delivery vehicles while at the same time not present an undue safety hazard to automobile, bicycle, or pedestrian traffic. Rural mailboxes should also be located so as to minimize the impact on maintenance operations along roadside ditches.

Rural Mailbox Offset		
Roadway Surface	**Distance from face of Mailbox to surface edge (feet)**	**Comments**
Paved	1	Paved with gravel shoulders
Gravel	Do not obstruct drivable roadway width	

In rural areas where the roadway is paved, the door or face of a mailbox shall be located at least one foot from the edge of the pavement and an adequate gravel shoulder should exist to allow the outside tires of the postal vehicle to exit and enter the pavement smoothly. On rural gravel roadways, the face or door of the mailbox shall be located no closer than the normal outside edge of the shoulder, leaving the entire drivable roadway width unobstructed.

Mailboxes may not obstruct sidewalks in any way. All portions of a mailbox shall be at least one foot outside the edge of a sidewalk or path. Where curb and gutter exists, the face or door of a mailbox that is accessible from the roadway must be located at between six inches and one foot behind the face of the curb. In higher density residential areas, multiple or gang mailboxes may be required. If multiple or gang mailboxes are provided, there shall be a pullout area (surfaced consistent with the adjacent roadway) at least ten feet wide so that no portion of a vehicle accessing the mailboxes extends into the normal traveled way of the adjacent roadway.

Mailbox supports shall be of a type that will yield or break away safely if struck by a vehicle. The AASHTO Green Book provides additional considerations for locating mailboxes along roadways.

5.3.8.7 Guardrail

The purpose of guardrail is to protect motorists from severe injury due to a vehicle traveling off of the road onto unsafe, unrecoverable side slopes. Recoverable side slopes are generally considered to be an incline of 4:1 or flatter. Slopes of 3:1 are often considered as a threshold for guardrail on heavily travelled roads. Roadway traffic volumes, vehicle speed, curvature, shoulder width, snow removal, icing potential, and accident history shall be considered when designing guardrails. Guardrail design shall start with the requirements of AASHTO and CDOT M&S Standards, with the understanding that guardrail length and location will be developed on a case-by-case basis.

5.3.8.8 Street Lighting

The County does not typically install or require street lighting along County roadways.

Street lighting will only be installed on local or local secondary streets where:

- local residents have requested street lighting;
- local residents are willing to pay for the design, installation, and operational costs; and
- lighting does not have a negative impact on the character of the area.

When lighting is to be installed it shall, to the extent possible, be downlit and full cut-off. Lighting shall be the most energy efficient feasible.

Street lighting may also be installed at Arterial/Arterial and Arterial/Collector intersections where an engineering evaluation indicates that there is a high accident history or potential that would be remedied by illuminating the intersection. Street lighting may also be installed, at the discretion of the County Engineer, at roadway intersections or pedestrian crossings where there is a high pedestrian volume, bicycle volume, proximity to a school, transit stops, etc.

5.3.8.9 Striping

Roadways will be striped according to the MUTCD. Lane widths and other lines will be as shown in the standard drawings, or as determined by the County Engineer. Roadways with less than 500 Average Daily Traffic (ADT) will not be striped unless a safety study indicates the need otherwise.

5.3.9 Pavement Structure Design

The policy and procedure for the design of pavement structure section shall be based on the CDOT Pavement Design Manual.

5.3.9.1 Design Standards

The following elements are to be used in the design procedure, with some minimum criteria provided. Several computer software pavement design programs, as approved by Boulder County Transportation, may be used to design pavements.

- The design procedure is based on the number of 18,000-pound single axle equivalent daily load applications (18k EDLA) per traveled lane. The 18k EDLA shall be equivalent to 100 percent of fully developed ADT adjusted for construction traffic (110 percent). In no case will the 18k EDLA be less than 10 on Local or Local secondary roads and 30 on Residential Collectors.
- The serviceability index (SI) for private roads, Local or Local Secondary roads and Residential Collectors will be 2.0. The SI for Collectors and Arterials will be 2.5.
- The regional factor shall be 1.0. Under drains may be required where high groundwater is present.
- Evaluation of subgrade soils and pavement structure materials shall follow the procedure in the CDOT Pavement Design Manual. An economic evaluation of alternate structure section is recommended. In making adjustments to the various layers of the pavement structure a more economical design may result. For example by increasing the asphalt thickness a decrease in gravel and earthwork may result. Stabilizing a poor subgrade with lime or cement may result in a thinner structure section. Also the use of asphalt treated base or cement treated subbase may be a more economical use of materials. Place treated subbase or a layer of milled Hot Mix Asphalt (HMA) mixed with Aggregate Base Course (ABC) directly below asphalt pavement or additional ABC layer.

5.3.9.2 Minimum Structural Sections

The minimum depths of Hot Mix Asphalt (HMA) and Aggregate Base Course (ABC) Class 6 (3/4 inch) per road type that will be allowed are the following:

	HMA	ABC
Private Roads	2”	4”
Local or Local Secondary	2.5”	4”
Residential Collector	2.5”	4”
Collectors or Arterials	As required by a Geotechnical Report	

Evaluation of the pavement design may result in an increase in HMA or substituting ABC with Plant Mix Bituminous Base (PMBB) or Portland Cement Treated Base. In no case will substitute sections be any less than 3 inches in depth.

5.3.9.3 Pavement Structure Design Report

A pavement design report shall be prepared by a Colorado registered professional engineer and shall be considered a requirement of road plan approval.

The pavement design report shall include the following minimum information:

- Soil logs along the proposed roadway alignment at a preferred interval of 500 feet or as directed by the County Engineer.
- Each log shall have a minimum soil profile of four feet below proposed subgrade elevation.
- Representative soil samples for pavement design from each log shall be taken within two feet below proposed subgrade elevation.
- Each representative sample shall be classified according to the AASHTO Unified Soil Classification Table, along with an Atterberg Limit’s Test and a sieve analysis.
- The pavement design procedure is based on the Hveem Stabliometer Test or the Expansion Pressure Test, which is used to compute a Resistance Value (r) of the subgrade. On private roads, local or local secondary roads and Residential Collectors a California Bearing Ratio (CBR) may be used to determine subgrade evaluation.
- Proposed average daily traffic volumes (ADT) for each road shall be based on 100 percent of full development including an adjustment for construction traffic. Traffic analysis for the purpose of pavement design shall be as given in Article 4.
- Recommended structural sections, based on the design considerations, proposed typical sections, and sections of roadway which may require additional stabilization or treatment.

5.3.9.4 Alternate Pavement Materials Requirements

Pavement shall include a minimum of 20 percent alternate materials such as RAP (Recycled asphalt pavement) or RAS (recycled asphalt shingles) as approved by the County Engineer. The proposed mix design shall be approved by the County Engineer prior to placement on the project.

5.4 Access Control

Access control on the County road system is necessary to maintain the operational efficiency and safety for all travel modes in a transportation corridor. Uncontrolled proliferation of driveway and other access approaches is a major contributor to roadway accidents, increased congestion, and the deterioration of a county road's functional capacity, particularly on Arterial and Collector roadways. Additional information regarding accesses can be found in Section 2.6.

5.4.1 Access onto Principal and Minor Arterials

5.4.1.1 Private Direct Access

Private direct automobile access to Principal and Minor Arterials shall be permitted only when the property in question has no other reasonable access to the general street system. When direct access must be provided, the following shall be considered:

- Access shall continue until such time that some other reasonable access to a lower functional category street is available and permitted. The access permit shall specify the future reasonable access location and, if known, the date the change will be made. Subdivisions shall be designed, if possible, to provide for alternative access at a future date.
- No more than one access shall be provided to an individual parcel or to contiguous parcels under the same ownership unless it can be shown that additional accesses will be significantly beneficial to the safety and operations of the road or the local circulation system.
- On two-lane roads, access approaches may be limited to right turns only, if the approach is the longer of 500 feet or the length of the turn lane from the nearest signalized intersection.
- Access approaches on multi-lane divided roads shall be limited to right turns only unless either the approach is at least one-half mile from the nearest traffic signal; or the access does not have the potential for signalization and it can be shown that allowing left turns would significantly reduce congestion and safety problems at a nearby intersection; or there are no intersections, existing or planned, which allow a U-turn; and left turns can be safely accommodated without signalization; and a median is present (or will be constructed) which allows appropriate left turning vehicle storage.
- Back out driveways shall not be allowed.

5.4.1.2 Intersection Spacing and Signalization

- For rural road sections where significant development is not expected in the foreseeable future, spacing of all intersecting public streets, roads, and highways shall be on one-half mile intervals for Principal Arterials and one-quarter mile intervals for Minor Arterials, plus or minus approximately 200 feet. Where topography makes such spacing inappropriate, topography, property ownerships, property lines, and physical design constraints shall determine the location of public approaches. The final location should serve as many properties and interests as possible to reduce the need for direct private access to the Road System.
- In suburban or developing areas where higher volumes are present or growth is expected in the foreseeable future that will require signalization, it is imperative that the location of all public approaches be planned carefully to ensure good signal progression. An approved traffic engineering analysis shall be made to properly locate all proposed connecting access approaches that may require signalization.
- Minimum spacing of private accesses in relation to the nearest cross street or in relation to the nearest access on the same side of the street, where allowed, shall be as shown in Standard Drawing 12.
- Accesses on opposite sides of the road shall be aligned or shall be separated by at least 200 feet where possible or approved by the County Engineer.

5.4.2 Access onto Collectors

5.4.2.1 Private Direct Access

No more than one access approach shall be provided to an individual parcel or to contiguous parcels under the same ownership unless it can be shown that additional access approaches are necessary for the safe and efficient use of the property. Back-out driveways shall not be allowed.

5.4.2.2 Intersection Spacing

Spacing of major intersecting roads, i.e., collectors or residential collectors should desirably be at one-quarter mile intervals plus or minus 200 feet unless an urban design plan that has been approved by County staff recommends a more frequent grid of intersecting roadways, and the intersection spacing has been approved by the County Engineer.

Spacing of public and private local road intersections with full movement access shall be at intervals no less than 300 feet, providing that reasonable access cannot be obtained from lower classification roads. Intersection spacing of less than 300 feet may require channelization of turning movements, subject to an engineering evaluation and approval by the County Engineer.

Minimum spacing of private accesses in relation to the nearest cross street or in relation to the nearest access on the same side of the street, where allowed, shall be as shown in Standard Drawing 12.

Accesses on opposite sides of the road shall be aligned or shall be separated by at least 200 feet where possible or approved by the County Engineer.

5.4.3 Access onto Residential Collectors

5.4.3.1 Private Direct Access

Access to Residential Collectors shall be permitted only when the property in question has no other reasonable access to a lower classification road. Back-out driveways shall only be allowed upon approval by the County Engineer.

5.4.3.2 Intersection Spacing

Spacing of public and private local road intersections shall be at no less than 150-foot intervals when on opposite sides of the street, and no less than 200 foot intervals when on the same side of the street.

Minimum spacing of private accesses in relation to the nearest cross street or in relation to the nearest access on the same side of the street, where allowed, shall be as shown in Standard Drawing 12.

5.4.4 Access onto Local Streets

5.4.4.1 Private Direct Access

The number of access approaches shall be controlled by the minimum spacing requirements as provided in Standard Drawing 12.

5.4.4.2 Intersection Spacing

Spacing of public and private local road intersections shall be at no less than 150 foot intervals when on opposite sides of the street, and no less than 200 foot intervals when on the same side of the street.

Minimum spacing of private accesses in relation to the nearest cross street or in relation to the nearest access on the same side of the street, where allowed, shall be as shown in Standard Drawing 12. Typically, there shall be only one access point per lot. More than one access point per lot shall require approval by the County Engineer. See Section 2.6.3.

5.5 Parcel Access Design Standards

The intent for parcel access such as driveways in Boulder County is to provide safe access to residences, businesses, or other properties for motor vehicles (including service and emergency response), pedestrians, and bicycles. They shall be designed to fit the terrain by minimizing cuts and fills, minimizing the removal of trees or other significant vegetation, and shall be finished using landscaping (softscape or hardscape) that minimizes visual impacts.

5.5.1 Design Standards

Accesses that serve up to 15 development units shall be designed according to the standards outlined on the following page. Private accesses that serve more than 15 development units shall conform to the standards for Local or Local Secondary roads. A Transportation System Impact Analysis, where required, shall be done as described in Article 4. See Table 5.5.1 Parcel Access Design Standards.

5.5.2 Additional Considerations

- Earthwork quantities for proposed access construction should be managed to minimize excessive waste or import of materials.
- Storm water management best practices are required on all disturbances.
- Access shall be designed to reasonably accommodate fire fighting and other emergency service vehicles.
- Seeding or appropriate revegetation blankets for slope stabilization are required as appropriate.
- Accesses shall be designed so that loose material does not run onto adjacent roads or migrate into drainage ways.

Table 5.5.1 Parcel Access Design Standards

	One-Lane Access		Two-Lane Access	
	Plains	**Mountains**	**Plains**	**Mountains**
# of units	1 - 5		6 - 15	
Travelway Width (8' turnouts 8'x 55' incl. tapers - required every 400')	10'	12'	18'	18'
Surface Course	Per geotechnical report[1]		Per geotechnical report	
ROW/Easement Width (min.)	20' 28' w/turnouts		30'	
Centerline Radius (min.)	40'		40'	
Max. Grade (%)	12	12 or up to 14 for 200' max.[2]	12	12 or up to 14 for 200' max.
Max. Grade through curve	6% [3]		6%	
Clearance Vertical/ Horizontal	13'-6" / 14'	13'-6" / 16'	13'-6" / 22'	
Roadside Ditches	Designed and constructed to Standard Drawings. See BCSDCM and USDCM for permanent erosion control practices.		Designed and constructed to Standard Drawings. See BCSDCM and USDCM for permanent erosion control practices.	
Slope Stability	Per geothechnical recommendations to design stability and facilitate revegetation [4]		Per geothechnical recommendations to design stability and facilitate revegetation [4]	
Signs and Traffic Control Devices	Required signs and traffic control devices must conform with the MUTCD, latest edition		Required signs and traffic control devices must conform with the MUTCD, latest edition	
Culverts	Min. 18" or equiv. capacity RCP or CMP in public ROW per Standard Drawing Cross-culverts outside of ROW sized to maintain historic flow		Min. 18" or equiv. capacity RCP or CMP in public ROW per Standard Drawing Cross-culverts outside of ROW sized to maintain historic flow	
Sight Distances	per AASHTO recommendations		per AASHTO recommendations	
Approach to Highway	90° to centerline of highway with max. 30° variation		90° to centerline of highway with max. 30° variation	
Standard Drawings	11, 12, 13, 14, 15, 16, 17, 18, 19		11, 12, 13, 14, 15, 16, 17, 18, 19	
Overall Design Principles	See Section 5.1		See Section 5.1	

[1] Accesses serving one dwelling unit shall use 4" ABC (Class 6) or other suitable material as approved by the Transportation Department.
[2] Accesses serving one dwelling unit may use 16% for 200' max.
[3] Accesses serving one dwelling unit may use up to 8% w/ 2' additional width.
[4] Accesses serving one dwelling unit may use 1 ½ : 1 max. cut and fill slopes or per geothechnical recommendations to design stability and facilitate revegetation.

5.6 Parking Facilities

The County strives to balance the need to provide convenient and sufficient parking accommodation with the need to minimize significant negative environmental and community character impacts from motorized vehicular use. These Standards describe the specific requirements for providing an appropriate quantity of parking to safely and effectively accommodate those who live, work, and recreate in Boulder County.

5.6.1 Space Requirements

Number of parking spaces shall be determined through appropriate Land Use Code provisions.

5.6.2 Parking Lot Design Standards

5.6.2.1 Paving / Materials

a. Parking lots for all public, office, commercial, industrial, and multi-family uses shall be paved. For other specific uses, parking lots shall be paved where the expected usage of the lot will exceed 150 daily vehicle trips averaged over a consecutive operating three day period.
b. The use of pervious or permeable pavement shall be encouraged in areas where the following benefits (among others) are desired:
    - Reduced ice build-up from snow melting and refreezing.
    - Reduced solar heat gain through absorption (permeable pavement typically reflects more solar energy to remain cooler than conventional pavement).
    - Reduced need for stormwater structures, piping, inlets, ponds, and other traditional stormwater management techniques.
    - Overflow or temporary parking areas that are used infrequently or in times of peak demand.

5.6.2.2 Stall Design

a. The size of a parking stall, its angle, and the width of the access aisle shall conform to Standard Drawing 1, except where specific use supports a design exception.
b. Parking spaces shall be defined by painted lines or other suitable means.
c. Both sides of the parking stall shall be the same angle.

5.6.2.3 Lot Design

a. The layout of the parking area shall be such that no vehicle shall protrude into a traffic lane.
b. The layout of the parking area shall be conducive to safe and logical internal circulation.
c. Dead-end aisles shall provide back-around space of three (3) feet in depth and the same width as the aisle.
d. Wheel or bumper guards or curbing shall be located so that no part of any vehicle shall extend beyond the boundary lines of the parking area, intrude on pedestrian ways, or come in contact with walls, fences, or plantings.
e. Except for parking areas provided for single-family units, suitable curbs or barriers shall be provided to protect public sidewalks and to prevent parking in areas where parking is not permitted.
f. In areas where daily parking demands fluctuate due to special events or seasons, the layout of the parking area may differentiate between regular and peak parking demands.

5.6.2.4 Signage

Entrance and exit signs and directional signs shall be installed as required by the County Engineer.

5.6.2.5 Landscaping

All off-street parking areas with more than 6 spaces shall be partially screened from public view by providing either decorative fencing or walls, contoured earth mounds, or suitable landscaping. Fencing or walls shall be a minimum height of four feet and shall be at least 50 percent solid in the horizontal plane. Contoured berms shall be completely treated with ground cover to reduce erosion, i.e., grass, cobbles, or rock and shall not

exceed 3:1 slope. Landscaping shall include a mix of trees, shrubs, and ground covers and shall be designed to consider ease of maintenance, hardiness, and water requirements.

5.6.2.6 Drainage

Parking lots shall be designed to conform to the requirements of Section 5.9. All paved areas shall be sloped to drain. Finished slope of areas paved with asphalt shall not be less than 1.0 percent.

5.6.3 On-Street Parking

On-street parking is allowed in areas where there is sufficient width to park a vehicle and where such parking does not limit safety or maintenance.

On-street parking can be an important component of the streetscape in certain places. It may reduce the need for additional pavement for off-street parking and will influence the character of the roadway and the speed of traffic using the roadway. The orientation of on street parking may range from being parallel to the edge of the roadway, to 45 degrees, 60 degrees, or 90 degrees relative to the edge of the roadway. The overall roadway section width needs to reflect the angle of parking when it is provided. On-street parking illustrated in Appendix I Cross-sections assume that the parking is parallel to the roadway.

When parallel parking is provided, the on-street parking lanes shall generally be 7 to 8 feet in width. It is sometimes desirable for the parking lane to be marked at 7 feet in width (measured from the face of the curb) to encourage vehicles to park as close as possible to the curb. Street furnishings behind the curb should be located to accommodate opening car doors to allow easy access to parked vehicles.

When parallel on-street parking and bicycle lanes are both present, parking shall be closest to the curb, with the bicycle lane between the parking lane and the travel lane. A four inch white line shall be striped between the bicycle lane and parking lane to encourage motorists to park closer to the curb and discourage motorist use of the combined bicycle/parking area as a travel lane when no parked vehicles are present.

Angled parking may be allowable in some areas where the primary roadway function is for local access and circulation where travel speeds are low. When angled parking is provided, the overall roadway width and functional parking and travel lane widths need to be sized accordingly, with consideration given to the angle of the parking stalls.

Angled parking is typically not recommended on roadways that have striped bicycle lanes due to the sight distance limitations for motorists accessing parking stalls. Angled parking on urban streets that experience significant bicycle traffic should be oriented to be “back-in” stalls. This significantly improves the available sight distance for motorists accessing the stalls. If back-in angled stalls are used, the street furnishings (trees, planters, etc.) should be located to accommodate the larger bumper overhang that can occur from vehicles backing in to the stalls.

Head-in or 90 degree angled parking should only be allowed when the street is specifically designed for local access and parking supply. Speeds on these streets must be low.

On-Street parking must not be allowed or designated in the following areas:

- Within 30 feet of a stop sign, traffic signal, flashing beacon, or yield sign on the street being considered
- Within 20 feet of a crosswalk on the street being considered
- Within 15 feet of a fire hydrant
- Within 5 feet of a driveway

- Within 20 feet of a fire station driveway on the same side and 75 feet on the opposite side of the street or roadway
- Per state statute for any other location

5.6.4 Accessible Parking

Accessible parking spaces shall be provided according to the specifications set forth in the ADA B & F Accessibility Guide. Size and graphics for signs for accessible parking spaces shall conform to the specifications set forth in the most current version of the MUTCD.

5.6.5 Bicycle Parking

This section outlines the type, placement, and quantity of bicycle racks to be provided to ensure the safety, convenience, and availability of bicycle parking facilities in appropriate areas of Boulder County.

5.6.5.1 Rack Types

The "Inverted U" style bicycle rack (shown below) is recommended. Other rack types may be used (subject to approval by Boulder County staff) if they adequately perform the following key functions:

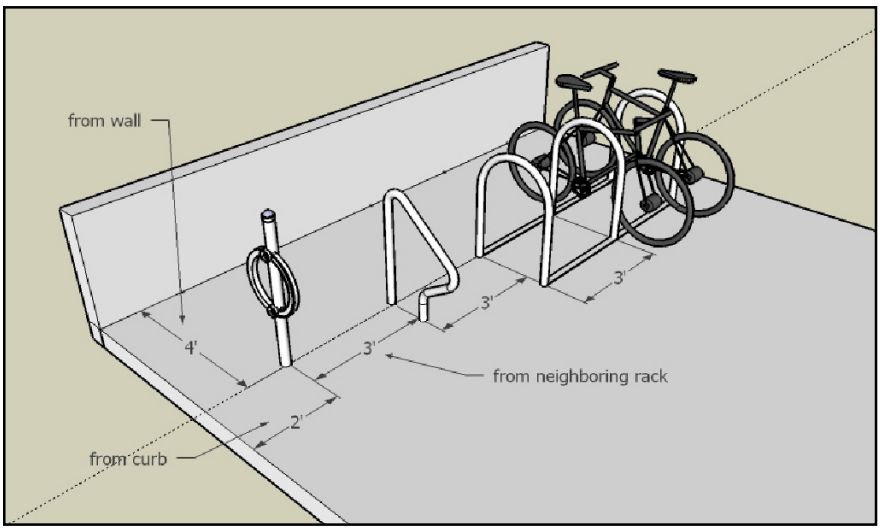
- Support the bicycle upright by its frame in two places
- Prevent the wheel of the bicycle from tipping over
- Enable the frame and one or both wheels to be secured

Inverted U Style Bicycle Racks

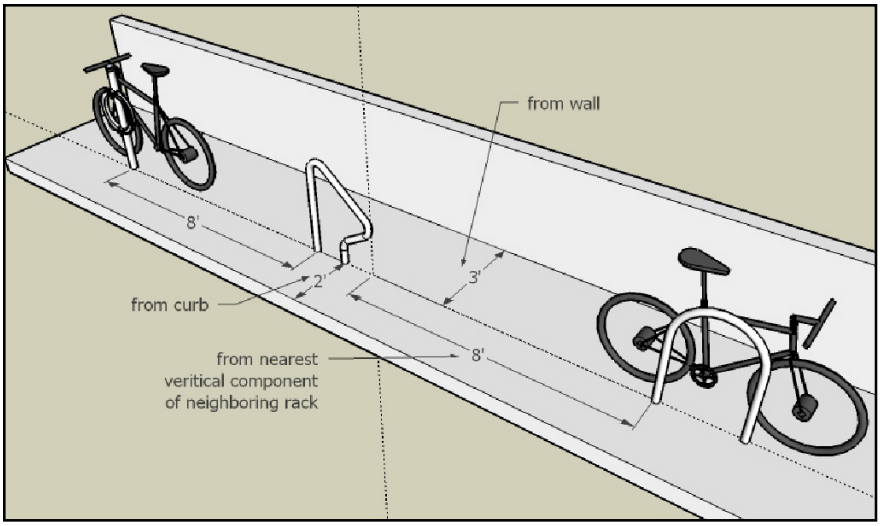
5.6.5.2 Placement

Bicycle racks shall be placed according to the guidelines and figures below:

- Racks aligned parallel to each other (side by side) must be at least 36 inches apart.
- Racks aligned end to end must be at least 96 inches apart.
- Racks placed perpendicular to a wall must be at least 48 inches from the wall to the nearest vertical component of the rack.
- Racks placed parallel to a wall must be at least 36 inches from the rack to the wall.
- Racks placed perpendicular to the curb must be at least 48 inches from the curb to the nearest vertical component of the rack.
- Racks placed parallel to the curb must be at least 24 inches from the curb to the rack.
- Racks perpendicular to a pedestrian aisle must be at least 48 inches from the rack to the edge of the aisle, and the aisle should be at least 60 inches wide.
- Racks shall be placed at least 14 feet from a curbside fire hydrant or at least 6 feet from a wall fire hydrant.



Racks Placed Side by Side



Racks Placed End to End

5.6.5.3 Quantity

The number of bicycle parking spaces shall be ten percent of the number of automobile parking spaces provided. (i.e. 10 bicycle parking spaces for every 100 automobile parking spaces). Deviations from this requirement shall be negotiated during development review based on land use and expected bicycle traffic. One automobile parking space may be eliminated for every four bicycle parking spaces provided above the minimum requirements, up to a maximum reduction of 5 percent of automobile parking. See Section 5.6.1.

5.6.5.4 Other Considerations

Bicycle parking spaces shall be located no more than 50 feet (walk distance) from the entrance of the use being served and within view of pedestrian traffic whenever possible. Where feasible provide space for bikes with attached bike trailers.

Bicycle parking shall be sufficiently secure to reasonably reduce the likelihood of bicycle theft or vandalism, including a permanent foundation that is securely anchored to the ground.

5.7 Shared Use Path Design Standards

Shared use paths provide efficient human-powered movement that is safe, enjoyable, and inviting for both recreation and transportation. Path facilities shall fit in the landscape with minimal impact.

5.7.1 Definition

A shared use path is an established dedicated transportation and recreation route that is physically separated from roadways by an open buffer or physical barriers (e.g. curbs or railings). It is designed for multiple user types including bicyclists, pedestrians and equestrians of varying skill levels.

5.7.2 Materials

Compacted crusher fines shall be the preferred material, although surface materials shall be considered on a case-by-case basis. The project location, expected usage, terrain, drainage, soil conditions, and cost must all be considered when selecting the appropriate surface material.

5.7.2.1 Compacted Crusher Fines

Compacted crusher fines shall be composed of irregular, angular particles that interlock into a tight matrix. Rounded particles, such as pea gravel, clay or decomposed granite shall not be used, as they do not compact properly. Crusher fines material shall meet the gradation shown in Table 5.7.2.1.

Table 5.7.2.1: Compacted Crusher Fine Gradation

Particle Size	% Passing
3/8”	100%
#4	90 - 100%
#8	55 – 80%
#16	40 – 70%
#30	25 – 50%
#200	6 – 15%

Compacted crusher fines shall be placed to provide a finished compacted surface thickness of 6 inches. Paths constructed on grade will be cut into existing grade so that final surface will be level with adjacent ground.

All subgrades shall be proof rolled according to CDOT Standard Specifications.

Compacted crusher fines material shall be underlain with a geotextile weed barrier meeting the requirements of AASHTO M288 Class 3.

When placed in or adjacent to active prairie dog colonies, 1 inch hexagonal, galvanized, 20 gauge wire mesh shall be placed under the geotextile and over the prepared base and anchored with galvanized landscape pins.

5.7.2.2 Other Materials

A concrete or other durable all-weather surface should be considered in the following cases:

- Paths located within the 10-year floodplain,
- Locations where concentrated flows of stormwater are expected and culverts or other drainage structures are inappropriate,

- Locations where saturated conditions are expected,
- On grades exceeding five percent,
- In tight radii (smaller than 35 feet),
- When approaching structures, or
- Where usage or location warrant.

If concrete is used, the path surface shall be 6-inch thick concrete (CDOT Class B) placed directly on a compacted subgrade or 6 inches of aggregate base course (CDOT Class 6), as determined by an evaluation of the site soil conditions.

When paths transition between compacted crusher fines and concrete, a beveled transition (1"H:1/2"V) shall be provided.

5.7.3 Geometric Standards

Geometric design considerations include:

- existing topography
- private property impacts
- accessibility
- sustainability / durability
- drainage
- environmental factors
- safety
- user experience
- construction and maintenance costs

All of these factors must be considered and balanced to produce a horizontal and vertical alignment that is the most appropriate for the path in its particular location.

For specific design parameters as well as procedures for determining geometric performance for shared use paths within these design standards, refer to the latest versions of the following documents:

Shared-Use Path Design:

- AASHTO Bicycle Guide
- FHWA Trail Design Guide
- MUTCD
- USDA Accessibility Guide
- AASHTO Pedestrian Guide
- AASHTO Roadside Guide

5.7.3.1 Design Speed and Safety

The preferred design speed for a shared use path shall be 15 miles per hour (mph) and the minimum shall be 2 mph. Compatible design speeds shall be considered in areas with restrictive topography, limited sight distance, steep grades, path or roadway intersections, or other safety concerns.

5.7.3.2 Width and Clearance

a. Width

The standard surface width for shared use paths shall meet the requirements of Table A-1 (in Appendix 1). A width of other than 10 feet may be considered based on usage or location. .

b. Cross Slope

A cross slope of 2 percent maximum shall be provided on all paths. Paths shall typically be sloped in one direction. Crowning may be appropriate in some circumstances, but is not typically desired.

c. Clearances

A 1-foot shoulder, graded to an optimum slope of 2 percent, with an allowable maximum slope of 6:1 should be provided at each side of the path. Two (2) foot shoulders shall be provided between continuous obstructions (fences, railings, and continuous structures). Shoulders may be reduced in areas of highly restricted topography, such as areas with steep side slopes.

An optimum separation of three feet should be provided between the edge of path and intermittent vertical obstructions, such as trees, utilities, and structures. Where the optimum separation cannot be provided, obstacle markers should be considered.

Where paths are adjacent to slopes greater than 3:1, an optimum separation of 5 feet from the top of slope should be provided. Fencing or other barrier should be considered, depending upon the situation (height, steepness, and other safety concerns).

See Standard Drawings 2 and 3 for additional details.

5.7.3.3 Horizontal Alignment

The AASHTO Bicycle Guide provides guidance for horizontal curve radii for various design speeds, surface conditions, superelevation rates, and lean angles and is generally appropriate for the following conditions:

- relatively flat (less than 4 percent) grades
- in open areas with adequate stopping sight distance
- away from safety concerns such as roadway or path intersections, restrictive topographic features, bridges, underpasses, or other confining features

In path sections with restrictive topography or adjacent to safety concerns, the optimum radii may not be feasible. Providing reduced horizontal curve radii may be considered in areas of steep grade, reduced sight distance, or approaching structures or intersections.

Natural features, such as trees, vegetation, and landforms should be incorporated into the path alignment to anchor the design to the site. The alignment should not be designed to be overly curvy, without relationship to the natural site features.

Path alignment in harmony with the natural environment

Path alignment overly curvy

5.7.3.4 Vertical Profile / Grades

Shared use paths should be designed to provide longitudinal grades of 5 percent or less wherever possible.

Existing site conditions may make grades of 5 percent or less impractical in some locations. In these cases, steeper grades may be used. Path grades should not exceed the following:

Table 5.7.3.4

Grade	Maximum Running Length
1:12 (8.33 %)	200’
1:10 (10%)	30’
1:8 (12.5%)	10’

When grades steeper than 5 percent are used, the following issues and mitigation measures shall be considered:

- Segments steeper than 5 percent shall be limited to the grades and distances in the Table 5.7.3.4 and shall be separated by path sections with grades of 5 percent or less, for a minimum length of 5 feet.
- If steep grades are not apparent in the approaching path segment, warning signs and speed restriction signs should be considered.
- Provide a widened path section and/or rest areas.
- If concrete surfacing is used and sight distance is limited, add solid yellow centerline striping.

5.7.4 Drainage

Proper drainage design minimizes surface degradation of compacted crusher fines. Dispersed sheet flow across paths is preferred when appropriate to maintain the existing natural drainage patterns, water quality, minimize maintenance of drainage structures, and reduce the overall site impacts.

Paths shall be cross-sloped to shed water, with the lower shoulder graded properly to avoid trapping or ponding of water or saturation of the base material. Also the path longitudinal grade should be less than the cross slope of the adjacent terrain (both uphill and downhill) to assure that drainage will be shed across the path tread, rather than running down it. This is especially important for compacted crusher fines, which will erode if drainage is allowed to run down it.

Culverts shall be sized and located as appropriate to convey concentrated flows beneath the path. Ditches and culverts shall be designed to accommodate 5-year design flows, in accordance with Section 5.9. Culvert materials may be reinforced concrete or corrugated steel. Culvert openings shall be set a minimum of 5 feet from the edge of path. If the culvert opening is less than 5 feet from the edge of path, it shall be marked.

Where existing terrain is not conducive to grading required for culverts, a concrete path section can be used to allow sheet flow across the path without erosion.

5.7.5 Roadway Crossings

See Section 5.3.6 and 5.3.7.

5.7.6 Sidepaths

Safety concerns and operational problems inherent with shared use paths located immediately adjacent to roadways are well known. However, if it is determined that this facility type is unavoidable, careful consideration of the safety and operational factors shall be evaluated. Some of these considerations include:

a. Separation between the roadway and path should be maximized. The minimum separation between the edge of pavement and path shall be as shown in Table A-1 (Appendix 1). Reductions in separation may be considered:

- On lower volume roads
- Where shoulders are 8 feet in width or greater
- For short distances
- Adjacent to auxiliary lanes

b. When the minimum separations cannot be provided, a physical barrier shall be considered. Examples of physical barriers may be delineators, curb and gutter, gutter, or railing.

c. Crossings of side streets, driveways and accesses shall be minimized. When unavoidable, these considerations shall be made.

- Sight distances at approaches to the intersections should be maximized.
- Warning signs and/or pavement markings on the path, access, and adjacent road should be considered.
- Stop signs on either the path or access should be considered.
- Separation between the path and roadway shall be reduced adjacent to the intersection to increase path user visibility.

5.7.7 Signing

Essential regulatory, warning, and wayfinding signs shall be provided. All signs shall be selected, sized, and installed in accordance with the MUTCD.

5.7.7.1 Warning Signs or Reflective Delineators

In general, warning signs shall be used when hazards exist that are not readily apparent. Not every hazard should be signed.

"Hill" (W7-5) signs shall be placed 50 feet in advance of all grades greater than five percent.

"Intersection Warning Signs" (W2 Series) signs shall be considered when visibility of the intersection is limited and placed 50 feet in advance of uncontrolled path or roadway intersections.

5.7.8 Landscaping/Slope Treatment

Cut and fill slopes shall be treated in accordance with Section 5.3.2.2.

5.8 Transit Facilities

This section recommends guidelines for the location and design of transit facilities. The County is a member of the Regional Transportation District's (RTD) service area. Accordingly, RTD has jurisdiction over most aspects of transit service within the County, such as routing, service, and operations parameters; stop locations and spacing; and other transit operations and facilities elements. The transit facility design parameters documented in this section are based on RTD Design Criteria.

Transit facility planning and design elements not addressed by RTD's Design Criteria, or information or other situations directly within the County's purview should refer to the latest version of TCRP Bus Stop Guidelines.

5.8.1 Bus Stop Spacing

Stop spacing for fixed route public transportation service shall balance walk distance, convenience, and access with bus service efficiency – speed, trip distance, and travel time within the specific local context of the route and corridor in consideration. In the rural context of the County, bus stops should generally be located at each development or activity node, particularly if intervening distance is more than one-half mile. Subdivision layout and other land use/design elements, particularly pedestrian connectivity to the transit route, are also critical to bus stop spacing.

5.8.2 Bus Stop Location

There are three options for locating bus stops:

- Far side: immediately after passing through an intersection
- Near side: immediately prior to passing through an intersection
- Mid-block: between intersections

In conformance with both RTD and County policy, new bus stops should be far side (as decided by RTD) unless local context, circumstances, or community preferences direct otherwise. Existing non-far side bus stops appropriate for far side relocation should be converted over time as opportunities arise. Factors to consider in bus stop location (and spacing) include safety, access for passengers with disabilities, pedestrian access, bus operations, access management, and others.

5.8.3 Bus Stop Type

There are several bus stop types:

- Curbside: along a typical street curb section
- Bus bay: bus pull-out lane with acceleration and deceleration space
- Open bus bay: bus bay located immediately after and adjacent to an intersection
- Queue jumper bus bay: open bus bay accessed by queue jumper lane originating before the intersection
- Nub: curb extension or bulb-out immediately after and adjacent to an intersection

The County's policy is to prefer curbside stops rather than bus bays, unless local context, circumstances, or community preferences direct otherwise. Curbside stops are preferable where there are two lane roadways with relatively low speeds and traffic volumes. Bus bays may be advisable on multi-lane, high-speed, high-traffic volume arterials for safety reasons.

5.8.4 Far Side, Curbside Bus Stop Zone Dimensions

RTD's Design Criteria does not provide dimensions for curbside bus stop zones, except for noting that they should be placed in locations where street grades are less than four percent. TCRP Bus Stop Guidelines recommends the following for non-articulated 40' or smaller buses with only one bus stopping simultaneously:

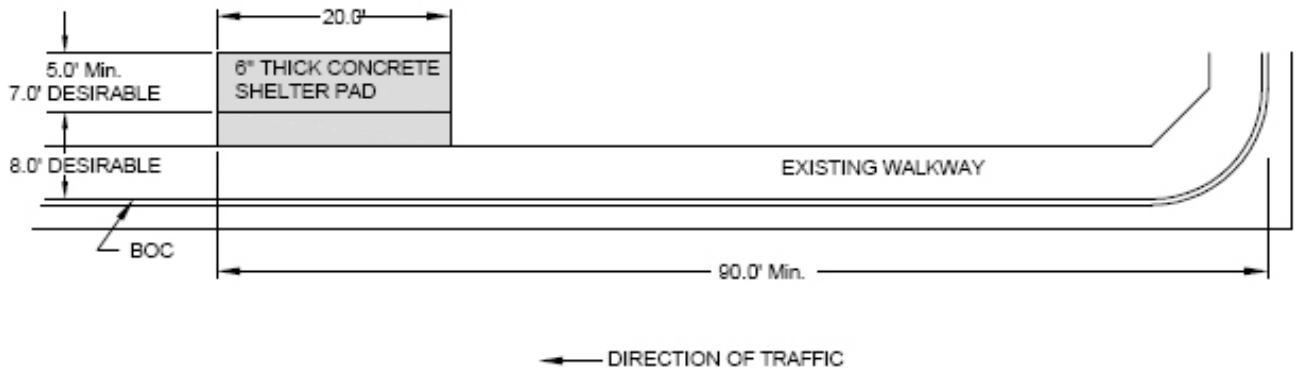
- Far side stop: at least 90 feet total clear zone distance, including at least 50 feet for re-entry acceleration.
- Far side stop after turn: at least 90 feet total clear zone distance, beginning at the end of turn radius, including at least 50 feet for re-entry acceleration.

5.8.5 Far Side, Curbside Bus Stop Dimensions

RTD's Design Criteria provides the following guidance:

- Bus stops located along detached sidewalks: concrete boarding area (pad) shall be installed between the back of curb and front of sidewalk.
- Bus stops located along attached sidewalks (less than 8 feet wide): concrete boarding area (pad) shall be added behind the sidewalk so that a minimum 8 feet wide area is provided.

For either situation, RTD specifies that concrete boarding areas shall be at least 30 feet in length.



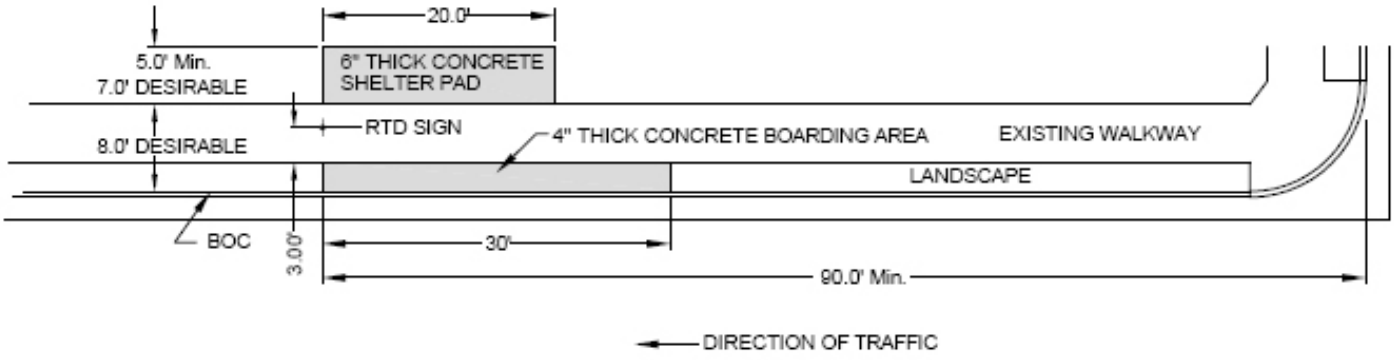
3 DETAIL 3 - BUS STOP LAYOUT FAR SIDE APPLICATION
SCALE: 1" = 10'
ATTACHED WALKWAY

RTD's Standard Drawings specify additional required and recommended stop dimensions for pads, shelters, and sidewalks.

5.8.6 Far Side, Curbside Bus Stop Facilities

RTD's Design Criteria specify that, in general, shelters shall be provided at bus stops exceeding 40 passengers per day, and as determined by the agency's shelter installation criteria evaluation process. These criteria include span of service, scheduling, physical space, safety, and others.

TCRP Bus Stop Guidelines recommend shelters for rural stops with at least 10 boardings per day, and indicates that passenger boarding volume is the primary determinant in whether to install a shelter (for passenger comfort from weather elements). Other considerations include available space, transportation disadvantaged mobility, proximity to major activity centers, service frequency, and adjacent land use compatibility. Exposure to adjacent high-speed vehicle traffic is also important.



1 DETAIL 1 - BUS STOP LAYOUT FAR SIDE APPLICATION
SCALE: 1" = 10'
DETACHED WALKWAY

5.8.7 Transit Queue Jump Lanes at Signalized Intersections

Signalized roadway intersections along a transit route may offer the opportunity to provide transit queue jump lanes for buses operating in the corridor. Queue jump lanes expedite transit service by allowing buses to move to the front of the line when a traffic signal is red. Buses using the queue jump lanes pass through the intersection when the signal turns green and often access a "far side" transit stop.

Transit queue jump lanes are often the continuation of a "right lane must turn right" lane for automobiles. The lane becomes a "bus only" lane straight through the intersection beyond the point where right turning automobiles have turned. In this context, the lane approaching the intersection is a "buses and right turns only" lane.

At larger intersections with multi-lane approaches and right turn bypass islands that channelize right turning vehicles, a bus queue jump lane shall be located along the left edge of the island, immediately to the right of the outside automobile through lane. The bus lane located against the island shall be at least 11 feet wide.

A bus queue jump lane next to a right turn island shall be designated as a "BUS AND BIKE ONLY" lane where the roadway has a bicycle lane or bikeable shoulder on the intersection approach. See Standards Drawing 6 and the MUTCD for additional signing and marking guidance.

5.9 Storm Drainage Design Standards

This section presents general recommended guidelines for the design of road drainage systems. For specific design parameters as well as procedures for determining drainage performance for urban and rural roads, refer to the latest version of the Boulder County Storm Drainage Criteria Manual (BCSDCM).

5.9.1 Design Criteria for Storm Drainage in Roadways

Minimum standards for inundation and conveyance of storm drainage in roadways are defined based on street classification and provided in the BCSDCM.

5.9.2 Culverts

5.9.2.1 Materials

Roadway cross culverts shall be constructed with reinforced concrete, unless otherwise approved by the County Engineer and Road Supervisor. Private driveways may be constructed with corrugated steel. The minimum pipe size shall be an 18-inch diameter round pipe or shall have an equivalent 18-inch round cross sectional area for other shapes.

5.9.2.2 Inlets and Outlets

An important consideration in the design of a culvert is the inlet configuration, since the inlet often limits the hydraulic capacity of the culvert. The inlet type can also increase the overall structural integrity by retaining the fill slope, and by preventing inlet scour with subsequent undermining of the culvert.

All culverts in the public right-of-way shall be designed using headwalls, wingwalls, or flared-end sections at the inlet and outlet. Additional protection using riprap may also be required at the inlet and outlet due to the potential scouring velocities.

5.9.2.3 Hydraulics

When evaluating the capacity of a culvert, refer to the BCSDCM.

5.9.2.4 Velocity

Minimum culvert velocity shall be 3 feet per second (fps) to ensure a self-cleaning condition. The maximum culvert velocity is dictated by the channel conditions at the outlet. If the outlet velocities are less than 7 fps for grassed channels, then only a minimal amount of protection is required, due to the eddy currents generated by the flow transition. Higher outlet velocities will require substantially more protection. The maximum outlet velocity shall be 12 fps along with the proper erosion protection.

5.9.2.5 Structure

All culverts, as a minimum, shall be designed in accordance with the procedures of AASHTO Bridge Standards or ASTM Pipe Standards and with the pipe manufacturer's recommendations.

5.9.3 Roadside Ditches

In rural areas or areas where no curb and gutter is required, roadside ditches should be designed with adequate capacity to convey the 5-year storm runoff peak. Where storm runoff exceeds the capacity of the ditch, a storm sewer system may be required. For capacity definitions and maximum allowable velocity, refer to the BCSDCM.

Roadside drainage ditches shall be grass lined. Revegetation and/or soil preparation for grass-lined ditches shall be in accordance with the Urban Drainage Storm Drainage Criteria Manual (UDSDCM), or as directed by the County.

5.9.4 Conveyance Systems

Refer to the latest version of the BCSDCM for storm water conveyance system design criteria that is not listed here.

5.9.4.1 Materials

Pipe material shall be reinforced concrete or corrugated steel pipe with a minimum of 18-inch diameter.

5.9.5 Hydraulic Criteria

Refer to the latest version of the BCSDCM for hydraulic design criteria.

5.9.6 Stormwater Permitting

Storm water is regulated by the State of Colorado and permits may be required based on the size of the disturbed area.

- Colorado Department of Public Health and Environment (CDPHE) requirements- A permit is required for work that disturbs greater than 1.0 of an acre, the Stormwater Discharge Permit must be obtained from the CDPHE for other construction site runoff control requirements. Refer to Article 7-903 of the Boulder County Land Use Code.
- U.S. Army Corps of Engineers (USACoE) 404 Permit – This permit shall be required for all projects within ordinary high water (in the absence of wetlands) in waters of the United States. Ordinary high water is defined as the level to which water rises in a typical spring runoff. Waters of the United States includes essentially all surface waters and their tributaries, all wetlands adjacent to these waters, and all impoundments of these waters. The need for a 404 permit will be determined by contacting the USACoE Denver Regulatory Office to request a pre-application consultation and/or official determination.

5.10 Bridges, Underpasses, Low Water Crossings and Retaining Walls

5.10.1 Vehicular Bridges

The intent of bridge design is to provide a safe waterway, vehicular or railroad crossing that provides adequate load carrying capacity, hydraulic capacity, and clearances for motorized vehicles, pedestrians and bicycles. Vehicular bridges are often community landmarks that are noticed by hundreds and perhaps thousands of residents daily. Because of this, it is important that their design reflects the character of Boulder County.

5.10.1.1 Standards

- Table 5.10.1.1 defines the standards for vehicular bridges.
- Vehicular bridge design shall be performed in accordance with the latest AASHTO Bridge Standards on public right-of-way and private roads (or IBC requirements on private driveways) as identified on Table 5.10.1.1.
- Vehicular bridge lane widths, shoulder widths and sidewalk widths shall match the approach roadway widths, but in no case shall they be less than identified in Section 5.3.1.
- Pedestrian sidewalks and/or bikeable shoulders shall be provided on all vehicular bridges in the public right-of-way.
- Vehicular bridges may need to be designed aesthetically, as determined through the Land Use Code process or by the County Engineer, to meet the character of the location. Architectural renderings of bridges shall be submitted to the County Engineer for approval when aesthetics are required.
- Vehicular bridges shall be constructed of concrete and/or structural steel. Timber bridges will only be allowed for residential and local roads with County Engineer approval.
- Bridge longitudinal slope shall be between 0.5 percent minimum to 4 percent maximum.
- Bridge foundation scour depth shall be designed according to the requirements as indicated in Table 5.10.1.1 below

TABLE 5.10.1.1					
Roadway Classification	Design Standard	Design Vehicle (1)	Bridge Rail Test Level (TL)	Min. Freeboard (2)	Scour Depth (3)
Residential	IBC or AASHTO (1)	50 psf (IBC), HS 15-44 min. or HL-93	TL-2	1’	4’ min.
Local, Local Secondary	AASHTO	HL-93	TL-2	Per AASHTO	100-year or 6’
Collector	AASHTO	HL-93	TL-2	Per AASHTO	500-year (3)
Arterial	AASHTO	HL-93	TL-3	Per AASHTO	500-year (3)

Table notes:
1) Design vehicle per local fire department loading requirements. Truck loading shall be used where grades permit permanent truck access or where the bridge is required for construction.
2) Freeboard at ditch crossings shall be coordinated with the ditch company.
3) Scour depths for indicated flood events to be determined through scour analysis using HEC-RAS.

5.10.1.2 Submittal Requirements

- Submittals shall be according to Section 2.8.3
- A geotechnical investigation and recommendations shall be submitted with each bridge design. A minimum of two borings, one at each abutment, shall be provided at each bridge location.
- A floodplain analysis according to the requirements of the Boulder County Storm Drainage Manual shall be performed for all vehicular bridges over waterways.
- Bridge design shall be signed and sealed by a registered Colorado Professional Engineer qualified in structural bridge design. Calculations with an independent design check and load rating shall be submitted on all bridges located on the public right-of-way.
- A Boulder County Building Permit is also required.

5.10.2 Pedestrian Bridges

The intent for pedestrian bridges in Boulder County is to provide a safe waterway, vehicular, or railroad crossing that provides adequate load carrying capacity, hydraulic capacity and clearances for pedestrians, bicycles, equestrians and maintenance vehicles. Pedestrian bridges, like vehicular bridges, are landmarks and should be designed with appropriate aesthetics for their particular location.

5.10.2.1 Standards

- Table 5.10.2.1 defines the standards for pedestrian bridges.
- Pedestrian bridges located on public lands shall be designed according to AASHTO requirements. Pedestrian bridges on private lands may be designed according to AASHTO or IBC requirements.
- Architectural renderings of bridges shall be submitted to the County Engineer for approval when aesthetics are required.
- Pedestrian bridges should be constructed of steel, concrete, or timber.
- Pedestrian bridges shall have longitudinal slope of 5 percent maximum.
- Pedestrian bridge foundation scour depth shall be designed according to the requirements as indicated in Table 5.10.2.1.
- Pedestrian bridges shall have 1 feet minimum freeboard over the 100-year flood elevation, or they shall be designed with break-away abutments that allow the bridge superstructure to swing to the side so as to not impede flows.

- The low chord of pedestrian bridges shall be a minimum of 16 feet above collector, arterial roads, and local roads; 14 feet over private and local roads; and 25 feet over railroads. Bridges less than 16 feet over roads shall be posted with the actual clear height.

TABLE 5.10.2.1

Classification	Design Standard	Vehicle/ Live Load	Min. Width	Deck Surface	Rail Height	Rub Rail Required	Footing Scour Depth
Public Land	AASHTO	per AASHTO	Trail Approach width, but not less than 8’	Concrete or Timber (Concrete where plowing occurs)	42”	Yes	4’ min.
Private Property	IBC or AASHTO	60 psf (Per IBC)	Trail Approach Width, but not less than 4’	Concrete or Timber	42”	No	Equal to frost depth

5.10.2.2 Submittal Requirements

- Submittals shall be according to Section 2.8.3
- A geotechnical investigation and recommendations shall be submitted with each bridge design. A minimum of two borings, one at each abutment, shall be provided at each bridge location.
- A floodplain analysis according to the requirements of the BCSDM shall be performed for all new pedestrian bridges over waterways where impacts are expected.
- Bridge design shall be signed and sealed by a Colorado Professional Engineer qualified in structural bridge design. Calculations shall be submitted for all pedestrian bridges on public lands.
- A Boulder County Building Permit is also required.

5.10.3 Shared-Use Path Underpasses

The intent for shared-use path underpass design is to provide, via an underground structure, a safe waterway, vehicular or railroad crossing that provides adequate load carrying capacity, hydraulic capacity, and clearances for pedestrians, bicycles, equestrians and maintenance vehicles. Underpasses may be stand-alone structures or they may be constructed under a bridge that has a span considerably greater than the required underpass width.

5.10.3.1 Standards

- Underpass design shall be performed in accordance with the latest AASHTO Bridge Standards as identified on Table 5.10.1.1 or standard Concrete Box Culvert sections from the M & S Standards. M & S Standards may be used for the underpass structure.
- Underpass width shall be the same width as the approaching path plus a minimum of 2-foot shoulders on each side; but in no case shall underpasses be less than 14 feet wide.
- Underpass vertical clearance shall be 8.5 feet minimum for normal use, and 10 feet for equestrian use. Vertical clearances as low as 7.5 feet may be used, with the approval of the County Engineer, in locations where utility and/or water table impacts will be significantly reduced.
- Underpasses may need to be designed aesthetically, as determined through the Land Use Code

process or the County Engineer, to meet the character of the location. Aesthetic treatment may consist of architecturally detailed vehicular railings on the roadway and/or veneer or form liner applied to wingwalls. Architectural renderings of bridges shall be submitted to the County Engineer for approval when aesthetics are required.

- Underpasses shall be constructed of cast-in-place or precast concrete. Cast-in-place concrete is preferred; however, precast may be used in locations where the water table is sufficiently below the underpass structure and where the speed of installation of precast members will provide substantial benefit to reduced construction time on roads with high traffic volumes. Three or four sided underpass structures are acceptable.
- Underpass longitudinal path slope shall be between 0.5 percent minimum to 4 percent maximum, with 2 percent being optimum.
- Concrete surfacing shall be used for the underpass and underpass approach to facilitate adequate drainage. Cross slope shall be 2 percent. The underpass path may be crowned or may be sloped to one side. A minimum 2-foot wide drainage pan shall be provided on the path side(s) to convey surface drainage to a storm inlet and manhole with a gravity outfall. A pumped drainage system may be used where site grading does not allow a gravity drain and electricity is accessible.
- All underpasses shall be provided with a subgrade drainage system, regardless of observed water table depth. The drainage system should consist of perforated drainpipe located behind the underpass structural walls and underneath the underpass slab. Drainage shall be carried to the same manhole used for collecting surface drainage.
- The exterior surface of underpass walls shall be coated with bituminous damp proofing and the top surface of underpass roofs shall be provided with waterproofing membranes.
- Exposed underpass wall, roof, and wingwall surfaces shall be provided with either a sacrificial graffiti resistant coating or textured form liner to resist graffiti.
- Underpass approach grades shall be according to ADA requirements, wherever possible. Underpass approach grades shall be as straight as possible entering and exiting the structure. In no instance shall the tangent at each end of the underpass be less than 10 feet long.
- Grading at underpass entrances shall be as physically and visually open as possible, using gentle slopes and/or tiered retaining walls to provide as open and inviting an entrance as possible.
- Lighting shall be considered for use in long underpasses or where public safety requires.

5.10.3.2 Submittal Requirements

- Submittals shall be according to Section 2.8.3
- A geotechnical investigation and recommendations shall be submitted with each underpass design. A minimum of two borings, one at each abutment, shall be provided at each underpass location. Water table elevations shall be indicated on all boring logs. Seasonal conditions at the time of recording water table depth shall be considered in determining water table impacts.
- A floodplain analysis according to the requirements of the BCSDM shall be performed for all underpasses that serve a dual purpose of transportation and floodplain mitigation. This includes stand alone precast or cast-in-place structures, or underpasses that travel below a bridge structure.
- Underpass structural design shall be signed and sealed by a Colorado Professional Engineer. Calculations with an independent design check and load rating shall be submitted on all underpasses located in the public right-of-way.

5.10.4 Low Water Crossings

The intent for low water crossing design is to provide via a series of culverts, safe waterway crossings that provide adequate load carrying capacity, hydraulic capacity and clearances for motorized vehicles, pedestrians and bicycles.

5.10.4.1 Standards

- Refer to the BCSDCM for Low Water Crossing details and design standards.
- Low water crossing design loads shall be the same as for vehicular bridges.
- Road approach grade shall be between 0.5 percent minimum and 12.0 percent maximum.
- Side slopes shall not be steeper than 3:1 and shall be protected by a six-inch concrete facing or by 18-inch riprap.
- The culverts used shall be corrugated steel pipe or reinforced concrete pipe with a minimum diameter of 18 inches.
- Minimum cover over culverts shall be 12 inches or as recommended by manufacturer for round pipe down to 6 inches for concrete pipe; 18 inches or as recommended by manufacturer for arch pipe; or 12 inches if HS 10-44 loading is applied.

5.10.4.2 Submittal Requirements

- Submittals shall be according to Section 2.8.3
- A floodplain analysis according to the requirements of the BCSDCM shall be performed for all low water crossings.

5.10.5 Retaining Walls

The intent for retaining walls is to safely retain soil to minimize site impacts.

5.10.5.1 Standards

- Retaining walls shall be designed according to AASHTO or IBC requirements.
- Retaining walls may need to be designed aesthetically, as determined by the County Land Use Code process or the County Engineer, to meet the character of the location. Architectural renderings of walls shall be submitted to the County Engineer for approval when aesthetics are required.
- Footing depth shall be 24 inches minimum for retaining walls susceptible to frost heave in mountainous areas; 30 inches minimum for walls susceptible to heave on the plains.
- Provide adequate surface and subsurface drainage, with erosion protection, behind the wall to carry drainage without damaging the retaining wall.
- Retaining wall height shall be limited to 6 feet (exposed height) tiers, although taller walls may be utilized if visual impacts are mitigated.
- Distance between wall tiers shall be determined by calculation, but shall not be less than the lower tier height.
- The entire retaining wall structure shall be contained within property or right-of-way, otherwise right-of-way shall be obtained for portion of the retaining wall that is beyond the existing property line.

5.10.5.2 Submittal Requirements

- Submittals shall be according to Section 2.8.3
- A geotechnical investigation and recommendations shall be submitted with each retaining wall design.
- Retaining wall design shall be signed and sealed by a Colorado Professional Engineer for retained heights greater than 4 feet. Calculations shall be submitted for all retaining wall heights over 6 feet in height.
- A Boulder County Building Permit is also required.

5.11 Utilities, Survey and Right-of-Way

5.11.1 Utility Location and Coordination

Utilities shall be located within road rights-of-way so as to minimize road maintenance costs. All utility construction shall conform to the Boulder County Utility Construction Permit Requirements, specific utility company standards, and CDOT Road and Bridge Standards.

5.11.2 Surveys

The County has a system of primary and secondary survey control points. All surveys within public right-of-way shall tie in to the primary control points where feasible or the secondary control points as agreed to with the Transportation Department.

Land surveys and plats shall conform to the latest Colorado Revised Statutes.

A Surveyor licensed in the State of Colorado shall stamp surveys.

5.11.3 Right-of-Way

Only traffic control signage is allowed within the right-of-way. All other signage must be placed on private property.

Private mailboxes are allowed in the right-of-way as long as they are installed on posts that will break away upon impact (see Section 5.3.8.6 for more details on Mailbox requirements).

Planting of trees, construction of berms, irrigation ditches and fences is not allowed within the road right-of-way.

Article 6 - Construction Specifications

6.0 Introduction

This Article outlines construction specifications for Boulder County's multimodal transportation system.

6.1 General Policies

6.1.1 Boulder County and Colorado Department of Transportation Construction Specifications

During the prosecution of work, all materials, performance, and quality of work shall conform to the requirements of these Standards and the CDOT Road and Bridge Standards. In the case of a conflict, assume the more stringent standard controls unless County enforcement of such standard is preempted by law.

If these Standards or the CDOT Road and Bridge Standards do not cover a specific situation during the course of work, alternate specifications must be approved by the County Engineer. The County Engineer shall be the final authority on the meaning or interpretation of all specifications.

6.1.2 Agreements Required Prior to Recordation of a Final Plat

No final plat may be recorded until the developer or Project Engineer has submitted and the Board or its designee has approved one or a combination of the following:

a. an improvements agreement to construct any required public improvements shown in the final approval documents, together with collateral which is sufficient, in the judgment of the Board of County Commissioners, to make reasonable provision for the completion of said improvements in accordance with design and time specifications; or
b. other agreements or contracts setting forth the plan, method, and parties responsible for the construction of any required public improvements shown in the final approval documents which, in the judgment of the Board of County Commissioners, will make reasonable provision for completion of said improvements in accordance with design and time specifications.

6.1.3 Control of Work

All work done within County road right-of-way and applicable work done on private property must be inspected and documented by the County or by a County- approved Colorado Registered Professional Engineer, to ensure compliance to these Standards, approved plans, and all applicable Land Use Code approval documents (including development agreements, Access Improvement and Maintenance Agreements, and the like). The Transportation Department has the authority to control work as determined by these Construction Specifications, decide all questions which may arise as to the quality and acceptability of materials furnished to the work performed or as to the rate of progress of the work, and questions as to the interpretation of the plans and specifications.

The Transportation Department is authorized to suspend the work, in writing, wholly or in part, due to:

- failure of the contractor to correct conditions unsafe for the workers or the general public
- failure to carry out provisions of these Construction Specifications and approved plans
- failure to carry out written or verbal orders as a result of unsatisfactory work found during inspections

- unsuitable weather conditions
- conditions considered unsuitable for the prosecution of the work
- any other condition or reason deemed to be in the public interest

6.1.4 Authority of the Construction Inspector

The Transportation Department must be represented by a Construction Inspector authorized to inspect all work done and materials furnished on public projects. Such inspection may extend to all or any part of the work and to the preparation, fabrication, or manufacture of materials to be used. The inspector is not authorized to waive the provisions of these Standards, nor is the Inspector authorized to issue instructions contrary to the approved plans and specifications, nor may the Inspector act as foreman for the Contractor.

Inspections for development review projects shall be performed by the contractor and the project engineer (See Section 6.1.5) to ensure that the project complies with the construction plans and these Standards. Although County representatives may periodically observe construction methods and materials to verify the above compliance, construction administration is the responsibility of the project engineer. That responsibility is not relieved by the presence of a County representative.

Submittals may be required from the contractor to verify compliance with the Standards.

6.1.5 The Project Engineer

The Project Engineer shall be the duly authorized agent of the developer and/or the contractor and has immediate charge of the engineering details of the work. It is the responsibility of the project engineer:

a. To provide to the Construction Inspector any engineering details, documentation, or any other information regarding the prosecution of the work.
b. To provide to the Transportation Department, for written approval, any proposed alterations to the approved plans and specifications.
c. Upon completion of all work to be performed on the project, to provide to the Transportation Department “as-built” plans and specifications approved by a Colorado Registered Professional Engineer, as a condition of final approval of the work.
d. To furnish and set construction stakes and marks establishing all lines, grades and measurements necessary to the proper prosecution of the work in its final location as shown on the approved plans and specifications.
e. Additionally, specific to development review, the Project Engineer is responsible for inspection of the work, documentation of inspections, and written requests for reduction in financial guarantees.

6.1.6 Inspection and Testing

To ensure compliance with these Standards and approved plans, adequate in-progress inspection and testing is required.

All materials and each part or detail of the work is subject to inspection by the Construction Inspector. The Construction Inspector must be allowed access to all parts of the work and must be furnished with such information and assistance by the Project Engineer and contractor as required for a complete and detailed inspection.

Any work done or materials used without inspection may be ordered removed or replaced by the Construction Inspector. The Construction Inspector may, at any time before acceptance of the work, direct the Contractor to remove or uncover any such portion of the finished work. After examination, and after approval of the work by the Construction Inspector, the Contractor shall restore the portions of work disturbed to the standard required by the specification.

When the Construction Specifications of other jurisdictions are used to govern the work, written approval must be provided by the other jurisdictions and made available to the Construction Inspector prior to final acceptance of the work. Regular in-progress materials testing must be provided to the Construction Inspector in a timely manner during the course of work, and shall be a requirement of final acceptance. The number of tests and their location must be approved by the Construction Inspector.

For private development, all materials testing shall be performed by an independent laboratory, under the supervision of a qualified Professional Engineer registered in the State of Colorado at the expense of the developer, the Project Engineer, or the contractor. At a minimum, the Project Engineer will inspect and the Transportation Department will observe the project at all or some of the following phases of work:

1. Prior to commencement of construction to document existing conditions.
2. Completion of grading, drainage, structures, and compaction and erosion control.
3. Completion of placement and compaction of the sub-base course.
4. Completion of placement and compaction of the base course.
5. Completion of each lift of asphalt or concrete pavement.
6. At final inspection.

At the completion of each phase, the Project Engineer will document and submit in writing to the Transportation Department the results of their inspection.

The Project Engineer in charge of the construction must supply materials test reports for each stage of the construction of the roadbed, including drainage, structures, pavements, and appurtenances, and as identified in the preconstruction meeting and the construction permit.

6.1.7 Certification of Work Completed by Private Developers

Adequate inspections and observations ensure compliance with these Standards are the basis for the County Engineer's recommendation to the Board of County Commissioners for maintenance acceptance and for release of the performance guarantee. Inspections shall be performed by the contractor and the Project Engineer to assure that the project complies with the construction plans and these Standards. County Representatives may periodically observe construction methods and materials to verify the above compliance. Construction administration is the responsibility of the Project Engineer. That responsibility is not relieved by the presence of a County representative.

Test results and construction reports may be required from the contractor to verify compliance with the approved project plans and specifications.

6.1.8 Removal of Unacceptable or Unauthorized Work

All work which does not conform to these Construction Specifications or approved plans shall be considered unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or any other cause found to exist prior to final acceptance of the work. Unacceptable work shall be removed and replaced according to these Construction Specifications prior to notice of acceptance of the work.

6.1.9 The Use of Approved Plans and Specifications

Any work performed without approved plans and specifications shall be considered unauthorized and may be ordered removed and the existing conditions restored. The approved plans, specifications, supplementary specifications, standards, supplementary standards, and any special provision required or approved by the Transportation Department shall be considered complementary to describe and provide for complete work.

Furthermore, the contractor shall not take advantage of any error or omission in the approved plans, standards, and specifications. In the event an apparent error or omission is discovered, the Project Engineer and the Construction Inspector shall be notified. The Project Engineer shall make any corrections required, subject to approval by the County Engineer. If in the event the work has already been completed, it may be deemed unacceptable and be required to be removed and correct work placed.

6.1.10 Acceptance of Work

6.1.10.1 Partial Acceptance

County acceptance of one element of work may be required prior to proceeding with the next element (e.g., acceptance of subgrade prior to the placement of subbase). If, after partial acceptance of an element of work, conditions change, the Construction Inspector may require a reinspection and acceptance as per Section 6.1.6.

6.1.10.2 Final Acceptance

Upon written notice from the developer, Project Engineer, or contractor of the completion of all work, the Construction Inspector will make a final inspection.

If all construction provided for in the approved plans, performance guarantee, or conditions of approval is found by the County Engineer to be satisfactory, the procedure for acceptance by the Board of County Commissioners for maintenance or release of the performance guarantee may be initiated. If, however, the inspection discloses any work, in whole or part, as being unsatisfactory or uncompleted, the County Engineer will notify the developer, Project Engineer or contractor of the deficiencies. In the event the work is not done, the developer is responsible for maintenance of the work until such time as all such items are completed or corrected and a successful reinspection occurs.

6.1.10.3 Warranties and Performance Guarantees

Before any permit is issued, a guarantee of financial security is required. The purpose of this guarantee is to assure that the applicant or permittee shall faithfully perform all requirements of the permit. Any requirement for a financial guarantee shall be specified in the written decision of the County on the permit application.

Public projects that do not include federal funding shall require the contractor to provide a two-year warranty. Public projects that include federal funding shall require the Contractor to provide a warranty in accordance with CDOT Standard Specifications for Road and Bridge Construction and supplemental requirements.

6.1.10.3.1 Amount of Financial Guarantee

If the County Engineer determines that financial guarantees are necessary to assure the performance of specific conditions of approval to construct public or private improvements, such guarantee must be in a form acceptable to the County Attorney. In the past, acceptable forms for financial guarantees have included a letter of credit with a County-approved banking institution in the State of Colorado, a cash deposit maintained by the County in a designated escrow account, bonds, certificates of deposit, and others.

The principal amount of the performance guarantee shall be 100% of the County-approved Project Engineer's estimate or the actual contract cost to construct all required improvements. In addition, regardless of whether estimate or actual cost is used, to assure the performance of the required improvements the County requires an additional 15% be held as warranty collateral for an appropriate period after completion or acceptance. At no time shall the performance guarantee fall below 100% of the Engineer's estimate or actual contract cost to complete the remaining improvements, plus 15% of the original principal amount for the warranty collateral.

6.1.10.3.2 Release of Collateral
To insure the County Engineer's ability to enforce the provisions of any approved permit, the County Engineer shall not release any financial guarantee provided under this Article for an individual permit until confirming that all applicable provisions of the permit have been complied with.

As improvements are completed, the developer or Project Engineer may apply in writing to the County Engineer for a release of part or all of the principal amount of the collateral deposited. The written request for release must detail the improvements constructed to date, the associated costs, and supporting documentation. Upon successful inspection/observation and written approval, the County Engineer shall release said collateral on behalf of the Board of County Commissioners. For private construction of public facilities, the County shall hold warranty collateral for two years after the roads have been accepted by the County for maintenance.

If the County Engineer determines that any improvements are not constructed in substantial compliance with specifications, it shall furnish the developer or Project Engineer a list of specific deficiencies and shall be entitled to withhold collateral sufficient to ensure such substantial compliance. Where circumstances warrant, the County Engineer may require the developer or Project Engineer to extend performance guarantees based on either the most current County-approved Engineer's estimate or on the previous guarantee amount as modified with reference to the Colorado Construction Cost Index.

6.1.10.3.3 County Right to Draw on Collateral
If an applicant violates any term or condition of an approved permit, the County Engineer shall be entitled to draw on any financial guarantee provided by an applicant pursuant to this Article, in addition to any other remedy available under law.

If the County Engineer has reason to believe that an applicant has violated an approved permit term or condition for which a financial guarantee has been provided, the County Engineer shall provide written notice to the applicant describing the violation and stating a reasonable time within which it must be corrected or filed a written appeal with the Board of County Commissioners. If, within that time period, the applicant has not either corrected the violation and not filed an appeal with the Board of County Commissioners, the County Engineer shall be entitled to enter upon the site to take any reasonable measures to correct the violation, and may draw on the financial guarantee to cover the costs of corrective measures.

If the applicant files a timely appeal with the Board of County Commissioners, the Board of County Commissioners shall schedule a hearing on the appeal at the soonest possible time and provide the applicant reasonable prior notice. If the Board of County Commissioners confirms at the hearing that the violation has occurred and has not been corrected, the Board of County Commissioners in its discretion may give the applicant additional time to correct the violation or may specify the time at which the County Engineer may take appropriate action to have the violation corrected and draw on the financial guarantee to cover the costs of corrective measures.

6.1.11 Cooperation with Utilities
The developer, Project Engineer or contractor shall be responsible for coordinating the location, relocation, installation or removal of all utilities involved with the construction of the project.

The construction plans for the proposed project shall be submitted to the affected utilities as soon as possible after final approval of the plans by the County Engineer. Adequate notice shall be given to utilities for utility locations required for the work to avoid damage to existing utilities and other conflicts.

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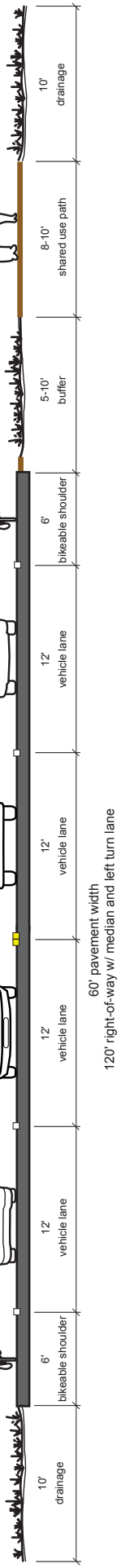
Appendix I - Cross Sections

TABLE A-1: OPTIMAL CROSS SECTION SUMMARY

(all dimensions in feet)

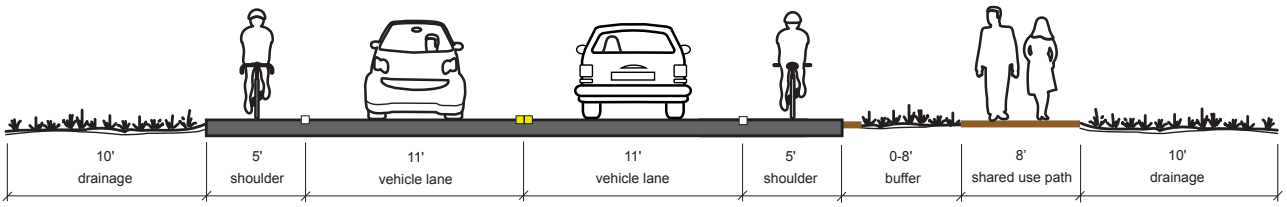
		Travel Lanes*		Bikeable Shoulders**	Sidewalk/ Shared Use Path***		Drainage, catch slopes each side	Nominal ROW****	Auxilliary Needs			
Corridor Type	Functional Classification	*Number of Lanes*	*Width*	*Width*	*Width*	*Buffer*			*Median*	*Lt Turn*	*Rt Turn*	*Parking*
Travel	Principal Arterial	4	12	6	8-10	5-10	10	120	8	11	11	7-8
Travel	Minor Arterial	2	11	5	8	0-8	10	90	6	11	10	7-8
Circulation	Collector	2	11	4	6	0	10	70	-	10	10	7-8
Circulation	Residential Collector	2	11	4	6	0	10	70	-	0	0	7-8
Access	Local, Local Secondary	2	11	-	6	0	10	60	-	0	0	-
Access	Other (Townsite Road)	2	9	-	-	-	^	20				

where gutters are installed they are outside the dimensions shown
***Travel lane width on principal arterials in urban/suburban areas may be reduced to 11' - requires County Engineer approval**
***Travel lane width on collectors or residential collectors in urban/suburban areas may be reduced to 10' - requires County Engineer approval**
****Shoulders shall transition to 5' wide Bike Lanes through intersections with right turn lanes and increase by 1' adjacent to guardrai**
***** Shared Use Paths and sidewalks should match existing widths where appropriate for missing links**
******Right-of-Way (ROW) does not include Auxilliary Right turn lanes**
^varies with Townsite



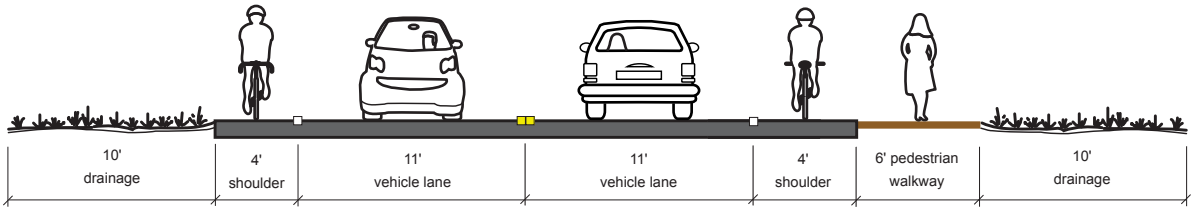
1 - Principal Arterial

2 - Minor Arterial



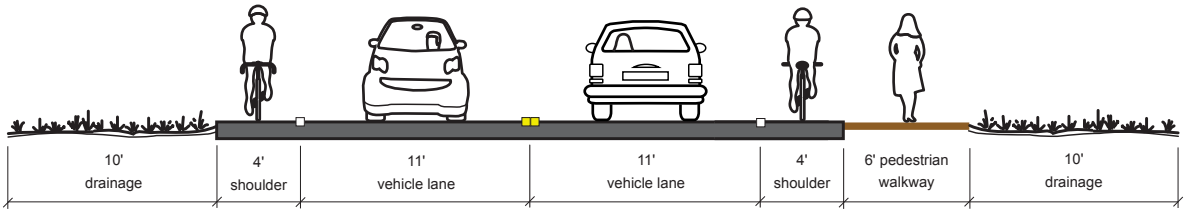
32' pavement width
90' right-of-way w/ median and left turn lane

3 - Collector



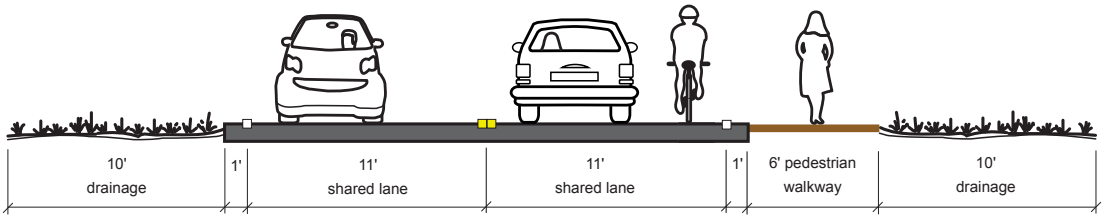
30' pavement width
70' right-of-way w/ left turn lane

4 - Residential Collector



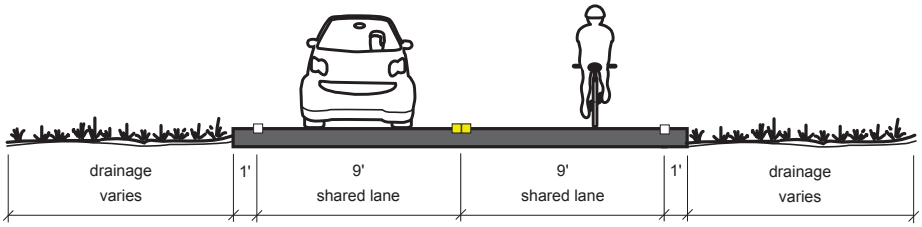
30' pavement width
70' right-of-way

5 - Local / Local Secondary



24' pavement width
60' right-of-way

6 - Townsite Road



20' pavement width
right-of-way varies by townsite

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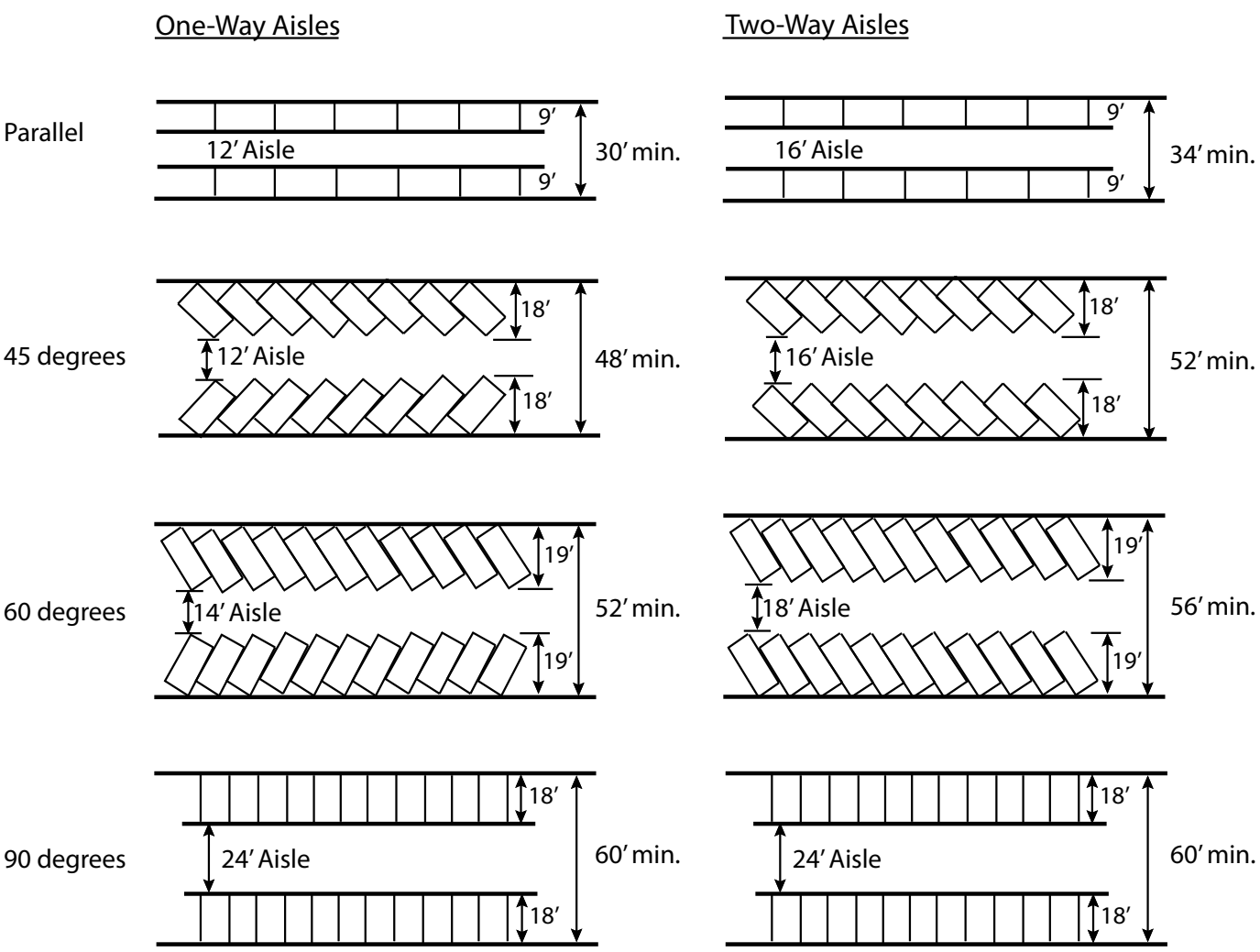
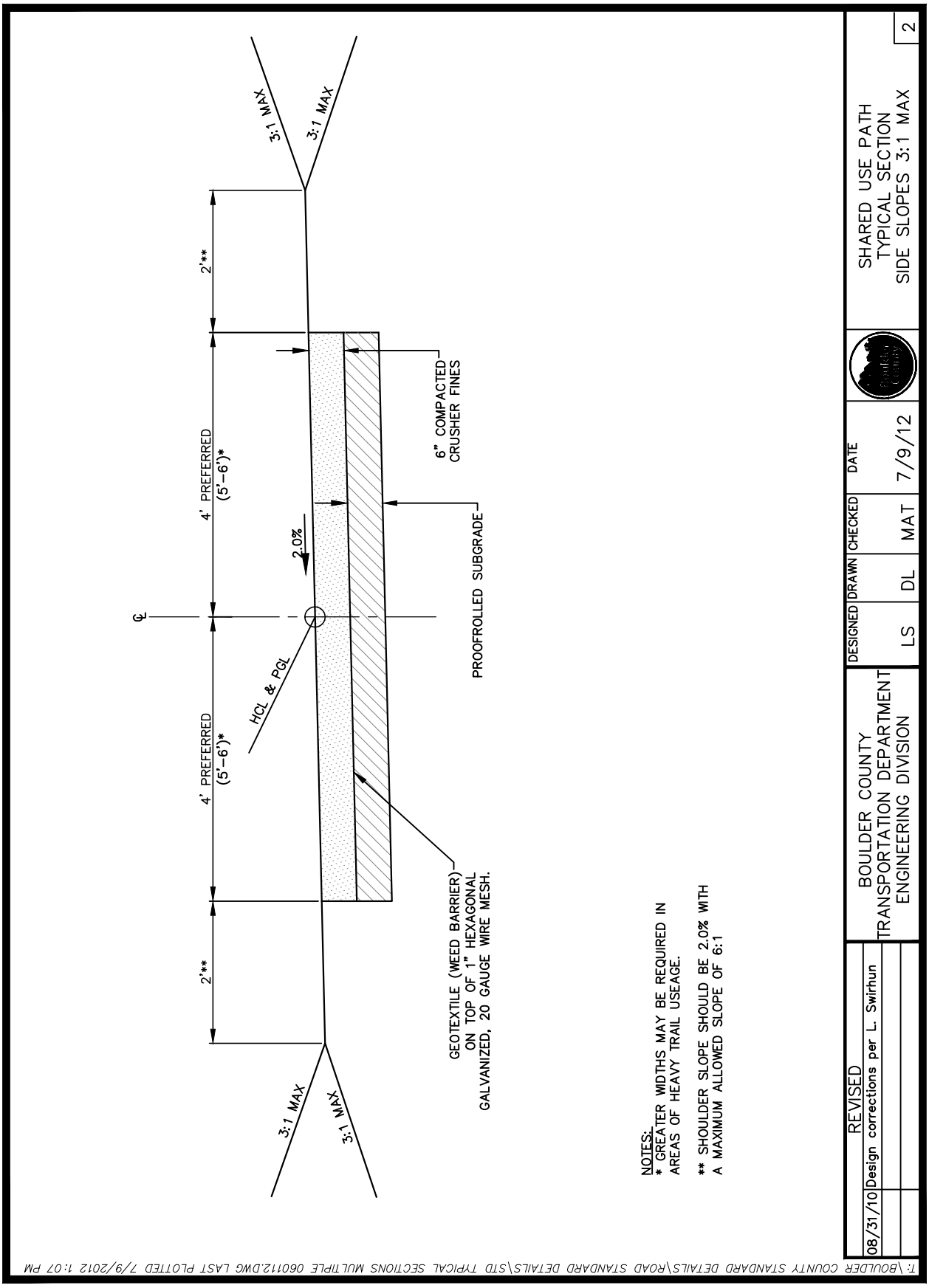
Appendix II - Standard Drawings

Standard Drawing 1 - Parking Lot Dimensions

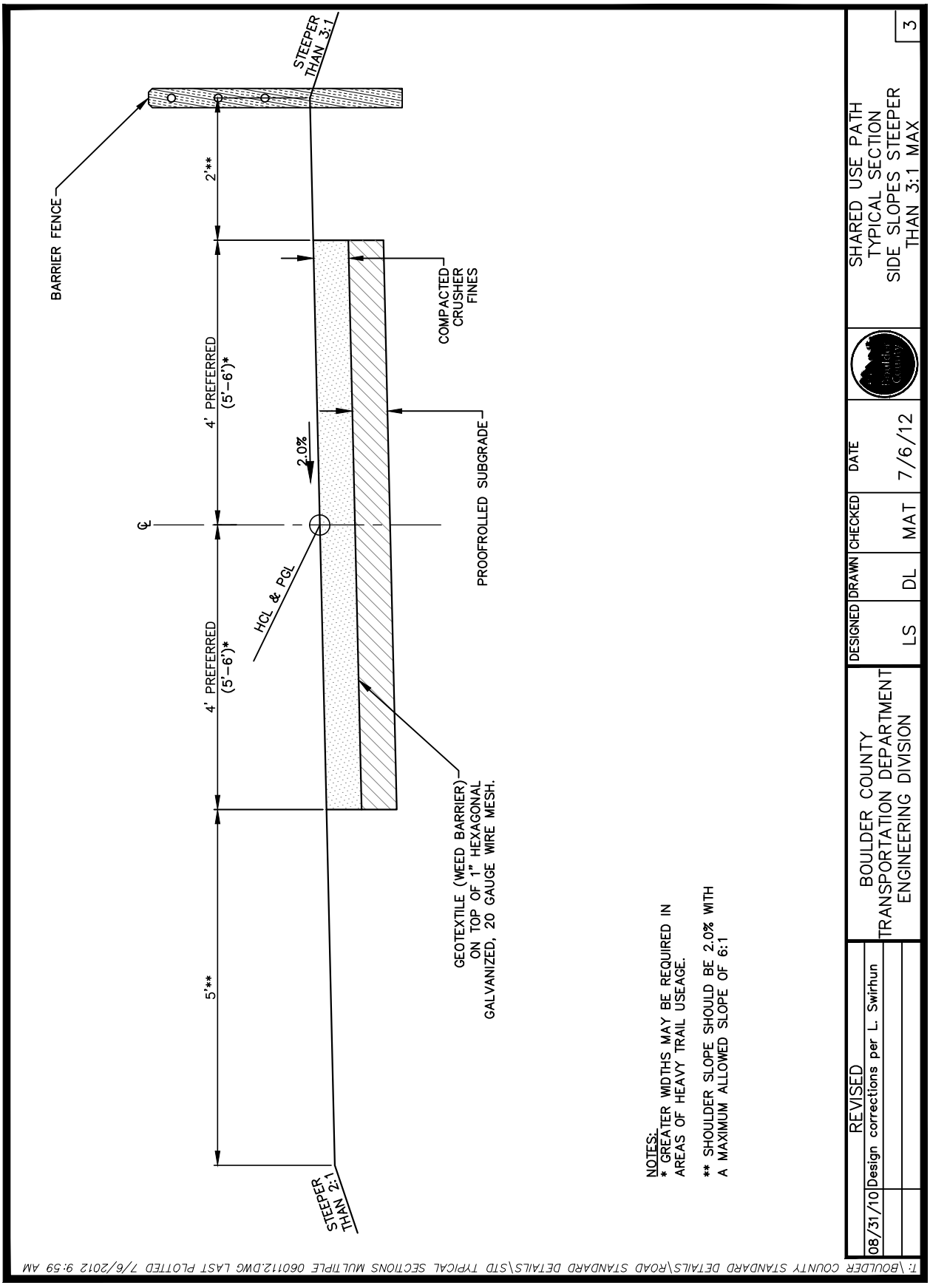


**All parking stalls are assumed to be 9′ in width.*

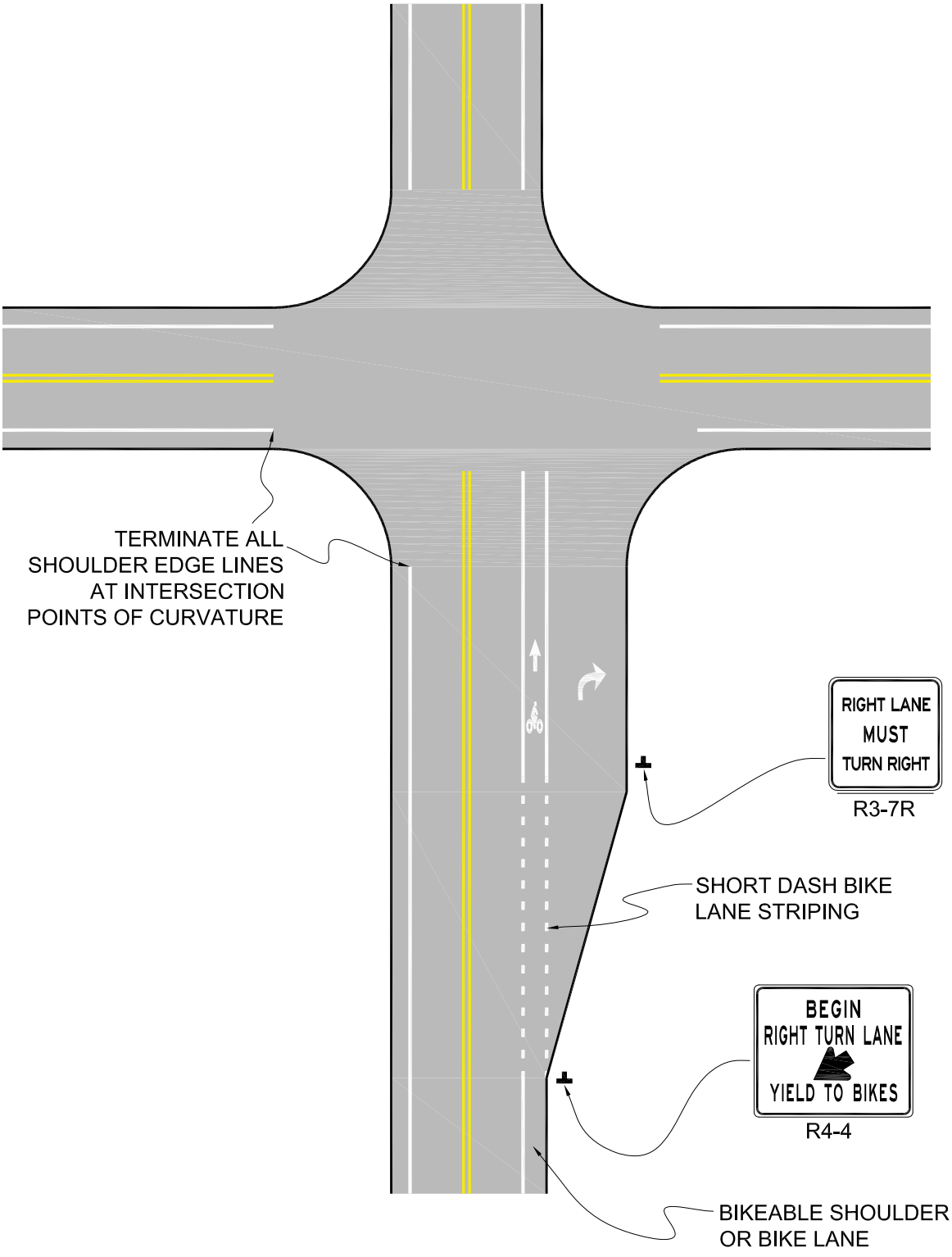
Standard Drawing 2 - Shared Use Path Typical Section (3:1 max slope)



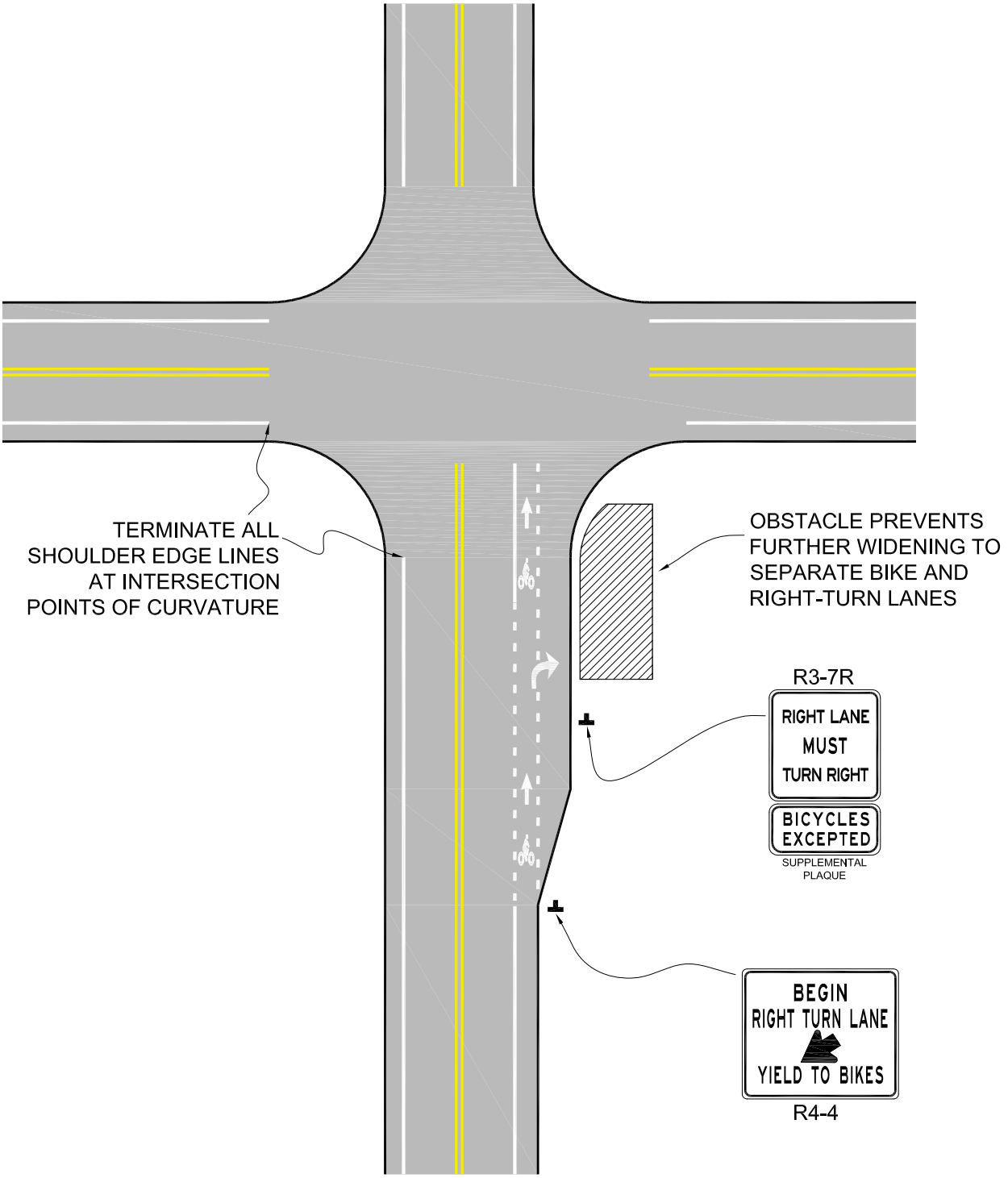
Standard Drawing 3 - Shared Use Path Typical Section (slope > 3:1)



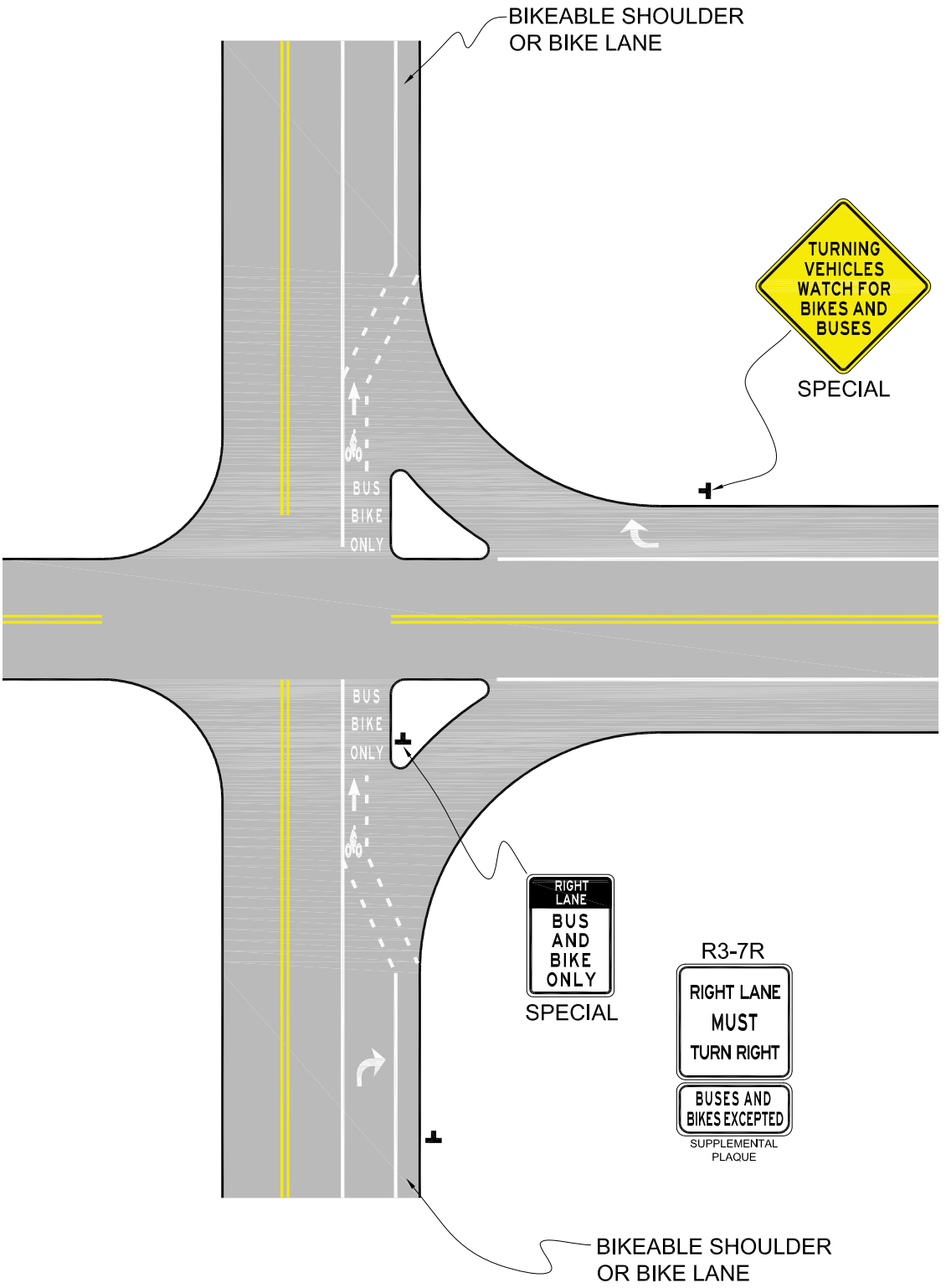
Standard Drawing 4 - Bicycle Lane Treatment at Right-Turn Only Lane



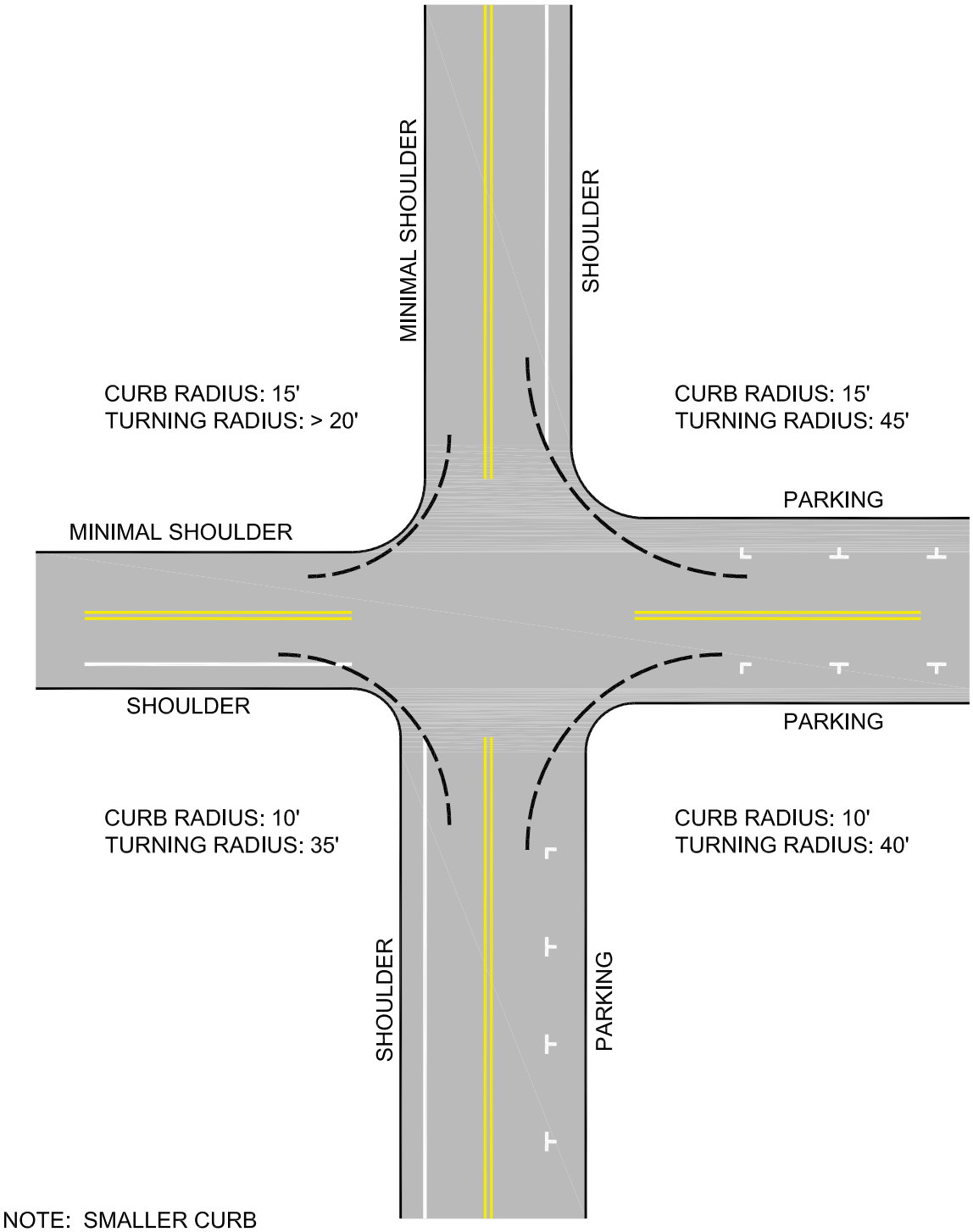
Standard Drawing 5 - Bicycle Lane and Right-Turn Lane Overlap (Constrained Space)



Standard Drawing 6 - Bus Queue Jump and Bike Lane Through Intersection

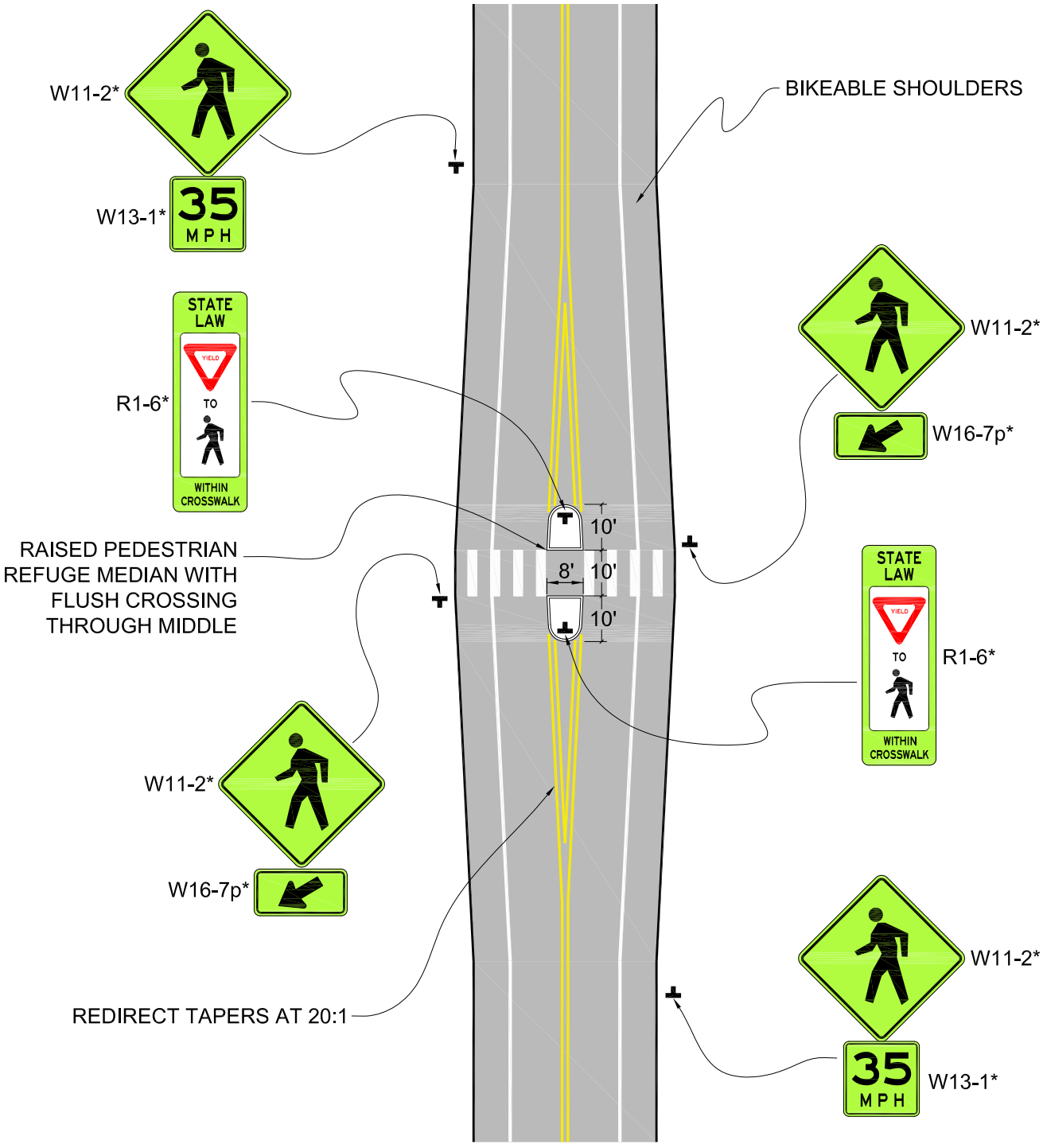


Standard Drawing 7 - Corner Radii and Equivalent Inside Turning Radii Examples



NOTE: SMALLER CURB RADII SUPPORT SHORTER PEDESTRIAN CROSSINGS

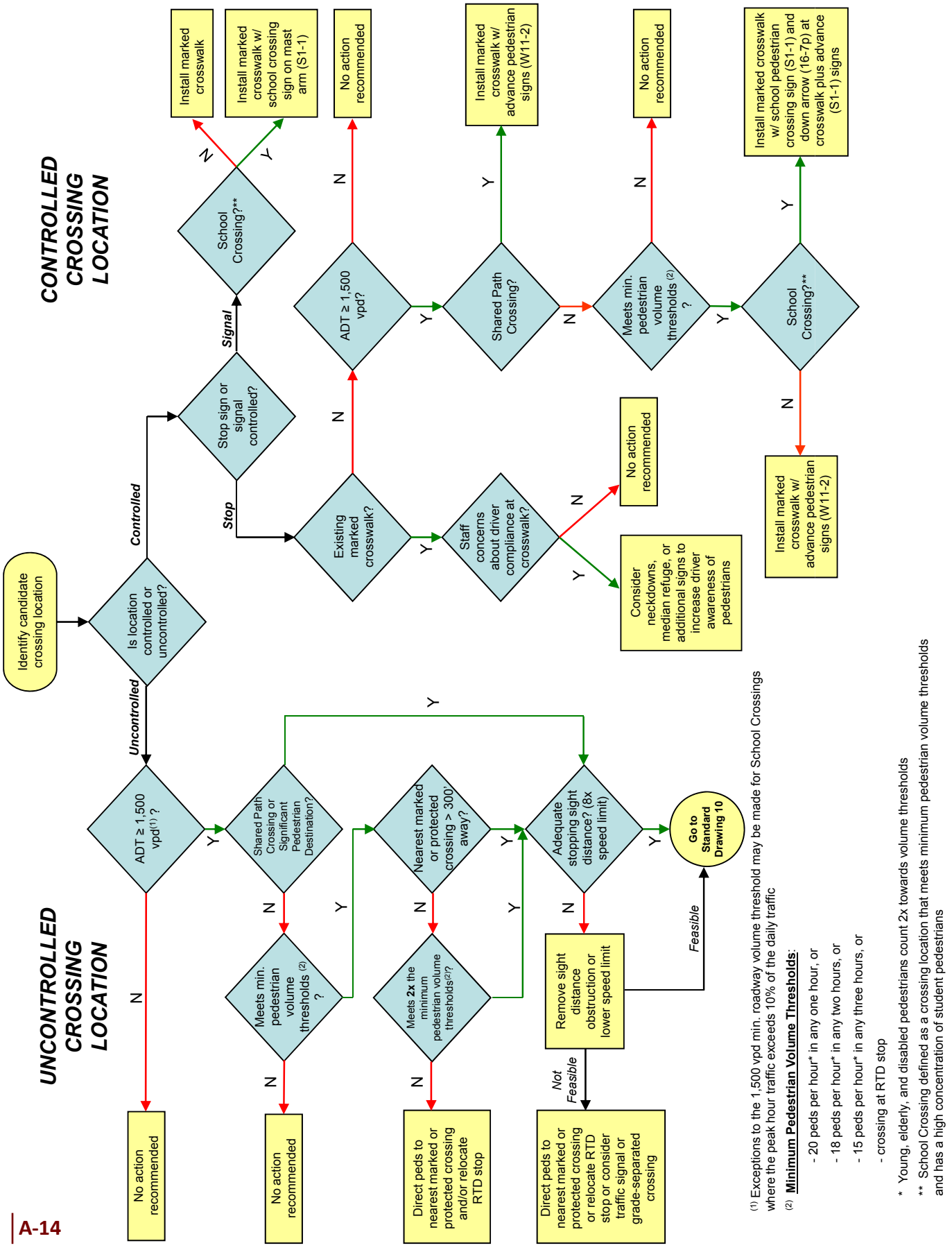
Standard Drawing 8 - Typical Pedestrian Crossing Treatment
(2-Lane Rural Roadway with Speed Limit >/= 35mph)



* USE FLUORESCENT
YELLOW-GREEN SIGNS

NOTE: STREET LIGHTING AT
PEDESRIAN CROSSING RECOMMENDED

Standard Drawing 9 - Pedestrian Crossing Treatment Flowchart



(1) Exceptions to the 1,500 vpd min. roadway volume threshold may be made for School Crossings where the peak hour traffic exceeds 10% of the daily traffic

(2) **Minimum Pedestrian Volume Thresholds**:

- 20 peds per hour* in any one hour, or
- 18 peds per hour* in any two hours, or
- 15 peds per hour* in any three hours, or
- crossing at RTD stop

* Young, elderly, and disabled pedestrians count 2x towards volume thresholds

** School Crossing defined as a crossing location that meets minimum pedestrian volume thresholds and has a high concentration of student pedestrians

Standard Drawing 10 - Criteria for Crossing Treatments at Uncontrolled Locations

Roadway Configuration	Roadway ADT and Posted Speed															
	1,500- 9,000 vpd				9,000-12,000 vpd				12,000-15,000 vpd				> 15,000 vpd			
	≤ 30 mph	35 mph	40 or 45 mph	> 45 mph	≤ 30 mph	35 mph	40 or 45 mph	> 45 mph	≤ 30 mph	35 mph	40 or 45 mph	> 45 mph	≤ 30 mph	35 mph	40 or 45 mph	> 45 mph
2 Lanes	A	B	C	E	A	B	C	E	B	B	C	E	B	C	C	E
3 Lanes w/Raised Median	A	B	C	E	A	B	C	E	B	C	C	E	C	C	C	E
3 Lanes w//Striped Median	A	B	C	E	A	B	C	E	B	C	C	E	C	C	C	E
4 Lanes	A	B	C	E	B	C	C	E	B	C	C	E	C	C	E	E
5 Lanes w/Raised Median	A	B	C	E	B	C	C	E	B	C	C	E	C	C	E	E
5 Lanes w/Striped Median	A	B	C	D	B	C	C	D	B	C	C	D	C	C	E	D
6 Lanes	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D

A ***Install marked crosswalk with enhanced road-side signs***

Specific Guidance : Install marked crosswalk with standard W11-2 pedestrian warning signs and W16-7p diagonal down arrow placards mounted on the side of the roadway with standard (W11-2) advance pedestrian warning signs; use S1-1 signs for School Crossing locations. Pedestrian or school crossing signs should be fluorescent yellow-green color.

B ***Install marked crosswalk with enhanced road-side and in-roadway (bollard mounted) signs***

Specific Guidance : If a raised median exists, Install signed and marked crosswalk as in "A" above and add R1-6 "State Law - Yield to Pedestrian" signs mounted on the raised median. If there is no raised median, replace the W11-2 signs at the crosswalk with R1-6 SPECIAL signs (rectangular, 3 color, "STATE LAW, YIELD, TO PEDESTRIANS IN CROSSWALK") mounted above W16-7p diagonal down arrow placards; In either case use standard (W11-2) advance pedestrian warning signs. If the location is a school crossing, use S1-1 signs instead of W11-2 or R1-6 SPECIAL signs. Pedestrian or school crossing signs should be fluorescent yellow-green color.

C ***Install marked crosswalk with enhanced signs and geometric improvements to increase pedestrian visibility and reduce exposure***

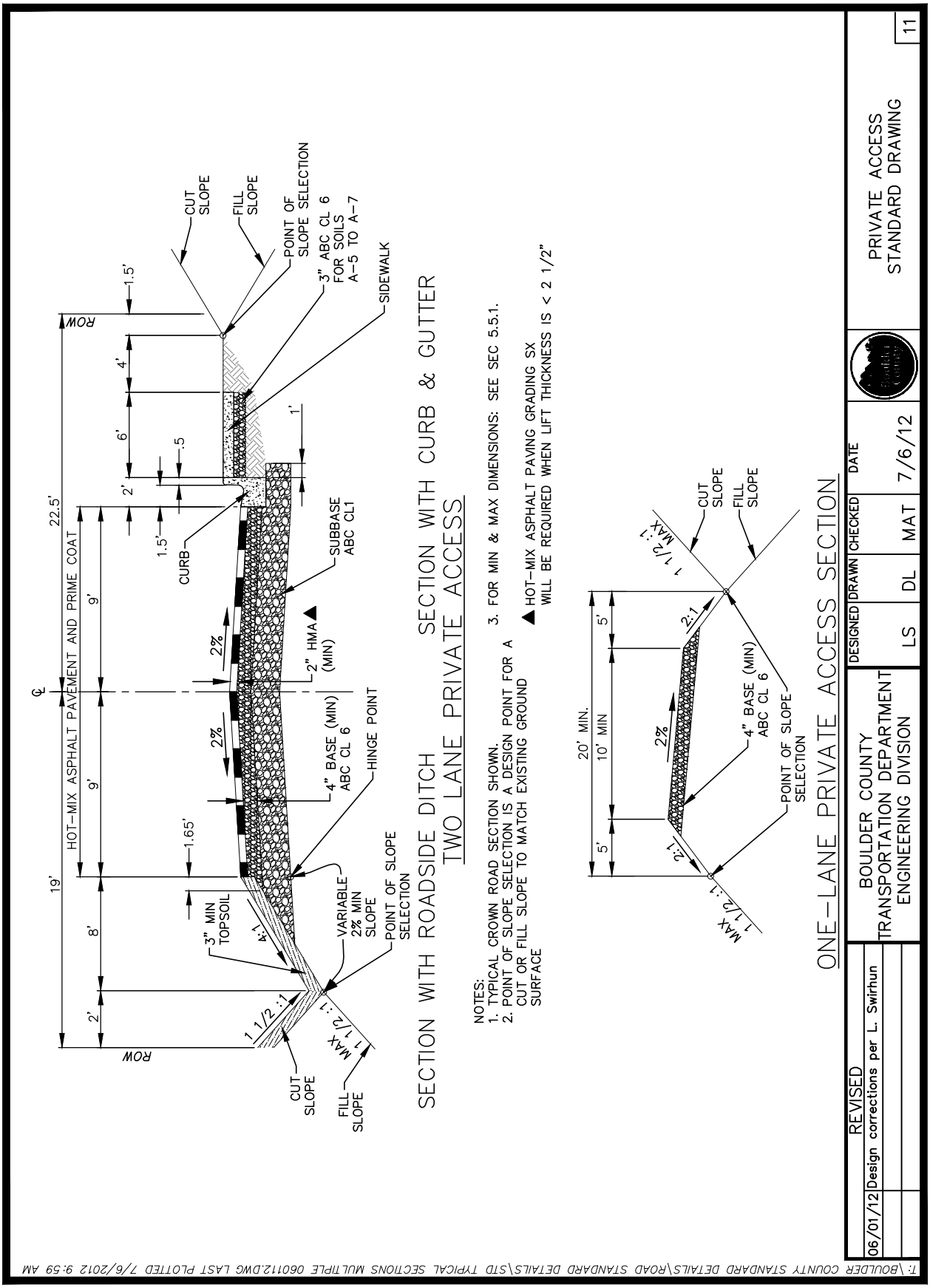
Specific Guidance : Install signed and marked crosswalk as in "B" above. There ***MUST BE A RAISED MEDIAN*** *in this treatment type; use standard (W11-2) advance pedestrian warning signs with a supplemental 35 MPH advisory speed placard; use S1-1 signs for School Crossing locations. Pedestrian and school crossing signs should be fluorescent yellow-green color.* ***For 4 or 5 lane roadways, overhead mounted W11-2 pedestrian crossing signs shall be installed*** *in addition to the side of roadway and center median signs. Advanced Stop Lines and associated R1-5 "yield here to pedestrians" signs shall be used as well on 4 or 5 lane roadways.*

D ***Do not install unsignalized marked crosswalk. Consider pedestrian traffic signal or grade-separated crossing.***

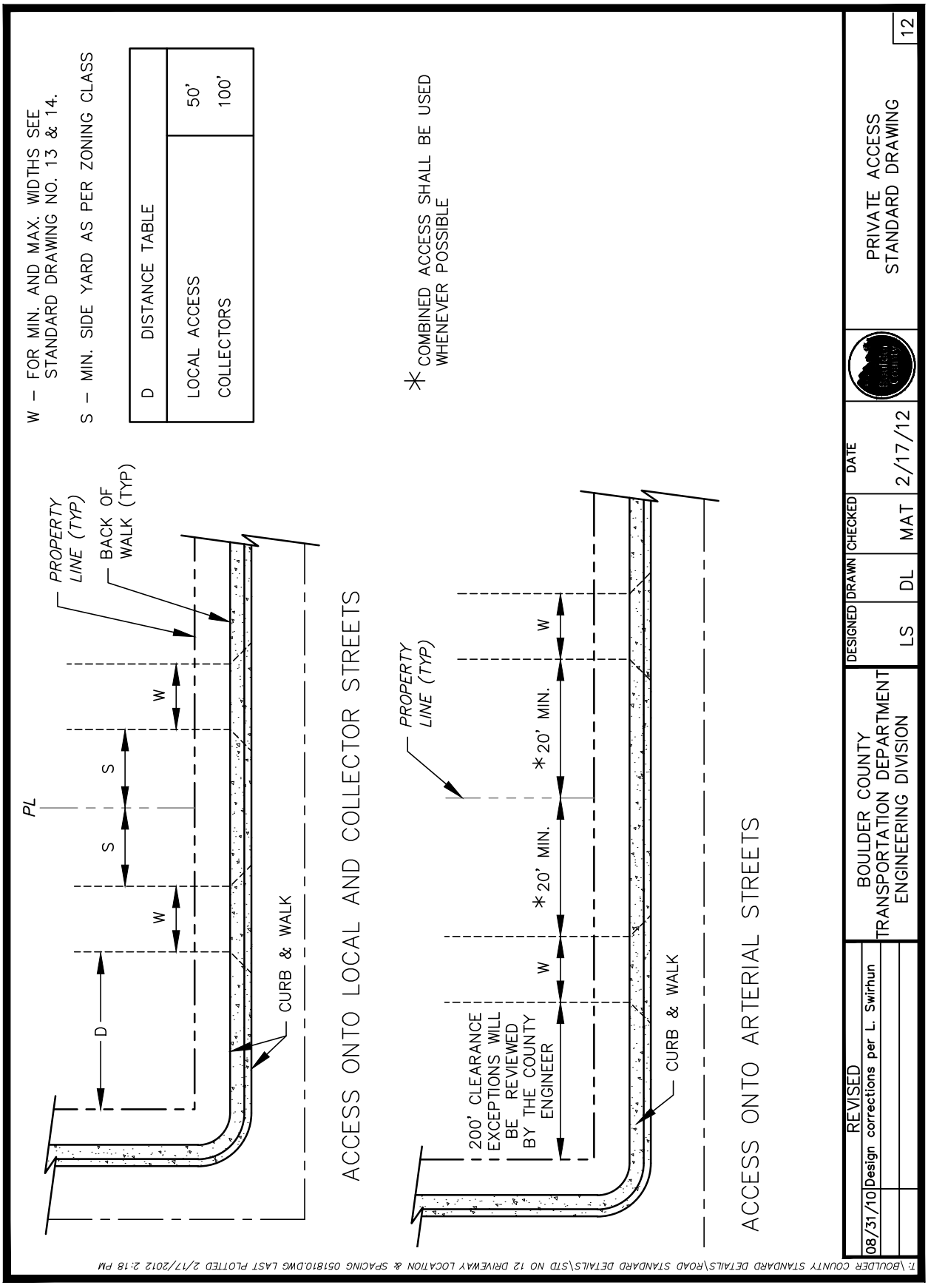
Specific Guidance : Consider traffic signal, pedestrian traffic signal, HAWK type traffic signal (an option that provides "red" traffic signal for approaching traffic) or grade-separated crossing; application of these treatments will consider corridor signal progression, existing grades, phyiscal contraints, and other engieering factors

E ***Consider lowering the regulatory speed limit to 35 or 40 miles per hour in the area of the pedestrian crossing, and then proceed with Treatment C. If speed limit cannot be lowered, proceed with Treatment D.***

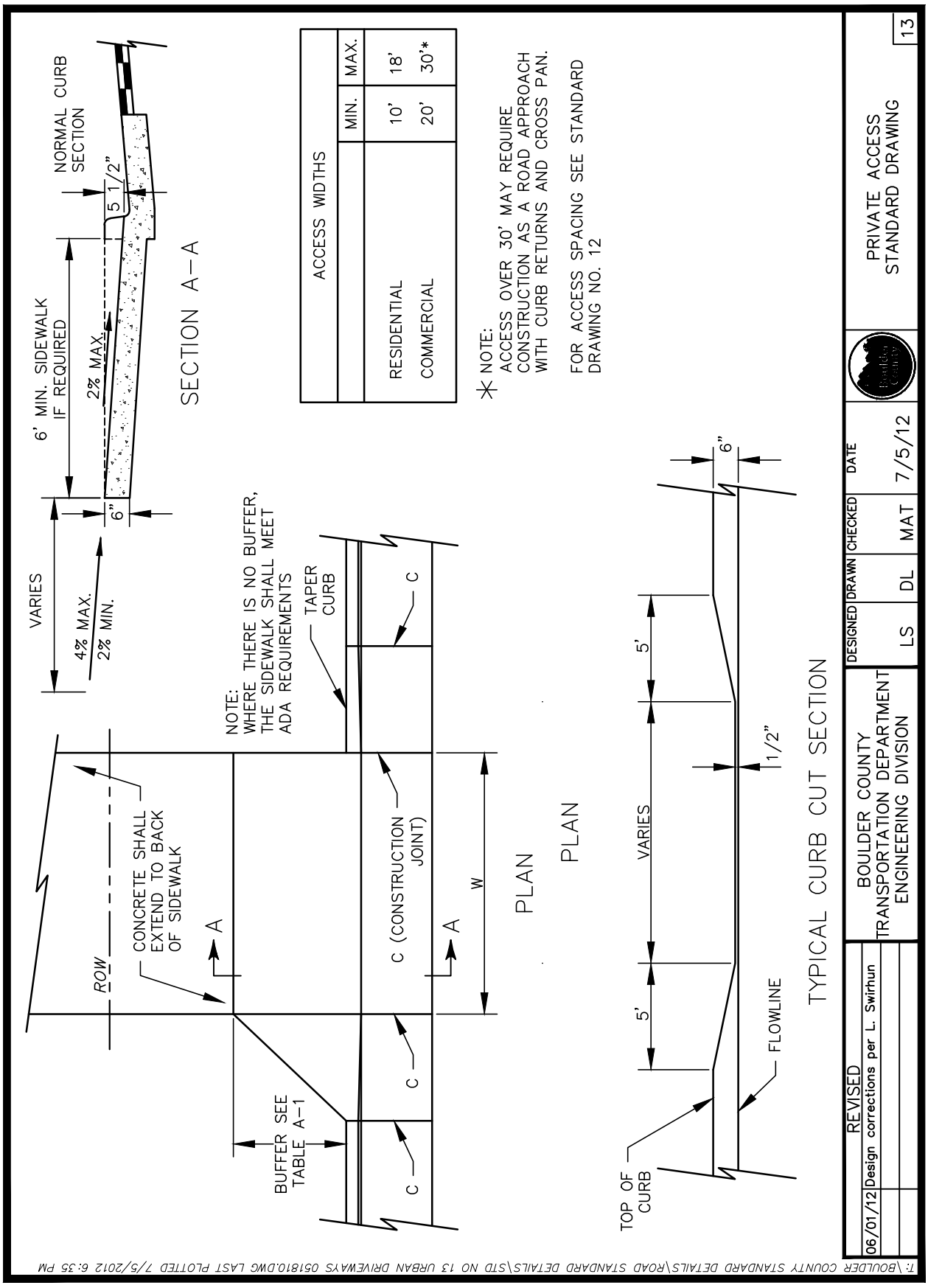
Standard Drawing 11



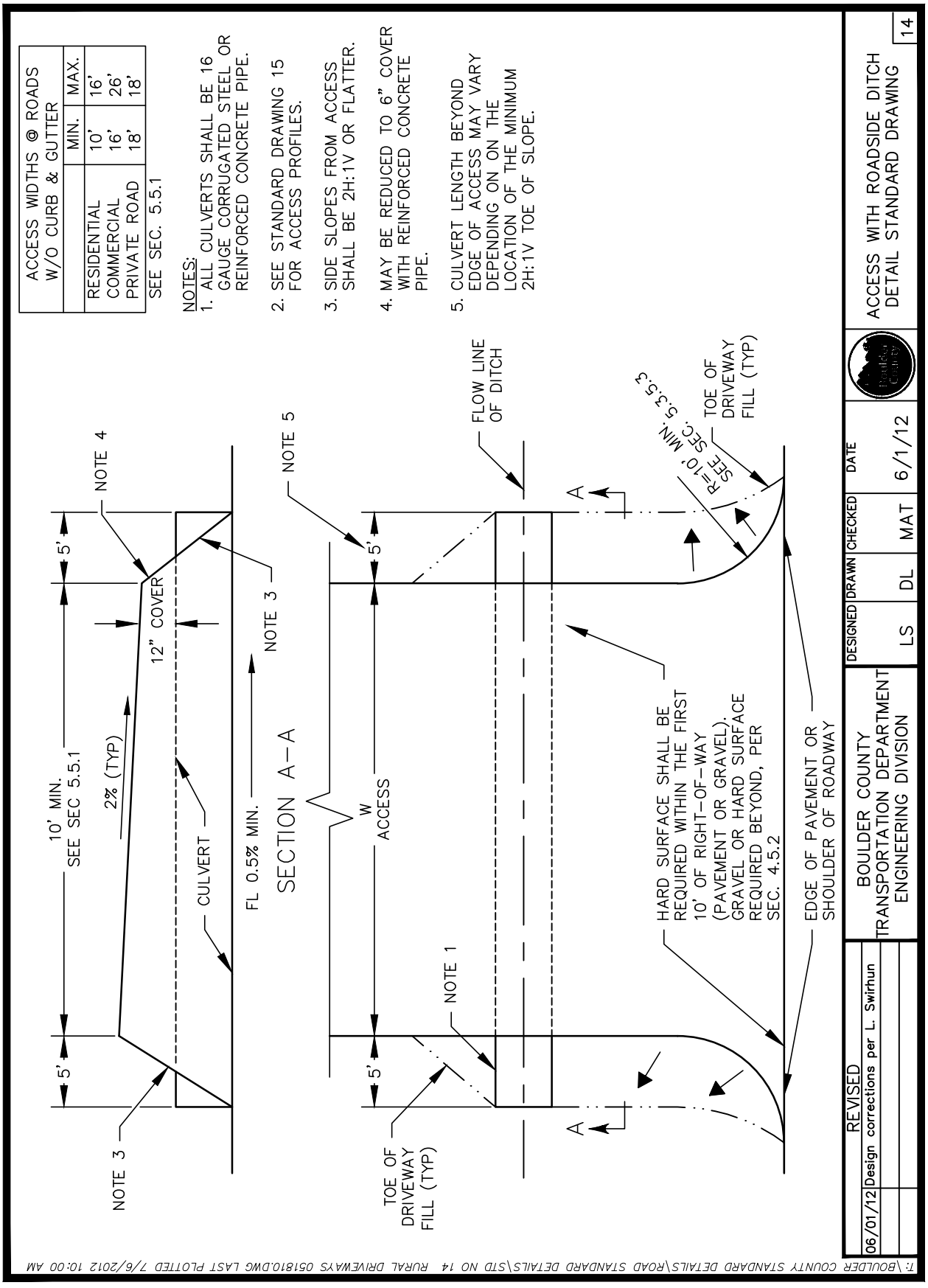
Standard Drawing 12



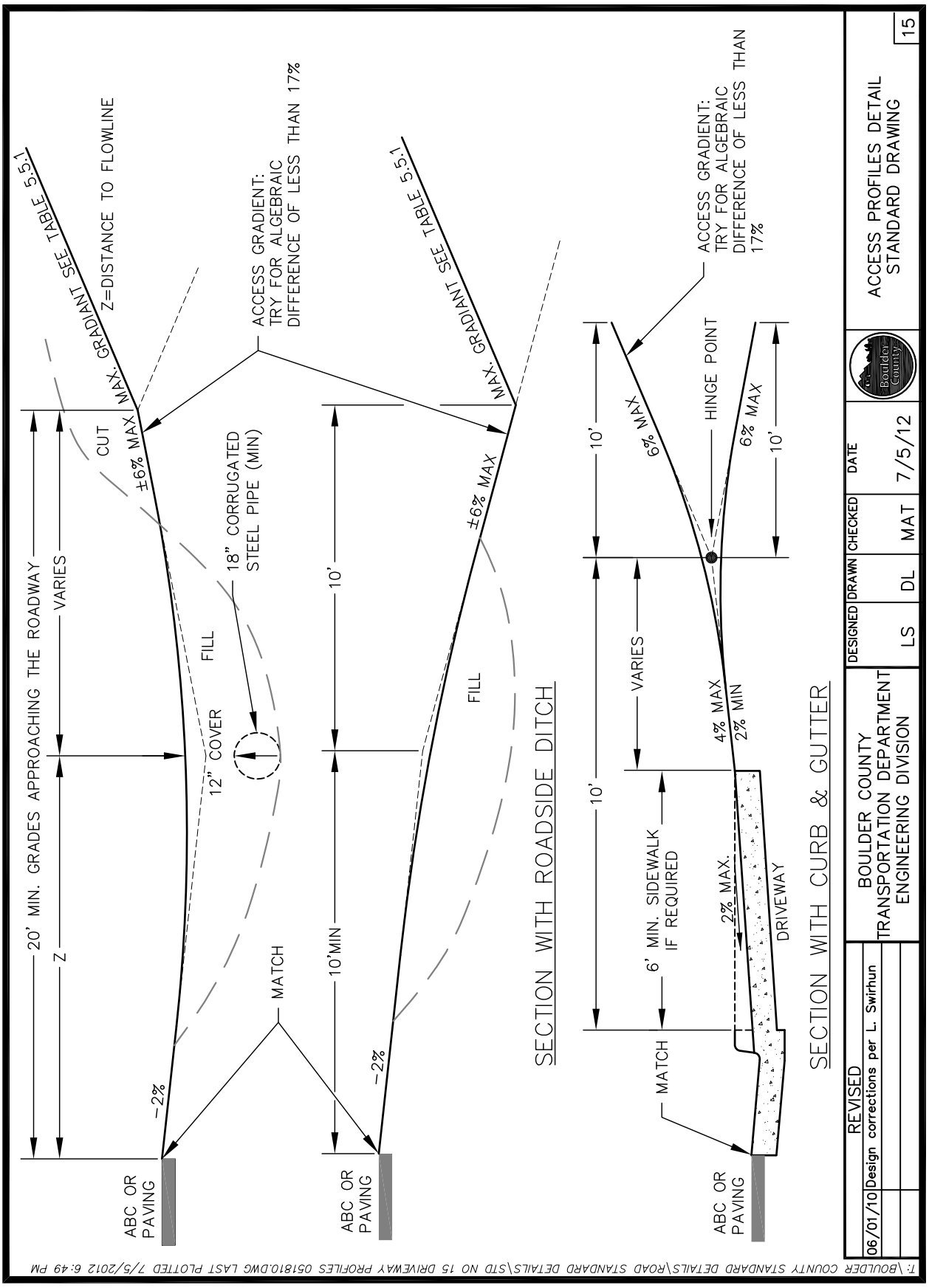
Standard Drawing 13



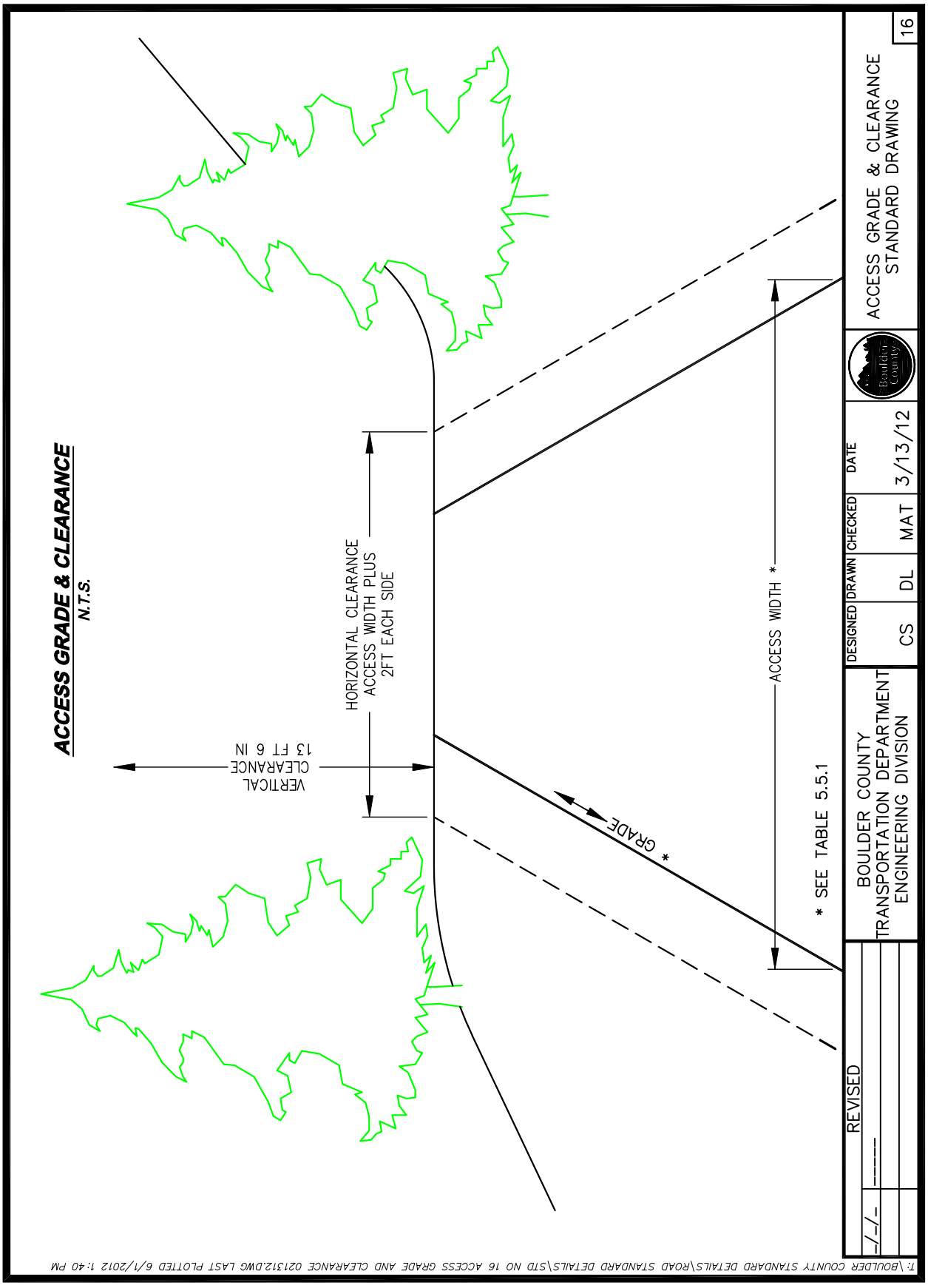
Standard Drawing 14



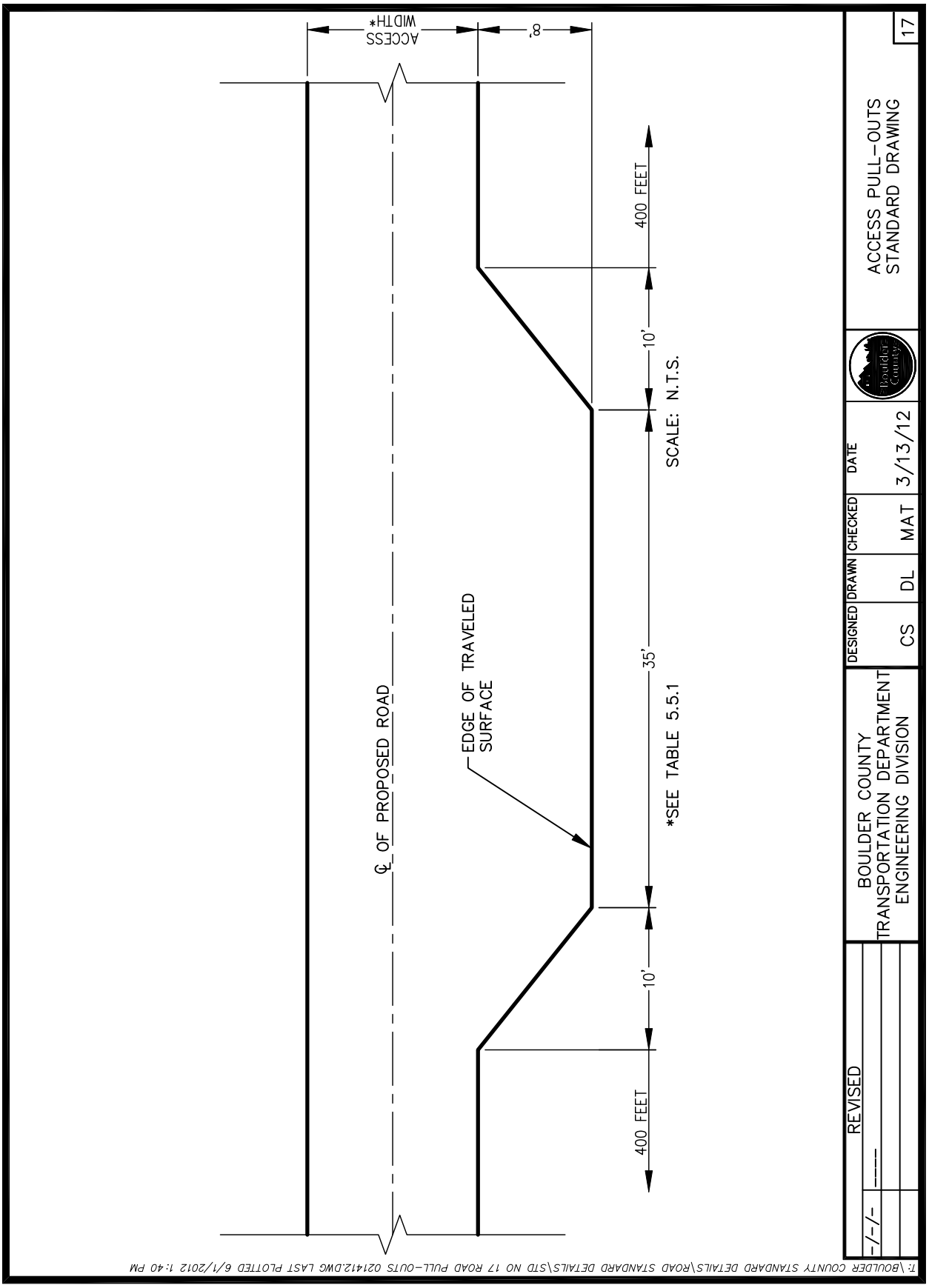
Standard Drawing 15



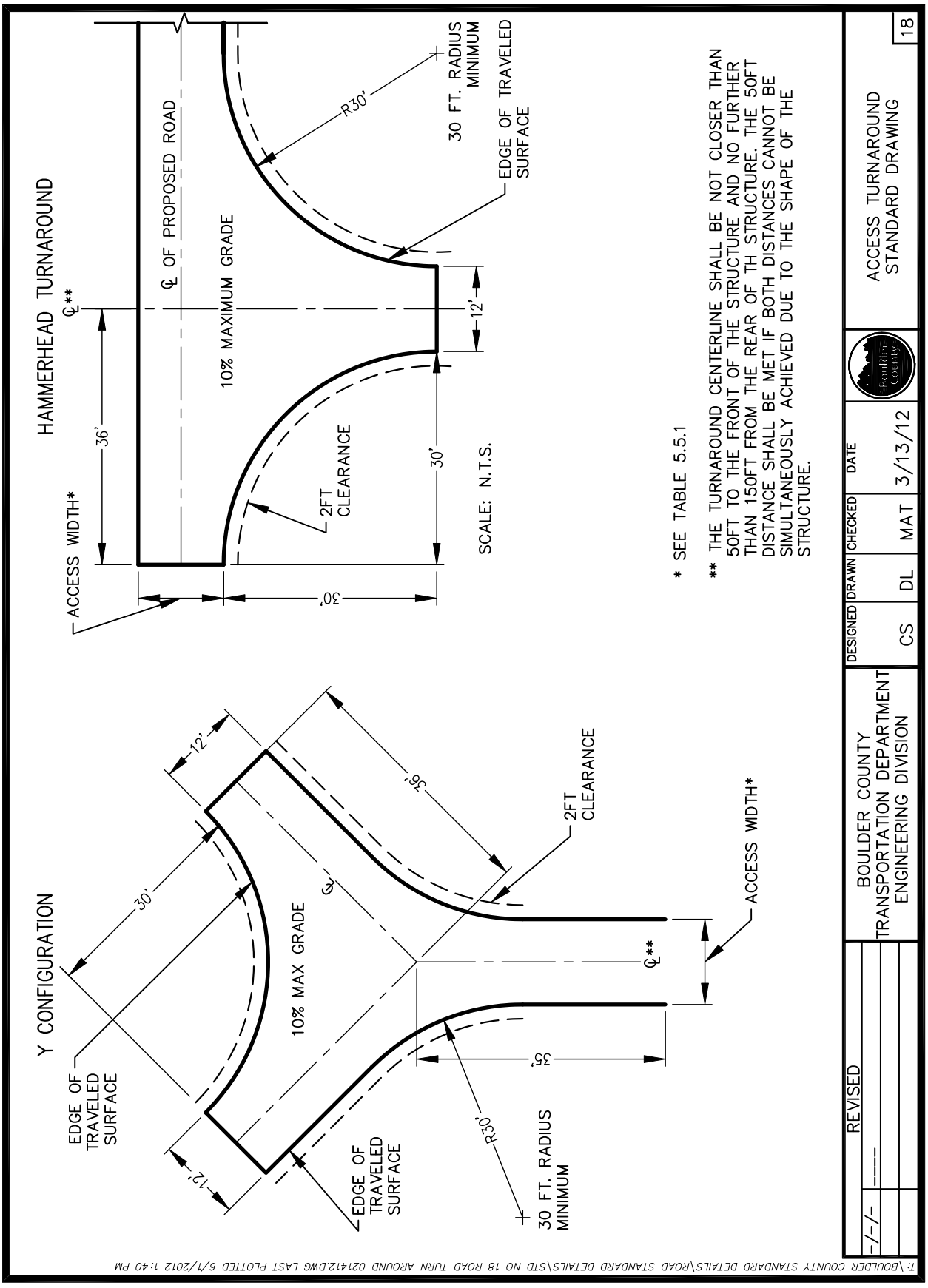
Standard Drawing 16



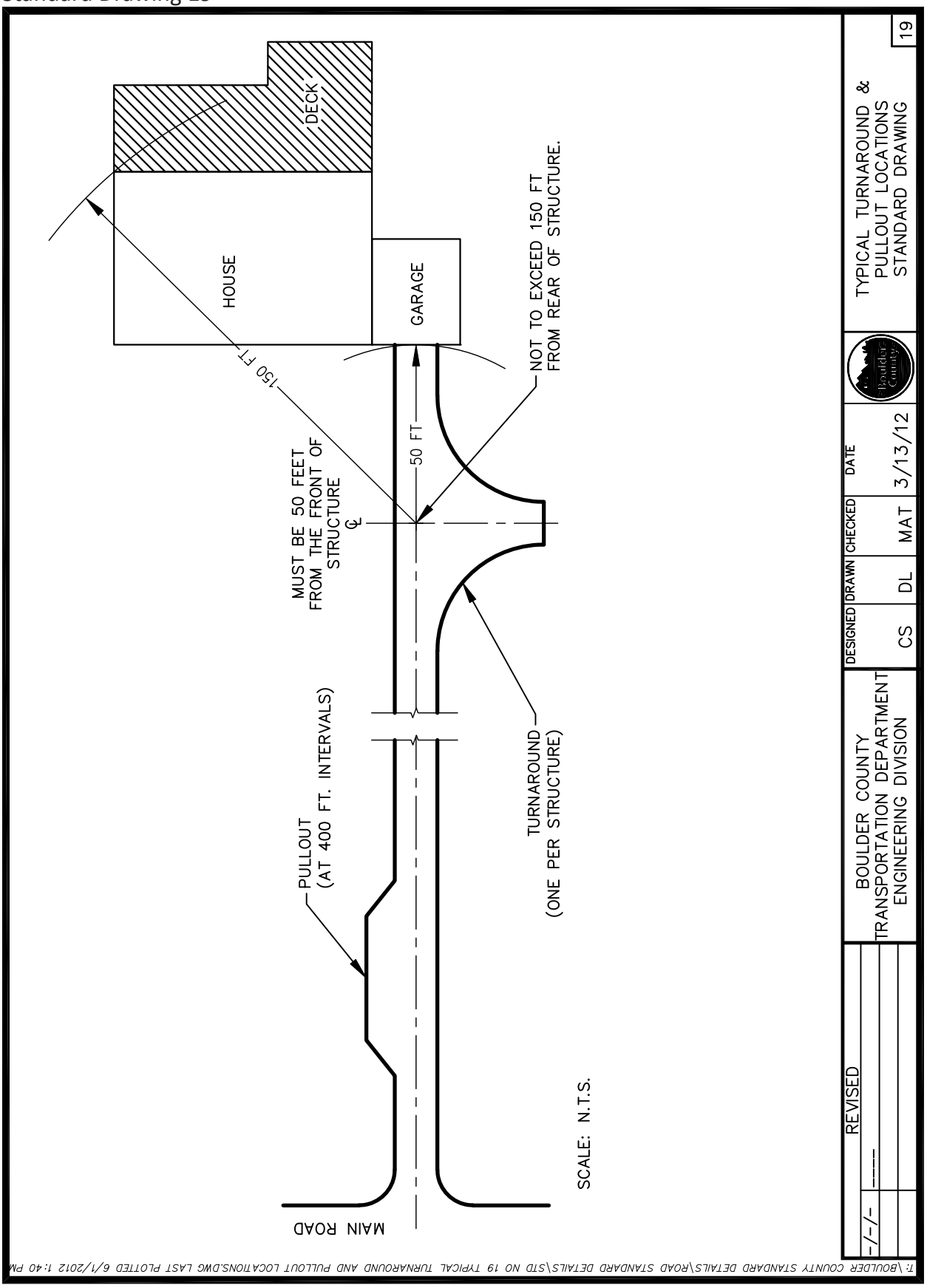
Standard Drawing 17



Standard Drawing 18



Standard Drawing 19



Appendix III - Definitions

Definitions

ACCELERATION LANE - A speed-change lane for the purpose of enabling a vehicle entering a roadway to increase its speed to a rate at which it can more safely merge with through traffic. In providing the necessary merging distance, it also gives the main roadway traffic the necessary time and distance to make appropriate adjustments.

ACCESS – A driveway or other point of entry and/or exit that creates an opening through the right of way line to abutting landowners, public street, or road.

ALLOWABLE HEAD - The highest headwater caused by the constriction which can be tolerated without damage to roadway structure or adjacent property.

AVERAGE DAILY TRAFFIC - The average 24-hour volume, of all lanes in both directions being further defined as the total number during a stated period, divided by the number of days in that period. Unless otherwise stated, the period is a year. The term is commonly abbreviated as ADT.

AXLE LOAD - The total load transmitted by all wheels on a single axle extending across the full width of the vehicle. Tandem axles 40 inches or less part shall be considered as a single axle.

BACKFILL - Material placed or used to replace, or the act of placing or replacing material removed during construction or adjacent to structures.

BARRIER – A feature constructed with the intention to prevent or deflect traffic from unintended collision with a more dangerous obstacle or feature (such as steep embankments, poles, trees, rocks or oncoming traffic). Barriers may also be used as screening devices.

BARRIER CURB - A curb that is designed with a near vertical face to prevent or discourage vehicles from leaving the pavement.

BASE COURSE - The layer or layers of specified or selected material of designed thickness placed on a subbase or a subgrade to support a surface course.

BERM - A raised and elongated area of earth intended, among other purposes, to direct the flow of water, screen headlight glare, or redirect out-of-control vehicles.

BIKE – Alternate term for bicycle.

BIKEABLE – Refers to ability for bicycles (in the common sense of usage) to use a facility or portion of a facility.

BIKEWAY – The facility intended for primary use by bicycles.

BRIDGE - A structure that includes walls or abutments over a depression or an obstruction, such as water, highway or railway, and having a track or passageway for carrying traffic or other moving loads.

CEMENT TREATED BASE - A base consisting of a mixture of mineral aggregate (or soil) and portland cement, mixed and spread on a prepared surface, to support a surface course.

CHANNELIZED INTERSECTION - An at-grade intersection in which pavement traffic is directed into definite paths by islands.

CHIPSEAL - Alternate layers of bituminous binder material and stone chips.

CLEARING - The removal of vegetation, structures or other objects as an item of highway construction.

CONSTRUCTION JOINT - A joint made necessary by a prolonged interruption in placing of concrete.

CONTOUR LINE - A line (as on a map) that connects points of equal elevation on a land surface.

CONTROL OF ACCESS - The condition where the right of owners or occupants of abutting land or other persons to access a highway is fully controlled, partially controlled or uncontrolled by the public authority.

CRITICAL DEPTH - The depth of water flowing in an open channel or a conduit partially filled, for which the velocity head equals one-half the hydraulic mean depth.

CRITICAL FLOW - A condition which exists at the critical depth; under this condition, the sum of the velocity head and static head is a minimum.

CRITICAL SLOPE - The slope of a channel that sustains a given discharge at a uniform and critical depth. A slope less than critical is called a mild slope whereas a steeper than critical slope is called steep slope.

CRITICAL VELOCITY - The velocity in an open channel or a conduit partially filled for which the velocity head equals one-half the hydraulic mean depth.

CROSS SLOPE (ROADWAY) – The transverse slope of the driving lane(s) designed to maximize drainage from the surface but not unnecessarily cause vehicles to lose traction while driving under normal conditions.

CUL-DE-SAC - A local street open at one end only, and with special provisions for turning around.

CULVERT - A closed conduit, other than a bridge, which conveys water carried by a natural channel or waterway transversely under the roadway.

CURVILINEAR ALIGNMENT - A design concept whereby the centerline projection has been developed in accordance with topographic and man-made controls and influences using a minimum of tangent sections.

DEBRIS - Scattered objects or fragments, such as limbs, ruins, rubbish, mass of stones or fragments of rocks.

DECELERATION LANE - A speed-change lane for the purpose of enabling a vehicle that is to make an exit turn from a roadway to slow to the safe speed on the curve after it has left the main stream of faster-moving traffic.

DELINEATORS - To define the roadbed and used as an aid to alert drivers of day and night hazard conditions.

DESIGN CAPACITY - The practical capacity or lesser value determined for use in designing the highway to accommodate the design volume.

DESIGN LOAD - The loads that must be supported by a structure in terms of live and dead weight loads.

DESIGN PERIOD - Geometric design generally based on estimated traffic requirements 20 years after construction.

DESIGN SPEED - A speed determined for design and correlation of the physical features of a highway that influence vehicle operation. It is the maximum safe speed that can be maintained over a specific section of highway when conditions are so favorable that the design features of the highway govern.

DESIGN VOLUME - A volume determined for use in design, representing traffic expected to use the highway or road segment. Unless otherwise stated, it is an hourly volume, commonly abbreviated as DHV.

DISCHARGE FREQUENCY - The runoff that can be expected to occur during the life of highway. Designed based on 10, 25 and 100-year flood.

DITCH CHECK - Checks are usually constructed of riprap, metal, concrete, timber or wire enclosed riprap, and should be used only as a last resort because they are a hazard to vehicles driving off the road, hamper the use of power-mowing equipment, and are subject to damage at time of unusual runoffs.

DIVIDED HIGHWAY - A highway with separated roadways for traffic in opposite directions.

EASEMENTS - A right to use or control the property of another for designated purposes. 18k EDLA - 18,000 pound single axle Equivalent Daily Load Applications (See 'Axle Load" and "Equivalence Factor.")

EMULSIFIED ASPHALT TREATED BASE - A base consisting of a mixture of mineral aggregate and emulsified asphalt spread on a prepared surface to support a surface course.

EQUIVALENCE FACTOR - A numerical factor that expresses the relationship of a given axle load to another axle load in terms of their effect of the serviceability of a pavement structure. All axle loads are equated in terms of the equivalent number of repetitions of an 18,000 pound single axle.

EROSION - The wearing away of a land surface by detachment and transporting of soil and rock particles by the action of water, wind, or other agents.

EXPANSION JOINT - A joint located to provide for expansion of a rigid slab, without damage to itself, adjacent slabs, or structures.

FLEXIBLE PAVEMENT - A pavement structure which maintains intimate contact with an distributes loads to the subgrade and depends upon aggregate interlock, particle friction and cohesion for stability.

FLOOD FREQUENCY - The average interval of time, based on the period of record, between floods equal to or greater than a specified discharge or height. It is generally expressed in years.

FOUR-LEG INTERSECTION – The location where four roadways come together at a common point.

GEOMETRIC DESIGN - The arrangement of the visible elements of a road, such as alignment, grades, sight distances, widths, slopes, etc.

GRADE - The rate of ascent or descent divided by length, expressed in terms of percent.

GRADE SEPARATION - A crossing of two highways, or a highway and a railroad, at different levels.

GRADING PLAN - A drawing showing an arrangement of contours intended to depict the final placement of ground and features for construction of drainageways, retaining walls, slopes and other topography disturbed by site construction activities.

GRUBBING - The process of removing roots, stumps and low-growing vegetation.

GUARDRAIL - A protective device intended to make highways safer by reducing accident severity.

HIGHWAY, STREET, OR ROAD - These are general terms, denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way. In rural areas, or in urban areas, where there is comparatively little access and egress, a way between prominent termini is usually called a highway or a road. A way in an urban area with or without provisions made for curbs, sidewalks and paved gutters, is ordinarily called a street.

HORIZONTAL ALIGNMENT - Horizontal geometrics for safe and continuous operation at a uniform design speed for substational lengths of highway and must afford at least the minimum stopping distance of the design speed at all points on the highway.

HOT MIX ASPHALT (HMA)- A combination of mineral aggregate and bituminous material mixed in a central plant, laid and compacted while hot.

HVEEM STABILIMETER - The measurement of the lateral pressure transmitted by a soil or aggregate being subjected to a vertical load. The pressure obtained is used to compute “R” Value. The internal resistance or the internal friction property of bituminous pavement or a base course. Data obtained is used to compute the Relative Stability.

INTERSECTION – The common point of connection of two or more roadways.

INTERSECTION ANGLE - The angle between two intersection legs.

INTERSECTION LEG - That part of any one of the roadways radiating from an intersection which is outside the area of the intersection proper.
a. Approach – the portion of a leg which is used by traffic approaching the intersection.
b. Exit – the portion of a leg that is used by traffic leaving an intersection.

INVERT - The floor, bottom, or lowest portion of the internal cross-section of a closed conduit or improved channel.

ISLAND - A defined area between traffic lanes for control of vehicle movements or for pedestrian refuge. Within an intersection a median or an outer separation is considered an island.

LEFT-TURN LANE - A traffic lane within the normal surface width of a roadway, or an auxiliary lane adjacent to or within a median, reserved for left-turning vehicles at an intersection.

LIME TREATED BASE - A base consisting of a mixture of soil, hydrated lime, and water, usually mixed in place and placed to support a pavement structure, or the components thereof.

LONGITUDINAL JOINT - A joint typically placed between traffic lanes to control longitudinal cracking.

MEDIAN - The portion of a divided highway separating the traveled ways for traffic in opposite directions.

MEDIAN OPENING - A gap in a median provided for crossing and turning traffic.

MINIMUM COVER - The point of minimum cover shall be the edge of the paved shoulder with the least cover over a pipe.

MINIMUM TURNING PATH - The path of a designated point on a vehicle making its sharpest turn.

MINIMUM TURNING RADIUS - The radius of a minimum turning path of the outside of the outer front tire.

MOUNTABLE CURB - One that can be readily climbed by a moving vehicle.

MULTI-LANE ROAD - A road having two or more lanes for traffic in each direction, or four or more lanes for traffic in two directions. It may be one-way, or two-way, divided or undivided.

NON-MOTORIZED TRAIL - A hardpack, gravel or paved trail suitable for bicycle, pedestrian and equestrian travel.

PARKING LANE - An auxiliary lane primarily for the parking of vehicles.

PASSING SIGHT DISTANCE - The minimum sight distance on roadways that must be available to enable the driver of one vehicle to pass another vehicle safely and comfortably without interfering with the speed of an oncoming vehicle traveling at the design speed should it come into view after the overtaking maneuver is started.

PAVEMENT - That part of a roadway having a constructed surface for the facilitation of vehicular contact and movement.

PAVEMENT JOINT - A vertical plane of separation or weakness.

PAVEMENT STRUCTURE - The combination of subbase, base course and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

PERMEABILITY - The property of soils that permits the passage of any fluid. Permeability depends on grain size, void ratio, shape and arrangement of pores.

PERMISSIBLE VELOCITY - The greatest velocity that will not cause excessive erosion.

PLANT MIXED BITUMINOUS BASE - A base consisting of mineral aggregate and bituminous material, mixed in a central plant, laid and compacted while hot, on subbase or subgrade, to support a surface course.

PLANT MIXED SEAL - A combination of mineral aggregate and bituminous material mixed in a central plant, laid and compacted while hot. This type seal is usually laid in very thin layers.

PRIME COAT - The application of a low viscosity liquid bituminous material to an absorbent surface, preparatory to any subsequent treatment, for the purpose of hardening or toughening the surface and promoting adhesion between it and the superimposed construction.

R VALUE - The resistance value of the soil while in a state of density and degree of saturation typical of the most adverse conditions to be expected on the road during the service life.

REGIONAL FACTOR - A numerical factor expressed as a summation of the values assigned for precipitation, elevation and drainage. This factor is used to adjust the structural number.

RIGHT-OF-WAY – An interest in property either owned in fee or as an easement transferred through grant, prescription, dedication, or the right of Eminent Domain.

RIGHT-TURN LANE - A traffic lane within the normal surfaced width of a roadway, or an auxiliary lane to the right of and adjacent to the through traffic lanes, reserved for right-turning vehicles at an intersection.

ROADBED - The graded portion of a highway, usually considered as the area between the intersections of top and side-slopes, upon which the subbase, base course, surface course and shoulders are constructed. Divided highways are generally considered to have two roadbeds.

ROADSIDE - A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered roadside.

ROADWAY - The portion of a highway, including shoulders, for vehicular use. A divided highway has two or more roadways.

SCREENING - The use of trees, shrubs, fences or other materials to obscure an objectionable view or action or reduce an objectionable sound.

SERVICEABILITY INDEX - A number used to indicate the pavement's ability to serve traffic at any specific time.

SHOULDER - The portion of a roadway contiguous with the traveled way for accommodation of bicycle traffic, stopped vehicles, emergency use and lateral support of base and surface courses.

SIGHT DISTANCE - The distance of unobstructed visibility to the driver of a passenger vehicle, measured along the normal travel path of a roadway, to the roadway surface or to a specified height above the roadway.

SINGLE-UNIT TRUCK - A freight vehicle of two or three axle and larger than a pickup.

SITE TOPOGRAPHY - May be obtained from aerial photographs, ground surveys or topographic maps, and shall include all improvements and physical controls within the area that may be affected by the design.

SLOPE EASEMENT - An easement outside the public right-of-way for cuts or fills adjacent to the roadway.

SOIL SUPPORT VALUE - A number which expresses the relative ability of a soil aggregate mixture to support traffic loads through the pavement structure.

SPECIALLY BENEFITTED PARTIES - Those parties designated by the relevant body as specially benefited by public improvements over and above the general benefit to the public at large, considering the factors listed in state statutes, including without limitation C.R.S. §§ 30-20-513 and 30-20-606, as well as related case law.

SPEED-CHANGE LANE - An auxiliary lane including tapered areas, primarily for acceleration or deceleration of vehicles entering or leaving the through traffic lanes.

STABILIZATION - Modification of soils or aggregates by incorporating materials that will increase load bearing capacity, firmness and resistance to weathering or displacement.

STOPPING SIGHT DISTANCE - The distance required by a driver of a vehicle, traveling at a given speed, to bring the vehicle to a stop after an object on the roadway becomes visible. It includes the distance traveled during the perception and reaction times and the vehicle braking distance.

STRENGTH COEFFICIENT - A factor used for expressing the relative strength, or substitution value of, layers, one to the other, for conversion purposes in a pavement structure.

STRUCTURAL NUMBER (PAVEMENT) - A number derived from an analysis of roadbed and traffic conditions. A Weighted Structural Number is a structural number that has been adjusted for environmental conditions. A weighted structural number may be converted to pavement structure thickness through the use of suitable factors related to the type of material being used in the pavement structure.

SUBBASE - The layer or layers of specified or selected material of designed thickness placed on a subgrade to support a base course.

SUBGRADE - The base surface of a roadbed upon which the pavement structure and shoulders including curbs are constructed.

SUPERELEVATION - The raised portion of highway above the normal cross slope to prevent a vehicle from sliding outward, or counteracting the centrifugal force of a vehicle traveling at an assumed speed.

SURFACE COURSE - One or more layers of a pavement structure designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion and the disintegrating effects of climate. The top layer is sometimes called the “Wearing Course.”

SUSTAINED GRADE - A continuous highway grade of appreciable length and consistent or nearly consistent gradient.

T INTERSECTION - A three-leg intersection in the general form of a “T”.

TACK COAT - The application of bituminous material to an existing surface to ensure bond between the superimposed construction and the old surface.

TERRAIN - The topography of the profile of a highway, road, or street. As used in these standards, the term generally has one of three modifiers: level, rolling, or mountainous. These three modifiers represent combinations of geometric features in varying degrees that relate primarily to gradients and horizontal and vertical alignment.

THREE-LEG INTERSECTION – The location where three roadways come together at a common point.

TIME OF CONCENTRATION - The time required for storm runoff to flow from the most remote point, timewise, of a drainage area to the point under consideration. It is usually associated with the design storm.

TOPOGRAPHY - The configuration of the earth surface including the shape and position of its natural and manmade features.

TRAFFIC ANALYSIS PERIOD - A common analysis period (usually 20 years) used in geometric design.

TRAFFIC CONTROL - Any sign, signal, marking, or installation placed or erected under public authority, for the purpose of regulating warning or guiding.

TRAFFIC ISLAND - An island provided in the roadway to separate or direct streams of traffic; includes both divisional and channelizing islands.

TRAFFIC LANE - A strip of roadway intended to accommodate a single line of moving vehicles.

TRAFFIC MARKING - A traffic control device consisting of lines, patterns or colors on the pavement, or other objects within or adjacent to the roadway, or words or symbols on the pavement.

TRAFFIC SIGN - A traffic control device mounted on a support above the level of the roadway that conveys a specific message by means of unchanging words or symbols.

TRAVELED WAY - The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

TRIP - A trip or trip end is a single or one-direction vehicle movement with either the origin or destination (exiting or entering) inside the study site. For trip generation purposes, the total trip ends for a land use over a given period of time are the total of all trips entering plus all trips exiting a site during a designated time period.

TRUCK COMBINATION - A truck tractor and a semi-trailer, either with or without full trailer, or a truck with one or more full trailers.

TURNING MOVEMENT - The traffic making a designated turn at an intersection.

TURNING PATH - The path of a designated point on a vehicle making a specified turn.

TWO-WAY ROAD - A road on which traffic may move in opposing directions simultaneously. It may be either divided or undivided.

Appendix IV - Referenced Reports

Document	Abbreviation
American Association of State Highway and Transportation Officials (AASHTO) A Guide for Achieving Flexibility in Highway Design, First Edition	AASHTO Flexibility Guide
AASHTO A Policy on Geometric Design of Highways and Streets, Sixth Edition	AASHTO Green Book
AASHTO Guide for the Development of Bicycle Facilities, Third Edition	AASHTO Bicycle Guide
AASHTO Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT<=400), First Edition	AASHTO Low-Volume Guide
AASHTO Guide for the Planning, Design and Operation of Pedestrian Facilities, First Edition	AASHTO Pedestrian Guide
AASHTO Roadside Design Guide, Fourth Edition	AASHTO Roadside Guide
AASHTO Standards Specifications for Highway Bridges, Seventeenth Edition Standards	AASHTO Bridge
Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities, 2002	ADA B&F Accessibility
ADA Guidelines for Accessible Public Rights-of-Way, 2005	ADA R/W Accessibility Guide
Boulder County Comprehensive Plan, 2009	Comprehensive Plan
Boulder County Storm Drainage Criteria Manual	BCSDCM
Colorado Department of Transportation (CDOT) M & S Standards, 2006, revised Feb. 16, 2012	M & S Standards
The Colorado Department of Public Health and Environment Colorado Discharge Permit System	CDPHE
CDOT Pavement Design Manual, 2012	CDOT Pavement Design Manual
CDOT Roadway Design Guide, 2005 (Revised November 2011)	CDOT Roadway Design Guide
CDOT Standard Specifications for Road and Bridge Construction, 2005 Standards	CDOT Road and Bridge
Colorado State Highway Access Code, 1998, Revised March, 2002	State Access Code
Federal Highways Administration (FHWA) Designing Sidewalks and Trails for Access, Best Practices Design Guide, 2001	FHWA Trail Design Guide
FHWA Manual on Uniform Traffic Control Devices, 2009, including the Colorado Supplement	MUTCD
Institute of Transportation Engineers (ITE) Trip Generation Manual, 8th Ed.	ITE Trip Generation Manual
Regional Transportation District (RTD) Design Criteria, 2006	RTD Design Criteria
Transit Cooperative Research Program (TCRP) Report 19 Guidelines for the Location and Design of Bus Stops, 1996	TCRP Bus Stop Guidelines
Transportation Research Board (TRB) Highway Capacity Manual, 2010	HCM
TRB, National Cooperative Highway Research Program (NCHRP) 279, Intersection Channelization Design Guide, 1985	NCHRP 279
United States Department of Agriculture (USDA) Forest Service Accessibility Guidebook for Outdoor Recreation and Trails, 2006	USDA Accessibility Guide
Urban Drainage and Flood Control District (UDFCD) Storm Drainage Criteria Manual, 2001 (Vol. 1 & 2), 2010 (Vol. 3)	UDSDCM