Larimer County
Urban Area Street Standards

Repealed and Reenacted: Effective August 1, 2021

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Adopted by:

LARIMER COUNTY

City of Fort Collins

City of Loveland

Larimer County

Urban Area Street Standards

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LARIMER COUNTY URBAN AREA STREET STANDARDS
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CHAPTER 1 – GENERAL PROVISIONS

1.1 AUTHORITY OF THIS DOCUMENT

These regulations, along with all future amendments, shall be known as the Larimer County Urban Area Street Standards (hereinafter called "these Standards" or "Urban Street Standards"). These Urban Street Standards have been adopted by each of the Local Entity Governing Bodies.

1.2 INTENT AND PROVISIONS

These Standards shall be required for all development projects within the jurisdiction of Local Entities, which are listed in **Section 1.2.1**, and their Growth Management Areas (GMA). These Standards shall also apply to any public and private transportation improvements that may be outside of the GMA's limits, but are integral to the planned infrastructure systems of the GMA. These standards do not apply to other unincorporated areas of Larimer County.

The Local Entity's review and approval of any plans, reports, or drawings or the Local Entity's inspection and approval of any improvements constructed by the Developer in accordance with these Standards, does not constitute a representation, warranty, or guarantee by the Local Entity that such improvements are free from defects or will operate adequately for the purpose intended.

The chapters and appendices that make up these standards pertain to planning, design, approval, construction, inspection, testing, and documentation of street improvements. The intent of this manual is to establish the minimum acceptable standards.

1.2.1 Local Entities Included Under the Urban Street Standards

The following Local Entities are covered by these Standards:

A. The City of Loveland, Colorado

B. The City of Fort Collins, Colorado

C. Larimer County, Colorado (unincorporated GMAs only)

Larimer County, Colorado jurisdictions covered by these Standards include the GMA boundaries around the City of Loveland and the GMA boundaries around the City of Fort Collins.

D. When Standards Differ Among Local Entities

A majority of the requirements in these Standards apply uniformly among all of the above entities. Where requirements differ among entities they will be distinguished with one or more of the following descriptions:

1. Loveland (GMA and city limits)
2. Fort Collins (GMA and city limits)

3. Loveland (city limits only)
4. Fort Collins (city limits only)
5. Loveland (GMA only)
6. Fort Collins (GMA only)

1.2.2 Objectives of Street Standards

A. Minimum Standards

These Standards shall be the minimum standards necessary for design and construction of all transportation public improvements in the Local Entities. Special situations as determined by the Local Entity may require different facilities and/or standards. For items not covered by these Standards, the Local Entities may require the use of resource standards in Section 1.3 below.

B. Objectives

It is the objective of these Urban Street Standards to address the following:

1. Public Safety and Convenience. To protect the public health, safety, and welfare to the greatest extent possible and minimize public inconvenience resulting from construction and maintenance activities within the public rights-of-way.
2. Maintaining Public Use. To assure that bicycle, pedestrian and vehicular uses of rights-of-way are the primary uses thereof and that the rights-of-way are properly maintained during construction and repair work in these areas.
3. Standardizing Criteria. To protect the Local Entity's infrastructure investment by establishing standardized design, materials, construction, and repair criteria for all public improvements.
4. Optimizing Use. To optimize the use of the limited physical capacity of public rights-of-way held by the Local Entity.
5. Permit System. To provide an efficient permit system which regulates and coordinates activities in an effective and safe manner.
6. Fees. To adopt fees that provide fair compensation to the Local Entity for related services and activities provided by such Local Entity.
7. Protecting Private Property. To protect private property from damages that could occur because of faulty design and construction of public improvements upon public rights-of-way.
8. Inspection. To provide criteria for inspection of public and private improvements, by the Local Entity or Local Entity designated inspector, in order to assure conformance with approved plan's uniformity, proper construction techniques, and to ensure that acceptable materials are used for the construction process of such public and/or private improvements.

1.3 RESOURCE STANDARDS

The following Resource Standards (the latest editions unless otherwise stated) may be used as reference material when certain design or construction methods and materials are not specifically addressed in these Standards and require approval of the Local Entity Engineer.

A. List of Resource Standards for Reference

1. Colorado Department of Transportation, **Standard Specifications for Road and Bridge Construction**.
2. Colorado Department of Transportation, **Standard Plans (M&S Standards)**.
3. Colorado Department of Transportation, **Roadway Design Manual**.
4. American Public Works Association, **Standard Plans**.
5. American Association of State Highway and Transportation Officials, **A Policy on Geometric Design of Highways and Streets.**
6. Institute of Traffic Engineers (ITE), **Trip Generation Volumes 1 through 3**.
7. Institute of Traffic Engineers (ITE), appropriate design publications.
8. National Cooperative Highway Research Program (NCHRP) Report 279, Intersection Channelization Design Guide, 1985.
9. Institute of Traffic Engineers, **Highway Capacity Manual**.
10. ASTM, American Society for Testing and Materials.
11. Federal Americans with Disabilities Act, (A.D.A.) Regulations.
12. U.S. Department of Transportation, **Manual on Uniform Traffic Control Devices (M.U.T.C.D.)**
13. Federal Highway Administration, Roundabouts: An Informational Guide.
14. American Association of State Highway and Transportation Officials, Guide for the Development of Bicycle Facilities.
15. National Association of City Transportation Officials (NACTO), **Urban Street Design Guide.**

1.4 AUTHORITY OF THE LOCAL ENTITY ENGINEER

The Local Entity Engineer shall have the authority on behalf of the Local Entity to determine that all design and construction is completed to a level that is equal to or exceeds the requirements set forth in these Urban Street Standards.

1.5 ENFORCEMENT RESPONSIBILITY

It shall be the duty of the Local Entity Engineer acting on behalf of the Local Entity to enforce the provisions of these Urban Street Standards.

1.6 AMENDMENTS AND REVISIONS TO STANDARDS

These Standards may be periodically amended as necessary to provide additional clarity or to reflect changes in policy or in construction or engineering practice. Such revisions to these Standards may consist of either "policy" revisions or "technical" revisions. The revision procedures set forth in Section 1.6.2 (Revisions) shall apply.

1.6.1 Updated Standards

Each Local Entity will maintain an electronic file of their Standards. All updates and revisions will be available on the Larimer County web page.

1.6.2 Revisions

From time to time, this document will require revisions. Revisions shall be grouped as either policy revisions or technical revisions.

A. Policy Revisions

Policy revisions shall be considered major changes, changes in law and changes that will cause significant increased cost or controversy. Policy revisions also include those changes that relate to the public use and convenience, such as changes in standard street width. Policy revisions require a public hearing process for their adoption. Each Local Entity staff shall make recommendations to the Local Entity Governing Body concerning the proposed policy revision prior to the adoption by the Local Entity Governing Body by an ordinance or resolution (as applicable) making such revision. No policy revision shall become effective until it has been properly adopted by the Local Entity Governing Body.

B. Technical Revisions

Technical revisions shall consist solely of such minor additions, revisions, and corrections to these Standards as may, in the judgment of the Local Entity Engineer, be necessary to better conform to good engineering and/or construction standards and practice. The Local Entity Engineer shall approve only those proposed technical revisions that: (1) are consistent with all existing policies relevant to the revision, (2) do not result in any significant additional cost to persons affected by the revision, and (3) are consistent with existing law. Technical revisions shall become effective when approved, in writing, by each Local Entity Engineer. If technical revisions are deemed necessary, the revisions may occur through one of two processes.

1. Normal Technical Revision Process. The normal technical revision process will occur during planned periodic revisions. Technical revisions determined necessary by each Local Entity Engineer shall be accomplished (with or without a public hearing process) through discussion and agreement among all Local Entities.

2. Accelerated Process. The accelerated process may occur outside of the planned periodic revision schedule. If a technical revision is determined to be immediately necessary, the Local Entities may discuss and agree upon the revision. If all Local

Entities have agreed upon such revision, then the change shall be made and notification given on the web page. The Local Entities will notify all document holders of the change.

3. Each Local Entity staff shall report such technical revisions to its Local Entity Governing Body as a part of a periodic review and update process.

1.7 DEFINITIONS OF TERMS AND ABBREVIATIONS

When the following words, phrases, or abbreviations appear in these Standards, they shall have the following definition and meaning:

AASHTO – American Association of State Highway and Transportation Officials.

ABC – Aggregate Base Course.

Access for Land Uses – The physical location where a legal traversable path may be constructed for vehicular movement between a parcel of land and the public right-of-way.

Access Management – The concept of a public agency controlling the location of access points in order to achieve the dual purposes of providing access to individual land uses and limiting access on higher order streets in order to facilitate the smooth flow of traffic with a limited amount of impedance.

Access Management Plan – A plan for a given corridor adopted by the Local Entity Governing Body or CDOT defining access locations and requirements based on the traffic impact study evaluation of existing and proposed traffic, access points, and intersections. An access management plan supplements the Local Entity's Transportation Master Plan, specifically adopted to regulate access on specific streets.

ACF – Adequate Community Facilities – also known as Adequate Public Facilities (APF). See County Land Use Code definitions.

ACI – American Concrete Institute.

AISC – American Institute of Steel Construction.

Alley – Minor public throughways that abut the side or rear of residential, industrial or commercial property and are used for vehicular access.

ANSI – American National Standards Institute.

Applicant – The person or designated agent providing pertinent information for preparation of permit, TIS, etc. This is often the Developer.

Approach Taper – A taper from the point where all approaching traffic must shift laterally, to the point of the beginning bay taper.

APWA – American Public Works Association.

Arterials – That part of the roadway system serving as the principal network for through traffic flow. Arterials connect areas of principal traffic generation and important rural highways

entering the urban areas. Arterials may contain 2, 4, or 6 through lanes, as designated on the Local Entity Master Street Plan.

ASA – American Standards Association.

ASTM – ASTM International (formerly American Society for Testing and Materials).

ATSSA – American Traffic Safety Services Association.

Attached Sidewalk – Sidewalk that is adjoining the curb.

Bay Taper – A taper from the edge of the adjacent through traffic lane to the beginning of the full width of the turn lane storage.

Bicycle Facilities – A general term denoting improvements and provisions made by public agencies to accommodate or encourage bicycling, including parking facilities, mapping of all bikeways, and shared roadways not specifically designated for bicycle use.

Bicycle Lane (Bike Lane) – The portion of the shoulder or roadway that has been designated by striping, signing, and pavement markings for the preferential or exclusive use of bicyclists.

Bicycle Lane (Protected) – Protected bike lanes provide some type of physical, stationary and vertical separation between vehicle traffic and the bike lane. As a facility that is parallel and approximate to the roadway, protected bike lanes are part of the street grid system and allocate space exclusively for bicyclists.

Bicycle Lane (Buffered) – Buffered bike lanes are conventional bicycle lanes paired with a designated buffer space separating the bicycle lane from adjacent vehicle travel lane and/or parking lane. Buffered bike lanes provide a greater shy distance between vehicles and bicyclists and encourage riders to go outside the door zone when adjacent to parking.

Bicycle Path (Bike Path) – A bikeway physically separated from motorized vehicular traffic by open space or barriers and either within the City right-of-way or within an easement.

Bicycle Route (Bike Route) – A segment of a bicycle system, designated by the Local Entity. Bicycle routes have appropriate directional or informational markers, with or without specific bicycle route number.

Bikeway – Any road or path that is designed for bicycle or pedestrian traffic, but not necessarily for their exclusive use.

Bridge – Any structure conveying a roadway or path over a body of water or other feature. Bridges shall be designed to carry a varying combination of loading, including vehicular, bicycle, and/or pedestrian traffic.

BP – Building Permit**.**

Calendar Day – Each and every day shown on the calendar, beginning and ending at midnight.

Capital Expansion Fee (CEF) Program – A program that has been established by the Local Entity for the purpose of funding certain transportation improvements. The streets funded by a CEF Program primarily serve the overall transportation system, not just a single development.

CDOT – Colorado Department of Transportation.

Chicanes – Offset curb extensions which change the path of vehicular travel from straight to curvilinear.

City – City of Loveland or City of Fort Collins, Colorado.

Civil Construction Plans – Detailed and working plans including plan and profile, details, notes and any other information necessary for complete construction of the required improvements. Also refer to Utility Plans.

CMP – Corrugated Metal Pipe.

Code – The latest official adopted ordinances, policies, codes, and/or regulations of Larimer County and the Cities of Fort Collins and Loveland, Colorado.

Collector – A street that provides both land access service and traffic circulation within residential neighborhoods and commercial and industrial areas. The primary purpose is to collect traffic from local streets and properties and channel it into the arterial system.

Commercial – A business area of a municipality where ordinarily there are many pedestrians during day or night hours. This definition applies to densely developed business areas outside, as well as within, the central section of a municipality.

Committed (Roadway) Improvements – Improvements identified in the Local Entity's Capital Improvement Program or CEF Program or identified as a financial obligation of a Developer.

Connective Access Between Public Streets – The physical location where one public street in one development connects to a public street in another development.

Construction Coordination Meeting – A meeting between the Local Entity, utility companies, the Developer, and other required attendees prior to the commencement of construction of the public improvements.

Construction Costs – Generally, the cost of all right-of-way, earthwork, paving, drainage, structures, signing and striping, traffic control, lighting, landscaping, curb and gutter, sidewalk, and utility relocation work necessary to complete the required improvements.

Consultant Engineer – A Colorado licensed professional engineer working on behalf of the Developer.

Continuity – The continuous length of a roadway segment that is uninterrupted by 90 degree turns or controlled intersections.

Contract Documents – The executed contract agreement, approved plans, and technical specifications, prepared by a Colorado licensed professional engineer, for constructing a facility.

Contractor – The person, firm, or organization to whom a construction contract is awarded by the Developer, or who has been issued a right-of-way work permit by the Local Entity. Agents, employees, workers, or designers employed by the Contractor are also bound by the terms of the contract or permit.

Corner Clearance – At an intersecting street, the distance measured along the curb line from the projection of the intersecting street flowline to the nearest edge of the curb opening.

Corner Sight Distance – The distance necessary for the driver of a motor vehicle stopped at a stop sign on a Minor Street or driveway to see approaching vehicles, pedestrians, and bicyclists along the intersecting major street and have sufficient space to make any allowed move to cross the Major Street or merge with traffic on the Major Street without causing vehicles, pedestrians, or bicyclists traveling at or near the design speed on the major street to slow down. The controlling distance for design is the longest distance, generally the distance necessary to merge with traffic.

Cross Slope – Slope of the pavement surface, excluding gutter, measured perpendicular to the street centerline.

Days – Intended as calendar days and not working days unless stipulated as working days.

DCP – Development Construction Permit.

Deceleration Lane – A right-turn lane or left turn lane lengthened to provide for safe reduction of travel speed.

Departure Taper – A left-turn bay from the point where through traffic beyond the intersection begins a lateral shift to the left to the point where the through lane is adjacent and parallel to the centerline.

Design Speed – The speed determined for design which takes into account the physical features of a street influencing vehicle operation; the maximum safe speed maintainable on a specified section of street when conditions permit design features to govern. Design speed is 5 to 10 mph higher than the posted speed limit to provide a factor of safety and allow for other conditions or uses of the street that may affect vehicle operation.

Designer – The person or persons responsible for the creation and submission of contract documents or construction plans for the purpose of one-time construction of a facility. This person shall be a Colorado licensed professional engineer.

Detached Sidewalk – Sidewalk that is offset from the curb.

Developer – The private party or parties desiring to construct a public or private improvement within Local Entity rights-of-way or easements, securing all required approvals and permits from the Local Entity, and assuming full and complete responsibility for the project.

Development – Construction of improvements on land that is essentially vacant.

Development Agreement – The contract between the Local Entity and the Developer that defines public improvement requirements, costs, and other related public improvement issues.

Development Construction Permit – Permit to construct public or private improvements for a project or within an unimproved right-of-way, obtained by application to the Local Entity.

Director – The Local Entity Service Director who oversees the Engineering Division (Fort Collins, Director of Planning, Development, and Transportation) (Loveland, Director of Public Works) (Larimer County, Director of Public Works).

Distance Between Double Driveways – The distance measured along the curb line between the inside edges of two adjacent curb openings.

Document Holder – All parties who have acquired these Standards by official registration with any Local Entity.

Driveway – A private access from a public or private roadway.

Driveway Approach – The portion of the driveway lying in the public right-of-way or public access easement between the street gutter lip or roadway of a public street and the right-of-way or public access easement line, for the full width of the access, including both apron and side slopes.

Easement – The property right of the Local Entity to use lands owned in fee by a private party for the purposes of maintenance, access, drainage, or other use, as specified on a plat or deed of dedication.

Edge Clearance – The distance measured along the curb line from the nearest edge of the curb opening to a point where the property line extended intersects the curb line.

Expressway – A divided major roadway for through traffic with partial control of access and usually with interchanges at major crossroads.

Eyebrow – A bulb or semi-circular extension of a curb on the outside edge of a street or at an "L" turn to provide more street frontage for adjacent lots.

Fees – Monetary charges which compensate the Local Entity for services rendered or infrastructure constructed.

FEMA – Federal Emergency Management Agency.

Fence – An artificially constructed barrier of wood, masonry, stone, wire, metal, or other manufactured material, or combination of materials, erected to enclose, partition, beautify, mark, or screen areas of real property.

FHWA – Federal Highway Administration, Department of Transportation.

Field Order – A written notice given by the Local Entity Inspector to the Designer, Contractor or Developer detailing a change, request, mandate, or corrective action necessary to conform to these Standards, approved plans, or other applicable Local Entity Codes.

Final Acceptance – The written notification from the Local Entity, after the Local Entity Engineer finds the Warranty Period to be satisfactorily completed, that all public improvements are free of defects and the Local Entity releases the Developer from future maintenance obligations.

FIRM – Flood Insurance Rate Map.

Franchise Agreement – An agreement between the Local Entity and certain private utility companies, specifying terms and conditions for use of the Local Entity's public rights-of-way or other public lands.

Freeway – A divided major roadway with full control of access and with no crossings at grade.

Frontage – The distance along the street right-of-way line of a single property or development within the property lines. Corner property at an intersection would have a separate frontage along each street.

General Development Plan -- The initial plan used by the City of Loveland to show preliminary development concepts.

GMA - Growth Management Area Overlay Zone District – The areas defined in the Larimer County Master Plan as existing or future potential annexation areas. Wherever these standards associate "GMA" with a particular city, "GMA" refers to that city's annexation areas. Examples are Loveland (GMA only) or Loveland (GMA and city limits).

HBP – Hot Bituminous Pavement. Pavements constructed with a mix of aggregate and asphaltic/bituminous cement. (Similar acronyms used by other references may include: ACP – Asphalt Concrete Pavement, HAC – Hot Asphalt Concrete, HMA – Hot Mixed Asphalt, and similar variations.)

High Volume Access – Access from a public roadway designed to service 350 or more vehicle trip ends per day or 35 or more vehicle trip ends per hour.

HMA – Hot Mix Asphalt

Improved Arterial Street – That portion of an arterial street that has been totally or partially constructed to arterial street standards and accepted by the Local Entity.

Improved Arterial Street Network – The system of improved arterial streets which are interconnected and which are defined on the Local Entity map titled "Improved Arterial Streets Network" maintained by the Local Entity Engineer.

Improvement Agreement – The Subdivision Improvements Agreement, Public Improvements Agreement or Development Agreement, which are written documents of terms and conditions related to a one-time development of a specific project within the Local Entity's jurisdiction. Such agreements are made between the Local Entity and Developer to outline responsibilities and duties of each party. (Refer to **Appendix B-2** for Public Improvements Agreement.)

Improvements – All public or private improvements within Local Entity rights-of-way or easements.

Industrial or Warehouse – Any establishment that manufactures or stores an article or product.

Initial Acceptance – This is the Local Entity's document and process, by which the Local Entity initially accepts for ownership, maintenance, and warranty the public improvements identified in the approved plans and Improvement Agreement for a specific project.

Insignificant Traffic Impact Development – A development project of less than 3 dwelling units or a development generating fewer than 20 trips per day.

Inspector – An authorized representative of the Local Entity Engineer, assigned to make inspections to assure work is completed in compliance with plans, standards and specifications.

Intersection Nose – The radius or distance from the end of the storage bay to the near edge of the cross-route exit lane for the left-turning vehicle. For left-turn bays the cross-route exit reference is normally the centerline of an unchannelized 2-way street or the far edge of the median in a channelized street.

Intersection Sight Distance – Refer to Corner Sight Distance.

"Issued for Construction" Plans – Design plans that conform to these Standards and are signed and stamped by the Designer and signed by the Local Entity Engineer, ready for distribution to the Contractor for construction.

ITE – Institute of Transportation Engineers.

Landscaping – Materials including, without limitation, grass, ground cover, shrubs, vines, trees, and non-living materials, commonly used in landscape development, as well as attendant irrigation systems.

Lane Width – The width of a travel lane measured from the centerline of the lane striping to the centerline of the parallel lane stripe, or to the face of the curb in Fort Collins (city limits only), or lip of gutter in Loveland (city limits only), whichever is applicable.

Lift – The maximum specified thickness of material that may be placed at one time.

Lip – Defines the outermost edge of the gutter pan.

LMC – Loveland Municipal Code.

Local Entity - The Local Entity that possesses legal authority to establish laws and regulations pertaining to the health, safety and welfare of the residents living within its jurisdictional boundaries. For the purposes of this document the Local Entities are Larimer County, the City of Fort Collins, the City of Loveland and other municipalities that adopt these Standards.

Local Entity Engineer – The Engineering Division Manager, City Engineer, or County Engineer, or another Local Entity representative authorized to act on behalf of the Local Entity. In Fort Collins (city limits only), reference to the Local Entity Engineer for traffic-related items shall mean the City Traffic Engineer.

Local Entity Governing Body – The Larimer County Commissioners and the City Councils of Fort Collins and Loveland.

Local Streets – All street facilities that are not in one of the higher systems. Their primary purpose is to provide direct access to abutting lands and connections to the higher classification streets.

Main Member – Any member designed to carry the loads applied to the structure. The trusses.

Major Street – A Major Collector or Arterial street. Major Streets are typically designated on the Master Street Plan or Transportation Master Plan.

Manager/Administrator. – The highest level of staff authority within the Local Entity.

May – A permissive condition.

Mini-Roundabout – Elevated circular islands placed in the center of a street intersection to reduce vehicular travel speeds by requiring the motorist to travel in a counter clockwise direction around the circular island.

Minor Development Project – Projects limited to one parcel which do not generate more than five peak hour vehicular trips per day.

Minor Street – A Local or Minor Collector Street.

MSP - *Master Street Plan* – Fort Collins, see TMP.

MUTCD – Manual on Uniform Traffic Control Devices.

Neckdowns – A narrowing of the roadway for traffic calming at intersections or mid-block.

Neighborhood – A residential or commercial area defined by ordinance, resolution or common understanding.

Official – A person appointed by the Local Entity to administer these Standards.

Opinion of Cost (Cost Estimate) – Unit costs, based on those approved by the Local Entity and assigned to materials and related quantities. The Opinion of Cost shall be broken down by Phase, when applicable, for each project and shall be submitted by the Designer at the time of first plan review by the Local Entity.

Ordinance – A law established by the Local Entity Governing Body.

Original Cost of Design and Construction – The cost of financing, engineering, construction, and any other costs actually and reasonably incurred that are directly attributable to the improvements.

OSHA – Occupational Safety and Health Administration.

Overall Development Plan – A plan used by the City of Fort Collins for phased development projects to generally describe preliminary improvements.

Parkway – Refer to Tree Lawn.

P.C. – Point of curvature.

P.C.R. – Point of curb return.

Pedestrian Walkway – A public facility for pedestrian traffic either within the right-of-way of the vehicular traffic roadway or within a public easement (e.g., public tunnels).

Permittee – The holder of a valid permit issued in accordance with these Standards or other Local Entity related process.

Phasing Plan – A plan that defines improvements to be completed in specified parts over a defined sequence.

P.I. – Point of intersection.

Plans – Construction plans (**mylar only**) signed by the Local Entity depicting public improvements to be constructed for the project.

Pre-Construction Meeting – A meeting between the Designer and assigned agents and the Inspector to review proposed work necessary to construct the project, **prior** to proceeding with the work. A meeting may be required for each project, at the Inspector's discretion.

Private Improvements – Improvements similar to Public Improvements, but which are installed within private easements and requiring a Development Construction Permit.

Professional Engineer (P.E.) – A Colorado licensed professional engineer.

Professional Land Surveyor (P.L.S.) – A Colorado licensed land surveyor.

Project – The public or private improvement(s) designated in the approved plans, which are to be constructed in conformance with these Standards. The term "Project" includes any and all public or private improvement projects for or within the Local Entity, whether development projects, private utility projects, or capital improvement projects.

Project Supervisor – The person appointed by the Developer or Contractor for management and control of the work on the project as performed by the Contractor and Subcontractors.

Proposed Roadway Improvements – Those roadway improvements deemed necessary due to the impact of the project development.

P.T. – Point of tangency.

Public Improvements – Those public-type facilities to include: pavement, curb and gutter, sidewalk, pedestrian/bike/equestrian paths, storm drain facilities with related appurtenances, culverts, channels, bridges, water distribution or transmission facilities with related appurtenances, sanitary sewer collection facilities with related appurtenances, water and waste water treatment facilities, pavement markings, signage and striping, traffic signals and related appurtenances, erosion control and right-of-way grading, or earth excavation processes integral to construction of other public improvements listed herein.

Punch list, Initial or Final – A written list of work items, compiled by the Inspector, which do not conform to these Standards, the plans or other associated Local Entity Codes that govern the project.

Raised Crosswalk – A roadway crossing that slightly elevates the pedestrian crossing surface above the general roadway surface. A raised crosswalk is a traffic calming device.

Record Drawings – Original design drawings updated by a Professional Engineer depicting all modifications from the design that occurred during construction.

Redevelopment – Removal or modification of existing improvements and construction of new improvements or substantial remodeling.

Reimbursement Agreement (3rd Party) – An agreement between the installing Developer and the Local Entity for the purpose of reimbursing the installing Developer for the front footage charge, when collected from the Developer of an adjacent property.

Report – A bound document, the contents of which may contain certain necessary analyses, surveys, tests, exhibits, and other pertinent data supporting the subject matter.

Right-of-way – (Also "public right-of-way.") A public street, way, alley, sidewalk, or easement.

Right-of-way Permit – A document, with or without conditions specified by the Local Entity, which allows a Developer to construct any public or private improvements within an improved right-of-way or easement.

Roadway – The portion of the highway, arterial, collector, or local street, including shoulders, intended for vehicle and/or bicycle use.

Roundabout – A circular street intersection used as a traffic control device in lieu of a multi-way stop or a traffic signal.

Scoping Meeting – A required meeting for the Applicant and Applicant's traffic engineer to review all the requirements for a Transportation Impact Study.

Secondary Member – Member not designed to carry primary loads. The deck, stringer and floor beams.

Setback – The lateral distance measured perpendicular to the street and extending from the right-of-way line, or other specific feature, to the closest point of a structure.

Shall – A mandatory condition.

Shared Roadway – Any roadway upon which a bicycle lane is not designated and which may be legally used by bicyclists regardless of whether such facility is specifically designated as a bikeway.

Should – An advisory condition, recommended, but not required.

Sidewalks – Paved or otherwise improved area for pedestrian use, located within the public street rights-of-way that also contain roadway for vehicular traffic.

Specifications – Construction specifications and standards adopted by the Local Entity.

Speed Humps - Paved humps placed in the street roadway with the intent to slow vehicular traffic. The geometrics of the speed hump determine how fast it can be navigated.

Standards – Larimer County Urban Area Street Standards, inclusive of all secondary/supplemental codes and any subsequent amendments.

Stop Work Order (S.W.O.) – A written instruction/notice from the Local Entity, revoking the Developer's and/or Contractor's rights to continue work on the project due to nonconformance with these Standards.

Stopping Sight Distance – The distance required by the driver of a vehicle traveling at the design speed to bring the vehicle to a stop after an object on the road becomes visible. This distance is measured from the driver's eye, 3.5 feet above the pavement to the top of an object 6 inches high on the pavement anywhere on the roadway.

Storage Length – The distance from the end of the bay taper to the nearest flow line extension of the intersecting street.

Street – A public way for vehicular, pedestrian, and bicycle travel, including the entire area within the right-of-way. This includes alleyways.

Streetscape – Pedestrian and landscape improvements in the right-of-way, generally occurring between the curb and the right-of-way line. Streetscape generally includes sidewalks, street trees, pedestrian lighting, fencing, furnishings, and landscaped areas, including medians and irrigation.

Structure – Anything constructed or erected with a fixed location below, upon, or above grade, including without limitation foundations, traffic signals, fences, retaining walls, buildings, inlets, vaults, poles, bridges, and major drainage facilities.

Subcontractor – A person, other than the Contractor, supplying labor and materials, or labor only, for the Project, and working for the Contractor or the Local Entity.

Substantial Completion – Major completion of all Work for the Project, prior to certain inspection(s) or the creation of Punch lists.

Surety – A financial instrument— such as cash, letter of credit, bond or escrow agreement as approved by the Local Entity—securing the Developer's responsibility to complete construction of Public or Private Improvements within an approved Project. Surety shall also mean a financial instrument securing the Developer's obligations throughout the Warranty Period.

TIS - Transportation Impact Study, as described in Chapter 4.

TMP – Transportation Master Plan or element thereof, including the Master Street Plan.

Trail – Any path used by pedestrians or bicyclists within a public right-of-way or easement. This would include concrete, gravel, or natural surfaces.

Transportation Master Plan (TMP) – Includes the Master Street Plan.

Traversable Barriers – A barrier placed across any portion of a street that is traversable by bicyclists, pedestrians, inline skaters, and emergency vehicles only.

Traversable Path – Consists of a curved curb transition, a curb cut, or a drive-over curb, along with a paved driveway width.

Tree Lawn – Area of right-of-way between the face of the curb and the sidewalk.

Turn – A roadway curve with a design speed of 30 mph or less.

USGS – United States Geological Survey.

Utility Plans – Civil Construction Plans. The term "Utility Plans" is used only in Fort Collins (city limits only).

Variance – A deviation from these Standards that has been duly and properly approved by the applicable Local Entity.

Vesting approval (Loveland city limits only) – vesting approval is generally granted by the City Council for most development application types. Exceptions include phased PDP developments that are part of an approved GDP, and preliminary plats with a standard zoning designation which are granted vesting approval by the Planning Commission. Minor subdivisions are approved through an administrative action by City staff.

VPH – Vehicles Per Hour

Warranty Period – The period of time that the Developer or Contractor is responsible for material and workmanship defects in the public improvements, until written notification by the Local Entity of final acceptance of the public improvements.

Wheel Path – The 3-foot wide wheel traveled portion located on both sides of the travel lane and starting 2 feet from the center of the travel lane.

Width of Curb Opening (W) – The width of curb opening measured at the curb line, excluding the curb transitions or curb returns.

Work – All construction activity, including materials, labor, supervision, and use of tools and equipment necessary to complete the Project in full compliance with these Standards, approved Plans, or Improvement Agreements.

Working Day – 7 a.m. to 6 p.m., Monday through Friday, excluding any holidays observed by the Local Entity.

1.8 INTERPRETATION OF STANDARDS

In the interpretation and application of the provisions of these Urban Street Standards, the following principles apply:

1.8.1 Governing Standards

Whenever a provision of these Standards or any provision in any law, ordinance, resolution, rule, or regulation of any kind contains any restrictions covering any of the same subject matter, the standards that are more restrictive or impose higher standards or requirements shall govern.

1.8.2 Prior Acceptance of Construction Plans

These Urban Street Standards shall not modify or alter any street construction plans that have been filed with and accepted by the Local Entity prior to the effective date of the ordinance or resolution adopting these Standards. This exception shall be subject to the

conditions and limitations under which said plans were accepted by the Local Entity Engineer.

1.9 DEVELOPMENT PROCEDURES AND POLICIES

1.9.1 General

The purpose of this section is to describe the development procedures and policies of the Local Entities as they pertain to planning, design, approval, and construction of streets for which approval by the Local Entity is required.

1.9.2 Street Construction Policy – On-Site and Off-Site Requirements

A. Street Construction Responsibility

The responsibility for the design and construction of all new streets and the widening of existing streets necessary to provide adequate transportation service to, or within, a development rests exclusively with the Developer, except as outlined in **Section 1.9.2.C** ("Adequate Transportation Service" is described in Chapter 4). This responsibility includes the acquisition and/or dedication of all necessary rights-of-way and easements. This responsibility applies to on-site streets, adjacent streets, transition sections, and connections to the arterial street system. Certain portions of these improvements may be eligible for reimbursement. Reimbursement for street improvements may be sought from the local entity and/or property owners adjacent to the improvements. Reimbursement policies are presented in **Section 1.9.3.** The following list outlines the improvements that are considered to be an integral part of the street construction.

1. Street grading and subgrade preparation or stabilization.
2. Concrete curbs, gutters, sidewalks and cross pans.
3. Installation of all street related ADA improvements.
4. Pavement section including aggregate base courses and asphaltic or Portland cement concrete pavement.
5. Traffic signals and/or required Roundabouts or Traffic Circles.
6. Traffic signing and pavement markings.
7. Railroad crossings.
8. Bridges, Ditch and drainage crossings.
9. Street lighting.
10. Water distribution system.
11. Sanitary sewer system.
12. Storm drain system.

B. Required Street Improvements

1. General. The Developer is responsible for all improvements required of their development. In some cases, a financial security in a form acceptable to the Local Entity may be allowed in lieu of construction of all or part of an improvement. Such allowances must be authorized in writing by the Local Entity Engineer.

Variances allowing less than minimum improvements may be allowed as provided in Section 1.9.4. Conversely, in discretionary actions such as annexations and certain rezoning actions, the Local Entity may require more than the minimum improvements provided for in these standards.

2. On-Site Criteria. The Developer is responsible for all improvements internal to the site. Ultimate right-of-way and easements must be dedicated to the Local Entity prior to or concurrent with approval of the development.

   Minimum easement requirements for City of Fort Collins (city limits and GMA). A minimum 15 foot wide utility easement shall be provided behind the right-of-way adjacent to all arterial roadways. A minimum 8 foot wide utility easement shall be provided adjacent to all public alleys, and a minimum 9 foot wide utility easement shall be provided behind the right-of-way for all other street classifications.

3. Adjacent Criteria. The Developer is responsible for improvements adjacent to the site boundaries. Where street upgrades are needed to comply with these Standards and/or Local Entity's Transportation Master Plan, the Developer shall be responsible for the design and construction of street improvements adjacent to the exterior boundary of the subject Property. When such improvements are designed and constructed, they shall be extended along the entire boundary(s) of the Property at the horizontal and vertical location that establishes the approved alignment for the long-range transportation facility as defined in these Standards. Ultimate and necessary right-of-way and easements must be dedicated to the Local Entity prior to or concurrent with approval of the development.

   Minimum Requirements for Loveland (city limits and GMA). At a minimum, the Developer shall always be responsible for the equivalent of half a major collector street adjacent to the development (vertical curb, gutter, a 6-foot sidewalk, and 17 feet of pavement). The Developer may also be responsible for curb, gutter, and sidewalk, as well as all or part of the remaining pavement on the opposite half of the adjacent street.

4. Transition Criteria. Where an improved street must be tied into an existing street, transition areas must be provided to safely shift traffic back onto the existing street. Transition plans must meet the length and design requirements provided in these standards. Transitions shall typically be designed and constructed off-site from the Project. The off-site transition(s) may be installed as a permanent street improvement (i.e., long-range pavement thickness and location) or as a temporary improvement (i.e., interim thickness and location as approved by the Local Entity Engineer). Permanent off-site transitions may be eligible for future reimbursement by the Local Entity or a future Developer, while temporary off-site transitions will not be eligible for reimbursement. Transitions adjacent to the Development may be approved by the Local Entity in situations where the long-range improvements are constructed adjacent to the Property and traffic safety or operational concerns warrant a waiver of the off-site transition requirement.

5. Connection to the Arterial Street Network. Any Development which does not have direct access to an improved arterial street within the Improved Arterial Street Network will be required to improve certain off-site streets to provide adequate access to the nearest Improved Arterial Street.

   Improved access must be provided in the most reasonable and/or most heavily traveled route, as determined by the Local Entity Engineer. In some cases, more than one off-site street may need to be improved. Pavement thickness shall be based on a 20-year design life including both projected site generated and background traffic growth. To facilitate construction of off-site street improvements, routing traffic through nearby residential areas will not be allowed unless the required traffic volume level of service for the respective street classification is maintained.

   a. Minimum Requirements for Loveland (city limits). Where required, street improvements must include, at a minimum, a 34-foot wide paved street, edge of pavement to edge of pavement, and 4-foot gravel shoulders along the edge of pavement.

   b. Minimum Requirements for Fort Collins (city limits). Where required, street improvements must include the following:
      1) For arterial and collector streets such improvements shall consist, at a minimum, of constructing a thirty-six foot wide paved street cross section on a base that is adequate to accommodate the ultimate design of the street either (1) as designated on the Master Street Plan, or (2) in accordance with the Standards, whichever is applicable.
      2) For all other street classifications, the off-site street improvements shall be designed and constructed to City standards including, without limitation, curb, gutter, sidewalk, and pavement.
      3) All intervening streets that connect to the Improved Arterial Street Network shall include the width and improvements necessary to maintain a level of service as defined by Part II of the City of Fort Collins Multi-modal Transportation Level of Service for the length required to connect to the Improved Arterial Street Network.

   c. Minimum requirements for Loveland (GMA) and Fort Collins (GMA). The need for off-site improvements within the Fort Collins and Loveland GMA's shall be determined by the Local Entity Engineer and shall meet the requirements of numbers a) and b) above.

6. Off-Site Right-of-Way and Easements. Prior to approval of any development which requires acquisition and dedication of off-site right-of-way or easements, the Developer shall provide legal documentation demonstrating their ability to obtain such right-of-way or easements without any restrictions and at no cost to the Local Entity.
   Prior to final approval of plat and construction plan documents, all off-site rights-of-way and easements must be dedicated and recorded with the County Clerk.

In some circumstances where off-site right-of-way is necessary but acquisition of such right-of-way or easements cannot be obtained from the property owner, the Local Entity may consider a condemnation action. In such cases the developer must demonstrate that a number of criteria have been met. In Loveland (city limits and GMA) Resolution #R-53-2001 establishes a policy for the exercise of the City's eminent domain powers in conjunction with the development of private property.

C. Waiver from Street Construction Responsibility. A Developer may not be responsible for constructing the street improvements needed to serve that development if circumstances meet any of the following conditions:

1. Improvements are included in the most recent Local Entity street capital improvement plan, the funds necessary for construction of the improvements have been appropriated, and the improvements are scheduled for construction by the Local Entity within three years from the time of Local Entity Governing Body approval of the final plat for the development; or

2. Improvements are included in a fully funded plan by another public agency, such as the Colorado Department of Transportation, and are schedule for construction within three years from final plat approval; or

3. Improvements are included in a binding agreement with another developer or private party, for which financial security acceptable to the Local Entity that fully covers the costs of the improvements is held by the Local Entity; or

4. For off-site street improvements only, the proposed development is a Minor Development Project within Loveland (city limits or GMA) or within Fort Collins (GMA only); or

5. In Loveland (GMA only) and Fort Collins (GMA only) the obligation to design and construct any street improvements may be waived for an Insignificant Traffic Impact Development.

1.9.3 Reimbursement Policy

Developments may be eligible for reimbursement of street and trail improvements made off-site and/or adjacent to the development if the requirements of the reimbursement policy for new street construction are followed (see next subsection). In addition, in Loveland (city limits only) those improvements for which street capital expansion fees are collected are also eligible for credit or reimbursement under the provisions of this section. In Fort Collins (city limits only), reimbursement may be received as long as the applicant follows all of the requirements provided in the City Code.

A. Larimer County Reimbursement Policy

The above policy does not apply to applications submitted to Larimer County. Reimbursement for Larimer County shall be in accordance with Larimer County Land Use Code, Section 9.5, and will be considered on a case by case basis.

B. Street Oversizing Reimbursements in the City of Loveland (city limits only)

1. General. Only streets identified in the City's current adopted Transportation Master Plan are eligible for oversizing reimbursement by the City. When a Developer is required to construct an arterial street, the Developer may be eligible to receive a reimbursement from the City for the costs necessary to oversize the street from a major collector to the arterial standard. In accordance with Section 1.9.2.B.3, the Developer is responsible to construct all street improvements up to and including those of a major collector street; only those costs incurred to increase a public street's structure and width beyond the major collector to an arterial may be eligible for reimbursement and these streets may be within, adjacent to, or off-site from the development.

2. Letter of Intent. For the City to consider a street oversizing reimbursement, the Developer must provide a written request of their intent to enter into a Street Oversizing Agreement with the City at the time of their Civil Construction Plans (CCPs) submittal. The Developer's written request shall include a letter along with a map of the location of the planned street improvements and a signed and sealed Engineer's Estimate of the full cost of the improvements as well as the City's portion. The City will respond to this request within 30-days.

3. Bidding & Construction. Once the Developer's request is approved by the City, the Developer shall:

    a. Competitively bid the construction work shown on the City-approved CCPs to a minimum of three contractors.

    b. Provide the bid results to the City. The lowest bid will be the basis for reimbursement of the construction costs; however, the Developer may use the contractor of their choice.

    c. Construct the improvements depicted in the CCPs to LCUASS standards.

    d. Obtain Initial Acceptance and begin the two-year warranty period per LCUASS.

    e. Obtain Final Acceptance per LCUASS.

4. Reimbursement Request. Within sixty (60) days of receiving Initial Acceptance, the Developer shall submit to the City documentation of the Street Oversizing costs along with other items required by the City Engineer or their Designee. The Developer's submittal for reimbursement shall include:

a. A letter from the Developer with detailed breakdown of all costs that are directly attributable to the street improvements and those eligible for reimbursement including a statement certifying that all such costs have been paid in full. The full payment documentation shall include certification that all costs for the construction, inspection, management or other services that are associated with the installation of the improvements are fully paid. All associated documentation must be received and accepted by the City before the Developer will be entitled to reimbursement under any Street Oversizing Agreement established hereunder.

b. A letter from the Contractor(s) confirming the costs for all improvements and a statement certifying that all such costs have been paid in full.

c. A letter from the Developer's financing office certifying any financial charges assessed that are eligible for reimbursement.

d. Record drawings prepared by a licensed Engineer per the requirements of LCUASS. Also included shall be drawings that clearly show the overall improvements including the oversizing areas, thicknesses, and widths of the areas greater than a major collector street.

e. The City will provide written notice of acceptance of the Developer's costs along with the Street Oversizing Reimbursement forms. The Developer shall complete and submit three signed original forms. Following execution of the Street Oversizing Agreement by the City, one signed original shall be returned to the Developer.

5. Timing of Reimbursements. The timing for reimbursements to Developers for Street Oversizing Agreements is subject to available transportation funding, the prioritized significance of the project related to other transportation needs, and subject to City Council's appropriation of funding. The prioritized significance will be based on the need compared to other identified projects in the current adopted Transportation Master Plan. All other projects will be reimbursed in the order they were completed. Reimbursements may be made several years after completion of the Final Acceptance, made as partial payments as funding is available, subject to City Council appropriation.

6. Construction Cost Adjustment. Construction Costs for inflation will be adjusted per the Colorado Department of Transportation Construction Cost Index. A multiplier for the costs will be determined by taking the Index for the date the Final Acceptance was issued and divided into the Index at the time the payment(s) is made. The adjustment will also be based on the amount owed at the time of payment(s) to the Developer.

C. Street Third-Party Reimbursements in the City of Loveland (city limits only)

1. General. When a Developer is required by the City to construct a public street, alley, or pedestrian-bike way through undeveloped areas or areas that may be underdeveloped, the Developer may be eligible for reimbursement of a portion of the costs of the design and construction from properties adjacent to the street improvements (the Third Party). In accordance with Section 1.9.2.B.3 the Developer is responsible for the entire costs for the engineering and construction, right-of-way acquisition, and other costs up to and including those of a major collector street. However, in situations where the Developer designs and constructs improvements that may be considered the responsibility of future developers of adjacent properties, those Third Parties may be required to reimburse the Developer for their portion of those improvements. Such reimbursement may occur by agreement between the Developer and the Third Party/Parties or, if no private agreement can be reached with the Third Party, the City may facilitate the reimbursement at the time the Third Party develops or redevelops its property.

2. Letter of Intent. The Developer must take the following steps prior to construction of the street improvements to be eligible to enter into a Third-Party Reimbursement Agreement with the City:

    a. The Developer shall first contact the Third Party in writing by certified mail with the intention of creating a private agreement for reimbursement.

    b. If the Developer and the Third Party are unable to reach an agreement, the Developer may then contact the City Engineer in writing stating the Developer's intent to enter into a Third-Party Reimbursement Agreement. The request shall include a letter of intent; a signed and sealed Engineer's Estimate of the Third Party's portion of the costs; a map of the location of the street improvements; a map of the affected property or properties; and copies of the certified notices that were provided to the Third Party prior to this request. The City will respond to this request within 30-days.

3. Bidding & Construction. When the Developer's request is approved by the City, the Developer shall:

    a. Competitively bid the construction work shown on the City-approved Civil Construction Plans (CCPs) to a minimum of three contractors.

    b. Provide the bid results to the City. The lowest bid will be the basis for reimbursement of the construction costs; however, the Developer may use the contractor of their choice.

    c. Construct the improvements depicted in the CCPs to LCUASS.

d. Obtain Initial Acceptance and begin the two-year warranty period per LCUASS.

e. Obtain Final Acceptance per LCUASS.

4. Reimbursement Request. Within 60-calendar days of receiving Initial Acceptance the Developer shall provide the following along with any other items that may be required by the City Engineer or their designee:

a. Documentation of the actual design and construction costs along with a list of the obligated properties.

b. All costs for the construction, inspection, management or other services that may be associated with the installation of the improvements must be fully paid by the Developer before such person shall be entitled to reimbursement under an Agreement. A letter from the Developer with detailed breakdown of all fees that are directly attributable to the street, alley, or pedestrian-bike improvements eligible for reimbursement and a statement certifying that all such fees have been paid in full.

c. A letter from the Contractor(s) confirming the costs for all improvements and a statement certifying that all such costs have been paid in full.

d. A letter from the Developer's financing office certifying any financial charges assessed that are eligible for reimbursement.

e. An accurate map prepared by a licensed Engineer or Surveyor which shows:
1) Location and limits of the eligible street, alley, or pedestrian-bike improvements;
2) Name, address, and telephone number of the owner of each property abutting the eligible improvements;
3) Frontage of each property with the lineal footage shown;
4) Reimbursement amounts due from each property based on the certified costs, divided by the frontage of all abutting properties, multiplied by the frontage of the individual property;
5) Book, page, and/or reception number from the records of the County Clerk and Recorder or the name of the recorded plat from which the information for each property was obtained; and
6) any other information deemed necessary by the City Engineer to properly prepare a reimbursement agreement.

5. Front Footage Charge. If the above conditions within this Section C are satisfied, the City may enter into an Agreement with the installing Developer such that, as a condition of approval of subsequent development or re- development of property adjacent to the newly constructed public street, alley, or pedestrian-bike way, the City may collect a front footage charge from the abutting Developer prior to the

issuance of any building permits for the abutting property. The front footage charge shall be established by prorating the total amount of original certified costs to the lineal frontage of all properties abutting the constructed improvement.

6. Reimbursement Agreement Forms Submitted to the City. The City Engineer will provide written notice of acceptance of the Developer's costs along with the Agreement forms. The Developer shall complete and submit three signed original Agreement forms. Following execution of the agreement by the City, two signed originals shall be returned to the Developer, who shall record the agreement with the Larimer County Clerk and Recorder.

7. Notification of Agreement. After execution and recording of the Agreement, the installing Developer shall certify, by affidavit, that all owners of properties obligated to provide reimbursement have been notified in writing through certified mail with return receipt requested. The City shall then cause to be published a public notice listing the properties and reimbursement amounts. The City shall endeavor to provide notice on future plats of property obligated to provide reimbursement of the recorded agreement, but the failure to provide notice shall not relieve the Third-Party owner of the platted property of any reimbursement obligation.

8. Third-Party Condition and Collection. The City, as a condition of approval of subsequent development or re-development of the Third Party's property adjacent to the newly constructed public street, alley, or pedestrian-bike way, may collect a front footage charge from the abutting Developer prior to the issuance of the first building permit for the abutting property. The City shall not attempt to make such collection until the reimbursement agreement is properly prepared and executed and the owners of abutting property have received or reasonably should have received notice of the reimbursement agreement.

9. Developer Reimbursement. The City's obligation to reimburse the Developer shall be contingent upon the City's actual collection of the front footage charge from the abutting property. The City shall have no obligation to reimburse any funds that it fails to collect, for whatever reason, provided that the City made a good faith attempt to collect such funds. When the front footage charge is collected, the City shall reimburse the installing Developer to the extent of such collection after deducting a service charge of $500 or 3 percent of the amount collected, whichever is greater, to cover the City's legal, engineering, and administrative costs. Funds collected pursuant to a Third-Party Reimbursement Agreement shall be paid to such person as identified in the Third-Party Reimbursement Agreement, and if such person cannot be found, to an alternate if designated in the Third-Party Reimbursement Agreement.

10. Inflation Adjustment. Construction Costs for inflation will be adjusted per the Colorado Department of Transportation Construction Cost Index. A multiplier for the costs will be determined by taking the Index for the date the Final Acceptance

was issued and divided into the Index at the time the payment is made. The adjustment will be based on the amount owed at the time of payment to the Developer.

11. Limitations. Any right to reimbursement pursuant to this provision shall not exceed a period of 10 years from the Final Acceptance by the City of the street, alley, or pedestrian-bike improvements. The Loveland City Council may approve extensions of the Third-Party Reimbursement Agreement for additional 10-year periods upon request of the Developer made no later than one-hundred eighty (180) days prior to expiration of an applicable period. No such reimbursement shall be made unless the person entitled to reimbursement has fully satisfied their obligations under any other agreements with the City.

1.9.4 Variances and Appeals Processes

A. Variances

Any design that does not conform to these Standards must be approved by the Local Entity Engineer. Variances from these Standards will be considered administratively on a case-by-case basis following a written request for a variance prepared by a Professional Engineer and submitted to the Local Entity Engineer. If the special district, developer, contractor, or utility responsible to the Local Entity for public improvements desires to design and construct such improvements in variance to criteria in these standards, such variance(s) shall be identified in a written attachment to the initial submittal of construction plans to the Local Entity Engineer. The design submitted for review shall show the variance. To assist with their plan preparation, designers may submit variance requests, along with sufficient documentation to support the variance, prior to formal submittal of construction plans for informal advisory consideration. Such advisory consideration shall not be binding on the Local Entity Engineer, but may help to guide the requestor in the preparation of plans. Variances may be considered by either of the following two administrative processes:

a. Variances requested as part of an application for approval of a preliminary plat only shall be shown on the preliminary plat (or on the preliminary construction plans) and shall also be specifically substantiated and justified in a letter addressed to the Local Entity Engineer. In Loveland (city limits only), variances requested as part of a combined application for approval of a preliminary development plan shall be described (complete with technical justification) in the regulatory procedures section on the preliminary development plan.

b. Variances requested as part of the submittal for approval of final civil construction plans shall be shown in the plans and shall also be specifically substantiated and justified in a letter addressed to the Local Entity Engineer. A summary of all approved variances shall be listed in the general notes on the approved plans.

2. The variance request(s) shall include the following:

a. Identifying Issue. Identification of the standard to be waived or varied and why the standard is unfeasible or is not in the public interest.

b. Proposing Alternate Design. Identification of the proposed alternative design or construction criteria.

c. Comparing to Standards. A thorough description of the variance request including impact on capital and maintenance requirements, costs, and how the new design compares to the standard.

d. Justification. The Professional Engineer must determine and state that the variance will not be detrimental to the public health, safety and welfare, will not reduce design life of the improvement nor cause the Local Entity additional maintenance costs. The proposed plan (as varied) must advance the public purpose of the standard sought to be varied equally well or better than would compliance with such standard.

e. Applicability to Transportation Level of Service Review. Based on Section 4.6 of these standards, a variance may be requested for development proposals that do not meet Level of Service standards for 1 -pedestrian, 2 – bicycle, and 3 – vehicular approaches or movements at an intersection. The variance may be submitted only in cases where the level of service cannot be restored or improved with improvements that are reasonably related and proportional to the development proposal's impact. The variance request must include items a-d above. The requested variance may include alternative mitigation measures that address the development's impact or relief from the applicable standard. A variance or exception for development proposals that do not meet Level of Service standards for overall operation of an intersection is not available under this section 1.9.4 and is addressed in LCUASS Section 4.6 and City of Fort Collins Land Use Code Section 3.7.3 (City of Fort Collins City Limits Only) or City of Loveland Municipal Code Section 18.15.01.02.C.4 (City of Loveland City Limits Only)

f. Approval or Denial of Variance. Based upon review of the plans and additional information submitted, and an analysis of the criteria set forth in this subsection (2), the Local Entity Engineer may approve or deny the variance request. If the Local Entity Engineer approves the variance request, the plans will continue to be reviewed and approved within the typical review process. If the Local Entity Engineer denies the variance request, the developer shall subsequently submit revised plans in compliance with these Standards. The Local Entity Engineer shall provide a written response outlining the basis for all approvals or denials of variance requests.

B. Appeals

1. Appeal to the Director. If a variance request is denied by the Local Entity Engineer, the Developer may appeal the decision to the Director. All appeals shall be processed through the Local Entity Engineer. The Developer shall give written notice of appeal to the Director within 10 days after denial by the Local Entity Engineer. The Director shall respond within 15 working days after receipt of the Developer's notice to appeal.

If the Director overturns the Local Entity Engineer's decision, the developer may then proceed with the requested variance(s) in the plans.

If the Director concurs with the Local Entity Engineer's decision, the Developer shall bring the Plans into compliance with these Standards, or appeal the Director's decision to the Local Entity Governing Body. In Fort Collins (city limits only) and Loveland (city limits only), the Director's decision shall be final.

2. Appeal to Governing Body. In Fort Collins (GMA only) and Loveland (GMA only), the Developer may appeal to the Local Entity Governing Body within 10 days from receipt of denial from the Director. The appeal shall be placed on the agenda for consideration by the Local Entity Governing Body in accordance with Local Entity procedure, but no later than 60 days following receipt of the written notice of appeal. The Local Entity Governing Body shall hold a public hearing on the appeal in accordance with Local Entity procedure. All notices and appeals shall be in writing. Any such appeal shall constitute a "new hearing" on the variance request before the Local Entity Governing Body.

1.9.5 Maintenance of Private Improvements

A. Compliance

When a request is made for the Local Entity to assume maintenance of any private improvement, it shall be the responsibility of the person(s) making the request to satisfactorily demonstrate that the private improvement is constructed in accordance with these Urban Street Standards.

B. Review

The Local Entity will review these requests under normal review procedures.

C. Refusal of Responsibility

The Local Entity will not accept maintenance responsibilities for private street improvements (and public street improvements in the unincorporated GMA unless otherwise agreed to by formal agreement or supplemental regulations) associated with land development activities. Private improvements that were not constructed in accordance with the applicable design and construction standards and specifications shall not be accepted for maintenance by the Local Entity.

1.10 COST ESTIMATE AND DEVELOPMENT AGREEMENT

Any Applicant for final plat approval must provide the Local Entity with an itemized estimate of all Public Improvements (as defined by Colorado law) associated with the development. Cost estimates are used to establish the amount of collateral to be provided by the Applicant to secure the requirements of the Development Agreement. An amount equal to 15 percent of the total cost estimate shall be added to the total cost to cover construction contingencies.

After review and acceptance of the cost estimate by the Local Entity Engineer, it shall be incorporated into a Development Agreement of a format suitable to the Local Entity Attorney. The Development Agreement should be executed by the Developer prior to the Local Entity approval of the final plat. Collateral must be provided by the applicant in the form and amount as defined in **Chapter 24, Acceptance Procedures and Record Drawings/Warranty**.

1.11 WORK SCHEDULE

Normal working day hours are 7 a.m. to 6 p.m., Monday through Friday. No work shall be permitted on weekends or holidays without written approval from the Local Entity Engineer. Work activity done at times other than during normal working hours may require reimbursement to the Local Entity for the overtime cost to the Local Entity. Work requests beyond normal working hours must be submitted to the Local Entity Engineer a minimum of 5 working days prior to the requested date.

1.12 UTILITY COORDINATION

The Developer shall coordinate construction with affected private utility companies and notify said utilities in accordance with their notification requirements at least 5 Working Days prior to interruption of service or operation. Prior to construction, the Developer shall be responsible to make special arrangements with private utilities for any relocation necessary within the approved project and to coordinate such relocation activities with adjacent affected property owners. The Developer shall be responsible to notify said utilities of any damage to utility systems caused during construction.

1.13 URBAN INFILL AND REDEVELOPMENT AREAS IN LOVELAND (CITY LIMITS ONLY)

For infill and redevelopment projects located in downtown Loveland and surrounding neighborhoods, flexibility shall be considered in the establishment of the requirements for road improvements, driveway placement, access management and other *Larimer County Urban Area Street Standards* (LCUASS) requirements (as deemed appropriate by the Local Entity Engineer). These downtown areas have an established traditional grid network of streets and existing road and access conditions. These conditions are unique and distinctive when compared to undeveloped and developing "greenfield" areas around the periphery of the City where there are fewer barriers to the application of standard LCUASS requirements. NACTO guidelines may be considered in these areas.

1.13.1 Design and Access Flexibility for Core of City

In core areas of the City, the imposition of roadway design and access criteria that are more suitable for greenfield locations is often contrary to their existing and intended urban character. In these areas, pedestrian access and circulation require greater priority relative to vehicular transportation, and design flexibility is needed to accommodate such considerations. For example, such design consideration may include, but may not be limited to the following:

A. Smaller Turning Radii

Smaller turning radii for roads and driveways to facilitate pedestrian activity by slowing vehicular turning movements and reducing walking distances for pedestrians. For local streets, where appropriate, templates for larger vehicular turning movements may factor broader lane usage to allow for smaller corner radii. Also, allowance should be made for bulb-outs at corner locations, and other traffic calming measures to slow vehicular traffic, and reduce pedestrian crossing distances and the exposure of pedestrians to high speed traffic. Mid-block pedestrian crossings may also be appropriate in some cases where deemed appropriate by the Local Entity Engineer.

B. Alternate Driveway Spacing

Standard driveway spacing requirements may be modified to factor existing driveway locations and the individual access needs of smaller redevelopment and infill development sites within smaller development blocks created by the existing grid network of streets.

C. Alternate Trip Generation Rates

Trip generation rates for mixed-use projects and projects located with good access to transit may be modified to reflect internal trip capture and the availability of alternate transit modes and pedestrian trips if verified by the applicant's traffic engineer in a scoping meeting with the Local Entity Engineer.

D. Alternate Speed Limits

Overall, slower design speeds may be desirable in traditional neighborhoods as they greatly increase the safety and comfort of pedestrians.

E. Other Trip Generation Factors

The grid network of streets located in the core areas provides a greater number of trip alternatives for motorists. These alternative routes may be factored into trip generation and distribution analysis so that traffic is distributed more evenly throughout the grid with less burden or demand placed on individual intersections and turning movements. Alleyways can also provide some circulation as long as the traffic volumes or delay do not exceed ACF thresholds.

F. Alternate Street Widths

Some LCUASS street standard suggested widths may be more suited to greenfield developments than to redevelopments where land is limited and where the surrounding street network functions well with narrower streets than those recommended in the LCUASS guidelines.

G. On-Street Parking

On-street parking may be encouraged because it reduces the need for off-street parking; serves as a buffer between pedestrians and motorists; and slows passing

vehicular traffic. Diagonal parking may be appropriate for some streets on a case-by-case basis.

H. Maintain Connectivity

Development and redevelopment in the core areas should maintain and enhance connectivity for pedestrians, cyclists and motorists as appropriate.

1.13.2 Preserve Public Health, Safety and Welfare

Any of the above flexibility in applying the LCUASS standards in these areas shall not be detrimental to the public health, safety and welfare nor will it reduce the design life of the improvement or cause the city of Loveland additional maintenance costs.

1.14 COMPLETE STREETS IN (FORT COLLINS CITY LIMITS ONLY)

In accordance with the Vision of the Transportation Master Plan new or redeveloped streets shall be developed as Complete Streets. Complete Streets include accommodations for each mode of travel recognizing that all streets are different and that the needs of various users will need to be balanced in a flexible manner. The standards as adopted within *Larimer County Urban Area Street Standards* (LCUASS), for areas within Fort Collins, shall support the accommodation of all travel modes. Implementation may be flexible to respond to the context and character of corridors, with the ultimate intent of safely accommodating all modes.

CHAPTER 2 – SUBMITTAL AND REVIEW PROCEDURES
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CHAPTER 2 – SUBMITTAL AND REVIEW PROCEDURES

2.1 GENERAL

2.1.1 General Submittal Criteria and Procedures

This chapter gives criteria and procedures for submitting engineering drawings as required by these Urban Area Street Standards. All other requirements for planning can be found in the **Fort Collins** *Land Use Code,* the **Loveland Municipal Code (Title 18),** and the **Larimer County Land Use Code**.

2.1.2 Authorization/Certification

A. Designer's Signature

All final documents, including plans and other submittals noted below, shall be prepared, stamped, signed, and dated by a Professional Engineer per the Colorado Department of Regulatory Agencies (DORA) requirements. Each sheet in the plan set shall contain the Designer's statement as shown in **Chapter 3, Information Requirements for Construction Plans,** and shall be signed and stamped by the Designer and submitted to the Local Entity.

B. Additional Requirements

The Designer should be aware that whenever unusual or serious problems are anticipated or encountered for a proposed construction project, additional information and analysis beyond the minimum requirements of these specifications and criteria will be required.

C. Final Authorization

No plans are considered final and ready for construction until signed and stamped by the Designer and signed by authorized Local Entity officials. Refer to **Chapter 3, Information Requirements for Construction Plans**.

D. Construction Traffic Control Plans

Plans for traffic control during construction for the development project must be approved by the Local Entity prior to any issuance of permits.

2.2 SUBMITTALS AND CONTENT

2.2.1 Checklists.

Checklists that identify the specific information requirements for the documents are included in **Appendix E**. Additional checklists for the various land use applications are available from the Local Entity. A complete submittal package for review shall include a completed checklist.

2.2.2 Civil Construction Plans

Refer to Chapter 3, Information Requirements for Construction Plans, for further description and requirements.

2.2.3 Landscape Plan

A. Plan Content

The landscape plan shall indicate the treatment of all landscaped area within and adjacent to the right-of-way. The design objective of the plan must be clear and supported by a written statement. The plan must show the inter-relationship between all existing and proposed buried utilities and the required landscape elements such as trees, irrigation, vegetation, turf, screening, buffering, walls, and fencing.

B. Choosing Appropriate Plants

Plant material must be adaptable to the physical conditions indicated by the landscape plan locations and must meet specifications of the American Association of Nurserymen (AAN) for number one grade.

C. Fort Collins (City Limits Only) Requirements

The landscape plan shall include all items addressed in the Ft. Collins Landscape Requirements in **Appendix C*, City of Fort Collins Streetscape Design Standards and Guidelines***.

D. Loveland (City Limits Only) Requirements

The landscape plan shall also meet Loveland Municipal Code standards and include all items shown above and shall be included in the Public Improvement Construction Plan set.

2.2.4 Soils Investigation Report

Refer to **Chapter 5, Soils Investigations and Report,** for the content and requirements for the soils report.

2.2.5 Pavement Design Report

Refer to **Chapter 10, Pavement Design and Technical Criteria,** for the content and requirements for the pavement design report.

2.2.6 Work Area Traffic Control Plan

The plans shall be designed in accordance with current MUTCD, Part 6 standards.

2.2.7 Street Cross Sections

Typical and unique street cross sections shall be submitted for each general category street, including the proposed width, treatment of curbs and gutters, sidewalk systems,

and bikeway systems where deviations are proposed from these Standards. Refer to checklists for location and presentation of cross sections.

2.2.8 Drainage Report, Erosion Control Report, and Hydrologic Report

The Developer is required to submit drainage, erosion control, and hydrologic reports (for subsurface water refer to **Chapter 5, Soils Investigation**) in compliance with Local Entity Standards.

2.2.9 Opinion of Costs

As a separate attachment to the Plans, a Public Improvements Opinion of Costs will be required. The Opinion of Costs shall include, but not be limited to, the items listed in **Chapter 20, Public Improvements Cost Estimate**. The items shall be identified by unit price and total cost for each item for each type of Project.

2.2.10 Transportation Impact Study

Refer to **Chapter 4, Transportation Impact Studies,** for study criteria and process and report content. The Developer may be required to submit a transportation impact study during the Local Entity's planning process. The Developer is required to use the recommendations of this report in the Plans submittal.

2.2.11 Final Plans

A. Mylar Requirements

The following describe the requirements for mylars or plans to be submitted to the Local Entity for permanent retention. Contact each Local Entity for their specific mylar requirements for the application:

1. Must be on good quality mylar or mylar sepia so that clearly legible blueprints or reproductions can be made from it on standard reproduction equipment. (i.e., 4 mil mylar, single or double matte)
2. Must be high quality print. No smudges or blurred text will be accepted. No photocopied mylars will be accepted.
3. Must be in good condition and unblemished. Torn, folded, or stapled mylars will not be accepted.
4. Must not have any attachments or any information attached by adhesive.
5. Must be 24 inches x 36 inches in size.
6. Signatures are to be in black indelible ink marker (i.e., black ultra-fine Sharpie™ or equivalent – NO ballpoint ink or pencil).

B. Plans Requiring Final Mylars

The following will require final mylars for Loveland (city limits only) and Fort Collins (city limits only):

1. Final plats
2. Annexation maps
3. Site plans
4. Landscape plans
5. Construction Plans
6. Record drawings
7. Overall development plan, in Fort Collins (city limits only)
8. Final development plan, in Loveland (city limits only)
9. General development plan, in Loveland (city limits only)

2.2.12 Revisions to Signed Plans

Requests to revise the Public Improvements Construction Plans (the Plans) after the Local Entity has reviewed and approved the Plans shall be made in conformance with the following criteria:

A. Minor Revisions

1. Minor revisions shall be limited to revisions in alignment of the pavement section, depth of structural section, locations of curbs and gutters or sidewalks, relocation of traffic control devices, etc., which do not alter or impair the overall functional aspects of the improvements or work necessary to install the improvements. A Minor Field Change Request Form shall be submitted for review and approval of minor revisions.

2. Minor revisions may be administratively approved, at the discretion of the Local Entity Engineer, by approving the minor field change request. For future reference written confirmation shall also be completed by initials and date noted in the revision box on the final approved record drawings. If the Local Entity Engineer does not approve the minor field change request, the Developer shall immediately comply with the approved plans or these Standards. The Local Entity Engineer's decision shall be the final decision regarding Minor Revisions unless appealed.

B. Major Revisions

1. Major revisions shall be a revision to the approved plans which are not specifically covered under the provisions for minor revisions and which affect the functional aspects of the improvements or work to install the improvements. (i.e.

change in street width or horizontal alignment, change in functional classification, etc.).

2. Major revisions cannot be administratively approved. The Developer is required to submit Revised Civil Construction Plans for review and subsequent approval by Staff. Additionally, all work related to the major revision may not be allowed to continue until the Local Entity has approved the major revisions or appeal.

2.2.13 Record Drawings

Record Drawings shall include the statement in **Chapter 24, Acceptance Procedures and Record Drawings/Warranty,** and be signed, stamped, and dated by the Professional Engineer. The Record Drawings shall be prepared utilizing the original plans. They must show any deviations from the approved plans. Record Drawings must be signed and stamped with the Professional Engineer's statement that the changes have not changed the intent of the approved plans.

A. City of Loveland Requirements

The Record Drawings shall be submitted in an approved electronic submittal format.

B. Larimer County Requirements

Two sets of Record Drawings shall be submitted in an approved blue-line submittal format.

2.3 SUBMITTAL PROCEDURES

2.3.1 City of Fort Collins

The City of Fort Collins has specific procedures for submittal, review, and approval within the development process. All submittals necessary for engineering requirements are discussed above in Section 2.2. An outline and checklist for the following procedures are available in the City of Fort Collins Development Review website.

2.3.2 City of Loveland

The City of Loveland has specific procedures for submittal, review, and approval within the development process. All submittals necessary for engineering requirements are discussed above in **Section 2.2**. The procedures for submittal, review, and approval of all construction documents, other than the plan set, shall be found in the **Loveland Municipal Code (Title 18)**

2.3.3 Larimer County GMA

The following specific Larimer County requirements apply to both Fort Collins (GMA only) and Loveland (GMA only):

Larimer County has specific procedures for submittal, review, and approval within the development process. All submittals necessary for engineering requirements are discussed above in **Section 2.2**. The procedures for submittal, review, and approval of all construction documents, other than the plan set, shall be found in the **Larimer County Land Use Code**.

CHAPTER 3 – INFORMATION REQUIRED FOR CIVIL CONSTRUCTION PLANS

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CHAPTER 3 – INFORMATION REQUIRED FOR CIVIL CONSTRUCTION PLANS

3.1 GENERAL

3.1.1 Plan Set

The Developer is required to submit a complete Plan set covering the design for all Public and Private Improvements in the Project. This Plan set shall include as a minimum a cover sheet with general notes, construction note sheet(s), vicinity map, sheet list, improvement design sheet(s) (one for each improvement), and appropriate detail sheets.

A. Loveland (City Limits Only)

The checklist in **Appendix E-4** is required with any submittal to the City of Loveland. This checklist must also be included in all resubmittal packages.

3.1.2 Final Drawings

Refer to **Chapter 2, Submittal and Review Procedures,** for additional information.

A. Fort Collins (City Limits Only)

Final mylar plan sheets shall be 4 mils thick, matted both sides, photostat, (silver) or original mylar plat. Sticky backs are allowed, however, a sepia mylar must be submitted for the Local Entity final mylar set. Final mylars submitted must be of good quality to obtain clear computer scanned copies for archiving, see **Appendix E-6, Scannable Quality Mylars**, for detailed requirements.

B. Loveland (City Limits Only)

Electronic files of all drawings will be required upon the submittal of Record Drawings.

3.1.3 Vertical Datum

Plans shall conform to vertical datum criteria provided by the Local Entity.

A. Local Entity's Vertical Datum (GMA and City Limits)

All projects must use benchmarks documented in the Local Entity's Vertical Control Network. This information is available at the Local Entity's Engineering Department.

3.1.4 Expiration of Plan Set

Civil Construction Plans shall be valid for a period of three years from the date of approval by the Local Entity Engineer or designee, except as noted below.

A. Fort Collins (City Limits Only)

In Fort Collins (city limits only) Civil Construction Plans shall be valid for a period of three years from the date of Plan approval, whichever is earliest.

B. Larimer County GMA

In Fort Collins (GMA only) and Loveland (GMA only), expiration of the Civil Construction Plans shall be as stated in the development agreement.

C. New Review after Expiration Date

Use of Civil Construction Plans after the expiration date will require a new review and approval process by the Local Entity prior to commencement of any work shown in these plans.

3.2 GENERAL FORMATTING AND REQUIRED INFORMATION

The following information is provided for the Developer when determining Plan format and design requirements required by the Local Entity. This information should be considered the minimum information to be provided.

3.2.1 Checklist

The Local Entities require the use of the checklist in **Appendix E-4**.

3.2.2 Size of Plan Sheets

All sheets in the construction plan set shall be 22 inches x 34 inches.

3.2.3 Title Block

A title block is required on every sheet and cover sheet submitted for review and acceptance. The title block shall be located in the extreme lower right-hand corner, the right side margin, or along the bottom edge of the sheet.

A. Required Information

Below is the list of information that shall appear in title block on each sheet:

1. The subdivision or Development name and filing number (if applicable).
2. The type of improvement.
3. Designer's Name, address, including zip code, and telephone number, and email address
4. Sheet number (consecutive, beginning with the cover sheet).
5. Revision block

3.2.4 Standard Signature Blocks

All sheets including the cover sheet should display standard Local Entity signature blocks in the lower right-hand quadrant of the sheet. Annotate the signature blocks as shown in **Appendix E-3**. These are the signatures required only for the Local Entity signoffs.

3.2.5 Incomplete Plans

Incomplete plan submittals will not be reviewed, and will be returned to the Applicant.

3.2.6 Stamped Plans & Designer Statement

All sheets shall include the Designer's signature, stamp and date and shall be signed in accordance with the regulations established by the State of Colorado Board of Registration.

3.2.7 Scale

A. General

All Plan and profile sheets should be at a scale that is legible when printed as determined by the Local Entity Engineer:

1. Horizontal. 1 inch = 20, 30, or 40 feet.
2. Vertical. 1 inch = 5 or 10 feet.
3. Overall Plan. 1 inch = 100 feet.
4. Cross Sections. Vertical exaggeration ratio shall be 5:1.

B. Bar Scale and Other Options

Show bar scale. Other scales may be used upon Local Entity approval.

C. Signing and Striping

All signing and striping plans require a legible scale when printed as determined by the Local Entity Engineer.

D. Key Map

Legible and to a scale

E. Vicinity Map

Legible

3.2.8 Dates

All sheets shall have dates shown in the Title Block for both Plan preparations and subsequent revisions. An electronic date shall appear on all electronic files to be submitted.

3.2.9 North Arrow

All design sheets shall have a north arrow oriented toward the top or right side of applicable sheets.

3.2.10 Background Facilities

Each sheet shall show all existing facilities in a ghosted or alternate line weight or type.

3.2.11 Private Improvements

Private Improvements, such as roadways, driveways, utilities, etc., shall be clearly shown and labeled as such on each sheet of the Civil Construction Plans.

3.2.12 Legend of Symbols

The cover sheet, or each sheet, shall include a legend that identifies the symbols pertaining to the sheet.

3.2.13 Key Map

For plan sets that include 3 or more specific sheets (grading, plan, profile, etc.), each sheet shall provide a key map showing the location of the area being detailed.

3.3 SHEET TITLE NAMES AND SPECIFIC REQUIREMENTS

This section outlines the minimum required information to be included on specific sheets of the Plan set. The following sheets are listed in the order they should appear in the Plan set. Some sections of the Plan set may have more than one sheet but should be labeled alike.

3.3.1 Cover Sheet(s)

All sets of construction drawings shall include a cover sheet with the following information provided:

A. General Construction Notes

General Notes shall be shown on this sheet. They are listed in **Appendix E**.

B. Vicinity Map

1. Information to Include. The vicinity map shall show the location and name of all Arterial roadways within one mile of the proposed construction, and all other roadways within 1/2 mile of the proposed construction. The project area shall be indicated by shading. The vicinity map shall show all Arterial roadways and major drainage ways. Section, Township, and Range shall also be shown.

2. Size. Minimum size of vicinity map shall be legible and to a scale.

C. Engineer/Owner Contacts

The name, address, phone number, and email address of the Developer (owner) and Consultant Engineer shall be listed on the cover sheet.

D. Index

Each cover sheet shall include an index of all sheets within the Plan set. The sheet numbers shall be sequentially ordered beginning with page 1.

E. Indemnification Statement

The indemnification statement shall be shown on the cover sheet. Annotate the following on Cover Sheet only:

These plans have been reviewed by the Local Entity for concept only. The review does not imply responsibility by the reviewing department, the Local Entity Engineer, or the Local Entity for accuracy and correctness of the calculations. Furthermore, the review does not imply that quantities of items on the plans are the final quantities required. The review shall not be construed for any reason as acceptance of financial responsibility by the Local Entity for additional quantities of items shown that may be required during the construction phase.

For Loveland, use the indemnification statement on the signature block.

F. Preamble (Project Title)

The project title and general location shall be shown in the top middle of the page. The title shall begin as follows and shall be in bold/large font:

CIVIL CONSTRUCTION PLANS

for

(OFFICIAL PLATTED NAME OF PROJECT)

(MARKETING NAME OF PROJECT)

Name of Local Entity

G. Legend of Symbols

Provide standard symbols for all appurtenances related to each type of facility.

H. Street Cross-sections used

Provide the street cross-sections of any streets that are to be constructed.

3.3.2 Construction Notes

Refer to **Appendix E-2** for standard construction notes.

3.3.3 Right-of-Way Grading and Erosion Control

These Plan sheets shall be drawn at a legible scale (1"=10' to 1"=50') which will clearly convey design and construction intent. Plan sheets shall display a legend of symbols. All erosion control devices (temporary and long term) shall be included, as well as revegetation methods with specific notes. The Plan must show grades of all drainage facilities. For average lot sizes under 1 acre, the Plan must show overlot grading with topographic contours before and after completion of grading.

3.3.4 Street Improvements

The Plans shall include Plan and Profile views for each street proposed in the development. Cross-section sheets are required for all Arterial and Collector roadways. In addition to the requirements set forth elsewhere in these Urban Area Street Standards, the following information shall be shown on all roadway plans submitted for review and approval.

A. Plan View

The Plan view shall include, but not be limited to, the following:

1. Existing and proposed property and/or right-of-way lines, easements, and/or tracts. Type and dimension of easement or tract is to be clearly labeled. Dimensions of property and right-of-way lines are to be marked.
2. Survey lines and stationing lines shall normally be based on centerline of street; other profiles may be included but shall be referenced to centerline stationing. Stationing in cul-de-sacs shall be on the centerline to the center of the bulb with flowlines dimensioned within the bulb.

   Survey lines and stationing lines shall deviate from centerline of street to parallel the roadway for situations where two sides of a divided roadway are not parallel.
3. Stationing shall read in ascending order in the direction of the north arrow or to the right.
4. Roadways and Roadway names.
5. Existing utilities and structures (shown as phantom lines), including, but not limited to:
   a. Storm sewer and appurtenances.
   b. Fence lines and gates.
   c. Water lines and appurtenances including hydrants.
   d. Ditches or swales.

e. Electric lines and appurtenances.

f. Curbs and gutters.

g. Sewer lines and appurtenances.

h. Pavement limits.

i. Telephone lines and appurtenances.

j. Bridges or culverts.

k. CATV lines and appurtenances.

l. Guardrails.

m. Signs.

n. Gas lines and appurtenances, etc.

6. Contour lines, existing and proposed.

7. Station and critical elevation (flowline, invert of pipe, etc.) of all existing and proposed utility or drainage structures. Location of utilities shall be identified with horizontal and vertical dimensions as measured from roadway centerline profile grade and shall conform to local, state, and federal requirements including SB18-167.

8. Storm drainage flow direction arrows, particularly at intersections and all high and low points.

9. Match lines, stations and consecutive sheet numbers, beginning with cover sheet.

10. Station and elevation of all horizontal curves including PI, PC's, PT's, etc.; high or low point and PI of all vertical curves; existing and proposed, centerline bearings, distances, and complete curve data.

11. Curb return radii, existing and proposed. Stations and elevations of all curb returns; mid-point elevations and additional locations necessary, flowline-flowline intersection elevations, and percent of grade from the P.C.R. to flowline-flowline intersections of all crosspans.

12. Curb ramp spot elevations, Figure 8-20.1

13. Mid-block pedestrian ramp locations at "T" intersections.

14. Centerline stations of all proposed driveways and all intersecting roadways.

15. Survey tie lines to section corners or quarter corners, consistent with that shown on the plat.

16. Typical roadway cross-section for all roadways, existing or proposed, within and adjacent to the proposed development. These cross-sections shall appear on the detail sheet, or if no detail sheet has been used, the first sheet of the submittal showing roadway design.

17. Intersections. Any roadway intersections shall include construction and lane details for the new construction and existing facilities for a minimum of 150 feet beyond the limits of construction. All collector/collector, collector/arterial, and arterial/arterial intersections shall be the subject of their own plan sheet with the intersection in question centered on the plan sheet.

18. Basis of plan view and profile elevations shall be the same, i.e., flowline and flowline, top of curb and top of curb, etc.

19. Cul-de-sac. High point and grades shown with percent arrows at critical points (cross-slope and flow line).

B. Profile

Profiles shall include, but not be limited to, the following:

1. All streets shall be designed to show profile of center line and flow lines. This requirement may be waived by the Local Entity Engineer when profile grades exceed 1.0% for flow lines and standard cross sections and cross slopes are used. In such cases, additional vertical data may be required at intersections and on curves.

2. Original ground (dashed) and design grade (heavy, solid). Both grades are to be plainly labeled for all centerline and flowline profiles.

3. Design elevations shall be provided for the centerline and for curb and gutter flowlines. The basis of Record Drawing information shall be the same as the design and grade (flowline and centerline, etc.).

4. Stationing shall be depicted as a continuous line for the entire portion of the Roadway shown in the plan view, with the centerline station of all proposed driveways and all intersecting roadways clearly labeled.

5. All existing curbs, gutters, sidewalks, and pavement adjacent to the proposed design. The existing profile grades shall be measured by survey. Previously approved designs or Record Drawings are not an acceptable means of establishing existing grades.

6. Existing and New Utilities. Elevation and location of all utilities in the immediate vicinity of the construction shall be shown on the plans shall conform to local, state, and federal requirements including SB18-167

7. Station and elevation of all vertical grade breaks, existing (as-built) and proposed.

8. Distance and grade between VPI's.

9. Vertical curves, when necessary, with VPI, VPC, and VPT, high or low point (if applicable) stations and elevations. All vertical curves shall be labeled with length of curve (L) and K=L/A where A is the algebraic difference in slopes, in percent.

10. Profiles for all curb returns (except medians) and intersection details.

C. Typical Street Section(s)

Provide any applicable horizontal or vertical dimensions, in addition to providing a section of all improvements within the right-of-way. A section should be provided for each roadway type planned within the project.

D. Cross-Sections

1. Roadway Cross-Sections. Roadway cross-sections shall be provided at intervals deemed necessary by the Local Entity to effectively evaluate connection with the existing facilities, (typically every 50 feet horizontally).

   Cross-sections shall be required on arterials and any other roadways as deemed necessary by the Local Entity Engineer. The cross-sections shall indicate:

   a. Profile grade design point (centerline, flow-line, top of curb, lip of gutter, etc.).

   b. Roadway width.

   c. Right-of-way.

   d. Pavement cross slope.

   e. Structural material components of the pavement, base and subbase, together with specifications for treatment of subgrade and installation of pavement structural members.

   f. Tie in of proposed improvements with existing ground.

   g. Slopes of the parkway

   h. Slopes of ground behind sidewalk.

E. Key Map

1. Clearly depict each sheet's relative position compared to the overall project. The Roadway or area that the design pertains to will be shaded.

2. Minimum scale is 1 inch = 500 feet, showing the location and name of all roadways within and adjacent to the proposed construction and all future roadways. Scale should be indicated. The key map should be oriented consistent with detail in the sheet, i.e., same north.

3.3.5 Street Improvements Details

All pertinent details related to street improvements shall be shown on a detail sheet (or sheets) for the Project.

3.3.6 Traffic Signing and Pavement Markings

All permanent and temporary traffic signing and pavement markings shall be shown on the signing and striping plan, with the existing and proposed street system used as the base layout. Locations of signs and pavement markings shall be indicated by

station/offset, or other specific dimensions indicating exact locations. This sheet shall also contain any construction or application notes, (e.g., application temperatures, surface cleaning methods to be used prior to application, etc.).

A. Area Map

Separate signage and striping plans are to consist of an overall area map noting all specific use areas, such as schools, parks, recreation centers, library, commercial, industrial, etc.

B. Road Segment Pages

The pages following the area map are to be broken down into road segments, for notation of signage and striping details.

C. Signing Plan

The permanent signing plan should:

1. Show the general longitudinal location of each sign (horizontal offset and station).
2. Specify the sign legend and sign type (from MUTCD).
3. Specify the sign size.
4. Provide the construction drawing shown in Appendix "A" of installation dimensions (height, distance from curb, etc).
5. Detail post and base dimensions and installation plan (showing sleeves, depth below surface, and materials used, according to Local Entity standards).

D. Striping Plan

The striping plan must show:

1. Color and type.
2. Lane widths, taper lengths, storage lengths, etc.
3. Striping/skip interval.
4. Typical treatments for acceleration/deceleration lanes, turning lanes, and crosswalks.
5. Type of pavement marking material per the Local Entity's Specifications
6. Station and offset or dimensions to all angle points, symbol locations, and line terminations.

3.3.7 Landscape Plan

Landscape Plan sheets shall show all plan views and details necessary for construction. The Landscape Plan sheets shall include all existing and all proposed utilities, plantings, shrubbery, trees, and all irrigation systems and appurtenances.

CHAPTER 4 – TRANSPORTATION IMPACT STUDY

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CHAPTER 4 – TRANSPORTATION IMPACT STUDY

4.1 INTRODUCTION

4.1.1 General

This chapter contains the policies and guidelines necessary for the preparation of Transportation Impact Studies (TIS) for development proposals for the Local Entity. The policies exist to ensure consistent and proper traffic planning and engineering practices when land use actions are being considered within the Local Entity. The guidelines provide for a standard process, set of assumptions, set of analytic techniques, and presentation format to be used in the preparation of the TIS. For projects within Loveland (city limits only) it also provides the technical requirements that must be satisfied in order for a land use application to comply with the Adequate Community Facilities ordinance found in Title 18.15 of the Loveland Municipal Code needs updated to the current code For projects within Fort Collins (city limits only) it also provides the process, requirements, and terms that apply to TIS certification by the Local Entity Engineer and reservation of intersection capacity for the project. Additionally for projects within Fort Collins (city limits only) it also provides the technical requirements that must be satisfied in order for a land use application to comply with the Adequate Public Facilities ordinance found in Title 3.7.3 of the Fort Collins Municipal Code.

4.1.2 Applicant Responsibility

The responsibility for assessing the traffic impacts associated with an application for development approval rests with the Applicant. The Local Entity serves in a review capacity. The assessment of these impacts shall be contained within a TIS report as specified herein. It shall be prepared under the supervision of, and sealed by, a Licensed Professional Engineer in the State of Colorado with experience in traffic engineering and transportation planning/engineering.

For all State Highways within the study area, the Applicant is required to meet the requirements of the Colorado Department of Transportation.

4.1.3 Capacity and Safety Issues

Development of property has a direct impact on transportation, including vehicular, transit, bicycle, and pedestrian traffic. In order to meet capacity and safety needs as they relate to the traffic generated from a particular land use, specific improvements can be made. The goal of the TIS is to address the traffic related issues that result from the new development and to determine the improvements required such that appropriate levels of service are safely maintained. The various objectives of vehicular movement, pedestrians, bicyclists, and others must be balanced in the development review process. A combination of elements is needed to provide streets that serve all transportation modes. The TIS will provide information and guidance as plans are developed and decisions made for the approved plan.

A. Vehicular Traffic Improvements.

Examples of capacity and safety improvements for vehicular traffic include: road widening, turn lanes, acceleration and deceleration lanes, intersection through lanes, traffic signals, stop signs, roundabouts, design speed adjustments, and modifications to access points.

B. Pedestrian Traffic Considerations and Improvements.

Examples of safe, comfortable, and convenient pedestrian services are narrower roadways with fewer lanes, short blocks, low traffic speeds, tree-lined sidewalks, smaller corner radii, well-defined crosswalks, bulbouts, median refuges and channelized islands in large street crossings, on-street parking, and bicycle lanes. Underpasses or overhead structures are examples of safety improvements if vehicular traffic causes unsafe conditions for pedestrians, space is available, and construction is feasible.

C. Bicycle Traffic Improvements.

The addition of on-street bicycle lanes or off-street bicycle paths may be needed to achieve connectivity between the proposed project and the existing bikeway system.

D. Transit Traffic Improvements.

Examples of Transit Traffic Improvements include accommodation of public transit facilities such as buses, bus stops, bus bays, stations, and transit stop facilities.

4.1.4 TIS Process Overview

A. Define TIS

1. Attend Scoping Meeting: Section 4.2.1 .
2. Confirm the type of study, Master or Individual TIS: Section 4.2.2 .
3. Identify Level of Analysis: Section 4.41 .
4. Write an amendment letter if required: Section 4.2.3 .

B. Define Study Parameters

1. Develop the project description: Section 4.3.1 .
2. Determine which Analysis Horizons to use: Section 4.3.2 .
3. Determine the limits of the study area: Section 4.3.3 .
4. Determine the evaluation components for the applicable type of TIS: **Section 4.3.4** .

C. Evaluate Traffic Volume

1. Vehicular Traffic
    a. Existing Traffic
        1) Perform roadway traffic turning movement counts: **Section 4.4.2 A**.
        2) Determine intersection level of service: **Section 4.4.2 B**.
    b. Background Traffic
        1) Determine short-range turning movement projections: Section 4.4.3 A.
    c. Project Generated Traffic
        1) Determine trip generation rate: Section 4.4.4 A.
        2) Determine the trip distribution and assignment: Section 4.4.4 F and Section 4.4.4 G.
2. Pedestrian and Bicycle Traffic and Facilities
    a. Existing Traffic.
    b. Background Traffic.
    c. Project Traffic.
    d. Total Traffic.
    e. Existing and Planned Facilities

D. Conduct Project Impact Analysis

1. Vehicular Traffic
    a. Identify the project impact using evaluation elements for the selected type of TIS: **Section 4.5.1** in Loveland (city limits and GMA) and **Section 4.5.2 in** Fort Collins (city limits and GMA).
    b. Evaluate each element under the following traffic conditions:
        1) Existing traffic conditions.
        2) Future traffic conditions without the proposed development.
        3) Future traffic conditions with proposed development.
    c. Identify all significant negative impacts: Section 4.5.1
2. Pedestrian Traffic

    Conduct the same procedure as for vehicular traffic in above **Section 4.5.3 B**
3. Bicycle Traffic

    Conduct the same procedure as for vehicular traffic in above **Section 4.5.3 B**

E. Determine Mitigation Measures

1. Vehicular Traffic

   Refer to **Section 4.6**. Also refer to **Section 4.6.1** if transportation demand management is used for mitigation.

2. Pedestrian Traffic

3. Bicycle Traffic

F. Determine Study Recommendations.

Identify the improvements that are needed to achieve the required LOS for the proposed land use action and background traffic in each design year.

1. Vehicular Traffic

2. Pedestrian Traffic

3. Bicycle Traffic

G. Present the Completed TIS

1. Submit the specified number of copies of the stamped and signed completed study to the Local Entity as an attachment to the land use application.

2. Revise and resubmit the TIS as necessary to address review comments provided to the applicant by the Local Entity Engineer.

H. TIS Certification and Intersection Capacity Reservation (Fort Collins city limits only)

1. Approved studies are certified by the Local Entity Engineer. See **Section 4.7.3.**

2. Certified Full TIS's reserve intersection capacity for the life of the project development application. See **Section 4.7.3.**

4.1.5 Listing of Attached TIS Worksheets

The worksheets listed below are included at the end of this chapter, as Attachments A through I. Note that Attachments E through I apply only to projects in Loveland (city limits and GMA) and Fort Collins (GMA).

A. Base Assumptions

Refer to **Section 4.2.1 B, Meeting Setup and Content.**

B. Pedestrian Analysis Worksheet

Refer to **Section 4.2.1 B, Meeting Setup and Content.**

C. Transportation Worksheet

Refer to **Section4.2.2 B,**

D. Recommended Improvements Summary -

Refer to **Section 4.7.1 D, Summary Presentation.** This sheet is an example of what a Developer must submit.

E. Peak Hour Intersection Level of Service Summary - Loveland (city limits and GMA) and Fort Collins (GMA)

Refer to the discussion of Intersection Delay in **Section 4.5.3 A, Motor Vehicle Impact Evaluations**. This sheet is an example of what a Developer must submit.

4.2 REQUIREMENTS AND STUDY TYPES

4.2.1 Scoping Meeting

A. Purpose.

The purpose of the scoping meeting is to determine the type of study to be completed and the parameters for the study for a specific development project. The parameters determined in the scoping meeting represent general agreement between the Local Entity and the consulting engineer, but they may not be all-inclusive. The Local Entity retains the right to determine the level of study and to require any additional information and / or analysis to complete an evaluation of the proposed development project.

B. Meeting Setup and Content.

The Applicant is required to contact the Local Entity to arrange for a Scoping Meeting to discuss the TIS requirements and determine the base assumptions. It is incumbent upon the Applicant to bring a completed Transportation Impact Study Base Assumptions Form and a complete Pedestrian Analysis Worksheet (included at the end of this chapter as Attachments “A” and “B”) to the meeting and be prepared to discuss the following:

1. Previous TIS prepared for the site, if any;
2. Location of the site;
3. Proposed access(es) and its relationship to adjacent properties and their existing/proposed access;
4. Preliminary estimates of the site's trip generation and trip distribution at build-out;
5. Identification of proposed year of build-out;
6. Trip adjustment factors proposed, if any;
7. Approved and proposed developments in the study area, and the associated committed roadway improvements;
8. Anticipated roadway improvements to be provided by the Applicant;

9. Phasing plan proposed;
10. Potential bicycle and pedestrian connections to the nearest attraction (existing or imminent) within 1320' of the site. This distance may be increased up to 1.5 miles for residential projects near existing or proposed school sites. Thompson School District generally does not provide transportation (busing) for students who live within 1.5 miles of an elementary school.
11. Special analysis needs.

C. Results of Meeting

The Scoping Meeting shall conclude with the Local Entity and Applicant in mutual agreement with regard to determining the type of study and level of detail and extent to which the TIS will need to address each of the following:

1. Study area for the impact analysis;
2. Other developments within the study area;
3. Existing intersection counts;
4. Intersections to be studied in detail;
5. Background traffic volume forecasts;
6. Location of the nearest bicycle and pedestrian facilities and
7. Special analysis needs. (Non-traditional peak hour volumes for some uses, neighborhood impacts, access management plans, etc.)
8. For studies involving signalized intersection analysis the local entity will provide detailed assumptions for evaluation methodology and/or software files to be utilized.

D. Documentation after Meeting

The approved scoping meeting form and attachments shall be inserted into the TIS.

E. Time Between Scoping Meeting and Project Submittal

If a scoping meeting was conducted more than six months prior to submittal, the Local Entity Engineer may require another scoping meeting.

4.2.2 Types of Study

A. Master TIS.

Where large complex projects are planned or a project is phased over a multi-year build-out, it may be appropriate to prepare a Master TIS for the overall land use action followed by periodic updates for specific phases. The Master TIS must include overall phasing of improvements to coincide with project phasing. Updates to the Master TIS shall be submitted with the land use applications for the specific phases.

The updates shall be either Full, Intermediate or Memorandum level studies as determined by the local entity engineer..

B. Full TIS.

A Full TIS shall be required if one or more of the following conditions occur:

1. The site generated traffic is expected to exceed 1,000 trips/day or 100 peak hour trips by any travel mode, or
2. New high volume access is requested for an arterial street or State Highway.
3. There is significant citizen concern due to expected traffic impacts.

C. Intermediate TIS.

An Intermediate TIS may be required if any of the following requirements are met:

1. The site generated traffic via any travel mode is expected to be between 501 trips/day and 1,000 trips/day inclusive, or the peak hour trip generation is between 51 and 100,
2. Site traffic will impact adjacent, existing residential areas.
3. There is significant citizen concern due to expected traffic impacts.

D. Transportation Memorandum.

A Traffic Memorandum, in lieu of a more detailed study, may be considered if all the following requirements are met:

1. The site generated traffic via any travel mode is expected to be less than or equal to 500 trips/day, and/or the peak hour trip generation is less than or equal to 50.
2. Any new access requests are for local or collector streets only.

E. No TIS Required.

Upon submittal of a Transportation Worksheet (Attachment "C") by the Applicant and/or written acceptance by the Local Entity Engineer, the TIS requirement may be waived if all of the criteria below are satisfied:

Note that in Loveland (GMA and city limits), the proposed land use will be exempt from demonstrating compliance with the transportation Adequate Community Facilities requirements, if the TIS requirement is waived. In Fort Collins (city limits only), the proposed land use will be exempt from demonstrating compliance with the transportation Adequate Public Facilities requirements, if the TIS requirement is waived.

1. Daily vehicle trip-end generation is less than 200 trips/day and/or the peak hour trip generation is less than 20.
2. There are no proposed minor or major street intersections on collectors, arterials, or State Highways;
3. If the property is being redeveloped, the increase in the number of vehicular trips for the proposed use does not exceed the trip generation from the existing use by more than 20 peak hour trips or 200 daily trip ends;
4. Any new or change in the type of traffic to be generated (i.e. the addition of new truck traffic) is not expected to adversely affect the traffic within, and adjacent to, the property;
5. The scale or use of the proposed development or redevelopment is not likely to cause less than acceptable levels of service on the adjacent public streets, accesses, and intersections; and
6. The proposed development or redevelopment is not in the vicinity of a street or intersection with a history of safety and/or accident problems.
7. There is no change of land use with access onto a State Highway.
8. Site traffic will not impact adjacent, existing residential areas.
9. There is no significant citizen concern due to expected traffic impacts.
10. Site traffic will not negatively impact adjacent bicycle or pedestrian facilities.

4.2.3 Revisions and Updates

A revision or update to an approved TIS may be required when a previously approved land use action proposes an expansion, a change to access, or a change in use where new trip generation estimates exceed the original trip generation estimates (or actual trips in the case of existing land uses),by 20 percent or by more than 20 peak hour trips or 200 daily trips, whichever is less. If the currently approved study was prepared within the last three years, an amendment letter addressing the changes may be accepted and satisfy the requirements of this guideline. The letter must address: a) an estimate of site trip generation, b) existing site trip generation, c) the differences between anticipated estimates and existing trip generation and d) changes to the bicycle or pedestrian facilities. If the original study is older than three years, an entirely new study may be required by the Local Entity Engineer.

4.3 STUDY PARAMETERS

4.3.1 Project Description

A description of the proposed project will be prepared and include the type of land use and size of the proposed project (number of dwelling units or building square footage).

Any proposed phasing will be discussed and the anticipated completion date established. A figure depicting the proposed site plan will also be included and the proposed vehicular access locations will be described. This section will also include a description of how pedestrian and bicycle travel will be accommodated within the proposed site plan. This will include a discussion of types of sidewalks (attached/detached), pathways, and connections to local and perimeter destinations.

4.3.2 Analysis Horizons.

Three study horizons are required for a Master or Full TIS analysis: the existing (current), the short range (short range build-out) and the long range (20 year). It may be acceptable for the short range and long range horizons to be identical for some large projects.

A. Existing Horizon.

The intent of completing an analysis of the existing (current) study horizon is to establish a baseline of traffic conditions.

B. Short Range Horizon.

The intent of the short range planning horizon is to investigate the immediate impacts of the completed, proposed project on the existing and committed roadway network. The short range planning horizon year is defined as one year after the full occupancy of the project. If the project is proposed to occur over multiple phases, each phase shall be evaluated for impacts one year after the occupancy of that phase for the short range analysis.

C. Long Range Horizon.

The third planning horizon is the long range planning horizon. It shall be based on the current Regional Transportation Plan 20-year planning horizon and related modeling, except where the existing counts identify discrepencies in the regional model. In such situations, the current counts shall be increased by application of a growth rate established by the Local Entity or as approved by the Local Entity Engineer. The intent of the long range planning horizon is to evaluate the implications of the fully developed proposed project on the long-range traffic condition. Data from the current official North Front Range Transportation & Air Quality Planning Council (MPO) regional computer model is available by contacting the Local Entity. This study horizon is for the Local Entity's use as an indicator of traffic for planning purposes and the determination of the necessary Right-of-Way. The Local Entity Engineer may elect to disallow use of the regional model when the data is deemed unreliable.

4.3.3 Study Area

The limits of the transportation network to be studied shall be defined for all levels of TIS analysis and are based on the size and extent of the application for development approval, the existing and future land uses, and traffic conditions on and near the site.

In Fort Collins (GMA and city limits), the study area determination begins with major streets and intersections within one mile of the project. This may be increased or

decreased, at the discretion of the Local Entity Engineer. The exact limits of the study area are to be based on good engineering judgment, and an understanding of existing and future land use and traffic conditions at and around the site. The limits of the study area shall be agreed upon at the Scoping Meeting. In the case of a Master TIS, its identified study area shall generally be used for all subsequent updates.

The concerns related to specific land use actions on specific studies vary greatly, at a minimum, the factors to be considered for the establishment of the limits of the study area should include:

A. Master TIS

1. All adjacent and internal collector and arterial streets and intersections.
2. Loveland (GMA and city limits). Offsite collector and arterial roadways and intersections within the study area that are impacted by 10% or more by the project, or provide the primary connections between the project and the urban services, unless otherwise approved by the Local Entity Engineer.
3. Fort Collins (GMA and city limits). Offsite arterial and collector roadways and intersections expected to be impacted and identified by local entity engineer during scoping.
4. Continuity and adequacy of pedestrian and bike facilities to the nearest attraction (existing or imminent) within 1320 feet of the site.
5. Access to the most direct transit facility or transit route within 1,320 feet of the site.
6. Any pedestrian routes within 1-1/2 miles of a school.

B. Full TIS

1. All adjacent streets, intersections, and High-Volume Driveways.
2. Nearest offsite major intersection(s).
3. Internal public roads, including establishing the road classification.
4. Loveland (GMA and city limits). Additional offsite major intersections where:
    a. The project contributes a 10 percent impact (during either the A.M. or P.M. peak hour) to any approach leg of the intersection where the intersection is operating at a level of service of C or better in the Short Range Horizon, unless otherwise approved by the Local Entity Engineer, or
    b. The project contributes a 5 percent impact (during either the A.M. or P.M. peak hour) to any approach leg of the intersection where the intersection is operating at a level of service of D or worse in the Short Range Horizon, unless otherwise approved by the Local Entity Engineer.
5. Loveland (GMA and city limits). Additional offsite minor intersections where the project contributes a 30 percent increase in volume (during either the A.M. or

P.M. peak hour) to any approach leg of the intersection where any existing leg of the intersection is currently operating at a level of service of E or worse.

6. Fort Collins (GMA and city limits). Offsite arterial and collector roadways and intersections expected to be impacted and identified by local entity engineer during scoping.
7. Pedestrian and bicyclist destinations (existing or imminent) within 1320 feet of the site.
8. Access to the most direct transit facility or transit route (existing or imminent) within 1,320 feet of the site.
9. Any pedestrian routes within 1-1/2 miles of a school (residential land uses only).

C. Intermediate TIS

1. All adjacent streets, intersections, and High-Volume Driveways;
2. Loveland (GMA and city limits). The nearest offsite major intersection(s) only if:
   a. The project contributes a 10 percent impact (during either the A.M. or P.M. peak hour) to any approach leg of the intersection where the intersection is operating at a level of service of C or better in the Short Range Horizon, unless otherwise approved by the Local Entity Engineer, or
   b. The project contributes a 5 percent impact (during either the A.M. or P.M. peak hour) to any approach leg of the intersection where the intersection is operating at a level of service of D or worse in the Short Range Horizon, unless otherwise approved by the Local Entity Engineer.
3. Fort Collins (GMA and city limits). Offsite arterial and collector roadways and intersections expected to be impacted and identified by local entity engineer during scoping
4. Internal public roads, including establishing the road classification;
5. Pedestrian and bicyclist destinations (existing or imminent) within 1320 feet of the site.
6. Access to the most direct transit facility or transit route (existing or imminent) within 1,320 feet of the site.
7. Any pedestrian routes within 1-1/2 miles of a school (residential land uses only).

D. Traffic Memorandum

1. All adjacent streets, intersections, and High-Volume Driveways;
2. Internal public roads, including establishing the road classification;
3. Continuity and adequacy of pedestrian and bike facilities adjacent to the site.
4. Access to the most direct transit facility or transit route adjacent to the site.

4.3.4 Evaluation Elements

A. Master TIS.

The purpose of the Master Transportation Impact Study is to provide a general sense of the overall impacts to the transportation system and to identify the larger scale improvement needs necessitated by the proposed development (i.e. roadway widening, connecting key gaps in the street system, etc.).

While the Master Transportation Impact Study does not need to include intersection analyses, they may be required by the local entity engineer, or included at the Applicant's option especially if the Applicant intends to proceed with a specific phase of the project immediately following approval of the General Development Plan in Loveland (GMA and city limits) or Overall Development Plan in Fort Collins (GMA and city limits).

In cases where a developer seeks vesting with a Planned Unit Development (PUD) Zoning Document or Overall Development Plan, the Master Transportation Impact Study is required to present all the detailed information required in a Full or Intermediate Transportation Impact Study as determined by the Local Entity

For example, for a large Planned Unit Development (PUD) Zoning Document or Overall Development Plan with a multi-phase build-out, the Master TIS would not only address the overall project, but also identify key measurable criteria that would trigger the construction of some incremental portion of the overall infrastructure improvement plan. Typically at the Development Plan or Preliminary Plat stage, with each phase of the project a new TIS specific to that phase would be prepared. This new study would verify the accuracy of the original traffic projections, both on-site and background, and check the criteria identified for infrastructure improvements, and other pertinent information.

The key elements of the project impact assessment for a Master TIS shall include the following minimum evaluations:

1. Conformity with the adopted Transportation Master Plan including any adopted access control plans.
2. Intersection analysis as identified during scoping (see peak hour level of service requirements in Table 4-1 and Table 4-2)
3. Adherence to relevant adopted planning documents (such as corridor plans);
4. Functional classifications and anticipated typical sections for any new roadways.
5. Appropriateness of access locations;
6. Multi-modal and TDM opportunities;
7. Pedestrian/bike requirements and/or improvements;
8. Safety and accident analysis.

9. Other items as requested by the Local Entity Engineer and agreed to in the Scoping Meeting.

10. Neighborhood and public input issues.

B. Full TIS.

The key elements of the Full TIS shall be specified by the Local Entity Engineer from the following list:

1. Conformity with the adopted Transportation Master Plan, including any adopted access plans.

2. Adherence to relevant adopted planning documents (such as corridor plans).

3. Peak hour intersection and driveway level of service (see Table 4-1 and Table 4-2).

4. Appropriateness of access locations.

5. Location and requirements for turn lanes or acceleration/deceleration lanes at accesses or intersections, including recommendations for taper lengths, storage length, acceleration/deceleration lengths, and other geometric design requirements per Local Entity or CDOT requirements;

6. Sight distance evaluations and recommendations (intersection, driveway, stopping, passing, etc.).

7. Multi-modal and TDM opportunities;

8. Continuity and adequacy of pedestrian and bike facilities to the nearest attraction (existing or imminent) within the study area.

9. Recommended traffic control devices for intersections which may include two way stop control, four way stop control or yield signs, school flashers, school crossing guards, crosswalks, traffic signals or roundabouts.

10. Traffic signal and stop sign warrants.

11. Progression analysis for signalized intersections.

12. Appropriateness and/or any needed changes to existing roadway signing, striping, and other traffic control devices.

13. Safety and accident analysis.

14. Other items as requested by the Local Entity Engineer and/or agreed to in the Scoping Meeting.

15. Neighborhood and public input issues.

C. Intermediate TIS.

No Long Range Horizon analysis is required as part of an Intermediate TIS. The key elements of the TIS shall be specified by the Local Entity Engineer from the following list:

1. Conformity with the adopted Transportation Master Plan, including any adopted access plans.
2. Adherence to relevant adopted planning documents (such as corridor plans).
3. Peak hour intersection and driveway level of service (see Table 4-1 and Table 4-2).
4. Appropriateness of access locations.
5. Location and requirements for turn lanes or acceleration/deceleration lanes at accesses or intersections, including recommendations for taper lengths, storage length, acceleration/deceleration lengths, and other geometric design requirements per Local Entity or CDOT requirements.
6. Sight distance evaluations and recommendations (intersection, driveway, stopping, passing etc.).
7. Multi-modal and TDM opportunities.
8. Continuity and adequacy of pedestrian and bike facilities to the nearest attraction (existing or imminent) within the study area.
9. Recommended traffic control devices for intersections which may include two way stop control, four way stop control or yield signs, school flashers, school crossing guards, crosswalks, traffic signals, or roundabouts.
10. Traffic signal and stop sign warrants.
11. Progression analysis for signalized intersections.
12. Appropriateness and/or any needed changes to existing roadway signing, striping, and other traffic control devices.
13. Safety and accident analysis.
14. Other items as requested by the Local Entity Engineer and/or agreed to in the Scoping Meeting.
15. Neighborhood and public input issues.

D. Traffic Memorandum.

No Long Range Horizon is required as part of a Traffic Memorandum. The key elements of the Memorandum shall be specified by the Local Entity Engineer from the following list:

1. Peak hour driveway and/or intersection level of service (see Table 4-1 and Table 4-2)
2. Appropriateness of access locations.
3. Location and requirements for turn lanes or acceleration/deceleration lanes at the access, including recommendations for taper lengths, storage length, acceleration/deceleration lengths, and other geometric design requirements per Local Entity or CDOT requirements.
4. Sight distance evaluations and recommendations (intersection, driveway, stopping, passing etc.)
5. Continuity and adequacy of pedestrian and bike facilities within the study area;
6. Appropriateness and/or any needed changes to existing roadway signing, striping and other traffic control devices.
7. Other items as requested by the Local Entity Engineer and/or agreed to in the Scoping Meeting.
8. Neighborhood and public input issues.

4.4 TRAFFIC ANALYSIS

4.4.1 Analysis Methodolgy

Assessment techniques shall include a capacity and level of service (LOS) analysis for the key intersections identified in the study area during the identified analysis time periods. The analyses shall be completed using the operational analysis methodology shown in the latest edition of the Highway Capacity Manual published by the Transportation Research Board. Base assumptions and signal timing parameters for the analysis shall be approved by the Local Entity, and any changes from existing noted in the TIS.

Roundabout analysis shall be completed as detailed in Appendix I of these standards (Roundabout Design Manual) or as otherwise specified by the Local Entity Engineer.

4.4.2 Existing Traffic

A. Roadway Traffic Volumes/Traffic Counts.

Current A.M. and P.M. peak hour traffic counts as specified by the Local Entity Engineer shall be obtained for the roadways within the study area for one, non-holiday Tuesday, Wednesday, or Thursday. Each peak hour count shall be conducted over a two hour period (or as specified by the Local Entity Engineer) and shall include fifteen (15) minute count data to clearly identify the peak hours.

Weekend counts and/or average daily counts on local streets may also be required where appropriate when requested by the Local Entity Engineer. Local Entity or CDOT average weekday traffic (AWT) counts may be used when available.

Pedestrian counts and bike usage should be obtained. Vehicle classification counts may be required.

In any case, these volumes shall be no more than one year old (from the date of application submittal), unless otherwise approved by the Local Entity Engineer. The source(s) of each of the existing traffic volumes shall be explicitly stated (CDOT counts, new counts by Applicant, Local Entity counts, etc.) Summaries of current traffic counts shall be provided. The Local Entity may require the use of seasonal adjustment factors depending on when data was collected and if the project is considered to be in an affected area (i.e. tourism).

B. Intersection Level of Service.

1. Existing and Short Range Horizon. Use calculated peak hour factors or 0.85, whichever is higher. Traffic signal timing parameters for the existing conditions will be the actual signal timing in effect unless determined otherwise by the Local Entity.

2. Long Range Horizon. A peak hour factor of 0.95 may be used for the Long Range Horizon. Greater values may be used if approved by the Local Entity Engineer. Traffic signal timing parameters for the existing conditions will be the actual signal timing in effect unless determined otherwise by the Local Entity.

4.4.3 Background Traffic

A. Short Range Volume Projections.

The traffic forecast for the short range planning horizon shall be the sum of existing traffic volumes plus cumulative development traffic from approved land use actions (or, in Fort Collins [city limits only], projects with reserved intersection capacity established through a certified TIS), plus background growth (as adjusted to avoid duplicative consideration of the identified development traffic from the approved land uses already considered). The cumulative development traffic shall be based, in part, on the A.M. and P.M. peak hour and ADT data established and accepted from planned and approved land use actions within and near the study area.

In Loveland (GMA and city limits), 100% of the committed trips from the build out of the planned (i.e. documented in a complete land use application accepted by the City) and approved projects in the study area must be included in the short range volume projection. The assumed baseline surface transportation network should reflect existing facilities (without the proposed project improvements) plus any committed improvements by the Local Entity, other public agencies, and/or other approved land uses within the study area as described in Title 16.41.080.C of the Loveland Municipal Code.

In Fort Collins (GMA and city limits), only the percentage of trips from the approved projects that are expected to be generated in the short range year must be included.

In both communities, the short range planning horizon background traffic growth rate shall be based on a growth rate from the Scoping Meeting based on one of the following methodologies:

1. Straight line projection for the build out year between the existing traffic volumes and the twenty year North Front Range Transportation and Air Quality Planning Council's (MPO) regional model forecast, CDOT rates or
2. Historical traffic counts projected to the build-out year (at least three years of traffic data should be used for this), or
3. Area-wide traffic count analysis which considers traffic volume trends in the study area's circulation system and uses proportion/extrapolation methods.

B. Long Range Volume Projections in Loveland (GMA and City Limits)

Long range A.M. and P.M. peak hour planning horizon traffic volume projections shall be based on the traffic modeling volumes contained in the most recent update to the Transportation Master Plan. Special requests for projections not contained in the accepted and published model results will require special approval by the Local Entity Engineer. Note that the modeled projections are based on future year population and employment projections that reflect a regional perspective on growth and development. The Applicant will need to investigate the land use assumptions as they apply to the transportation network to be studied to document in the TIS any projection adjustments if necessary. For the long range planning horizon network analysis, all planned and funded surface transportation facilities as per the Local Entity's Transportation Master Plan within the study area may be included for the baseline assumptions. In addition, use the growth rate agreed upon with the Local Entity Engineer.

C. Long Range Volume Projections in Fort Collins (GMA and City Limits)

Long range peak hour planning horizon traffic volume projections shall be based on one or more of the following as determined in the scoping meeting:

1. Straight line projection for the build out year between the existing traffic volumes and the twenty year North Front Range Transportation and Air Quality Planning Council's (MPO) regional model forecast, CDOT rates or
2. Historical traffic counts projected to the build-out year (at least three years of traffic data should be used for this), or
3. Area-wide traffic count analysis which considers traffic volume trends in the study area's circulation system and uses proportion/extrapolation methods, or
4. Growth rate agreed upon with the Local Entity Engineer.

4.4.4 Project Traffic

A. Trip Generation Rate.

Trip generation should be calculated from the latest data contained within the Institute of Transportation Engineers' Trip Generation Manual or be based on local data approved by the Local Entity Engineer. Other industry publications (such as the ITE Journal or other sources) may be approved by the Local Entity. Data limitations, data age, choice of peak hours (for the land use or adjacent street traffic), choice of independent variables, and choice of average rate versus statistically significant modification should be discussed in the study when appropriate. When data is not available for a proposed land use or a modification is proposed, the Applicant must conduct a local trip generation study following procedures prescribed in the ITE Trip Generation Manual and provide sufficient justification for the proposed generation rate. This rate must be approved by the Local Entity prior to its use in the written study.

B. Preliminary Land Use Assumptions.

The trip generation values contained in studies submitted prior to the establishment of a site-specific development plan shall be based on the maximum number of dwelling units permitted for the approved land uses, and/or the maximum trip generation rates for the non-residential development proposed land use action. When a TIS is being developed for a project with an established site-specific development plan, trip generation shall be based on actual dwelling unit counts and square footage(s) proposed on the final plan.

C. Trip Generation Table.

The Applicant shall prepare a Trip Generation Table, listing each type of land use within the site at build-out, the size and unit of measure for each land use, trip generation rates (total daily traffic, A.M. and P.M. peaks), directional splits for each in/out driveway, the resultant total trips generated. The data source shall be stated (state ITE land use code, if used). Build-out land uses and trip generation shall be used for both the short range and long range planning horizons. Land use action proposed that is of a type that build-out in the short-range is not feasible due to the size of development (as agreed upon by the Local Entity at the Scoping Meeting), may propose phases (such as 2-year increments) for the development.

D. Committed Trips/Capacity in Loveland (GMA and City Limits)

To assure the public and the Local Entity that the traffic impact analysis adequately addresses the full impact of the development, the trip generation stated in the TIS will establish the maximum number of trips permitted entering and exiting the development. If the amount of committed trips is reached prior to full occupancy, the Local Entity reserves the right to request from the owner, at the owner's expense, supplemental traffic analyses prior to the issuance of additional building permits. This information shall demonstrate that uncommitted capacity is available on the transportation network to serve the excessive trips, or that additional transportation

mitigation improvements can be reasonably installed to maintain compliant operation with the excessive trips. If no additional capacity is available, or no reasonable mitigation conforming to the requirements of these street standards can be implemented, the Applicant shall obtain a exception from the City Council for the non-conformity with the ACF requirements or scale back the intensity of the proposed land uses as needed to achieve compliance. If the project is fully occupied and it is determined that the approved land use action's traffic exceeds that which was included in the approved TIS, the Local Entity Engineer is authorized to require the property to conduct additional traffic analysis and provide additional mitigation measures.

E. Adjustments to Trip Generation.

Trip-making reduction factors may be used after first generating trips at full ITE rates or pre-approved rates from other sources. These factors fall into two categories: those that reassign some portion of generated trips to the background stream of traffic, and those that remove or move generated trips. In all cases, the underlying assumptions of the ITE trip generation rates must be recognized and considered before any reductions are used in the TIS.

Several situations will be closely reviewed. One is when the traffic study assumes rates where the collection of mixed uses, such as at a shopping center, result in lower peak hour trips than when applying individual rates to each land use. Another is when reductions in the trip generation rates are assumed based on reductions due to travel demand management. Finally, adjustments may be considered for higher than typical mode split. Adjustments to trip generation must be agreed to by the Local Entity Engineer during TIS scoping.

1. Pass-by Trips**.** This first category may be considered when trips to the proposed development currently exist as part of the background traffic stream, referred to as a pass-by trip. Pass-by percentages identified in the ITE Trip Generation report or other industry publications may be considered with appropriate explanation and documentation. Pass-by traffic must remain assigned to driveways and access points. They are not additive to the background traffic stream. A technical appendix, table or map that illustrates the re-diversion of pass-by trips is required which may be submitted as a legible, hand-written work sheet(s).

2. Internal Site Trips/TDM. Analytic support documentation of internal site trips, transit use, and TDM (Transportation Demand Management) actions shall be provided to show how trip adjustments are derived. Optimistic assumptions regarding transit use and TDM actions will not be accepted unless accompanied by specific implementation proposals that will become a condition of approval. Such implementation proposals must have a high expectation of realization within a 5-year period after project initiation.

3. Mode Split. Mode split assumptions and subsequent reduction in vehicular trips may be considered with appropriate explanation and documentation.

F. Trip Distribution.

Trip distribution must be documented in the TIS. It may be based on the professional engineer's judgment applied to one or more of the following: regional MPO traffic volume projections, gravity model, market analysis, existing traffic flows, or applied census data. Regardless of the basis of the estimates, the procedures and rationale used in determining the trip distributions must be fully explained and documented.

G. Trip Assignment.

The project traffic will be assigned to the roadway system according to the trip distribution established above. The resulting project site generated traffic and total site traffic will be depicted on figures for each analysis horizon. These figures will include peak hour traffic volume information, plus daily traffic volume information for Fort Collins (GMA and city limits). Separate maps or values are required when the trip distribution differs by more than 10% between the short and long range analysis horizons.

4.4.5 Total Traffic

The total traffic projections will be determined for each of the analysis horizons identified earlier in the base assumptions. The total traffic projections will include the existing traffic, plus the future background traffic, plus the project generated traffic. The future total traffic projections will be depicted on figures for each study year. Based upon the total traffic projections and the Local Entity's street standards and Transportation Master Plan, the Applicant shall provide roadway functional classification recommendations. For Loveland (GMA and city limits), a roadway projected to carry between 3,500 and 5,000 vehicles per day would be recommended as a Major Collector Street, where as if the projected traffic was between 1,000 and 2,500 vehicles per day, it would be recommended as a Connector Local Street.

4.5 PROJECT IMPACTS

4.5.1 Significant Negative Impacts In Loveland (GMA and City Limits)

Significant Negative Impacts are defined as:

A. Exceeding Maximum Traffic Volume.

When the project's (land use action) traffic causes the estimated traffic to exceed the established maximum traffic volumes allowed for the specific classes of roadways; or

B. Exceeding the LOS standard.

When the added project traffic causes any portion of an intersection to exceed the LOS standard; or

C. Failing the ACF delay standard

When the project traffic when added to all other traffic in the design year, will cause any movement or leg of an intersection to fail the ACF delay standard; unless the increased delay caused by the project is less than or equal to two percent of the ACF delay standard for that movement or leg of the intersection.

D. Calculation Basis

The project traffic analysis shall be calculated based upon the cumulative increase in traffic and/or the cumulative increase in intersection delay of all phases, lots, tracts or other subsections of a GDP or any subsection not contained within a GDP.

4.5.2 Significant Negative Impacts in Fort Collins (GMA and City Limits)

This section applies primarily to vehicular related impacts associated with the proposed project. A project is defined as significantly impacting a study intersection when one of the following criteria are satisfied:

A. For Signalized Intersections.

1. When the added project traffic causes movements, approaches or the overall intersection to fail the minimum acceptable level of service standards in Table 4-3; or
2. When the background traffic conditions (without project traffic) causes an intersection to fail the minimum acceptable level of service standards; and when the project adds additional traffic (10 or more trips during the peak hour); or
3. When added project traffic is determined to create potential safety problems.

B. For Unsignalized Intersections.

1. When the added project traffic causes movements at an intersection or the overall intersection to fail the minimum acceptable level of service standards in Table 4-3; or
2. When backstacking (queuing) would create impeded traffic flows and/or excessive congestion; or
3. When added project traffic is determined to create potential safety problems.

4.5.3 Project Impact Assessment.

The key elements of the project impact assessment include evaluations of issues outlined for a specific Analysis Level. Refer to **Section 4.3.4** for a listing of the Evaluation Elements.

A. Motor Vehicle Impact Evaluations

1. Existing Condition Diagrams in Loveland (GMA and city limits). Drawings shall be prepared and included in the report to document traffic counts, lane geometrics

(including striping, signing and other pavement markings), traffic control, existing access locations, lane lengths, widths, tapers, and any other notable features. When arterial roadways are impacted by the proposed project, the report shall include a tabulation or diagram which identifies the number of existing and proposed accesses contained within, and up to one-quarter mile of, the evaluated arterial road and/or intersection

2. Within one block (approximately 500 to 1000 feet) of an intersection with a street of higher functional classification, additional through and turning lanes may be required on a street to meet the level of service requirements for the intersection. The additional lanes shall not be considered a reclassification of the street.

3. Intersection Delay

    a. An A.M. and P.M. peak hour intersection level of service analysis shall be conducted for each intersection analyzed in the TIS, based on procedures specified in the most recent release of the Highway Capacity Manual. **In Loveland (GMA and city limits),** specific level of service summary work sheets shall be included in the TIS. See **Attachments "H" and "I"** for sample forms for reporting the results of the intersection level of service evaluations.

    b. The principal objective of the intersection level of service traffic impact analysis is to identify whether the traffic from the proposed project when added to the short range planning horizon traffic will result in a significant impact and an unacceptable level of service. For definition purposes, the thresholds for acceptable level of service are as shown in Table 4-2 and Table 4-3. All intersection components shall meet the following requirements. All intersection components shall meet the following requirements:

Table 4-1
Loveland (GMA and City Limits)
Motor Vehicle LOS Standards (Intersections)

Intersection Component	Major Intersection[1]	Minor Intersection[2]	Driveway
Overall (City Limits)	LOS C	LOS C	No Limit
Overall (GMAs)	LOS D	LOS D	No Limit
Any Leg	LOS D	LOS E	No Limit
Any Movement	LOS E	LOS F	No Limit

[1] Includes all signalized and unsignalized arterial/arterial and arterial/ major collector intersections.
[2] Includes all unsignalized intersections (except major intersections) and high volume driveways
[3] There are no LOS standards for I-25 Interchanges.
[4] On State Highways, overall LOS D is acceptable.

Table 4-2
Fort Collins (GMA and City Limits)
Motor Vehicle LOS Standards (Intersections)

	Overall	Any Approach leg	Any Movement
Signalized	D[1]	E	E[2]
Unsignalized Arterial / Arterial Collector / Collector	E[3]	F[4]	
Unsignalized Arterial / Collector Arterial / Local Collector / Local Local / Local	D[3]	F[4]	
Roundabout	E [3,5]	E[54]	E[5]

[1] In mixed use district including downtown as defined by structure plan, overall LOS E is acceptable
[2] Applicable with at least 5% of total entering volume
[3] Use weighted average to identify overall delay
[4] Mitigation may be required
[5] Apply unsignalized delay value thresholds to determine LOS

4. Driveway Access. The design, number, and location of access points to collector and arterial roadways must be submitted for approval by the Local Entity Engineer. State Highway accesses require the issuance of an Access Permit from CDOT. The number of access points must be kept to a minimum and be designed to be consistent with the type of roadway facility. If multiple adjacent roadways are available for access, access should be taken from the lowest classified roadway available. Access points will be reviewed and approved by the Local Entity based on the following information:

    a. Access location(s) as shown on the site plan.

    b. Proposed traffic turning movements.

    c. Analysis of on-site (driveway) stacking/queuing and impacts to adjacent streets.

    d. Signalization requirements and design in accordance with these guidelines.

    e. Geometric design of the access and proposed improvements to the Local Entity facilities in accordance with these standards.

    f. Compliance with the CDOT State Highway Access Code and any adopted access management plans if access is requested to a State Highway.

    g. In Fort Collins, access spacing standards shown in Table 7-3.

5. Traffic Signals.

    a. Proposed and existing access points, proposed intersections, and existing intersections affected by the land use actions being analyzed in the report that have any potential for signalization will be reviewed and discussed during the scoping meeting. Discussion will include review of existing signals/potential modifications, proposed signals, school signals for school crossings, school flashers, pedestrian signals/crossings, and any other potential for signal devices and signal interconnect issues.

    b. During the Scoping Meeting an outline of locations for signal warrant analysis will be agreed upon. Generally, most traffic signal locations have been predetermined by each Local Entity Engineer and policies have been set in the comprehensive Transportation Plan of the Local Entity for its planning area including the Growth Management Area.

    c. Signal Warrant Analysis for potential signal locations shall consist of a review of the applicable signal warrants contained in the Manual on Uniform Traffic Control Devices.

    d. If any location proposed for signalization is not spaced according to the appropriate Comprehensive Transportation Plan or Local Entity's signal spacing policy, then a traffic signal progression analysis shall be required. The analysis limits, parameters (including allowable phasing, split times, walk timing, clearances and methods) to be used for the study will be discussed at the Scoping Meeting.

e. Alternatives to signalization at potential signal locations will be discussed in the scoping meeting and the report. The alternatives to adding new intersections to be discussed should include no new intersection, limited movements, and roundabouts.

f. If any signal timing and/or phasing changes are proposed, an appropriate signal progression analysis may be required.

B. Pedestrian and Bicycle Impact Evaluations.

All projects are expected to achieve the minimum acceptable LOS standard for on-site and off-site bicycle and pedestrian facilities. Refer to the *City of Fort Collins Multimodal Level of Service Criteria Manual* located in **Appendix H** and **Loveland (GMA and city limits), Table 4-3** for detailed descriptions of the LOS standards. Pedestrian and bike facility demand shall be identified and related items for discussion should include:

1. School routing plans per the MUTCD between the project and all schools within 1-1/2 miles of the project boundary;

2. The demand for pedestrian and bike facilities to serve high pedestrian activity areas within the land use;

3. The need for links of bicycle or pedestrian facilities to neighboring land uses or attractions (trails, etc.) within 1320’ (or greater if applicable to unique pedestrian oriented destinations) of the project site;

4. Existing and proposed sidewalk width, separation from traffic, and space available for trees, transit stops (if any), or other related elements (if any).

5. Geometric improvements and recommended traffic control devices to accommodate pedestrians and bicyclists;

6. Existing and proposed pedestrian and bike facilities shall be evaluated for compliance with the following elements:

   a. Directness. Walking distance to destinations like transit stops, schools, parks, and commercial or activity areas should be direct. Measurement of directness is the ratio of the Actual distance to a destination via a sidewalk or pathway divided by the Minimum distance characterized by a grid street system.

   b. Continuity. The sidewalk/ walkway system should be complete, without gaps. The pedestrian corridor should be integrated with the activities along the corridor and should provide continuous access to destinations.

   c. Street Crossings. Safety and comfort is essential while crossing streets, intersections and mid-block crossings. Factors that affect the LOS include: number of lanes to cross, crossing delay for pedestrians, signal indication, cross-walks, lighting, raised medians, visibility, curb ramps, pedestrian buttons, convenience, comfort, and security.

d. Visual Interest and Amenity. Pedestrians enjoy visually appealing environments that are compatible with local architecture and include street lighting, fountains, and benches.

e. Security. Pedestrians should be visible to motorists, separated from motor vehicles and bicycles, and under adequate street lighting.

f. Surface Condition. Pedestrian facilities should be free from obstructions, cracks, and interruptions.

Table 4-3
Loveland (GMA and City Limits)
Pedestrian Levels of Service

QUALITY INDICATORS	A	B	C	F
SECURITY	Well used, good lighting levels and unobstructed lines of sight	Unobstructed lines of sight, good lighting levels	Sidewalk configuration and parked cars present sight problems, moderate lighting	Major pedestrian visibility problems, streetscape is pedestrian intolerant
DIRECTNESS	< 1.4	1.4-1.8	1.8-2.2	> 2.2
CONTINUITY	Quality, continuous pedestrian networks that are physically separated from street and built to current standards	Continuous sidewalk network on both sides of the street. May not be built to current standards	Sidewalk network where there may not be sidewalks on both side of the street or there are minor interruptions in connectivity	Breakdown in pedestrian network to where each pedestrian chooses a different route
STREET CROSSINGS Signalized Intersection	3 or fewer lanes to cross, clear indications (striping, etc.), well marked crosswalks, good lighting, standard curb ramps, automatic pedestrian signal, pedestrian amenities, unobstructed views	4 or 5 lanes to cross, clear indications, well marked crosswalks, pedestrian refuge area, standard curb ramps, pedestrian amenities, standard curb ramps, unobstructed views	6 or more lanes to cross, clear indications, well marked crosswalks, pedestrian refuge area, standard curb ramps, pedestrian amenities, unobstructed view	Missing 5 elements of A, 4 elements of B, and 2 elements of C
STREET CROSSINGS No Signal	Well-marked cross walks, good lighting levels, standard curb ramps, street character suggests pedestrian crossing, unobstructed views	Missing 1 element of A	Missing 2 elements of A	Missing 3 or more elements of A
VISUAL APPEAL AND PEDESTRIAN AMENITIES	Visually appealing and compatible with local architecture and artist themes, wide sidewalks, window shopping, pedestrian lighting, trees and street furniture	Wide sidewalks, visual clarity, some street furniture and landscaping	Functionally operational with less importance placed on visual appeal	Design ignores pedestrian with negative metal image, intimidating
SURFACE CONDITION	Smooth asphalt or concrete with few breaks or cracks	Relatively smooth asphalt or concrete with frequent breaks or cracks	Rougher, broken surface such as older concrete or cobblestone	Difficult, unpaved terrain such as hiking trails

C. Special Studies.

This section provides the Local Entity with opportunities to request specific focused traffic analyses that may be unique to the proposed land use action. The Applicant

and the Local Entity will determine if special studies are required in the Scoping Meeting. These may include, but are not limited to the following:

1. Access Management Plan Analysis in Loveland (GMA and city limits). If a development is proposing a new access location on an arterial and an Access Management Plan does not exist, the Local Entity may require the Applicant to provide an Access Management Plan
2. Access spacing,
3. Accident/safety concerns (accident statistics),
4. Truck routing,
5. Emergency and snow routes,
6. Hazardous material routes.
7. Neighborhood Transportation Impact Evaluation. The TIS may be required to include a focused analysis of the potential project related impacts on adjacent residential neighborhood quality of life issues such as potential cut-through traffic and speeding/volume concerns. If it is determined that a neighborhood transportation impact evaluation is required the following procedure should be followed:
    a. Examine existing transportation conditions within the neighborhood. This should follow the same procedure as set forth earlier for the transportation impact analysis. Daily and peak hour traffic volumes should be collected for the local streets to be included in the analysis.
    b. Determine project generated traffic for all modes within the neighborhood and show on a figure.
    c. Determine total traffic projections for the local streets. This should follow the same procedures as described earlier, including other projects and area wide growth if applicable.
    d. Determine if the proposed project would create significant impacts to the residential streets using the criteria stated earlier.
    e. If necessary, develop measures, including but not limited to traffic calming techniques, to mitigate any significant impacts.
    f. The neighborhood TIS should also discuss how pedestrians and bicyclists would access the proposed project to/from the adjacent neighborhood(s), and the need for special facilities to enhance direct pedestrian and bicycle connectivity.
8. Sight Distance. Sight distance concerns that are anticipated or observed which may impact driveway, intersection, or roadway operation and safety need to be discussed in the TIS. Recommendations regarding stopping sight distance, intersection sight distance, and passing sight distance needs should be provided by

the Applicant's traffic engineer for detailing on the final development, site plan, or final construction plans.

4.6 MITIGATION MEASURES

When a project's vehicular impacts are determined to not meet the minimum acceptable level of service standard, the TIS shall include feasible measures, which would mitigate the project's impacts. The mitigation measures are intended to be *in addition to* the minimum required improvements necessary to meet the Local Entity's standards and codes. Potential mitigation categories/strategies are listed below and may not be all-inclusive.

The LOS should be recalculated to reflect the effectiveness of the proposed mitigation measures and show that the project-related impacts have been reduced to an acceptable LOS for all transportation modes (vehicle, bicycles, and pedestrians). If mitigation that is reasonably related and proportional to impact is not feasible (or not desired by the Local entity) to address the specific LOS issue then the following can occur:

1. For bicycle and pedestrian level of service issues Section 4.6.7 Variances can be utilized.
2. For vehicular level of service issues related to intersection approaches or movements, Section 4.6.7 Variances can be utilized.
3. For vehicular level of service issues related to overall intersections Section 4.6.8 Alternative Mitigation Strategies can be utilized.

4.6.1 Transportation Demand Management (TDM) Measures (GMA and City Limits)

Transportation Demand Management measures are designed to facilitate the use of alternate transportation modes in an effort to decrease demand on the roadway system by single occupant vehicles. A detailed description of the proposed TDM measures and implementation plan must be included in the TIS for any project seeking TDM-related trip reductions. If the TDM program is acceptable to the Local Enity, the applicant will be allowed to reduce total project vehicle trips by an amount commensurate with applicable trip reduction policies.

A. Examples of TDM measures

1. Vehicle trip reduction incentives and services offered by employers to encourage employees to utilize alternative modes of travel such as carpooling, vanpooling, riding public transit, bicycling, walking, telecommuting, etc.
2. Vehicle trip reduction incentives and services affecting visitors to the project, such as shoppers, clients, patrons, etc.
3. Financial support for the capital and/or operating costs of enhanced transit or vanpool service to the project.

4. Provision of a mix of land uses in close proximity, facilitating trip making by walking, bicycling, or local shuttles.
5. Provision of on-site facilities that encourage the use of alternate forms of transportation, such as bicycle lanes and amenities, enhanced pedestrian connections, telecommuting facilities, etc.
6. Site trip cap and/or parking cap including trip-monitoring agreements.

4.6.2 Transit Capacity and Access Improvements.

A. Suggested elements of a transit program

1. Contributions of equipment or funds to increase the capacity of existing transit systems
2. Transit shuttles provided by applicant (e.g., bus, taxicab, van, etc.)
3. Contributions toward transit stations or centers

4.6.3 Traffic Signal Operations Improvements.

Traffic Signal Operational improvements would include upgrading signal to include additional signal phases and/or, signalization of an unsignalized intersection. Signalization of project access drives would not be considered as a mitigation measure. The Local Entity Engineer must approve signal improvements and/or installations.

4.6.4 Street Widening and Other Physical Improvements

Mitigation measures, which include street widening, and other physical improvements must be demonstrated to be physically feasible and must meet minimum City standards and codes for both on-site and off-site improvements.

4.6.5 Street Restriping and Parking Regulations

The Local Entity Engineer must approve proposed striping and parking regulation mitigation(s). Generally, street restriping is not a preferred mitigation measure because it often requires parking regulations, which may cause secondary impacts in certain commercial and residential areas. Therefore, any parking impacts should be clearly identified and proposed for mitigation to the extent feasible.

4.6.6 Geometric Improvements

Turn lanes and other auxiliary lane needs shall be identified for each access. Warrants and design standards are shown in Chapter 8. In addition to the standards shown in Chapter 8, all proposed project entrances onto State Highways shall be evaluated as to whether they require acceleration lanes or deceleration lanes as per the current Colorado Department of Transportation State Highway Access Code. The design speed shall be selected from the ranges given in the **Street Design Technical Standards Table 7-3** or **7-4**.

4.6.7 Variances

Requests for variances to the requirement for mitigation measures should follow the process outlined in Section 1.9.4. In Fort Collins and Loveland (City Limits Only), such a variance is applicable for level of service issues related to bicycle, pedestrian and/or intersection approach or movements.

4.6.8 Alternative Mitigation Strategies

In cases where a study intersection does not meet overall level of service standards, and reasonably related and proportional mitigation to address the level of service is not possible or not desired by the Local Entity, an Alternative Mitigation Strategy may be requested and considered using the following process:

1. The applicant submits preliminary information from the Transportation Impact Study related to the intersection, the impact, mitigation measures considered, discussion related to feasibility and any recommendations for alternative mitigation to the Local Entity.

2. The Local Enity identifies a multi-departmental team of at least two staff members. Staff members may typically come from Department or Divisions related to Transportation Engineering, Traffic Operations, FCMoves (Fort Collins Only), Streets and/or Planning.

3. The team reviews the submitted information, develops an Alternative Mitigation Strategy and identifies the reasonably related and proportional contribution based on impact. The Strategy should be specifically linked to project impact, and may include improvements for any mode of travel at the impacted intersection or elsewhere, or a fee in lieu of improvements towards a project anticipated to be constructed within three years. If the Local Entity Engineer determines that no reasonably related and proportional mitigation based on impact is possible or desired by the Local Entity Engineer, no alternative mitigation may be required.

4. Implementation of an identified Alternative Mitigation Strategy serves as fulfillment of intersection level of service requirements. In Fort Collins (City Limits Only) the administrative determination with regard to an Alternative Mitigation Strategy is final and may only be appealed pursuant to City of Fort Collins Land Use Code Division 2.1.3.

4.7 REPORT CONCLUSIONS

4.7.1 Recommended Improvements

The findings of the Transportation Impact Study should be provided in summary format, including the identification of any areas of significant impacts and recommended improvements/mitigation measures to achieve the LOS standards for all modes. If variance requests or Alterative Mitigation Strategies are being utilized, those shall be detailed in the report.

A. Geometric Improvements.

The TIS shall include recommendations for all geometric improvements such as pavement markings, signs, adding through or turn lanes, adding project access and assorted turn lanes, acceleration lanes, and changes in medians. Sufficient dimensions/data shall be identified to facilitate review. Anticipated right-of-way needs shall also be identified. This information shall be made available to the project civil engineer for use in preparing scaled drawings.

B. Responsibility.

The Applicant shall describe the location, nature, and extent of all transportation improvements that the Applicant recommends to achieve the required Level of Service for each analysis horizon's year. In addition, the party(ies) responsible to complete the improvements shall be identified. For this discussion, the following definitions apply:

1. Master Planned. Improvements planned having committed funding, including those identified in short range capital improvement programs by the City of Loveland, a special district, MPO, CDOT or other agency. These may be identified in the Scoping Meeting. The Local Entity will provide this information to the Applicant.

2. Background Committed. Improvements committed to by previously approved development as identified in the Scoping Meeting provided by the City at the Scoping Meeting.

3. Applicant Committed. There are two conditions when improvements need to be identified:

    a. Existing plus cumulative traffic with planned and background improvements exceed established levels of service, the Applicant shall identify mitigation to offset project impacts.

    b. Existing plus cumulative traffic with planned and background improvements do not exceed established levels of service, but the addition of project traffic lead to non-compliance, the Applicant shall identify mitigation to achieve established levels of service.

C. Proposed Transportation Demand Management.

If TDM measures are recommended to mitigate the traffic impact of the proposed land use action, a specific TDM Implementation Proposal shall be developed and presented to the Local Entity. If accepted, this Implementation Proposal will become a condition of approval of the land use action requested. Each TDM Implementation Proposal shall be developed in conformance with the Local Entity's and the MPO's Transportation Demand Management Program.

D. Summary Presentation.

The Applicant shall submit a Recommended Improvements Summary Table similar to the example shown in **Attachment "D"** to present the recommendations. The recommended improvements identified on the Recommended Improvement Table shall be categorized as Master planned, Background Committed, or Applicant Committed. Each project should include a description of its location, the type of project, right-of-way needs (for roadways), and signal or turn lane improvements (for intersections). Commitment to funding and constructing the improvements should be identified, either by local governments, districts, or by the Applicant.

4.7.2 Adequacy Statement in Loveland (GMA and City Limits)

The TIS shall include a clear statement clarifying whether or not the transportation facilities will be adequate and available to serve the proposed development within one year of full build out of the project. The statement shall include specific reference to the facility status paragraph (selected from items in Title 18.15.03.03 of the Loveland Municipal Code) that supports the adequacy conclusion.

A. Alternative Solutions.

The Applicant should assure that all practical solutions (project phasing, reductions in development intensity, etc) have been considered when developing the list of necessary improvements, so that the resulting operating conditions are made to approach the established level of service.

B. Cost Considerations.

When identifying improvement possibilities (either by the Applicant, the Local Entity or the State) necessary to yield an acceptable level of service, the cost of the improvements shall not be considered a limiting constraint within the context of the TIS.

4.8 TIS CERTIFICATION AND INTERSECTION'S CAPACITY RESERVATIONS IN FORT COLLINS CITY LIMITS ONLY

4.8.1 TIS Certification

When a TIS is submitted to the Local Entity Engineer for review, the developer will submit an application for TIS certification.

Once all Local Entity TIS review comments have been satisfactorily addressed, the Local Entity Engineer will issue a letter documenting that the TIS has been accepted and certified by the Local Entity Engineer.

A TIS must be certified by the Local Entity Engineer prior to approval of its associated development application.

4.8.2 Effect of TIS Certification

Once a TIS has been certified, its findings regarding compliance with the Level of Service standards contained in 3.6.4 of the Fort Collins Land Use Code will remain valid for the effective life of the development application unless the character of the proposed development that is the subject of the development application is significantly changed.

4.8.3 Pre-Submittal TIS Certification

A TIS may be certified prior to the submission to the City of a development application for the project. Any such independent certification shall be valid for a period of one year, within which a complete development application for the project must be received by the City, or the TIS certification shall lapse. If a complete development application for the project is received by the City the TIS certification shall be valid for the life of the development application.

4.8.4 Intersection Capacity Reservation

Once a TIS has been certified, the projected traffic volumes associated with the project must be included in the background traffic assumptions of all subsequent TIS that address intersections included in the certified TIS. The Local Entity Engineer will provide this information to the developer in the scoping meeting. A certification of a Master TIS will not reserve intersection capacity. Reserved intersection capacity may not be transferred between projects.

A. Intersection Capacity Reservation Lapse:

If a development application should lapse for whatever reason, any intersection capacity reserved by the project shall also lapse.

Attachment A
Transportation Impact Study Base Assumptions

Project Information			
Project Name			
Project Location			
TIS Assumptions			
Type of Study	Full:		Intermediate:
	MTIS:		Memo:
Study Area Boundaries	North:		South:
	East:		West:
Study Years	Short Range:		Long Range:
Future Traffic Growth Rate			
Study Intersections	1. All access drives		5.
	2.		6.
	3.		7.
	4.		8.
Time Period for Study	AM: 7:00-9:00	PM: 4:00-6:00	Sat Noon:
Trip Generation Rates			
Trip Adjustment Factors	Passby:		Captive Market:
Overall Trip Distribution	SEE ATTACHED SKETCH		
Mode Split Assumptions			
Design Vehicle Information			
Committed Roadway Improvements			
Other Traffic Studies			
Areas Requiring Special Study			

Date: _____

Traffic Engineer: _____

Local Entity Engineer: _____

Attachment B
Transportation Impact Study
Pedestrian Analysis Worksheet

		DESTINATION						
Origin (project land use)		Rec.	Res.←	Inst.	Ofc/Bus.	Com.	Ind.	Other (Specify)
	Recreation							
	1) Residential							
	Institution (school, church, civic)							
	Office/Business							
	Commercial							
	Industrial							
	Other (specify)							

INSTRUCTIONS:
Identify the pedestrian destinations within 1320' (1.5 miles for schools) of the project boundary in the spaces above. The pedestrian Level of Service for the facility/corridor linking these destinations to the project site will be based on the directness, continuity, types of street crossings, walkway surface condition, visual interest/amenity, and security of the selected route(s).

← 12 Dwelling units or more.

Attachment C
Transportation Worksheet

This form must be completed and submitted when requesting a waiver of the TIS submittal and compliance requirements. This form is not required with building permit applications for residential projects proposing twelve dwelling units or less and no substantial access changes on a collector or arterial roadway.

Project Name: _____

Date: _____

Property Legal Description (lot, block, subdivision) _____

_____

_____

_____

Developer: _____

By: _____

Title: _____

Address: _____

Phone #: _____

Fax #: _____

Email: _____

NON-RESIDENTIAL DEVELOPMENT:

Provide the following information for all non-residential projects:

A. Existing use:

1. Description of existing land use: (if none, proceed with Proposed Use) _____

   _____

   _____

2. Existing building area (square footage) for above use(s): (2)_____
3. Number of employees on site each day: (3)_____
4. Daily trip ends for employees [mult. line (3) by the number 4]: (4)_____
5. Number of customers on site each day: (5)_____
6. Daily trip ends for customers [multiply line (5) by the number 2] (6)_____
7. Number of venders on site each day (include trash, ups, etc): (7)_____
8. Daily Trip Ends for venders [mult. line (7) by the number 2]: (8)_____
9. Total Vehicular Daily Trip Ends [line (4) plus line (6) plus line (8)]: (9)_____
10. Source of trip generation data (circle one): ITE, business records, traffic engineer,

personal estimate, other: _____. **Attach documentation to support your data**.

11. Number of accesses existing onto the public street(s) from this property: _____

12. Number of pedestrians visiting the site each day: _____

13. Number of bicyclists visiting the site each day: _____

14. Do sidewalks exist along street(s) adjacent to the property? Yes___ No___

15. Are bike lanes existing (striped) along major collector or arterial street(s) adjacent to this property (on both sides of the street)? Yes___No___ NA___

16. Is the property adjacent to a major collector or arterial street as shown on the City's transportation plan? Yes___ No___

B. Proposed use:

1. Description of proposed land use: _____
_____
_____
_____

2. Proposed building area (square footage) for above use(s): (2)_____

3. Anticipate number of employees on site each day: (3)_____

4. Daily Trip Ends for employees [multiply line (3) by the number 4]: (4)_____

5. Anticipate number of customers on site each day: (5)_____

6. Daily trip ends for customers [multiply line (5) by the number 2]: (6)_____

7. Anticipate number of venders on site each day: (7)_____

8. Daily Trip Ends for venders [multiply line (7) by the number 2]: (8)_____

9. Total Daily Trip Ends [line (4) plus line (6) plus line (8)]: _____

10. Source of trip generation data (circle one): ITE, business records, traffic engineer, personal estimate, other: _____.
Attach documentation to support your data.

11. Proposed number of accesses onto the public street(s) from this property (does NOT include any existing accesses proposed to remain for use): _____

11. Number of existing accesses proposed to remain and be used: _____

13. Number of pedestrians visiting the site each day: _____

14. Number of bicyclists visiting the site each day: _____

15. Are sidewalks proposed to be installed (or exist in good condition) along the street(s) adjacent to the property? Yes___ No ___

16. Are bike lanes existing or proposed to be installed (to be striped with any required no parking signs installed) along major collector or arterial street(s) adjacent to this property (on both sides of the street)? Yes___ No___ NA___

17. Is the property adjacent to a major collector or arterial street as shown on the City's current transportation plan? Yes___ No___

If the total trip new trips, (that is the difference between the daily trip ends calculation for any existing use and the total daily trip ends calculated for the proposed use), is less than 200 and if peak hour and/or daily traffic counts demonstrate that the existing traffic plus the site generated traffic volumes are within the limits set by City Street Standards, the applicant may request a waiver of the Traffic Impact Study submittal requirements by signing below.

_____

Signature Date

Full TIS Required: _____ Intermediate TIS Required:_____ TIS Waived:

By: _____ Date:

RESIDENTIAL DEVELOPMENT:

The following residential development projects require an Intermediate or full Traffic Impact Study.

1. Any application proposing more than 20 single family detached dwelling units.

2. Any application proposing more than 24 multi-family dwelling units where dwelling units are within duplex, triplex, or four-plex structures.

3. Any application proposing more than 34 multi-family dwelling units where dwelling units are within structures containing five or more units.

4. Any application proposing a substantial access change onto a major collector or arterial roadway.

Fill out the table below and indicate in the table the number of dwelling units or access changes proposed for the type(s) of residential development included in your development. If the number of dwelling units and changes in access are less than the thresholds established above and if peak hour and/or daily traffic counts demonstrate that the existing traffic plus the site generated traffic volumes are within the limits set by City policy, the applicant may request a waiver from the TIS requirement by signing your name below.

_____

Signature Date

Full TIS Required: _____ Intermediate TIS Required:_____ TIS Waived:
By: _____ Date:

NUMBER	RESIDENTIAL DEVELOPMENT TYPE
	Single family detached/dwelling units
	Multi-family dwelling units in duplex, triplex, or four-plex structures
	Multi-family dwelling units in structures containing five or more units
	Access changes onto a collector or arterial roadway
Yes___ No___	Sidewalks exist along streets adjacent to this property, and exist offsite to provide a pedestrian connection to this property?
Yes___ No___	Bike lanes exist and are striped on the major collector or arterial street(s) adjacent to this property (on both sides of the street) and exist offsite to provide a bicycle connection to this property? The property is not adjacent to a major collector or arterial street as shown on the City's Latest Master Transportation Plan.
Yes___ No___	Sidewalks are proposed to be constructed for this use.
Yes___ No___	Bike lanes along the major collector or arterial roadways (both sides of street) are proposed to be constructed for this use.
NA	The property is not adjacent to a major collector or arterial street as shown on the City's Latest Master Transportation Plan

Attachment D
Recommended Improvements Summary

Improvement Description and Location [1]	Responsible Party		
	Applicant Committed	Background Committed [2]	Master Planned [3]
Year 20_ (Short Range)			
Year 20_ (Long Range)			

1. Describe improvement type and location (i.e. intersection or roadway widening, number of lanes needed, functional classification). Example: Widen First St from Boise Ave to Denver Ave to 2-lane arterial standards. Be certain to include any necessary offsite bicycle and pedestrian improvements.
2. The responsible party or project must be identified in this table for any improvements assigned in this column.
3. Master planned improvements committed by the City or State must be approved and fully funded at the time this table is completed.

Attachment E (Loveland city limits and GMA, and Fort Collins GMA)
Peak Hour Intersection Level of Service Summary

Intersection and Critical Movements	Existing		2006 w/o Project		2006 w/ Project		ACF
	AM	PM	AM	PM	AM	PM	Compliant?
SIGNAL CONTROL	LOS	LOS	LOS	LOS	LOS	LOS	(Yes/No)
Madison@1st Street 4-WAY	**B**	**C**	**C**	**C**	**C**	**C**	**YES**
Northbound Left	C	D	D	D	D	E	YES
Northbound Through	B	B	C	C	B	C	YES
Northbound Right	A	C	C	D	B	B	YES
Southbound Left	C	C	C	D	E	E	YES
Southbound Through	A	B	D	C	C	C	YES
Southbound Right	A	A	B	C	D	B	YES
Eastbound Left	D	D	B	D	B	D	YES
Eastbound Through	B	B	D	B	D	C	YES
Eastbound Right	A	A	C	B	C	B	YES
Westbound Left	B	C	B	D	C	D	YES
Westbound Through	B	C	D	B	B	B	YES
Westbound Right	B	B	B	B	B	B	YES
Boise@1st Street 4-WAY	**B**	**C**	**C**	**C**	**C**	**C**	**YES**
Northbound Left	C	D	D	D	D	E	YES
Northbound Through	B	B	C	C	B	C	YES
Northbound Right	A	C	C	D	B	B	YES
Southbound Left	C	C	C	D	E	E	YES
Southbound Through	A	B	D	C	C	C	YES
Southbound Right	A	A	B	C	D	B	YES
Eastbound Left	D	D	B	D	B	D	YES
Eastbound Through	B	B	D	B	D	C	YES
Eastbound Right	A	A	C	B	C	B	YES
Westbound Left	B	C	B	D	C	D	YES
Westbound Through	B	C	D	B	B	B	YES
Westbound Right	B	B	B	B	B	B	YES
Madison@7th Street 2-WAY	**B**	**C**	**C**	**C**	**C**	**C**	**YES**
Northbound Left	C	D	D	D	D	E	YES
Northbound Through	B	B	C	C	B	C	YES
Northbound Right	A	C	C	D	B	B	YES
Southbound Left	C	C	C	D	E	E	YES
Southbound Through	A	B	D	C	C	C	YES
Southbound Right	A	A	B	C	D	B	YES
Eastbound Left	D	D	B	D	B	D	YES
Eastbound Through	B	B	D	B	D	C	YES
Eastbound Right	A	A	C	B	C	B	YES
Westbound Left	B	C	B	D	C	D	YES
Westbound Through	B	C	D	B	B	B	YES
Westbound Right	B	B	B	B	B	B	YES

Stop Sign LOS Criteria
LOS A = < or =10 seconds average delay
LOS B = >10 and < or = 15 seconds
LOS C = >15 and < or = 25 seconds
LOS D = > 25 and < or = 35 seconds
LOS E = >35 and < or = 50 seconds
LOS F = more than 50 seconds average delay

CHAPTER 5 – SOILS INVESTIGATIONS

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CHAPTER 5 – SOILS INVESTIGATIONS

5.1 GENERAL

5.1.1 General Requirements

Three categories of testing and reports are required for all projects requiring right-of-way grading and paving; geotechnical report, final pavement design (refer to **Chapter 10, Pavement Design and Report**) report, and extra testing (e.g., imported fill).

A. Geotechnical Report.

This report evaluates the characteristics of the soils and the general issues of groundwater, soil stability, and swell potential. If groundwater is found within certain parameters, a subsurface water investigation is required. A geotechnical report is required for street and related improvements within the right-of-way, public easements, or slope easements. This report is required as part of the preliminary plat submittal.

B. Final Pavement Design Report.

This report is required for all projects with public roadway improvements. The soil investigation associated with this report will occur after grading for roadways and utilities is complete. This report must be submitted and approved prior to any nonstructural concrete or paving installation (refer to **Chapter 10, Pavement Design and Report**).

C. Extra Testing.

If fill material is required for the project, this material shall also be tested before placement.

D. Supervision by Engineer.

All sampling and testing of soils shall be performed under the direct supervision of a Professional Engineer who must sign and stamp the report.

5.2 SOIL TESTING FOR GEOTECHNICAL REPORT

5.2.1 Timing of Soil Borings

A. Initial Borings.

The information from the initial soil borings must be summarized in the geotechnical report. The entire site shall be sampled for initial testing. This is required because street locations may not yet be determined or may change.

B. Structures.

Soil borings for design of structures shall be taken prior to the design of the structure.

C. Imported Fill for Right-of-Way Grading.

All fill material shall be tested by the Developer and approved by the Local Entity prior to its use on the project. The material should meet minimum requirements and be equal to or better than existing conditions. No material shall be imported which has a liquid limit greater than 40 and plasticity index greater than 20 unless otherwise approved by the Local Entity.

5.2.2 Frequency of Testing

A. Basic Requirements.

A minimum of two borings shall be provided for each project. The number of borings should be dependent on project size and geotechnical Engineer's recommendations. The Local Entity Engineer may require more frequent testing.

B. Structures.

Testing frequency for structures shall satisfy **AASHTO Bridge Design** requirements and **CDOT Materials Testing** requirements.

5.2.3 Location of Samples

A. Basic Requirements.

Samples shall be taken to a minimum depth of 10 feet below the finished grades.

B. Groundwater or Bedrock.

Borings shall extend deeper if needed to determine if bedrock or high groundwater levels are design concerns. Minimum depth to bedrock shall be three feet below the finished subgrade surface.

C. Number of Samples.

Use standard care in determining the number of samples that are needed to characterize soils.

D. Structures.

Samples for structures shall be taken to a minimum depth of 10 feet below the footing elevation. Additional depth may be required for piers or piles.

5.3 SOIL GROUPING

5.3.1 General

To simplify subgrade support testing, soil samples may be combined to form soil groups consistent with the **AASHTO** classification, group index, and location for the area investigated. Groupings shall not mix samples with different **AASHTO** classifications. (For example, soils with swell potential greater than 2 percent may not be grouped).

5.3.2 Composite Samples

A. Composite Samples.

Composite samples may be obtained by mixing portions of each sample within a soil group to provide a uniform sample of the soil group. The composite samples shall be representative of the worst case subgrade soils for the project site unless separate designs are proposed for distinct soil groups and sufficient field sampling is conducted to determine the special limits of each soil unit identified. Composite samples used for Hveem, subgrade strength testing (R-values) shall not be improved in R-value strength by mixing soils with a higher sand content with material of less strength. Appropriateness of the composite sample shall be evaluated through the comparison of soil gradation and Atterberg limits and soil gradations for the site soils as compared with the subject composite sample.

Table 5-1
Required Tests

Test	Geotechnical Report	Final Pavement Design Report
Visual	X	X
Liquid Limit	X	X
Plastic Limit	X	X
Moisture	X	X
Percent Passing 200	X	X
Gradation (Granular Soils)	X	X
AASHTO Classification	X	X
Subgrade Support: R-value		X
Swell Evaluation(Preliminary Considerations)	Indicator: Low/Moderate/High For Moderate or High, Run Swell Tests	Mitigation and Detailed Analysis
Percentage of Soluble Sulfates	X	X
Standard Penetration Test	X	X
Groundwater	X	X
Bedrock Level	X	X
Corrosion Potential Resistivity	X	

B. Specific Tests for Composite Samples.

Composite samples shall be classified using the methods described in **Section 5.4.2**. Composite samples remolded in the laboratory shall not be used for swell/consolidation testing.

C. Soluble Sulfate Test.

A minimum of one soluble sulfate test shall be run on each composite sample.

5.4 TESTING

5.4.1 Required Tests

The required tests (in Table 5-1) marked with an "X" are required for the subgrade soils investigations or final pavement design testing. Refer to **Chapter 10, Pavement Design and Report** for Final Pavement Design.

5.4.2 Classification Testing

Soils shall be classified visually and tested to determine the properties listed in **Section 5.5**. Sands and gravel samples shall be analyzed for gradation where needed to comply with classification requirements.

5.4.3 Subgrade Support Testing

Individual subgrade or composite samples shall be tested for subgrade support value. The geotechnical report shall clearly state whether or not the subgrade soil is capable of supporting the proposed construction and design traffic loads. The top foot of subgrade shall have an R-value of 20 or greater. Recommendation for subgrade stabilization, if required, shall also be provided. The final pavement report shall contain specific mitigation. Refer to **Chapter 10, Pavement Design and Report**, for requirements.

5.4.4 Right-of-Way Fill Material Testing

A. Test Prior to Use.

All imported fill material shall be evaluated for swell and R-value and approved by the Local Entity Engineer prior to use in the right-of-way.

B. R-value and Plasticity Index.

All imported fill shall have an R-value and plasticity index equal to or better than the subgrade material within the right-of-way.

C. Expansion Potential.

Imported fill shall not have a liquid limit greater than 40 and plasticity index greater than 20.

5.5 GEOTECHNICAL REPORT

5.5.1 Basic Report Requirements

A geotechnical report shall be submitted with Civil Construction Plans. The report shall show results from all required testing in **Table 5-1**. The report shall also include a description of site characteristics, e.g., topography, drainage features, etc.

5.5.2 Detailed Report Requirements

In addition to the basic report requirements, each soils report shall include the following items (refer to **Chapter 10, Pavement Design and Report**, for pavement design report requirements).

A. List of Required Items

1. Site location and description
2. Laboratory test reports with evaluations (classification tests)
   a. Visual classification
   b. Liquid limit - AASHTO T89 or ASTM D4318
   c. Plastic limit - AASHTO T90 or ASTM D4318
   d. In-situ moisture content
   e. Percent passing No. 200 sieve - AASHTO T11 or ASTM C117-90
   f. Gradation of granular (sand & gravel) materials - AASHTO T27, ASTM D422 or ASTM C136
   g. AASHTO classification and group index - AASHTO M145
   h. Standard Penetrations Test
   i. Swell Evaluation
3. Boring logs
4. Soil and groundwater conditions. The expected seasonal elevation variation shall be summarized.
5. Depth to bedrock. To indicate shallow bedrock. Include mitigation requirements if bedrock is within 3 feet of subgrade.
6. Percentage of soluble sulfates.
7. Recommendations and discussions
8. Mitigation plans
9. Additional tests. These may be required for trench backfill evaluation, fill evaluation, etc.

10. Elevation of groundwater encountered in each boring

11. Engineer seal and signature. Required.

5.6 SUBSURFACE WATER INVESTIGATION

5.6.1 When a Subsurface Water Investigation Is Required

A. Criteria.

If groundwater or bedrock is encountered or predicted to be encountered within 5 feet of the original or proposed ground surface, a subsurface water investigation report shall be submitted for approval by the Local Entity Engineer. This report is required to ensure mitigation of high groundwater effects upon public improvements within the right-of-way. This information may be a separate report or may be included in the geotechnical report.

B. Requirement Waiver.

This report requirement may be waived if the Applicant and Designer certify that the street subgrade elevations will be a minimum of 3 feet above the "maximum" predicted (seasonal highest) water table. The requested waiver shall be signed and stamped by a Professional Engineer.

C. Exception for Buried Utility Construction.

This report is not required for temporary dewatering activity needed to facilitate construction of buried utilities. However, all applicable state requirements must be followed.

5.6.2 Report Requirements

The subsurface water investigation report shall include the following information.

A. List of Required Information

1. Site location and description. Include locations of any irrigation ditches and wetlands.
2. Elevation of water table, direction of flow, flow rates, groundwater barriers, and seasonal high water level.
3. Potential sources of groundwater. Include proximity to irrigation ditch systems.
4. Water rights.
5. Other relevant subsurface information such as water ownership (water rights), groundwater quality (contamination or other undesirable characteristics).
6. Potential future groundwater conditions or over-watering lawns.

7. Subsurface drainage recommendations, including its effects on all conditions, including sensitive habitat.
8. Cone of influence.
9. Control measures and designs.
    a. Subsurface Drains. If subsurface drains are recommended, the drains must have a gravity discharge without any possibility of back flow or blockage of the outlet. Any subsurface drain system shall be owned and maintained by the Developer or the Developer's assigned successor(s). These drains may discharge into the Local Entity's storm drainage system, including inlets or detention ponds, upon approval of the Local Entity Engineer. The underdrains may not drain to the gutter/flowline of public streets. Anticipated impacts to the groundwater table on adjacent properties must be quantified. The plat and construction plans shall clearly state that the City/County has no maintenance responsibility for this utility and any damage caused by said maintenance shall be repaired by the entity in charge of maintenance to pre-existing conditions or better.
    b. Drain Lines. The drain lines may be installed in the sanitary sewer trench, at an elevation of one sewer diameter lower than the sanitary sewer line, except in Loveland (city limits only). Refer to the section/subsection titled **Drainage Systems – Subdrains** in **Chapter 7** for location in Loveland (city limits only). Flexible pipe will not be accepted.
    c. Drain Line Separation from Sewer. The drain line shall be marked to specifically distinguish the drain from the sanitary sewer line.
    d. Pipe. The drain line shall be an approved material pipe, for long-term 100 years minimum design life, with appropriate cleanouts.
    e. Drain Outlet. The outlet of the drain into an inlet structure or detention pond shall be designed to prevent any possibility of backflow and blockage of the drain line.
10. Professional Engineer's seal and signature.

5.7 SOIL PROBLEM MITIGATION

Mitigation plans for soil problems revealed by the soils investigation shall be submitted to the Local Entity Engineer. The following specific factors shall be addressed:

5.7.1 Mitigation Plans and Approval

All special problems found in soils investigation (e.g., expansion, frost, soluble sulfates, shallow bedrock, heave, groundwater, soil instability, utility backfill, etc.) shall be addressed in the mitigation plans. All mitigation procedures must be approved by the Local Entity Engineer prior to their implementation.

5.7.2 Mitigation for Swell

If the swell of any subgrade soils is 2.0 percent or greater, the pavement design report must provide mitigation measures for said soils. Soil swell testing shall be conducted with soil samples that have an initial moisture content equal to or less than 4 points below optimum moisture for said material. The mitigation measures shall reduce destructive swell potential under the public improvements, including landscaping, to an acceptable level of less than 2.0 percent at 150 psf surcharge. The swell test report shall specify sample conditions, surcharge pressures, and other key testing factors.

5.7.3 Swell Mitigation Measures

Possible measures for mitigation may include the following:

A. Over-Excavation.

Over-excavation and replacement with suitable non-expansive or low-expansive material to a depth sufficient to mitigate expansion is a common mitigation method.

B. Chemical Treatment.

Chemical treatment may be used to mitigate expansive characteristics of the soil.

C. Subdrains.

Subdrains may be effective at reducing the groundwater, thereby reducing swelling. However, subdrains will be subject to all of the subsurface drain requirements in these Standards.

D. Moisture Treatments.

Condition with moisture and compact to an appropriate level of compaction for the expansive condition, including stability requirements. The geotechnical engineer shall specify the target moisture content based on laboratory testing. Moisture content of the prepared subgrade soils shall be tested within 24-hours prior to paving. If unstable paving conditions due to over moistened soils appear, the contractor shall cease paving and the geotechnical engineer shall develop other forms of mitigation.

E. Other Procedures.

Other procedures may be proposed for review and approval by the Local Entity Engineer. The chosen method must work for the full life expectancy of the improvements.

5.7.4 Mitigation of Unstable Subgrade (Examples)

A. Over-Excavation.

Over-excavation and replacement with suitable non-expansive material to a depth sufficient to stabilize the subgrade is a common mitigation method.

B. Chemical Treatment.

Chemical treatment to eliminate unstable characteristics of the soil is another common mitigation method.

C. Other Procedures.

Other procedures may be proposed for review and approval by the Local Entity Engineer.

5.7.5 Specific Mitigation Requirements

A. Extent of Mitigation.

Moisture treatment alone may not be sufficient. If soil problem mitigation is made, the soil treatment shall extend to the back of curb, or to the back of walk for attached or monolithic walk. For detached walk, separate mitigation procedures may be required.

B. Approval of Chemical Treatment.

Mitigation procedures that alter existing soil conditions (such as lime, fly ash, or cement treatment) shall follow an approved mix design process. Additional testing is required to verify that no swell is introduced in the chemical treatment.

CHAPTER 6 – PERMITS
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CHAPTER 6 – PERMITS

6.1 GENERAL

This chapter pertains only to the Loveland (GMA and city limits) and Fort Collins (GMA and city limits) with the exception of **Section 6.5.4** , **Special Transport Permit**. Work in the Larimer County GMA will follow the policies and procedures in place in Larimer County at the time of the recording of the plat.

6.1.1 Permits Required

All Contractors, public utility agencies, and property owners installing public or private improvements, or storing materials or equipment, within any public right-of-way or easement must obtain the required permit prior to the commencement of the work. The following are permits required prior to doing certain described activities in the public right-of-way:

A. Development Construction Permit (DCP)

All Public Improvement construction connected with an approved development project must follow the process outlined in **Section 6.2**.

B. Right-of-Way Permit (RWP)

All work in public right-of-way and easements must be permitted in accordance with the criteria outlined in **Section 6.3**

C. Revocable Encroachment Permit

All encroachments of Private Improvements in the right-of-way must follow the process outlined in **Section 6.4**.

D. Oversized Load Permit

All permits for oversize loads, special transports and moving buildings, houses, and mobile homes must follow the process outlined in **Section 6.5**. Additional costs to the Local Entity and other agencies (escorts, street repairs, utility adjustments, etc.) shall be the responsibility of the Applicant.

E. Hazardous Materials

All moving of hazardous materials must be permitted through the State of Colorado.

F. Blasting Permit (Approved by the Local Fire Authority)

The Contractor's blasting procedures shall conform to Federal, State, and local ordinances and shall be approved by the local fire authority. The Contractor

shall acquire all required permits prior to the start of blasting. All permits for blasting must follow the process outlined in **Section 6.6A**.

G. Stockpiling in Fort Collins (City Limits Only)

A permit is required for stockpiling fill material on vacant land in anticipation of future use of the material. Follow the process outlined in **Section 6.6C**.

H. State and Federal Permits

Land development activity and the construction of public infrastructure often require additional permits from state and federal agencies. Examples include an **Emission Permit** for fugitive dust (issued by the **Colorado Department of Public Health and Environment**), a **Discharge Permit** for storm water associated with construction activity (issued by the **Colorado Department of Health**), and a **Section 404 Permit** for impacts to wetlands or waterways (issued by the **US Army Corps of Engineers**). Applications and submittal requirements for these permits may be obtained from the City of Loveland Building Division, or directly from the issuing agency.

6.1.2 Application

Applications for the various permits, except for Blasting Permits, are available at the public counter of the Local Entity Engineer. The application form must be completed and submitted to the Local Entity Engineer along with the required items stated on the permit application. Blasting Permits can be acquired through the local Fire Authority.

6.1.3 Review and Approval of Submittals

The application will be reviewed by the Local Entity. If additional information is required, the Applicant will be contacted. The Local Entity will check to make certain that the Applicant has provided the required bond and when applicable the license and insurance certificates.

Once the permit application and all required submittals have been reviewed and found to be complete, the requested permit may be issued by the Local Entity.

6.1.4 Issuance of Permit

Requested permits that are outlined in this Chapter are issued to the Applicant after all fees have been collected. Refer to **Section 6.7** for fees.

Any modifications to approved permits including any scope or schedule changes must be submitted in writing to the Local Entity Engineer for review and approval.

The Local Entity may authorize a private entity to issue permits for all work described in this chapter.

6.1.5 Plans

Any plans required for a permit process shall clearly indicate the proposed work and its location. Refer to **Chapter 3, Information Requirements for Construction Plans** and the supplemental traffic plan submittal requirements for Loveland (city limits only) contained in **Appendix B-3**.

6.1.6 Warranty and Surety

Refer to **Chapter 24, Acceptance Procedures and Record Drawings/ Warranty**, for Warranty Period and surety to remain in place for the construction of all Public Improvements.

6.1.7 Permit Standards and Conditions

A. General Requirements

The Applicant shall be responsible for all of the following requirements which are relevant for the Project:

1. Approval of Permits. Permits are issued subject to the approval of the Local Entity, State, or other governmental agencies having either joint supervision over the section of road, or authority to regulate land use by means of zoning and/or building regulations.

2. Other Agency Approval. Permit Applicants are responsible for obtaining separate permits or permission as may be required. Examples may be when work is proposed within the state highway, railroad or irrigation company rights-of-way or private property.

3. Easements. It shall be the Applicant's responsibility to determine the necessity of any Easements and to obtain those Easements and approvals that may be required.

4. Submittals and Fees. The Applicant shall pay all required fees, provide insurance, surety (if required), and provide appropriate plans, if necessary.

5. Coordination of Utility Work. The Applicant shall be responsible for coordinating any utility work including relocation of the utilities (e.g., power poles, transformers, signals, etc.).

6. Affected Area. The Applicant is responsible for returning the areas affected by construction to equal or better condition. The Applicant is responsible for repairing any damage to private or public property or other adjacent right-of-way that occurs during construction. Refer to Chapter 25, Reconstruction and Repair, for additional detail.

7. Not Transferable. A permit may not be transferable or assignable except as designated in the Development Agreement. The Applicant may subcontract the work to be performed under a permit, provided that the Applicant remains responsible for the performance of the work identified in the

permit, the insurance and Surety, and the Warranty period. If a permit is transferred, a new construction coordination meeting may be required.

8. Supplemental Permit. No work outside the scope of the approved permit may occur without the approval of the Local Entity Engineer. It is the Applicant's responsibility to notify the Local Entity of the issues and apply for a supplemental permit for the additional work.

9. Time for Approval and Issuance. The Local Entity may require up to 10 working days for approval of a permit after receipt of the complete application package.

10. Public Display. All required permits and approved plans must be available on the job site at all times during construction and placement of traffic control devices.

11. Erosion Control Inspector. The Local Entity erosion control inspector must be notified at least 48 hours prior to any planned construction. Refer to **Chapter 23, Street Inspection and Testing Procedures,** for additional detail.

12. No Reimbursement of Fees. In general, once a permit is approved and fees are collected, no permit fee will be reimbursed, even if the permit has expired before construction takes place.

B. Requirements to Preserve Quality of Streets and Traffic Flow

1. Traffic Control Plans. A Traffic Control Plan (TCP) shall be submitted prior to or submitted with the permit application for all proposed work for approval by the Local Entity. In Loveland (city limits only), work in/on residential streets may not need a separate TCP but all signs, barricades and other necessary traffic control devices shall be placed in accordance with the **MUTCD, Part 6**.

   All work described above shall be performed by a Traffic Control Supervisor and a certificate for the Traffic Control Supervisor shall be submitted with the TCP. The TCP shall detail all devices, hours of work, days, dimensions of tapers and barricades, work area, etc. The TCP shall provide a device summary on the sheet.

   The Local Entity may require the Developer to notify the local newspaper and/or the impacted residents, depending on the size and type of project, a minimum of 48 hours prior to the commencement of work.

2. Traffic Flow During Peak Hours. No interference with traffic flow on Arterial or Collector streets shall be permitted during the hours of 7:00 a.m. to 8:30 a.m. or from 4:30 p.m. to 5:30 p.m. unless otherwise authorized in writing by the Local Entity Engineer.

3. Barricades, Warning Lights, and Signal Lights. Any person performing work in the public right-of-way shall place barricades, warning lights, and

any other safety devices at the location, sufficient to warn the public of the hazard and which are in compliance with the MUTCD. The Contractor shall be responsible for the maintenance of all barricades at all times.

On all Collector and Arterial Roadways (and some local streets, as determined by the Local Entity Engineer,) there shall be an individual responsible for the Traffic Control and able to be contacted 24 hours a day. This individual shall be certified as a Traffic Control Supervisor (TCS), by the American Traffic Safety Services Association (ATSSA) and/or Colorado Contractors Association (CCA).

4. Protection of Existing Improvements. Ensure protection as follows:

   a. Existing Installations. The Contractor shall at all times take proper precautions and be responsible for the protection of existing street and alley surfaces, driveway culverts, street intersection culverts or aprons, irrigation systems, mail boxes, driveway approaches, curb, gutter, and sidewalks, and all other identifiable installations that may be encountered during construction.

   b. Utilities. The Contractor shall at all times take proper precautions for the protection of existing utilities, the presence of which are known or can be determined by field locations of the utility companies. The Contractor shall contact Colorado 811 (UNCC) - for utility locates a minimum of 2 working days prior to his proposed start of work.

   c. Existing Improvements. Existing improvements to adjacent property such as landscaping, fencing, utility services, signs, driveway surfaces, etc. that are not authorized for removal, shall be protected from injury or damage resulting from the Contractor's operations.

   d. Survey Markers. The Contractor shall at all times take proper precautions for the protection of property pins/corners and survey control monuments encountered during construction. Any damaged or disturbed survey markers shall be replaced by a registered land surveyor at the Contractor's expense.

   e. Responsibility for Repair. The repair of any damaged improvements as described above shall be the responsibility of the permit holder.

   f. Minimizing Inconvenience. The Contractor shall abide by the requirements set forth by the permit to minimize inconvenience to traffic and any inconvenience to adjacent property owners.

5. Permanent Pavement Patches. All permanent pavement patches and repairs shall be made with "in-kind" materials. For example, concrete patches in concrete surfaces, full depth asphalt patches with full depth asphalt, concrete pavement with asphalt overlay patches will be expected in permanent "overlaid" concrete streets, etc. In no case is there to be an asphalt patch in concrete streets or concrete patch in asphalt streets. Any

repair not meeting these requirements will be removed and replaced by the Contractor at their expense.

6. Pavement Less than 5 Years Old. In streets that are less than five (5) years old the Local Entity reserves the right to deny any street excavation or require repairs that are over and above these specifications.

7. Work to be Done in Expedient Manner. All work shall be done in an expedient manner. Repairs shall be made as rapidly as is consistent with high quality workmanship and materials. Use of fast setting concrete and similar techniques may be required and are encouraged whenever possible without sacrificing the quality of repair.

   Completion of the work including replacement of pavement and cleanup shall be accomplished immediately after the repair work or activity involving the cut is done. Extension of time for completion shall be with the written approval of the Local Entity Engineer. If the repairs are not completed in the allotted time, the Local Entity has the right to repair the street and bill the full cost of work and administrative expenses to the Contractor. The Local Entities require a reasonable continuous, diligent effort from the Contractor to complete work and daily cleanup.

8. Inspection Requests. It shall be the responsibility of the person performing the work authorized by the permit to notify the Local Entity Engineer or their authorized representatives that such work is ready for inspection. The Local Entity Engineer requires that every request for inspection be received at least 24 hours before such inspection is desired. Such requests may be in writing or by telephoning or emailing the Local Entity Engineer. Refer to **Chapter 23, Street Inspection and Testing Procedures,** for additional discussion regarding inspections.

9. Removal and Replacement of Unsatisfactory Work. Removal and replacement of unsatisfactory work shall be completed within 15 days of written notification of the deficiency unless deemed an emergency by the Local Entity Engineer requiring immediate action. If deemed an emergency for health/safety reasons, the contractor must complete the work immediately. In the event the replacement work has not been completed within the allotted time, the Local Entity will take action against the Contractor's bond to cover all related costs.

10. Road Closures. Road closures will only be allowed with the written approval of the Local Entity Engineer. Proper posting and public notification will be required 7 days in advance of any closure. Forms of notification may include door hangers, variable message signs and press releases.

6.1.8 Stop Work Orders

Any person, corporation, quasi-governmental agency, special district, public utility, or private utility company that has performed work without first having obtained a required permit, has performed work in the right-of-way that is considered a safety hazard or has non-conforming items that have not been addressed will be issued a notice to stop work. All specified work shall be discontinued until such time that the appropriate repair or permits are in place. The Local Entity Engineer or Inspector is authorized to issue Stop Work Orders. The Stop Work Order shall contain a written statement of the violations that caused the issuance. Immediately upon receipt of a Stop Work Order, the Applicant shall consult with the Local Entity Engineer to resolve the violations. See **Appendix E-5** for sample document.

A. Stop Work Fines

Any Applicant who does not immediately discontinue work upon issuance of a Stop Work Order shall be subject to fines. The Applicant may be fined in accordance with Local Entity code requirements.

B. Mitigation Expenses for Unsafe or Untimely Performance

In cases where the Local Entity deems it necessary to effect a remedial action or repair to mitigate any dangerous or unsafe circumstances, due to emergencies or untimely performance by the Applicant, the Local Entity may bill the Developer for all of its costs. Untimely performance occurs when the contractor has not performed the remedy within 24 hours of notification. Emergency repairs are expected to be implemented immediately.

1. Costs for Repairs. Mitigation repair costs shall include, but not be limited to the following:
    a. Administrative charge.
    b. All labor costs (at Local Entity rates).
    c. All material costs.
    d. All equipment costs.
2. Stoppage of Work. Once a Stop Work Order has been issued, no specified work may continue under the permit and no subsequent permits will be issued until the Local Entity receives full payment for permit and/or poor workmanship or safety issues have been resolved.

6.1.9 Insurance Requirements

The insurance requirements in this Section 6.1.9 are intended to protect the public, as well as the Contractor who is providing any construction services in the public right-of-way.

A. Listing of Specific Requirements

The Developer is responsible to provide insurance prior to any work:

1. The Applicant and/or the Contractor shall present proof of carrying a liability and property damage insurance policy or policies known as Commercial General Liability, for the period of time required for complete installation of facilities authorized by the permit, including the repair and restoration of the road facilities, and also, during such future periods of time when operations are performed involving the repair, relocation or removal of said facilities authorized by the permit. Coverage shall be provided against any claim, demand, suit, or action for the property damage, personal injury, or death resulting from any activities of the applicant, his officers, employees, agents or contractors in connection with the construction, installation, repair or removal of the said facilities authorized by the permit.

2. The policy shall include as named insured: The Local Entity, Local Entity Authority, its officers, agents and employees, except as to claims against the applicant, for personal injury to any members of the Council, its officers, agents and employees, or damage to any of its or their property. The said insurance shall provide coverage of property damage insurance, public liability insurance, and bodily injury insurance in the amount of not less than $1,000,000 each, or such other maximum amount as may be specified in the Colorado Governmental Immunity Act, and protecting the Local Entity against any and all claims for damages to persons or property resulting from construction and/or installation of any required improvements pursuant to the permit.

3. The policy will provide that the Local Entity shall be notified at least 30 days in advance of any reduction in coverage, termination or cancellation of the policies. Such notice shall be sent to the Local Entity Engineer by certified mail, return receipt requested.

4. The Applicant shall also obtain and keep in force during the duration of all work covered under the permit a policy of Automobile Liability insurance with similar terms as mentioned above. This policy shall insure the Applicant against any liability for personal injury, bodily injury or death arising from the use of motor vehicles and shall cover operations on or off the site of all motor vehicles controlled by the Applicant.

6.1.10 Licensing in Fort Collins and Loveland (City Limits Only)

The City of Fort Collins and the City of Loveland require Contractor's licenses, bonding, and insurance prior to the issuance of permits. Please refer to the Local Entity for further information in addition to the following:

A. Contractor's License

A right-of-way Contractor's license shall be required to perform work in the public right-of-way. Additionally, any person wishing to perform work in one

of the following categories shall first qualify for and obtain an endorsement on their right-of-way Contractor's license to perform such work.

1. Categories Requiring Endorsement. The categories are as follows:
   a. Asphalt.
   b. Utility.
   c. Non-Structural Concrete.
   d. Structural Concrete.
   e. Exception: A homeowner is not required to obtain a license to install their own sidewalk adjacent to their property.

B. Bonding

The right-of-way Contractor's license shall be accompanied by a license and permit bond in the amount of $20,000. Each endorsement shall be accompanied by a separate license and permit bond in the amount of $10,000. The bond shall be conditioned upon compliance with all provisions of the permit for all work in the public right-of-way and the ordinances of the Local Entity. All bonds shall be continuous with a minimum cancellation notice of 60 days.

In the event the bond is canceled, the license will be immediately revoked and no further work will be allowed to occur. However, the bond must remain effective through the warranty period associated with all previously completed work items. The bond is used as the Local Entity's insurance in case the Contractor is unwilling or unable to repair problems found during the Warranty Period or during construction. The Local Entity can choose to complete the repairs either through its own resources or by hiring a different construction firm.

C. Insurance

Any license application shall be accompanied by an original certificate of commercial general liability insurance insuring the contractor according to **Section 6.1.10**.

6.2 DEVELOPMENT CONSTRUCTION PERMIT

6.2.1 Application

A Development Construction Permit (DCP) shall be required prior to any construction or installation of new public infrastructure or new Private Improvements within the public right-of-way as shown on a set of Civil Construction Plans reviewed and signed by the Local Entity Engineer. The DCP is required to coordinate the transition from completion of the development review process to the construction process. This permit will be issued after all project plans and documents noted in the standards are finalized and approved.

In Loveland (City Limits Only), the DCP may be waived by the Local Entity Engineer if the public improvements do not include a lane widening or construction of a new lane of travel and when the monetary value of the public improvements is minor relative to the total project cost.

In the City of Fort Collins (City Limits Only), the permit type required for new public infrastructure will be determined during the development review process.

No work is allowed to occur within the right-of-way until the Developer obtains an approved DCP. If work commences in the right-of-way without a permit, a Stop Work Order will be issued. Refer to **Section 6.1.8** for Stop Work Order procedures.

For projects within the Development Review process, the permit application and approval process are part of the review process. For projects where the development review and approval process are complete.

6.2.2 Submittals

A complete application for the DCP includes the following:

1. 8-1/2 x 11 inch copy of the approved site plan.
2. Copy of approved Civil Construction Plans
3. Proposed project schedule.
4. Public Improvements Opinion of Cost - Project quantities and cost estimate for all Public Improvements to be constructed, as well as all Private Improvements that are required to be inspected by the Local Entity. These quantities and costs are to be submitted, signed and stamped by a Professional Engineer in an electronic spreadsheet format as required by the Local Entity.
5. Permit fee.
6. Additional items may be required and marked on the application by the Local Entity Engineer.
7. Application completed and signed by the Developer.

6.2.3 Construction Coordination Meeting.

If required by the Local Entity, a construction coordination meeting will be held by the Local Entity staff to meet the involved parties, to review the plans and schedule, to exchange information about the project, to help establish communication lines and discuss key issues about the project. This is not a construction meeting to solve problems or discuss details of the project. Separate preconstruction meetings for utilities, if needed, are the responsibility of the Developer to coordinate. See Section 6.1.1.A for list of meeting attendees.

A. Scheduling

All Construction Coordination Meetings will be scheduled by the Local Entity.

B. Items Required Prior to the Meeting

The review is based on the receipt of the following items, which must be completed and/or received by the Local Entity Engineer a minimum of one week and a day prior to the anticipated meeting date (8 calendar days). For the items required prior to DCP meeting, contact the Local Entity Engineer for forms and requirements.

6.2.4 Issuance of Permit.

Upon completion of the application process and construction coordination meeting outlined above, the following must be completed and submitted to the Local Entity before the DCP is issued:

1. Construction Traffic Control Plan submitted and approved. See **Section 6.3.3 A**.
2. Revised schedule updated to reflect results of construction coordination meeting.
3. Performance surety received.
4. Liability and property damage insurance policy on file except in Fort Collins (city limits only).
5. Applicable construction inspection fee paid. See discussion of inspection fees at the end of **Chapter 23, Street Inspection and Testing Procedures**.
6. In Fort Collins (city limits only), erosion control deposit paid.
7. Additional requirements of the DCP
8. Applicant's signature on the DCP.

6.2.5 Expiration and Extension

A. Commence within 60 Days

The DCP shall be void if work does not commence within 60 days from the date of issuance of the DCP. The Applicant will forfeit the DCP fee and must re-apply for a new DCP. However, the Applicant may apply for a DCP extension or renewal prior to expiration.

B. Renewal of Permit

If the public infrastructure is not completed within one year from the date of issuance of the Development Construction Permit (DCP), an extension of the

permit of up to 90 days must be applied for at least 2 weeks prior to expiration of the permit.

C. New Permit after Expiration

If the DCP expires and infrastructure improvements remain incomplete, construction work must stop and a new application for the DCP must be submitted. The new DCP is subject to all submittal requirements and fees.

6.2.6 Performance and Warranty Surety Requirements

Newly constructed streets and related Public Improvement infrastructure shall carry a performance guarantee and a repair and maintenance guarantee covering design and construction defects. The performance guarantee period shall commence with the construction of the Public Improvements and the repair and maintenance (i.e. warranty) guarantee period shall commence after completion and initial acceptance of the work. Refer to **Chapter 24, Acceptance Procedures and Record Drawings/Warranty**, for further information.

A. General Requirement for Surety

All Applicants shall provide surety in the form of a bond, letter of credit, or other forms of cash or escrowed funds in the amount of 100 percent of the estimate of costs for Public Improvements. In Loveland (city limits only), the required surety is 15 percent of the estimated Public Improvements costs.

B. Possible Waiver for Other Entities

Other municipalities, quasi-governmental agencies, special districts, electric, gas, and communication utilities may not be required to provide a surety as outlined in an approved agreement.

C. Reduction of Surety

As the project progresses, the Applicant may request from the Local Entity a reduction of the surety based on the level of completion of the project. In Fort Collins (city limits only), surety shall not be reduced to less than 25% of the full amount. In Loveland (city limits only), reductions in surety are not considered until completion of the warranty period.

1. Points at Which Surety Reduction May Be Requested. The Local Entity will accept written requests to reduce the project sureties at key milestones in the construction process.
    a. At completion of buried utilities.
    b. Preliminary street improvements are completed.
    c. Final street improvements are installed.

d. Other key points in the construction process, as approved by the Local Entity Engineer.

These requests may be limited to the substantial completion of key improvements as determined by the Local Entity's Inspectors. However, at no time, prior to final acceptance shall the surety be reduced to less than 15 percent of the total value of the Public Improvements.

2. Warranty Surety. The Warranty Surety shall be 15 percent for all projects, unless otherwise approved by the Local Entity Engineer. In Fort Collins (city limits only) the amount of surety shall be based on the potential cost of repairs and shall not exceed 25 percent of the total cost of the Public Improvements. (See City of Fort Collins codes for specific details).

3. Reduction Request Process. The Applicant must submit a request in writing to the Local Entity Engineer providing documentation as to the status of the improvements to be reviewed and a request to release monies for the completion of this work.

4. Release for Surety. See **Chapter 24, Acceptance/Warranty Procedures and Record Drawings**.

6.3 RIGHT-OF-WAY PERMIT

6.3.1 Uses for Right-of-Way Permit

A Right-of-Way Permit is required prior to beginning any repair or modification of existing public infrastructure or Private Improvements within the public right-of-way. It is also used to authorize the construction of minor Public or Private Improvements that do not require the review and approval of Civil Construction Plans, but are instead shown on an approved site plan. The Right-of-Way Permit also applies to three additional types of work:

A. Storage of Materials and Equipment in the right-of-way

A Right-of-Way Permit shall be required for the storage of materials and equipment within the public right-of-way adjacent to a work site. This also includes borrow pits and fill material stockpiles.

B. Excavation in right-of-way

A Right-of-Way Permit shall be required for all excavation performed within the public right-of-way.

C. Access to Public Streets

A Right-of-Way Permit and a CDOT access permit (if applicable) shall be required for construction or modification of all private or public accesses into the public right-of-way, except where such construction or modification is authorized with a Development Construction Permit.

6.3.2 Application

The permit application and information is available on the Local Entity website.

6.3.3 Submittal Requirements

A. Plans

Plans that clearly show the proposed work must be included with the permit application. The plans must be drawn to a proper scale to show the location and position of the proposed work, including street right-of-way (features, names, dimensions and property lines), existing utilities, topographic and man-made features, existing drainage patterns and any other information needed to clearly present the proposed work. Any plans that propose changes in the original design, other than constructing improvements in accordance with standard construction drawings, are required to be prepared by a Professional Engineer and conform to the requirements of Chapter 3 of these Standards

B. Work Area Traffic Control Plan

A work area traffic control plan shall be submitted with application for work within, or any access to, a public right-of-way.

The traffic control plan shall be a minimum of 8-1/2 x 11 inches. The plan shall detail the work zone location, dimensions and the traffic control devices (including dimensions of tapers, closure area, etc.) proposed as well as construction traffic routing requirements. The traffic control plan may require additional detail at the discretion of the Local Entity Engineer due to unique or unusual conditions.

C. Proposed Project Schedule

A time schedule stating the desired time when the work will commence, be performed, and be completed shall be submitted.

D. Project Quantities and Estimates

An estimate of quantities and costs for all Public Improvements as well as Private Improvements that are required to be inspected by the Local Entity in accordance with **Chapter 20, Public Improvements Cost Estimate** shall be submitted. These costs are used in the determination of permit fees.

E. Certificates of Insurance

Certificates of Insurance for commercial general liability and automobile liability shall be submitted. Refer to **Section 6.1.9** , concerning insurance requirements.

F. Hours of Construction

The standard hours of inspection are 7 a.m. to 6 p.m. Construction work hours will be limited on the permit. Refer to **Section 6.1.7 B.2**.

G. General Conditions

The construction shall be done in accordance with these Standards and the General Notes in **Appendix E-1**.

6.3.4 Approval and Expiration

A minimum of 5 working days is required for the Local Entity Engineer's approval. The permit expires 30 days from date of approval unless otherwise stated on the permit.

6.4 REVOCABLE ENCROACHMENT PERMIT

A revocable encroachment permit shall be required where any portion of street, alley, sidewalk, or other public right-of-way is occupied in connection with erection, construction, remodeling, or demolition of any building or improvement. Erection of any fence, barrier, post, or other obstructions or encroachments with any street, alley, sidewalk, or public right-of-way within the Local Entity shall require a revocable encroachment permit as well. Contact Local Entity for the revocable encroachment permit application and specific requirements.

6.5 OVERSIZED LOAD PERMIT

6.5.1 Moving Over-Length, Over-Sized, Over-Weight Vehicles

A permit is required for the movement of all over-length, over-sized and/or over-weight vehicles. Refer to Local Entity for permit requirements.

A. Long Combination Vehicles

Long Combination Vehicles (LCVs) may be authorized on an annual basis over specific routes and hours in accordance with the Model Traffic Code.

B. Oversized Load Permit

An Oversized Load Permit shall be required for oversized loads in accordance with the Model Traffic Code. Oversized load permits shall require submittal to and approval from all effected utility and railroad companies prior to approval by the Local Entity. Approval from CDOT will be required for all oversized loads travelling on or crossing a state highway. Any required utility or other infrastructure relocations shall be done in accordance with the effected utility or infrastructure owner's policies and procedures, including payment of all required fees.

C. Approval and Expiration

A minimum of 5 working days is required for the Local Entity Engineer's approval. A Long Combination Vehicle approval expires at the end of the calendar year. An Oversized Load Permit expires when the load has been moved. Additional Oversized Loads will require additional permits be secured.

D. Proof of Insurance

Proof of insurance in the following amounts must be submitted:

1. $1 million General Liability insurance.
2. $1 million Auto Liability insurance.

6.5.2 Moving Buildings, Houses, and Mobile Homes

A permit is required for the movement of all buildings, houses, or mobile homes on public streets.

A. Notification

All house moving permits shall require submittal to and approval from all effected utility and railroad companies prior to approval by the local entity. Approval from CDOT will be required for all oversized loads travelling on or crossing a state highway. Any required utility or other infrastructure relocations shall be done in accordance with the effected utility or infrastructure owner's policies and procedures, including payment of all required fees. Once the permit has been obtained, all effected utility and infrastructure owners, as well as the Local Entity Forester and law enforcement, shall be notified a minimum of 72 working hours prior to moving of the structure or mobile home. Applicant shall also be required to obtain appropriate building permits on both ends of the move in accordance with the Local Entity's requirements.

B. Expiration, Renewal

The permit may be issued for no more than 90 days and may be renewed for 90-day periods with written application and payment of fees. Permits are issued for a single move, which can contain multiple structures.

C. Proof of Insurance

Proof of insurance in the following amounts must be submitted:

1. $1 million General Liability insurance.
2. $1 million Auto Liability insurance.

6.5.3 Hazardous Materials

All moving of hazardous materials must be permitted by the State and/or Local Entity fire authority. The Oversized Load permit is not valid for vehicles transporting hazardous materials.

6.5.4 Special Transport Permit, Larimer County

Submittal requirements for obtaining a special transport permit are as follows:

A. Proof of Insurance

Proof of insurance in the following amounts must be submitted to and approved by Larimer County Risk Management before the Special Transport Permit will be issued.

1. $1 million General Liability insurance.
2. $1 million Auto Liability insurance.
3. Larimer County shown as "Additional Insured" on both.

B. Routing Map

The routing map must be submitted, checked for bridge weight restrictions, overhead utilities, and other obstructions, and approved before the permit will be issued.

C. Axle Configuration

The proposed axle configuration will also be checked against the listed items for the routing map, particularly for any bridge weight restriction.

D. Utility Notification

The Applicant will be required to notify any affected utility companies on the proposed route.

6.6 OTHER PERMITS

A. Blasting Permit

1. General. The Contractor's blasting procedures shall conform to Federal, State, and local ordinances. The local Fire Authority issues the blasting permit. In addition, the Contractor shall acquire all required permits prior to the start of blasting.
2. Storage of Explosives. The Contractor shall use the utmost care to protect life and property. All explosives shall be safely and securely stored in compliance with local laws and ordinances, and all storage places shall be clearly marked "Dangerous Explosives." No explosives shall be left unprotected where they could endanger life or property.

3. Safety Precautions. When blasting in trenches, the Contractor shall cover the area to be shot with earth backfill or approved blasting mats. Prior to blasting, the Contractor shall station flaggers and provide signal of danger in suitable places to warn people and stop vehicles. The Contractor shall be responsible for all damage to property and injury to persons resulting from blasting or accidental explosions that may occur in connection with the use of explosives.

B. Stockpiling Permit

1. General. A permit is required for stockpiling fill material on vacant land in anticipation of future use of the material. Refer to the Local Entity for permit application and requirements.

6.7 FEES

Fees are established separately by each Local Entity. Applicants should refer to the applicable Local Entity requirements for the current fees.

CHAPTER 7 – STREET DESIGN AND TECHNICAL CRITERIA
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CHAPTER 7 – STREET DESIGN AND TECHNICAL CRITERIA

7.1 GENERAL

This chapter defines layout criteria and other design criteria that shall be followed for locating and designing all streets. The chapter provides the following information:

- How streets are to be located (layout criteria);
- Street classifications and purposes; and
- Minimum design criteria that must be met.

7.1.1 Conforming to Standards and Master Plans

The Project's street design and layout shall conform to these Standards and with the Local Entity's Transportation Master Plan (TMP) and other applicable plan documents such as Master Plans, Corridor Plans, Area Plans, codes and standards adopted by the Local Entity.

7.1.2 Construction Drawings Relating to Chapter 7

Appendix A includes Construction Drawings that are a part of these Standards. Note that "F" and "L" denote Fort Collins or Loveland on drawings that are specific to just one Entity and its related Growth Management Area. Please refer to the Construction Drawing List at the beginning of **Appendix A**.

7.2 STREET LAYOUT REQUIREMENTS

The locations of Major streets shall be in accordance with the TMP. Other streets shall be located in accordance with all other applicable street layout requirements.

7.2.1 Logical Placement and Extension

All streets shall have a logical relationship to the existing topography and to the location of existing or platted streets within adjacent properties. Certain streets within the Project may need to be extended to the Project boundary to provide for the future logical extension of the street through adjacent properties. Signs shall be placed at the end of roads planned for future road extensions (see Drawing 1412L).

In the City of Fort Collins, street layout shall conform to the Connectivity and Block Size Standards in the *City of Fort Collins Land Use Code*.

To ensure connectivity, enhance general circulation and to provide secondary points for access, the street layout for all subdivisions should include the following connecting street spacing:

A. Fort Collins (city limits only)

At least one connecting street to neighboring vacant land for every 660 feet in Fort Collins (city limits only).

B. All Other Urban Areas

At least one connecting street to neighboring vacant land for every 1320 feet in all other areas.

7.2.2 Master Planned Arterial and Major Collector Streets

The TMP for each Local Entity shows the approximate locations of all Arterial streets and some Collector streets for the Local Entity and its Growth Management Area (GMA). The TMP shall be used for establishing approximate locations of Major streets. The Local Entity Engineer shall hold approval authority for specific locations for all Arterial and Collector streets.

A. Transportation Master Plan (TMP) Documents

The relevant TMP documents for each Local Entity are as follows:

1. City of Fort Collins current Master Street Plan.
2. City of Loveland current Transportation Plan
3. Larimer County Transportation Plan.

B. Larimer County will use each Local Entity's current Master Street Plan to identify a road's classification and determine a road's right-of-way and typical sections within their respective Growth Management Areas. However, Larimer County reserves the right to use the classification shown on the Larimer County Road Functional Classification Map.

C. New Streets

New Arterial streets are unlimited in continuity. The maximum permitted length between 90 degree turns and sign-controlled or roundabout intersections is 2 miles on Major Collector streets.

7.2.3 Local and Minor Collector Streets

Layout of new Local streets and Collector streets not covered by the Local Entity's TMP shall meet the needs of the specific development and satisfy all other specific requirements of this chapter. The Local Entity retains the authority to designate Collector streets and to approve the overall street layout.

A. Neighborhood Traffic Safety and Traffic Calming

A major component in street layout is neighborhood traffic safety. This is an essential transportation issue in the Larimer County urban areas. Traffic calming is the implementation of physical and perceptual techniques intended to slow or divert traffic on existing or planned roadways. It is often a reactive approach to minimize high speeds and volumes of vehicular traffic. Significant efforts in traffic calming have been put forward on existing Roadways and in the development of new Roadways to limit traffic speeds and traffic volumes in neighborhoods and to provide for safer travel for all modes of transportation including pedestrian, bicycle, and vehicular. In addition, new streets shall be laid out to minimize opportunities for cut-through traffic. See **Chapter 18, Neighborhood Traffic Safety**.

B. Roadway Use

The necessity or desire for traffic safety and calming stems from the perception that at times Local roadways, particularly in residential areas, do not function as they are intended. Local Roadways are intended as a low volume roadways used for direct access to residences fronting on the street and as a multi-modal system that is shared by vehicular, bicycle, and pedestrian traffic equally in a manner that minimally impact residents who reside in these areas.

C. Commercial

Commercial Local streets have less multi-modal conflicts and are permitted to have longer continuity and less restrictive traffic calming requirements.

D. Maximum Length

New Minor Collectors and Local streets are limited in continuity. The maximum permitted length between 90 degree turns and controlled intersections is 660 feet on local streets. The maximum continuous length for a Minor Collector is 2640 feet.

7.3 STREET CLASSIFICATIONS

All streets are classified as Arterial, Collector, Local streets, Lanes, or Alleys. These classifications relate to the function of the streets. Lower order streets function primarily as access to individual lots, and higher order streets function primarily for the purpose of mobility (expeditious movement of people and goods). Each Local Entity has adopted an expanded classifications system that is to be used within their respective jurisdictions.

Each classification used must conform with the Local Entity TMP, when applicable, and meet all of the criteria for the specific classification. The primary test for the new streets not shown on the Local Entity's TMP shall be the anticipated traffic volumes for the desired classification (refer to **Chapter 4, Transportation Impact Study,** for traffic study requirements).

7.3.1 Street Classifications for Each Local Entity

A. City of Fort Collins Classifications

Figures 7-1F through **7-13F**, located at the end of this chapter, show street classifications and specific requirements for Fort Collins (city limits and GMA). provides a summary of the classification requirements. In Fort Collins (city limits and GMA), variations of these classifications may be approved with the adoption of subarea plans and other specific plans of the Local Entity. Classifications and related figure numbers are as follows:

Figure No.	Street Classification
Figure 7-1F	6-Lane Arterial Street
Figure 7-2F	4-Lane Arterial Street
Figure 7-3F	2-Lane Arterial Street
Figure 7-4F	Major Collector Street
Figure 7-5F	Minor Collector Street
Figure 7-6F	Commercial Local Street
Figure 7-7F	Industrial Local Street
Figure 7-8F	Connector Local Street

Figure 7-9F	Residential Local Street
Figure 7-11F	Alley (A) (Drainage to Center)
Figure 7-12F	Alley (B) (Drainage to One Side)
Figure 7-13F	Rural Residential Local Street

B. City of Loveland Classifications

Figures 7-1L through **7-11L**, located at the end of this chapter, show street classifications and specific requirements for Loveland (GMA and city limits). **Table 7-2** provides a summary of the classification requirements. Classifications and related figure numbers are as follows:

Figure No.	Street Classification
Figure 7-1L	6-Lane Arterial Street
Figure 7-2L	4-Lane Arterial Street
Figure 7-3L	2-Lane Arterial Street
Figure 7-4L	Major Collector Street/Commercial Collector Street
Figure 7-5L	Minor Collector Street
Figure 7-6L	Commercial/Industrial Local Street
Figure 7-7L	Residential Local Street
Figure 7-8L	Lane
Figure 7-9L	Alley (A) (Drainage to Center)
Figure 7-10L	Alley (B) (Drainage to One Side)
Figure 7-11L	Rural Road

7.4 GENERAL DESIGN ELEMENTS

All streets shall be designed in accordance with design speeds specified for each street classification in the above-referenced figures and **Table 7-3** or **Table 7-4**.

7.4.1 Alignment

Horizontal and vertical street alignments should conform to existing land layout plus the following criteria:

A. Horizontal Alignment

On Arterial and Major Collector roadways, curve radii and tangents shall be as large as possible using the minimums only where necessary. However, minimum radius curves shall be used on Local Residential, Minor Collector, and Connector Local streets unless otherwise required. Angle point direction changes are not allowed. All changes in direction shall be made using standard curves.

1. Horizontal Curve Radii. The minimum allowable centerline radii for horizontal curves shall be as designated in **Table 7-3** or **Table 7-4**. Reverse and compound curves should be used only when a single radius curve will not work. For driver safety, compound curves shall have a ratio no greater than 1.5 where the value of the larger radius is divided by the smaller radius.
2. Minimum Tangent Length
   a. Intersection. Whenever a street intersects a street of higher or equal classification, a tangent length (as measured in a straight line from the nearest gutter flowline of the intersected street to the point on the centerline of the

intersecting street) shall be provided for safe sight distance and safe traffic operation. The minimum required tangent lengths indicated in **Table 7-3** and **Table 7-4** apply to the, the leg(s) for which the crown is not carried through the intersection. The angle of departure shall not exceed 10 degrees for the length of tangent. Alternatively, in constrained re-development areas, with approval of the local entity engineer, all or a portion of the minimum tangent length may be measured within a curve so long as the there is no more than a 10-degree departure from the point where the curve centerline intersects the gutter flowline of the intersected street.

b. Reverse Curves. The tangent between reverse curves shall be no less than the length shown in **Table 7-3** and **Table 7-4**.

Table 7-1
Fort Collins (GMA and City Limits)Street Standards - General Parameters

Street Classification:	6-Lane Arterial	4-lane Arterial	Modified 4-lane Arterial *n	2-lane Arterial	Major Collector (without parking)	Minor Collector (with parking)	Commercial Local	Industrial Local	Connector Local	Residential Local	Alley *a	Rural Residential Local
Right-of-Way (ROW) Width	141'	115'	102'	84'	69'	81'	77'	71'	63'	57' *m	12'- 20'	46'
Roadway Width	107'	83'	74'	52'	42'	54'	50'	44'	36'	30'	12'-20'	28'
Median Width	19'&7' *b	19'&7' *b	Optional *c	None	Optional *c	Optional *c	Optional *c	Optional *c	Optional *c	None	None	Optional *c
No. of Travel Lanes	6	4	4	2	2	2	2	2	2	1	1	2
Travel Lane Width *p	11'-12'	11'-12'	11'	11'	11'-12' *d	11'	10'	11'12'	10'	16'	12'-20'	0
Designated Bike Lanes?	Y	Y	Y	Y	Y	Y	Y	N *e	N *e	N *e	N *e	N *e
Bike Lane - width (P)rotected, (B)uffered	7' P	6' B	6.5' *o B	7' B	7' B	5' w/parking 6' w/lt turn' B	7' or 8' *h B	0'	0' or 6' *f B	0' *i	0'	0'
Parking Lane Width	None	None	None	None	None	8' or None *j	7' or None *j	10'	8' or None *j	7'	None	Not Defined
Lane Striping Req'd (T)ravel, (B)ike, (P)arking	T,B	T,B	T,B	T,B	T,B	T,B,P	T,B/P or T,B	None	T,P or None	None	None	None
Min. Parkway Width	10'	10'	8'	10'	8'	8'	8'	8'	8'	8' *m	NA	9'
Min. Sidewalk width * k	7'	6'	6'	6'	5'	5'	5'	5'	5'	5'	None	None
Left Turn Lanes Req'd?	Y	Y	Y	Y	N or Y *d	N or Y *j	N or Y *j	N	N or Y *j	N	NA	N
Left Turn Lane Width	12'	12'	11'	11'	0' or 12'	0' or 12'	0' or 12'	0'	0' or 10'	0'	NA	0'
Speed Limit, mph	40 - 45	35 - 45	35 - 45	30-45	30 – 35	25 - 30	25	25	25	25	15	25
Fence minimum setbacks, feet from parkway edge of sidewalk	10'	8'	8'	8'	7'	7'	7'	6.5'	6.5'	6.5'	3' or 8' *l	9' *d
Driveway & Street Access	Limited	Limited	Limited	Limited	Limited	Limited	Limited	Limited	Unlimited	Unlimited	Unlimited	Unlimited
Curb & Gutter Vertical or Driveover	V	V	V	V	V	V	V	V	V	V or D	V or D	V or D

*a The maximum length of an Alley shall be 600 feet.
*b Medians shall be 19' wide standard width or 7'wide where a 12' left turn lane is needed.
*c Additional street width shall be required for development requested medians.
*d To provide left turn lanes at intersections, 8' additional roadway width is required to provide an 12' wide left turn lane with 5' buffered bike lanes and 11' travel lanes.
*e Bikes share travel lanes with motor vehicles.
*f If bike lanes are required, additional street width will be required to provide 6' wide bike lanes.
*g An 11' lane for shared parking and bikes is provided.
*h A 7' wide bike lane is provided when parking is removed for a left turn lane.
*i Additional street width up to 4' wider may be required in the travel lane to accommodate higher volumes of bike traffic within and leading to activity areas.
*j To provide left turn lanes at intersections, parking shall be removed.
*k Additional sidewalk width may be required to accommodate anticipated higher pedestrian traffic volumes within or leading to activity areas.
*l An 8' fence setback is required for a garage door setback of 8' from the alley ROW. With a garage door setback at 20' or greater, the minimum fence setback is 3' from the alley ROW.
*m To use driveover curb and gutter the parkway width must be widened by 1 foot, thereby increasing street ROW width by 2 feet to provide 53 feet.
*n The Modified 4-Lane Arterial is to be applied in constrained right-of-way situations and after review and approval of the City Engineer.
*o 6-ft bike lane is acceptable if built using a continuously poured concrete gutter pan
*p 11 foot lanes may be considered in constrained situations and upon review and approval by the City Traffic Engineer

Table 7-2
Loveland (GMA and City Limits) Street Standards - General Parameters

Street Classification:		Major Arterial (4-6 Lanes)	Minor Arterial (2 Lanes)	Major Collector	Minor Collector	Local Com/Ind	Local Resid	Lane	Alley
Functional Parameters	**No. of Dwelling Units Served**	NA	NA	>300	101-300	NA	21-100	<50	–
	Average Daily Traffic At Build-out	16,001-48,000	7,001-16,000	3,001-7,000	1,001-3,000	201-1,000	201-1,000	Max. 200	Max. 200
	Access	See Table 7-4	See Table 7-4	1 forward access per lot (if access cannot be provided from a lower classification	Max. 2 per Street Frontage	No limit	No limit	No limit	No limit
	Continuity (see definitions)	Unlimited	Unlimited	2 miles	2640' Max	660' Max	660' Max	660' Max	660' Max
Land Use Requirements	**Min. right-of-way**	120' or 140' [5,11]	100'	80'	60'	60'	58'	50'	16'-20'
	Min. Utility (Each Easement Side)	14'	14'	14'	14'	14'	14'	14'	10'
Geometric Parameters	**Minimum Street Width (Flowline to flowline)**	80'-116' [4,12]	40'-56' [4]	48' (w/parking) 38' (no parking)	38' (w/parking) 36' (no parking)	38' (w/parking)	34' (w/parking)	34' (w/parking) 28' (restricted parking[7])	16'-20' (in 16'-20' ROW[8])
	Min. Lane Width[9]	12'	12'	12'	11'	–	-	–	–
	Turn Lanes	Required[3]	Required[3]	Not Req.	Not Req.	Not Req.	Not Req.	Not Req.	Not Req.
	Bicycles	5'-7' lane	5'-7' lane[2]	5'-7' lane[2]	5'-7' lane[2]	Share Street	Share Street	Share Street	Share Surface
	Sidewalk Width[1]	6' min.	6' min.	6' min.	6' min.	5' min.	5' min.	5' min.	NA
	Sidewalk Location	Detached by 10' min.	Detached by 10' min.	Detached by 6' min.	Detached by 6' min. [6]	Detached by 6' min.	Detached by 6' min.	Detached by 5' min.	NA
	Curb Type	Vertical	Vertical	Vertical	Vertical, Drive over or Rollover	Vertical, Drive over or Rollover	Vertical, Drive over or Rollover	Vertical, Drive over or Rollover	

1 Sidewalk may not be required in industrial zones with initial development
2 5' width exclusive of gutter
3 Left turn lanes always required, right turn lanes required if TIS indicates need.
4 Minimum widths must be increased to provide auxiliary turn lanes where needed
5 Required on Taft Ave., Wilson Ave., Eisenhower Blvd., Hwy 287, and 14th St. SW
6 Sidewalks may only be attached when adjacent to single family residential homes through a formal variance per LCUASS Section 1.9.4.
7 One side only
8 May be reduced to 16' when necessary due to existing obstructions (power poles, etc.)
9 Lane width is measured from lip of gutter to center of lane stripe.
10 Commercial / Industrial area
11 This width includes turn lanes and minimum right-of-way at the intersection
12 This width includes turn lanes and double lefts at the intersection

Table 7-3
Fort Collins (GMA and City Limits) Street Standards - Technical Design Criteria

Design Element		Arterial				Collector		Local		Alley
		4 or 6 lane		2 lane		Major	Minor	Comm/Industrial	Residential	
Overall Design Parameters										
Design Speed / Posted Speed		50/40-45 (6) 50/35-45 (4)		50/30-45		40/30-35	40/25-30	30/25	30/25 connector 25/25	15
Stopping Sight Distance		425		425		305	305	200’	200’	80
Horizontal Alignment										
Minimum centerline radius (with no super-elevation)		1075’		1075’		600’	600’	275’	275’ connector 165’	50’
Maximum super-elevation		0.04 ft/ft		0.04 ft/ft		0.04 ft/ft	NA	NA	NA	NA
Minimum tangent between curves or at intersections [1]		200’		200’		150’	100’	100’	100’	20’
Vertical Alignment										
Maximum Centerline Grade		5%		5%		6%	8%	8%	8%	8%
Minimum Gutter Flowline Grade		0.5%		0.5%		0.5%	0.5%	0.5%	0.5%	0.5%
Minimum K-values for Vertical Curves	Crest	84		84		44	44	19	19 connector 12 all others	3
	Sag	96		96		64	64	37	37 connector 26 all others	10
Intersection Design										
Minimum sight distance at driveways and intersections		1030’		1030’		660’	660’	310’	260’	210’
Access Management		Without Raised Median	With Raised Median	Without Raised Median	With Raised Median					
Distance between intersections[2]	Signalized	2640’[5] Min.		2640’[5] Min.		NA	NA	NA	NA	NA
	Unsignalized	460’ – 660’ [5] 1320’[6] Min.	460’ – 660’ [5] 660’[6] Min.	460’ – 660’ [5] 1320’[6] Min.	460’ – 660’ [5] 660’[6] Min.	330’ Min.	250’ Min.	200’ Min.	200’ Min.	NA
Distance between high volume driveways and intersections[2]		460’ – 660’ [5] 1320’[6] Min.	460’ – 660’ [5] 660’[6] Min.	460’ – 660’ [5] 1320’[6] Min.	330’ Min.	200’ Min.	175’ Min.	175’ Min.	150’ Min.	NA
Distance between driveway edges		460’ – 660’ [5] 660’[6] Min.	460’ – 660’ [5] 660’[6] Min.	460’ – 660’ [5] 660’[6] Min.	330’ Min.	75’ Min.	30’ Min.	30’ Min.	12’ Min.	No limit
Corner clearance between driveways/alleys & street intersections[2]		460’ – 660’ [5]		460’ – 660’ [5]		175’ Min.	100’ Min.	175’ Min.	50’ Min.	40’ Min.
Driveway approach street config. [3]		Radial curb return		Radial curb return		Curb cut [4]	Curb cut [4]	Curb cut [4]	Curb cut [4]	Curb cut [4]

1 Intersection tangents are measured from flowline of the intersected street at intersections. Note: Two curves in the same direction must be separated by a tangent at least two times the minimum tangent lengths shown in Table 7-3 and Table 7-4.
2 These distances are measured as shown in Figure 9-1.
3 Table indicates residential driveways. All commercial driveways shall be constructed with radial curb returns (see Section 9.3.2).
4 Radial curb returns are also allowed where traffic volumes meet the requirements for a High Volume Driveway.
5 For a distance less than 460’ an administrative variance must be approved by the Local Entity Engineer; for a distance greater than 660’ a modification in accordance with the Land Use Code will be required.
6 Minimum spacing for full movement and/or potentially signalized intersections

Table 7-4
Loveland (GMA and City Limits) Street Standards - Technical Design Criteria

Design Element		Arterial				Collector		Local		Lane	Alley
		4 or 6 lane		2-lane		Major	Minor	Comm/Industrial	Residential		
Overall Design Parameters											
Design Speed / Posted Speed		50/45		45/40		35/35	30/25	30/25	25/25	20/20	NA
Stopping Sight Distance		400'		325'		275'	200'	200'	150'	125'	100'
Horizontal Alignment											
Minimum centerline radius (with no super-elevation)		1075'		825'		600'	275'	275'	165'	90'	50'
Maximum super-elevation		0.04 ft/ft		0.04 ft/ft		0.04 ft/ft	NA	NA	NA	NA	NA
Minimum tangent between curves or at intersections [1]		200'		200'		150'	100'	100'	50'	0	0
Vertical Alignment											
Maximum Centerline Grade		5%		5%		6%	8%	8%	8%	8%	8%
Minimum Gutter Flowline Grade		0.5%		0.5%		0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Minimum K-values for Vertical Curves	**Crest**	84		84		44	44[6]	19[6]	19[6]	19[6]	12[6]
	Sag	96		96		64	64	37	37	26	26
Intersection Design											
Minimum sight distance at driveways and intersections		1030'		830'		660'	310'	310'	260'	210'	210'
Access Management		Without Raised Median	With Raised Median	Without Raised Median	With Raised Median						
Minimum distance between intersections[2]	**Signalized**	2640'		2640'		NA	NA	NA	NA	NA	NA
	Unsignalized	1320'[3]	660'	1320'[3]	660'	330'	250'	200'	200'	200'	NA
Minimum distance between high volume driveways and corner clearance between high volume driveways and intersections[2]		1320'[3]	660'	1320'[3]	660'	200'	175'	175'	150'	NA	NA
Minimum distance between driveway edges		660'	660'	660'	330'	75'	30'	30'	12'	12'	No limit
Minimum corner clearance between driveways or alleys and intersections[2]		1320' [3,4]		660'		175'	100'	100'	80'	60'	50'
Driveway approach configuration		Radial curb return		Radial curb return		Curb cut [5]	Curb cut [5]	Curb cut [5]	Curb cut [5]	Curb cut [5]	Curb cut [5]

[1] Tangents are measured from flowline of intersecting street at intersections. See Section 7.4.1, A, .2. for more information.
[2] These distances are measured as shown in Figure 9-1.
[3] Only allowed if shown to comply with ACF ordinances.
[4] 600' for speeds ≤ 45 mph subject to Traffic Impact Study findings.
[5] Radial curb returns are also allowed.
[6] AASHTO values may be used within 100' of controlled intersections, or other locations where speeds are reduced.

c. Broken Back Curves. Two curves in the same direction (broken back curves) shall be separated by a tangent with a length of at least 2 times the minimum length shown in **Table 7-3** and **Table 7-4**.

3. Consistent Radii. All curves along a street shall be designed with radii that are approximately equal. The purpose of this limitation is to provide consistency and minimize unexpected difficult or quick maneuvers for the driver.

4. Curves with Small Deflection Angles (10° or less). To reduce the appearance of kinks in the street, minimum lengths of curve shall be designed with minimum arc lengths as shown in **Table 7-5**.

Table 7-5
Centerline Arc Lengths

Street Classification	Minimum Centerline Arc Length (ft.)
Arterial	400
Collector	300
Local, Commercial & Industrial	200
Local, Residential	100

5. Horizontal Curves on Vertical Curves. For driver safety, horizontal curves shall not begin near the top of a crest vertical curve nor near the bottom of a sag vertical curve.

6. Transitions for Roadway Shifts or Lane Drops. Refer to requirements for redirect /approach and bay taper, **Figures 8-2 and 8-3**.

7. Coefficient of Friction. The coefficient of friction shall conform to the values in Figure III-1 of the **AASHTO "Green Book."**

8. Off-Site Design Centerline, Flowlines and Cross Sections. To assure that future street improvements will meet these Standards, the centerline, flowline, and cross sections of all streets, except cul-de-sacs, shall be continued for 500 feet beyond the proposed construction. The grade and ground lines of all Arterials shall be continued an additional 500 feet for a total of 1000 feet beyond the end of the proposed construction.

9. Joining Existing Improvements. Connection with existing streets shall be made to match the existing alignment grade of the existing improvements, in accordance with horizontal alignment criteria.

10. Street Widening at Turns. See **Section 7.6.3**

B. Vertical Alignment

1. Maximum and Minimum Grades for Streets. The maximum and minimum grades for specific street classifications are shown in to **Table 7-3** and **Table 7-4**. The

centerline grade in the bulb of a cul-de-sac shall not exceed 3 percent. For Fort Collins (city limits only), the flowline grade in the bulb of a cul-de-sac shall be a minimum of 1 percent. Where sidewalks and/ or ramps cross the flowline ADA requirements shall be met for the flowline grades.

2. Minimum Flowline Grades. Minimum flowline grades for gutters shall be 0.50 percent, except the bulb of cul-de-sacs where the minimum shall be 1.0 percent.
3. Grade Breaks. No single point grade break shall exceed 0.50 percent, except for the flow line in sag curves where the maximum grade break is 1.0%. In curb returns, a grade break may be as great as 3.0% for extreme circumstances. Grade breaks, except for those located within curb returns shall be spaced at least 25 feet apart.
4. Requirements for Using Vertical Curves. Vertical curves are required for grade changes that exceed 1.0 percent. Both centerlines and the curb and gutter flowlines shall be designed with vertical curves to meet the requirements of **Figures 7-17** and **7-18.** A series of grade breaks may be used in lieu of a specified vertical curve as long as the series of breaks meet the vertical curve criteria in these Standards for the design speed. K-values for design shall conform to **Table 7-3** or **Table 7-4.** No grade changes are allowed at the beginning or end of a vertical curve; the curve information shall be based on the curve going into or out of the vertical curve. In sag curves on flow line, the minimum grade requirement shall override the slope within the vertical curve.
    a. Minimum Length Crest and Sag. **Figures 7-17** and **7-18** give minimum length of crest and sag vertical curves for various algebraic differences in grade. Street designs shall meet or exceed these minimums. Within the intersection transition of stop-controlled intersections, shorter vertical curves may be considered on a case-by-case basis.
    b. Crest Curves. For crest curves, the street centerline, curb, and gutter shall be designed with vertical curves in accordance with minimum requirements shown on **Figure 7-17**. K-values for design shall conform to **Table 7-3** and **Table 7-4**.
    c. Sump Sag Curves. For sag curves the street centerline shall be designed with a vertical curve with minimum length as shown on **Figure 7-18**. The minimum flowline grade on a sag curve shall be 0.5 percent. Curb and gutter shall be constructed with no vertical curve in these areas. The grade into an inlet located in a sump shall have a .5 percent grade into and out of the inlet. The inlet(s) themselves in these situations do not need to meet the minimum flowline grades.
5. Joining Existing Improvements. Connection with existing streets shall be made to match the existing grade of the existing improvements, in accordance with vertical alignment criteria. (Grade breaks shall not exceed allowable.)
6. Vertical Clearance. Vertical clearance above a roadway is a minimum of 16.5 feet.
7. Intersection Approach Grades. Intersection approach grades are discussed in **Chapter 8, Intersections**.
8. Off-Site Continuance of Grade and Ground Lines. To assure that future street improvements will meet these Standards the centerline and flowline profiles, the

grade and ground lines of all local and collector streets, except cul-de-sacs, shall be continued for 500 feet beyond the proposed construction. The centerline and flowline profiles, the grade and ground lines of all Arterials shall be continued 1000 feet beyond the end of the proposed construction.

C. Sight Distance

Sight distance is the distance necessary for a vehicle operator to perform expected functions and be able to do so without causing a hazard for the driver or other vehicle operators for the specific design speed of the street. Vehicles shall perform moves without causing other vehicles to slow from the average running speed. In no case shall the distance be less than the stopping sight distance. This includes visibility at intersections and driveways as well as around curves and roadside encroachments.

1. Stopping Sight Distance for Vehicle Crest Curves. Stopping sight distance is calculated as follows:

   Object height is 2.00 feet above road surface and viewer's height is 3.50 feet above road surface. Stopping Sight Distance on Horizontal Curves. Where an object off the pavement restricts sight distance, the minimum radius of curvature is determined by the stopping sight distance (see **Figures 7-15.1**and **7-15.2**). In no case shall the stopping sight distance be less than as specified in **Table 7-3** or **Table 7-4.** The sight distance design procedure shall assume a 6-foot high fence (as measured from actual finished grade) exists at all property lines except in the sight-distance easements that may be required to preserve the needed sight distance.

   Stopping sight distance on horizontal curves is based upon lateral clearance from the inner edge of pavement to sight obstruction, for various radii of inner edge of pavement and design speeds. The position of the driver's eye and the object sighted shall be assumed to be 6 ft. from the inner edge of pavement, with the sight distance being measured along this arc. Stopping sight distances are given in **Table 7-6**.

Table 7-6
Stopping and Passing Sight Distance

Design Speed (Mph)	Stopping Sight Distance (feet)	Passing Sight Distance (feet)
20	115	400
25	155	450
30	200	500
35	250	550
40	305	600
45	360	700
50	425	800
From latest edition of the AASHTO **"Green Book" Table 3-1 and Table 3-5** (For Intersection and Driveway Sight- Distance, see **Figure 7-16.**)		

2. Passing Sight Distance (Rural Applications Only). Two-lane roads shall provide adequate passing zones. Required passing sight distance for given design speeds is

given in **Table 7-6**. Passing zones are to be provided on 2 lane roads, which may be classified as 4 and 6 lane Arterials and occasionally on 2-lane Arterials and Major Collectors.

3. Corner Sight Distance. The corner sight distance provides for vehicles to enter traffic and accelerate to the average running speed. Corner sight distance shall be measured as shown in **Figure 7-16**.
4. Sight Distance Triangles and Easements. All sight-distance easements must be shown on the street plan/profile plans. All sight distances must be within the public right-of-way or a sight distance easement. If the line of sight crosses onto private property, a "Sight Distance Easement" shall be dedicated to provide the required sight distance. The easement or right-of-way shall be dedicated to the Local Entity, however, maintenance shall be noted on the final plat as the responsibility of a private entity such as the property owner or the home owners association.
5. Sight Obstructions. Any object within the sight distance easement more than 30 inches above the flowline elevation of the adjacent street shall constitute a sight obstruction, and shall be removed or lowered. Such objects include but are not limited to berms, buildings, parked vehicles on private property, cut slopes, hedges, trees, bushes, utility cabinets or tall crops.

   Mailbox clusters must be installed a minimum of 2 feet from back of walk and not cause any sight obstruction. Mailboxes must not pose a fixed object hazard for vehicles and pedestrians. Since parked vehicles are under the control of the Local Entity, parked vehicles shall not be considered an obstruction for design purposes. The city may limit parking to protect visibility. The sight distance shall be measured to the centerline of the closest through-lane in both directions.

   In no case shall any permanent object encroach into the line-of-sight of any part of the sight-distance triangle. Street trees required by the Local Entity are excepted from this requirement. Trees are permitted if pruned up to 8 feet.
6. Sight Distance (City of Loveland and Loveland GMA only). In addition to the sight distance triangle requirements, a clear space zone is required within all curb returns (measured from point of curb return to point of curb return) where no trees, shrubs, aesthetic structures/features, monument signs, or objects that have the potential to hinder driver visibility, and/or pedestrian and bicycle safety, are allowed. See Figure 7-34L.

D. Interim Pavement Edge

In situations where curb and gutter are not installed along the roadway edge and/or in situations where the full street widening in accordance with the Street Classification is not being constructed, an asphalt shoulder shall be provided that is the same width as existed prior to construction or 4 feet, whichever is greater. A minimum 2-foot gravel shoulder shall be provided beyond the edge of asphalt.

7.4.2 Cross Slope

Cross slope on a pavement is provided to drain water from the street surface. The design of cross slope shall consider driver comfort and safety.

A. Minimum Cross Slope

A minimum cross slope on all streets shall be 2.0 percent. Minimum cross slope on reconstruction or overlays is 1.5 percent.

B. Maximum Allowable Cross Slope

Maximum allowable cross slope on all new construction shall be 3 percent. Maximum allowable Cross Slope on any reconstruction or overlays of existing roadways shall be 4 percent.

C. Cross Slope for Street Modifications

When widening an existing street or adding turn lanes to an existing street, the resulting cross slope of the widened portion shall be within the limits stated above and the new Cross Slope shall be no less than the existing cross slope.

However, if the cross slope of the existing street exceeds the Standards then new curb and gutter shall be designed such that the existing pavement, when overlaid, will result in a straight line cross slope grade that meets these Standards. Alternatively, the existing pavement may be removed and reprofiled to comply with these Standards.

D. Cross Slope for Cul-de-Sacs

Refer to **Figure 7-19** for cul-de-sac bulb cross slopes.

7.4.3 Superelevation on Horizontal Curves

The purpose of superelevating a roadway is to maintain the riding comfort on smaller than standard curves. Superelevation may only be used when other means of design will not work. If superelevation is necessary, the following criteria shall be followed:

A. Where Superelevation Is Permitted

Superelevation may be allowed for curves on Arterial and Major Collector streets in order to reduce the minimum centerline radius. In no case shall superelevation exceed 4.0 percent cross slope. As specified in **Table 7-3** or **Table 7-4**, superelevation shall not be used to reduce minimum radii on Local or Minor Collector Streets.

B. Run-Out

When superelevation is used, a minimum 100-foot run-out shall be used entering and exiting the superelevated portion.

C. Drainage

Where the superelevation is used, the gutter shall always be an inflow type. The water must enter a storm sewer system or other acceptable outlet from the street rather than crossing the street in sheet flow or in crosspans.

7.4.4 Design Speed

Each roadway classification has a specific design speed. See **Table 7-3** or **Table 7-4**.

7.4.5 Curb Return Radii

The required curb return radii are defined in **Table 8-1** or **Table 8-2,** unless otherwise approved or required by the Local Entity Engineer.

7.4.6 Streetscape Design

For all street landscaping standards, including median and parkway sections within the Fort Collins (city limits only), see **Appendix C,** ***City of Fort Collins Streetscape Design Standards and Guidelines.***

7.5 MEDIANS

7.5.1 Medians

A. General Requirements

General criteria for medians are specified on **Figures 7-1 through 7-13.** In Loveland (GMA and city limits) painted or raised medians are required on all Arterial Streets. In Fort Collins (GMA and city limits) raised medians are required on all 4-Lane and 6-Lane Arterial Streets. Other medians may be required by the Local Entity Engineer for specific circumstances to control traffic. Medians requested by Developers may be approved as long as additional right-of-way are dedicated and all maintenance shall be done by viable private parties.

1. Refer to **Construction Drawings 704, 705, 801** for design and construction details on medians.
2. The minimum width of any raised median shall be 4 feet wide. See **Construction Drawing 801**.
3. Raised center medians shall have an 8-inch-high curb measured from the pavement surface (Loveland City Limits and Loveland GMA only).

B. Turn Lane and Access

The design of medians shall include the evaluation for needed turn lanes and accesses. For the minimum requirements of turn lanes, refer to **Chapter 8, Intersections**.

C. Drainage

Landscaped medians shall be provided with drainage facilities to handle sprinkler runoff and nuisance flows. Sprinklers shall be designed to prevent spray onto the pavement surface. Refer to Local Entity requirements for specific median landscape design in **Appendix C**. A properly designed drain system shall be required.

D. Curb and Gutter

If gutters are not needed to handle drainage referenced above, medians may be constructed with barrier curb. All barrier curb shall be full depth and not glue down unless otherwise approved by the Local Entity Engineer

E. Nose

Use vehicle turning templates to determine the position of the median nose so that vehicles do not track onto the median. Refer to **Construction Drawing 703**.

The minimum radius for nose curbs shall be 2 feet to flowline. See **Construction Drawing 801**.

F. Paving

All non-landscaped areas of medians shall be paved with stamped concrete, brick pavers, concrete, or exposed aggregate concrete in accordance with streetscape standards of the Local Entity. Standard width medians shall be designed in accordance with streetscape standards for the Local Entity.

G. Transitions

The ends of medians shall transition into turn lanes with a minimum radius of 100 feet. A change of directions must be accomplished with the use of radii. Angle points shall not be allowed.

H. Objects

No permanent structures, including light poles, fire hydrants, trees, etc., shall be placed within 5 feet of the travel lane or in any location that would obstruct sight distance except for structures as approved in these Standards. If a median streetlight is placed within 5 feet of the travel lane, the light pole standard must be a breakaway model.

7.6 NON-CONNECTIVE STREET ALIGNMENTS

7.6.1 Cul-de-Sacs

Cul-de-sacs shall be used only where necessary.

A. Permitted Locations

Cul-de-sacs are permitted only on Local Streets in conformance with **Figures 7-19** and **7-21**. In Loveland (GMA and city limits) cul-de-sacs may conform to Figure 7-22L**.**

B. Maximum Length

The cul-de-sac shall have a maximum length of 660 feet, (400 feet in Loveland (city limits only)). If commercial sites or residences install fire sprinkler systems, the Local Entity may increase this length to 1,000 feet, or to 1,320 in Fort Collins (city limits only) in accordance with Local Entity Fire Standards.

C. Secondary Access in Loveland (GMA and City Limits)

Any cul-de-sac that does not meet the requirements of **Section 7.6.1 B** shall be provided with a secondary access road per **Section 7.8**.

D. Minimum Radius

The cul-de-sac shall have a minimum flowline radius per **Figures 7-21**.

E. Minimum Parking

A minimum of one parking space must be provided for each residence. All parking areas outside of the right-of-way shall have the appropriate easements and shall be maintained by private entities. Refer to **Chapter 19, Parking**.

7.6.2 Eyebrows

A. Permitted Locations

Eyebrows shall be permitted only on Local Streets that intersect Local Streets in conformance with **Figure 7-23**.

B. Spacing Requirements

The location of the Eyebrow shall be in conformance with spacing requirements in **Chapter 9, Access Requirements and Criteria**.

C. Permitted Lengths

Eyebrows shall be a minimum of 25 feet in length and a maximum of 100 feet measured along the flowline.

7.6.3 Turns

When a roadway width is less than 36 feet wide and the centerline radius is less than requirements of **Table 7-3** or **Table 7-4**, the requirements of Figure 7-24 shall be met for turns. No other widening (Knuckles) are permitted.

7.6.4 Dead-End Streets.

A. Permanent Dead-End Streets

New permanent dead-end streets are prohibited.

B. Temporary Dead-End Streets

Temporary dead-end streets will be permitted only on streets that have no direct access from adjoining property. Additionally, a temporary dead-end street shall be planned to extend into neighboring property during a later development phase or project. The road must be fully constructed to the property line, except in Loveland (GMA and city limits) where the length must exceed 150' before the temporary turnaround would be required).

1. Signage. Signage for temporary, dead-end Roadways shall be in accordance with **Chapter 14, Traffic Control Devices.**

C. Temporary Turnarounds

At locations where a street will be temporarily terminated with access provided from the street and the street is planned to be extended with future development, a temporary turnaround shall be constructed. The turnaround shall have a minimum radius of 50 feet to the edge of the completed dead-end street. Refer to **Figure 7-26** No curb and gutter is required on temporary turnarounds. Surface requirements of temporary turnarounds must be approved by the Local Entity Engineer.

D. Temporary Turnaround Easements

All temporary turnarounds shall be constructed within an access Easement. The Easement may be vacated by the Local Entity when the Easement is no longer necessary. Application for vacation of the easement must be initiated and paid for by the Developer or property owner.

7.7 DRAINAGE SYSTEMS

7.7.1 Drainage

Drainage system design shall be in accordance with current Local Entity storm drainage requirements.

7.7.2 Grading in Right-of-way

A. Slopes

The maximum slopes for all areas within the right-of-way or outside of the right-of-way that can affect the public improvements, shall be 4:1 unless designed with retaining walls. Any slopes proposed to exceed 4:1 must be proven to be stable and must be approved by the Local Entity Engineer. In general, retaining walls are discouraged and not allowed within the right-of-way. Refer to **Chapter 11, Structures** for design requirements. The minimum slopes in non-roadway areas shall be 2 percent unless otherwise allowed by the Local Entity Engineer. All areas shall be seeded or stabilized in accordance with these Standards or the requirements of the Local Entity Storm Water Utility, whichever is more conservative.

B. Off-site Fill Material

Any material from an off-site location to be used in right-of-way or areas within the influence area of the right-of-way must be tested and discussed within the Soils Investigation Studies. Refer to **Chapter 5, Soils Investigation** for specific requirements.

7.7.3 Subdrains

A. Controlling Groundwater

Subdrains used for the purpose of controlling groundwater on private property may be constructed within public right-of-way if certain criteria are met. The system shall be private and must be maintained by viable private parties and approved with an Encroachment Permit if applicable. Refer to **Chapter 12, Utility Locations,** for allowable locations within the right-of-way. Refer to **Chapter 5, Soils Investigations** for information on design criteria.

B. Protecting Right-of-way Improvements

Subdrains constructed for the purpose of protecting public right-of-way improvements may be installed only if other means are not possible. In Loveland (GMA and city limits) and Fort Collins (GMA only), subdrain systems must be owned and maintained by a private party other than the Local Entity.)

C. Design Criteria

1. All subdrains covered by these Standards shall be designed to meet the following criteria:

a. Positive Outfall: Demonstrate that subdrain has positive outfall for gravity drainage; prevent surcharging of subdrain.

b. Adequate Engineering: Demonstrate that the system has been designed in consideration of site-specific groundwater conditions, soil properties, topography, and layout of proposed development. Address maintenance aspects of recommended design.

c. Sanitary Sewer Kept Dry (minimize infiltration): Demonstrate that the subdrain system maintains adequate flow capacity under peak hydraulic loading rates to keep groundwater below the invert of the sanitary sewer.

d. No Offsite Transport: Show that the system will neither receive groundwater inflow from additional upstream developments, nor transfer collected groundwater to downstream developments.

e. Water Rights: The system shall be shown to create no injury to existing water rights or others on their property in the project vicinity.

f. One Year Monitoring After Construction: The system shall incorporate provisions to allow monitoring of groundwater levels to confirm that it is functioning as designed.

g. Design for Seasonal High Water: The system shall be designed in consideration of seasonal high groundwater levels anticipated at the project site.

h. Groundwater Barriers: The system shall be designed such that clay cutoff walls are provided at boundaries of the development to preclude hydraulic communication with offsite utility trenches either upstream or downstream.

i. Filter Fabric: The utility trench shall be lined with a filter fabric specifically selected in consideration of on-site soil conditions in order to minimize the invasion of fine soil particles into the bedding gravel.

j. Pipe Diameter: 8 inches minimum for mains; 3 inches minimum for laterals (pipe diameter shall be different from the sewer lateral).

k. Engineer and designer needs to show in the design how future tree roots will not negatively impact the subdrain (if applicable).

D. Subdrain Placement and Cleanouts

Construction Drawings 713.1F, 713.1L, 713.2F, and 713.2L show general requirements for subdrain placement, location of cleanouts and service.)

7.7.4 Sidewalk Culvert (Chases)

Storm water from concentrated points of discharge shall not be permitted to flow over sidewalks, but shall drain to the roadway by use of a sidewalk culvert or other methods approved by the Local Entity Engineer.

A sidewalk culvert shall not be located within a curb ramp, curb cut, or driveway. Sidewalk culverts shall only be allowed in special situations, on a case-by-case basis, as determined by the Local Entity Engineer. Sidewalk chase sections shall be constructed in accordance with **Construction Drawing 709.**

7.7.5 Crosspans

A. Basic Requirements

Crosspans for passing storm drainage flow across roadways shall be constructed in accordance with the **Construction Drawings 708 and 710**. The pans shall be a minimum of 6 feet wide with 7/8-inch typical catch. Mid-block crosspans shall be a minimum of 12 feet wide with 1-3/4 inches typical depth. Greater widths may be required by the Local Entity Engineer.

B. Dimensions and Depth

Crosspans shall be a minimum width of 6 feet and a 7/8-inch typical catch adjacent to residential streets. Crosspans adjacent to Collector streets shall be 8 feet wide with a typical depth of 1-1/8 inches and crosspans adjacent to an Arterial shall be 10 feet wide with a typical depth of 1-1/2 inches. Refer to **Construction Drawing 708**.

C. Prohibited on Arterial and Collector Streets

No crosspans are allowed to cross Arterial streets. No crosspans are allowed to cross Collector streets in Fort Collins (GMA and city limits).

D. Minimum Grade

Minimum grade on crosspans at flowline of pan shall be 0.5 percent.

E. Crosspan Transitions

The following criteria shall be followed for crosspan approaches:

1. Design Speeds. Pavement transition from standard crown to crosspan shall be designed using the appropriate design speeds as given in **Table 7-3** and **Table 7-4**.
2. Intersections. Transitions from standard crown to crosspan at intersections shall be designed in accordance with **Figures 7-27 and 7-28.** Details shall be prepared to show the elevations in the locations shown on **Figures 7-27 and 7-28**.
3. Pavement Material. In asphalt paved streets, approaches to crosspans shall be constructed with full depth asphalt wedges per **Construction Drawing 710.**

F. Monolithic Paving

If pavement is concrete, any drainage conveyance, such as crosspans, may be poured monolithically with the main line paving process.

7.7.6 Sidewalks, Curb and Gutter

A. Sidewalks

1. Typical Cross-Sections. Roadway typical sections that include sidewalks shall be as specified in this chapter. The typical cross-sections are summarized in **Figures**

7-1F through **7-13F** and **7-1L** through **7-11L and Construction Drawing 1601 and 1602.**

2. Other Sidewalk Requirements. Refer to **Chapter 16, Pedestrian Facilities,** for specific sidewalk requirements.

B. Curb and Gutter

Tables 7-1 and 7-2 and Figures 7-1 through 7-13 or the type of curb and gutter to be used for the various street classifications.

1. Drive-Over Curbs. Drive-over combination curb, gutter, and walk is permitted as indicated on Tables 7-1 and 7-2 and as indicated in the referenced Figures, on Local Roadways only.
2. Median Islands. All median islands shall be designed with curb and gutter as shown in **Construction Drawing 703, 704 and 705**. For median island standards, see **Section 7.5**.
3. Vertical Curb and Gutter (Type II). The vertical curb or curb and gutter section shall be in accordance with **Construction Drawing 701**. In Fort Collins (GMA and city limits), all new streets shall be constructed using vertical curb and gutter except for the Residential Local Street and Alley where Drive-Over curb and gutter may be used.

7.7.7 Inlets

Inlets located in a sidewalk shall be integrated with sidewalks. The inlet access shall be flush with the sidewalk surface. No manholes, inlets, or other storm sewer facilities are allowed within curb ramps. Refer to the appropriate Local Entity requirements for sizing of inlets. Inlets are not allowed in the curb return, but shall be located at or behind the tangent points of the curb returns.

7.7.8 Waterway Crossings

All waterway crossings beneath and/or within the public right-of-way shall be designed to minimize maintenance requirements. For irrigation structures, the minimization of silting within the structure must be addressed. The design shall maintain or increase the water velocity through the structure to minimize silting or provide other design elements to address this issue.

7.7.9 Rural Roadside Ditches

Any rural or interim roadway sections developed without curbs (and with roadside drainage ditches) must complete the ditch construction with the installation of sod, erosion control blanket, hydro mulch, or approved equivalent within the ditch area. The profile grade of the ditch shall be maintained at a minimum slope of one (1) percent and a maximum slope of five (5) percent. The side slopes of the ditches outside of the right-of-way shall be a minimum of 4:1 and meet any specific criteria of the Local Entity Storm Water Utility. Flatter slopes may be considered when a paved invert is designed for the ditch bottom.

A. Slope

The slope and capacity of any roadside ditches shall be maintained in any areas that driveways cross the ditch. Each site is required to provide a HDPE or concrete pipe, a minimum of fifteen (15) inches in diameter, calculated to meet capacity and strength requirements of the Storm Water Utility. The pipe shall be designed to have no less than twelve (12) inches of cover over the pipe. All portions of the driveway within the right-of-way shall be paved with concrete or asphalt.

B. Maintenance

All driveway improvements within the right-of-way including piping, ditches, curb and gutter, and sidewalk are the responsibility of the adjoining property owner. The Local Entity will not provide maintenance of these items.

7.8 EMERGENCY ACCESS REQUIREMENTS

Any emergency access not on public streets shall be provided in accordance with the Emergency Access Section in the City of Fort Collins Land Use Code or in accordance with the requirements of the Loveland Fire Marshall.

7.8.1 Slope

The slope of the fire lanes shall be a minimum of 0.5 percent and a maximum of 8 percent.

7.8.2 Cross Slope

The Cross Slope of the fire lanes shall be minimum of 1.0 percent and a maximum of 4.0 percent.

7.8.3 Lane Width

The lane width shall be a minimum of 20 feet from the edge of the roadway to edge of the roadway and shall be in an access Easement. The access Easement shall have a minimum width of 20 feet. The lane widths may be required to be increased through horizontal curves to accommodate fire truck passage.

7.8.4 Vertical Clearance

There shall be a minimum of 14 feet of vertical clearance over the entire fire lane.

7.8.5 Barricade

The fire lane may have an approved barricade, but it must be approved by the Local Entity Fire Department.

7.8.6 Roadway Surface

The surface of the roadway must be a paved surface complying with Local Street pavement thickness requirements, unless approved otherwise by the Local Entity Engineer.

7.8.7 Maintenance

All access roadways shall be maintained and kept clear for emergency use at all times.

7.9 BUS STOPS

7.9.1 General

The following minimum design criteria for the construction of bus stops. The Local Entity Engineer may vary any of the following requirements as deemed appropriate for the site and its particular situation. The Designer shall propose and the Local Entity Engineer will approve the exact location of the bus stop in a proposed development. All bus bay locations shall be coordinated with the Local Entity Engineer.

7.9.2 Bus Lane Width

Bus bays should be at least 10 feet wide.

7.9.3 Bus Stops

All bus stop locations shall be constructed with concrete pavement in accordance with **Chapter 22, Construction Specifications and Bus Stop Design Standards and Guidelines**

A. Approach Leg (Near-side) Minimum Criteria

Bus stops on the approach leg of an intersection (near-side) should be at least 55 feet back from the pedestrian crosswalk at the intersection or at least 50 feet back from the intersection curb return (point of curvature, P.C.), plus 50 feet long for a single bus. If on-street parking is present, an additional 50 feet minimum shall be provided behind the bus stop for the bus to transition to the stop. See Figure 5 of the Bus Stop Design Standards and Guidelines for more information.

B. Departure Leg (Far-side) Minimum Criteria

Bus stops on the departure leg of an intersection (far-side) should provide at least a 50-foot long loading area for a single bus, measured at least 5 feet from the pedestrian crosswalk or measured from the intersection curb return (point of curvature, P.C.).. If on-street parking is present, an additional 50 feet minimum shall be provided behind the bus stop for the bus to transition back into traffic. See Figure 5 of the Bus Stop Design Standards and Guidelines for more information.

C. Mid-Block

Mid-block stops shall be designed with entrance and exit designed for the posted speed limit in accordance with the transition criteria in **Construction Drawing 711**. For example, impacted area for a single bus stop ranges from about 150 to 200 feet, yielding a minimum of a 400 to 600-foot block for application.

7.9.4 Bus Bays

All bus pullouts and bays shall be designed and constructed in accordance with the requirements in **Construction Drawing 711**.

7.9.5 Bus Shelters

For access and design guidelines for bus shelters, refer to **Chapter 16, Pedestrian Facilities**.

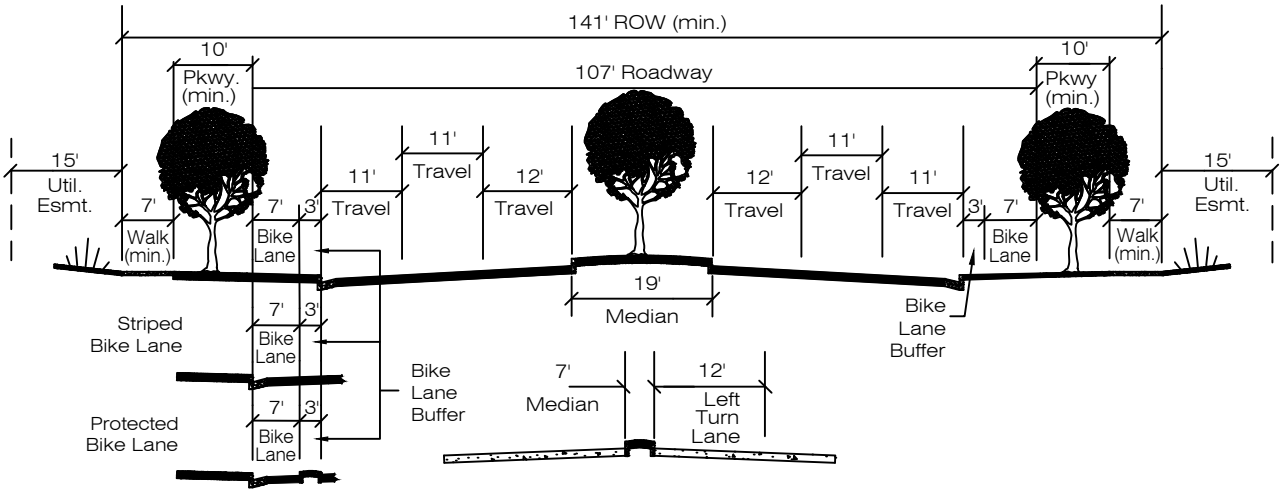
7.9.6 Bus Pullout Lanes

Bus pullouts shall be constructed with no less than 50 feet between an intersection curb return (point of curvature, P.C.) and the beginning of the lead in taper. Bus pullouts for higher speed limits shall be as shown in **Construction Drawing 711**.

7.10 IMPROVEMENT OF ANNEXED STREETS

For improvement of annexed streets in Fort Collins (city limits only), See **Appendix "H".**

FORT COLLINS ONLY



LEFT TURN MEDIAN

ROADWAY WIDTH: 107'

RIGHT OF WAY WIDTH: 141' (min.) plus 15' (min.) utility easement each side of street.

TRAVEL LANES: Six lanes (4) -11' wide and (2) -12' wide

LEFT TURN LANE: 12' wide

BIKE LANES: Two lanes, 7' wide lane, 3' wide painted buffer (optional protected bike lane per Blke Plan).

BIKE LANE OPTIONS: Striped bike lane and protected bike lane options will require City Engineer approval.

PARKING: None.

PARKWAY: 10' (min.) wide. Additional width optional.

SIDEWALK: 7' (min.) wide. Additional width may be required for higher pedestrian traffic within and leading to activity centers or as required by Area Plans.

MEDIAN: Center Median: 19' wide landscaped; Left Turn Median: 7' wide landscaped. Barrier curb or or out-fall curb and gutter.

WHERE USED: These specifications shall apply as required by the Local Entity when a 6-lane arterial street is shown on the Master Street Plan.

DESIGN SPEED: 50 MPH

SPEED LIMIT: 40-45 MPH

ACCESS: Access will be limited. Points of access must be approved by the Local Entity.

CONTINUITY: Unlimited

FENCES: Fences shall be setback a minimum of 2' from back of sidewalk or on the property line, whichever is greater.

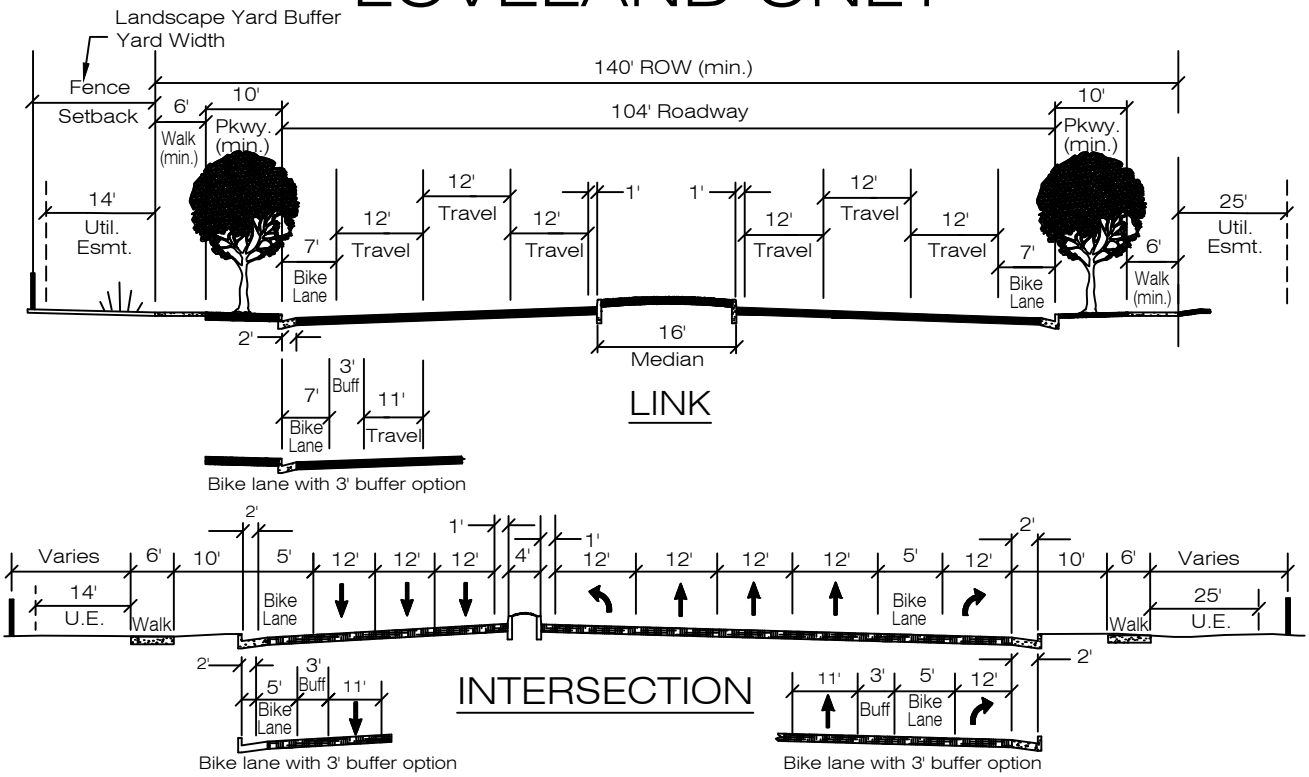
LANDSCAPING: See Appendix "C"

CURB AND GUTTER: Vertical curb and gutter.

6-LANE ARTERIAL STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	7-1F

LOVELAND ONLY



ROADWAY WIDTH: 104'

RIGHT OF WAY WIDTH: 140' (min.) plus 14' and 25' (min.) utility easement.

TRAVEL LANES: Six lanes, 12' wide (exclusive of gutter or 12" from face of curb where no gutter).
11' with Buffered Bike Lane options

RIGHT TURN LANE: 12' wide, required at intersections or accesses receiving more than 200 right turning vehicles per hour.

BIKE LANES: Two lanes, 5' wide (exclusive of gutter).

BUFFERED BIKE LANE OPTIONS: Options will vary depending on the project and will require City Engineer approval.

PARKING: None.

TREE LAWN: 10' (min.) wide. Additional width optional.

SIDEWALK: 6' (min.) wide detached by at least 10'. Additional width may be required for higher pedestrian traffic in and leading to activity centers.

MEDIAN: Center Median: 16' wide. (4' wide in left turn lane area). Colored concrete (6" flag stone brown) painted or landscaped. 7-2 See CONST. DWG. 801.

WHERE USED: These specifications shall apply as required by the Local Entity when a major arterial street is shown on the Master Street Plan, or when the traffic volume on the street is anticipated to be 32,001 to 48,000 vpd.

DESIGN SPEED: 50 MPH

POSTED SPEED: 45 MPH

ACCESS: No primary access to individual lots. 1/2 mile spacing for signalized intersections.

CONTINUITY: Unlimited

FENCES: Fences shall be placed outside of the landscape buffer yard.

LANDSCAPING: Tree Lawn, Median, and Buffer Area landscaping maintenance shall be the responsibility of the adjacent property owner, HOA or Metro Districts.

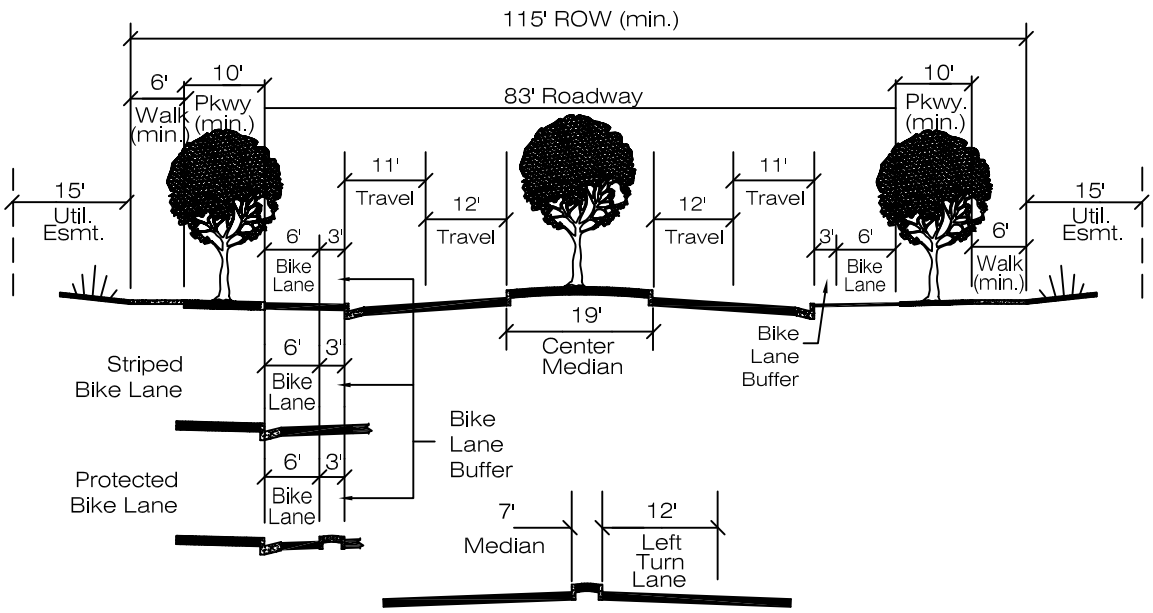
CURB AND GUTTER: Vertical curb and gutter.

Note: Cross Section may vary on State Highways, approved corridor studies or adopted IGA's with adjacent jurisdrictions.

6-LANE ARTERIAL STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	7-1L

FORT COLLINS ONLY



LEFT TURN MEDIAN

ROADWAY WIDTH: 83'

RIGHT OF WAY WIDTH: 115' (min.) plus 30' (min.) utility easement.

TRAVEL LANES: 4 Lanes, (2) 11' wide and (2) 12- wide.

LEFT TURN LANE: 12' wide

BIKE LANES: Two lanes, 6' wide lane, 3' wide painted buffer (optional protected bike lane per Bike Plan).

BIKE LANE OPTIONS: Striped bike lane and protected bike lane options will require City Engineer approval.

PARKING: None.

PARKWAY: 10' (min.) width. Additional width optional.

SIDEWALK: 6' (min.) width. Additional width may be required for higher pedestrian traffic in and leading to activity areas or as required by Area Plans.

MEDIAN: Center Median: 19' wide landscaped; Left Turn Median: 7' wide landscaped. Barrier curb or out-fall curb and gutter.

WHERE USED: These specifications shall apply as required by the Local Entity when a 4-lane arterial street is shown on the Master Street Plan.

DESIGN SPEED: 50 MPH

SPEED LIMIT: 35-45 MPH

ACCESS: Access will be limited. Points of access must be approved by the Local Entity.

CONTINUITY: Unlimited

FENCES: Fences shall be setback a minimum of 2' from back of sidewalk or on the property line, whichever is greater.

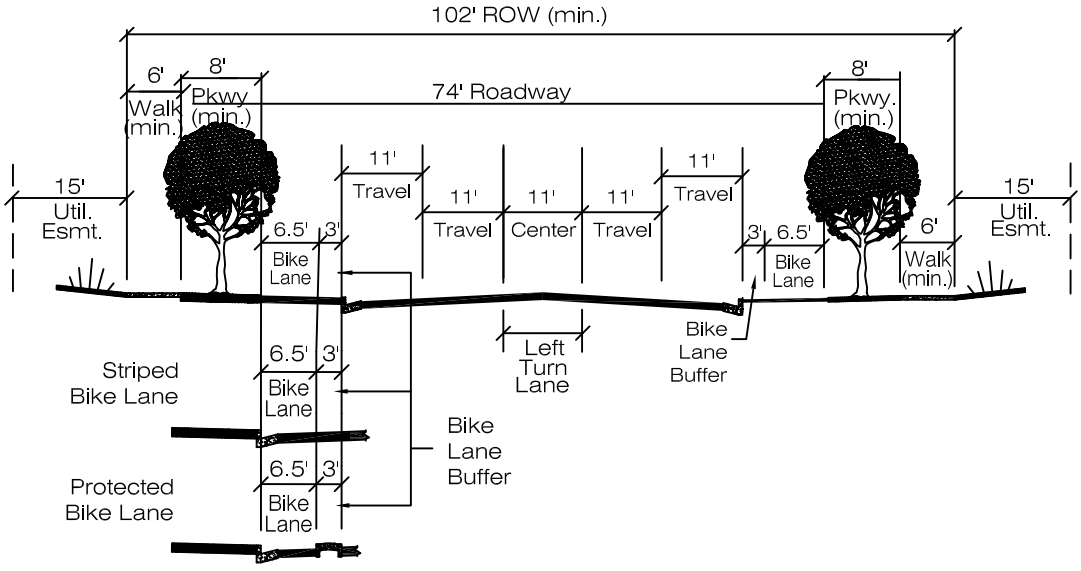
LANDSCAPING: See Appendix "C"

CURB AND GUTTER: Vertical curb and gutter.

4-LANE ARTERIAL STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	7-2F

FORT COLLINS ONLY



ROADWAY WIDTH: 74'

RIGHT OF WAY WIDTH: 102' (min.) plus 30' (min.) utility easement.

TRAVEL LANES: 5 lanes, 11' wide

LEFT TURN LANE: 12' wide

BIKE LANES: Two lanes, 6.5' wide lane, 3' wide painted buffer.

BIKE LANE OPTIONS: Striped bike lane and protected bike lane options will require City Engineer approval.

PARKING: None.

PARKWAY: 8' (min.) width. Additional width optional.

SIDEWALK: 6' (min.) width. Additional width may be required for higher pedestrian traffic in and leading to activity areas or as required by Area Plans.

MEDIAN: Not required, except where necessary to control access and/or to provide pedestrian refuge or where Developer requested medians are approved by the local entity. Additional roadway and right of way width may be required.

WHERE USED: These specifications shall apply as required by the Local Entity when a 4-lane arterial street is shown on the Master Street plan in constrained right of way situation after review and approval of the City Engineer.

DESIGN SPEED: 50 MPH

SPEED LIMIT: 35-45 MPH

ACCESS: Access will be limited. Points of access must be approved by the Local Entity.

CONTINUITY: Unlimited

FENCES: Fences shall be setback a minimum of 2' from back of sidewalk or on the property line, whichever is greater.

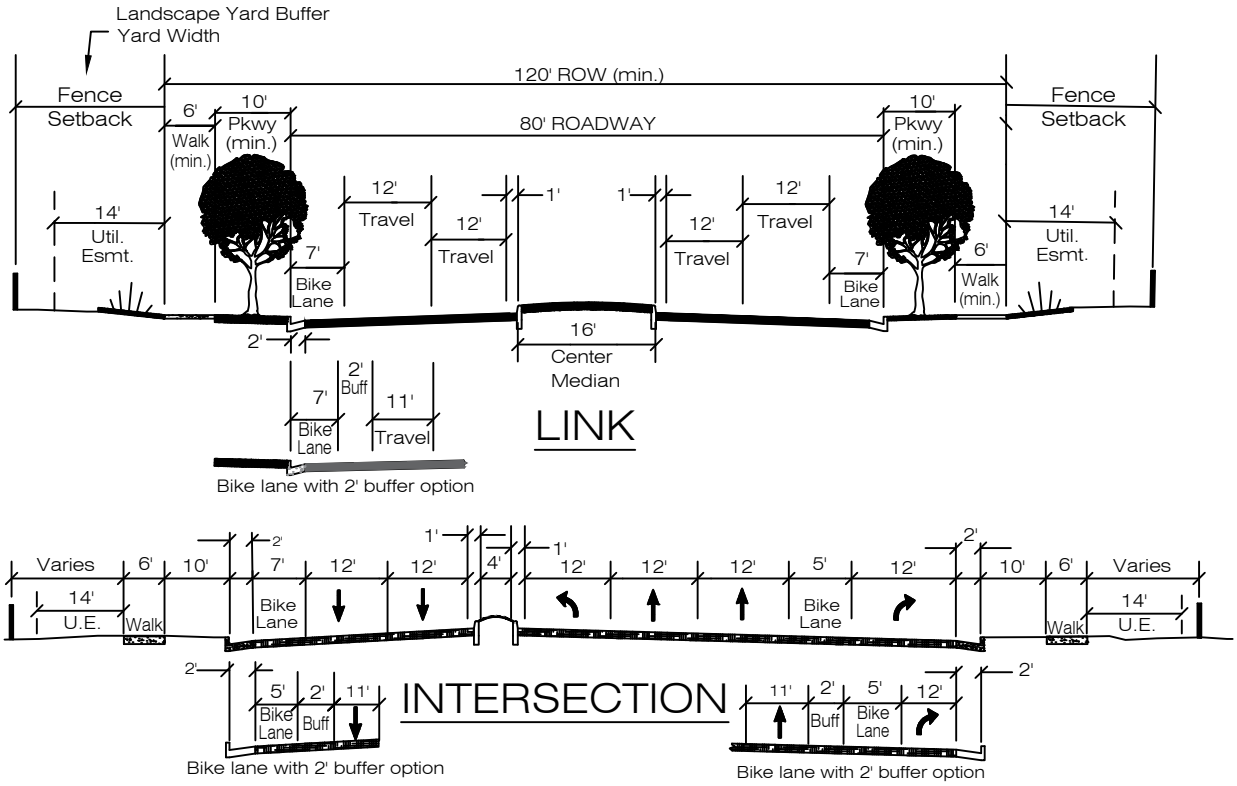
LANDSCAPING: See Appendix "C"

CURB AND GUTTER: Vertical curb and gutter.

4-LANE MODIFIED ARTERIAL STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	7-2.5F

LOVELAND ONLY



ROADWAY WIDTH: 80' between intersections; 104' at intersections; 116' at intersections with double left turn lanes.

RIGHT OF WAY WIDTH: 120' (min.) between intersections; 140' at intersections plus 28' (min.) utility easement.

TRAVEL LANES: 4 lanes, 12' wide (exclusive of gutter or 12" from face of curb where no gutter).
11' with Buffered Bike Lane option.

LEFT TURN LANE: 12' wide, required at intersection.

BIKE LANES: 2 lanes, 5' wide (exclusive of gutter).

BUFFERED BIKE LANES OPTIONS: Options will vary depending on the project and will require City Engineer approval.

PARKING: None.

PARKWAY: 10' (min.) width. Additional width optional.

SIDEWALK: 6' (min.) wide if detached by at least 10'. Additional width may be required for higher pedestrian traffic in and leading to activity areas.

MEDIAN: Center Median:18' wide (6' wide in left turn lane area). Colored concrete, painted, or landscaped. See **Table 7-2**. (6" concrete flag stone brown)

WHERE USED: These specifications shall apply as required by the Local Entity when a major arterial street is shown on the Master Street Plan, or when the traffic volume on the street is anticipated to be 16,001 to 32,000 vpd..

DESIGN SPEED: 50 MPH

POSTED SPEED: 45 MPH

ACCESS: No primary access to individual lots permitted. 1/2 mile spacing for signalized intersections.

CONTINUITY: Unlimited.

FENCES: Fences shall be placed outside of the landscaping buffer yard.

LANDSCAPING: Tree, Lawn, Median, and Buffer Area landscaping maintenance shall be the responsibility of the adjacent property owner, HOA, or Metro Districts.

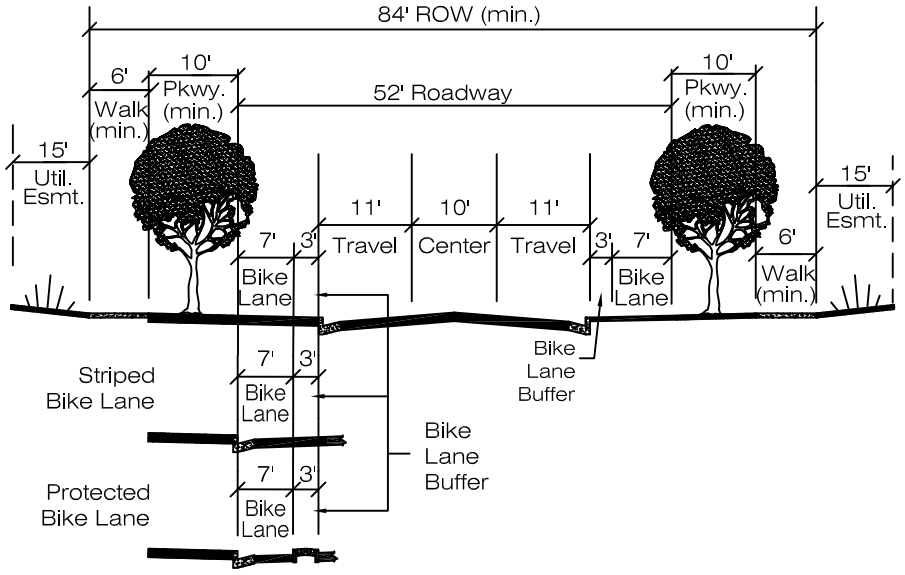
CURB AND GUTTER: Vertical curb and gutter.

Note: Cross Section may vary on State Highways, approved corridor studies or adopted IGA's with adjacent jurisdrictions.

4-LANE ARTERIAL STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	7-2L

FORT COLLINS ONLY



ROADWAY WIDTH: 52'

RIGHT OF WAY WIDTH: 84' (min.), plus 18' (min.) utility easement.

TRAVEL LANES: Three lanes, (2) 11' wide and a 10' center lane.

LEFT TURN LANES: 10' wide provided in center lane.

BIKE LANES: Two lanes, 7' wide lane, 3' wide painted buffer.

BIKE LANE OPTION: Striped bike lane and protected bike lane options will require City Engineer approval.

PARKING: None

PARKWAY: 10' (min.) width. Additional width optional.

SIDEWALK: 6' (min.) wide. Additional width may be required for higher pedestrian traffic in and leading to activity areas.

MEDIAN: Not required, except where necessary to control access and/or to provide pedestrian refuge or where developer requested medians are approved by the local entity. Additional roadway and right of way width may be required.

WHERE USED: These specifications shall apply as required by the Local Entity when a Collector street is shown on the Master Street Plan.

DESIGN SPEED: 50 MPH

SPEED LIMIT: 30 - 45 MPH

ACCESS: Access will be limited. Points of access must be approved by the Local Entity.

CONTINUITY: Unlimited

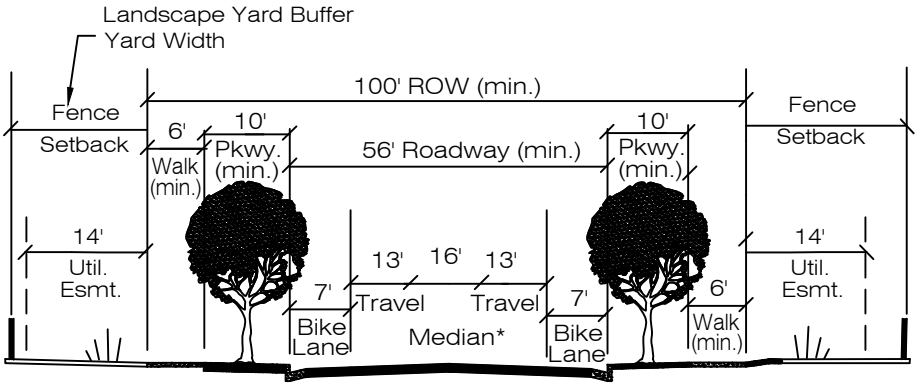
FENCES: Fences shall be setback a minimum of 2' from back of sidewalk on the property line, whichever is greater.

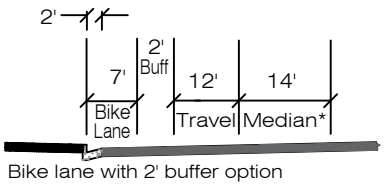
CURB AND GUTTER: Vertical.

2-LANE ARTERIAL STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	7-3F

LOVELAND ONLY





Bike lane with 2' buffer option

* Continuous left turn lane as determined by the Local Entity. Additional auxiliary lanes may be needed as determined by the Local Entity. Raised median may be required.

ROADWAY WIDTH: 56' (min.) (Widen where a right turn lane is required).

RIGHT OF WAY WIDTH: 100' (min.) plus 28' (min.) utility easement.

TRAVEL LANES: Two lanes, 13' wide. 12' wide with Buffered Bike Lane option.

LEFT TURN LANES: 12' wide, required at intersection.

BIKE LANES: Two lanes, 5' wide (exclusive of gutter).

BUFFERED BIKE LANE OPTIONS: Options will vary depending on the project and will require Engineer approval.

PARKING: None

PARKWAY: 10' (min.) width. Additional roadway and right of way width optional.

SIDEWALK: 6' (min.) wide if detached by at least 10'. Additional width may be required for higher pedestrian traffic in and leading to activity areas.

MEDIAN: 14' (min.) Painted median if required or 16' (min.) raised median if required.

WHERE USED: These specifications shall apply as required by the Local Entity when a Collector street is shown on the Master Street Plan or when the traffic volume on the street is anticipated to be 7,000 to 16,000 vpd. See **Table 7-2**.

DESIGN SPEED: 45 MPH

POSTED SPEED: 40 MPH

ACCESS: No primary access to individual lots. See **Table 7-2**.

CONTINUITY: Unlimited

FENCES: Fences shall be placed outside of the landscaped buffer yard.

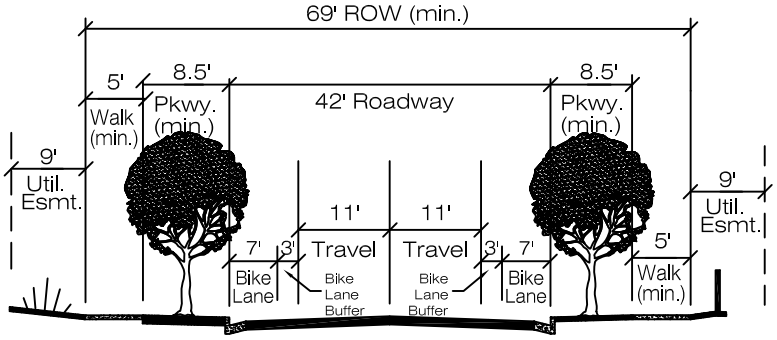
LANDSCAPING: Tree, Lawn, Median, and Buffer Area landscaping maintenance shall be the responsibility of the adjacent property owner, HOA or Metro Districts.

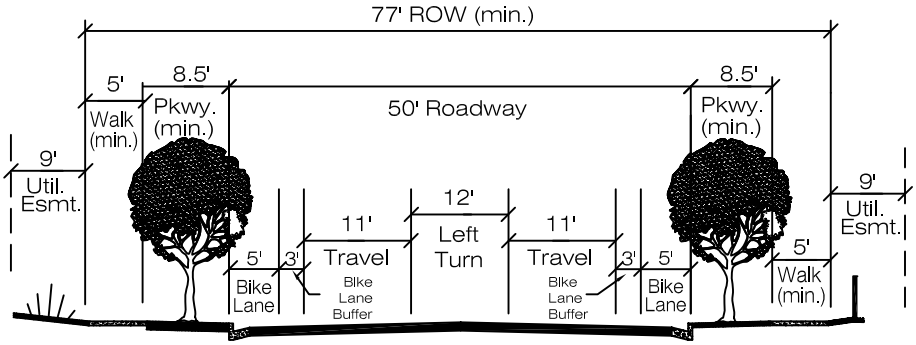
CURB AND GUTTER: Vertical.

2-LANE ARTERIAL STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	7-3L

FORT COLLINS ONLY





INTERSECTIONS
(WHERE NEEDED)

ROADWAY WIDTH: 42' (Widen to 50' where a left turn lane is required).

RIGHT OF WAY WIDTH: 69' (min.) (Widen to 77' where a left turn lane is required.) plus 18' (min.) utility easement.

TRAVEL LANES: Two lanes, 11' wide

LEFT TURN LANES: 12' wide at intersection where needed.

BIKE LANES: Two lanes, 7' wide lane, 3' wide painted buffer.

PARKING: None. Parking must be provided off street for any development adjoining the street.

PARKWAY: 8' (min.) width. Additional width optional.

SIDEWALK: 5' (min.) width. Additional width may be required for higher pedestrian traffic within and leading to activity areas.

MEDIAN: Not required, except where necessary to control access and/or to provide pedestrian refuge or when requested by the Developer and approved by the Local Entity. Additional roadway and right of way width may be required.

WHERE USED: These specifications shall apply as required by the Local Entity, when a Collector street is shown on the Master Street Plan.

DESIGN SPEED: 40 MPH

SPEED LIMIT: 30-35 MPH

ACCESS: Access will be limited. Points of access must be approved by the Local Entity.

CONTINUITY: The street shall be continuous for no more than 1320 feet.

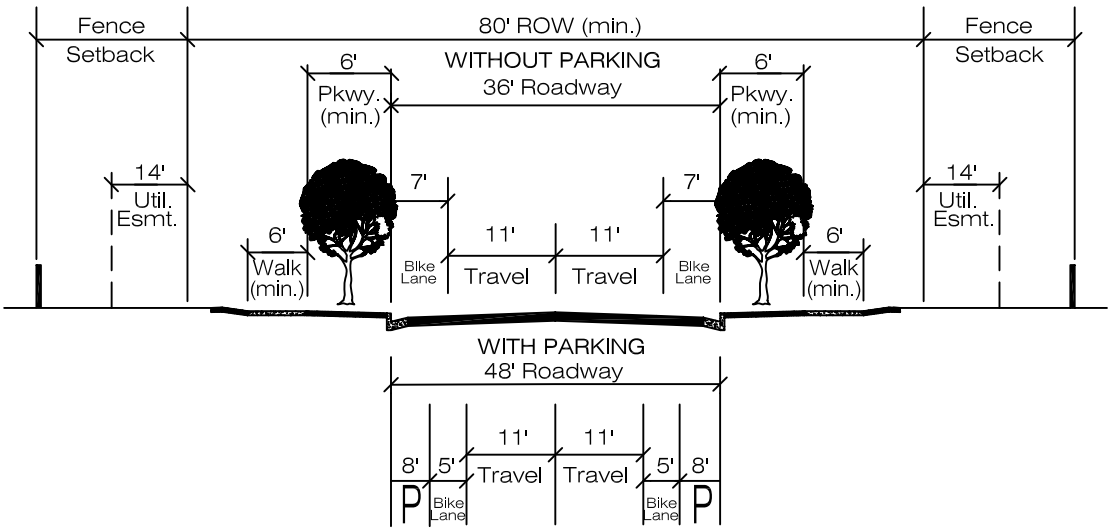
FENCES: Fences shall be setback a minimum of 2' from back of sidewalk or on the property line, whichever is greater.

CURB AND GUTTER: Vertical curb and gutter.

COLLECTOR – WITHOUT PARKING

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	7-4F

LOVELAND ONLY



ROADWAY WIDTH: 48' with parking. 36' without parking. 50' without parking but with left turn lane.

RIGHT OF WAY WIDTH: 80' (min.) plus 14' (min.) utility easement each side.

TRAVEL LANES: Two lanes, 11' wide.

BIKE LANES: Two lanes, 5' wide when adjacent to a parking or turn lane, 7' wide when adjacent to the curb.

PARKING: Developer needs to demonstrate a need for parking if to be installed (No parking within 200' of intersections)

PARKWAY: 6' (min.) width.

SIDEWALK: 6' (min.) width, detached.
Additional width may be required for higher pedestrian traffic in and leading to activity areas.

MEDIAN: None. Additional width would be required for development requested medians.

WHERE USED: These specifications shall apply as required by the Local Entity, when a Collector street is shown on the Master Street Plan or when the traffic volume on the street is anticipated to be in the range of 3,001 to 7,000 vehicles per day.

DESIGN SPEED: 35 MPH - If intersections are greater or equal to 1/2 mile spacing the City can increase the Posted Speed.

ACCESS: 1 forward-direction access per lot (if access cannot be provided from a street of lower classification.

CONTINUITY: 2 miles

FENCES: Fences shall be placed outside of the landscaped buffer yard.

PARKWAY LANDSCAPING: Tree Lawn, Median, and Buffer Area landscaping shall be the responsibility of the adjacent property owner, HOA or Metro Districts.

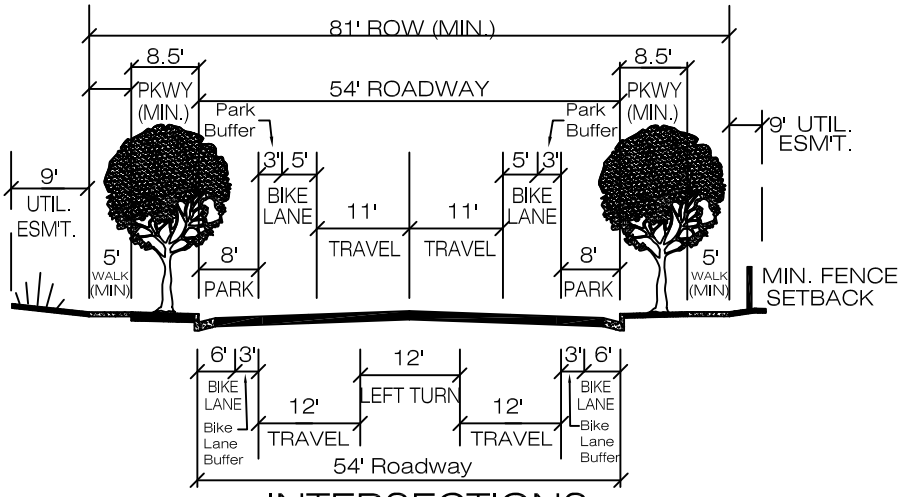
CURB AND GUTTER: Vertical.

STRIPING: The centerline and separate bike and parking lanes shall be marked on the pavement in conformance with the requirements of Chapter 14 Traffic Control Devices and CONST. DWG. 1408L.

MAJOR COLLECTOR/COMMERCIAL COLLECTOR STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1	FIGURE
		DATE: 07/01/21	7-4L

FORT COLLINS ONLY



INTERSECTIONS (WHERE NEEDED)

ROADWAY WIDTH: 54'

RIGHT OF WAY WIDTH: 81' (min.) plus 18' (min.) utility easement.

TRAVEL LANES: Two lanes, 81' (min.) plus 18' (min.) utility easement.

LEFT TURN LANES: 12' wide at intersections where needed.

BIKE LANES: Two lanes, 5' or 6' wide lane, 3' wide painted buffer.

PARKING: Two lanes, 8' wide; parking may be removed at certain locations to provide a left turn lane at intersections where needed.

PARKWAY: 8' (min.) width. Additional width optional.

SIDEWALK: 5' (min.) width. Additional width may be required for higher pedestrian traffic within and leading to activity areas or as required by Area Plans.

MEDIAN: Not required, except where necessary to control access and/or to provide pedestrian refuge. additional roadway and ROW width may be required.

WHERE USED: These specifications shall apply as required by the Local Entity, when a Collector street is shown on the Master

DESIGN SPEED: 40 MPH

SPEED LIMIT: 25-30 MPH

ACCESS: Access will be limited. Points of access must be approved by the Local Entity.

CONTINUITY: The street shall be continuous for no more than 1320 feet.

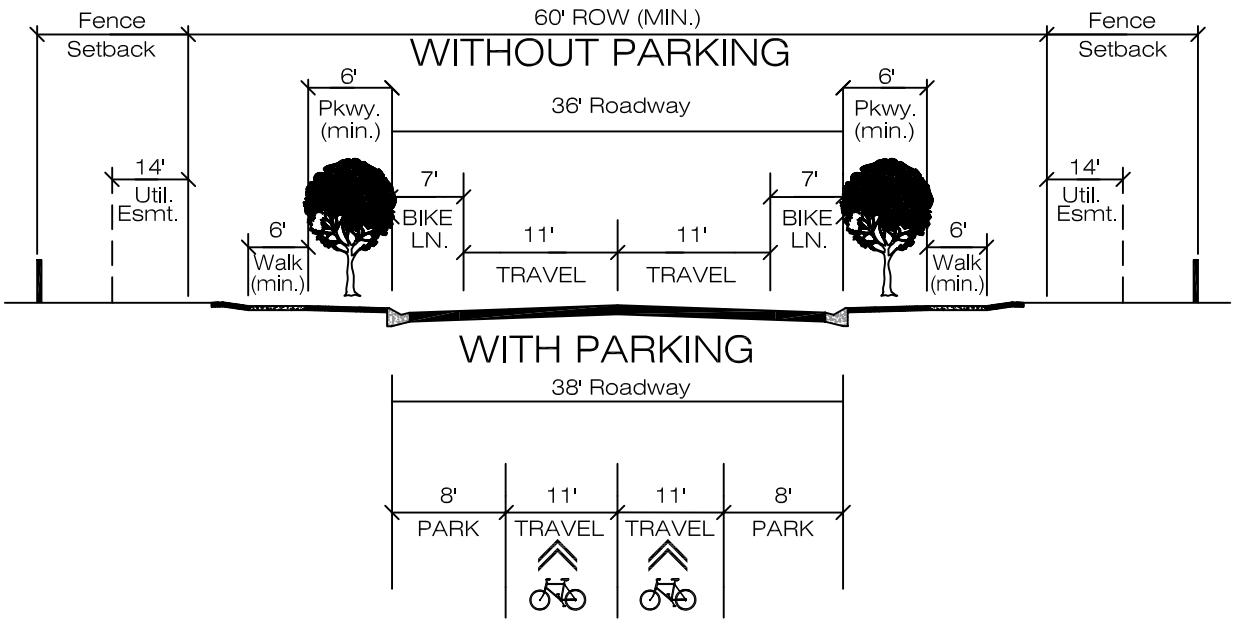
FENCES: Fences shall be setback a minimum of 2' from back of sidewalk or on the property line, whichever is greater.

CURB AND GUTTER: Vertical curb and gutter.

COLLECTOR - WITH PARKING

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	7-5F

LOVELAND ONLY



ROADWAY WIDTH: 38' with parking: 36' without parking.

RIGHT OF WAY WIDTH: 60' (min.) plus 28' (min.) utility easement.

TRAVEL LANES: Two lanes, 11' wide.

LEFT TURN LANES: 11' wide at intersections where needed.

BIKE LANES: Two lanes, 7' wide. If parking approved on street sharrows as per MUTCD standard shall be installed

PARKING: Developer needs to demonstrate a need for parking if to be installed (None provided at intersections)

PARKWAY: 6' (min.) width.

SIDEWALK: 6' (min.) width, detached.

MEDIAN: None. Additional roadway and right of way width would be required for development requested medians.

WHERE USED: These specifications shall apply as required by the Local Entity when a Collector street is shown on the Master Street Plan or when the traffic volume on the street is anticipated to be in the range of 1,000 to 3,000 vehicles per day.

DESIGN SPEED: 30 MPH

POSTED SPEED: 25 MPH

ACCESS: Maximum of two (2) per lot per street frontage.

CONTINUITY: The street shall be continuous for no more than 2640 feet.

FENCES: Fences shall be placed outside of the landscaped buffer yard.

LANDSCAPING: Tree, Lawn, Median, and Buffer Area landscaping shall be the responsibility of the adjacent property owner, HOA or Metro Districts.

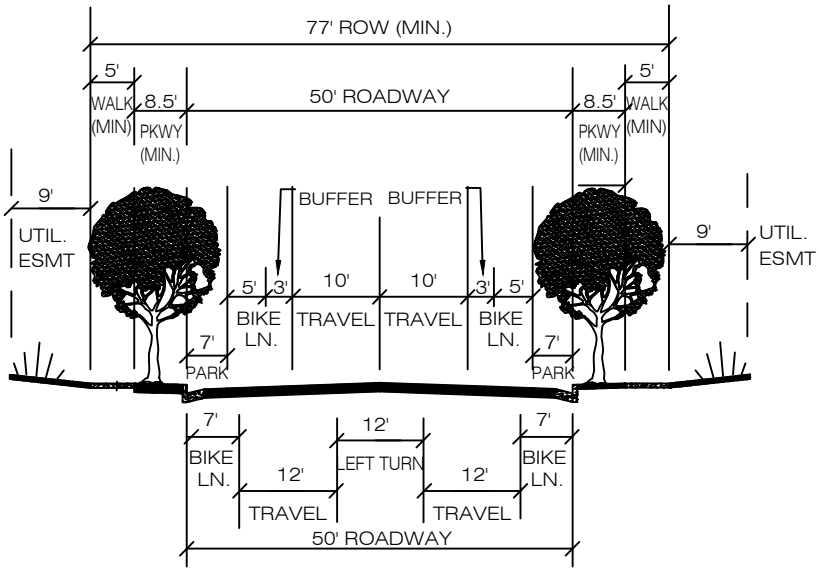
CURB AND GUTTER: Vertical, drive-over, or rollover (see in table 7-2).

STRIPING: Center line only.

MINOR COLLECTOR STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1	FIGURE
		DATE: 07/01/21	7-5L

FORT COLLINS ONLY



INTERSECTIONS
(WHERE NEEDED)

ROADWAY WIDTH: 50' wide

RIGHT OF WAY WIDTH: 77' (min.), plus 18' (min.) utility easement.

TRAVEL LANES: Two lanes, 10' wide.

LEFT TURN LANES: 12' wide, provided at certain intersections where needed.

BIKE LANES: Two lanes, 5' wide with 3' buffer. The buffer may be moved to the parking side if there if there is a high parking turnover rate and traffic is anticipated to be slower than standard speeds.

PARKING: Two lanes, 7' wide. None provided at intersections or where a left turn lane is required.

PARKWAY: 8' (min.) width. Additional width optional.

SIDEWALK: 5' (min.) width. Additional width may be required within and leading to activity areas.

MEDIAN: Not required, except where necessary to control access and/or to provide pedestrian refuge. Additional roadway and right of way width may be required.

WHERE USED: These specifications shall apply to streets used in commercial areas for local access and circulation.

DESIGN SPEED: 30 MPH

SPEED LIMIT: 25 MPH

ACCESS: Access will be limited. Points of access must be approved by the Local Entity.

CONTINUITY: Streets are limited in length to 1320 feet.

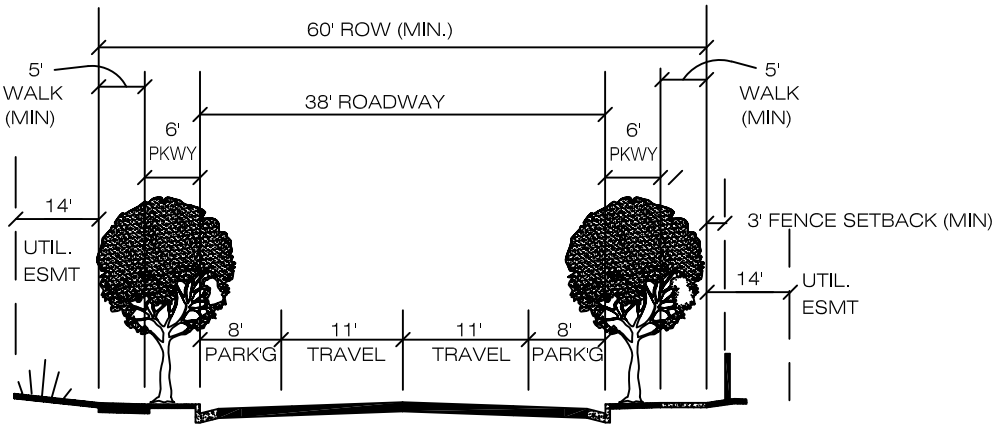
FENCES: Setback a minimum of 2' from back of the sidewalk or on the property line, whichever is greater.

CURB AND GUTTER: Vertical curb and gutter.

COMMERCIAL LOCAL STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	7-6F

LOVELAND ONLY



ROADWAY WIDTH: 38' wide (with parking).

RIGHT OF WAY WIDTH: 60' (min.) plus 28' (min.) utility easement.

LEFT TURN LANES: 11' wide at intersections where needed.

BIKE LANES: Share street.

PARKING: Two lanes wide shared with bikes. None provided at intersections.

PARKWAY: 6' (min.) width.

SIDEWALK: 5' (min.) width detached. Additional width may be required within and leading to activity areas.

MEDIAN: None. Additional width required for development requesting medians.

WHERE USED: These specifications shall apply to streets used in commercial areas for local access and circulation, when the traffic volume on the street is anticipated to be in the range of 201 to 1,000 ADT.

DESIGN SPEED: 30 MPH

POSTED SPEED: 25 MPH

ACCESS: No limit.

CONTINUITY: Streets are limited in length to 660 feet.

FENCES: Setback a minimum of 3' from the edge of the sidewalk.

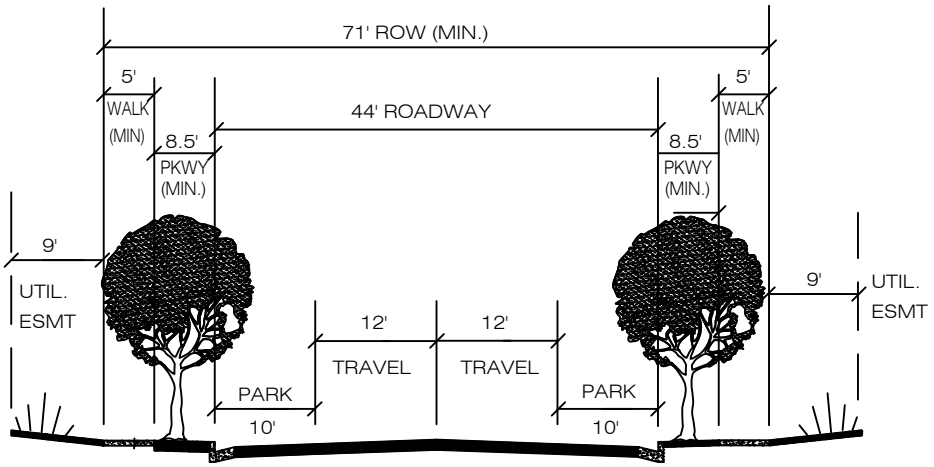
PARKWAY LANDSCAPING: Tree Lawn, Median, and Buffer Area landscaping shall be the responsibility of the adjacent property owner, HOA or Metro Districts.

CURB AND GUTTER: Vertical, rollover, or driveover.

COMMERCIAL/INDUSTRIAL LOCAL STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/1/21	7-6L

FORT COLLINS ONLY



ROADWAY WIDTH: 44' wide

RIGHT OF WAY WIDTH: 71' (min.) plus 18' (min.) utility easement.

TRAVEL LANES: Two lanes, 12' wide.

LEFT TURN LANES: None. If needed, parking would be prohibited.

BIKE LANES: Bicyclists shall share the travel lanes with motor vehicles. Additional width may be required in the parking lanes to provide 14' wide bike/parking shared lanes within and leading to activity areas.

PARKING: Two lanes 10' wide.

PARKWAY: 8' (min.) width. Additional width optional.

SIDEWALK: 5' (min.) width. Additional width may be required within and leading to activity areas.

MEDIAN: Not required, except where necessary to control access and/or to provide pedestrian refuge. Additional roadway and right of way width may be required.

WHERE USED: These specifications shall apply to streets used in industrial areas for local access and circulation.

DESIGN SPEED: 30 MPH

SPEED LIMIT: 25 MPH

ACCESS: Access will be limited. Points of access must be approved by the Local Entity.

CONTINUITY: Streets are limited in length to 1320 feet.

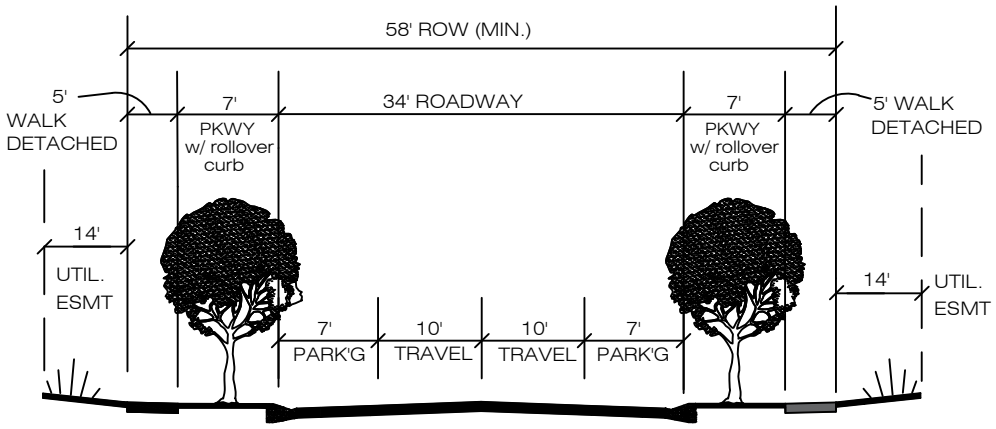
FENCES: Setback a minimum of 2' from back of sidewalk or on the property line, whichever is greater.

CURB AND GUTTER: Vertical curb and gutter.

INDUSTRIAL LOCAL STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	7-7F

LOVELAND ONLY



ROADWAY WIDTH: 34' wide (with parking).

RIGHT OF WAY WIDTH: 58' (min.) plus 28' (min.) utility easement.

BIKE LANES: Share street.

PARKING: Two lanes 7' wide shared with bikes.

PARKWAY: 6' (min.) width where vertical curb is used. 7' (min) where drive over or rollover is used.

SIDEWALK: 5' (min.) width detached. Additional width may be required within and leading to activity areas.

MEDIAN: None. Additional width required for development requesting medians.

WHERE USED: These specifications shall apply to streets used in residential areas for local access and circulation, when the traffic volume on the street is anticipated to be in the range of 201 to 1,000 vpd.

DESIGN SPEED: 25 MPH

SPEED LIMIT: 25 MPH

ACCESS: No limit.

CONTINUITY: Streets are limited in length to 660 feet.

FENCES: Setback a minimum of 3' from the edge of the sidewalk.

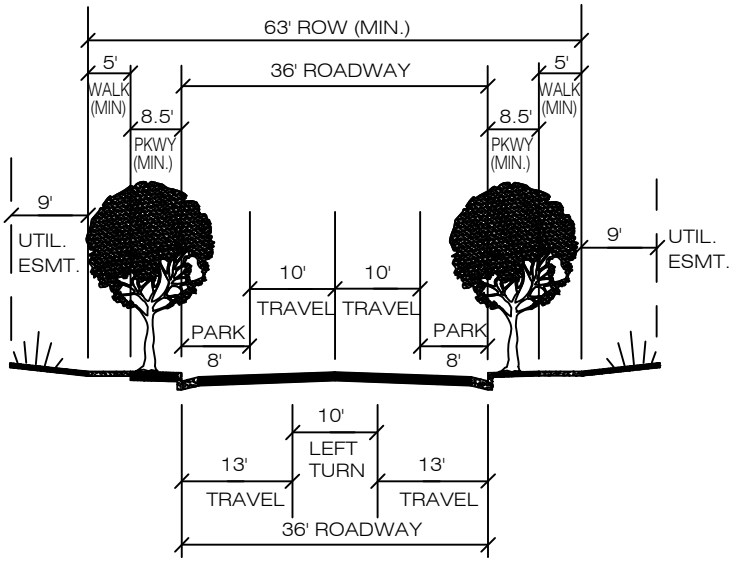
PARKWAY LANDSCAPING: Tree, Lawn, Median, and Buffer Area landscaping shall be the responsibility of the adjacent property owner, HOA or Metro Districts.

CURB AND GUTTER: Vertical, rollover, or driveover.

RESIDENTIAL LOCAL STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	7-7L

FORT COLLINS ONLY



INTERSECTIONS
(WHERE NEEDED)

ROADWAY WIDTH: 36' wide without bike lane; 42' wide with bike lane; 36'; wide with left turn lane.

RIGHT OF WAY WIDTH: 63' (min) plus 18' (min.) utility easement.

TRAVEL LANES: Two lanes, 10' wide, 13' wide at intersections shared with bicyclists, or 10' wide where bike lanes are required.

LEFT TURN LANES: 10' wide, at intersections where needed.

BIKE LANES: Bicyclists shall share the roadway with motor vehicles in the travel lanes. Additional street width may be required to add bike lanes 6' wide on each side to accommodate bike traffic within and leading to activity areas.

PARKING: Two lanes 8' wide. Parking will be removed at intersections where a left turn lane is required.

PARKWAY: 8' (min.) width. Additional width optional.

SIDEWALK: 5' (min.) width. Additional width may be required for higher pedestrian traffic serving activity areas.

MEDIAN: Not required, except where necessary to control access and/or to provide pedestrian refuge. Additional roadway and right of way width may be required.

WHERE USED: These specifications shall apply to streets providing local access and in areas without driveways.

DESIGN SPEED: 30 MPH

SPEED LIMIT: 25 MPH

ACCESS: Access will be limited. Points of access must be approved by the Local Entity.

CONTINUITY: The street shall be continuous for no more than 1320 feet.

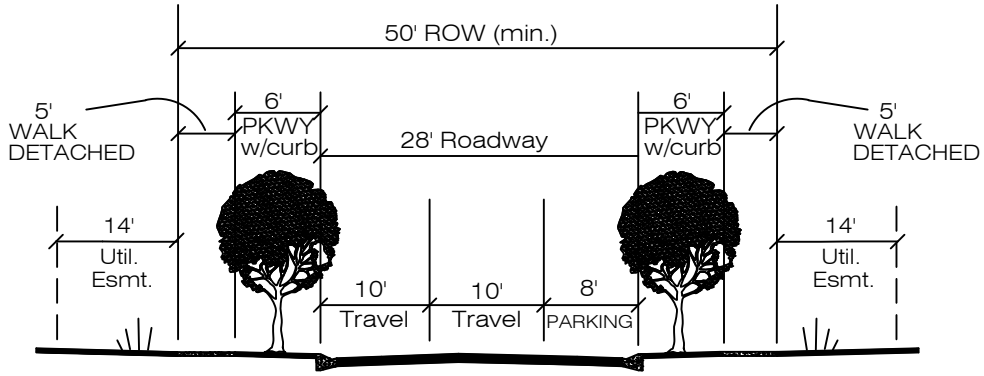
FENCES: Fences shall be setback a minimum of 2' from back of sidewalk or on the property line, whichever is greater.

CURB AND GUTTER: Vertical curb and gutter.

CONNECTOR LOCAL STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	7-8F

LOVELAND ONLY



ROADWAY WIDTH: 28' Wide with parking on one side, 34' with parking on both sides.

RIGHT OF WAY WIDTH: 50' (min.) plus 28' (min.) utility easement.

BIKE LANES: Share street.

PARKING: One side for 28' roadway; both sides for 34' roadway.

PARKWAY: 5' (min.) width where vertical curb is used. 6' (min) where drive over or rollover is used.

SIDEWALK: 5' (min.) width detached. Additional width may be required within and leading to activity areas.

MEDIAN: None. Additional width required for development requesting medians.

WHERE USED: These specifications shall apply to streets used in residential areas for local access and circulation, when the traffic volume on the street is anticipated to be up to 500 vpd.

AFFORDABLE HOUSING USE: In accordance with the Unified Development Code Section 18.17.15.04.F.1, these specifications may be used in designated affordable housing developments for local access and circulation, when the traffic volume on the street is anticipated to be up to 1,000 vpd. Any modifications to the specifications will require City Engineer approval in accordance with the Unified Development Code Section 18.17.15.04.F.2.

DESIGN SPEED: 20 MPH

SPEED LIMIT: 20 MPH

ACCESS: No limit.

CONTINUITY: Streets are limited to 660 feet.

FENCES: Setback a minimum of 3' from the edge of the sidewalk.

PARKWAY LANDSCAPING: Tree, Lawn, Median, and Buffer Area landscaping maintenance shall be the responsibility of the adjacent property owner, HOA or Metro Districts.

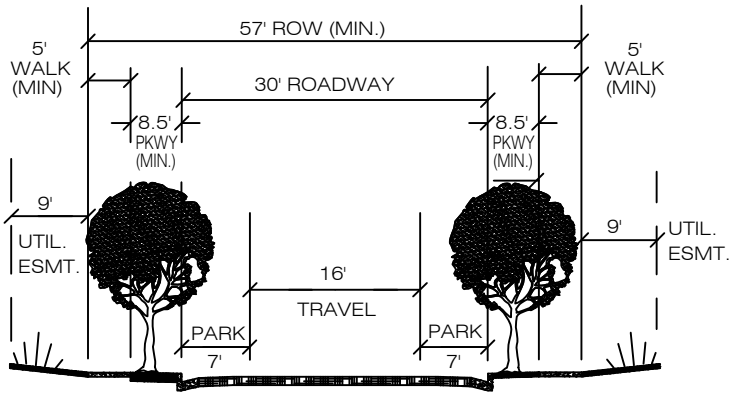
CURB AND GUTTER: Vertical, rollover, or driveover.

SIGNS: "No Parking" signs are required on one side of the street for restricted parking if roadway width is less then 34'.

LANE

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	7-8L

FORT COLLINS ONLY



ROADWAY WIDTH: 30' wide.

RIGHT OF WAY WIDTH: 57' (min.), plus 18' (min.) utility easement.

TRAVEL LANES: 16' wide.

LEFT TURN LANES: None.

BIKE LANES: Bicyclists to share travel lane with motor vehicles. Additional street width, up to 4' wider, may be required in the travel lane to accommodate bike traffic to serve activity areas, such as schools and parks.

PARKING: Two lanes 7' wide.

SIDEWALK: 5' (min.) width. Additional width may be required for higher pedestrian traffic serving activity areas.

MEDIANS: None.

WHERE USED: May be used for residential local streets providing access to single family detached dwellings with driveways.

DESIGN SPEED: 25 MPH

SPEED LIMIT: 25 MPH

ACCESS: Access will be unlimited in accordance with these standards.

CONTINUITY: The street shall be continuous for no more than 1320 feet.

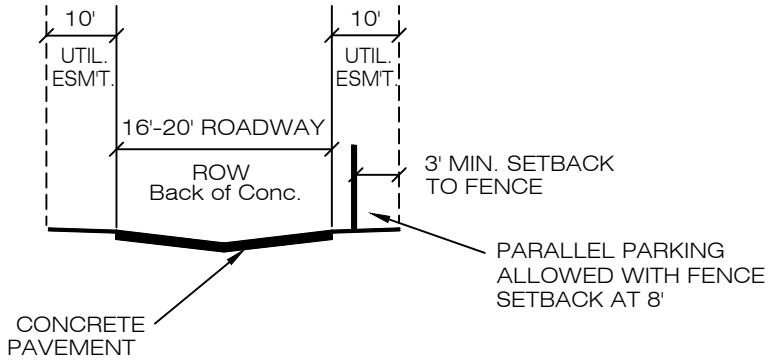
FENCES: Fences shall be setback a minimum of 2' from back of sidewalk or on the property line, whichever is greater.

CURB AND GUTTER: Vertical curb and gutter, or driveover. However, if driveover is used, the parkways must be widened by 1' and thereby, the required right of way width will increase by 2' to provide 59'.

RESIDENTIAL LOCAL STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	7-9F

LOVELAND ONLY



ROADWAY WIDTH: 16'-20' (20' min. width required for commercial and industrial areas or as required by City Engineer)

RIGHT OF WAY WIDTH: 16'-20' (20' min. width required for commercial and industrial areas or as required by City Engineer)

TRAVEL LANES: 16'-20' wide (exclusive of gutter 1' shy distance to curb).

PARKING: None. Parking must be provided on private property.

WHERE USED: Secondary access only unless otherwise approved by the City Engineer. Traffic volume is anticipated to be less than 200 ADT.

DESIGN SPEED: N/A.

ACCESS: Access will be unlimited.

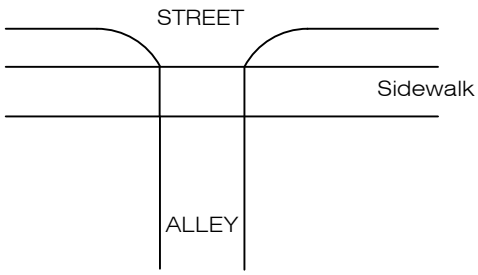
CONTINUITY: Streets are limited in length to 660 feet.

FENCES: Fences may be placed as close as 3' from the right of way line on private property.

DRIVEWAY CONNECTIONS TO ALLEYS: Driveway connections to alleys must be flared.

ALLEY CONNECTIONS TO STREETS: Where an alley intersects the right of way for a street, 10' x 10' corner cuts shall be dedicated R.O.W. for visibility as shown in Detail 1 below. These areas may be landscaped no higher than 24". No fences may encroach.

GARAGE DOOR SET BACK: Setbacks shall be in accordance with the Unified Development Code.



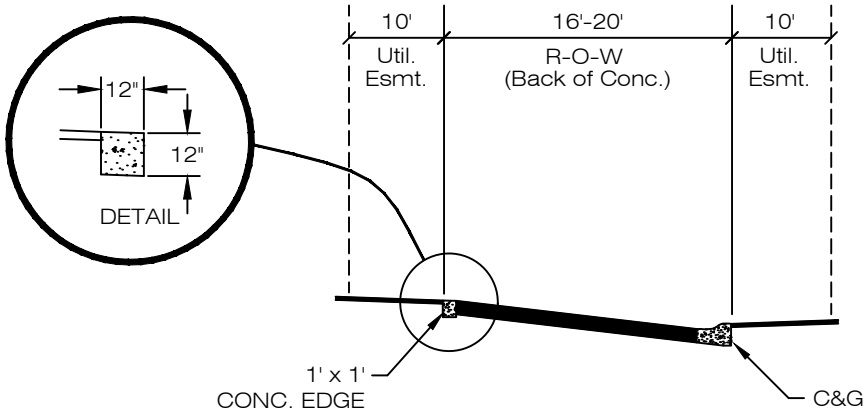
DETAIL 1

Alley Width FT.	Driveway Flare	
	a FT.	b FT.
20	0	0
18	2'	6'
16	4'	8'

ALLEY OPTION (A) (DRAINAGE TO CENTER)

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1	FIGURE
		DATE: 07/01/21	7-9L

LOVELAND ONLY



ROADWAY WIDTH: 16' to 20' (20' min. width required for commercial and industrial areas or as required by City Engineer)

RIGHT OF WAY WIDTH:16' to 20' (20' min. width required for commercial and industrial areas or as required by City Engineer)

TRAVEL LANES: 16'-20' wide (exclusive of gutter 1' shy distance to curb).

PARKING: None. Parking must be provided on private property.

WHERE USED: Secondary access only unless otherwise approved by the City Engineer. Traffic volume is anticipated to be less than 250 ADT.

DESIGN SPEED: N/A.

ACCESS: Access will be unlimited.

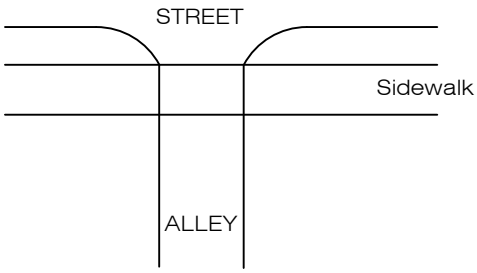
CONTINUITY: Streets are limited in length to 660 feet.

FENCES: Fences may be placed as close as 3' from the right of way line on private property.

DRIVEWAY CONNECTIONS TO ALLEYS: Driveway connections to alleys must be flared.

ALLEY CONNECTIONS TO STREETS: Where an alley intersects the right of way for a street, 10' x 10' corner cuts shall be dedicated R.O.W. for visibility as shown in Detail 1 below. These areas may be landscaped no higher than 24". No fences may encroach.

GARAGE DOOR SETBACK: Setbacks shall be in accordance with the Unified Development Code.



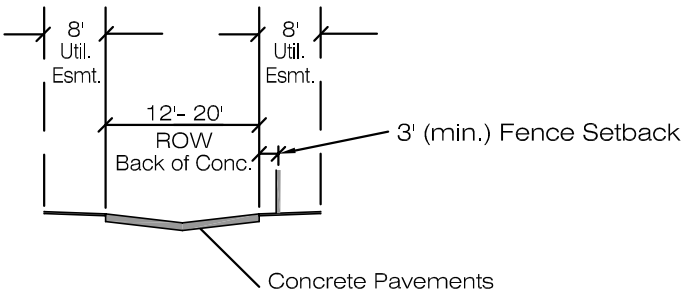
DETAIL 1

Alley Width FT.	Driveway Flare	
	a FT.	b FT.
20	0	0
18	2'	6'
16	4'	8'

ALLEY OPTION (B) (DRAINAGE TO ONE SIDE)

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1	FIGURE
		DATE: 07/01/21	7-10L

FORT COLLINS ONLY



ROADWAY WIDTH: 12' to 20'. (20' width required for commercial and industrial areas)

RIGHT OF WAY WIDTH: 12' to 20'. (20' width required for commercial and industrial areas)

PARKING: None. Parking must be provided on private property.

WHERE USED: An alley may be used to provide secondary vehicular access only to the rear of properties served by a street, if allowed by city code.

DESIGN SPEED: 15 MPH

SPEED LIMIT: 15 MPH.

DRIVEWAY CONNECTIONS TO ALLEYS: Driveway connections to alleys must be flared in accordance with Detail 1.

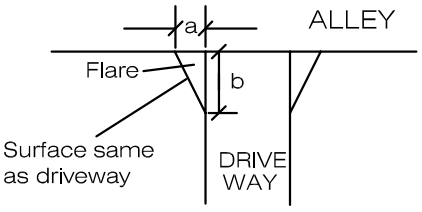
ALLEY CONNECTIONS TO STREETS: Where an alley intersects the right of way for a street 10' x 10' corner cuts shall be dedicated as R.O.W. for visibility as shown in Detail 2 below. These areas may be landscaped no higher than 12". No fences may encroach into this area.

CONTINUITY: Alleys are limited in length to 660 feet.

GARAGE DOOR SET BACK: * Option 1: 8' for fences placed with a setback equal to 8' or more.
Option 2: 20' feet minimum for fences placed less than 8' from the edge of the alley.

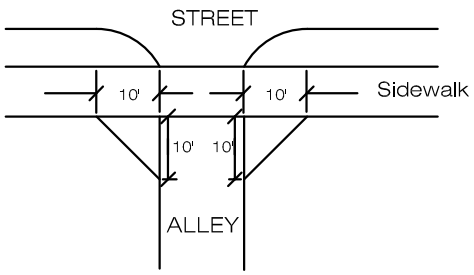
FENCES: Fences may be placed as close as 3' from the right-of-way line on private property when the garage door is set back at least 20' from the right-of-way. Minimum setback is 8' for garage door setback less than 20' from the right-of-way.

* Building setbacks shall be in accordance with the Land Use Code.



DETAIL 1

Alley Width FT.	Driveway Flare a FT.	Driveway Flare b FT.
20	0	0
18	2'	6'
16	4'	8'
14	5'	8'
12	6'	8'

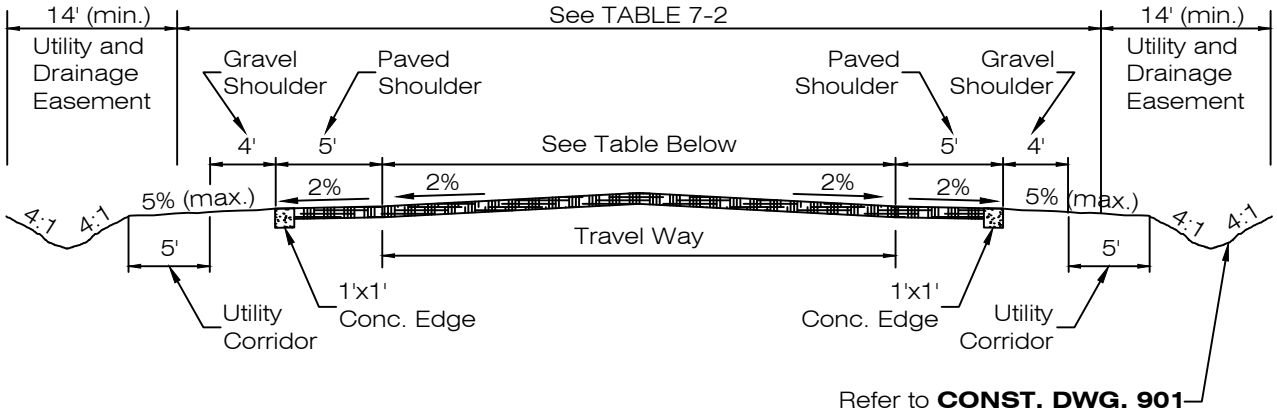


DETAIL 2

ALLEY OPTION (A) (Drainage to Center)

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1	FIGURE
		DATE: 04/01/07	7-11F

LOVELAND ONLY



CLASSIFICATION	WIDTH OF TRAVEL WAY
Lane	18'
Local	22'
Collector	24'
Arterial	Per Local Entity

ROADWAY WIDTH: See table above.

RIGHT OF WAY WIDTH: See **TABLE 7-2.**

PARKING: No parking permitted on arterial roads. Shoulder may be used for parking on other roads.

CURB AND GUTTER: optional

WHERE USED: These specifications may be used for estate type developments / 2.5 min. acre lots or within separator or transition areas as recommended in other studies adopted by local entities.

DESIGN SPEED: See **TABLE 7-4.**

SPEED LIMIT: See **TABLE 7-4.**

GARAGE DOOR SETBACKS: Setbacks shall be in accordance with the Unified Development Code.

SIDEWALK: None.

BIKE LANES: Bicyclists may use the 5' paved shoulder or share the roadway with motor vehicles.

GRAVEL SHOULDERS: Surface shall be covered with a minimum of 6" Class 5 or 6 Roadbase.

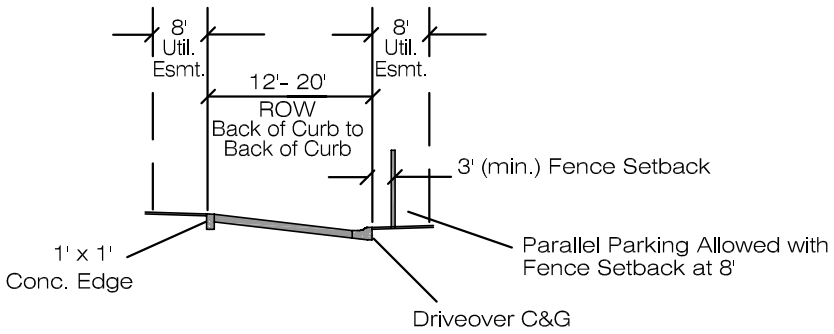
CONTINUITY: See **TABLE 7-2.**

DRAINAGE MAINTENANCE: The drainage ditches are the responsibility of the adjacent property owner, HOA or Metro District.

RURAL ROAD

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1	FIGURE
		DATE: 07/01/21	7-11L

FORT COLLINS ONLY



ROADWAY WIDTH: 12' to 20'. (20' width required for commercial and industrial areas)

RIGHT OF WAY WIDTH: 12' to 20'. (20' width required for commercial and industrial areas)

PARKING: None. Parking must be provided on private property.

WHERE USED: An alley may be used to provide secondary vehicular access only to the rear of properties served by a street, if allowed by city code.

DESIGN SPEED: 15 MPH

SPEED LIMIT: 15 MPH.

DRIVEWAY CONNECTIONS TO ALLEYS: Driveway connections to alleys must be flared in accordance with Detail 1.

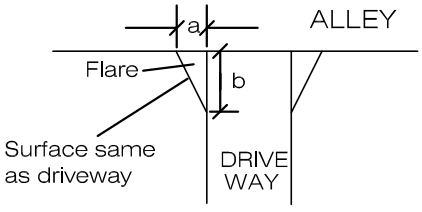
ALLEY CONNECTIONS TO STREETS: Where an alley intersects the right of way for a street 10' x 10' corner cuts shall be dedicated as R.O.W. for visibility as shown in Detail 2 below. These areas may be landscaped no higher than 12". No fences may encroach into this area.

CONTINUITY: Alleys are limited in length to 660 feet.

GARAGE DOOR SET BACK: * Option 1: 8' for fences placed with a setback equal to 8' or more.
Option 2: 20' feet minimum for fences placed less than 8' from the edge of the alley.

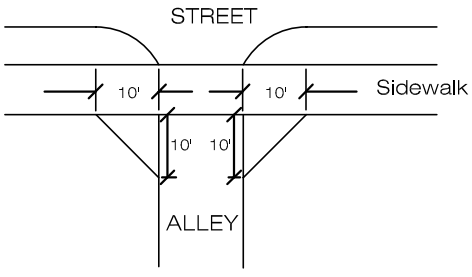
FENCES: Fences may be placed as close as 3' from the right-of-way line on private property when the garage door is set back at least 20' from the right-of-way. Minimum setback is 8' for garage door setback less than 20' from the right-of-way.

* Building setbacks shall be in accordance with the Land Use Code.



DETAIL 1

Alley Width FT.	Driveway Flare a FT.	Driveway Flare b FT.
20	0	0
18	2'	6'
16	4'	8'
14	5'	8'
12	6'	8'

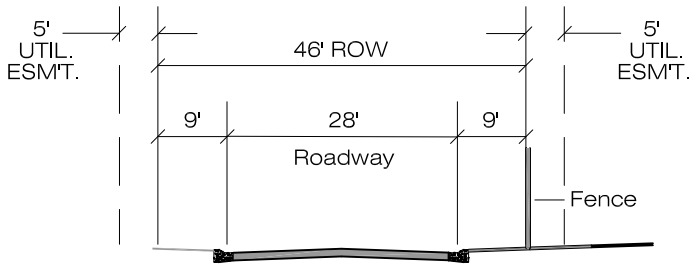


DETAIL 2

ALLEY OPTION (B) (Drainage to One Side)

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1 DATE: 04/01/07	FIGURE 7-12F

FORT COLLINS ONLY



ROADWAY WIDTH: 28'.

RIGHT OF WAY WIDTH: 46' (min.)

BIKE LANES: Bicyclists share the travel lanes with motor vehicles.

PARKWAY: Both sides of the street.

PARKING: Both sides of street.

CURB AND GUTTER: Drive over or vertical curb and gutter.

WHERE USED: These specifications may be used for internal local streets of developments, with minimum lot sizes of one (1) acre or larger, and when the traffic volume, on the street is anticipated to be less than 300 vpd.

ACCESS: Access will be unlimited in accordance with these standards.

CONTINUITY: Streets are limited in length to 1,320 feet.

DESIGN SPEED: 25 MPH

SPEED LIMIT: 25 MPH

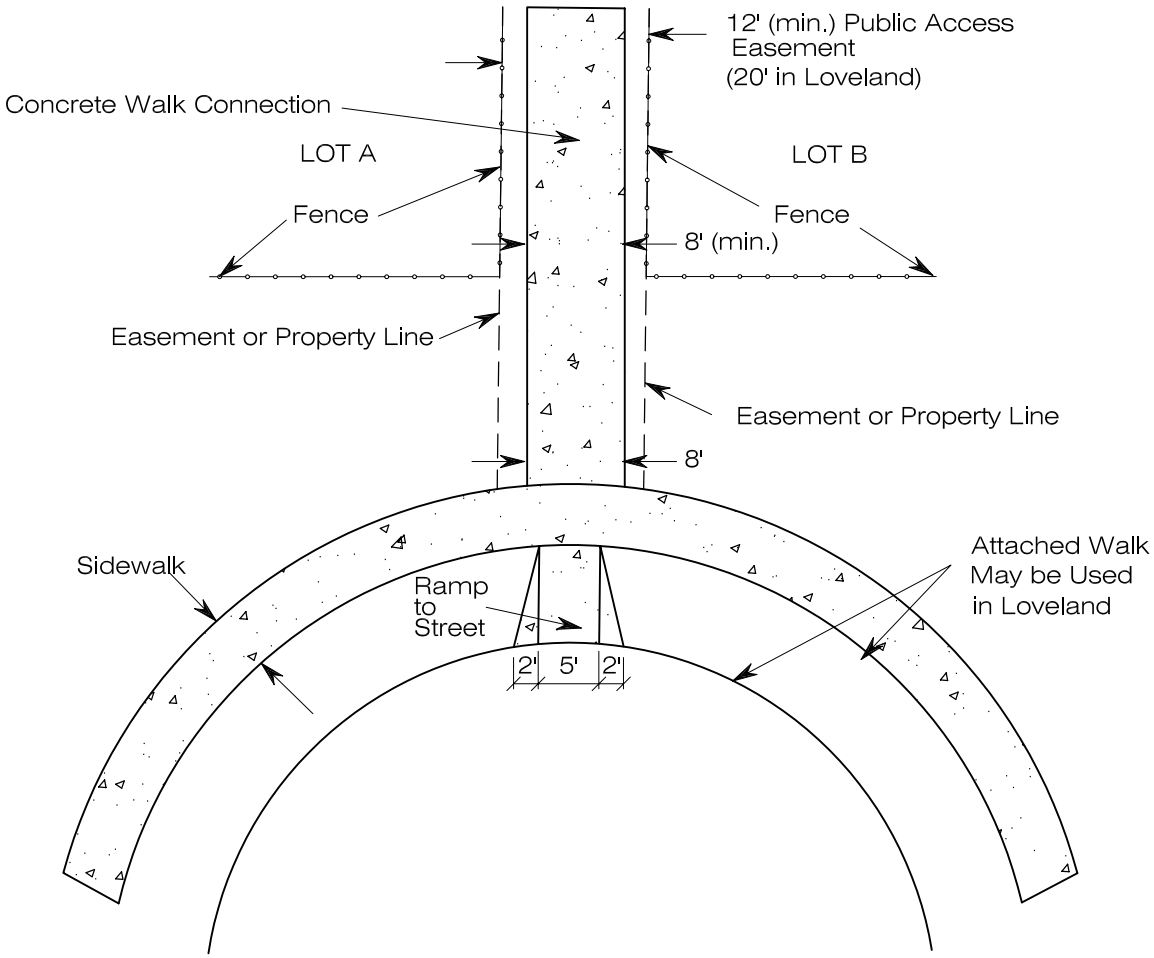
FENCES: Fences may be set on the right-of-way line as long as required sight distance is not obstructed.

GARAGE DOOR SETBACKS: 50'.

SIDEWALK: None.

RURAL RESIDENTIAL LOCAL STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 09/11/00	7-13F



NOTES:

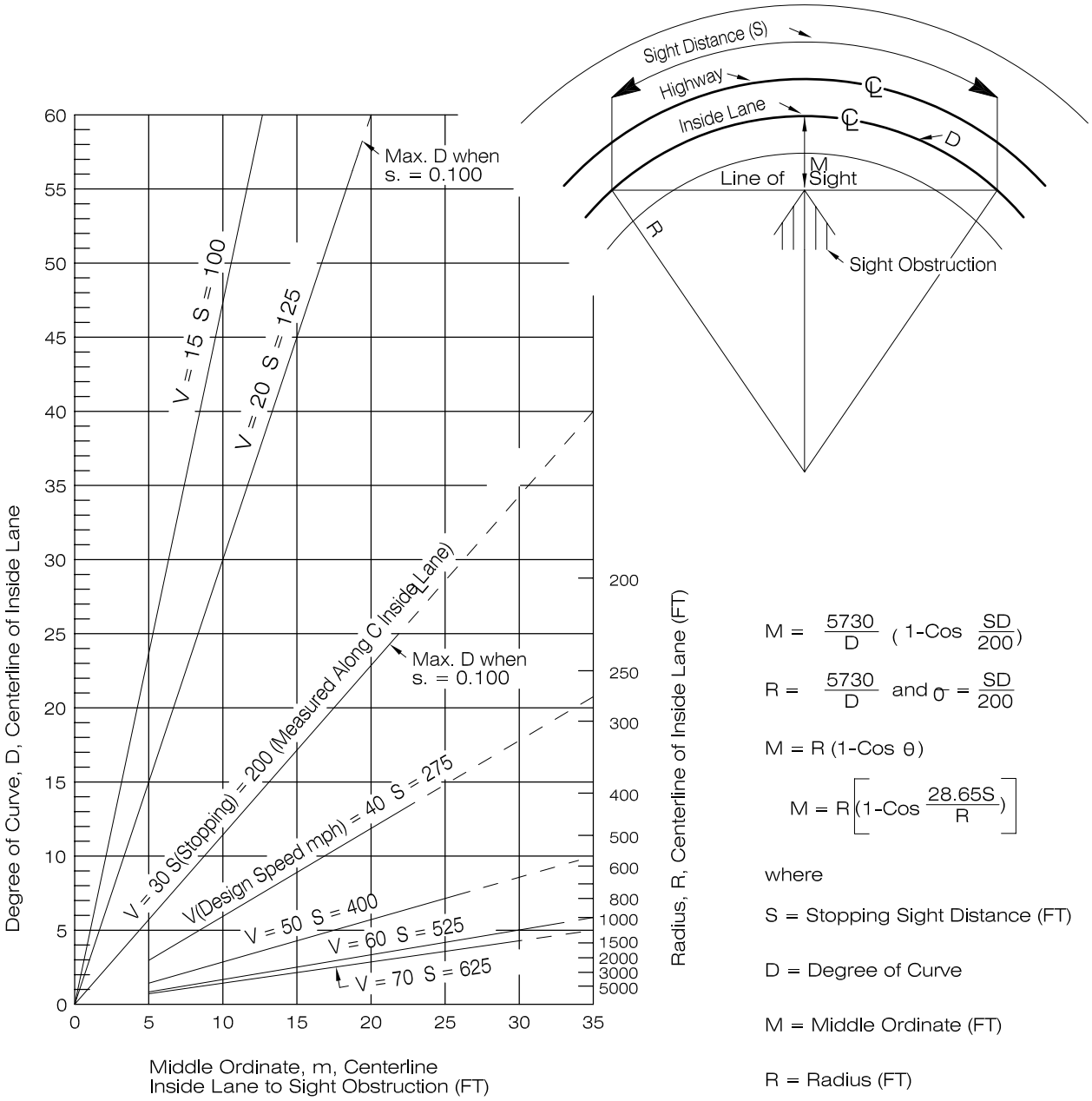
WALK WIDTH: 5' width for ramp at the street; 8' (min.) from sidewalk along side yards, with 12' wide easements and 2' buffers on both sides of the walk or 10' wide walk in a 10' wide easement and no buffer shall be okay.

EASEMENT LOCATION: Easement shall be located on one lot or on a common area tract.

WHERE USED: When required by the Local Entity, used to make neighborhood connections where streets are not required or feasible. Not limited to cul-de-sac locations.

PEDESTRIAN/BICYCLE PATH CONNECTIONS

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 09/11/00	7-14



$$M = \frac{5730}{D}\left(1-\text{Cos}\ \frac{SD}{200}\right)$$

$$R = \frac{5730}{D} \quad \text{and} \quad \theta = \frac{SD}{200}$$

$$M = R\,(1-\text{Cos}\ \theta)$$

$$M = R\left[\left(1-\text{Cos}\ \frac{28.65S}{R}\right)\right]$$

where

S = Stopping Sight Distance (FT)

D = Degree of Curve

M = Middle Ordinate (FT)

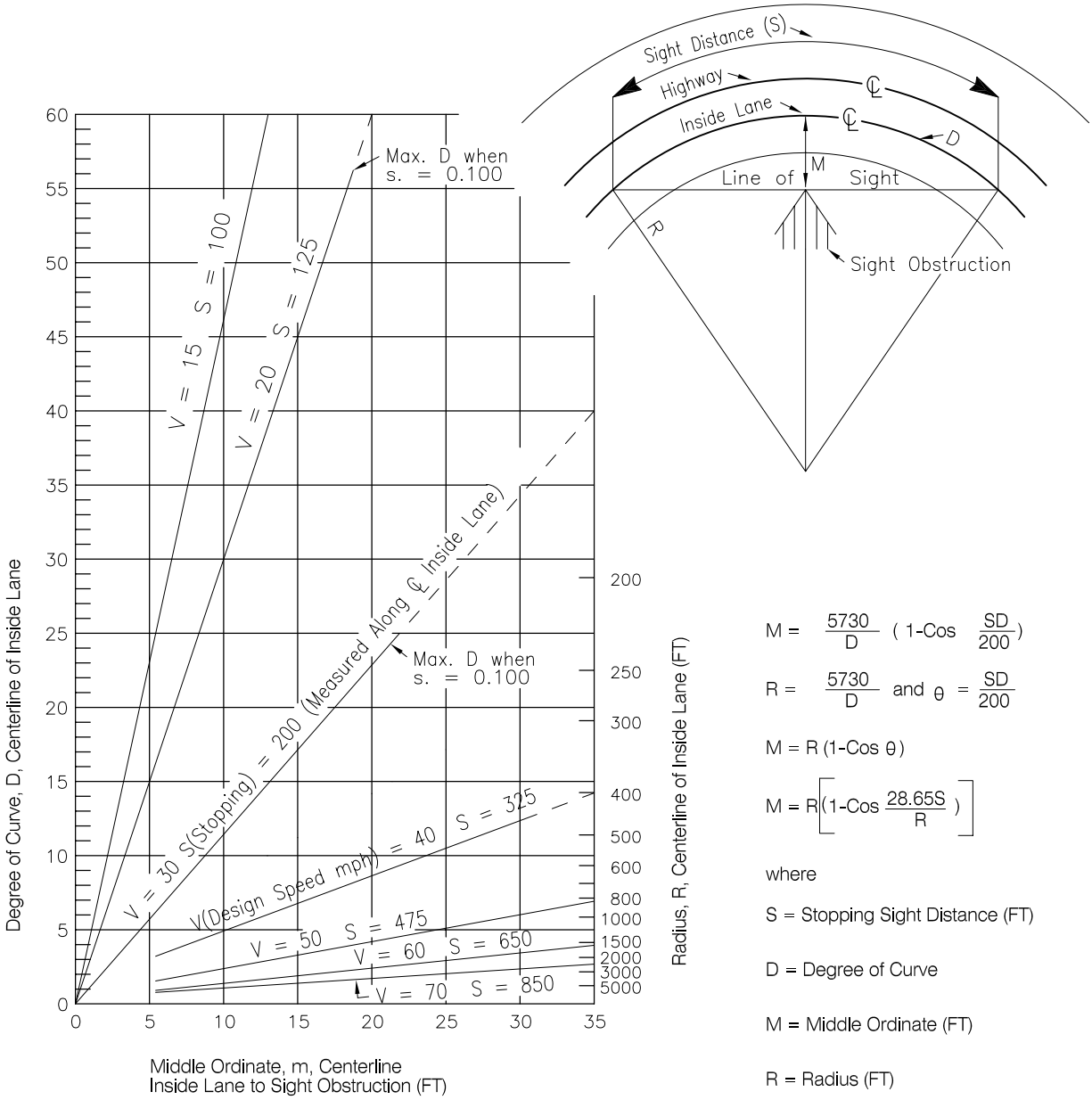
R = Radius (FT)

RANGE OF LOWER VALUES - relation between degree of curve and value of middle ordinate necessary to provide stopping distance on horizontal curves under open road conditions.

From "A Policy on Geometric Design of Highways and Streets 1990" by American Association of State Highway and Transportation Officials

LATERAL CLEARANCE TO SIGHT OBSTRUCTION INSIDE OF HORIZONTAL CURVES PROVIDING STOPPING DISTANCE FOR TURNING ROADWAYS

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	7-15.1



$$M = \frac{5730}{D}\left(1-\text{Cos}\ \frac{SD}{200}\right)$$

$$R = \frac{5730}{D} \text{ and } \theta = \frac{SD}{200}$$

$$M = R(1-\text{Cos}\ \theta)$$

$$M = R\left[\left(1-\text{Cos}\ \frac{28.65S}{R}\right)\right]$$

where

S = Stopping Sight Distance (FT)

D = Degree of Curve

M = Middle Ordinate (FT)

R = Radius (FT)

RANGE OF UPPER VALUES - relation between degree of curve and value of middle ordinate necessary to provide stopping distance on horizontal curves under curves under open conditions.

From "A Policy on Geometric Design of Highways and Streets 1990" by American Association of State Highway and Transportation Officials

LATERAL CLEARANCE TO SIGHT OBSTRUCTION INSIDE OF HORIZONTAL CURVES PROVIDING STOPPING DISTANCE FOR TURNING ROADWAYS

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	7-15.2

MAJOR STREET DESIGN SPEED (MPH)	CORNER INTERSECTION SIGHT DISTANCE (FT.)*
55	550
50	500
45	450
40	400
35	350
30	300 **
25	250 **
20	210 **
15	210 **

* Corner sight distance measured from a point on the minor road at 13 feet back from the edge of the major road pavement (flowline) and measured from a height of eye at 3.50 feet on the minor road to a height of object at 4.25 feet on the major road.

** At Local-Local street intersections only, the "D" distance shall be ten feet (10') and the sight distance shall be measured to the centerline of the street.

*** For private driveway access to a public street, use 10 feet back from flowline (or shoulder for gravel roads).

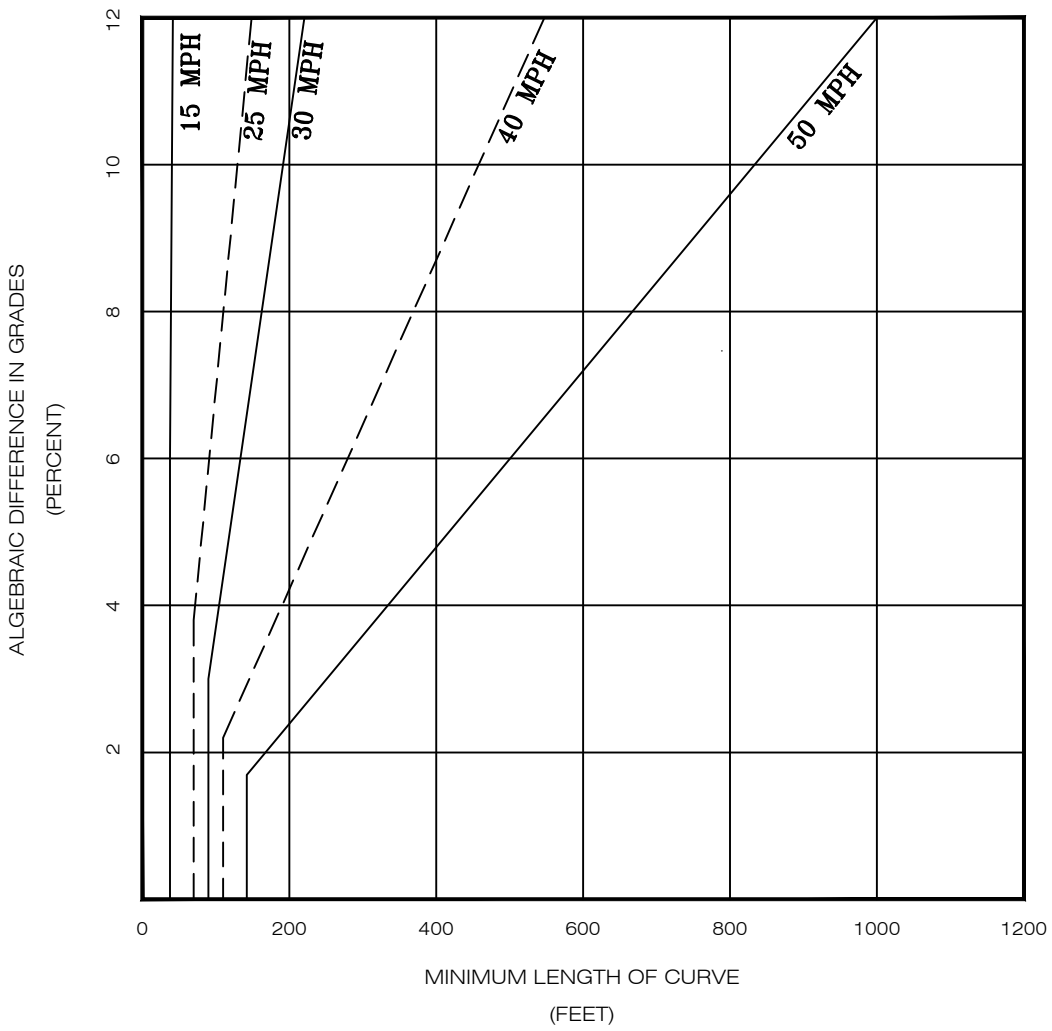
1. These values apply to passenger cars on 2-lane roads with grades of 3% or less. Intersections with trucks, steeper grades, or on multi-lane roadways requires additional analysis.
2. Adjustments may be required for a skewed intersection.

SIGHT DISTANCE AT INTERSECTIONS
(Unsignalized)

From CDOT State Highway Access Code Table 4-2

SIGHT DISTANCE (SIGHT TRIANGLE)

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/01/21	7-16

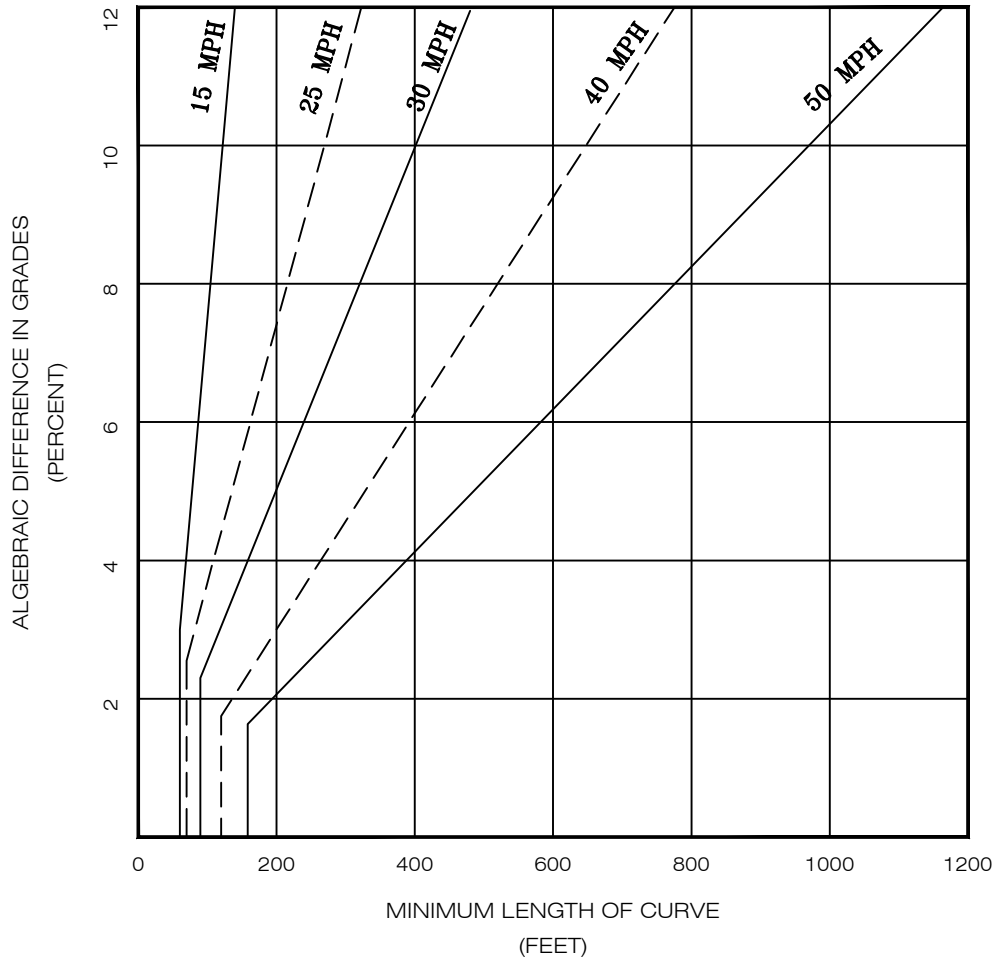


Design controls for crest vertical curves at design speeds.

From "A Policy on Geometric Design of Highways and Streets" by American Association of State Highway and Transportation Officials (AASHTO)

VERTICAL CURVE LENGTHS – CREST

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: DATE: 07/01/21	FIGURE 7-17

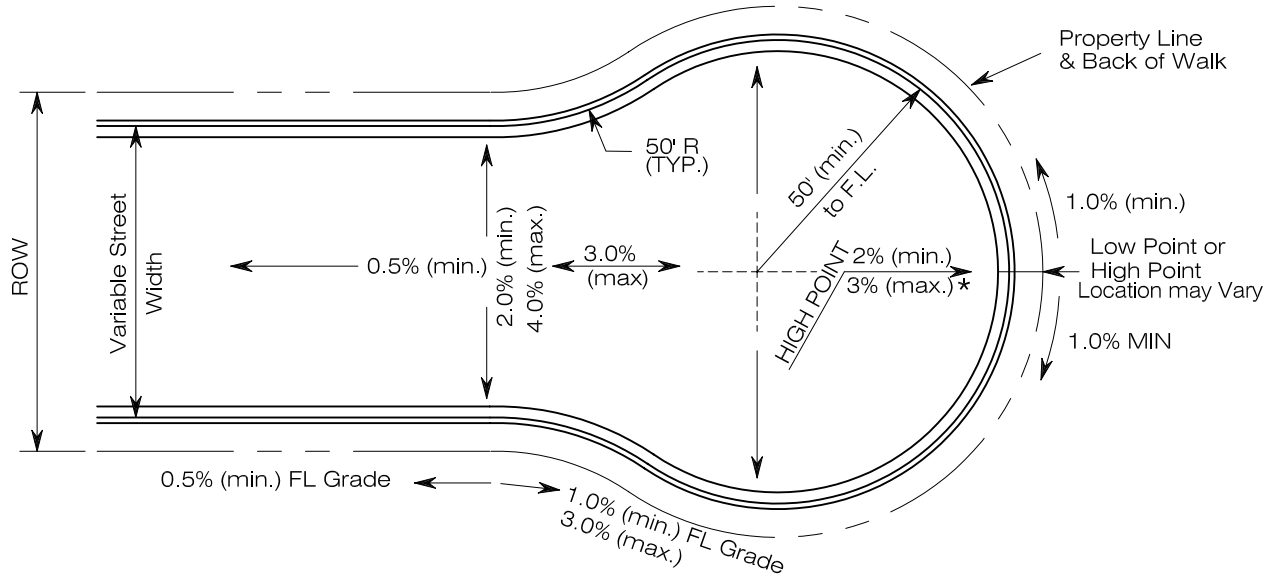


Design controls for sag vertical curves at design speeds.

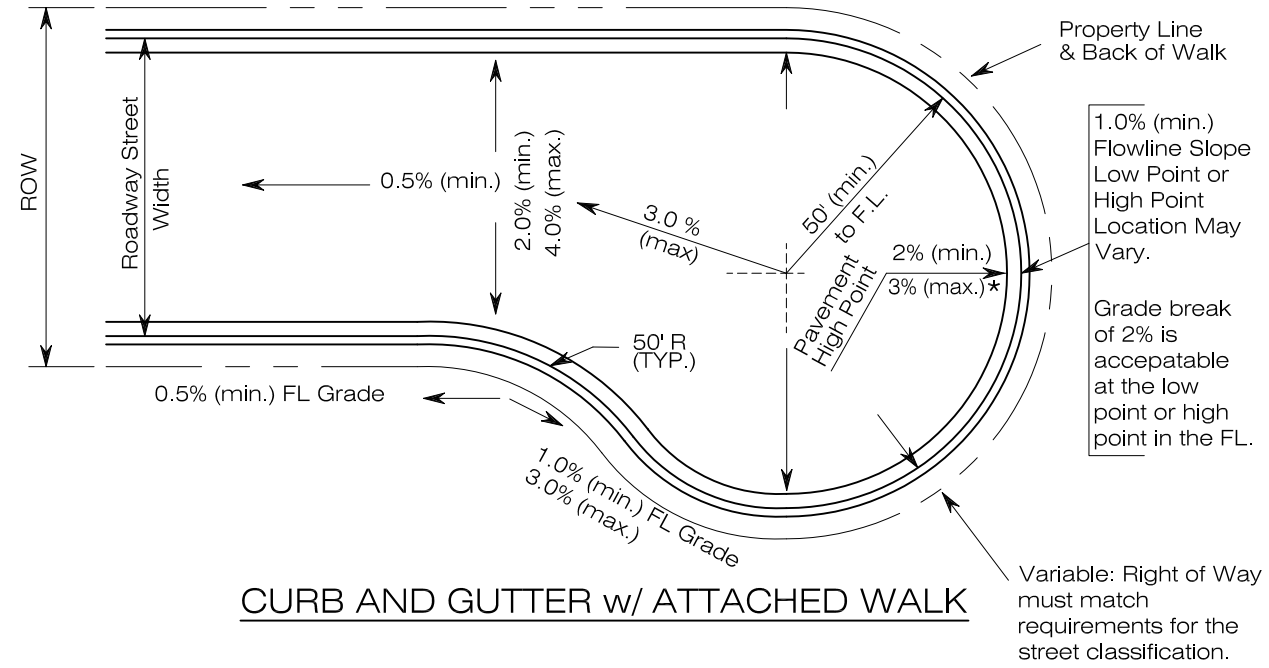
From "A Policy on Geometric Design of Highways and Streets" by American Association of State Highway and Transportation Officials (AASHTO)

VERTICAL CURVE LENGTHS – SAG

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	7-18



DRIVE-OVER CURB, GUTTER AND SIDEWALK



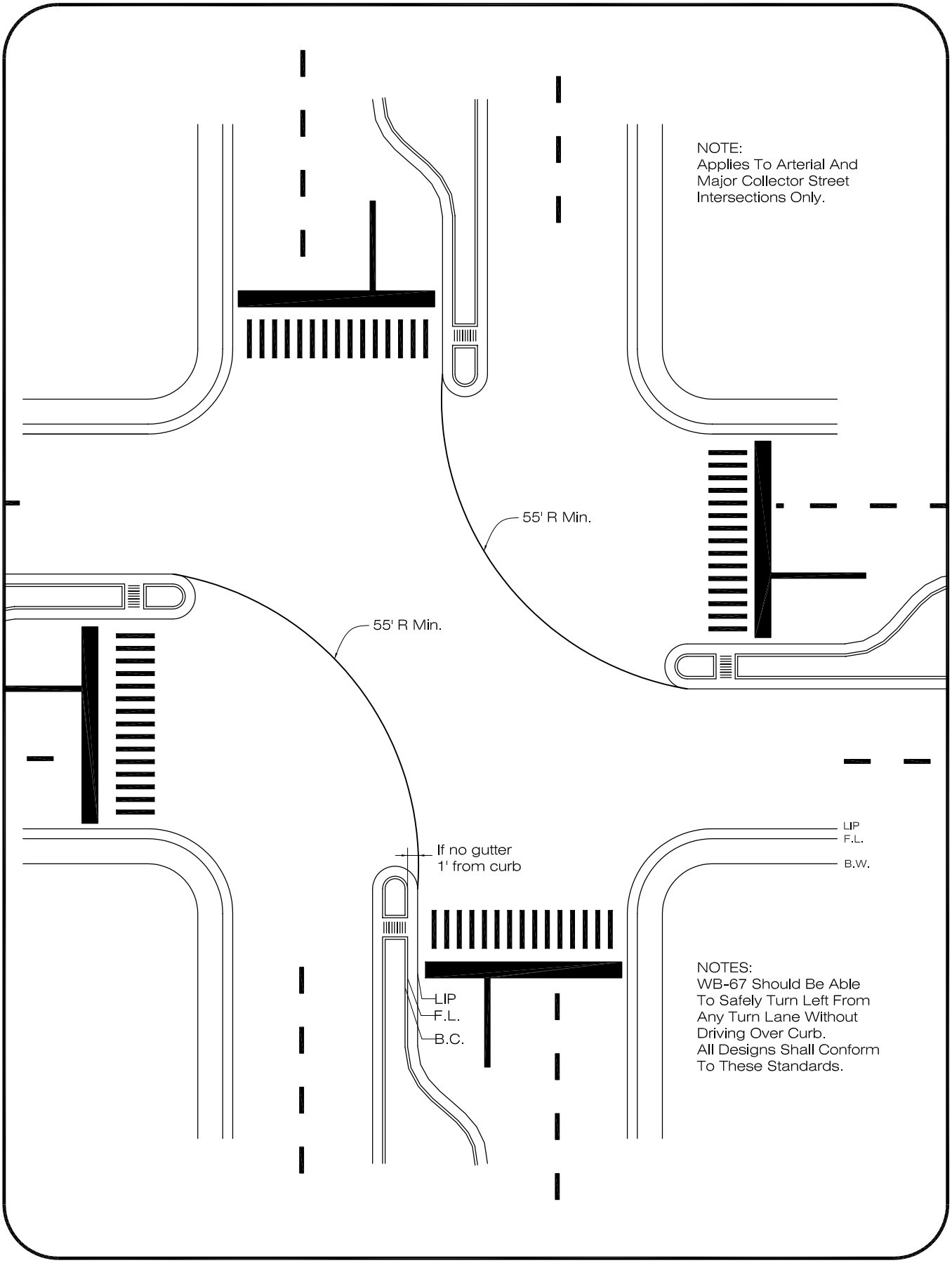
CURB AND GUTTER w/ ATTACHED WALK

* Maximum grade shall be 4% on reconstruction.

Note: Cul-de-sac may be asymmetrical

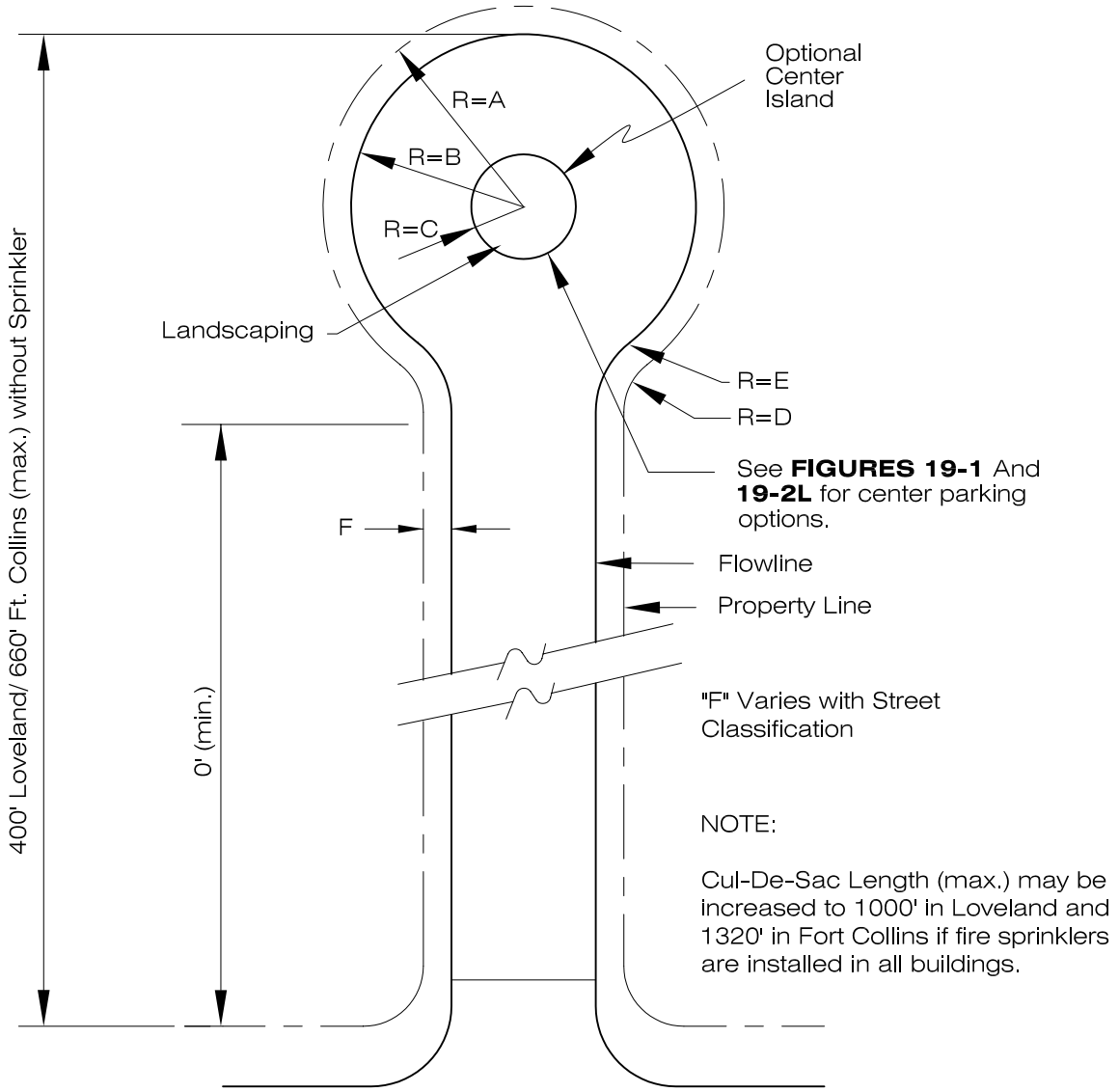
CUL-DE-SAC DETAIL

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1 DATE: 03/01/02	FIGURE 7-19



LEFT TURN CLEARANCE

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1 DATE: 03/01/02	FIGURE 7-20



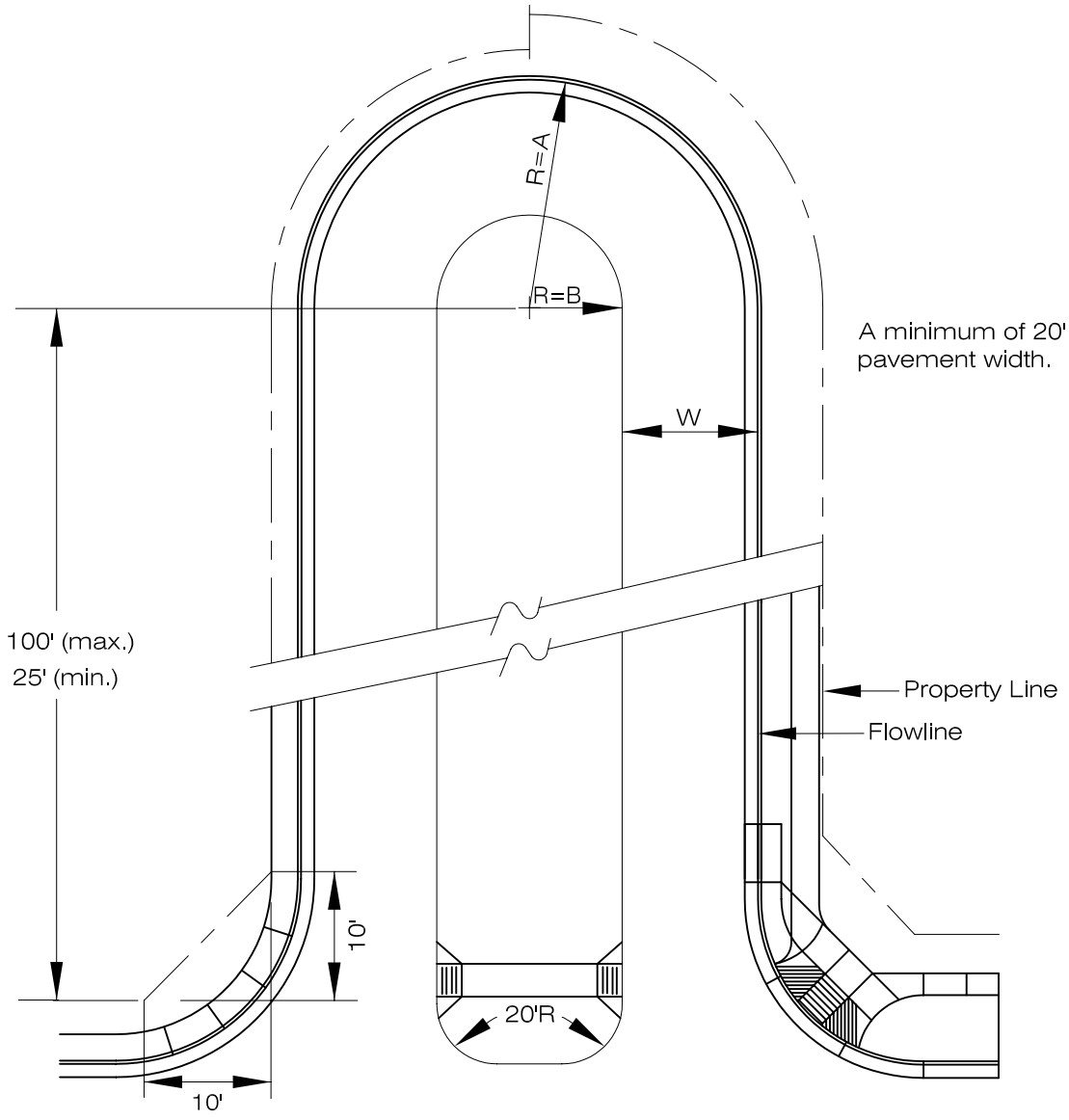
CLASSIFICATION OF CONNECTING STREET	RADIUS				
	A	B	C	D	E
LOCAL STREET	B + F	50'	22'	E - F	50'

NOTES:

1. All additional off-street parking shall be within private easement and maintained by a viable private party.
2. Cul de sac lengths over 1000' (L), 1320' (F) require secondary access.
3. All cul de sacs must meet Local Entity fire requirements.

STANDARD CUL-DE-SAC

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1	FIGURE
		DATE: 03/01/02	7-21



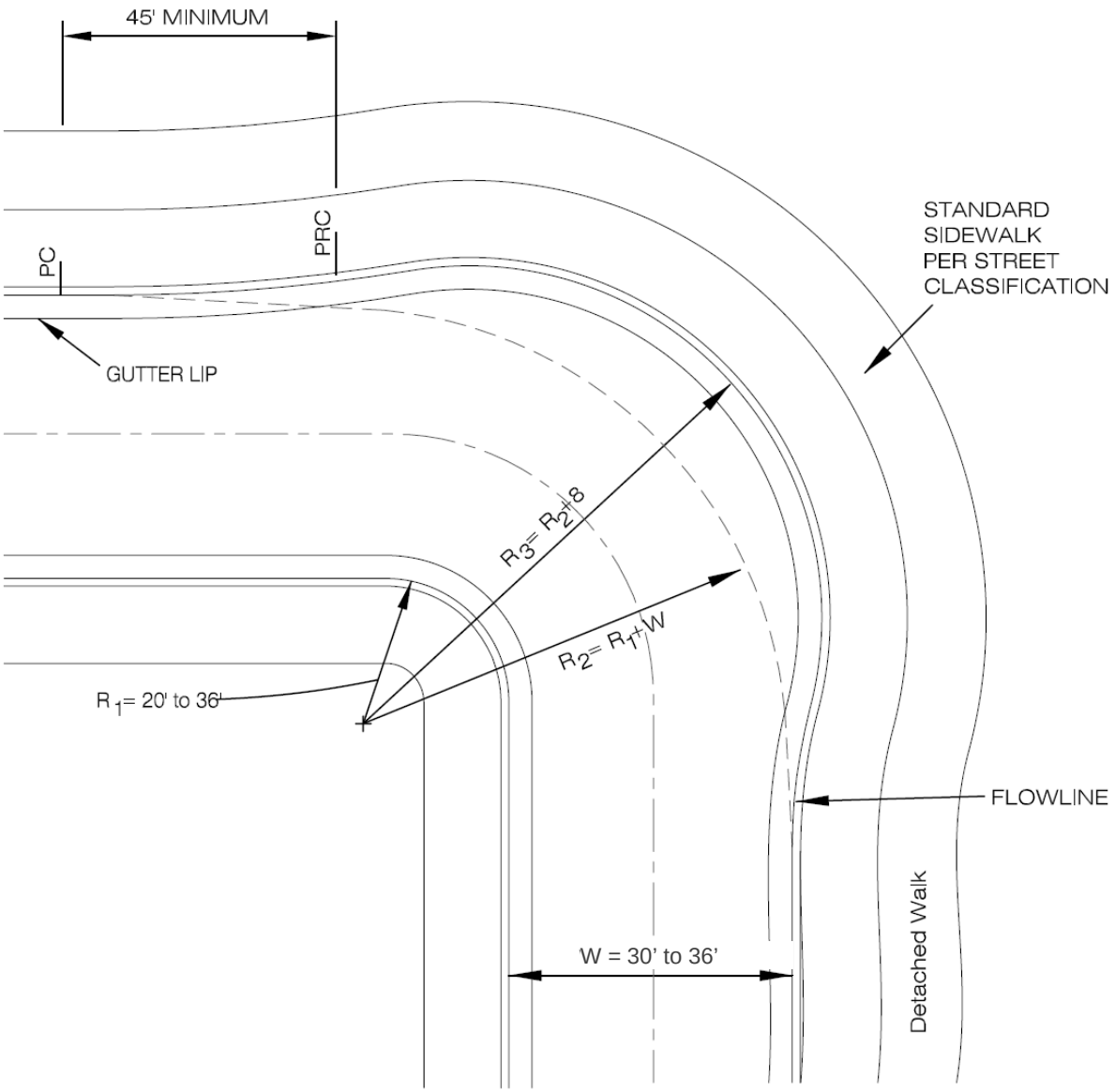
STREET CLASSIFICATION	RADIUS (MIN.)		Parking		
			No Parking	One Side	Two Sides
	A	B (MAX.)	W	W	W
LOCAL SINGLE FAMILY RESIDENTIAL	55'	30'	20'	28'	34'
LOCAL MULTIPLE FAMILY RESIDENTIAL	60'	30'	20'	28'	36'
LOCAL COMMERCIAL & INDUSTRIAL	65'	26'	24'	32'	38'
			Note 3	Note 4	

NOTES:

1. The sidewalk around the eyebrow shall be placed according to the street classification. The sidewalk across the street end of the island is to be placed in the same location as on the cross street.
2. Median may be landscaped or hardscaped as required be the Local Entity and shall be maintained by a viable private party.
3. Offstreet parking at the rate of 1 space for each dwelling unit served by the the eyebrow shall be provided in the median or in a perimeter parking bay.
4. When parking is restricted to one side, it shall be provided on the median-side of the roadway.

STANDARD EYEBROWS (LOCAL STREETS ONLY)

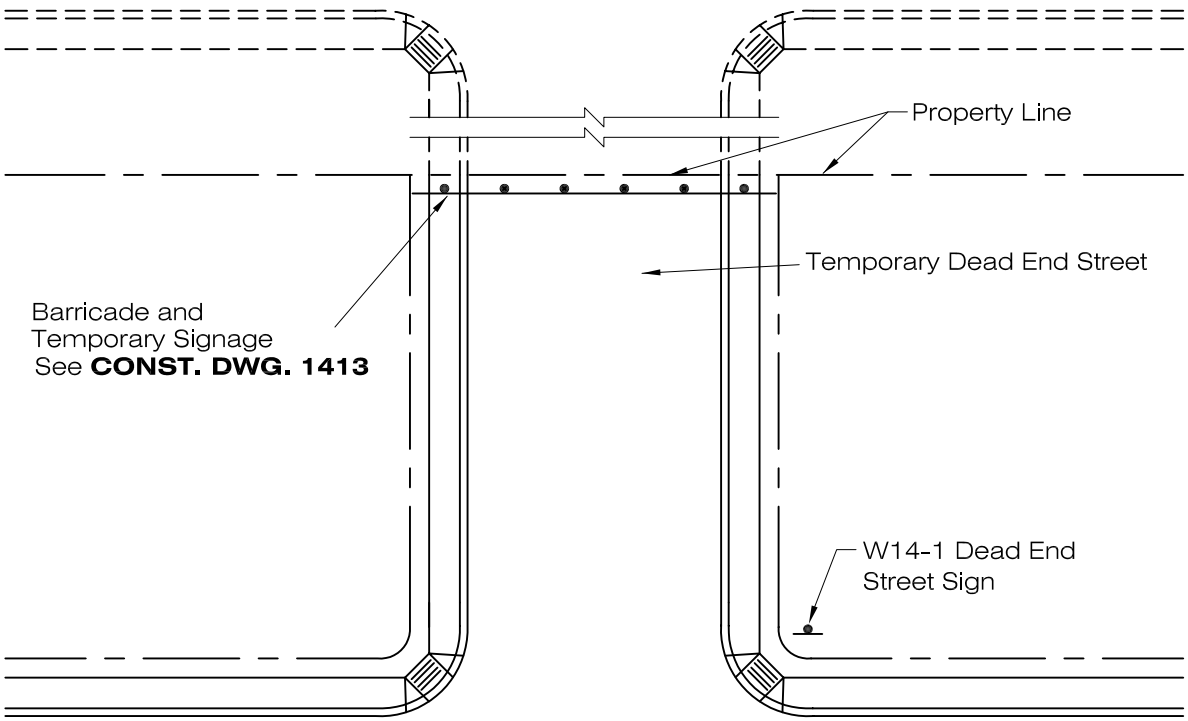
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 11/16/00	7-23



WIDENING DETAIL FOR STREET TURNS>60° (LOCAL STREETS ONLY)

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: DATE: **September, 2016**	FIGURE 7-24

FUTURE ROADWAY



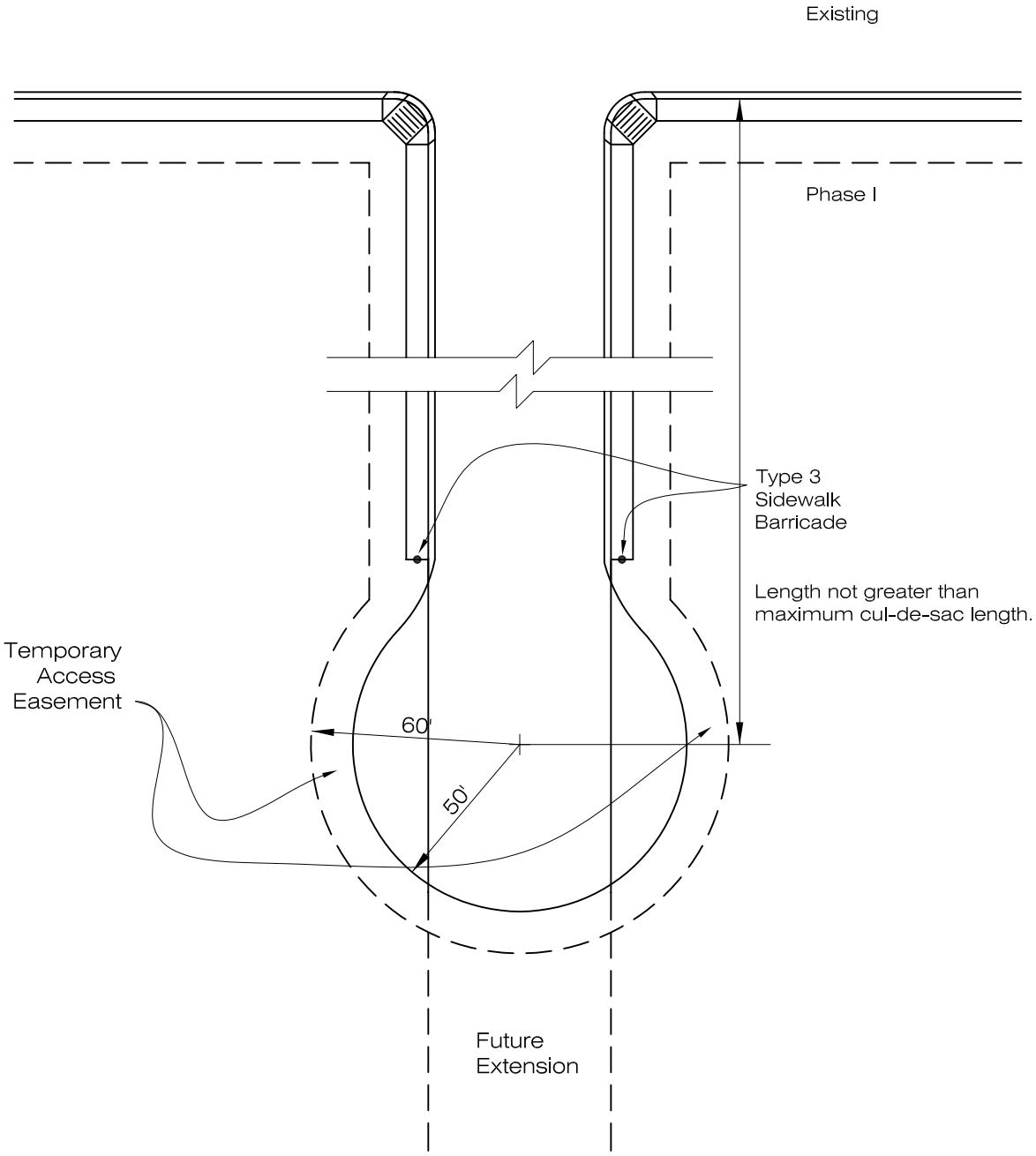
EXISTING ROADWAY

Notes:

1. The temporary dead end is limited to 150' in length.
2. A cul-de-sac is not required.
3. In Fort Collins, no access may be taken from a dead end street with no turn-around or cul-de-sac.

TEMPORARY DEAD END STREET

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1 DATE: 03/01/02	FIGURE 7-25

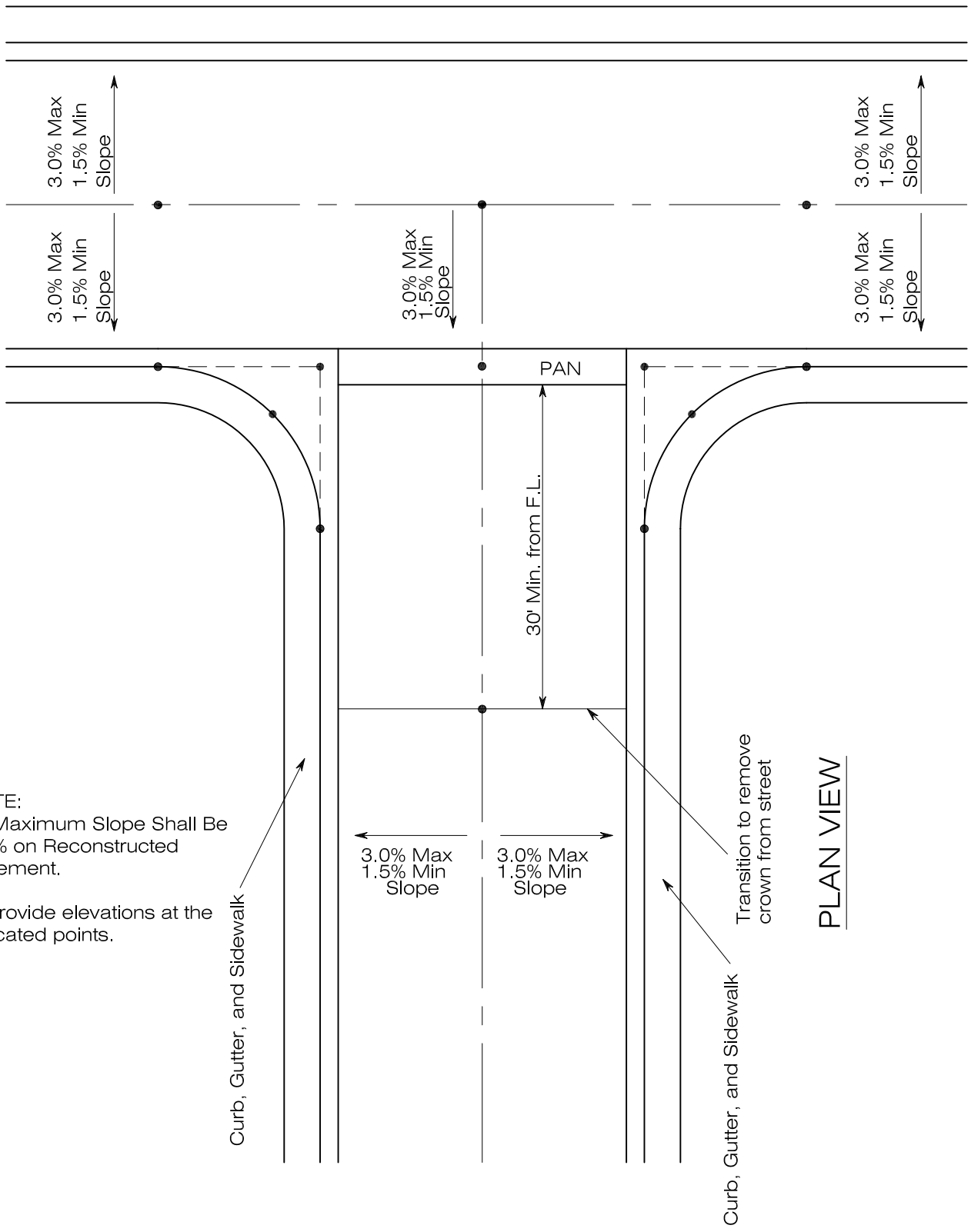


NOTES:

1. A temporary easement is required for the temporary turnaround. The easement shall incorporate all of the all-weather surface, pavement and signage.
2. The turnaround shall consist of an all weather surface.

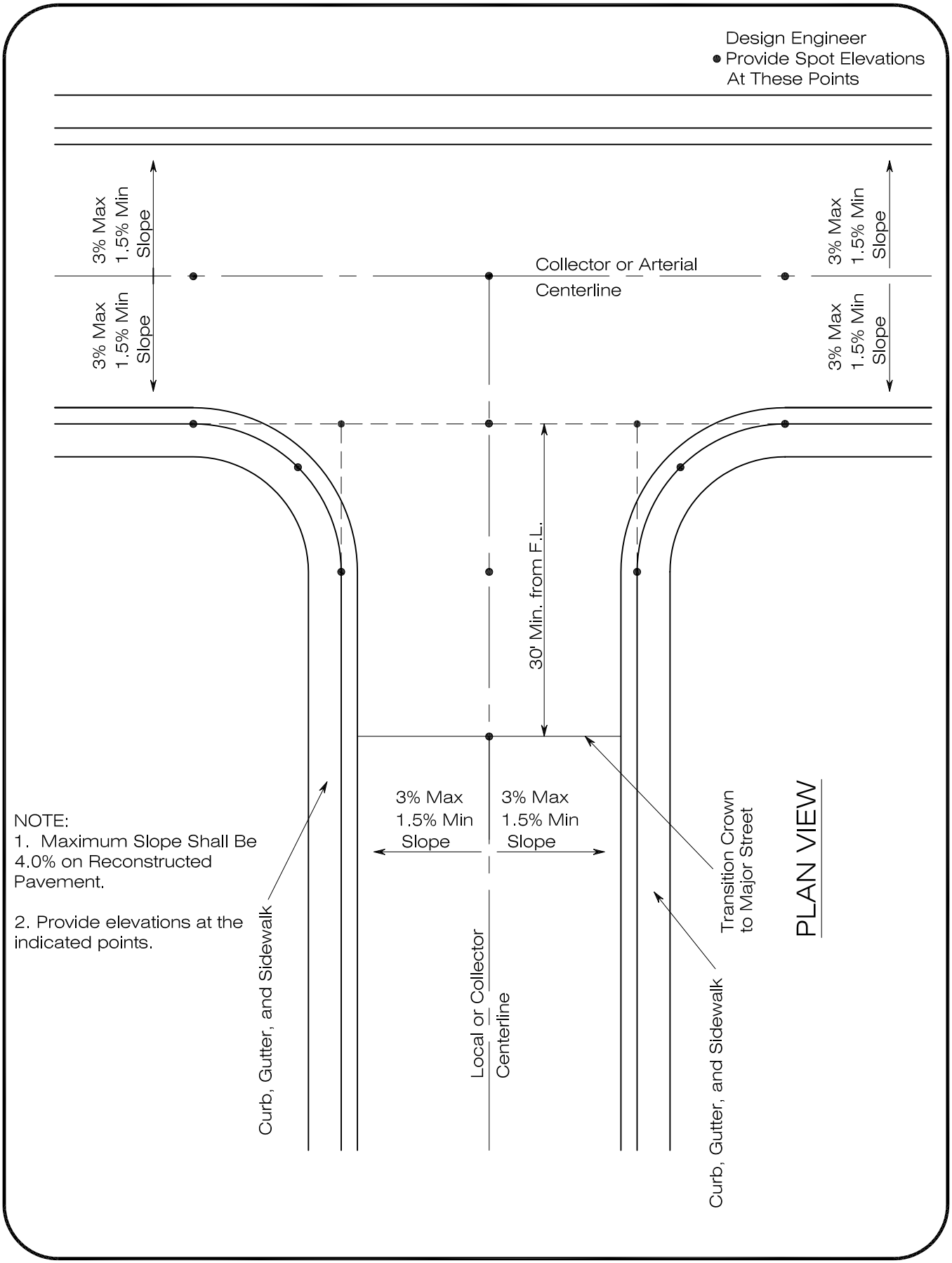
TEMPORARY TURNAROUND

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1 DATE: 03/01/02	FIGURE 7-26



STREET INTERSECTION CROSSPAN APPROACH DETAIL

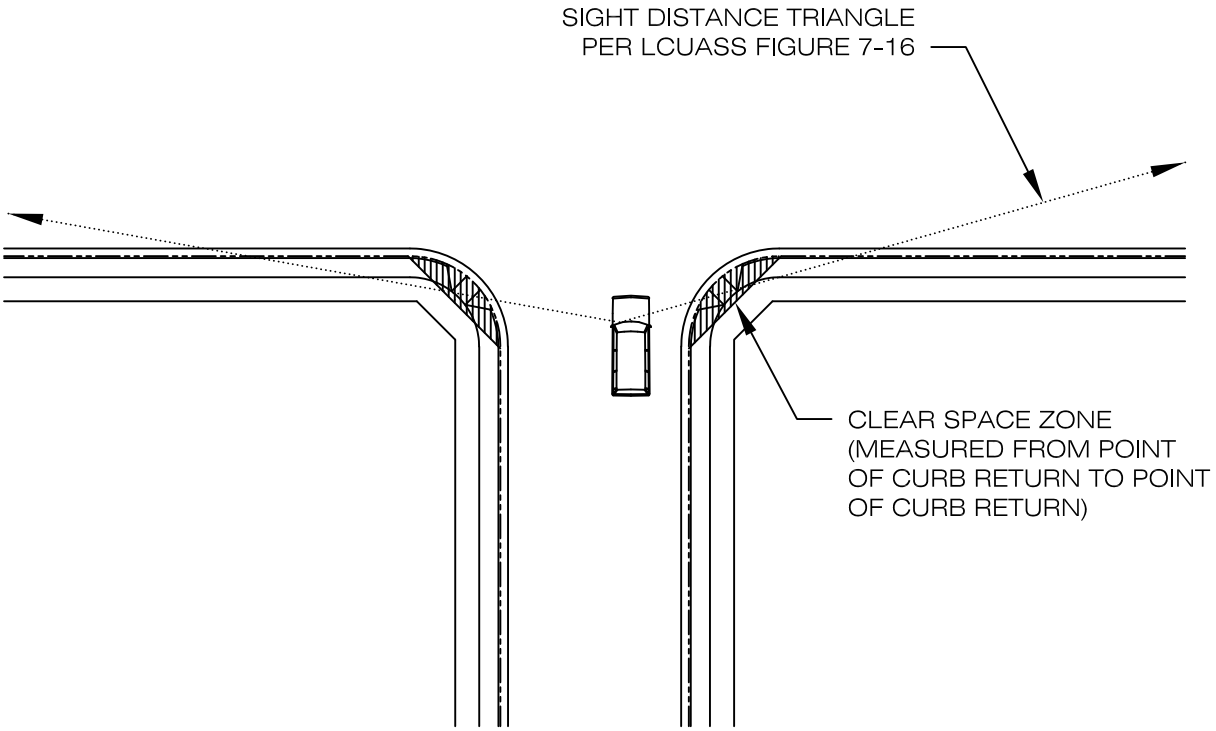
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	7-27



STREET INTERSECTION APPROACH DETAIL

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 11/16/00	7-28

LOVELAND ONLY

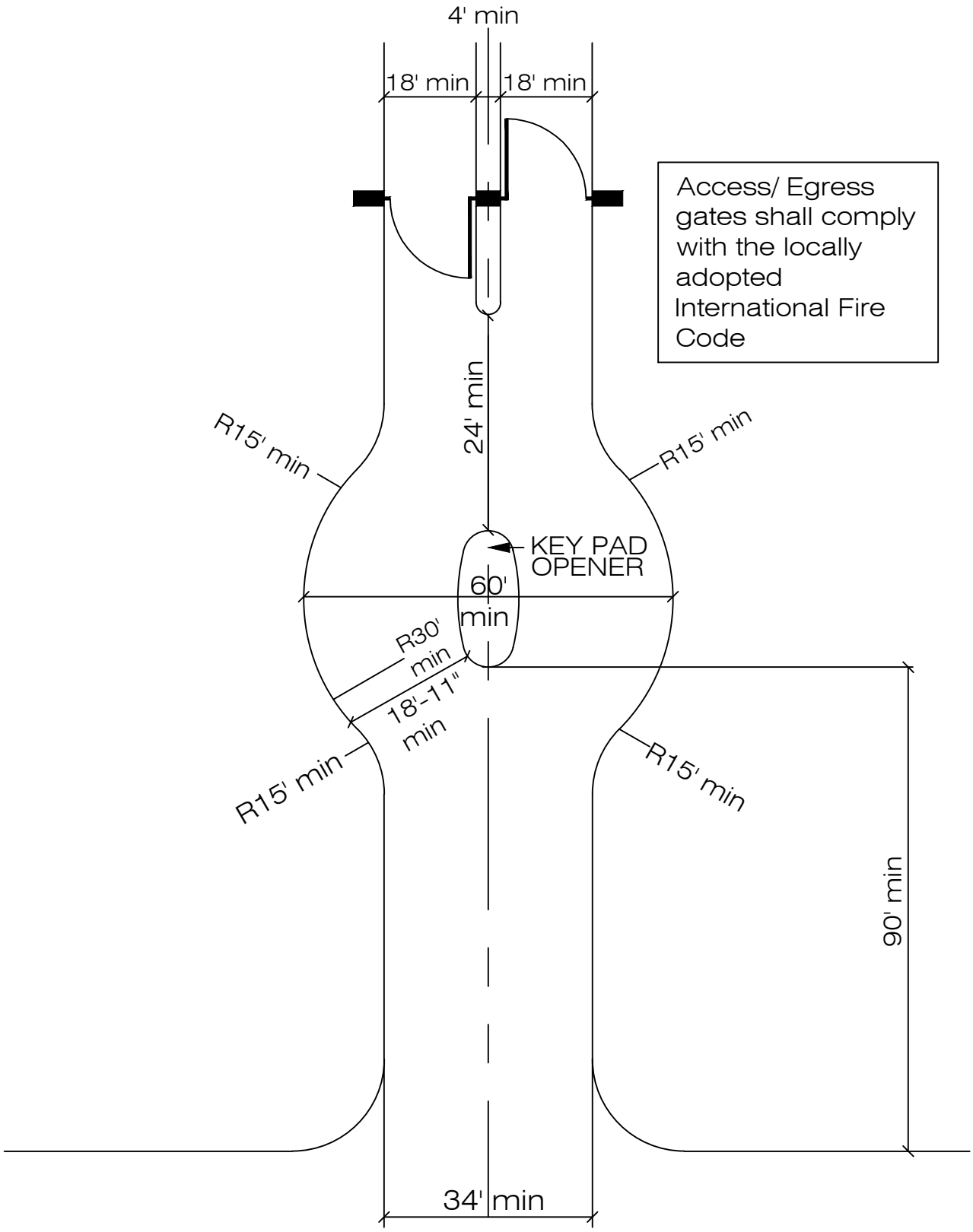


NOTE:
In addition to the sight distance triangle requirements, a clear space zone is required within all curb returns (measured from point of curb return to point of curb return) where no trees, shrubs, aesthetic structures/features, monument signs, or objects that have the potential to hinder driver visibility, and/or pedestrian and bicycle safety, are allowed.

CLEAR SPACE ZONE

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/01/21	7-34L

LOVELAND ONLY



GATED ENTRY

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
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CHAPTER 8 – INTERSECTIONS
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CHAPTER 8 – INTERSECTIONS

8.1 GENERAL

Intersections shall be designed to provide for the safety of motorists, pedestrians, and bicyclists. This chapter is based on criteria from the Institute of Transportation Engineers Traffic Engineering Handbook and **AASHTO's A Policy on Geometric Design of Highways and Streets**.

8.1.1 Intersections as Conflict Locations

By their nature, intersections are conflict locations. Vehicles, pedestrians, and bicycles all cross paths. Each crossing is a conflict point. Intersections contain many conflict points.

A. Basic Intersection Design

The basic design of intersections includes the following objectives:

1. Minimize points of conflict;
2. Simplify areas of conflict;
3. Limit conflict frequency; and
4. Limit conflict severity.

These objectives can be achieved using the design elements presented below.

8.2 INTERSECTION DESIGN CRITERIA

8.2.1 Location of Intersections

For intersection location criteria, refer to **Chapter 9, Access Requirements and Criteria,** the current Master Street plan for each Local Entity and street layout criteria for the Local Entity.

8.2.2 Lane Alignment

All lanes shall be in general alignment through each intersection, however a maximum 2-foot shift is allowed across an intersection without a variance approval by the Local Entity Engineer.

8.2.3 Angle of Intersection

New crossing roadways should intersect at 90 degrees whenever possible. In no case shall they intersect at less than 80 degrees or more than 100 degrees.

8.2.4 Horizontal Alignment and Vertical Profile

A. Horizontal

The horizontal alignment of streets through an intersection shall be designed in conformance with **Tables 7-3 and 7-4.** Intersections may be placed on horizontal curves, provided that the tangent lengths given in **Tables 7-3 and 7-4** are provided on the minor street and the required sight distance is met.

B. Vertical

The street profile grade shall not exceed 4 percent on the approach to the intersection, as measured along the centerline of the street for a minimum distance equal to the tangent length for the street classification. The profile grade within the intersection streets shall not exceed 3 percent as shown on **Figure 8-17**.

C. Prevailing Street Grade

The grade of the street with the higher classification shall prevail at intersections. The lesser street shall adapt to the grade of the Major street. Grading of adjacent property and driveways shall adapt to the street grades. When roads are of equal classification, the Local Entity Engineer shall determine which street grade prevails.

8.2.5 Exclusive Left Turn Lanes

Exclusive left turn lanes shall be provided on all arterial streets and other streets wherever left turn lanes are specified as needed by an access plan, required by these Standards or warranted and approved by the Local Entity Engineer. The Designer shall use information in the TIS to determine whether an exclusive left turn lane is warranted on non-arterial streets. To determine warrants, the following criteria shall be followed (modified) from the National Cooperative Highway Research Program Report 279 (NCHRP 279):

A. Warrants for Signalized Intersections

A separate left turn lane shall be required if one of the following criteria is met:

1. The left turn design volume is at least 20 percent of total approach volumes, or
2. The left turn design volume exceeds 100 vph in peak periods, or
3. The LOS criteria in **Chapter 4, Transportation Impact Studies,** are not satisfied without a separate left turn lane.

B. Warrants for Unsignalized Intersections

Left turn lanes may be required at approaches to intersections for which the combination of through, left, and opposing volumes exceeds warrants shown in **Figure 8-1.** The Local Entity Engineer will determine which peak hours to consider in this evaluation.

C. Design Criteria

Left turn lanes shall be designed to provide the following functions:

1. A means for safe deceleration outside the high speed through lane.
2. A storage length long enough for left turning vehicles so that signal phasing can be optimized and intersection delay minimized.
3. A means of separating movements at unsignalized intersections to reduce left turn impacts on other flows.

The design elements for a left turn lane are as shown in **Figure 8-11.** The elements are the approach taper, bay taper, lengths of lanes, width of lanes, and departure taper. For bay taper and approach taper lengths, see **Figure 8-2** and **Figure 8-3**. The required left turn lane widths shall be as specified in either **Table 7-1 or 7-2.**

8.2.6 Exclusive Right Turn Lanes

Exclusive right turn lanes shall be provided at locations where they are specified as needed by an access plan, or where required by the applicable TIS, approved by the Local Entity Engineer.

A. Warrants for Right Turn Lanes

Figure 8-4 provides guidelines and warrants for whether a right turn lane shall be provided at intersections or accesses.

B. Design Criteria

Right turn lanes shall be designed to accomplish the following functions:

1. Provide a means of safe deceleration outside the high speed through lane.
2. Provide a separate storage area for right turns to assist in the optimization of traffic signal phasing.
3. Provide a means of separating right turn movements at stop controlled intersections.

The design elements, as shown in **Figure 8-9**, are the approach taper, bay taper, lengths of lanes, width of lanes, and departure taper. For approach taper lengths, see **Figure 8-5**.

C. Pedestrian Refuge

Where Pedestrian refuge is required, it shall be designed in accordance with Figure 8-19. If a right turn lane turns into an exclusive lane that continues into an acceleration lane or thru lane, use Figure 8-18.

8.2.7 Acceleration/Deceleration Lanes

For each high volume driveway and major intersection, acceleration/ deceleration lanes shall be considered. The criteria for the requirements are provided below. The specific designs for these lanes shall be in accordance with NCHRP 279 (1985 Edition) and this chapter.

A. Deceleration

Deceleration lane requirements are outlined in **Sections 8.2.5 and 8.2.6** .

B. Acceleration

Refer to NCHRP 279 (1985 Edition) for acceleration lane criteria. Fort Collins (GMA and city limits) does not generally recommend using acceleration lanes.

8.2.8 Design Vehicles

As a minimum, intersections shall be designed to accommodate the following AASHTO design vehicles for the specified turning movements. The minimum allowable intersection turning radii are as presented in the **AASHTO A Policy on Geometric Design of Highways and Streets**.

A. SU-30 (Single Unit Truck)

All SU-30 vehicles must be able to turn easily from one street to the next and remain in the correct lane for each roadway. This shall be required for all roadways and alleys.

B. CITY-BUS (Bus)

All CITY-BUS (formerly B-40) vehicles may use more than one traffic lane to complete the turn when turning from the correct lane without crossing into opposing traffic lanes and without tracking onto the curb at corners. This shall apply to all streets. Refer to the Local Entity Engineer for which Bus turning template to use.

C. WB-50 (Large Semitrailer)

WB-50 vehicles may use more than one traffic lane to complete the turn without tracking onto the curb at corners. In addition, the vehicle must make the turn in one forward maneuver without encroaching into opposing traffic lanes. This requirement shall apply to all Arterial/Arterial, Arterial/Collector, Arterial/Connector, Arterial/Local Commercial, Arterial/Local Industrial, Collector/Collector, and Collector intersections at Connectors, Local Commercial, and Industrial streets.

For all other intersections (including mini-roundabouts), the vehicles may use the entire paved surface of the street to negotiate the turn. The vehicle may have to back up to complete the turn.

D. WB-67 (Large Semitrailer).

All arterial intersections containing raised medians and channelizing islands shall be designed to accommodate a WB-67 vehicle. Refer to LCUASS Appendix I for roundabout turning template requirements.

E. Other Vehicles.

For special circumstances other design vehicles may be required by the Local Entity Engineer.

8.2.9 Curb Returns

A. Curb Return Radii

The corner radii shall meet the following requirements in **Table 8-1** or **Table 8-2** unless otherwise approved or required by the Local Entity Engineer.

Table 8-1
Minimum Curb Return Radii -
Loveland (GMA and City Limits)

	Local	Collector	Arterial
Commercial Driveways, High Volume Driveway & Alley	15’	20’	20’
Local	20’	20’	30’
Collector	20’	25'	30'
Arterial	30’	30’	35’

Table 8-2
Minimum Curb Return Radii -
Fort Collins (GMA and City Limits)

	Local	Collector	Arterial
High Volume Driveway	15’	15’	20’
Alley	5’	5’	5’
Local	20’	20’	25’
Collector	20’	20’	25’
Arterial	25’	25’	25’

For curb returns on a State Highway, **CDOT**’s curb radii requirements shall supersede these Standards.

B. Curb Return Grades

The minimum desirable grade for flowlines around the curb return should be 1 percent. The minimum allowable grade for flowlines around curb returns shall be 0.5 percent.

8.2.10 Traffic Islands.

The following is a list of different types of traffic islands:

A. Corner Islands Separating Right Turns

Standard corner islands shall be used in 4- or 6-lane Arterial/Arterial intersections to channelize traffic where required to provide pedestrian refuge or where required by the Local Entity Engineer. The corner islands shall be designed as raised islands in accordance with Figures 8-18 or 8-19 for a right turn lane continuing to an exclusive lane or for a right turn lane stop condition, respectively. The striping shall be in accordance with the requirements of **Chapter 14**, **Traffic Control Devices**.

B. Median Islands Separating Opposing Traffic

Median islands are required at all Arterial/Arterial intersections. If raised medians are not required by these Standards, the median islands may be raised or painted. The length of the island shall include the appropriate approach taper, bay taper and length of lane required by the Standards, or supported by another approved resource standard. The design shall be in accordance with **Construction Drawings 801** and **Figure 8-11** and as follows:

1. No Obstruction. Medians must not obstruct the minimum left turn radius for the design vehicle(s).
2. Drainage. Landscaped medians shall include drainage facilities to handle sprinkler run-off and nuisance flows. When low maintenance landscaping is used in conjunction with trickle irrigation, drainage requirements may be waived and outfall curb and gutter should be used.

   In Fort Collins (GMA and city limits), use barrier curb in accordance with **Construction Drawing 703**. Otherwise, inflow curb and storm drainage inlets and systems shall be provided to carry storm water.
3. Glue-down Curb. Glue-down curb is acceptable for medians when specifically approved by the Local Entity. In Loveland (GMA and city limits), the design must provide for 1 foot of clear distance between the face of the curb and the travel or auxiliary lane width.
4. Median Islands Required. Median islands are standard on all new 6-lane and 4-lane Arterial streets. These islands shall be designed to provide pedestrian refuge. (See **Chapter 16, Pedestrian Facilities Design and Technical Criteria**, for design requirements.)

C. Median Islands on Minor Arterials, Collectors, or Local Streets

Raised medians may be placed in Minor Arterial, Collector, and all Local streets. If medians are included, they shall be placed in the public right-of-way, and they must meet the following Standards for design:

1. No Obstruction. The medians may not obstruct the design vehicle turns.
2. Visibility. The medians must be placed such that the required visibility in the intersection is not obstructed.
3. Undiminished Use. Medians must be placed so they do not diminish the intersection use.
4. Alignment. Lanes on one side of the intersection must align with the correct lanes on the opposite side of the intersection. Refer to **Section 8.2.2** .
5. Median Maintenance. These medians must be maintained by parties other than the Local Entity. The maintenance responsibility must be defined on the Final Development Plan, Plat or Development Agreement.
6. Public Use. The appropriate Local Entity may use these islands for roadway signing and may choose to remove the medians if it is deemed necessary by that Local Entity.
7. Additional Right-of-way. The Developer shall dedicate all additional right-of-way necessary to include these medians.
8. Compliance with these Standards. The median design must comply with all applicable median criteria in these Standards and the streetscape standards of the Local Entity.

D. Splitter Islands on Roundabouts

In modern roundabout designs, raised splitter islands shall be designed in accordance with **NCHRP Report 672 – Roundabouts: An Informational Guide, Second Edition** to direct traffic and provide pedestrian refuge.

8.2.11 Traffic Signals, Striping and Signing

See **Chapter 14, Traffic Control Devices**.

8.2.12 Access Ramps

See **Chapter 16, Pedestrian Facilities Design and Technical Criteria**.

8.2.13 Right-of-way

A. Requirements

All intersection rights-of-way and utility easements shall be dedicated as shown in **Figure 8-12** to provide adequate right-of-way to include sidewalks, access ramps, and utilities. Additional right-of-way may be required at intersections to provide space for additional left or right turn lanes without reducing the widths of standard required facilities.

B. Roundabouts

In Loveland (GMA and city limits), on all Arterials and Major Collectors, additional right-of-way may be required at intersections in conformance with **Figure 8-16L** to accommodate the potential installation of a roundabout in the future.

8.2.14 Intersection Sight Distance

Street intersections shall be designed so that adequate sight distance is provided along all streets. The required sight distance shall be determined by the design speed and grades of the street and the acceleration rate of an average vehicle as prescribed below.

A. Minimum Requirements

All designs must provide minimum safe stopping sight distance in accordance with **Chapter 7, Street Design and Technical Criteria,** and **AASHTO**. In addition, for all streets that intersect with Arterial and Collector streets, the sight distance must be large enough to allow a vehicle to enter the street and accelerate to the average running speed without interfering with the traffic flow on the Arterial or Collector street. The design sight distance values to be used are provided in **Figure 7-16**.

B. Landscaping and Hardscaping

Landscaping or hardscaping shall not be permitted to be higher than 24 inches within an intersection corner or access that will block the line of sight for pedestrian visibility.

8.2.15 Channelization

Channelization refers to physical or visual guides used to separate vehicles, bicycles and pedestrians into particular lanes.

A. Intent of Channelization

Channelization is intended to:

1. Prohibit undesirable or wrong way movements.
2. Define desirable vehicular paths.
3. Encourage safe vehicle speeds.
4. Separate points of conflict wherever possible.
5. Cause traffic streams to cross at right angles and merge at flat angles.
6. Facilitate high-priority traffic movements.
7. Facilitate traffic control scheme.
8. Remove decelerating, stopped, or slow vehicles from high-speed through-traffic streams.
9. Provide safe crossings for pedestrians/bicycles.
10. Provide safe refuge for pedestrians.

B. Specific Channelization Requirements

Channelization shall be required at locations where it is necessary for safety or to protect the operation of the major street. Examples include:

1. Providing raised medians in all Arterials where left turns are prohibited.
2. Providing exclusive turning lanes, with appropriate striping as shown in **Figures 8-18 and 8-19**.
3. Providing travel lanes, with widths as specified in the standard street cross sections. See **Figures 7-1F** through **7-13F** or **7-1L** through **7-11L.**
4. Raised islands must be large enough to be visible to vehicle drivers. Therefore, no single island, including pedestrian paths and/or pedestrian refuge, shall be smaller than 100 square feet.

8.2.16 Roadway Narrowing

Minor Collector or Local streets may be narrowed at intersections to provide more visibility for pedestrians. This shortens the distance necessary for pedestrians to cross the street. The narrowing shall not encroach into bike lanes or travel lanes. Narrowing may not be used on Major Collectors without parking lanes, on Arterials. Roadway narrowing may not be used on Major Collectors or Arterials without a formal Variance per Section 1.9.4. See **Chapter 18, Neighborhood Traffic Safety,** for design criteria.

8.2.17 Roundabouts

Roundabouts are considered a form of traffic control. Roundabouts shall be designed in accordance with the Roundabout Design Manual, included as Appendix I for reference only, and NCHRP Report 672. Check with the Local Entity Engineer for the most current version of the Roundabout Design Manual. Roundabouts shall be the standard form of traffic control provided at all new and reconstructed intersections between collectors (both minor and major) and other collectors. Roundabouts shall also be the preferred form of traffic control at any intersection that meets MUTCD warrants for the installation of all-way stop control.

8.2.18 Bike Lanes at Intersections

See Chapter 17, Bicycle Facilities; Chapter 4, Transportation Impact Study; and Chapter 14, Traffic Control Devices.

8.2.19 Pedestrian Requirements

See Chapter 14, Traffic Control Devices, concerning crosswalk requirements and Chapter 16, Pedestrian Facilities Design and Technical Criteria.

8.2.20 Drainage

See Chapter 7, Street Design and Technical Criteria, concerning drainage.

8.2.21 Pavement Requirements for Arterial/Arterial Intersections

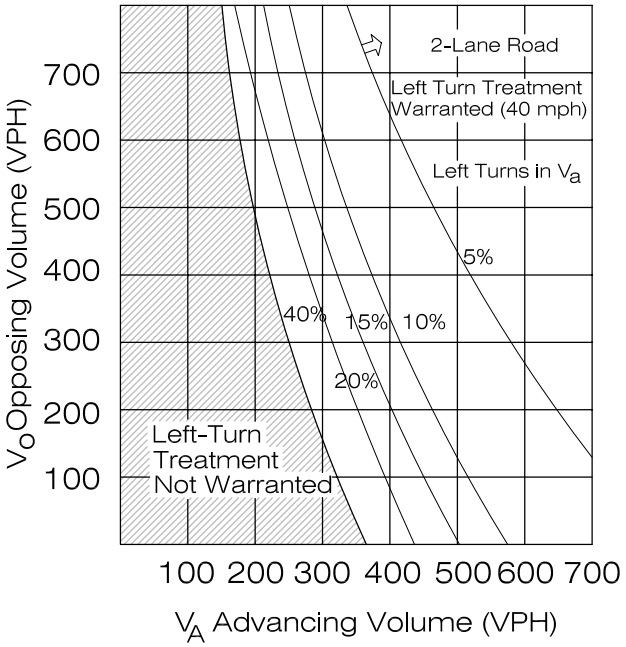
All new and reconstructed Arterial/Arterial intersections are required to be designed and constructed with concrete pavement. The concrete paving shall extend on each approach leg to the beginning points of the bay tapers. When existing arterial/arterial intersections are expanded, the use of concrete pavement is only required where one or more complete lanes are added. Refer to **Chapter 10**, **Pavement Design and Report.** See CDOT M&S Standards for the typical concrete pavement joint locations.

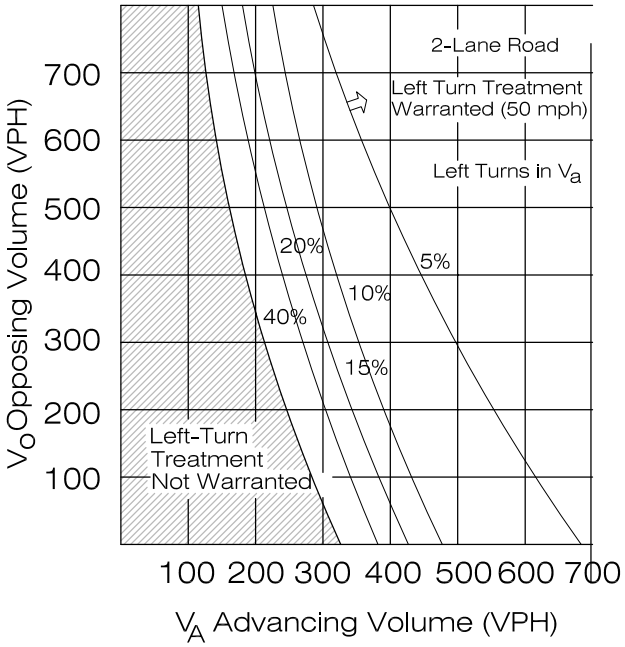
8.2.22 Intersection Lighting

See **Chapter 15, Street Lighting**, for street lighting requirements.

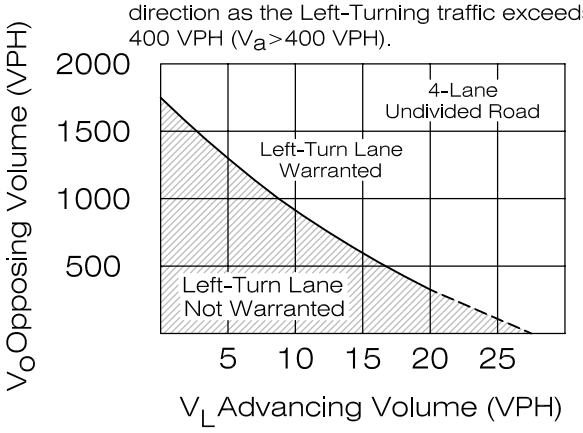
8.2.23 Intersection Control

See **Chapter 14, Traffic Control Devices**, for intersection control.





NOTE: When V_o < 400 VPH (dashed line). A Left-Turn Lane is not normally warranted unless the advancing volume (V_a) in the same direction as the Left-Turning traffic exceeds 400 VPH (V_a>400 VPH).



Notes: 1. Left turn lanes are required at all intersections and all-movement accesses on arterial roadways except where roundabouts are provided.

VOLUME WARRANTS FOR LEFT TURN LANES AT UNSIGNALIZED INTER.

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 12/14/00	8-1

GUIDELINES FOR DESIGN OF LEFT TURN LANES

LARIMER COUNTY
URBAN AREA
STREET STANDARDS

DESIGN FIGURE

REVISION NO:

DATE: 08/07/00

FIGURE 8-2

$L_d/_b$ -- Length of Taper and Lane for Deceleration and Braking

Functional Basis: To provide sufficient length for a vehicle to decelerate and brake entirely outside the through traffic lanes.

Desirable Design: Deceleration in gear for 3 seconds (occurs over bay taper) followed by comfortable braking to a stopped position.

Design Values For $L_d/_b$

S--Speed (mph)	Length (ft) Total	Lane	Bay Taper
30	235	115	(120)
40	315	155	(160)
50	435	235	(200)
60	530	290	(240)

Minimum Design: Braking begins at 2/3 full lane width, with minimum 50-foot storage. For low speeds only, the following values apply:

Design Values For $L_d/_b$

S--Speed (mph)	Length (ft) Total	Lane	Bay Taper
30	230	50	(180)
35	250	70	(180)
40	280	100	(180)
45	320	140	(180)

L_s -- Length of Lane for Storage (Full Width Lane)

Functional Basis: To Provide sufficient length for a reasonable number of vehicles to queue within the lane without affecting other lanes.

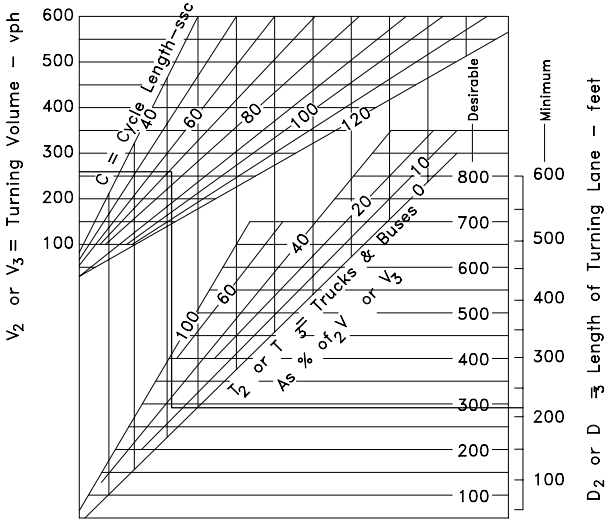
Desirable Design: Based on twice the mean arrival rate (per cycle for signals, per 2-minute period for stop control) during the peak hour of traffic.

Minimum Design: Based on mean arrival rate, with minimum storage for one vehicle.

L_s for Stop Control

DHV (vph)	L_s (ft)
≤60	50-75
61-120	100
121-180	150
>180	200 or more

L_s for Traffic Signal Control



GUIDELINES FOR DESIGN TAPERS FOR LEFT TURN LANES

LARIMER COUNTY
URBAN AREA
STREET STANDARDS

DESIGN FIGURE

REVISION NO:

DATE: 08/07/00

FIGURE 8-3

T_a -- Approach Taper Design (ft) (Redirect Taper)

Functional Basis: To provide a smooth lateral transition for all vehicles approaching the intersection.

Form of Alignment: Tangent

Low Speed Design: (<45) Provide a fully shadowed lane.

$$T_a = \frac{W S^2}{60}$$

W = Width of Offset (ft)
S = Speed (mph)

Typical Values for T_a*

S--Speed (mph)	W -- Width of Offset (ft) 11	11.5	12
25	115	120	125
30	165	170	180
35	225	235	245
40	295	305	320

*Rounded to nearest 5 ft.

High Speed Design: (≥45) Provide a fully shadowed lane. Design as follows:

$$T_a = WS$$

W = Width or Offset (ft)
S = Speed (mph)

S--Speed (mph)	W -- Width of Offset (ft) 11	11.5	12
45	495	520	540
50	550	575	600

*Rounded to nearest 5 ft.

T_b -- Bay Taper Design

Functional Basis: To direct left-turning vehicles into the turn lane.

Form of Alignment: Tangent; or reverse curves with 1/3 of the total length comprised of a central tangent.

Desirable Design: For fully shadowed left turn lane.

$$T_b = \frac{W_1 S}{3}$$

W_1 = Width of Lane
S = Speed (mph)

Typical Values for T_b*

S--Speed (mph)	W -- Width of Lane (ft) 11	12
30	110	120
40	145	160
50	185	200

*Rounded to nearest 5 ft.

Minimum Design: Taper ratios of 8:1 can be used for tangent bay tapers in constrained locations.

NOTE:

1. Right turn lanes are required on 6-lane arterial when the right turn volume exceeds 200 vph.
2. Refer to the National Cooperative Highway Research Program (NCHRP) Report 279 for more information

TRAFFIC VOL. GUIDELINES FOR DESIGN RIGHT TURN LANES

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/01/21	8-4

GUIDELINES FOR DESIGN LENGTHS OF RIGHT TURN LANES

LARIMER COUNTY
URBAN AREA
STREET STANDARDS

DESIGN FIGURE

REVISION NO:

DATE: 08/01/21

FIGURE 8-5

$L_{d/b}$ -- Length of Taper and Lane for Deceleration and Braking (ft)

Functional Basis: To provide sufficient length for a vehicle to decelerate and brake entirely outside the through traffic lanes.

Desirable Design: Deceleration in gear for 3 seconds (occurs over bay taper) followed by comfortable braking to a stopped position or to the design speed of the corner radius.

Design Values For $L_{d/b}$

Highway Design Speed, V (mph)	Stop Condition*	Design Speed of Corner Radius (mph) 15	20	25	30
30	235	185	160	140	-
35	275	240	213	188	93
40	315	295	265	235	185
45	375	350	325	295	250
50	435	405	385	355	315

*Appropriate for right turn lanes in approaches to stop signs and traffic signals.

Bay Taper Length = $\frac{WS}{3}$

$T_b = \frac{W_1 S}{3}$

T_b -- Bay Taper Design

Functional Basis: To direct left-turning vehicles into the turn lane.

Form of Alignment: Tangent; or reverse curves with 1/3 of the total length comprised of a central tangent.

Desirable Design: For fully shadowed right turn lane.

$T_b = \frac{W_1 S}{3}$

W_1 = Width of Lane
S = Speed (mph)

Typical Values for T_b*

S--Speed (mph)	W_1 -- Width of Lane (ft) 11	12
30	110	120
40	145	160
50	185	200

*Rounded to nearest 5 ft.

Minimum Design: Taper ratios of 8:1 can be used for tangent bay tapers in constrained locations.

L_S -- Length of Lane for Storage (Full Width Lane) (ft)

Functional Basis: To Provide sufficient length for a reasonable number of vehicles to queue within the lane without affecting other lanes.

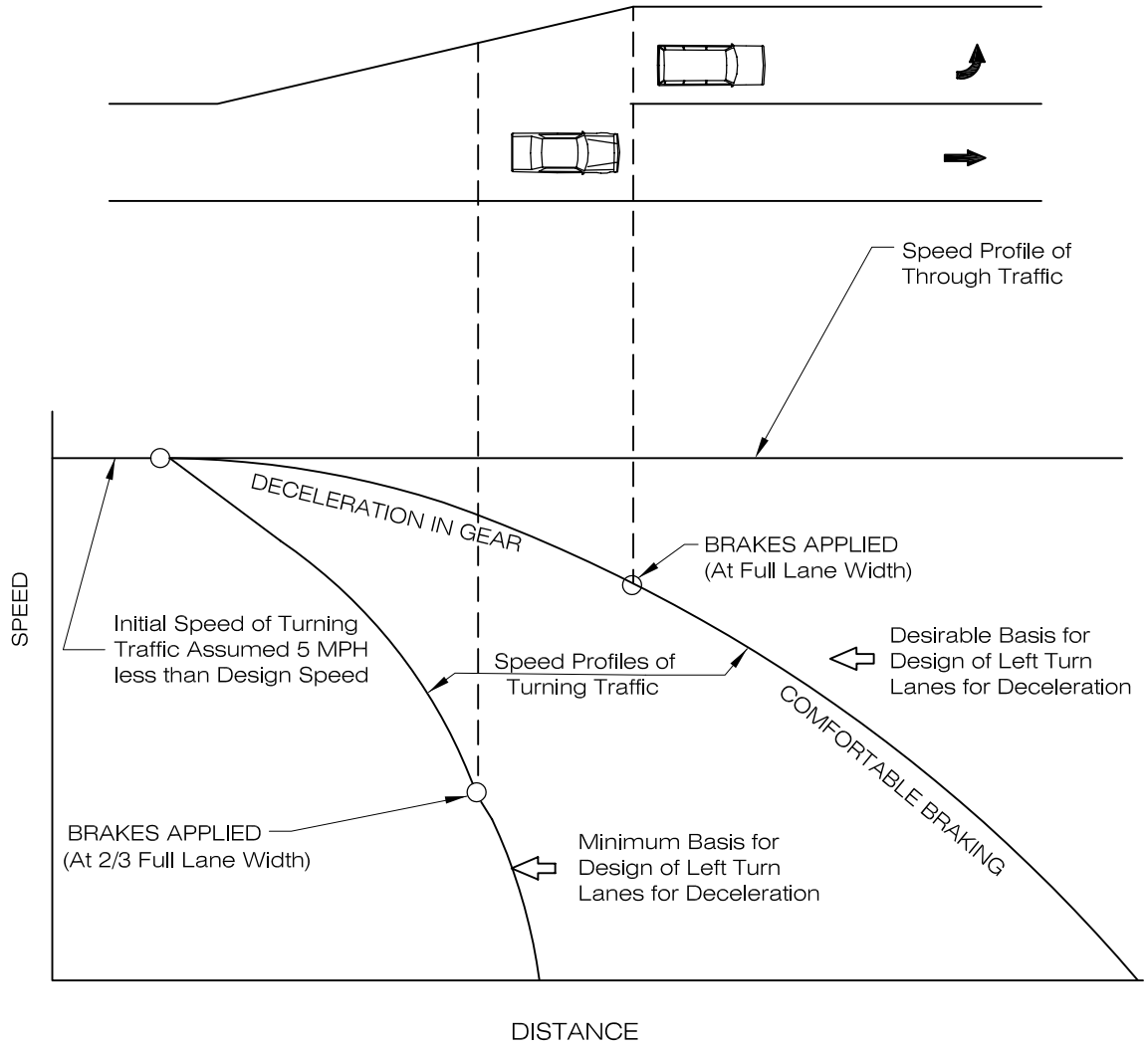
Desirable Design: Based on twice the mean arrival rate (per cycle for signals, per 2-minute period for stop control) during the peak hour of traffic.

Minimum Design: Based on mean arrival rate, with minimum storage for one vehicle.

L_S for Stop Control

DHV (vph)	L_S (ft)
≤60	50-75
61-120	100
121-180	150
>180	200 or more

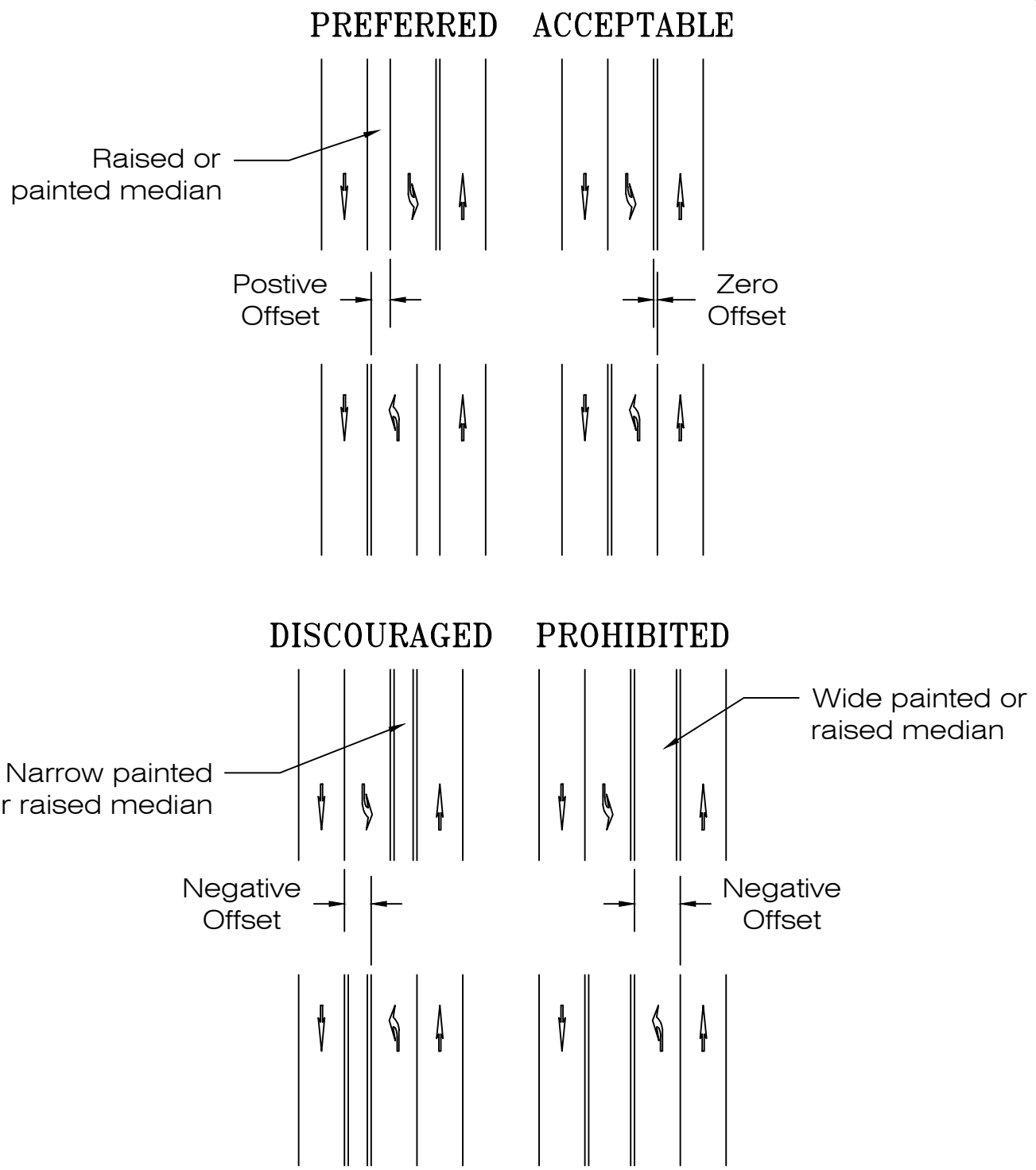
Reference NCHRP 279



CONCEPTUAL

LEFT TURN LANE DECELERATION

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 12/14/00	8-6

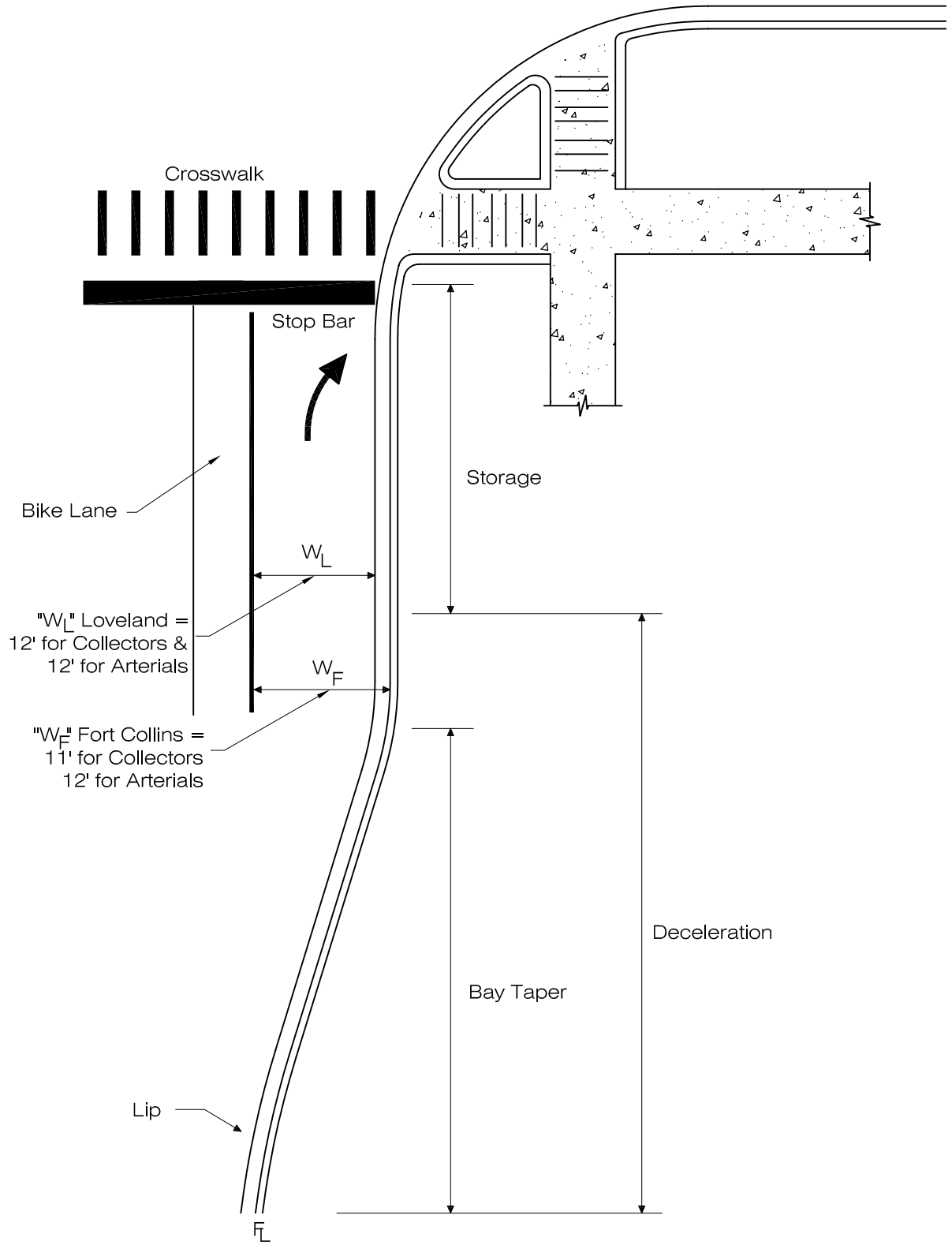


NOTES:

1. Positive offsetting of left turn bays allows opposing left turn movements to see around each other, generally improving safety of permissive left turn movements.

OPPOSING LEFT TURN BAY CONFIGURATIONS

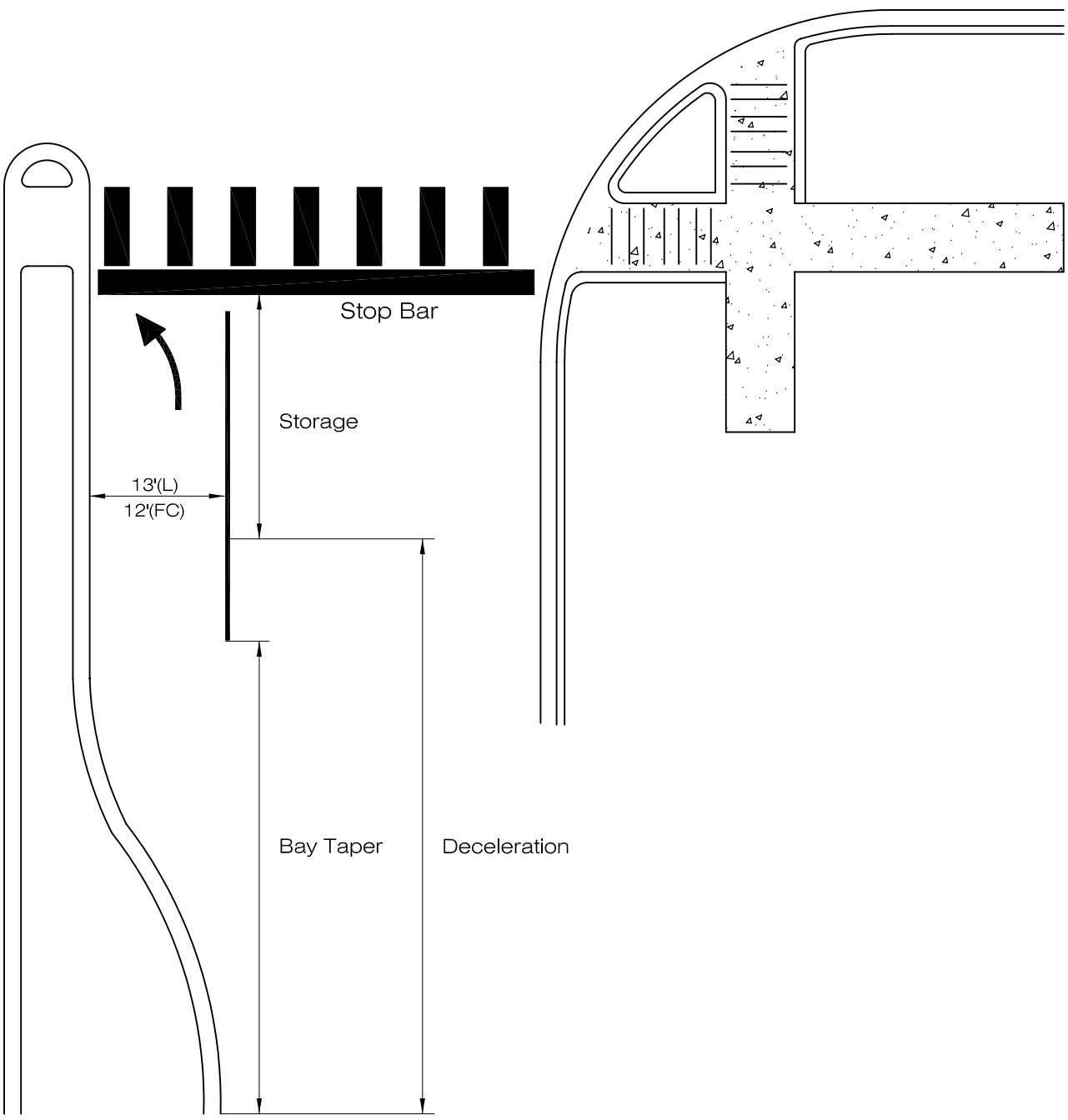
LARIMER COUNTY URBAN AREA STREET STANDARDS	CONSTRUCTION DRAWINGS	REVISION NO:	FIGURE
		DATE: 08/01/21	8-7



NOTE: 1) Refer to **Figure 8-5** for design requirements.
2) Provide a 50'± arc length at angle points for a smooth curve.

EXCLUSIVE RIGHT TURN

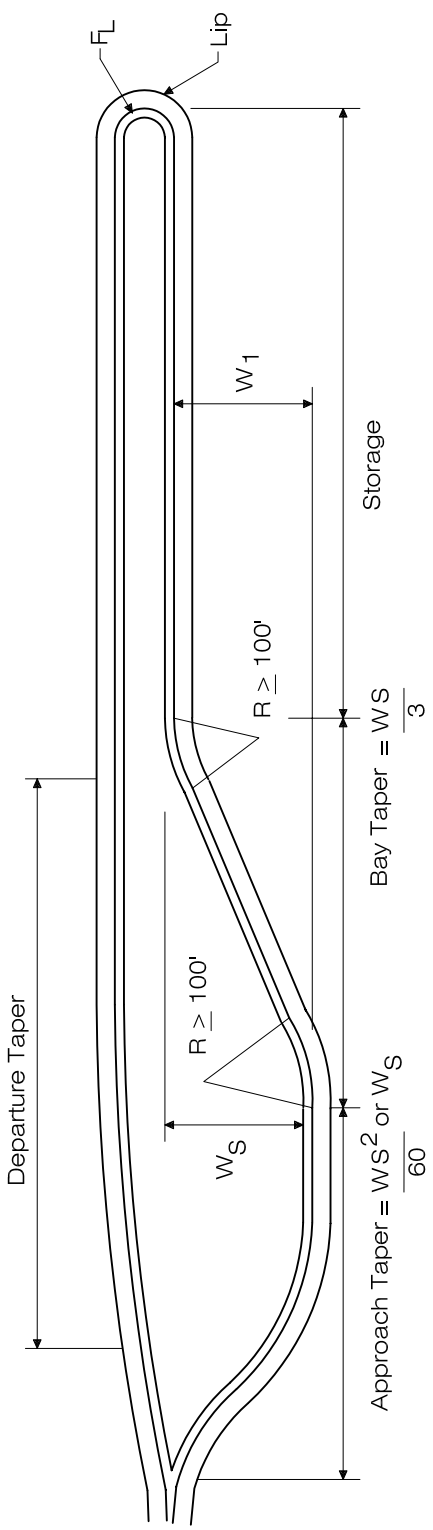
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	8-9



NOTES:
1. If high pedestrian area, then minimum median width is 7' flowline to flowline.
2. Refer to **Figures 8-2, 8-3 and 8-11** for design requirements.
3. Provide a 50'± arc length at angle points for a smooth curve.

EXCLUSIVE LEFT TURN

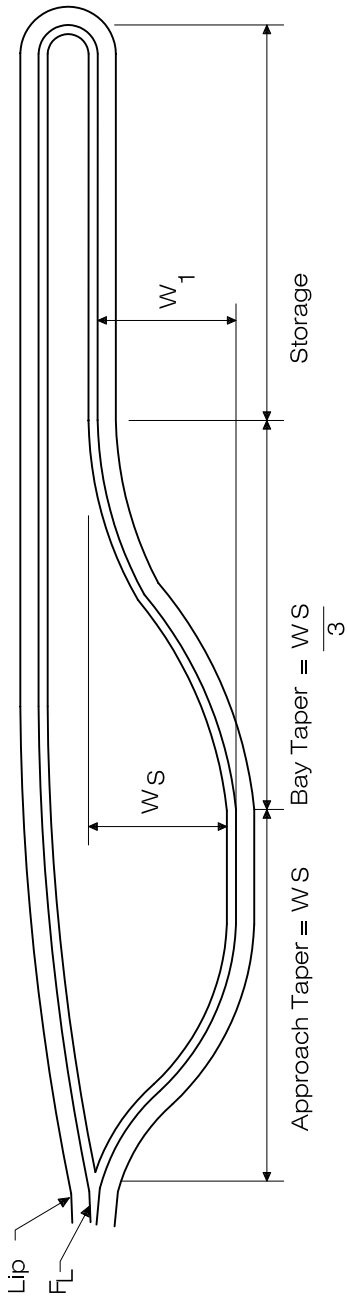
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: DATE: 08/07/00	FIGURE 8-10



Left Turn Lane with Full Shadow

High Speed (≥45 MPH)

TAPER RATIOS				
TAPER TYPE	DESIGN SPEED			
	35	40	45	50
Bay	12:1	13.3:1	15:1	16.7:1
Approach	20:1	27:1	45:1	50:1
Depart	NA	NA	NA	NA
combined	20:1	27:1	45:1	50:1

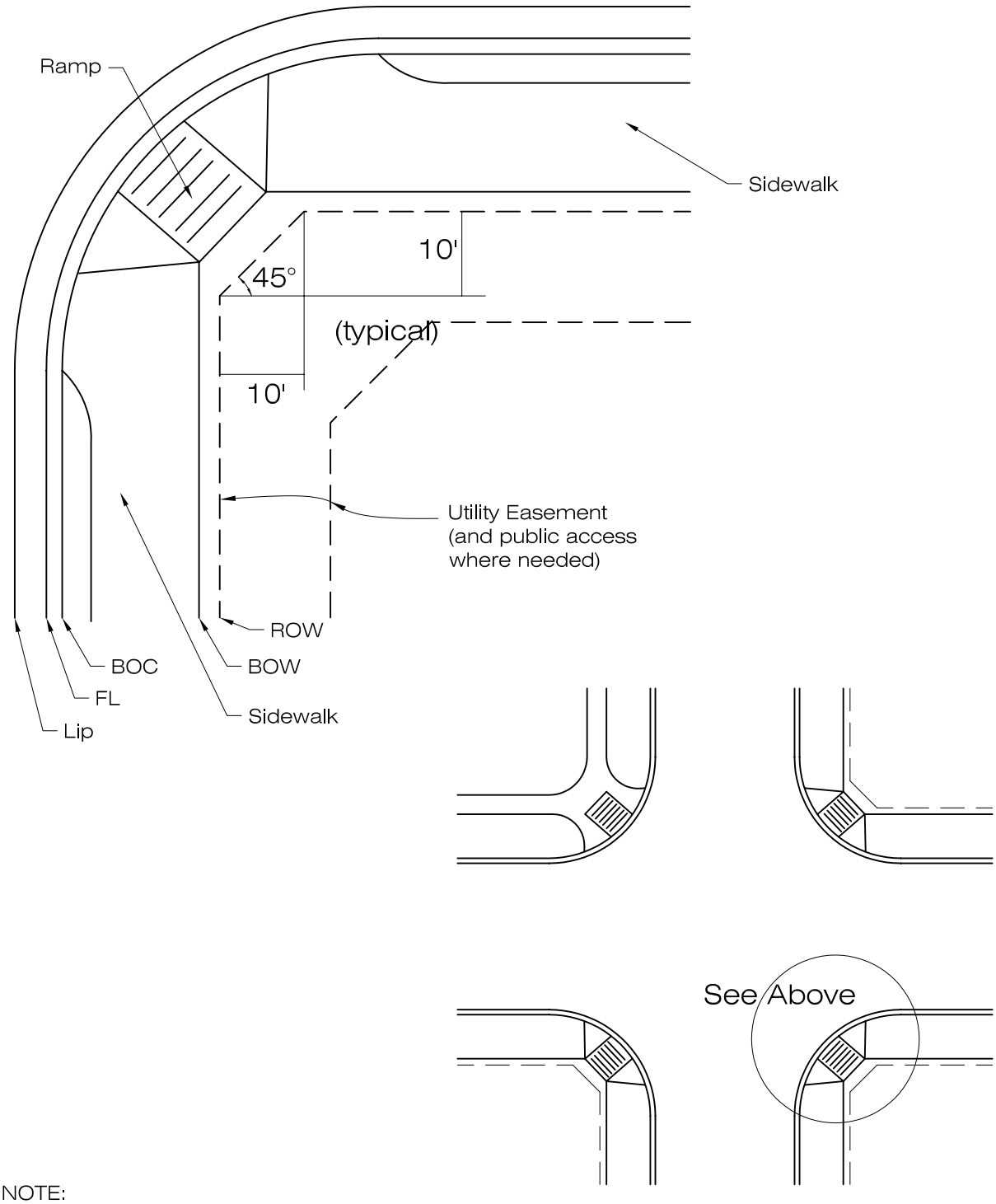


Left Turn Lane with Partial Shadow

NOTE: Refer to **Figure 8-3** for design requirements.

TURN LANE DESIGN CRITERIA

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1	FIGURE
		DATE: 03/01/02	8-11

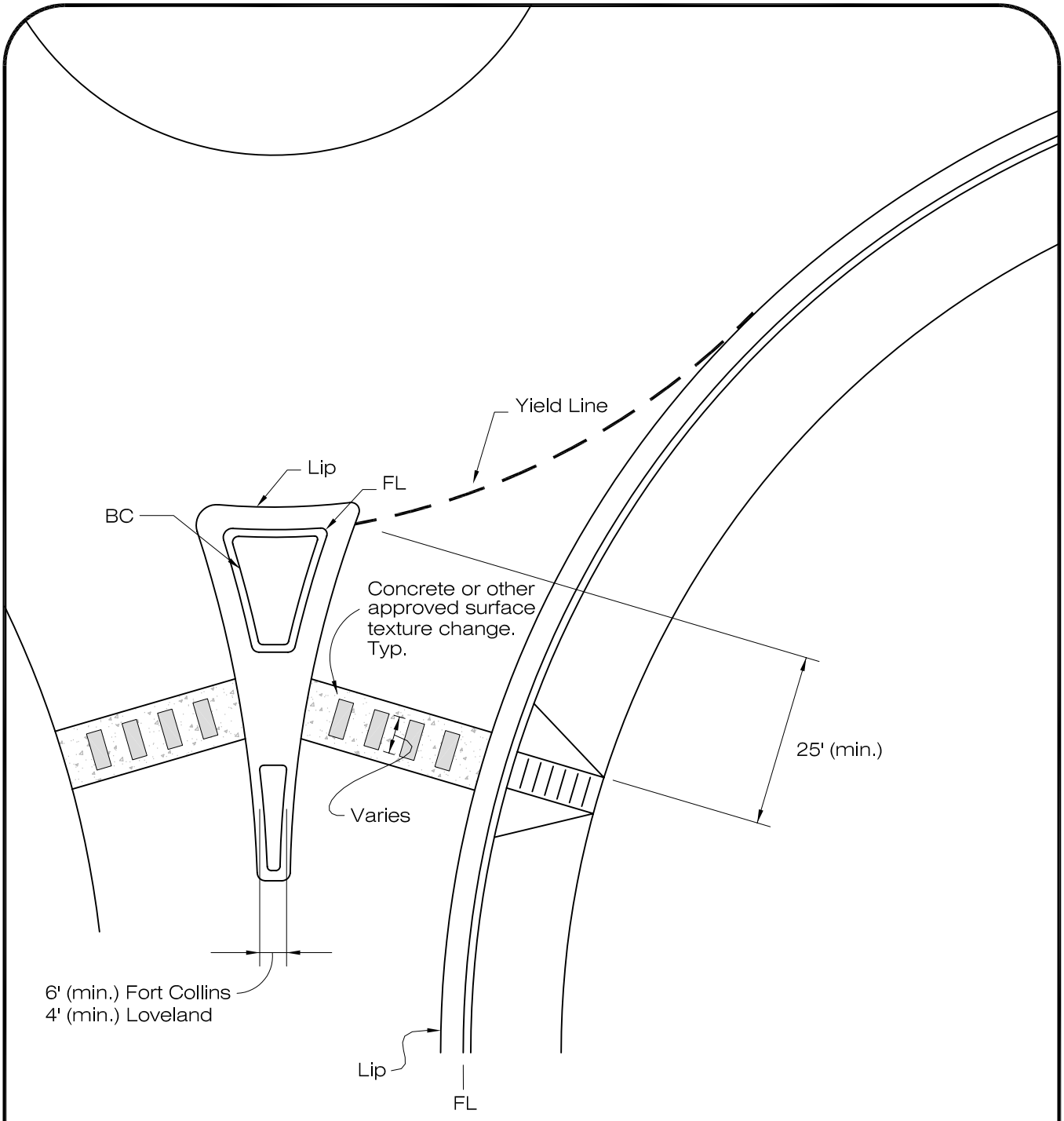


NOTE:

1. Right of Way must be dedicated in the form of a radius or corner cut to include all of the required public improvements. However, sidewalk may be placed in a public easement when approved by the Local Entity Engineer.
2. If intersection is determined to accommodate a roundabout in Loveland (GMA & City Limits), see **Figure 8-16L** for ROW requirements.
3. Easements at the corner must be dedicated to provide corner cuts similar to ROW.

RIGHT OF WAY REQUIREMENTS AT INTERSECTIONS

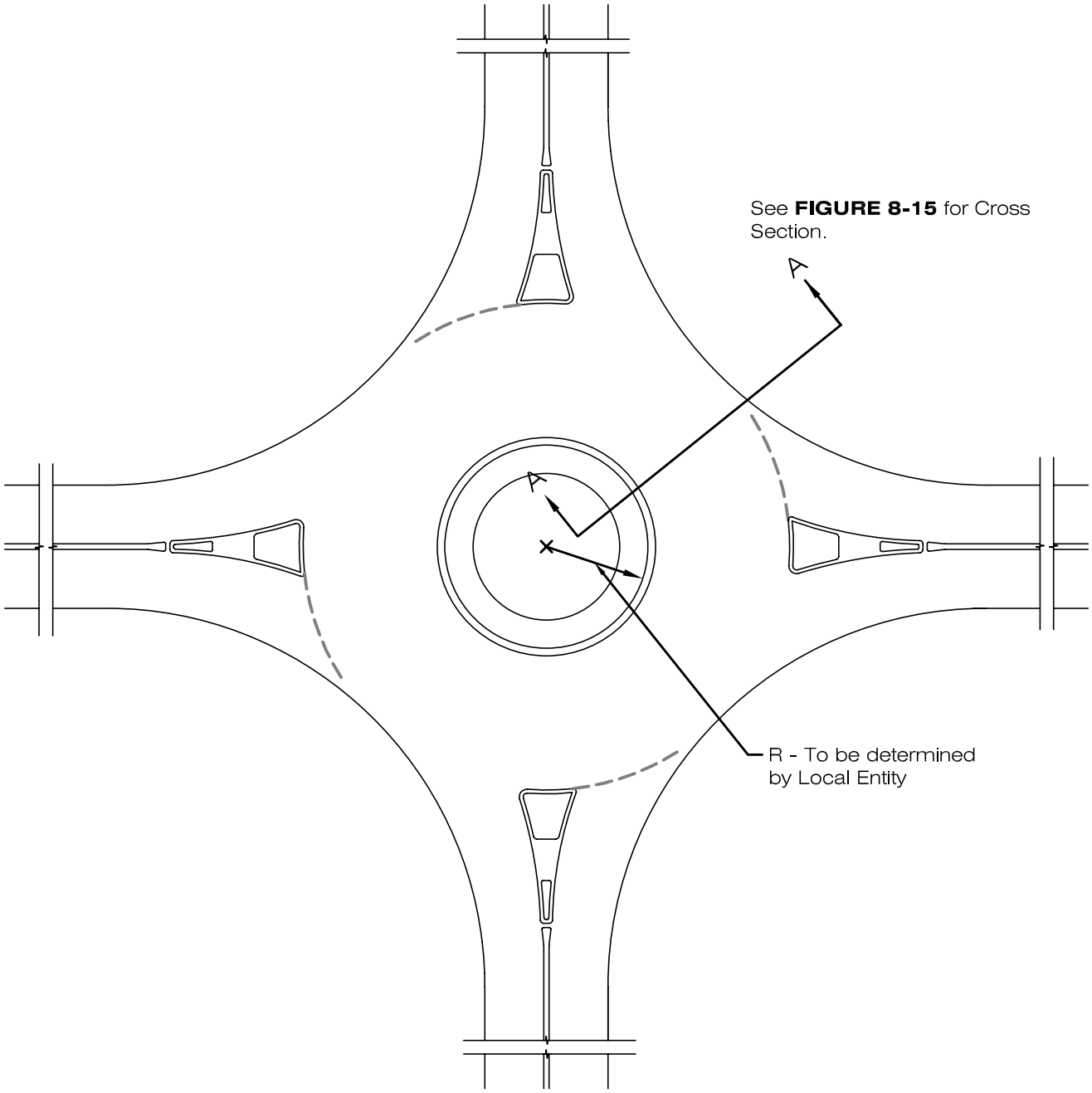
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	8-12



NOTES:
1. Each Splitter Island shall have a minimum width equal to the street classification sidewalk width and Refuge area that is in line with cross walks.
2. The specific design shall determine minimum radii and island lengths.
3. Raised crosswalk may be required by Local Entity.
4. Designer shall provide design to drain water out of pedestrian refuge.
5. Pedestrian refuge area shall be in line with crosswalks.
6. A mountable style curb and a decorative structural concrete surface shall be used for mini roundabouts that cannot accomodate WB50 and larger trucks solely on the roadway and truck apron surfaces.

SPLITTER ISLAND FOR MINI ROUNDABOUTS

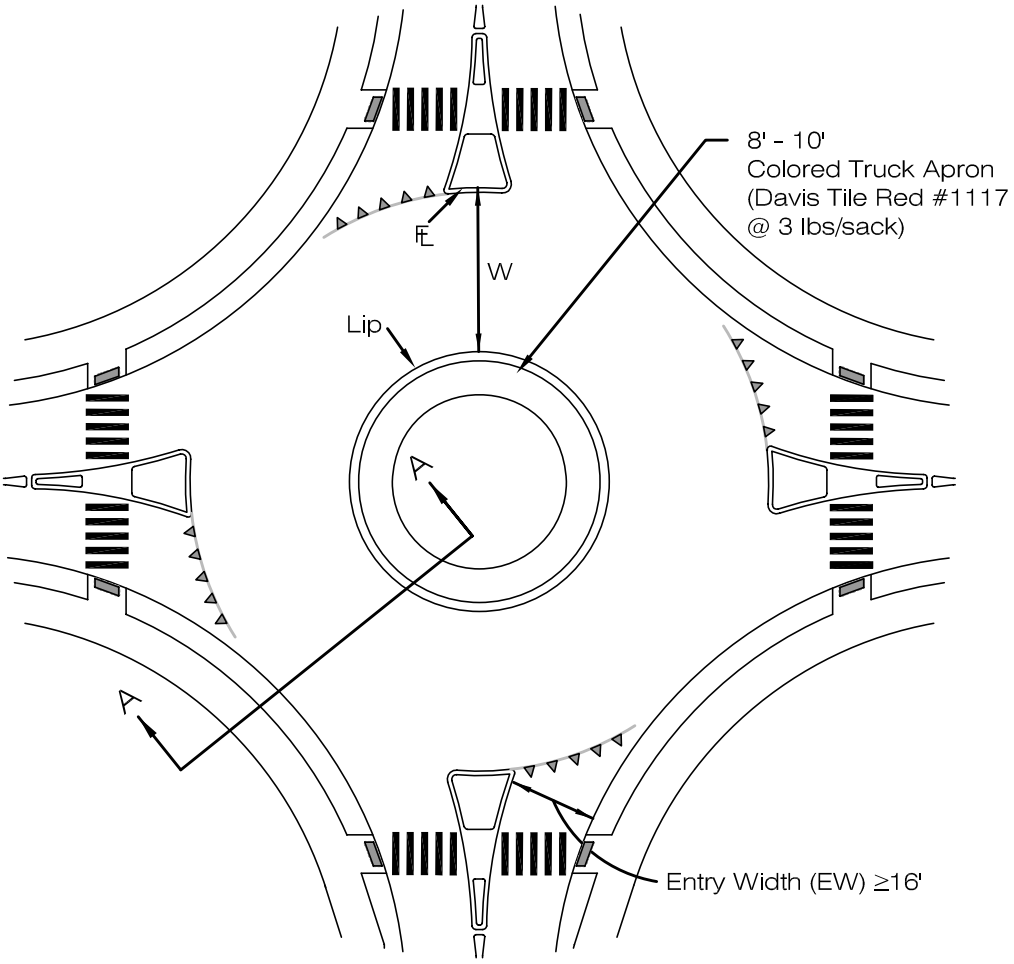
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1	FIGURE
		DATE: 03/01/02	8-13

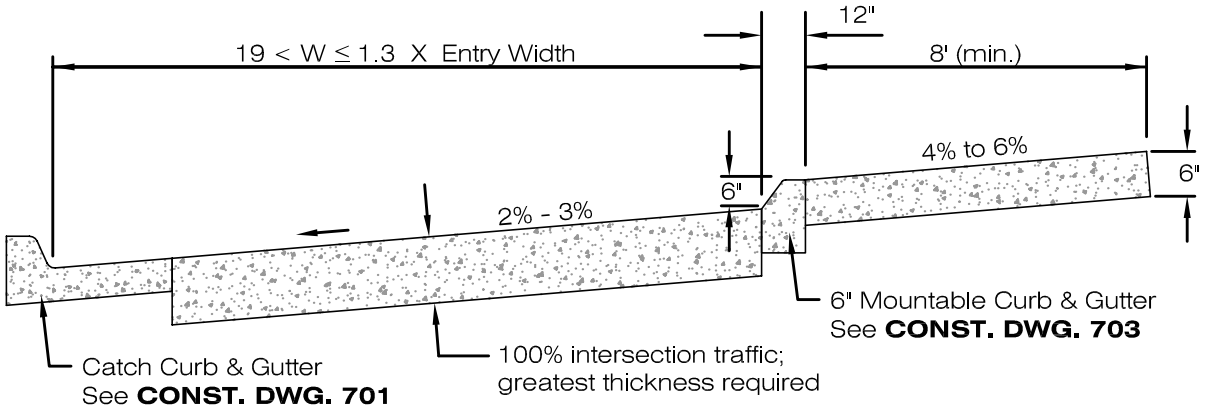


NOTE:
1. Refer to **Figure 14-2** for Mini Roundabout Sign Details & to **CONST. DWG. 802** for Barrier (Splitter Island) Details.

MINI ROUNDABOUT

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 2	FIGURE
		DATE: 04/01/07	8-14



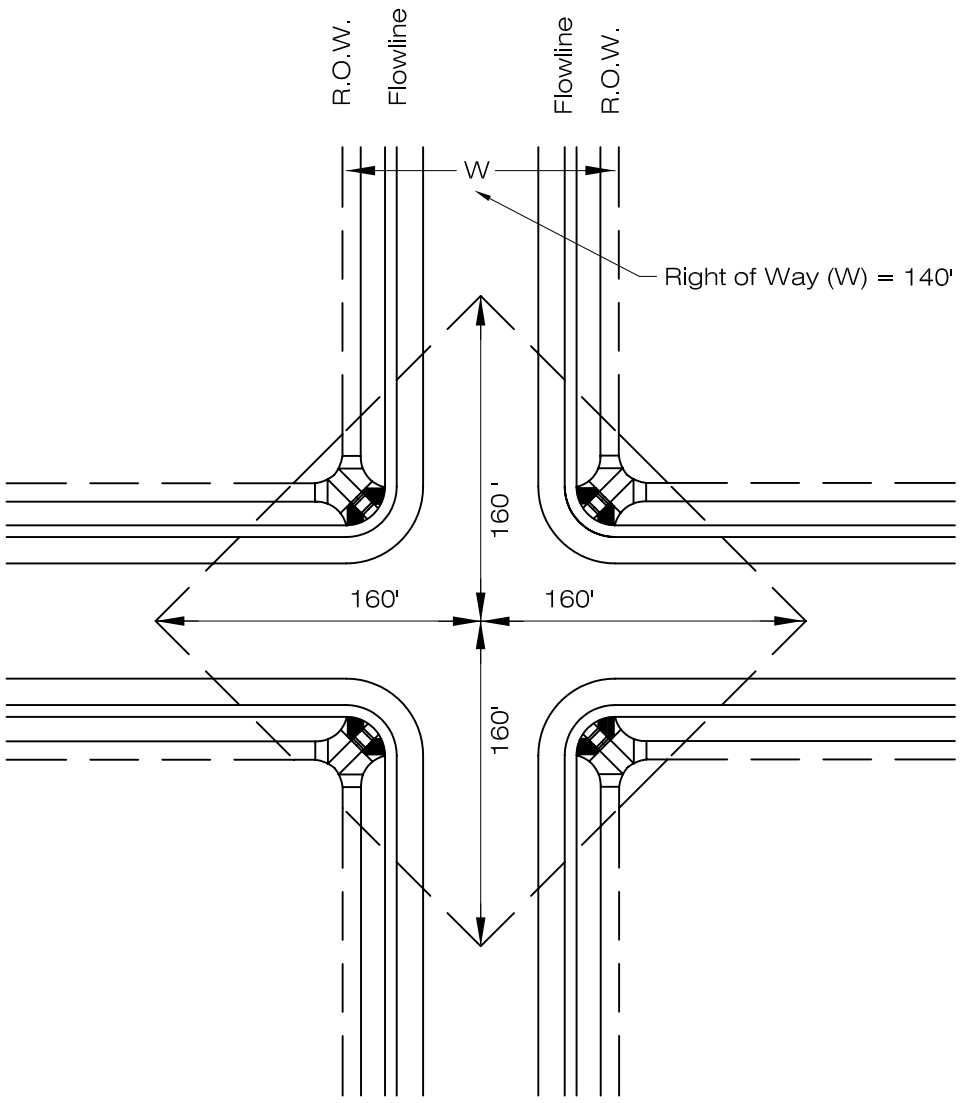


SECTION A-A

MINI ROUNDABOUT CROSS SECTION

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 2 DATE: 04/01/07	FIGURE 8-15

LOVELAND ONLY



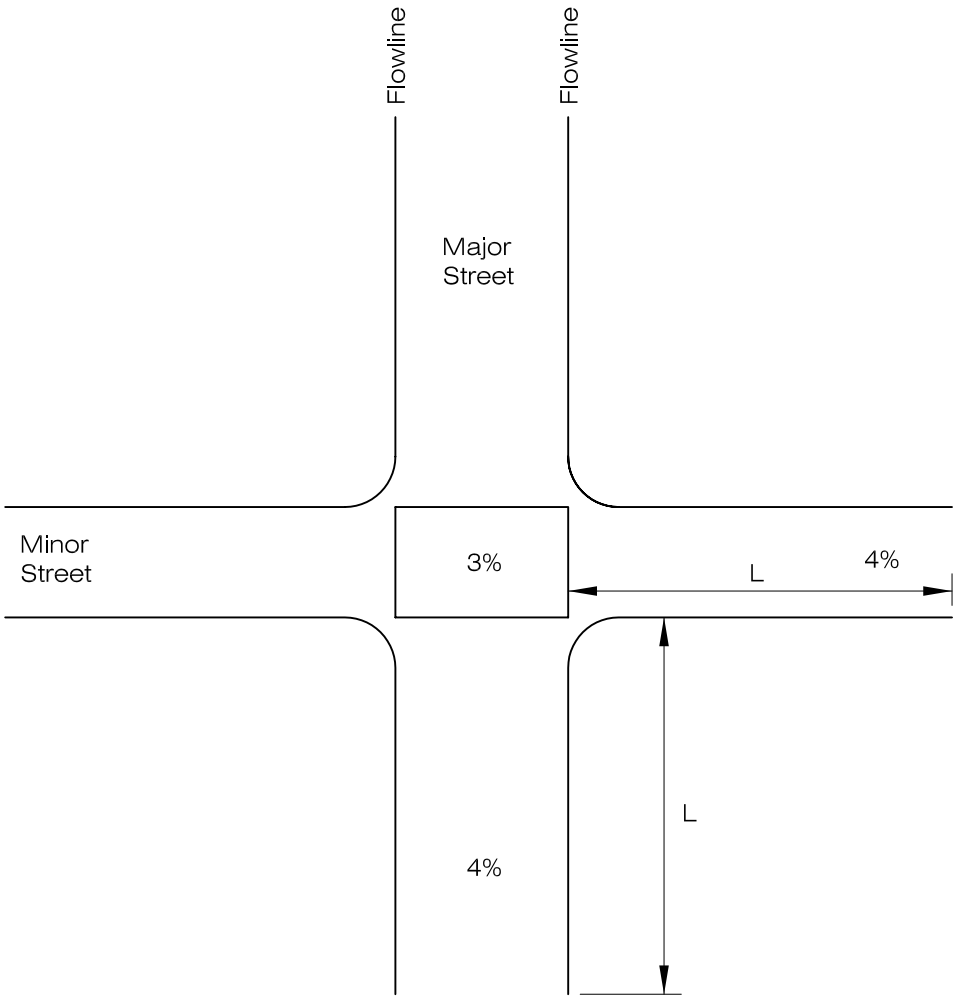
6 LANE ARTERIAL

NOTE:

The Local Entity may require the Developer to provide Right-of-Way for future Roundabout locations on any Major Collector or 2, 4 or 6 lane Arterial.

ARTERIAL INTERSECTION RIGHT-OF-WAY REQUIREMENTS

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 01/24/01	8-16L

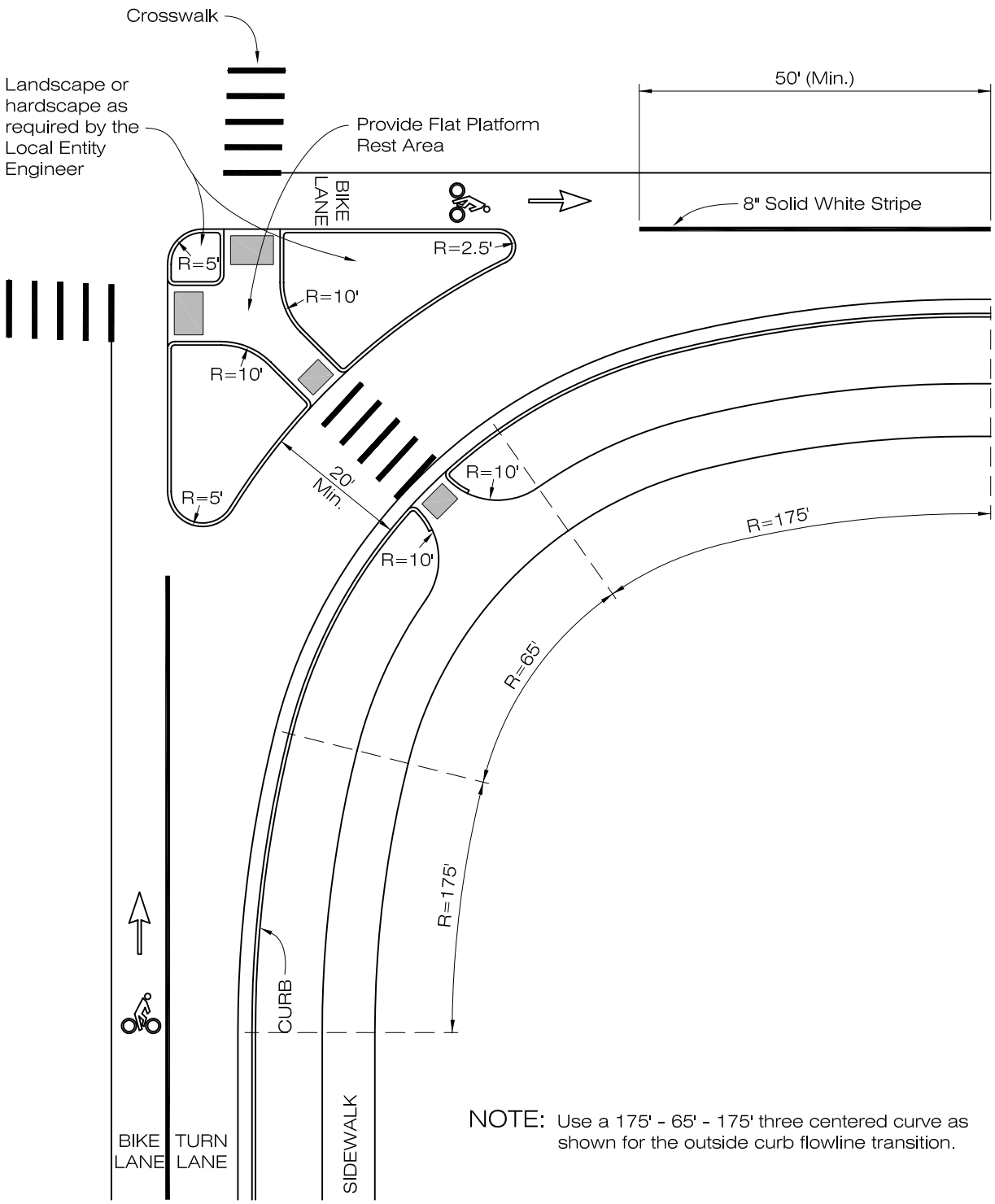


INTERSECTION GRADE CONTROL LENGTHS (L)

MINOR LEG	LOCAL	COLLECTOR	ARTERIAL
Private Drives	65 ft	65 ft	75 ft
Local	95 ft	100 ft	125 ft
Collector	100 ft	120 ft	200 ft
Arterial	125 ft	200 ft	200 ft

INTERSECTION GRADES

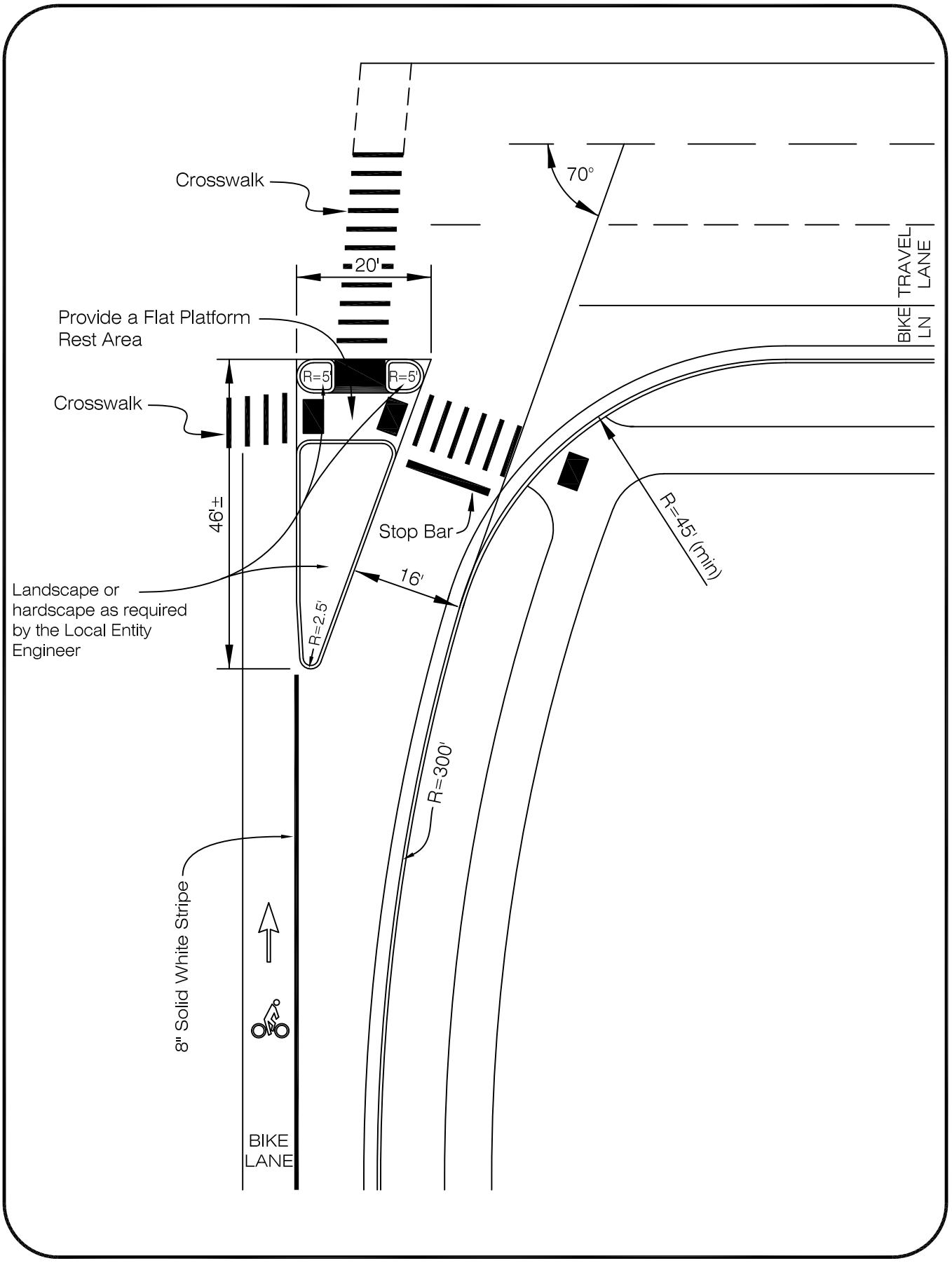
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	8-17



NOTE: Use a 175' - 65' - 175' three centered curve as shown for the outside curb flowline transition.

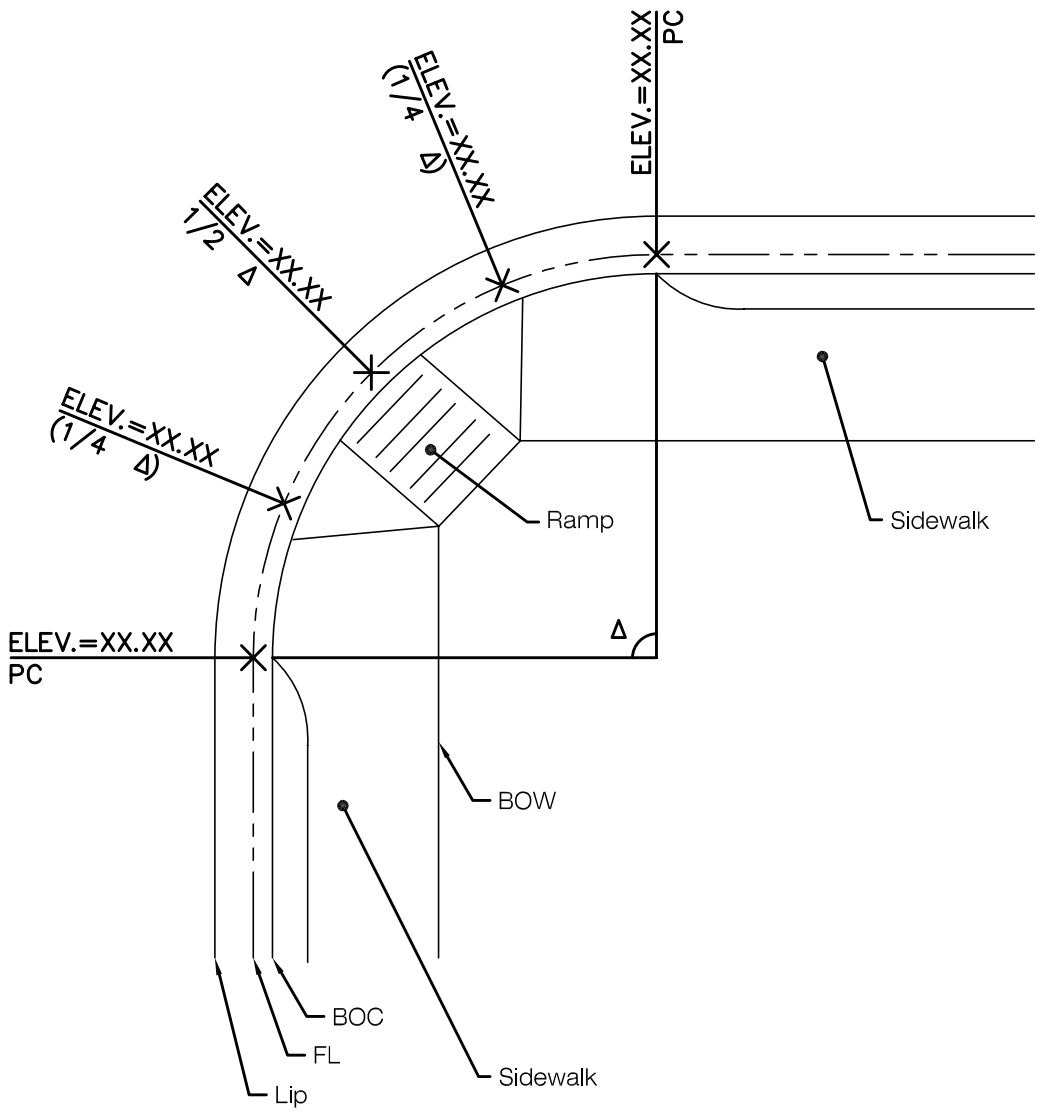
RT TURN LANE TO A CONTINUOUS LANE W/PED. REFUGE

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 02/02/01	8-18



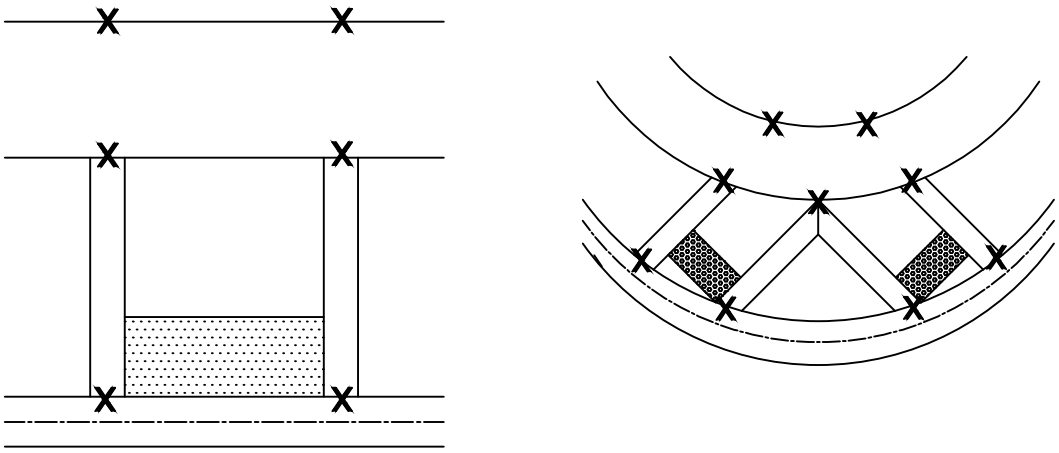
PEDESTRIAN REFUGE ISLAND/RIGHT TURN LANE

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	8-19

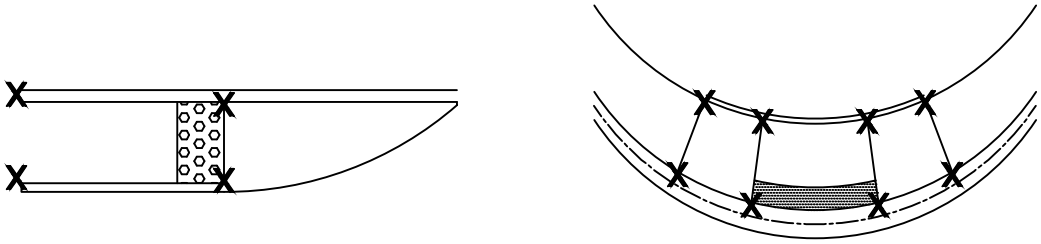


REQUIRED SPOT ELEVATIONS FOR CURB RETURNS

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 04/01/07	8-20



RAMPS & DETACHED SIDEWALK



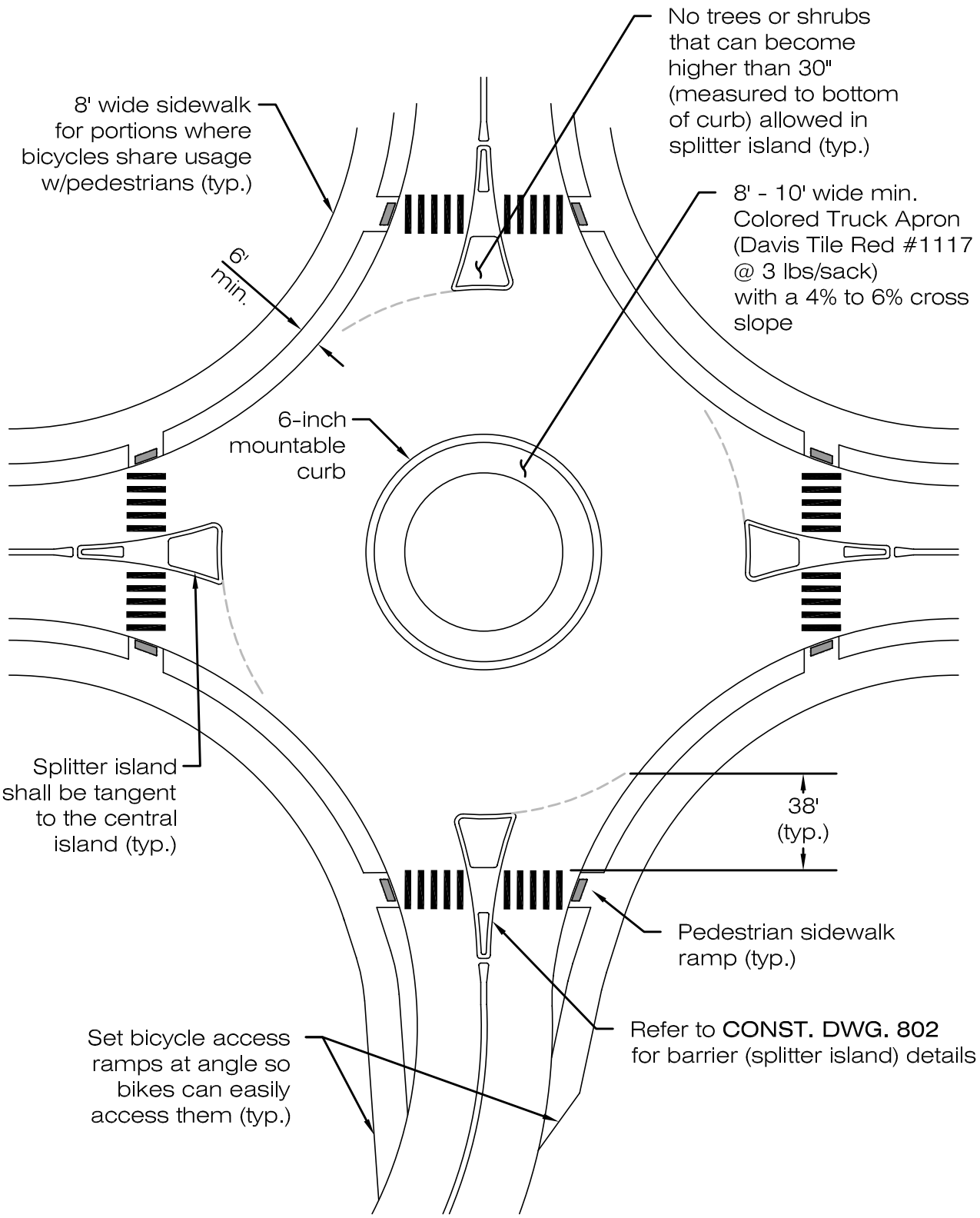
RAMPS WITH ATTACHED SIDEWALK

NOTE: CROSS SLOPES AND RUNNING SLOPES ON CURB RAMPS SHALL BE ADA COMPLIANT.

REQUIRED SPOT ELEVATIONS FOR CURB RAMPS

LARIMER COUNTY URBAN AREA STREET STANDARDS	CONSTRUCTION DRAWINGS	REVISION NO:	FIGURE
		DATE: 07/01/21	8-20.1

LOVELAND ONLY



TYPICAL ROUNDABOUT

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 2	FIGURE
		DATE: 04/01/07	8-21

CHAPTER 9 – ACCESS REQUIREMENTS AND DESIGN CRITERIA

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LIST OF TABLES

This Chapter Does Not Contain Tables

LIST OF FIGURES

Figures are Located at End of Chapter

CHAPTER 9 – ACCESS REQUIREMENTS AND DESIGN CRITERIA

9.1 GENERAL

Access may occur as one of two types: (1) access for land use (driveways) and (2) public streets (street intersections).

9.1.1 Designing Placement of Accesses

A. Direct Access Restricted

Direct access to individual lots from Arterials is restricted. For City of Loveland (GMA and city limits) direct access to is restricted from Arterials and Collectors.

B. Avoiding Conflicts in Center Left Turn Lane

When establishing the placement of offset accesses (either driveways or intersections), ensure that traffic making left-hand turns into the accesses does not conflict or compete for the simultaneous use of a center left turn lane.

C. Separation Distances

The specific separation distances between accesses shall be as shown in **Table 7-3** or **Table 7-4**. Greater separation may be required to eliminate conflicts or overlaps of center left turn lanes as determined by TIS.

D. Access Control Plan

For a street controlled by an adopted Access Control Plan, the proposed access shall conform with the applicable Access Control Plan.

9.1.2 Review and Approval

A. Review Procedure

1. Advice Available. To determine the extent of technical justification required for all access requests, consult with the Local Entity Engineering staff. It is recommended that this advice be sought prior to submitting any application.
2. Access Permits. All access permits shall be reviewed and approved through the Local Entity, in Fort Collins (GMA and city limits) and in Loveland (GMA only). Loveland (GMA and city limits) does not issue or require a separate access permit. The requirements of this chapter are covered in the City of Loveland's design review of the right-of-way permit.
3. Permit Required. A permit must be requested by the Developer and approved by the Local Entity prior to the construction or reconstruction of any access. See Chapter 6, Permits.
4. CDOT Approval for State Highway Access. The Colorado Department of Transportation shall review and approve all State Highway access.

B. Approval

Access is granted through Local Entity approval of the final plat, final construction plans, or final site plan. The number and location of access points shall conform to

the criteria outlined in this section, unless an exception is approved by the Local Entity Engineer.

C. Approval for Existing Developments (City of Loveland only)

Zoning determines how to obtain approval for access from existing developed property to Local Entity streets.

1. Planned Developments. For planned developments, new or altered access shall be obtained through the Administrative Amendment Process. This involves applying through the Planning Department to amend the property Final Development Plan. The application shall be accompanied by appropriate plans for the proposed access and technical justification, including justification for the extent of improvements proposed at the access point.
2. Conventionally Zoned Property. For conventionally zoned property, application for access can be made using the Local Entity's application form identified in Chapter 6, Permits. This application shall be accompanied by plans for the proposed access and technical justification for the access and associated public improvements.

9.2 CRITERIA FOR ACCESS ONTO ROADWAYS

9.2.1 State Highways

A. Access to State Highways

Access to state highways is governed by the State Highway Access Code, state highway access plans and these Standards. All access issues on state highways within the Larimer County Urban Area shall be submitted to the Colorado Department of Transportation and approved before access permits will be issued by CDOT. The proposed access points to a state highway shall be in accordance with **Tables 7-3 or 7-4**.

B. Access to Existing Frontage Roads

Proposed access to all frontage roads shall comply with the requirements of the Colorado Department of Transportation State Highway Access Code, any applicable access control plan and the requirements of these Standards. Refer to **Chapter 7, Street Design and Technical Criteria**. The proposed access points to a frontage road shall be in accordance with **Table 7-3** or **Table 7-4**.

9.2.2 Freeways

All new freeway access in the Larimer County GMA shall meet the requirements of the Colorado Department of Transportation. All design issues must meet CDOT standards.

9.2.3 4-Lane or 6-Lane Arterials (Master Planned)

A. Access Approval

Access approval must be obtained from the Local Entity for any private access constructed to a 4- or 6-lane Arterial street. This approval must be granted during the

development review process (through plan approval) or by issuance of the Local Entity's right-of-way or access permit.

B. Conditions for Private Access

For any driveway or street access to a 4-lane or 6-lane Arterial, an Access Management Plan and a signal progression plan may be required by the Local Entity Engineer. Refer to **Chapter 4, Transportation Impact Studies**. Generally, no private direct access shall be allowed onto a 4- or 6-lane Arterial street. Private direct access may be permitted only when the property in question has no other reasonable access to the general street system and appropriate auxiliary turn lanes are provided. Access may be permitted when the alternative direct access to another roadway would cause unacceptable traffic operation and safety problems to the overall traffic flow of the general street system.

When private access must be provided, the following shall be considered:

1. Temporary Nature. Such access shall continue only until such time that some other reasonable access to a lower function category street is available and permitted. The Access Permit shall specify the future reasonable access location(s), if known, and what changes will be required under what circumstances.
2. Limitations. 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:
    a. Allowing only one access conflicts with safety regulations (e.g., fire access), or
    b. Additional access would significantly benefit safety and operation of the highway or street and is necessary to the safe and efficient use of the property.
3. Right Turns Only. An access shall be limited to right turns only (through signage and a raised median), unless
    a. The access has the potential for signalization, in accordance with the general spacing requirements in Table 7-3 or Table 7-4,
    b. Left turns would not create unreasonable congestion or safety problems and not lower the level of service, and
    c. Alternatives to the left turns would not cause unacceptable traffic operation and safety problems to the general street system.
4. Access Management Plan. Private access must be included as part of the Access Management Plan if required by the Local Entity.
5. Offset from Opposite Streets. Intersections of streets with Arterial streets shall only align with streets intersecting on the opposite side of the Arterial street where a traffic signal or Roundabout will be permitted unless a raised median exists within the arterial roadway that restricts the access at the intersections to right-in and right-out turns only. All other intersections must be offset by the distances given in Tables 7-3 or 7-4.

C. Public Direct Access Requirements

Public direct access to a 4- or 6-lane Arterial, where left turns are to be permitted, must meet the signal spacing criteria and the Access Management Plan. Those that do not meet these requirements shall be limited to right turns only, unless they meet the requirements above. Local streets should not intersect 4- or 6-lane Arterials, except in Fort Collins (GMA and city limits), where local street intersections shall be spaced at a minimum of 460 feet. See **Table 7-3** for exceptions.

D. Spacing and Signalization Criteria

Full access to 4-lane or 6-lane Arterials shall be limited to one-half mile intervals, or one-quarter mile intervals in Fort Collins (city limits only), plus or minus approximately 200 feet, in order to achieve good speed, capacity, and optimal signal progression. However, to provide flexibility for both existing and future conditions, an approved engineering analysis of signal progression shall be made to properly locate any proposed access that may require signalization. The specifics of this analysis are detailed in **Chapter 4, Transportation Impact Studies.**

9.2.4 2-Lane Arterials

A. Approval for Private Access

Approval must be obtained from the Local Entity for any private access constructed onto a 2-lane Arterial. Generally, no private direct access shall be allowed onto a 2-lane Arterial except where no alternative access is available. The Local Entity Engineer may permit private direct access onto a 2-lane Arterial under the following conditions:

1. No Signalization Potential. The access does not have the potential for signalization as per the requirements of Section 9.2.3 B above, or,
2. Does Not Interfere. The access does have the potential for signalization, (by meeting the signal spacing requirements for intersecting public streets stated below) and does not interfere with the location, planning, and operation of the general street system and access to nearby properties in accordance with the Access Management Plan.
3. Movements May be Limited. Left turns may be prohibited, allowing right turns only. If left turns are restricted, raised medians will be required to prevent the left turn movements.

B. Public Direct Access Requirements

Public direct access to a 2-lane Arterial, where left turns are to be permitted, must meet the signal spacing criteria in **Table 7-3** or **Table 7-4**. Those that do not meet these requirements shall be limited to right turns only, unless they meet the requirements of **Section 9.2.3 B** above. No local streets should intersect 2-lane Arterials, except in Fort Collins(GMA and city limits), where local street intersections shall occur with a minimum spacing of 660 feet See **Table 7-3** for exceptions).

C. Spacing and Signalization Criteria

1. Limited Intervals. Non-signalized full access to 2-lane Arterials shall be limited to one-quarter mile intervals, plus or minus approximately 100 feet, in order to achieve good speed, capacity, and optimal signal progression. Signalized intersections shall still be spaced at one-half mile spacing.
2. Proper Locations. However, to provide flexibility for both existing and future conditions, an approved engineering analysis of signal progression shall be made to properly locate any proposed access that may require signalization. The specifics of this analysis are detailed in Chapter 4, Transportation Impact Studies.

9.2.5 Major and Minor Collectors

A. Private Access

Private access to Collectors shall be governed by the curb opening and driveway criteria in **Table 7-3** or **Table 7-4**. Single family residence access to Collectors is not permitted unless access to a lower function category street is not available. In Fort Collins (GMA and city limits), access to Minor Collectors should be shared access.

B. Intersections

Refer to **Tables 7-3** and **7-4**.

C. Offsets

Streets intersecting on opposite sides of a Collector Street shall be either directly across from each other or offset by the distances given in **Tables 7-3** and **7-4**.

9.2.6 Local Streets and Lanes

Private access to local streets shall be governed by the following curb opening and driveway criteria.

A. Spacing

Public streets shall meet spacing requirements of **Tables 7-3** and **7-4**.

B. Arrangement

Local streets shall be designed to divert traffic to Collector streets and provide for circulation and movement within the subdivision. In Fort Collins (GMA and city limits), new streets should be laid out so the streets interconnect with simple routes (not circuitous) and multiple routes provided for all locations in the development. In addition streets should be located to match Local Entity planning requirements.

9.2.7 Eyebrows

The spacing of eyebrows shall be consistent with the intersection spacing requirements given in **Tables 7-3** and **7-4**.

9.2.8 Alleys

The spacing of alleys shall be centered at half the distance between two intersections or not less than 150 feet from the nearest intersection.

9.3 BASIC PRINCIPLES FOR CURB OPENINGS AND DRIVEWAYS

9.3.1 General

Curb openings for driveways require minimum dimensions in some instances and maximum dimensions in other instances. Appropriate design will provide good driveway access operation and at the same time minimize interference to street traffic. The dimensions established in these Design Standards are derived from studies of the largest vehicles authorized on streets and highways.

Driveways, which serve properties adjoining the right-of-way, shall be served access by the street through a curb cut. The portion of the driveway within the right-of way is called the driveway approach.

9.3.2 Layout Criteria

The opening or driveway approach width shall be adequate to properly handle the anticipated traffic volume and character of traffic, as well as being within the limits specified for the type of property development. The controls established for curb openings and driveways shall apply to existing streets as well as new streets that may be developed in the future.

A. High Volume Access

1. Radial Access. A driveway shall have a radial access opening in accordance with Construction Drawings 707.1 or 707.2 (as applicable) and Tables 8-1 and 8-2 (as applicable) whenever any of the following conditions occur:
   a. Access onto an arterial street
   b. The driveway is for an adjoining commercial land use
   c. The driveway has a volume of 350 or more trip ends per day and enters directly onto a Collector, Commercial Local, or Industrial street
2. Maximum Width. High volume driveways shall have a maximum width of 36 feet.
3. Median. If it is necessary to increase the maximum width, a median (minimum width of 6 feet) shall be provided to divide the inbound from the outbound traffic.
4. Turn Lanes. Additionally, the need for turn lanes will be evaluated in accordance with Chapter 4, Transportation Impact Studies, requirements and in accordance with the requirements of Chapter 8, Intersections.

B. Low Volume Driveways

Any driveways not determined to be built with a radial access opening in accordance with the requirements set forth in 9.3.2.A, shall be designed and constructed as a standard driveway in accordance with Construction Drawings 706.1 or 706.2 (as applicable).Multi-Family Dwelling Unit Driveways

Multi-Family dwelling unit driveways (3 or more units) are acceptable with a minimum width of 24 feet. Driveways that serve 12 units or more shall have a minimum width of 28 feet (this width may be reduced to 24 feet on low traffic volume streets) and a maximum width of 36 feet.

9.3.3 Sight Distance - Driveways

A. Adequate Intersection Sight Distance

To the extent possible, all openings for driveways shall be located at the point of adequate sight distance along the street. Accesses to commercial, office and multifamily residential establishments shall have sufficient space reasonably clear of any obstructions to provide drivers entering the property sufficient sight distance for proper and safe movements. All design must provide minimum safe stopping sight distance in accordance with Section 7.4.1.C and AASHTO requirements.

B. Profile

The profile of a driveway approach and the grading of the adjacent area shall be such that when a vehicle is located on the driveway outside the traveled portion of the street the driver can see a sufficient distance in both directions to enter the street without creating a hazardous traffic situation.

9.3.4 Adjustments for Existing Structures

Any adjustments made to utility poles, street light standards, fire hydrants, catch basins or inlets, traffic signs and signals, or other public improvements or installations required for the curb openings or driveways shall be accomplished without cost to the Local Entity.

9.3.5 Entrance-Only and Exit-Only Approaches

Driveway approaches, where the driveway is to serve as an entrance only or as an exit only, shall be appropriately signed by, and at the expense of, the property owner. The property owner shall provide means to ensure that motorists will use the driveway as only an entrance or an exit only.

9.3.6 Access to Roadways with No Curb and Gutter

Private drive access to Local, Collector, or Arterial roadways that have no curb and/or gutter improvements shall be constructed to meet the following requirements:

A. Surface Requirements

The driveway shall extend from right-of-way line to edge of existing driving surface and shall be constructed with a minimum of 3.5 inches of asphalt or concrete in accordance with **Construction Drawing 901**.

B. Right-of-way

New driveway accesses from private property to existing pavement shall be paved within the right-of-way. On Local rural roads HBP or concrete pavement shall be installed from the right-of-way line to the edge of the traveled roadway. The width of the driveway within the right-of-way shall be 12 to 22 feet.

C. Culvert

A culvert shall be installed at the established roadside ditch flowline elevation beneath the private drive access in accordance with the requirements of **Construction Drawing 901** and the culvert diameter shall be specified by the approved storm drainage report or in absence of the report by the Local Entity. A culvert shall be

installed in the flowline of the borrow ditch of a size necessary for the design storm flow (@15-inch minimum diameter). The pipe shall have flared end sections in accordance with **Construction Drawing 901**. The minimum cover over the culvert should be 1 foot. Additional cover may be required for heavy vehicles. Refer to **Chapter 7, Street Design and Technical Criteria,** for the improvement requirements to roadside ditches.

D. Sketch Plan

A drawing of the proposed driveway installation showing all dimensions shall be submitted with the right-of-way or Access permit application. Refer to **Construction Drawing 901** for driveway requirements.

9.3.7 Residential Approaches

All driveway approaches shall comply with **Construction Drawings 706.1, 706.2 or 707.1** or 707.2 and the following:

A. Width

Residential driveway approaches shall have a minimum width of 12 feet and a maximum width of 24 feet.

B. Driveway Frontage

No more than 50 percent of the street frontage of a lot shall be occupied with driveways except for cul-de-sacs and flag lots.

C. Adjacent Parking

Parking immediately adjacent to driveways shall meet the parking setback requirements. Refer to **Chapter 19, Parking**.

D. Off-Street Driveway Parking

Off-street parking provided off or along driveways shall meet parking setback requirements in accordance with **Figure 19-6**.

E. Continuous Sidewalks

All concrete sidewalks shall be designed with a uniform, continuous profile grade at driveway crossings. A maximum Cross Slope of 2% shall be maintained where the sidewalk crosses the driveway per ADA requirements. Refer to **Construction Drawing 1601**.

F. Accessibility Alternatives

Pedestrian accessible driveways may be required in lieu of mid-block access ramps for residential areas. In those cases, the slope of the driveways shall be 1:12 or less. This access shall be provided at approximately 300-foot intervals on both sides of the street. The lot line locations shall be designated on the Construction Plans.

G. Three-Car Garage Driveway Width

Driveways serving 3-car garages shall have a maximum drive approach width of 30 feet unless otherwise approved.

H. Garage Door Location

Garage doors entering onto public or private streets shall be set back such that 20 feet of space is provided for a vehicle to park without blocking the sidewalk or encroaching into the driveway approach. In Fort Collins, Garage doors onto alleys shall be set back in accordance with Figures 7-11F or Figure 7-12F as applicable. In Loveland (City Limits and GMA), no garage door that faces an alley shall be located in the area that is between five feet from the edge of pavement of the alley and the area that is 20 feet from the edge of pavement of the alley.

9.3.8 Commercial Approaches

A. Width

No single opening shall exceed 36 feet in width.

B. Driveway Footage

The total length of curb opening on a street for access to a commercial property shall not exceed 40 percent of the property frontage.

9.3.9 Maintenance Responsibility

Maintenance of the access and drainage improvements within the right-of-way described in **Section 9.3.6** of this chapter shall be the responsibility of the adjacent property owner or other designated private entity, including all improvements to driveways within right-of-way, including sidewalk, curb and gutter and parkway.

9.4 GENERAL REQUIREMENTS

9.4.1 Number of Openings

A. Single Family Residential

In general, each Single Family residential property should be limited to one access point. Multiple accesses may be provided as long as spacing, clearance, and percentage of lot frontage requirements are satisfied.

B. Multi-Family Residential

Access shall be determined by information provided by the Owner/Developer as specified in **Chapter 4, Transportation Impact Studies** and by comments generated during the review and acceptance of that study.

C. Commercial

In general, commercial property having less than 150 feet of frontage and located mid-block should be limited to one access point to the street. An exception to this may be where a building is constructed in the middle of a lot and parking is provided for on each side of the building.

D. Industrial

Access shall be determined on a case-by-case basis. The Local Entity shall consider good traffic engineering practice and the information provided by the applicant

(specified in **Chapter 4, Transportation Impact Studies**) accompanying their submittal.

9.4.2 Entrance Angle

In general, the entrance angle for all driveway approaches and intersections shall be as near 90° to the centerline of the street as possible. The minimum angle that will be permitted is 90° plus or minus 10° for a minimum of 25 feet measured perpendicular to the street and measuring from the curb or edge of pavement toward the private property served.

9.4.3 Minimum Space Between Openings

The minimum spacing between curb openings shall be the footage measured at the curb line. This spacing will apply to the distance between drives serving adjoining properties. This does not apply to residential projects using mountable curb, gutter, and sidewalks. Refer to **Table 7-3** or **Table 7-4**.

9.4.4 Slope

Driveways within the walk and parkway area shall slope toward the street. The driveway profile grade within 20 feet of flowline shall not exceed 8 percent unless otherwise approved by the Local Entity Engineer.

9.4.5 Intersection with Street

Driveways should intersect streets at right angles and shall in no case intersect at less than 80 degrees.

9.4.6 Pavement

A. General

All areas within the public right-of-way used for vehicular traffic shall be paved with Portland cement concrete (PCC) from the edge of pavement to the edge of right-of-way. PCC may only be required to extend to the back of sidewalk if approved by the Local Entity Engineer.

B. Loveland (City Limits Only)

In Loveland (city limits only) all driveway and parking areas used by vehicular traffic shall be paved with PCC or HMA. Outdoor storage areas subject to infrequent vehicular traffic may be surfaced with a dust free material approved by the Local Entity Engineer.

9.4.7 Shared Access

Whenever possible and feasible, shared entrances should be provided to serve two adjacent properties. Recorded, private access easements are required for all shared accesses.

9.4.8 Access Approaches

Access approaches shall not be approved for parking or loading areas that require backing maneuvers within the right-of-way except on Local Residential streets. All off-street parking areas on Collector and Arterial streets must include on-site maneuvering areas and aisles to permit user vehicles to enter and exit the site in forward drive. Refer to **Chapter 19, Parking**, for general parking information.

9.4.9 Abandoned Access

If a parcel of land with direct access has been in a state of non-use for more than one year, re-commencement of access use shall be considered a change in use. If the use of the access exceeds the design limitations of the access or does not conform with the present code, a new approval may be required through the development plan review process, access management plan, or the Local Entity's work in right-of-way permit.

9.4.10 Change in Use

If the use of an existing access to right-of-way changes, or there is a change in the use of the property, the change in access use must be approved through the development review process, access management plan, or the Local Entity work in right-of-way or access permit. Change in access or property use may include, but is not limited to, change in the amount or type of traffic (20 percent or more or more than 100 total daily trips), structural modifications, remodeling, change in type of business, expansion in existing business, change in zoning, change in property division creating new parcels, etc. In Loveland (city limits only), refer to the Site Development Performance Standards and Guidelines for the percent change.

9.4.11 Drainage

A. Drainage at Curb Cuts

Where curb cuts are allowed, concentrated storm water runoff from property adjoining the right-of-way shall not be discharged across the sidewalk. These flows must be directed elsewhere or directed to a sidewalk chase where storm water may pass under a sidewalk section.

B. Sheet Flow Drainage

Sheet flow drainage is allowed where it does not interfere with the pedestrian use of the sidewalk. (In Fort Collins) A maximum area of 750 square feet behind the sidewalk may sheet flow over the sidewalk.

9.4.12 Minimum Off-Street Parking Set Back Distance

Refer to Chapter 19, Parking, and **Figure 19-6**.

9.5 CONTROL DIMENSIONS

To accomplish the objectives of the basic principles stated earlier, certain control dimensions are necessary. There are many variables that affect these control dimensions. Some of the variables are as follows: type of street classification, type of private property development, volume and type of traffic, and width of right-of-way.

9.5.1 Width of Curb Opening (W)

The total width of curb opening for properties shall be in conformance with **Construction Drawings 706 or 707.**

9.5.2 Edge Clearance

Refer to **Table 7-3** or **Table 7-4**. Note that shared access with adjoining property is encouraged. Shared access shall be the only justification for reducing the minimum edge clearance dimension.

9.5.3 Corner Clearance

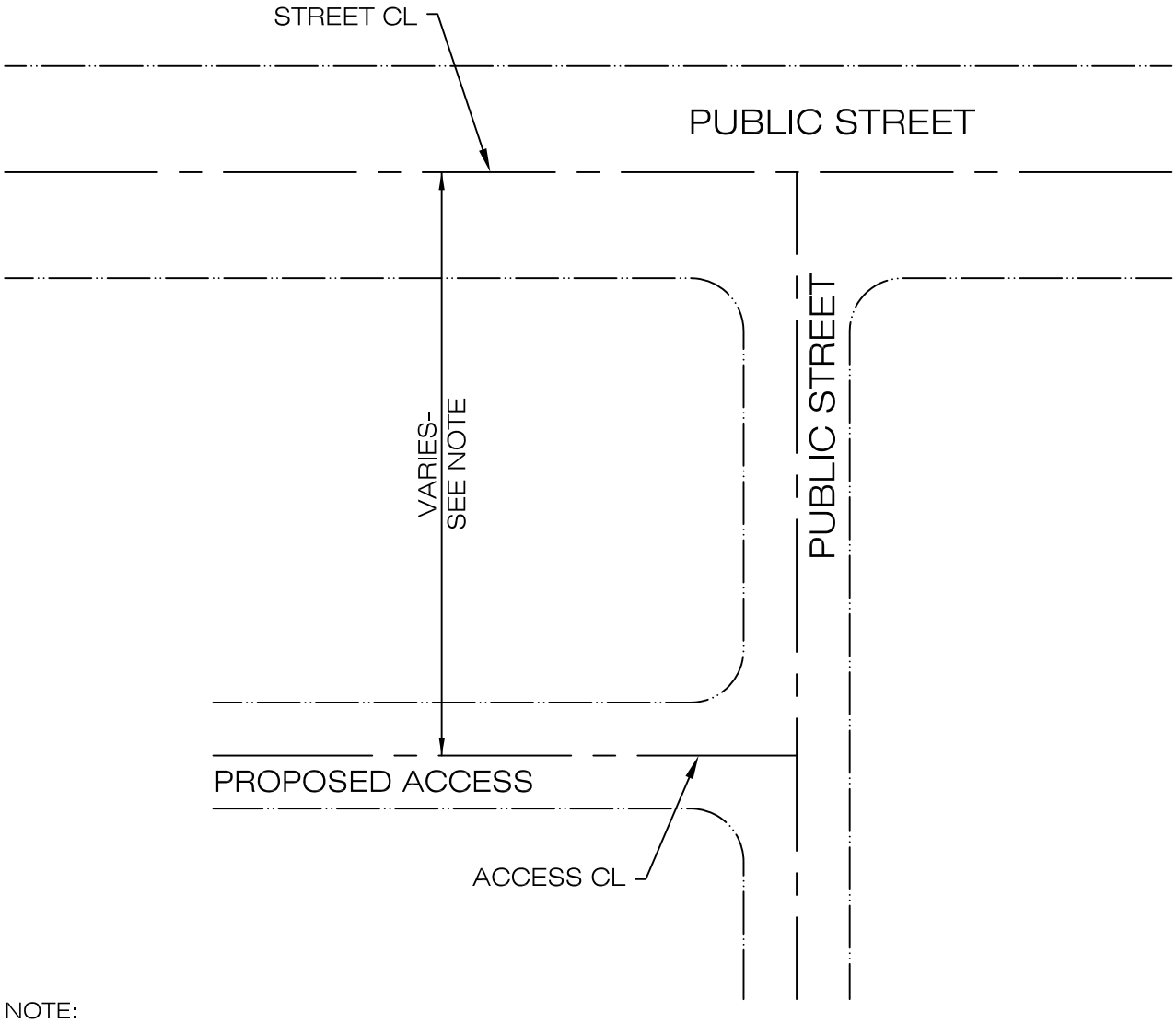
It is important to locate driveways away from major intersections. This constraint is as much for the ability to enter and leave the property as for the benefit of intersection safety and operations. Exiting a driveway during peak-hour conditions at traffic signals is difficult where the queue of standing or slow-moving vehicles never allows a sufficient gap for entry from the driveway. Corner clearances shall be as specified in **Table 7-3** or **Table 7-4**.

9.6 UNPERMITTED ACCESS

Any access, driveway, or curb-cut which is constructed within public right-of-way without a right-of-way or access permit issued by the Local Entity shall be subject to removal. Failure to remove the unpermitted access may result in the removal of said access by the Local Entity. The cost for removal shall be charged to the property owner from which the access originates.

9.7 REMOVAL

Any curb opening or driveway that has been abandoned shall be removed and restored by the property owner except where such abandonment has been made at the request of, or for the convenience of, the Local Entity.



NOTE:

1. Refer to **TABLES 7-3 & 7-4** for separation requirements for different road classifications.
2. Additional separation distance maybe required as deemed appropriate by the Local Entity Engineer when the adjacent intersection is a roundabout.
3. The proposed access shall not be <200' from the centerline of an arterial roadway unless otherwise approved by the Local Entity Engineer.
4. Additional separation distance maybe required as deemed appropriate by the Local Entity Engineer.

ACCESS SPACING

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 2	FIGURE
		DATE: 04/01/07	9-1

CHAPTER 10 – PAVEMENT DESIGN AND REPORT
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CHAPTER 10 – PAVEMENT DESIGN AND REPORT

10.1 GENERAL

The purpose of this chapter is to present the Street Structural Design Criteria required for use on all streets in the Larimer County GMA. These criteria shall be used in conjunction with **Chapter 7, Street Design and Technical Criteria**.

General Soils Investigations and Report requirements are outlined in **Chapter 5, Soils Investigations and Report**. Chapter 5 defines requirements for soil testing and backfill requirements for all cut and fill areas within the right-of-way or public easements. The Final Pavement Design Report shall include follow-up testing for subgrade soil expansion, subsurface water, and R-value, in accordance with **Table 10-2**.

10.1.1 Existing Streets

For existing streets the Local Entity Engineer may require deflection tests or other testing of the existing pavement and base structure to determine if an overlay is feasible, or if reconstruction is necessary.

10.1.2 AASHTO Design

The design criteria and procedures presented follow the latest edition of the **American Association of State Highway and Transportation Officials (AASHTO)** guide for the Design of Pavement Structures. Mechanistic Empirical design procedures may be substituted, if approved in advance. The designer shall review the M.E. design criteria with the City prior to submitting the final pavement design.

10.1.3 Pavement Type

Streets are to be constructed of either asphaltic concrete pavement or Portland cement concrete, base course material, and subbase material (where required), placed on compacted subgrade. The subgrade shall have a minimum one-foot layer of R=20 material. Refer to **Chapter 22, Construction Specifications,** for subgrade, subbase, and base course information. All new and reconstructed Arterial/Arterial intersections shall be constructed in Portland cement concrete pavement, in accordance with **Chapter 8, Intersections**. Exceptions to the Portland cement concrete pavement requirement may be granted for interim conditions described in **Chapter 8**, in the subsection **Pavement Requirements for Arterial/Arterial Intersections**.

10.1.4 Treated Subgrade

The use of treated subgrade, treated base, and/or full depth asphalt pavement may be acceptable when designed and submitted by the designer, and approved by the Local Entity Engineer in accordance with these standards. The local entities for projects in Fort Collins (GMA and city limits) and Loveland (GMA only) generally will not approve full-depth asphalt pavement.

For treated subgrade, refer to **Chapter 23, Street Inspection and Testing Procedures**. For full depth asphalt refer to **Section 10.4.2 B**. The subgrade must be within 6 inches of final grade prior to any soil sampling and testing.

10.1.5 Arterial and Collector Level Intersections

The pavement thickness design for arterial and collector level intersections shall be the combined 20-year design for both directions for the shared use areas. A separate design analysis is required.

10.1.6 Roundabouts

The pavement thickness design for the circulatory roadway shall be based on the sum of the 20-year design volumes from all legs. A separate design analysis is required. Refer to **Section 8.2.17** for Roundabout design requirements.

10.1.7 Approval

A preliminary pavement design may be submitted with final construction plans. The Local Entity Engineer shall review the Final Pavement Design Report within two weeks of the submittal. The Local Entity Engineer's approval is required prior to subgrade treatment, placement of base or pavement (including curb and gutter) construction.

10.1.8 New Pavement Design

A new, revised Pavement Design investigation and report shall be required if the following conditions occur:

A. Phases

If a street is to be built in phases, (i.e., the center two lanes are built first, then at some later date more lanes are added), and it has been at least two years since the original design was completed.

B. Imported Fill Material

If any new fill material that does not match the properties of the subgrade soil is imported, the Local Entity may require a new pavement design report or additional testing to verify the acceptability of this material for roadway fill.

10.2 FINAL PAVEMENT DESIGN – SOIL INVESTIGATION REQUIREMENTS

10.2.1 Timing of Soil Borings

Soil borings shall be taken in the existing or proposed street right-of-way. Subgrade samples shall be taken upon the material that will be subgrade after the installation of the sanitary sewer, waterline, other utilities, on which the final insitu subgrade strength characteristics may be affected by their installation. The subgrade shall be at or near its

final elevation, generally within 6 inches or final subgrade elevation. Any required fill material shall be placed to the subgrade elevation prior to sampling.

Table 10-1
Flexible Pavement Design Criteria

ROAD CLASSIFICATION	20-Year Design Traffic Information		Serviceability Index (psi)			Relia-bility	Minimum Asphalt for Composite Section	Default Agregate Base Course Section	Default Full Depth Asphalt Pavement Thickness inches[2]	Min. Struct. No.[4, 7]
			S_i	S_t	D		Layer, inches	Layer, inches	Layer, inches	
	EDLA[3]	ESAL	Init.	Final	psi	(%)	HMA	ABC	Min.	
LOCAL										
Resid. two lane	5	36,500	4.5	2.0	2.5	75	4.0	6.0	6.0	2.45
Resid. Cul-de-sac and single lane[5]	10	73,000	4.5	2.0	2.5	80	5.4	6.0	6.5	2.82
Indust./commercial	50	365,000	4.5	2.3	2.2	75	5.5	11.0	8.5	3.60
COLLECTOR										
Minor	25	182,500	4.5	2.3	2.2	75	5.5	7.0	7.5	3.20
Major	50	365,000	4.5	2.3	2.2	85	6.5	9.0	8.5	3.82
Indust./commercial	100	730,000	4.5	2.3	2.2	85	7.0	11.0	10.0	4.30
ARTERIAL										
Two lane	100	730,000	4.5	2.5	2.0	90	7.5	11.5	NA	4.51
Four lane	200	1,460,000	4.5	2.5	2.0	90	8.0	15.0	NA	4.90
Six lane	300	2,190,000	4.5	2.5	2.0	90	8.5	17.0	NA	5.25

NOTES:
[1] Wearing surface course shall be Grading S or SX for residential roadway classification and Grading S for collectors, arterials, and all industrial/commercial roadways.
[2] Full depth pavement may be used only on Local / Residential Class roads with written approval of the Local Entity Engineer.
[3] EDLA shall be calculated based on projected traffic uses. Minimum EDLA values are as given for the design lane. The Engineer may require greater EDLA values if warranted. City of Fort Collins will provide all EDLA numbers for City of Fort Collins projects. The EDLA for a roundabout shall include the cumulative EDLA for each entry leg. EDLA for arterial/collector intersections shall be two-way traffic.
[4] Minimum structural numbers are based on subgrade R-value = 5 and CDOT calculations ; M_R = 3,025 and Std. Deviation = 0.44 CDOT Design methods shall be used for resilient modulus calculations for all roads
[5] Single lane refers to a paved surface less than 20 feet wide, including residential alleys.
[6] Min/max lift thicknesses: Grade SX – 1 1/2"/2 1/2", Grade S - 2"/3.5", Grade SG - 3"/5" (2" Minimum surface wearing course) In Loveland, Grade SG may only be used with a variance approval.
[7] The minimum HMA section for Composite pavement s shall be 4-inches for Local, 5-inches for Collectors, and 6-inches for Arterials.

10.2.2 Frequency of Testing

A minimum of one boring shall be obtained for any roadway segment. A second boring shall be required in the trench of any installed utilities. The distance between borings shall not exceed 500 feet, two borings per location where utility trenches exist (one boring in the trench and one in compacted subgrade). Multiple samples shall be taken

alternately among lanes and shall be evenly spaced. The Local Entity Engineer may require more frequent testing.

10.2.3 Depth of Borings

A. In Utility Trenches

In utility trenches, samples shall be taken to a minimum depth of 5 feet below the proposed subgrade elevation.

B. Outside of Trenches

Outside of trenches, samples shall be taken to a minimum depth of 10 feet below the proposed subgrade elevation.

C. Extra Depth

Borings shall extend deeper if bedrock or high groundwater are design concerns.

10.3 TESTING

The following tests, **Table 10-2**, are required for the Final Pavement Design testing.

Table 10-2
Required Tests

Test	Final Pavement Design Report
Visual	X
Liquid Limit	X
Plastic Limit	X
Moisture	X
Percent Passing 200	X
Gradation (Granular Soils)	X
AASHTO or USC Classification	X
Subgrade Support R-Value	X
Swell	**Mitigation and Detailed Analysis**
Percentage of Soluble Sulfates	X
Standard Penetration Test	X
Groundwater	X
Bedrock Level	X

10.3.1 Classification Testing

Soils shall be classified visually and tested to determine the properties listed in **Chapter 5, Soils Investigations and Report**. Sands and gravel samples shall be analyzed for gradation where needed to comply with classification requirements.

10.3.2 Subgrade Support Testing

Individual subgrade or composite samples shall be tested for subgrade support value. The Subgrade Soils Investigation report shall clearly state whether or not the subgrade soil is capable of supporting the proposed construction and design traffic loads. Recommendation for subgrade stabilization, if required, shall also be provided. The Final Pavement Report shall contain specific mitigation. The following subgrade tests shall be conducted:

A. Hveem Stabilometer

The subgrade support value shall be determined using Hveem Stabilometer (R-Value). The design R-value shall be for 300 psi (2070 kPa) exudation pressure. Reported data shall include the following:

1. Test procedure reference.
2. Dry density and moisture content for each sample.
3. Expansion pressure for each sample.
4. Exudation Pressure. Corrected R-value curve showing the 300 psi (2070 kPa) design R-value.

B. Swell Tests

Swell tests shall be conducted for samples with probable expansion (volume change estimate) greater than 2 percent based on actual test results. **Table 10-3** provides a guideline for expansion potential. Surcharge pressure shall be 150 psf, or as specified by the Local Entity Engineer. Refer to **Section 5.7** for mitigation requirements.

1. Minimum number of samples. At least two samples shall be required per soils report, with one test sample within trench backfill and one outside of trench backfill. Thereafter continue with one swell test every fourth sample unless waived by the Local Entity Engineer.

Table 10-3
Expansion Potential of Subgrade Soils

% Passing No. 200 Sieve	Liquid Limit (%)	Standard Penetration Resistance (Blows/Ft)	Volume Change Estimate (% of Total)	Expansion Classification
>95	>60	>30	>10	Very High
60–95	40–60	20–30	3–10	High
30–60	30–40	10–20	1–5	Medium
<30	<30	<10	<1	Low

10.4 PAVEMENT THICKNESS DESIGN CRITERIA

Pavement design procedures in this section provide for a 20-year service life of pavement when normal maintenance is provided to keep the roadway surface in an acceptable condition.

10.4.1 Design Factors

A. Equivalent Daily Load Applications (EDLA)

Equivalent Daily Load Applications (EDLA) and Equivalent Single Axle Loads (ESAL) units are based on 18 kip (80 kN) axle loading on each design lane. All data and design procedures in this section use EDLA or ESAL units for pavement loading repetitions. Minimum EDLA and ESAL criteria for each roadway classification are given in **Table 10-1**. The values shall be increased for roadways with a traffic study showing higher traffic numbers. In Fort Collins (city limits only), the City will provide all EDLA (ESAL) numbers.

B. Design Serviceability

The Serviceability Index to be used for all Local Entity Roadways dedicated for public use is given in **Table 10-1**.

C. Minimum Pavement Section

Table 10-1 provides the default acceptable pavement sections for each roadway classification based on assumed subgrade support and traffic values. These pavement thicknesses may be used for preliminary planning purposes and cost estimates. All pavement thickness designs must be based on actual subgrade support test results (refer to **Chapter 5, Soils Investigations and Report**) and traffic projections (refer to **Chapter 4, Transportation Impact Study**) for the specific project. In specifying layer thickness, the designer shall consider how the pavement section will be physically constructed (e.g. Specify how to construct 2' of treated subgrade or the number of lifts and the grade for asphalt in a 6-inch asphalt section .)

D. Flexible Pavement Strength Coefficients

Table 10-4 contains the standard design coefficient for various pavement materials. Nonstandard design coefficients may be used, only if approved in advance by the Local Entity's Engineer. In addition, design values must be verified by pre-design mix test data and supported by daily construction tests (refer to **Chapter 23, Street Inspection and Testing Procedures**).

E. Portland Cement Concrete Working Stress (f^t)

The working stress (f^t) to be used in the design shall be 75 percent of that provided by third-point beam loading, which shall have a minimum laboratory 28-day strength of 600 psi based on actual tests of materials to be used.

10.4.2 Special Considerations

A. Staged Construction

This is an alternative for the Developer to provide a minimum thickness pavement during construction, and after repairs, construct the final lift of asphalt, providing for a new finished pavement surface. Minimum asphalt and aggregate base course thicknesses are given in Table 10-1. If the full pavement section is not to be placed

immediately, a pavement design for staged construction may be required by the Local Entity Engineer. The staged construction design must include asphalt thickness for each proposed stage. Calculations, traffic numbers, and construction truck traffic numbers supporting the staged design must also be submitted. For staged construction, accommodations must be provided for the paved surface to drain with no water left standing on the pavement.

1. Overlay at End of Warranty Period. After the end of the two-year warranty period, (and after all Punch list repairs have been made), the Contractor shall pave a 1.5inch SX overlay.

   The report shall instruct the Contractor to pave 0.5 inch less than required pavement section at initial construction, leaving the finish asphalt 0.5 inch below the design crown elevation. After two years, (and after all warranty repairs have been made), the Contractor shall perform a tapered milling (0 to 1-inch depth) of the outside 4 feet of pavement along the gutters prior to placing the 1.5 inch SX overlay. This shall be accomplished before the Local Entity accepts the streets for full-term maintenance.

2. Manhole and Valve Settings. All manholes and valve boxes shall be set at grade for the interim paving surface. Manholes and valve boxes must be adjusted to final grade prior to placement of the final overlay. Riser rings shall not be used.

B. Full Depth Sections

1. Loveland (city limits only). Full depth asphalt pavement sections will be considered on a case by case basis where depth of bedrock, drainage, and soil conditions are compatible with full-depth asphalt. Refer to **Chapter 22, Construction Specifications,** for minimum and maximum lift requirements. When permitted by the Local Entity Engineer, full depth asphalt pavements shall consist of one or more layers of Grade S HMA topped with one or more layers of Grade S or SX HMA placed directly on a stabilized subgrade.

2. Fort Collins (city limits only). Full depth asphalt pavement sections are generally not allowed.

C. Rehabilitating Existing Asphalt Streets

Prior to overlaying existing asphalt, the Local Entity Engineer may accept nondestructive testing to determine the amount of overlay necessary to bring the street to current standards. The method of nondestructive testing and the data obtained must be in a form compatible with the pavement management system for the Local Entity. All "pot-holes," utility trench settlement, cracking, and any similar imperfections shall be repaired to the Local Entity Engineer's satisfaction prior to overlaying. Refer to **Chapter 25, Reconstruction and Repair,** for specific requirements.

D. Special Requirements

The Local Entity Engineer may require full depth asphalt or Portland cement concrete or chemically treated base or subgrade in locations where traffic, utilities, type of construction, subsurface drainage, or time of construction would make asphalt on aggregate base impractical.

10.4.3 Pavement Structure Components

The Pavement Structure Components shall be a combination of one or more of the following courses placed on a subgrade to support the traffic load and distribute it to the roadbed. However, the pavement section must be composite in nature.

A. Subbase

The layer(s) of specified or selected material of designed thickness placed on a subgrade to support a base course, surface course, or both.

B. 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.

C. 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. For asphalt pavement the top layer is sometimes called "Wearing Course."

10.5 PAVEMENT DESIGN PROCEDURES

10.5.1 Flexible Pavement Design

A. General

Flexible pavements are those pavements that have sufficiently low bending resistance to maintain continuous contact with the underlying structure, yet have sufficient stability to support a given traffic loading condition. An example is asphaltic concrete pavement.

B. Procedure

Computer generated printouts and/or other design calculations must be included with the design submittal. The following procedure should be used in determining the structural number and thickness of the pavement being designed:

1. Confirm the roadway classification and corresponding EDLA. The predicted volumes in the traffic impact study must be used whenever they exceed the minimum EDLA values given in **Table 10-1**.

2. Determine the serviceability index (SI) and reliability for the roadway classification (**Table 10-1**).

3. Convert the R-value to a Resilient Modulus for each soil subgrade type identified in the exploration using the **CDOT equations 2.1 and 2.2** as detailed in Section 2.5 of the latest edition of the CDOT Pavement Design Manual.

4. Determine the required structural numbers using **AASHTO** pavement design software or nomographs from **AASHTO** along with soil support test results and EDLA values previously determined. If used, copies of the nomograph determinations must be included with the design submittal.

5. Once the required structural number (SN) has been determined, the design thickness of the pavement structure can also be determined by the software that uses the general equation:

   SN = A1D1M1 + A2D2M2 + A3D3M3 + . . .

   Where:

   A1 = Hot Mix Asphalt (HMA) Strength Coefficients

   A2, A3, … = Strength Coefficients of Additional Pavement Components

   The strength coefficients for various components of the pavement structure are given in **Table 10-4**.

   D1 = Thickness of Hot Mix Asphalt (HMA)

   D2, D3, … = Thickness of Additional Pavement Component Sections

   M1, M2, . . . = Drainage Coefficient

   Total HMA thickness selected shall not be less than the minimum specified in **Table 10-1**, and the aggregate base course thickness selected shall not exceed 2.0 times the total HMA thickness selected.

6. The standard deviation for design of asphalt pavements shall be 0.44.

7. The design must reference any mitigation measures required when the subgrade contains swelling soils. Refer to **Chapter 5, Soils Investigations and Report**. Design reports recommending permeable layers in the pavement system must present the measures to be used to ensure adequate drainage of such layers and to maintain separation of the layers from the swelling soils.

Table 10-4
Pavement Strength Coefficients

Pavement Structure Component **Conventional Materials**	Design Strength Coefficients (Per Inch of Material)[3]	Limiting Test Criteria
Plant Mix Seal Coat	0.25	
Hot Bituminous Pavement	0.44	R 90+
Existing Bituminous Pavement	0.24	See Note 1
Aggregate Base Course	0.11	R>72
Existing Aggregate Base Course	0.10	R>69
Granular Subbase Course	0.07	R>50
Recycled Asphalt/Concrete Pavement Subbase Course	0.07	R>50
Chemically Treated Subgrades[2] (or Approved Substitute)		**Compressive Strength of Field Specimen**
Cement Treated Subgrade	0.23	7 day, 650–1000 psi
Fly Ash Treated Subgrade	0.10	7 day, 150 psi @ 70°±
Lime Treated Subgrade	0.14	7 day, 160 psi, PI <6
Kiln Dust Treated Subgrade	0.10	7 day, 150 psi, PI <6

NOTES:
1. Greater strength coefficient may be considered if derived from deflection data collected on the existing street in compliance with procedures outlined in the Asphalt Institute Manual MS-17.
2. Strength coefficient is only acceptable if material is properly mixed and field tests correlate with laboratory results. Strength Coefficient shall be reduced by 50 percent if field test correlations are not performed.
3. The credited thickness of chemically treated subgrade shall be 2-inches less than the maximum specified tilling depth (e.g. 12-inches of fly ash stabilization will get a 10-inch strength credit. Chemical soil stabilization shall not proceed between October 31 and April 1 without the Local Entity Engineer's approval, due to freeze thaw issues with frozen subgrade. Minimum tilling depth shall be 12-inches to meet subgrade scarifying requirements.

10.5.2 Rigid Pavement Design

A. General

Rigid pavements are those that possess a high bending resistance and distribute loads over a large area of foundation soil. Examples include Portland cement concrete pavement or Portland cement concrete surfaced with asphalt.

B. Procedure

Computer generated printouts and/or other design calculations must be included with the design submittal.

The design of rigid pavements is a function of structural quality of the subgrade soil (R-value), traffic (EDLA), and the strength of the concrete (working stress). In comparison to the strength of the concrete slab, the structural contributions of underlying layers to the capacity of the pavement are relatively insignificant. Therefore, the use of thick bases or subbases under concrete pavement to achieve greater structural capacity is considered to be uneconomical and is not recommended. However, street sections with landscape medians may require a drainage layer section to provide positive drainage from the median to an acceptable outlet. In all cases,

subgrade shall be stable as determined by proof-rolling requirements outlined in **Chapter 22, Construction Specifications**, concerning final proof-rolling.

The following procedure should be used in determining the structural number and thickness of the pavement being designed:

1. Confirm roadway classification and corresponding EDLA. The predicted volumes in the traffic impact study must be used whenever they exceed the minimum EDLA values given **Table 10-1**.
2. Determine the serviceability index of the roadway classification from **Table 10-1**.
3. The reliability factor for design of all concrete pavements shall be 90 percent.
4. The working stress of the concrete is to be obtained from laboratory tests. For preliminary design see **Section 10.4.1 E**.
5. The standard deviation for design of concrete pavements shall be between 0.30 and 0.40.
6. Determine the structural numbers using **AASHTO** pavement design software. Nomographs of the **AASHTO** parameters may be used instead. If used, copies of the nomograph determinations must be included with the design submittal.
7. Determine the slab thickness. A minimum thickness of 6 inches must be provided.
8. Refer to **Section 10.3**. Design must reference any mitigation measures required when the subgrade contains sulfates.

C. Joint Design

The construction plans for rigid pavement areas shall include a joint pattern layout for each street or alley. All joints and joint filling in rigid pavement shall be designed and detailed in accordance with the current Colorado Department of Transportation Standard Plans (M&S Standards).

10.6 PAVEMENT DESIGN REPORT

The pavement design report shall be prepared by or under the supervision of and signed and stamped by a Professional Engineer registered in the State of Colorado. The report shall make a recommendation for a typical pavement structural section based on known site soil conditions and the valid traffic impact study (refer to **Chapter 4, Transportation Impact Study**).

10.6.1 Required Information for Pavement Design Report

A. List of Required Info

1. Vicinity map to locate the investigated area.
2. Scaled drawings showing the location of final borings.
3. Final Plat with street names.

4. Scaled drawings showing the estimated extent of subgrade soil types and EDLA for each street classification.
5. Pavement design alternatives for each street classification.
6. Tabular listing of sample designation, sample depth, Group Number, liquid limit, plasticity index, percent passing the No. 200 sieve, **AASHTO** Classification, Group Index and soil description. Refer to **Chapter 5, Soils Investigations and Report**.
7. R-value test results of each soil type used in the design. Refer to **Chapter 5, Soils Investigations and Report**.
8. Swell/consolidation tests. Refer to Chapter 5, Soils Investigations and Report.
9. Identification of any samples that were consolidated to create composite samples for testing purposes. Refer to **Chapter 5, Soils Investigations and Report**.
10. Borrow source identification.
11. Pavement design computer printouts or nomographs properly drawn to show Soil Support - EDLA - SN. Refer **to Sections 10.4.1 A** and **10.5.1 B** and **Table 10-1**.
12. Design calculations for all phases of soil report.
13. Design coefficient used for asphalt, base course, etc. Refer to **Table 10-4**.
14. Mix design test results as discussed in **Chapter 23, Street Inspection and Testing Procedures**, where chemical stabilization has been approved by the Local Entity Engineer.
15. A discussion of potential subgrade soil problems including, but not limited to:
    a. Heave or settlement prone soils.
    b. Frost susceptible soils.
    c. Ground water.
    d. Drainage considerations (surface and subsurface).
    e. Cold weather construction (if appropriate).
    f. Soluble sulfates in subgrade.
    g. Other factors or properties that could affect the design or performance of the pavement system.
16. Recommendations to alleviate or mitigate the impact of problems discussed in the previous paragraph. Also refer to **Chapter 5, Soils Investigations and Report**.
17. Professional Engineer Stamp

CHAPTER 11 - STRUCTURES
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CHAPTER 11 - STRUCTURES

11.1 GENERAL

This chapter provides design guidelines for structures in public rights-of-way. All designs shall be stamped by a registered PE proficient in structural engineering.

11.1.1 Design Standards

Designs of structures shall conform to these Standards and supplemented by the following documents

A. List of Structural Standards to be Followed

1) AASHTO, LRFD Bridge Design Specifications, latest edition.
2) AASHTO, LRFD Bridge Construction Specifications, latest edition.
3) AASHTO, A policy on Geometric Design of Highways and Streets, latest edition.
4) AASHTO, Roadside Design Guide, latest edition.
5) CDOT LRFD Bridge Design Manual (BDM), latest edition
6) CDOT Bridge Rating Manual, latest edition
7) CDOT, Standard Specifications for Road and Bridge Construction, latest edition.
8) CDOT, M&S Standards, latest edition.
9) AASHTO, LRFD Guide Specifications for the Design of Pedestrian Bridges, latest edition
10) AASHTO, LRFD Specifications for Structural Supports, for Highway Signs, Luminaires, and Traffic Signals, latest edition

11.1.2 Borings and Soils Tests

Appropriate borings and soils tests shall be conducted as outlined in **Chapter 5, Soils Investigations**.

11.1.3 Design Approaches

Recognized design approaches for structures in this chapter are as follows:

A. Load and Resistance Factor Design (LRFD)

LRFD enlists both load and resistance factors, derived from the theory of reliability, statistical knowledge of loads, and structural performance. This design philosophy employs explicit use of load variability. AASHTO's LRFD Bridge Design and Construction Specifications uses the LRFD design philosophy, and must be used for all new design.

B. Load Factor Design (LFD)

LFD adjusts WSD to reflect various loads such as vehicular and wind forces. This design philosophy employs a limited use of load variability. These design methodologies are not typically used for new construction and will be allowed only with approval from the agency for special circumstances.

C. Working Stress Design (WSD)

WSD establishes allowable stresses as a fraction or percentage of a given material's load-carrying capacity. Calculated design stresses must not exceed those allowable stresses. These design methodologies are not typically used for new construction and will be allowed only with approval from the agency for special circumstances.

11.1.4 Deflection Control

Designs of all structures in this chapter must include deflection control.

11.2 BRIDGES

11.2.1 General

Bridges shall be considered major structures if the span length between supports is greater than 20 feet.

Bridges shall be considered minor structures if the span length between supports is between 4 feet and 20 feet.

Design Life. All structures shall have a minimum design life of 75 years.

11.2.2 Bridge Load Rating

The design of all structures shall be rated for structural sufficiency prior to approval of the Local Entity of the public improvement plans. The design shall be in compliance with Federal Bridge Rating Guidelines and CDOT Bridge Rating Manual for new bridges. Refer to **Chapter 23, Street Inspection and Testing Procedures, CDOT Road and Bridge Specifications and LRFD Bridge Construction Specifications (for Major Structures),** for further information regarding inspection and rating.

11.2.3 Structure Selection Report

A bridge selection report is required for all structures (unless waived by local engineer) to determine possible structure alternatives that meet project requirements and conditions.

Requirements of the structure selection report is provided in the **CDOT Bridge Design Manual**, Chapter 2.

11.2.4 Vehicular Bridges

Any structure with the intent to carry vehicular traffic as part of the public transportation network shall be treated as a vehicular bridge. Vehicular bridges shall be designed to carry pedestrians and bicycles as well as vehicles. Simultaneous loading of the sidewalk dead load and vehicle live load is required when barrier separation is not present to cover the likelihood of errant trucks mounting the sidewalks or medians.

A. Design Loads

All vehicular bridges shall be designed utilizing a HL-93 design vehicle and load combinations as per **AASHTO LRFD Bridge Design Specifications**

B. Design Details

See the standards mentioned in **Section 11.1.3**concerning design approaches, for further use of design methods. Maximum deflection on a vehicular bridge shall be per **AASHTO, LRFD Bridge Design Specifications**

C. Clear Width

The clear width for new bridges on all streets with curbed approaches shall meet or exceed the curb-to-curb width of the roadway approaches. For streets with shoulders and no curbs, the clear roadway width should be the same as the approach roadway width.

D. Sidewalks

Requirements for sidewalks on bridges are as follows:

1) General. Sidewalks and bicycle lanes will be provided on both sides of the bridge. Sidewalks and/or bike lanes may be omitted from a bridge when separate bike/pedestrian bridges exist or when approved by the Local Entity Engineer.

2) Width Criteria. Width of the pedestrian/bicycle path on bridge shall be the same width as shown in typical sections for roadway classification in Chapter 7 unless alternate width is approved by the Local Entity Engineer. Bridges within the Fort Collins GMA shall have a minimum width of 8’ sidewalks on both sides.

E. Median Barriers

Median barriers shall not be used in an urban setting with design speeds less than 45 mph.

11.2.5 Pedestrian/Bicycle Bridges (P/B Bridges)

P/B bridges shall be designed with the LRFD method as provided by **AASHTO LRFD Bridge Design Specifications** and **AASHTO, LRFD Guide Specifications for the Design of Pedestrian Bridges**.

Whenever vehicle access is not prevented by permanent physical methods or is greater than 6 feet, pedestrian/bicycle bridges shall be designed to accommodate maintenance traffic.

A. Design Loads

1) Vehicular. The minimum design vehicular loading for a P/B bridge follows the H-truck configuration loading. Specific H-truck loading depends upon clear deck width as follows:

Table 0-1
H-Truck Loading

P/B Bridge Width	H-Truck Loading
6 – 10 feet	H-5 truck configuration (10,000 lb)
> 10 feet	H-10 truck configuration (20,000 lb)
< 6 feet	Not wide enough for any vehicles

2) Pedestrian. Do not design for a combination of pedestrian and vehicular loads. Design live loads shall be per **AASHTO, LRFD Guide Specifications for the Design of Pedestrian Bridges**.

B. Wind

Wind Design Factors. Pedestrian bridges shall be designed for wind loads as specified in **AASHTO, LRFD Guide Specifications for the Design of Pedestrian Bridges**.

C. Design Details

1) Deflection. Maximum deflection on a P/B bridge shall be per **AASHTO, LRFD Guide Specifications for the Design of Pedestrian Bridges**.

2) Vibrations. Refer to **AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges** for requirements for vibration limits of pedestrian bridges.

3) Allowable Fatigue Stress. Fatigue provisions are not required for pedestrian live load stresses where heavy pedestrian loads are infrequent. Fatigue provisions shall be included for wind loads.

4) Minimum Thickness of Metal. Closed structural tubular members shall have a thickness of at least 1/4 inch, at the end of 75 years design accounting for corrosions.

11.3 RAILINGS

11.3.1 General

A. Purpose

Railings offer protection to pedestrians, bicyclists, and motorists. They can be designed to retain and redirect vehicles upon impact or to prevent rollover with high center of gravity vehicles. Railings provide a transition from a roadway or pedestrian/bicycle way to a bridge.

B. Using Rigid Railings

Railing systems can be rigid, or they can allow deflection to reduce penetration. Highway structures normally warrant the use of a rigid railing.

C. Compliance with Standard Drawings

This section provides criteria for roadside/bridge, pedestrian, bicycle, and combination barriers. Railings shall comply with **CDOT and AASHTO Standards**

11.3.2 Traffic Railing

A traffic railing is used for roadway traffic when there is a hazard within the clear zone. It is also used to separate the travel lane from an attached sidewalk in cases where there is no bike lane and the posted speed is greater than or equal to 40 mph. Two types of traffic railing are the bridge railing and the roadside barrier.

A. Bridge Railing

Bridge railings must handle vehicles on the bridge under impact conditions. Vehicles and impact conditions are specified in the design. When selecting the rail bridge rail consideration should be given to a system that reduces maintenance and future repair costs. Where feasible an open rail system is preferred to prevent snow/ice buildup. A NCHRP Report 350 Test Level 3 is required for all railings unless approved by the Local Entity Engineer

1) Types of Railings (Crash-Tested)

   i) CDOT Railing – Type 10, This is a combination concrete and steel railing that provides openings to promote snow and ice melting.

   ii) CDOT Railings. Type 7, This is solid rigid concrete system

2) Using Other Types of Railing.

   The utilization of Figure 11-1 is approved on local and collector streets. This railing is not crash tested approved but must be designed by professional engineer per AASHTO LRFD Bridge Design Specifications

3) Other railing may be proposed for review and approval by the Local Entity.

Structural calculations or crash test results need to be submitted with such proposals. For a designed railing system that is not one of the standard CDOT rails mentioned above, the railing system shall be designed in accordance **AASHTO LRFD Bridge Design Specifications**, Section 13.7.

4) Transitions. Transitions shall be provided when a semi-rigid roadside guard rail meets a rigid bridge railing per AASHTO Roadside Design Guide

   i) Gradual Stiffening. The transition shall provide a gradual stiffening of the approach by adjusting the post spacing or rail strength or by transitioning to a different, stiffer barrier.

   ii) Alternatives in Congested Areas. In urban areas or where city streets and/or sidewalks prevent installation of approach guardrail transitions, one or more of the following alternatives shall be followed:

      (a) Install a crash cushion (i.e. Quadguard II) or a section of approach guardrail parallel to the roadway with a suitable end terminal may be used.

      (b) Extend the guardrail or bridge rail in a manner that prevents encroachment of a vehicle onto any roadway system near the bridge. A lower test level end treatment or a tapered end section parallel to the roadway may be an option on low speed local or collector roadways. Restrict speed. See **Chapter 14, Traffic Signals, Signs, and Striping,** for regulatory signs. Local Entity Engineer approval is required for this option.

      (c) Provide a recovery area.

5) Placement and Lateral Clearance. The rail system shall be placed 2 feet beyond the useable shoulder when possible. Near bridge approaches, the use of longer guardrail posts or structural guardrail mounted on a moment slab under roadway may be viable options if space is limited.

6) Transitioning From Bridge Railing When Outside of Clearzone. If the edge of the bridge railing is outside of the clearzone per the AASHTO Roadside Design Guide then no roadside guardrail is required. This typically happens on slow speed roadways with wide sidewalks or on trailing ends of the bridge.

B. Roadside Barrier

A roadside barrier railing shields motorists from natural or manmade obstacles located along either side of a traveled way. Barriers are required only when the warrants, contained in the **AASHTO Roadside Design Guide**, are met. A NCHRP Report 350 Test Level 3 is required for all railings unless an alternate railing is approved by the Local Entity Engineer

1) Common Roadside Barriers. Roadside barriers are flexible, semi-rigid, or rigid. Refer to **AASHTO Roadside Design Guide** for the most applicable roadside barrier for a given situation.

2) Transitions. As a roadside barrier transitions from the roadway to a bridge a gradual stiffening will be required per **AASHTO Roadside Design Guide**.

3) Placement and Lateral Clearance. Placement of roadside barriers shall relate to lateral offset, terrain effects, flare rate, and length of need.

   i) Lateral Offset from the Edge-of-Traveled Way. Roadside barriers shall be placed as far from the traveled way as conditions allow. The "shy line offset" is defined as the distance from the edge of the traveled way beyond which a roadside object will not be perceived as an obstacle. A roadside barrier should not be placed beyond the shy line offset listed in the **AASHTO roadside design guide, Table 5.7.** The offset is calculated as a function of design speed, especially for short, isolated installations. For long, continuous runs of railing, this offset distance is not as critical.

   ii) Deflection Distance. A barrier's deflection distance on impact is a critical factor in its placement. If a rail is installed along the face of an exposed pier, abutment, or wall, sufficient clearance shall be provided to allow dynamic lateral deflection. This will enable the rail to cushion and deflect an errant vehicle. See **AASHTO Roadside Design Guide, Table 5.6** for appropriate distance required.

   iii) Terrain Effect. Most roadside barriers are designed and tested on level terrain. **Refer to AASHTO Roadway Design Guide, Section 5.6.2.2** for appropriate placement of barriers adjacent to the roadway with slopes greater than 1:10.

   iv) Length of Need. See **AASHTO Roadside Design Guide** for length of need requirements.

11.3.3 Pedestrian Railing

A pedestrian railing shall be used at all locations where pedestrians are adjacent to a 2:1 or steeper drop-off equal to or greater than 30 inches high.

A. Placement

The railing shall be placed on the outer edge of the sidewalk when pedestrian traffic is separated from vehicular traffic by a traffic railing. Pedestrian railing height shall be a minimum of 42 inches, measured from the walkway surface and in accordance to the **AASHTO LRFD Bridge Design Specifications**, Section 13.7.3.2

B. Construction Materials

Permanent pedestrian railing shall consist of either concrete or metal.

C. Design Loads

Pedestrian Railing live loading will be per **AASHTO LRFD Bridge Design Specifications**, Section 13.8.2.

11.3.4 Bicycle Railing

A bicycle railing shall be used wherever bicycles are allowed adjacent to the edge of a bridge or hazard.

A. Placement

The bicycle railing shall be placed on the outer edge of the bike lane. Bicycle railing height shall be a minimum of 48 inches, measured from the riding surface

B. Construction Materials

A bicycle railing shall be constructed of metal rails only, metal rails above a concrete parapet is authorized.

C. Design Loads

See **AASHTO LRFD Bridge Design Specifications**, Section 13.9.3.

11.3.5 Combination Pedestrian, Vehicle and/or Bicycle Traffic Barrier

A. Conditions for Use

The combination barrier shall be provided whenever a raised curb and an attached sidewalk exist adjacent to a roadway.

B. Placement

The combination barrier shall be installed adjacent to the roadway with either a pedestrian or bicycle railing, as appropriate. If the sidewalk width is 6 feet or greater, the railing height shall be a minimum of 48 inches, measured from the riding surface. The combination barrier shall be placed on the outboard side. See **AASHTO LRFD Bridge Design Specifications**, Section 13.10

11.4 RETAINING WALLS AND ABUTMENTS

11.4.1 General

A. Description

Retaining walls and abutments will be designed per **CDOT Bridge Design Manual** and the **AASHTO LRFD Bridge Design Specifications**, Chapter 10. All retaining walls greater than 30” shall be designed by a State of Colorado Professional Engineer with structural calculations provided to the local entity Engineer upon request. Although the local entity cannot dictate the type of wall used, the project structural

and geotechnical engineers should coordinate to select and design an appropriate wall system capable of meeting project requirements.

B. Placement of Walls

1) Avoid Placement in Right-of-way

Retaining walls are discouraged within the public right-of-way. They will be allowed only when necessary to support public improvements and when approved by the Local Entity Engineer.

2) Requirements When Beyond Right-of-way

Retaining walls needed to support private improvements shall not be located in the public right-of-way. However, if the failure of a related retaining wall could threaten any improvements or safety within the right-of-way, the Local Entity shall require it to be designed by a State of Colorado Professional Engineer with structural calculations provided to the local entity Engineer upon request.

3) Relationship to Shoulder

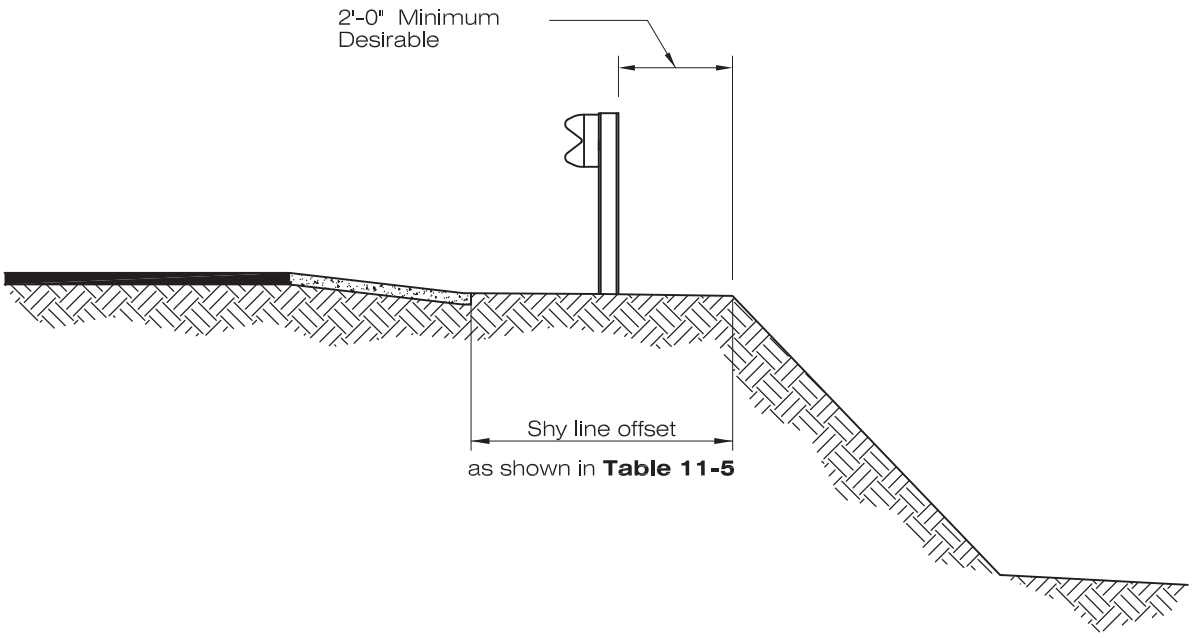
Full or partial height walls shall not be located closer than the outer edge of shoulder. Walls shall be outside of roadway clearzone per the AASHTO Roadside Design Guide. If retaining wall is within clearzone and is considered a roadside obstacle per **Section 5.2.2** in the **AASHTO Roadside Design Guide** then an appropriate protective barrier shall be installed to protect motorist from obstacle.

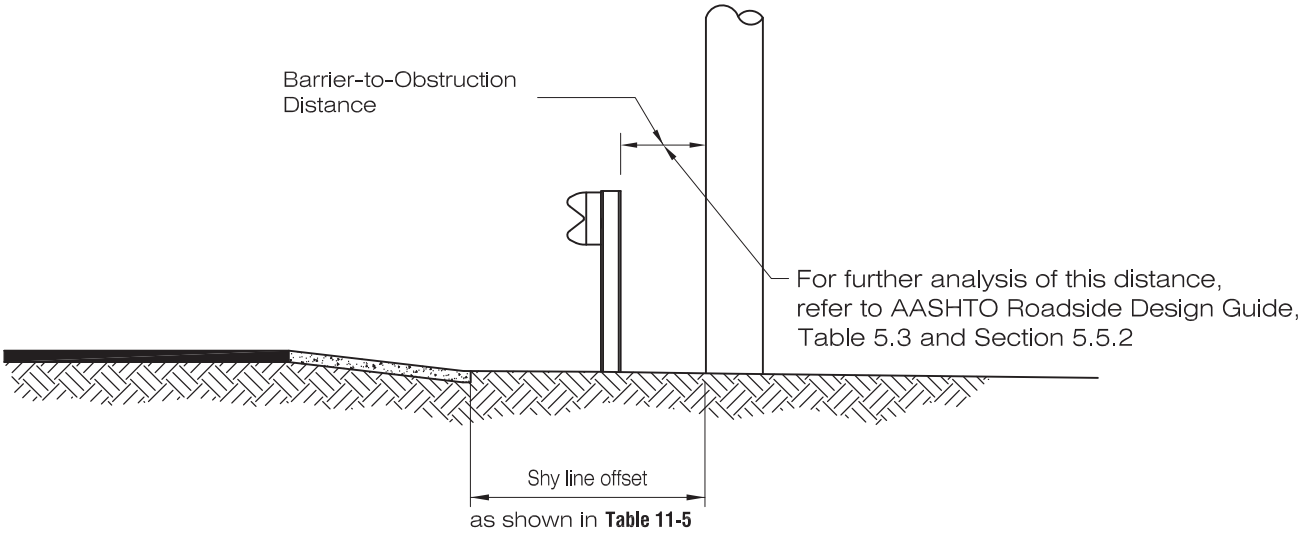
4) Retaining Wall at Roadway Level

When the top of the retaining wall is at the level of a roadway, the face of the parapet wall or rail shall be at least 4 feet from the edge of the traveled way. If retaining wall is within clearzone and is considered a roadside obstacle per **Section 5.2.2** in the **AASHTO Roadside Design Guide** then an appropriate protective barrier shall be installed to protect motorist from obstacle.

11.5 BURIED STRUCTURES

A buried structure is a feature constructed by embankment or trench methods. Buried structures may be constructed of precast or cast-in-place concrete, aluminum, steel, or thermoplastic materials. Refer to Section 11 of the **CDOT Bridge Design Manual** and the **AASHTO LRFD Bridge Design Specifications.** If the buried structures are being considered due to hydraulic reasons then the Local Entity stormwater requirements shall also be utilized.



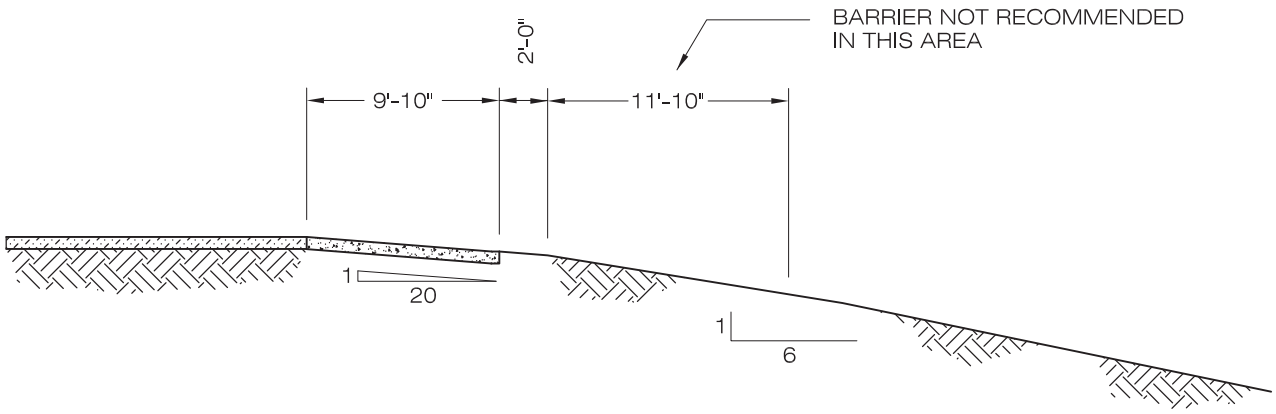


RECOMMENDED BARRIER PLACEMENT FOR OPTIMUM PERFORMANCE

FROM AASHTO ROADWAY GUIDELINE

NOTE: This drawing has been converted from metric to English units.

RECOMMENDED BARRIER PLACEMENT			
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	11-1



RECOMMENDED BARRIER PLACEMENT FOR OPTIMUM PERFORMANCE

FROM AASHTO ROADWAY GUIDELINE

NOTE: This drawing has been converted from metric to English units.

RECOMMENDED BARRIER PLACEMENT			
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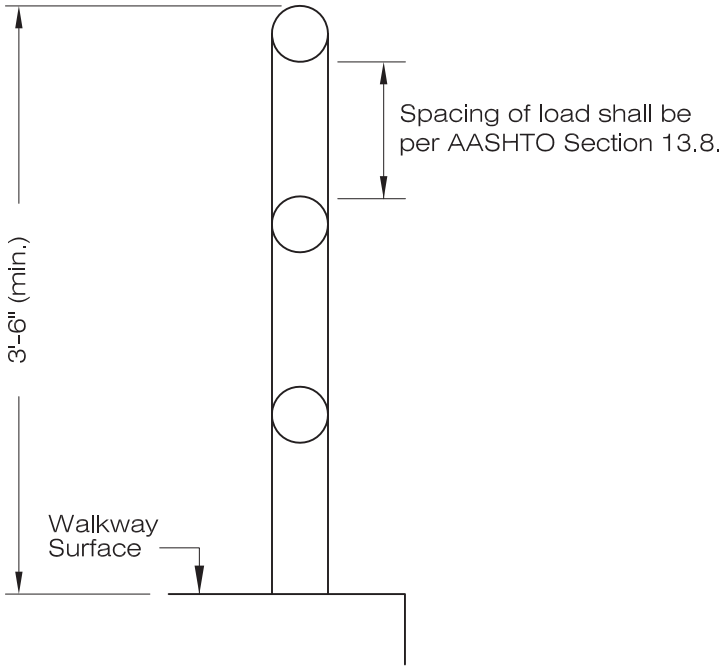
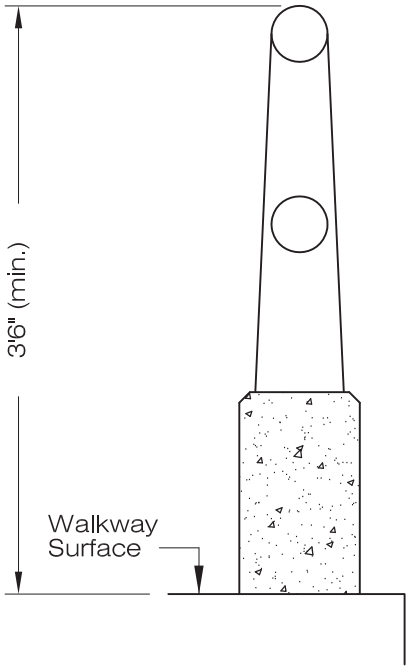
		DATE: 08/07/00	11-2



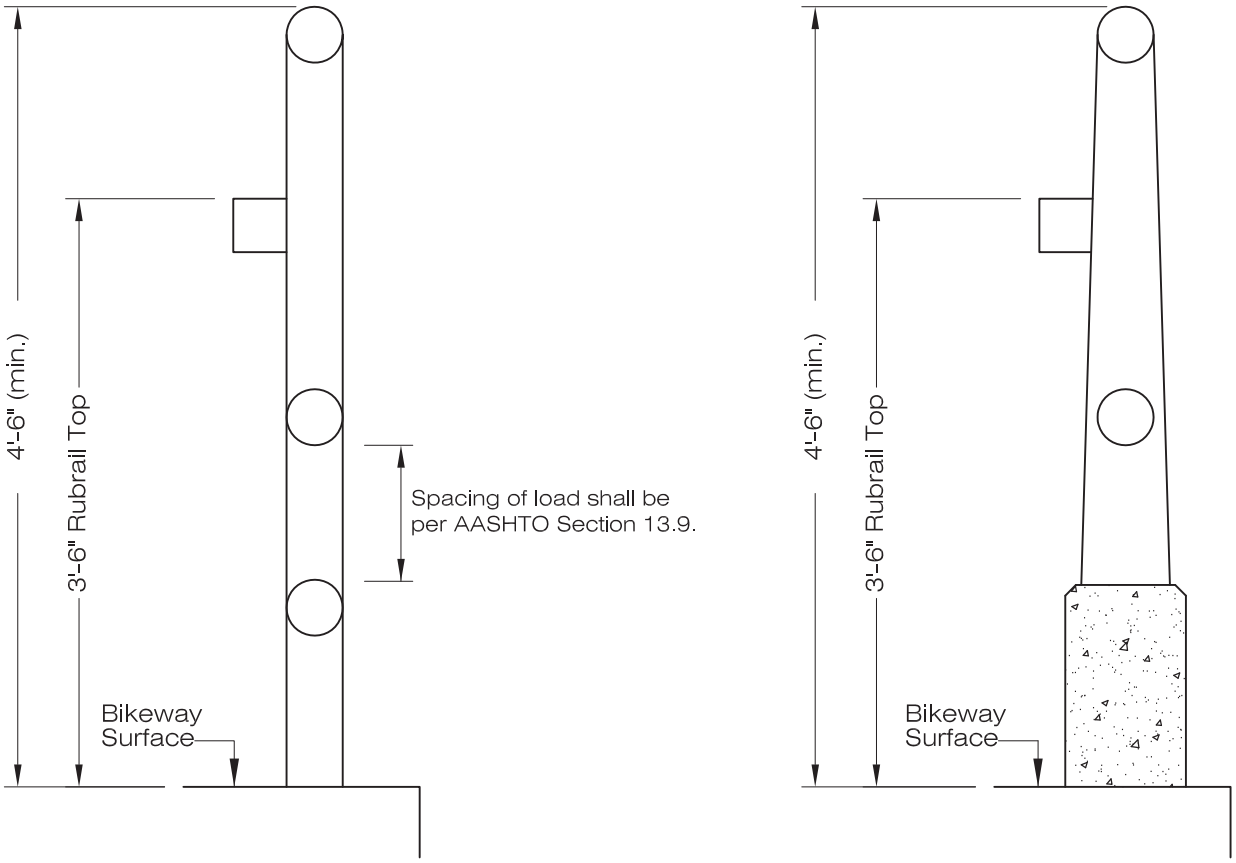


NOTE: To be used on the outer edge of a sidewalk when traffic is separated from pedestrian traffic by a traffic railing. Railing shape illustrative only.

FROM AASHTO ROADWAY GUIDELINE

PEDESTRIAN RAILING LOADS

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	11-3

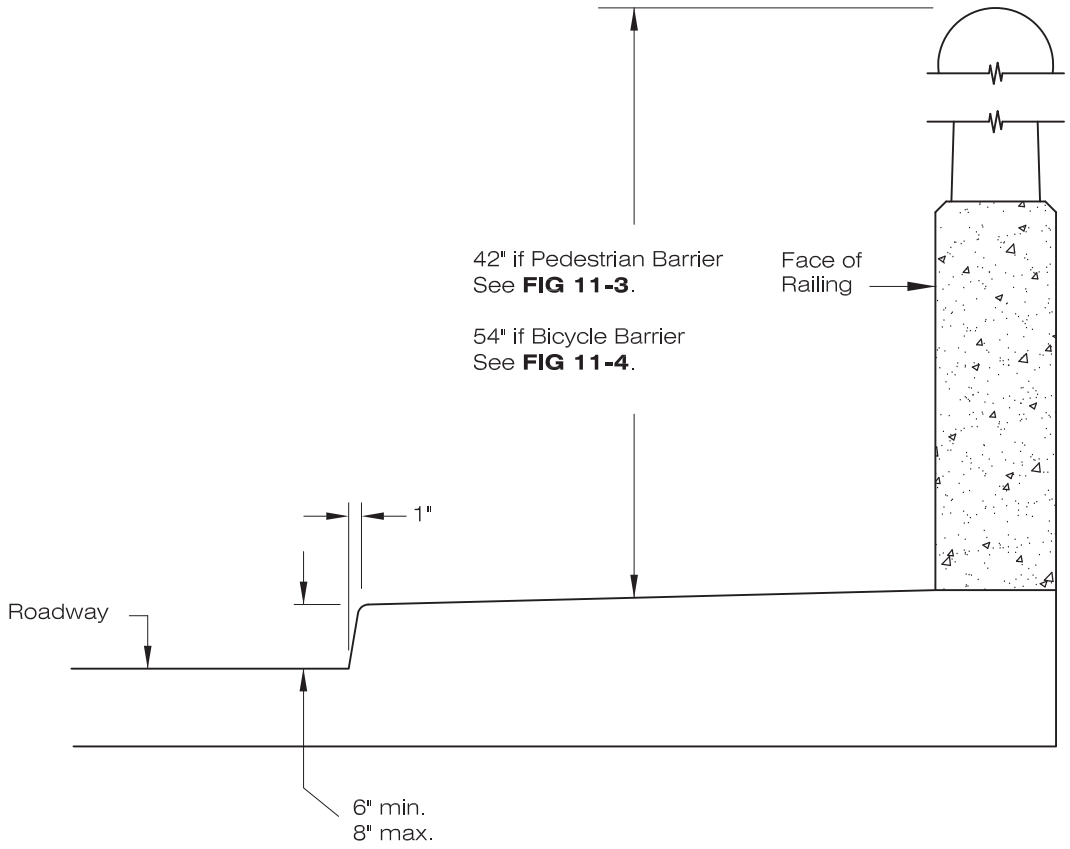


NOTE: To be used on the outer edge of a bikeway when traffic is separated from bicycle traffic by a traffic railing. Railing shape illustrative only.

FROM AASHTO ROADWAY GUIDELINE

BICYCLE RAILING LOADS

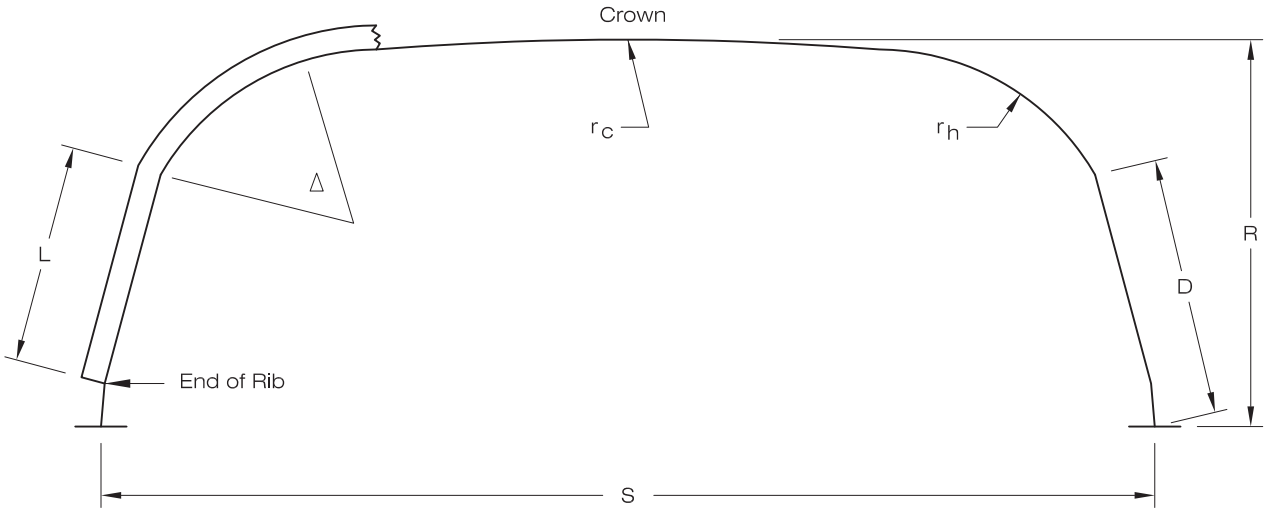
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	11-4



FROM AASHTO ROADWAY GUIDELINE

COMBINATION VEHICLE, PEDESTRIAN, BICYCLE BARRIER

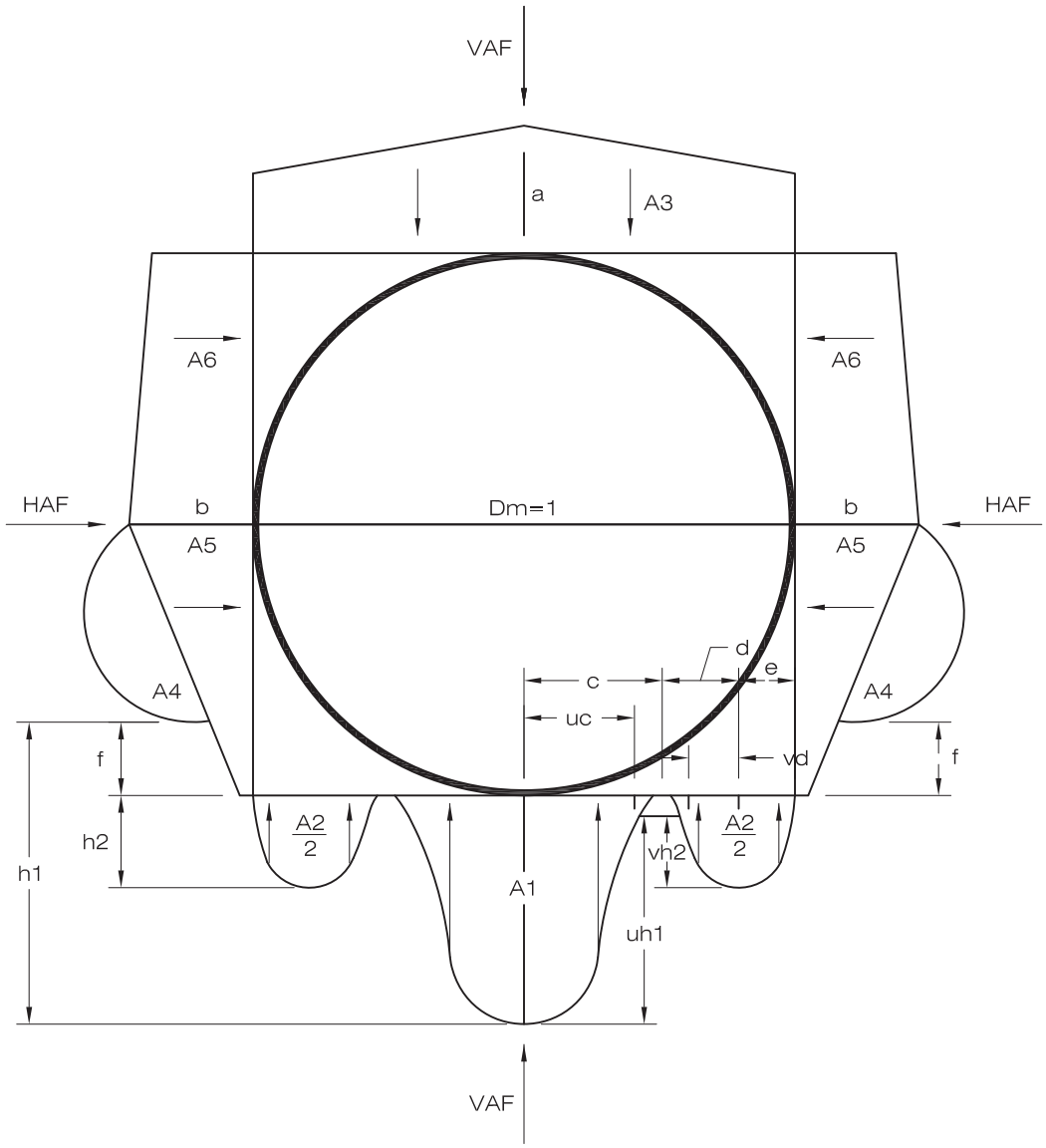
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	11-5



FROM AASHTO ROADWAY GUIDELINE

STRUCTURAL PLATE BOX GEOMETRIC REQUIREMENTS

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	11-6



NOTES:

1. VAF and HAF are vertical and horizontal arching factors. These coefficients represent nondimensional total vertical and earth loads on the pipe, respectively. The actual total vertical and horizontal loads are (VAF) x (PL) and (HAF) x (PL), respectively, where PL is the prism load.

2. Coefficients A1 through A6 represent the integration of nondimensional vertical and horizontal components of soil pressure under the indicated portions of the component pressure diagrams, i.e., the area under the component pressure diagrams.

3. The pressures are assumed to vary either parabolicly or linearly, as shown in Figure 1, with the nondimensional magnitudes at governing points represented by h1, h2, uh1, vh2, a, and b.

FROM AASHTO ROADWAY GUIDELINE

HEGER PRESSURE DISTRIBUTION & ARCHING FACTORS

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
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CHAPTER 12 – INSTALLATION OF UTILITIES AND OTHER SYSTEMS
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CHAPTER 12 – INSTALLATION OF UTILITIES AND OTHER SYSTEMS

12.1 GENERAL

This chapter sets forth the criteria and location requirements for all utilities, such as: water, sanitary sewer, storm sewer, subdrains, power (electric and natural gas), phone, CATV, traffic signals and mailboxes, within the right-of-way and/or public utility easements. The appropriate utility and the Local Entity's utility department shall determine all final alignments of utilities.

12.2 DESIGN STANDARDS

12.2.1 General Requirements

Standard plan requirements and layout requirements are discussed in **Chapter 3, Information Requirements for Construction Plans.** Refer to **Figure 12-1** for general utility requirements. Refer to Local Entity's Water and Wastewater requirements.

12.2.2 Minimum Depth

All utilities shall be located at least 2 feet below the scarified subgrade elevation, unless specifically approved to be less by the Local Entity Engineer. Greater depth of cover may be specified by the Local Entity Engineer.

12.2.3 Access Covers

A. Clearance

All manhole lids, utility access covers, and range box access covers shall be flush with the roadway finished surface or depressed no more than ¼ inch below the finished surface. If located in concrete, all access covers shall be set flush with surrounding concrete. Refer to **Drawing 1201**.

B. Wheel Path

Manholes or valves shall not be designed or constructed in the wheel paths of the travel lane or at any location within a bike lane.

C. Access Cover Location

Manhole, water valve or other utility access covers and lids shall not be located in the flowline of curbs, aprons or crosspans. Manholes and water valve covers shall be located more than 4 feet away from the curb or crosspan.

12.2.4 Trees and Large Shrubs Prohibited Over or Near Utilities

A. Buried Utilities

Trees, berms or large shrubs shall not be placed over buried utilities. Additional horizontal clearances from the trunk of any tree or shrub to any buried utility may be required by the Local Entity's utility department.

B. Overhead Utilities

Trees should not be planted under overhead power lines when mature growth of the tree would come within 10 feet of the power lines.

12.2.5 Use of PVC Sleeves by Franchised and Private Utilities

A. General

It is the intent of these standards to reduce the amount of open cuts in the roadway. Therefore, franchised and private utility companies shall install all utilities within a non-corrosive sleeve equivalent to Schedule 40 PVC or other sleeves encased in concrete, slurry or flow-fill material, across all public streets to accommodate future repairs without street cuts. PVC sleeves shall conform to **Construction Drawing 1202**.

B. Exceptions

Steel gas line street crossings will not require sleeves.

C. Depth

Sleeves shall be installed at a minimum depth of 36 inches from the top of the pipe to the top of pavement or 24 inches from the top of pipe to the top of subgrade, whichever is greater.

D. Location

Sleeves shall be located within 15 feet of the parallel gutter flowline of the existing street and shall be coordinated with other utilities. All sleeve locations shall be marked according to **Chapter 22, Construction Specifications**. Sleeves shall be separated for existing buried utilities in accordance with the utility owner requirements. Ten feet of separation is typically preferred. Private utilities shall be outside of the ROW unless otherwise approved by the Local Entity Engineer.

E. Street Cuts

Utility crossings of existing streets shall be performed in accordance with **Chapter 25, Reconstruction and Repair**.

12.2.6 Use of PVC Sleeves for Potential Signalized Intersections

A. Extra PVC Sleeves

Extra PVC sleeves may be required by the Local Entity on Collector or Arterial intersections for future traffic signalization.

12.3 LOCATION CRITERIA

Refer to **Figure 12-1** for general notes about Utility locations within street rights-of-way.

12.3.1 Utilities

A. General

The utility locations discussed below are required for new development and preferred in the case of existing streets/established developments.

B. Water

1. Water Mains. Water mains should be located on the north and east sides of streets approximately 7 feet south or west of the north or east gutter flowline. Water mains shall be separated by a minimum of 10 feet horizontally from sanitary sewer and storm sewer facilities.

2. Fire Hydrants. Fire hydrants shall be located 2 feet minimum from curb and gutter flowline or 2 feet minimum from back edge of a sidewalk or 10 feet minimum from edge of pavement if no curb is present. In addition, the water line shall be located such that the valves will not be in the wheel path of the street lane.

3. Requirements. The vertical depth of the water lines shall meet the requirements of the Local Entity's utility department.

C. Sanitary Sewer

1. Location. Sanitary sewer should be on the centerline of the right-of-way unless a median is present. If a median is present, the sanitary sewer line shall be located 6 feet west or south of the median. The sanitary sewer shall be located such that the manhole locations are not within the wheel path of the street lane.

2. Requirements. The vertical depth of the sanitary sewer lines shall meet the requirements of the sanitary sewer standards of the Local Entity.

D. Storm Sewer

1. Location. The storm sewer shall be placed so the manhole locations are not within the wheel path of the street lane.

2. Requirements. The storm sewer lines shall meet the requirements of the storm sewer standards of the Local Entity.

E. Natural Gas

1. Location. Gas mains shall be located either within the right-of-way or in an adjacent easement on the south and west sides of the street.

2. Double Mains. For double mains (a main on each side of the street), the requirement of north and east/south and west may be waived by the Local Entity Engineer. Double mains are recommended.

F. Power and Street Lighting

1. Location. Generally, power and street lighting lines shall be located on both sides of the street either within the right-of-way or in an adjacent easement.

2. Double Mains. Double mains are common and acceptable.

12.3.2 Other Systems

A. Broadband, Fiber Optic, Communications, Cable TV, Telephone, etc.

Cable TV and telephone lines generally serve properties from the back. For mains along the street front the utility shall coordinate the location in the right-of-way or easements with the Local Entity Engineer. All pedestal boxes located in the right-of-way between the curb and the sidewalk shall be installed below ground. Refer to Local Entity's regulations for other systems (broadband, fiber optic, communications, wireless communications, cable TV, telephone, small cell, etc.)

B. Mailboxes

Mailbox clusters must be installed a minimum of 2 feet from back of walk and not cause any sight obstruction. Mailboxes must not pose a fixed object hazard for vehicles and pedestrians.

C. Poles

1. Location. Poles, signs, and any other above ground streetscape (except regulatory signs) should be located within 5 feet of the right-of-way line or 10 feet from the travel lane (flowline), whichever is most restrictive.

2. Clearance. Light poles shall be placed no closer to the roadway than 2 feet behind a vertical curb line and no closer than 2 feet to any sidewalk.

3. Pole Requirements. The Local Entity Engineer may require breakaway poles on public right-of-way where speed limit is 40 m.p.h. or higher. Refer to **CDOT Roadway Design Manual, Section 1002.6, Specifications**.

4. Engineer Approval. All poles within the public right-of-way must be accepted by the Local Entity Engineer prior to the permit application for installation.

5. Other Requirements. All signs and heights shall meet the requirements of **Chapter 14, Traffic Signals, Signs, and Striping**.

D. Subdrains

Subdrain main lines may be permitted within the public right-of-way. The Developer shall be required to provide additional information and soils investigation, as discussed in **Chapter 5, Soils Investigations and Report**. In addition, subdrains shall be designed in accordance with the requirements in **Chapter 7, Street Design and Technical Criteria**. If the soils investigation shows that subdrains are required for private property foundations, these lines may be designed to be installed within the public right-of-way only if all requirements of these Standards are met.

1. Private Property. Subdrains built within the right-of-way for private drainage shall be private improvements and shall have provisions for viable maintenance by the local homeowners association, Metro District, or other private entities. If the system is deemed non-functional by the City, the HOA or Metro District will be informed in writing of the needed maintenance or repairs and the schedule for this to be completed. The Local Entity may require the private entity to abandon or relocate such subdrains.

2. Public Property. A subdrain is public if it is used to drain public improvements, such as the street/pavement section.

3. Requirements. The subdrain design shall meet or exceed these minimum requirements:

   a. Depth. Top of pipe shall be at least 36 inches below pavement surface.

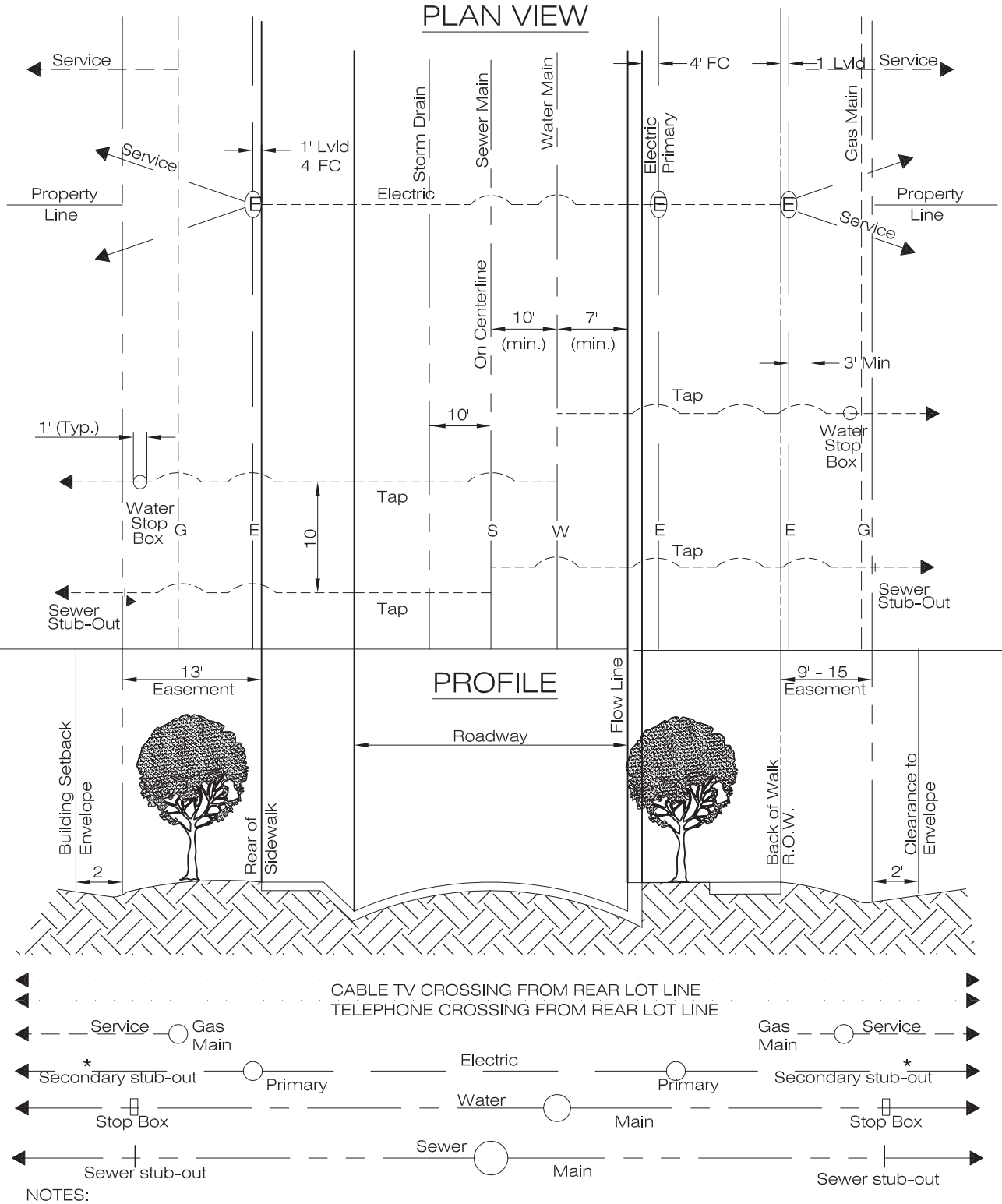
   b. Outlet. All subdrains shall outlet to a detention pond, inlet, or other approved location. Each outlet shall have a device to prohibit backflow into outlet pipe.

   c. In Loveland. Perforated subdrains for private improvements shall not be allowed within any public right-of-way or easement.

4. Professional Engineer. Subdrains must be designed by a Professional Engineer and are subject to approval of the Local Entity Engineer.

12.3.3 Utility Crossings with Bridge Structures

Sleeves may be required within the bridge structures to provide for electrical, gas, telephone, fiber optic, broadband, wireless communications, and cable crossings, etc. The Local Entity Engineer may require additional sleeves to be designed with the bridge structure for sewer, water, or other utilities.



NOTES:

1. No scale to the drawing above. All measurements shown are minimums.
2. Storm and sanitary sewers, manholes, water valves or telephone manholes are not allowed in the wheel path.

UTILITY LOCATIONS

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 01/22/01	12-1

CHAPTER 13 – STREET NAMING AND ADDRESSING
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CHAPTER 13 – STREET NAMING AND ADDRESSING

13.1 GENERAL

This chapter describes the criteria used to name new streets and assign addresses to properties along those streets. Street names and addresses should be easy to locate. It is important that street names not be duplicated nor sound similar to any other street. Addresses must be consistent to provide easy location of all properties. Street layout is an important factor for being able to assign addresses that carry on in a general logical sequence. For the health, safety and welfare of the public, people must be able to describe their location for emergency services, and responding emergency personnel must easily find the location.

13.2 STREET NAMING

Since the 911 emergency dispatch system operated by the Larimer Emergency Telephone Authority (LETA) is a countywide system, all Local Entities within the Larimer County coordinate on their selection of street names to ensure that there are no duplicate street names county wide. This is a need for the rapid and efficient dispatch of emergency services. Each Local Entity participates in a web site based Street Name Inventory System coordinated by Larimer County.

13.2.1 Name Selection System

The system may be accessed by anyone to check on street names. A proposed street name may be entered for testing to determine whether the name is acceptable. The system will indicate names already in use and show names the sound too similar. The web site address for the system is https://www.larimer.org/engineering/subdivisions-and-road-names/street-inventory#/streets . Only the Local Entities assigning addresses may enter street names for reservation in the system. Street names are reserved as proposed at the time a plat is submitted for development review. Upon approval of the plat, the proposed street names will be transferred to the "existing" list. In some cases, Local Entities have reserved specific names for their future use.

13.2.2 Street Naming Criteria

When assigning names to streets, follow the street naming criteria in **Table 13-1** titled "Rules of the Street**."** This list appears on the Name Selection System web site, https://www.larimer.org/engineering/subdivisions-and-road-names/street-inventory#/streets

In Loveland (city limits only), refer to Title 12, Section 12.08 of the Loveland Municipal Code for the street naming policy.

13.2.3 Major Street Names

In Fort Collins (city limits only) all arterial and collector street names shall be selected from a City Council approved list of reserved names. The names relate to the history of Fort Collins. Refer to Local Entity's for updated list.

In Loveland (city limits only), refer to Title 12, Section 12.08 of the Loveland Municipal Code for the street naming policy.

Table 13-1
Road Naming Criteria

Standardization of road naming criteria
1. Use only accepted suffixes 2. Homonyms for road names are not acceptable. 3. Road names should be unique and not repeated in the County from this point forward, with the exception of continuation of existing streets. 4. Each Municipality and the County may develop a list of acceptable or recommended names for use in its jurisdiction. If there are duplications on such lists, and another Municipality or the County utilized the name, the name will be removed from the acceptable or recommended lists in the other jurisdictions. 5. Within the Growth Management Area around each Municipality, roads will be named using city/town names, not County road numbers. Outside of the GMA Boundary, County road numbers will be used. Street names, rather than County road numbers, will be used for internal roads in County subdivisions and 35 acre developments. 6. In the unincorporated area any road that serves as an access to multiple properties must be named. Multiple properties accessing of a single point from a County road may not use the single access point as a common address. 7. Continuous roads should have continuous names (with the exception of circle roads). Names should not change except at the Growth Management Area boundary, however, names are not required to change at the Growth Management Area boundary. 8. Recommend that road names must be simple to pronounce, in the opinion of the review jurisdiction. 9. Cardinal directions cannot be used in the name. Directions are used only to designate the portion of an existing road. (not acceptable - North Road, East Fort Road, Northstar Drive.) 10. No curse words or derogatory terms shall be used for road names. 11. These are meant to be minimum standards for each Municipality and the County. The main objective is to provide clear street names for citizens and for emergency dispatch and to minimize the possibility of emergency personnel being unable to find a location. Nothing in this Agreement is intended to limit any Municipality or the County from developing more extensive street naming guidelines. 12. Numerical addressing will not change from the current process. 13. All names shall be of the commonly acceptable spelling, according to a standard dictionary. 14. Street names cannot contain any punctuation or special characters. Only alphabetical symbols A through Z, and numbers 0 through 9 and blank spaces may be used in street names. 15. Anytime that a street makes a directional change of approximately ninety degrees, the street name shall change. A directional change of approximately ninety degrees shall mean a horizontal curve where a reduction in the design speed is required (i.e. a sharp turn vs. a sweeping curve). 16. Existing street names shall continue across intersections and roundabouts.

13.2.4 Suffixes

Street suffixes, such as Court, Avenue, etc., which are used to complete the street name, shall conform to the requirements shown in **Table 13-2** titled "Approved Street Suffixes." This list appears on the Name Selection System web site.

13.3 STREET ADDRESSING

The purpose of addressing is to provide a means to locate all properties within the Local Entity. The intent of each Local Entity is to assign addresses with an orderly system, which is consistent, predictable and understandable for everyone.

13.3.1 Address Assignment

All addresses shall be assigned by the Local Entity. Addresses shall be assigned at the time, or shortly thereafter, the approved plat or deed is filed with the Larimer County Clerk and Recorder. The record of addresses is kept and maintained by each Local Entity for its own jurisdiction.

13.3.2 Address Changes

The Local Entity must approve any change in a property address. Any changes must conform to the addressing convention used by the Local Entity.

Table 13-2
Approved Street Suffixes

*The following table lists the only suffixes that can be used for **new** street names.*

Suffix	Abbreviation	Description
Avenue	AVE	A roadway or thoroughfare that is continuous and not limited to a single subdivision.
Boulevard	BLVD	Street with a landscaped median dividing the roadway.
Court	CT	Permanently dead-end street or terminating in a cul-de-sac, not longer than 660 feet in length.
Drive	DR	A curvilinear street.
Lane	LN	Minor street within a subdivision.
Parkway	PKWY	A thoroughfare designated as a collector or arterial, with a median reflecting the parkway character implied in the name.
Place	PL	Permanently dead-end street, terminating in a cul-de-sac, or short through street, not longer than 660 feet in length.
Road	RD	A designated thoroughfare.
Street	ST	The common or default suffix.
Way	WAY	A curvilinear street.

CHAPTER 14 – TRAFFIC CONTROL DEVICES
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CHAPTER 14 – TRAFFIC CONTROL DEVICES

14.1 GENERAL

This chapter describes general signal, signing, and striping design requirements for use in the Local Entity. All design and construction of signals, signing, and striping shall be in conformance with this chapter and the latest revision of the MUTCD. Also refer to each Local Entity's latest Traffic Operations Manual.

14.2 DESIGN REQUIREMENTS

14.2.1 Traffic Signal Design Requirements

The design of traffic signals shall be performed by the Local Entity or a qualified Traffic Engineer approved by the Local Entity. The Local Entity may charge the cost of design and construction to the Developer when the work is completed by the Local Entity.

For CDOT highways, the design will follow the current version of **Colorado Department of Transportation Standards** for a standard mast arm type traffic signal installation. For city streets not on the state highway system the design will follow the current version of **Colorado Department of Transportation Standards** for a standard mast arm type traffic signal installation, with the changes below in Loveland or Fort Collins (GMA and city limits):

A. Special Requirements for Loveland (GMA and City Limits)

1. Galvanized and painted mast arm/signal poles, luminaire arms, and extensions shall be painted with Standard Valmont Color Medium Bronze (Brown).
2. Street light luminaire extensions (galvanized and powder coated) shall be delivered for all poles. A 35-foot luminaire mounting height and a 15-foot luminaire arm (galvanized and painted) shall be used to mount a 250 or 400 Watt LED Equivalent streetlight fixture (or approved equal). Streetlight fixtures are to be obtained from the City of Loveland's warehouse at no cost to the project or the traffic division. The luminaire arm shall be rotated 10 degrees in front of the mast arm (-10 degrees). If free right turn lanes are provided or anticipated, a second luminaire arm shall be provided 145 degrees clockwise from the first luminaire arm.
3. Current requirements for signal cabinets, battery backup, controllers, conflict monitors, CCTV cameras, fiber optic switches, data radios, vehicular detection equipment, and other ancillary devices shall be obtained from the local agency engineer during the design process as they change frequently. In general, all new and reconstructed traffic signals shall be compatible with and connected to the City's existing central traffic signal management system. Some corridors are running special hardware or software and signals added to those corridors shall be compatible.
4. Opticom fire preemption system complete with detectors, wiring, and card in the cabinet (3M system) is required. Refer to Local Entity's Traffic Operations Manual for latest requirements.

5. Attachment height for mast arms to signal pole shall meet CDOT specifications on CDOT corridors (20' attachment height) and 19 feet on other corridors.
6. Pan-tilt-zoom (PTZ) camera shall be required at each signalized intersection. The camera shall include all wiring including an unspliced CAT 5e cable from camera to controller cabinet, properly terminated in accordance with manufacturer's recommendations. Refer to Local Entity's Traffic Operations Manual for latest requirements.
7. Black, 12"-12"-12" polycarbonate signal head cap visors with 5" black louvered aluminum back plates shall be mounted using Sky Brackets (or approved equal) over the center of each lane. Side of pole mounted 12"-12"-12" are for the far side right, which will cover any dedicated right turn lanes. Use of far side left 12"-12"-12" or 12"-12"-12"-12" heads with cut away visors are determined on an intersection by intersection basis but will be used in most cases on State Highways and/or arterials with significant large truck traffic. Intersections with left turn phasing shall have far left side heads. Four section Flashing Yellow Arrow indications shall be standard for all new left turn phasing installed at intersections where permissive left turn phasing is a possibility.
8. Black 16-inch poly LED countdown pedestrian heads and a clamshell/banding mounting system are required for all standard pedestrian movements.
9. Two 3-inch conduits and one 2" conduit will be used for wiring between the signal bases and the cabinet. For vehicle loops, use a 2-inch conduit from the water valve pull boxes to the nearest pull box. Trenched conduit shall be UL Listed Schedule 80 PVC with glued joints. Bored conduit shall be continuous UL Listed HDPE Schedule 80 smooth wall conduit designed for directional boring.
10. Traffic signal pull boxes shall be polymer concrete Tier 22 with traffic logo on the lid. There are 4 standard sizes depending on the application: 13" x 24"x 12", 17" x 30" x 12", 24" x 36" x 18", and 36" x 48" x 18". Split lid for fiber optics. See Figure 14-4 for pull box specifications.
11. Pedestrian buttons with audio alert, LED light, and sign housing/back plate that shall be a 5" x 7" man/arrow white on black. Accessible pedestrian signals where required by the Local Entity. Refer to Local Entity's Traffic Operations Manual for latest requirements.
12. All design work of the cable installation and selection of the communications electronic equipment shall be approved by the Traffic Engineer prior to acquisition and installation. Upon completion of the cable installation, final as-builts shall be submitted for review and approval.
13. All new signals shall be interconnected into the existing City signal system using either fiber optics (preferred) or data radio.
14. Three-inch conduit shall be installed along all arterials for future signal interconnect. Pull boxes shall be provided at spacing in accordance with the Local Entity's requirements. Separate pull boxes shall be provided adjacent to signal cabinets for signal wiring and fiber optics. When installed, fiber optic cables shall be 48 strand single mode fiber with 100 feet of slack provided at each pull box.

Laterals between the signal cabinet and the fiber optic pull box may be 12 strand single mode fiber.

B. Special Requirements for Fort Collins (GMA and City Limits)

1. Galvanized and painted mast arm/signal poles, luminaire arms, and extensions painted with Standard Valmont Color Medium Bronze (Brown).
2. Street light luminaire extensions (galvanized and painted) shall be ordered on all poles. A 30-foot luminaire mounting height and a *IS-foot* luminaire arm (galvanized and painted) shall be used to mount a 250 Watt HPS streetlight fixture. Streetlight fixtures are to be purchased from the City of Fort Collins warehouse.
3. Current requirements for signal cabinets, battery backup, controllers, conflict monitors, CCTV cameras, fiber optic switches, data radios, vehicular detection equipment, and other ancillary devices shall be obtained from the local agency engineer during the design process as they change frequently. In general, all new and reconstructed traffic signals shall be compatible with and connected to the City's existing central traffic signal management system. Some corridors are running special hardware or software and signals added to those corridors shall be compatible.
4. Opticom fire preemption system complete with detectors, wiring, and card in the cabinet (3M system) is required.
5. Yellow, 12"-12"-12" aluminum signal heads with 4" black back plates shall be mounted using skybrackets over the center of each lane. Side of pole mounted 12"-12"-12" are for the far side right, which will cover any dedicated right turn lanes. Intersections with left turn phasing shall have far left side heads. Four section Flashing Yellow Arrow indications shall be standard for all new left turn phasing installed at intersections where protected/permissive left turn phasing is indicated.
6. Yellow 16-inch LED pedestrian heads (hand/man) with visors and a clamshell/banding mounting system.
7. One 3-inch and one 2-inch conduits (Schedule 40 PVC minimum) shall be installed between the signal bases and each corner secondary pull box. Two 3-inch and two 2-inch conduits (Schedule 40 PVC minimum) shall be installed connecting the secondary pull boxes. Three 3-inch and three 2-inch conduits shall be installed between the main pull box and the cabinet. Vehicle loop detection is not allowed for Fort Collins.
8. Traffic signal pull boxes shall be polymer concrete Tier 22. The lid shall be marked "TRAFFIC" or "TRAFFIC SIGNAL". There are 4 standard sizes depending on the application: 13" x 24"x 18", 17" x 30" x 18", 24" x 36" x 18", and 36" x 48" x 18".
9. Pedestrian buttons shall be the yellow bulldog type with audio alert, and 9" X 12" sign housing/back plate. Accessible pedestrian signals where required by the Local Entity. Refer to Local Entity's Traffic Operations Manual for latest requirements.
10. All new signals shall be interconnected into the existing City signal system using either fiber optics (preferred) or data radio.

11. All design work of the cable installation and selection of the communications electronic equipment shall be approved by the Traffic Engineer prior to acquisition and installation. Upon completion of the cable installation, final as-builts shall be submitted for review and approval.
12. Where interconnection does not exist, a 2-inch conduit shall be installed along all arterials for future signal interconnect. Pull boxes shall be provided at 1000-foot spacing. Separate pull boxes shall be provided adjacent to signal cabinets for signal wiring and fiber optics. When installed, fiber optic cables shall be 48 strand single mode fiber with 150 feet of slack provided at each pull box. Laterals between the signal cabinet and the fiber optic pull box may be 12 strand single mode fiber.

14.3 TRAFFIC SIGNING

14.3.1 General

A. Type and Location of Signs

The Local Entity Engineer shall make the final determination regarding the type and location of signage controls within the right-of-way. These controls shall include traffic control signs, street name signs, delineators, and permanent barricades.

B. Design, Installation, and Maintenance

Because the Local Entity will maintain the permanent traffic control devices on public rights-of-way, all traffic control devices shall be fabricated and installed in accordance with **Chapter 22, Construction Specifications.** All design shall be in accordance with this chapter and the latest revisions of the MUTCD and Standard Highway Signs and Markings, and in Fort Collins (GMA and city limits) refer to Appendix F, City of Fort Collins Traffic Operations Manual.

C. New Roadway

Permanent signage, unless otherwise approved by the Local Entity Engineer, shall be completely in place before any new Roadway is opened to the public.

D. Other Standards

These Standards are to be used in conjunction with other applicable Local Entity Regulations.

E. Sign Posts, Supports, and Mountings

For Fort Collins (GMA and city limits) also refer to Appendix F, City of Fort Collins Traffic Operations Manual. Sign posts and their foundations and sign mountings shall be constructed to hold signs in a proper and permanent position, to resist swaying in the wind or displacement by vandalism.

1. Sign Post. The post shall be constructed in two sections:
    a. Anchor (Stub). A 2-1/4-inch 12-gauge galvanized steel square stub section with holes, three (3) feet long, is driven into the ground 30 to 33 inches with 3 to 6 inches remaining above the final grade. The sign post system's material

specification is Telespar 22F12A 03PG, 2-1/4-inch x 3 feet anchor post with holes, or perforated.

b. Sign Post. A 2-inch square galvanized steel post section with holes is inserted into the stub and bolted. The material specification is Telspar 20F12P-10PG, 2-inch square 12-gauge 10-foot post with holes. Posts shall be installed 6 to 8 inches into the anchor (stub), which has 3 to 6 inches sticking out above the final grade.

2. Post Bolts. Two 2-1/2-inch long, 3/8-inch hex head bolts are used to attach sign posts to sign anchor (stubs). These bolts shall be installed in adjacent holes at the top of the anchor (stub), at 90 degrees to one another.

3. Sign Bolts. Signs shall be mounted to the post with a minimum of one drive rivet (TL3806 EG) and nylon washer (against sign face) at the top of sign. The bottom of the sign shall be attached with one 5/16" hex bolt, one metal washer and one nylon washer against sign face. The bolt or rivet system is used to fasten signs to the Telespar post.

4. Other Sign Mounts. Streetlights and approved utility poles, when located appropriately, may be used for signs such as warning, parking, and speed limit signs. Streetlight locations should be checked for potential sign installation during the design process and shown on the sign plan sheets. Refer to Section 14.4.3 B.

5. Breakaway Post System. Posts must be of appropriate length to comply with MUTCD specifications for the location, must conform to the Local Entity's Specifications, and must meet the Federal breakaway standards.

F. Sign Sheeting and Fabrication

All traffic control signs must be fabricated with reflective materials. All reflective sheeting to be a minimum of diamond grade material per Section 14.3.3. All signs or traffic control devices must have a 7-year materials warranty. No silk screened signs will be permitted. All sign material must comply with the latest MUTCD standards.

For Fort Collins (GMA and city limits) also refer to Appendix F, City of Fort Collins Traffic Operations Manual.

G. Aluminum Sign Blanks

Aluminum blanks of 0.080 inch thickness are standard, except for signs larger than 36 x 36 inches, which shall be 0.125 inch thickness aluminum.

14.3.2 Intersections

A. Street Name Sign

1. General. All street name signs must conform to these standards, See **Construction Drawing 1411**. If the intersection has a traffic signal, street name signs will be designed as part of the signal. Internally illuminated signs are not permitted in Loveland or Fort Collins (GMA and city limits).

2. Minor Intersection. Eight-inch plates with 6" lettering shall be used at all minor intersections; lengths will vary to fit street names. Also see street name sign Drawing 1411.

3. Multi-Lane Intersection. Ten-inch plates with 8" lettering shall be used at all intersections on roadways with two or more lanes of traffic moving in the same direction.
4. Signalized Intersections. In Loveland (GMA and city limits), street name signs placed on mast arms at signalized intersections shall use 18" plates with 14" letters.
5. Sign Assembly. There shall be two plates for each road, with a minimum of four plates per street sign assembly. In Loveland (city limits only), street name signs shall be mounted directly to the sign post with two drive rivets per sign and nylon washers against sign face. Typical installation shall include four street name signs, two for each direction. For signs with lengths of 18" – 30" use 0.080 inch blank thickness; for signs 36" – 48" use 0.100 inch blank thickness.
6. Sign Face.
   a. Letter Size. Refer to the following table and **Construction Drawing 1411** for letter size specifications.

Type of Mounting	**Letter Size**	**Height of Sign Blank**
Minor Intersection	6"	8", Lengths may vary
Major Intersection	8"	10", Lengths may vary
Metro Overhead	14"	18", Lengths may vary

   b. Color. Letters and numbers are to be white on a green background face. Private streets shall use green letters on a white background face. The colors shall not fade when exposed to an accelerated test of ultraviolet light equivalent to 5 years of outdoor exposure.
   c. Block Numbers and Arrows. All signs shall include block numbers plus arrow pointing toward the higher block number, except on one way streets. Arrow on one way streets shall point in the direction of traffic. Arrows shall meet MUTCD standards as illustrated in the Standard Highway Sign Handbook. Where intersection is in the middle of a numbered block, provide only block numbers without arrows.
   d. Border. There shall be no borders on street name signs
7. Street Name. Street names and 100-block (where applicable) designations should be obtained from the approved plat.
8. Change of Name or Numbers. At the point where a street changes names/numbers from one section to the next, the change shall be designated with a street name assembly by using standard names, numbers, and directional arrows to indicate change. This will be accomplished using an 18" double height street name plate.
9. No Outlet Signs. On any cul-de-sac, temporary dead-end street, or any other streets with only one access point a "No Outlet" sign is required. The "No Outlet" signs may be placed under the street name signs. In Loveland (GMA and city limits), signs shall be W14-2a adapted to fit a 30" x 8" blank.

B. Stop Signs

1. Location of all stop signs shall be determined and discussed in the TIS.

2. Stop signs will be placed in accordance with the TIS, approved construction plans, and the MUTCD. In general, stop signs should be placed at point of curvature (PC) a minimum of 6 – 12 feet from the edge of pavement with a 2-foot minimum for curbed roadways.

C. Warning Signs

Intersection warning signs may be required on 4- or 6-lane Arterial Roadways in advance of major intersections. An advisory plaque identifying the name of the intersecting side street shall be placed beneath the advance intersection warning sign. Placement of these signs shall be per MUTCD standards.

14.3.3 Traffic Control Signs

A. Design and Size

Sign specifications and diagrams are detailed in the latest revision of the Federal "Standard Highway Signs and Markings," latest version. This publication is available from the U.S. Department of Transportation, Federal Highway Administration. Acceptable sign sizes are listed in the standard column of the table printed with each diagram. Expressway and construction warning signs shall be a minimum 36" x 36".

B. Mounting

Signs should be mounted on existing streetlight and power poles, with new posts being used only if necessary. **Streetlight locations should be checked for potential sign installation during the design process and shown on the signing and striping plan sheets.** 3/4" stainless steel banding shall be used to mount signs to fiberglass and steel poles. Installation of signs on wood poles can be achieved by using 3/8" x 2-1/2 inch lag bolts.

C. Regulatory Signs

1. Stop Sign. Stop sign sizing shall conform to the MUTCD. However, stop signs shall also not be less than 30" x 30" in.
2. Yield Sign. For roundabouts or minor intersections only, a 36"x36"x36" yield sign may be used in lieu of a stop sign, at the discretion of the Local Entity according to MUTCD.
3. Speed Limit Sign. All Collectors and Arterials should have speed limit signs at a minimum ½ -mile intervals. All subdivisions shall have a speed limit sign at each entrance.
4. Parking/No Parking Sign. Designated parking and "no parking" zones shall be signed in accordance with MUTCD.

D. Warning

1. Sheeting Requirements. All school crossing signs and associated W16-7P arrow signs shall be made with fluorescent yellow/green sheeting. All other warning signs shall be made with fluorescent yellow sheeting.
2. "No Outlet" Sign. On dead end streets, cul-de-sacs, and temporary dead end streets, a "No Outlet" sign will be required and mounted with standard mounting system

under the street name sign. The sign shall be an MUTCD #W14-2a, 30 x 6-inch minimum size (30" x 8" minimum in Loveland [city limits only]) black on yellow warning sign. A separate 30" x 30" No Outlet sign may also be required in specific locations.

3. "Road Closed" Sign and Barricades.

   a. Temporary Dead End. All temporary dead-end streets shall have a Type III barricade with appropriate advance warning sign(s) and as shown in **Construction Drawing 1413.** A temporary dead-end street is anticipated to be a dead end for less than a year. Type III Barricades shall have a "Road Closed" (R11-2, 48 x 30 inches) sign mounted on both sides of the barricade.

   b. Long-Term Dead End. All dead-end streets anticipated to be a dead end for more than a year must use long-term barricades. The barricade shall consist of a split rail fence with round vertical and horizontal members, pressure treated, with two horizontal rails and a centerline of 10 to 12 feet for vertical members. Delineators shall be installed on the vertical members with a minimum of 2 per member. The "Road Closed" sign shall be mounted directly on the fence. For Fort Collins (GMA and city limits), Type III barricades or OM4-2 object markers may be mounted on telspar posts and anchors shall meet MUTCD standards.

4. Crosswalk Sign. Crosswalks shall be signed where adjacent to a school and on an established school pedestrian route. There are usually a minimum of 4 signs per crosswalk. The color and installation shall be completed according to MUTCD. The color shall be fluorescent yellow green.

E. Guide

1. Bikeway Signs in Loveland (GMA and city limits). Bicycle signs for bike lanes shall be provided. If the approved design allows no parking along bike lanes located adjacent to the curb, standard symbol signs for "No Parking" shall be used (MUTCD #R7-9a, 12 x 18 inches). Appropriate right, left, or double arrows shall appear on the bottom portion of the standard sign. Refer to **Drawing 1402a**. Other signs for the beginning and ending points of bike lanes shall be used according to the MUTCD and **AASHTO Guide for Development of Bicycle Facilities** and as shown on the signing and striping plans or required by the Local Entity Engineer.

   In Fort Collins (GMA and city limits), bikeway signs will be furnished by the City of Fort Collins Traffic Operations, and shall be billed to the contractor installing the signs.

14.3.4 Roundabouts

A. Modern Roundabouts

See Roundabout Design Guidelines Appendix I

B. Mini Roundabouts

See Roundabout Design Guidelines Appendix I

14.4 PAVEMENT MARKING AND STRIPING

14.4.1 General

A. Type and Location of Striping and Markings

The Local Entity Traffic Engineer shall make the final determination in regards to the type and location of pavement striping and marking within the right-of-way during the review of the project signing and striping plans.

B. Design, Installation, and Maintenance

The Local Entity maintains the permanent pavement striping and marking on public rights-of-way after completion of the warranty period. All such devices shall be specified and installed in accordance with these Standards; all designs shall be in accordance with these Standards and the latest revision of the MUTCD and Colorado supplement. Refer to **Chapter 22, Construction Specifications,** for materials and installation.

C. New Roadway

Permanent striping and marking, unless otherwise approved by the Local Entity Engineer, shall be completely in place before any new Roadway is opened to the public. New striping on new roadways, overlays, and chip seals, etc. will require two full applications of paint in Loveland (GMA and city limits) and Fort Collins (GMA and city limits).

14.4.2 Pavement Markings (Symbols, Arrows, "ONLY"s)

A. General

For Loveland (GMA and city limits), all crosswalks, arrows, and legends shall use preformed thermoplastic.

For Fort Collins (GMA and city limits), pavement markings (symbols, arrows, "ONLY"s, crosswalks, stop bars, yield lines, word messages, bike symbols, etc.) shall be painted with epoxy paint.

B. Preformed Thermoplastic Pavement Marking Specifications

1. Preformed thermoplastic pavement markings shall be 125 mils (90 mils for bike symbols) in thickness and consist of white or yellow pigmented plastic film with imbedded reflective glass spheres, uniformly distributed throughout their entire cross-sectional area. It shall be required to affix the markings to bituminous or Portland cement concrete pavements by use of a two part sealer/primer when recommended by the manufacturer. Preformed thermoplastic pavement markings installed on concrete surfaces shall have a black contrasting border as shown in Appendix L (Loveland Thermoplastic Standards). Prefabricated legends and symbols shall conform to the applicable shapes and sizes as outlined in the MUTCD. All concrete curing compound shall be removed before installing thermoplastic. All linear lines (yield, center, edge, crosswalks, & lane lines) in concrete shall be inlayed thermoplastic. The inlay process shall be per CDOT Specification Section 627.08.

C. Crosswalks

1. General. Crosswalks shall be used at all signalized intersections, approved crossings, school routes, adjacent to schools, and as otherwise directed. Refer to **Appendix C** for maps of Local Entity designated school routes.
2. Standard Crosswalk. White 9-feet long, except 12-feet long in Fort Collins (GMA and city limits) x 18-inch wide "Continental" or "Denver" style bars shall be used for all crosswalks.

   For Fort Collins (GMA and city limits), pavement markings (symbols, arrows, "ONLY"s, crosswalks, stop bars, yield lines, word messages, bike symbols, etc.) shall be painted with epoxy paint.

D. Stop Bars

All stop bars shall be white and a minimum of 18 inches wide. Stop bars are required at signalized locations where the speed limit is 35 mph or higher and other locations specified by the Local Entity Engineer.

1. Fort Collins (GMA and city limits). Locations where stop bars are required shall be specified by the Local Entity Engineer.

E. For Fort Collins (GMA and city limits), pavement markings (symbols, arrows, "ONLY"s, crosswalks, stop bars, yield lines, word messages, bike symbols, etc.) shall be painted with epoxy paint.

F. Bikeways

The purpose of the placement of bicycle markings on the roadway is to reinforce the specified use of this designated area (Bike Lane/Bike Routes) and to supplement any regulatory signs. Bicycle markings are to be used on Collector and Arterial Roadways with designated Bike Lanes. Bicycle markings are to be re-installed in the same location on Roadways that have been under construction for routine street maintenance or rehabilitation.

For Fort Collins (GMA and city limits), pavement markings (symbols, arrows, "ONLY"s, crosswalks, stop bars, yield lines, word messages, bike symbols, etc.) shall be painted with epoxy paint.

14.4.3 Striping

A. General

1. Typical. Typical striping widths for lane lines are 4 inches, unless otherwise noted. Double yellow centerline shall have a 4-inch gap between stripes.
2. Pavement. Two coats latex paint (highway type high-solids fast-dry) shall be used for asphalt and concrete pavement striping.
3. Layout. All striping on sealcoats shall require a layout line. Prior to striping, tabs are required for sealcoats (prior to the sealcoat process). All other conditions require spot taping at an interval of 25 feet or closer.

4. Retro-reflectivity. The 2 coats of paint shall be applied with beads for each coat. The application rate for beads shall be 6.5 pounds per gallon. The beads shall be AASHTO M247 Type II, non-floating, water resistant.

B. Broken Line

All broken lines shall be 4-inches wide using a 40 foot cycle (10' paint or thermoplastic, 30' gap).

C. Dotted Line

All dotted lines shall be 4-inches wide or 8–inches wide using a 3' stripe with 12' gap per CDOT criteria. Dotted lines (8-inches wide) are required at signalized intersections with dual or triple left turns. Dotted lines within intersections shall be inlaid thermoplastic.

D. Turn Bay Line

All turn bay lines shall be created with a minimum 8-inch wide line. However, if a turn bay occurs on a horizontal curve, the bay taper from the start of the turn bay to the 8" solid line shall be marked with short 8-inch wide dotted lines (2' long with 4' gap).

E. Centerline

All centerline striping shall be double yellow, each a minimum of 4 inches wide, with a 4-inch minimum gap between the two.

F. Parking Stalls and Angle Parking

All striping for parking shall be white and 4 inches wide. All edge lines of parking areas shall also be white and a minimum of 4 inches wide.

G. Bikeway

A 4-inch minimum wide white stripe shall be used for Bike Lanes.

14.4.4 Temporary Striping

All temporary striping shall conform to "Standard Specifications for Road and Bridge Construction," published by **CDOT**, the latest revision except as herein amended. When approved, temporary striping shall be required prior to the opening of a Roadway for travel where pavement and/or permanent striping cannot be completed due to weather and/or time constraints. Refer to **Section 14.4.1 C** if not approved.

A. Specifications

Temporary striping shall be the same color and width as for permanent striping. Temporary striping shall consist of tabs or 4 x 4-inch (min.) tape, depending on the pavement surface, spaced at 25-foot intervals. Refer to **Chapter 22, Construction Specifications,** for additional detail regarding temporary striping.

B. Time Duration Limit

Temporary striping is permitted on Collectors for no more than 7 days.

C. Extensions

Extensions must be requested in writing if weather does not allow installation of permanent striping. For Fort Collins (GMA and city limits), also refer to Appendix F, City of Fort Collins Traffic Operations Manual.

CHAPTER 15 – STREET LIGHTING
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CHAPTER 15 – STREET LIGHTING

15.1 GENERAL

The Developer shall coordinate all aspects of design and installation of new or upgraded street lighting.

15.1.1 Fort Collins (City Limits Only) Street Lighting

All street lighting of public streets in the City of Fort Collins will be designed and installed by the City in accordance with these Standards for lighting. Exceptions to reduce lighting requirements may be approved by the Local Entity Engineer for parts of developments bordering rural areas.

15.1.2 Loveland (City Limits Only) Street Lighting

All street lighting of public streets in the City of Loveland will be designed by the City in accordance with these Standards. The City will be responsible for all costs involving the material and installation of street lights on arterial and major collector streets. On all other streets, the Developer will be responsible for all costs involving the design, material, and installation of street lights.

The street lighting design shall be commenced by the City of Loveland only after the developer has provided to the City the required electrical design deposit, along with electronic files of the overall utility design sheet(s) and the street plan design sheet(s). These items must be submitted to the City prior to the submittal of any land use application that requires the submittal of preliminary Public Improvement Construction Plans. Upon completion of the street lighting design by the City, the design engineer shall show the locations of all proposed street lights in the final Public Improvements Construction Plans as described in the checklist contained in **Appendix E.**

15.1.3 Underground Service

Street lighting shall be installed with underground electric service on all newly developed dedicated public streets in the City. Curb returns shall be installed after the installation of the electrical system, including underground vaults.

The Developer is responsible for coordinating with the appropriate utility company all aspects of design and installation.

15.2 PURPOSE

The purpose of streetlight installations shall be to illuminate the public traveled ways to a level that provides for the safe passage of public traffic, both vehicle and pedestrian.

15.2.1 Residential Areas

All lighting in residential areas shall be installed to minimize light pollution (light directed skyward) and light trespass (light spilling onto neighboring properties).

15.2.2 Design Guidelines

Uniform lighting will be used on new projects involving Arterial and Collector streets. The guidelines shall be the most recent editions of the American National Standard Practice for Roadway Lighting (ANSI/IES RP-8), the Colorado Department of Transportation Lighting Design Guidelines and supplemental revisions or guidelines approved by the Local Entity. All fixtures, poles, and designs will be reviewed and approved by the power provider.

A. Pole Loading

Streetlight poles, attachments to poles (mast arms, luminaires, banners, etc.) and pole foundations shall withstand loading due to forces from wind and ice loading as specified in the most recent American Society of Civil Engineers ASCE/SEI 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures. Interpretation of exposure and risk categories used to determine ultimate wind speeds specified in ASCE/SEI 7 shall be reviewed and approved by the local entity engineer.

15.2.3 Layout Criteria

A. Mounting Height.

Streetlight mounting height shall not exceed 20 feet in residential areas. In areas other than residential, the mounting height shall not exceed 40 feet.

B. Signalized Intersections.

Signalized intersections will be lighted using combined streetlights and mast arms. Mounting of signals will be perpendicular to the flowline.

C. Railroad Crossing Lighting.

Railroad crossing lighting will conform to the Railroad-Highway Grade Crossing Handbook (FHWA).

D. Lighting in Undercrossings.

All bridge underpasses, where vehicles, pedestrians, bicyclists, or equestrians may be present, shall require lighting.

E. Attached Sidewalks.

Install street lighting behind sidewalks where sidewalks attached to the curb are used with a minimum clearance of 1 foot from back of walk to street side of support pole.

F. Detached Sidewalks.

For sidewalks detached from the curb, install street lighting with a minimum of 2 feet clearance from back of curb to roadway side of support pole and 2 feet clear from all walks (1 foot on Local Streets).

G. Drawings.

Except within the Local Entity power service territories, drawings for installations will be prepared by the Developer with assistance from the power provider and approved by the Local Entity Engineer prior to installation. In new subdivisions, a street lighting plan will be required prior to approval of the subdivision.

H. Permission for Alternate Designs.

Alternate designs for fixtures, if approved by the Local Entity Engineer, may be used if installed in more than 20 locations.

I. Fire Hydrant Conflicts.

When locating proposed lighting, avoid possible conflicts with fire hydrants.

J. Roundabout Lighting.

Lighting columns should be arranged around the perimeter of the roundabout in a simple ring, with the lights equidistant from the center and from each other. Lighting should extend at least 200 feet back along each approach road. Mounting height should be uniform throughout the intersection and not less than on any approach road. Minimum horizontal illuminance at the curblines should be as given in **Table 15-1**. The minimum illuminance required should not be less than the highest level of lighting for any of the approach roads.

15.3 LIGHTING SYSTEMS DESCRIPTIONS

These lighting standards apply to all new street lighting systems.

15.3.1 Cobra-Head Style Luminaire

The cobra-head style luminaire with a type-2, type-3, or type-4 distribution pattern and full-cutoff optics mounted on poles shall be the standard construction for Collector and Arterial streets. The backlight, uplight and glare (B-U-G) ratings of the luminaire shall not exceed B2-U0-G2.

15.3.2 Acorn-Style Fixture – Loveland (City Limits Only)

An acorn-style fixture with a Type-3 distribution mounted on poles shall be used on Local streets.

15.3.3 Old English Fixture – Fort Collins (City Limits Only)

An Old English-style fixture with a Type-3 distribution pattern and full cut-off optics mounted on poles shall be used on Local streets. The B-U-G ratings of the fixture shall not exceed B2-U0-G2.

15.3.4 Light Types and Location of Use

Specific light types (HPS, LED, etc.) shall be installed according to Local Entity requirements. Refer to **Table 15-2** and **Table 15-3.** Poles or luminaries, that are equivalent to those described below, may be approved by the Local Entity's appropriate representative.

Table 15-1
Recommended Street Illumination Levels

Street Classification	Pedestrian Area Classification	Average Maintained Illuminance Values	Illuminance Uniformity Ratio (Average to Minimum)
Arterial	High Medium Low	17 lx (1.7fc) 13 lx (1.3 fc) 9 lx (0.9 fc)	3 to 1
Collector	High Medium Low	12 lx (1.2 fc) 9 lx (0.9 fc) 6 lx (0.6 fc)	4 to 1
Local	High Medium Low	9 lx (0.9 fc) 7 lx (0.7 fc) 4 lx (0.4 fc)	6 to 1
Pedestrian Area Classification Definitions:			
High:	A business area of a municipality where ordinarily there are many pedestrians during night hours. This definition applies to densely developed business areas outside, as well as within the central part of a municipality. The area contains land use which attracts a relatively heavy volume of night time vehicular and/or pedestrian traffic on a frequent basis.		
Medium:	Those areas of a municipality often with moderately heavy night time pedestrian activity such as in blocks having libraries, community recreation centers, large apartment buildings, industrial buildings, or neighborhood retail stores.		
Low:	A residential development, or a mixture of residential and small commercial establishments, with few pedestrians at night.		
Note:	Values in table assume typical asphalt roadway surface (pavement classification R2 or R3). Consult the IES document for other pavement surfaces.		
Source:	Illuminating Engineering Society RP-8 (8).		

Table 15-2
Loveland (City Limits Only) Street Light Requirements

Street Classification	Lighting System
6-lane Arterial	400-W cobra, semi-cutoff style, fiberglass pole, 38-foot mounting height
2 and 4-lane Arterial	250-W cobra, semi-cutoff style, fiberglass pole, 32-foot mounting height
Major Collector	150-W cobra, semi-cutoff style, fiberglass pole, 27-foot mounting height
Minor Collector	70-W acrylic acorn, fiberglass pole, 15-foot mounting height
Local/Lane	70-W acrylic acorn, fiberglass pole, 15-foot mounting height

Table 15-3
Fort Collins (City Limits Only) Street Lighting Requirements

Street Classification	Maximum Spacing (ft)	Recommended Lumen Output	Luminaire Style	Luminaire Final Height (ft)
6-Lane Arterial	150	10,500	Cobra-Head	32
4-Lane Arterial	150	9,000		
2-Lane Arterial	180			
Collector	200	7,200		
Local - Commercial	175	6,400		
Local - Industrial	200			
Local - Connector	200	5,500	Old English	18
Local - Residential	300			

Where possible, streetlights shall be staggered on alternate sides of the roadway. However, for "T" intersections, the light shall be located as prescribed in section 15.5.

Notes:

1. Local residential streets shall have one light at each intersection. If the intersection lights would exceed 300 feet apart on a straight street, mid-block lights shall be added so lights do not exceed 300 feet spacing. If the street has a curve, judgment shall be used to reduce the spacing to less than 300 feet.
2. Collector street widths vary depending upon the allowance for parking between the curb and bike lane. If the street has a curve, judgement shall be used to reduce the spacing to provide adequate lighting levels for small target visibility.
3. 6-Lane Arterial street lights shall be placed on EACH side of the street spaced no greater than 150 feet apart (not staggered). Exception: College Avenue between LaPorte Avenue and Magnolia shall have LED area lights spaced 100 feet apart. Please refer to section 15.8.1 for further details.
4. For all street classifications, crosswalks that are located away from intersections shall include additional lighting to provide adequate lighting levels for small target visibility.
5. All new street developments shall use LED type luminaires.

15.4 SPACING

This chapter is restricted to lighting on public streets and rights-of-way. The Designer shall design the spacing of all street lighting according to **Table 15-4**.

Table 15-4
Loveland (City Limits Only) Street Lighting Spacing

Classification	Luminaries	Spacing	Layout
Major Arterial	400-W Cobra	120–150 feet	Staggered layout
Minor Arterial	250-W Cobra	150–175 feet	Staggered layout
Major Collector	150-W Cobra	150 feet	Staggered layout
Minor Collector	70-W Acorn	160–200 feet	Staggered layout
Local/Lane	70-W Acorn	160–200 feet	Staggered layout

15.5 POSITIONING AT INTERSECTIONS

In general, the nighttime visibility of a pedestrian or hazardous object within an intersection is enhanced by increased contrast between the object and the surrounding street area. The optimum contrast (and hence safety) is achieved when the street lights are situated to silhouette (or backlight) objects in the intersection. Therefore, street lights at intersections are required to be placed on the downstream side of the intersecting street, as viewed by a motorist approaching the intersection in the lane directly beneath the luminaries. See **Figure 15-1**. The positioning of light standards at intersecting streets shall be as noted in **Table 15-5**.

Table 15-5
Intersection Light Locations

Major Collectors/Arterials	4 lights, one on each corner
Arterials/Arterials	4 lights, one on each corner
Collector/Collector	2 lights, one on opposite corners
Local/Collector	2 lights, one on opposite corners
Local/Local	1 light on one corner
End of Cul-de-sac	1 light

15.6 LIGHT POLE OFFSET DISTANCES

Distance behind back of walk for local streets shall be at least 1 foot, and must be within easements or right-of-way on Local residential streets. For Major Collectors and Arterials, the light must be offset at least 2 feet from the back of curb and provide a clearance space between the light pole and edge of walk that equals or exceeds the required sidewalk width.

15.7 STREET LIGHTING CLEARANCE REQUIREMENTS FOR TREES

Street trees (full shade) shall not be placed within 40 feet of a street light. Ornamental trees shall be no closer than 15 feet to any street light.

15.8 COLLEGE AVENUE – SPECIAL CONDITION

The following specifications apply only to College Avenue in Fort Collins (city limits only).

15.8.1 LaPorte to Magnolia

From LaPorte Avenue to Magnolia Street, College Avenue shall be lighted with a minimum of four LED luminaires at each intersection. Between intersections, there shall be one LED luminaire at 100-foot spacing or equivalent, as determined by the Light and Power Utility. Minimum lumen output shall be 30,000 lumens per luminaire. The correlated color temperature shall not exceed 3000 K.

15.8.2 Other College Avenue Blocks

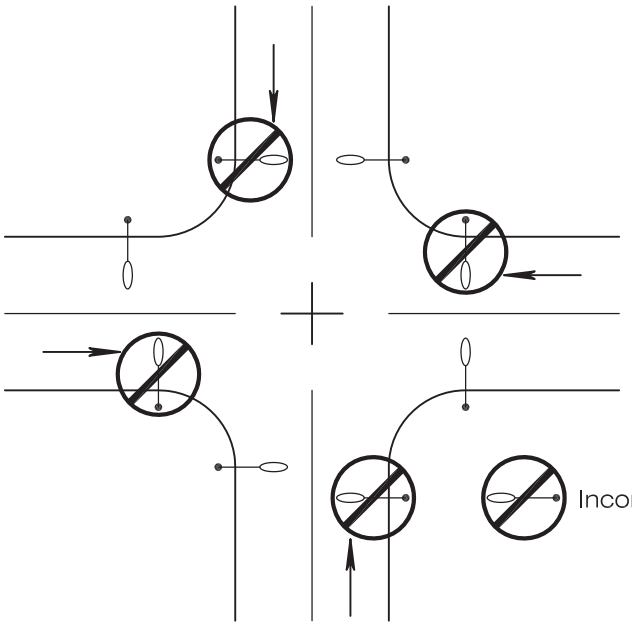
The remainder of College Avenue shall have a minimum of four LED luminaires at each intersection and two LED luminaires spaced at approximately 150 feet or as determined by the Light and Power Utility.

15.9 INSTALLATION SEQUENCE

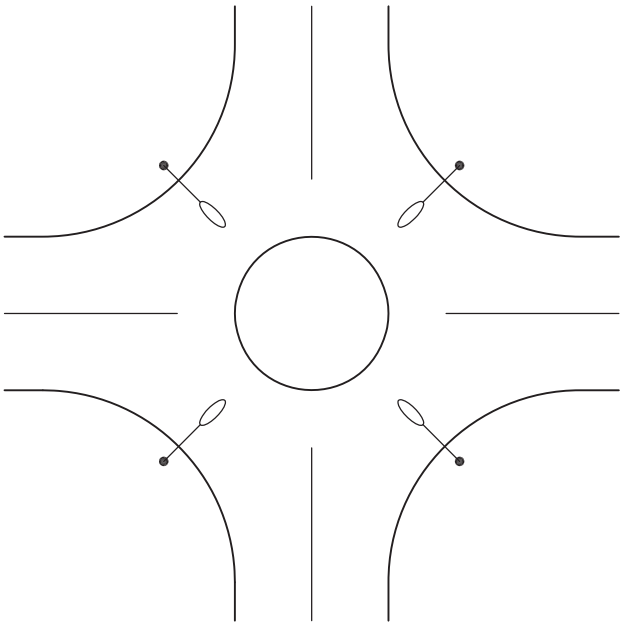
Underground electrical installation shall not begin until after curb and sidewalk is installed, unless other arrangements have been made with the appropriate light and power department for each Local Entity. Curb returns shall not be installed on any street until after electrical installation, to facilitate the installation of underground vaults and other facilities.

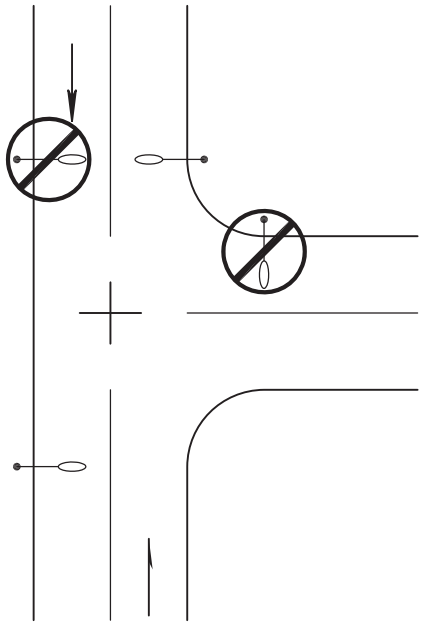
15.9.1 Fort Collins (City Limits Only)

In Fort Collins (city limits only), refer to the City of Fort Collins Utilities' most recent version of the document titled "Electric Service Standards" for installation policies, practices and procedures.



Incorrect Street Light Placement





Street Lights Shall Be Placed On The Downstream Side Of Intersection, As Viewed By A Motorist In The Lane Beneath The Luminaire.

STREET LIGHT PLACEMENT AT INTERSECTIONS

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 10/25/00	15-1

CHAPTER 16 – PEDESTRIAN FACILITIES DESIGN AND TECHNICAL CRITERIA

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CHAPTER 16 – PEDESTRIAN FACILITIES DESIGN AND TECHNICAL CRITERIA

16.1 GENERAL

This chapter sets forth the minimum criteria to be used in the design of all sidewalks, access ramps, and other pedestrian facilities within the right-of-way, or other public easements.

16.1.1 AASHTO Reference

Within this chapter, AASHTO's **"A Policy on Geometric Design of Highways and Streets",** as published by the American Association of State Highway and Transportation Officials, was used as a reference. It is also commonly called the **AASHTO "Green Book."**

16.1.2 ADA Requirements

All pedestrian facilities within Public Rights-of-Way shall be designed in accordance with American Disabilities Act (ADA) regulations under the Standards for Transportation Facilities (latest edition) as Published on the United States Access Board web site and the Guidance on the 2010 Standards for Accessible Design and the requirements of these Standards.

16.2 SIDEWALKS

16.2.1 General Layout and Design Criteria

A. Sidewalk Widths

Minimum sidewalk widths for the various street classifications shall be as specified in **Table 7-1** or **7-2** and on **Figures 7-1F** through **7-13F** and **Figures 7-1L** through **7-11L**.

The Local Entity Engineer may require additional width for activity areas and routes leading to and from these areas. The final sidewalk width shall be determined through additional study of higher pedestrian traffic areas.

B. Sidewalk Crossings of Driveways and Alleys

All sidewalks that cross driveways and alleys shall be designed in accordance with **Construction Drawing 1601**.

C. Sidewalk Both Sides of Street

All street designs shall include sidewalks on both sides of the street. Rural roads or qualified affordable housing projects in Loveland (GMA and city limits) are the only exceptions (see **Section 16.2.1 J**).

D. In-Fill Sidewalk, Curb, and Gutter

In all existing areas previously developed, sidewalks, curbs, and gutters may be required to match existing conditions or Standards, as determined by the Local Entity Engineer.

1. Sidewalk Upgrades Required in Loveland (GMA and city limits). When redevelopment is proposed on in-fill parcels, the redevelopment plans shall show the location of all existing and proposed sidewalk improvements. The installation of sidewalks is required where no sidewalk exists. Widening of the existing sidewalks should occur whenever the addition of 2' or more is needed to comply with **Section 16.2.1.A** and proposed redevelopment of the site will cause an increase in the number of pedestrian trips on the sidewalk. In Loveland (GMA and city limits), the upgrading of sidewalk adjacent to redeveloped sites may be postponed up to three years when the existing sidewalk is in good repair and a satisfactory financial guarantee has been provided to the Local Entity.
2. Sidewalk Upgrades Not Required in Loveland (GMA and city limits). When redevelopment is proposed that is not expected to cause an increase in the number of pedestrian trips on the sidewalk, no sidewalk widening is required. In such situations, the redevelopment plans shall still identify and preserve a sidewalk corridor that will accommodate the future widening of the sidewalk in full compliance with these standards for such time that the sidewalk widening is deemed necessary.

E. Sidewalk Widening

When a sidewalk must be widened, the widening shall only be allowed for an increased width of 4 feet or more. If the added width needed is less than 4 feet, the existing walk shall be removed and reconstructed to the new required width.

F. Storm Water Runoff at Curb Cuts

Drainage shall meet the requirements specified in **Chapter 7**, in the section/subsection titled **Drainage Systems/Sidewalk Culvert (Chases)**.

G. Concrete Thickness

All detached sidewalks less than 8 feet in width and not within driveways shall be a minimum of 6-inch thick concrete. All detached sidewalks 8 feet and greater in width shall be 6 inches thick. All sidewalks within a driveway shall be a minimum of 6 inches thick. All attached sidewalks shall be a minimum of 6 inches thick. Sidewalks shall be a minimum of 8 inches thick where crossed by commercial traffic. See **Construction Drawing 1601**.

H. Slope

1. Cross Slope. Maximum cross slope for sidewalks shall be less than or equal to 2%.

2. Longitudinal Slope. Longitudinal slope of attached sidewalks shall be consistent with the street slopes.

3. ADA Requirements for Steeper Slopes. Sidewalks detached from the curb, with greater than 5 percent longitudinal slope, shall be constructed to meet ADA ramp requirements.

I. Pedestrian Underpasses and Overpasses

On major Collectors and Arterials, where required by the Local Entity Engineer, underpass or overpass (grade separated) pedestrian crossings shall be provided for regional/neighborhood paths and trails. These pedestrian crossings shall be coordinated with the appropriate department.

J. Rural Roads

Rural road sections shall provide sufficient shoulder width for pedestrian travel. Refer to **Table 7-1** or **7-2** for rural road widths.

K. Horizontal/Vertical Curves

Horizontal/vertical curves on all sidewalks shall follow the design criteria for bikeways. Refer to **Chapter 17, Bicycle Facilities**.

L. Vertical Clearance

Sidewalk vertical clearance shall be 8 feet in accordance with **Figure 16-1.**

M. Horizontal Clearance

Sidewalk horizontal clearance shall be in accordance with **Figure 16-1**.

N. Off-Site Connections

The Local Entity Engineer may require off-site sidewalk extensions to provide pedestrian connectivity to destinations within ¼ mile of the project as identified in the Transportation Impact Study. Additional offsite sidewalk construction extending greater than ¼ mile from the project may also be required in some circumstances such as when the project is within a school walking area boundary.

Industrial Area Sidewalks in Loveland (GMA and city limits) the installation of sidewalks along public streets in industrial zoned areas may be postponed when primarily industrial types of uses (i.e. NOT retail or office uses) are proposed. When sidewalks are not installed with new industrial development, they must still be designed, located, and noted on the plans in accordance with these standards. They should be noted as future potential sidewalk locations with indication that the Local Entity Engineer reserves the right to require installation of sidewalks by the property owner in accordance with Title 12 of the Loveland Municipal Code at such time as they may be deemed necessary.

16.3 ACCESS RAMPS

16.3.1 Ramp Requirements

Access ramps shall be installed at all intersections and at certain mid-block locations for all new construction or reconstruction of curb and sidewalk, as follows:

A. Locations

1. 4-Way Intersections. Access ramps shall be included at all intersection corners. Access ramps shall be constructed in accordance with **Construction Drawings 1603 through 1607**.

2. "T"-Intersections. All "T" intersections shall have a minimum of 3 access ramps as shown in **Figure 16-2**. Driveways shall be positioned as to not preclude the necessary mid-block ramp.

3. Local Streets/Mid-Block. Local streets longer than 600 feet will require additional accesses, which should be spaced approximately 300 feet apart. Driveways or mid-block ramps may be used for these access points. If mid-block ramps are used, pavement markings and signing in accordance with **Chapter 14, Traffic Signals, signing and Striping**, shall be provided.

4. Cul-de-Sacs. Either an access ramp or a driveway that meets access ramp requirements shall be provided in all cul-de-sacs. If a public walkway or bikeway intersects the street, a ramp shall be provided to connect the walkway or bikeway to the street. The ramp must line up with the walkway.

5. Detached Sidewalks. Where sidewalks are detached from the curb, directional ramps should be used in accordance with **Construction Drawing 1606**. On arterial streets with detached sidewalks and corner radii greater than or equal to 35 feet, directional ramps shall be installed in accordance with **Construction Drawing 1604**.

16.3.2 Use of Standard Details

Project drawings shall call out the specific Construction Drawing from these Standards to be used in construction for each access ramp.

16.4 UNDERWALK DRAINS (CHASES)

Underwalk drains shall not interfere with the pedestrian's use of the sidewalk. The chase plate shall be flush with the sidewalk surface and be securely fastened as specified. See **Construction Drawing 709**. Underwalk drains shall not be located within an access ramp, curb cut, or driveway.

16.5 CURB RETURNS

In certain cases, to be determined by the Local Entity Engineer, the Local Entity may require the radius of the curb return to be reduced from the values given in **Tables 8-2** and **8-3**, to reduce pedestrian travel time and distance. The curb return radius shall not be less than 20 feet.

16.6 PEDESTRIAN CROSSINGS

All crosswalks shall be marked in accordance with **Chapter 14, Traffic Control Devices.** Crosswalks will be required at all signalized intersections, school areas, and high pedestrian areas as designated by the Local Entity Engineer.

16.6.1 Enhanced Crosswalks.

In Fort Collins (GMA and city limits), Enhanced Crosswalks may be required by the Local Entity, and at a minimum, they shall be used at mid-block crossings in neighborhoods, activity centers, trail or path crossings, school crossings and at signalized Arterial-Collector and Arterial-Arterial intersections.

Enhanced crosswalks shall be constructed of Portland Cement concrete. Stamped-colored asphalt pavement is not acceptable. Larimer County will not maintain enhanced crosswalks.

16.6.2 Cross Slope

Sidewalk/accessible paths shall maintain a cross slope of 2% or less across driveways crossing said path.

16.6.3 Crosspans

Crosswalks shall not be located in crosspans.

16.6.4 Maximum Crosswalk Length Fort Collins (GMA and City Limits)

In Fort Collins (GMA and city limits), the maximum length for any crosswalk shall be 56 feet. Any street crossing longer than 56 feet shall be provided with pedestrian refuge such that the longest length of any crosswalk segment shall be 56 feet. See **Section 16.8**.

16.7 TRAFFIC SIGNALS

All pedestrian traffic signals shall be in accordance with **Chapter 14, Traffic Control Devices.**

16.8 PEDESTRIAN REFUGE AREAS

For Arterials with raised medians and on splitter islands for roundabouts, a pedestrian refuge area shall be created in the median to increase pedestrian safety. See **Figure 8-18 and Figure 8-19 and Construction Drawings 801 and 802**. The vehicle turning radii must be taken into account with the specific design of islands. Fort Collins (city limits only) requires delineation of

the pedestrian crossing by using a different surface material or texture in the roadway. This guides the sight-impaired to the refuge area.

16.9 MULTI-USE PATHS

Where a single, multi-use path is used to serve both pedestrians and bicyclists, the minimum path width shall be 10 feet.

16.10 PEDESTRIAN MINIMUM CLEAR PATH

The minimum clear path around utility structures, street furniture and other encroachments shall be greater or equal to the sidewalk widths listed in **Tables 7-1** and **7-2** for the applicable street classification. For any private improvements within the right-of-way, the Designer will be required to obtain an encroachment (Revocable) permit from the Local Entity. Refer to **Chapter 6, Permits**.

16.11 BUS SHELTERS

16.11.1 Location

The location of a bus shelter shall be determined by the Local Entity Transit Provider.

16.11.2 Visibility

Bus shelters shall have maximum transparency, and be highly visible from the surrounding area to assure the users' safety. The shelter may not be located within sight distance triangles as specified in **Chapter 8, Intersections.**

16.11.3 Minimum Size and Capacity

A. Opening Size

Openings shall be at least 36 inches wide and shall meet the requirements of ADA.

B. Capacity and Size

Capacity shall be based on maximum passenger accumulation at the stop. The shelter size shall be based on approximately 5 square feet per person.

C. Placement

Shelters shall not obstruct pedestrian flow or motorist's sight distance. The minimum pedestrian clear path width given in **Section 16.10** shall be maintained at bus shelters.

16.11.4 Pad Requirements

A. Under Shelters

The design shall include a 6-inch thick concrete pad under all bus shelters. The pad shall extend at least 6 inches past each edge of the shelter.

B. Passenger Loading Area

Any shelters next to detached sidewalks shall include a minimum 15-foot wide concrete area between the sidewalk and the curb for passenger loading and unloading. Fort Collins requirements for pad sizes are incorporated in their Bus Stop Design Standards and Guidelines.

16.11.5 Relocation of Shelters

The Local Entity Engineer may require a shelter to be relocated or removed in the future to accommodate other needs within the street right-of-way.

16.11.6 Bicycle Racks and Trash Containers

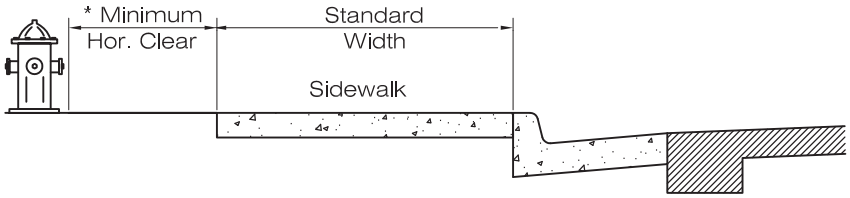
All shelters are required to provide one trash container and one bicycle rack. The bicycle racks shall be in accordance with **Chapter 17, Bicycle Facilities**.

16.11.7 Shelters on State Highways

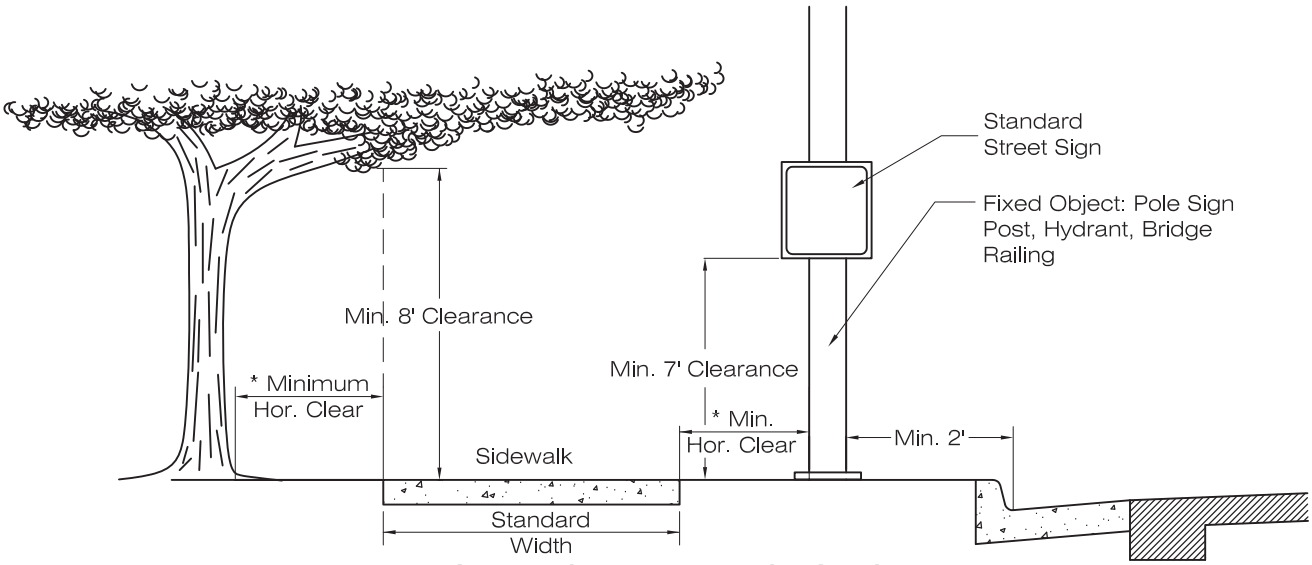
Approval for installations of all bus shelters proposed in state highway rights-of-way shall be obtained from CDOT prior to any construction of the shelters.

16.11.8 Sidewalk Connections

A sidewalk connection shall be provided between the bus shelter and the existing sidewalk or nearby pedestrian destinations. The minimum width shall be as required in **Section 16.2.1.**



ATTACHED SIDEWALK SECTION



DETACHED SIDEWALK SECTION

NOTE:

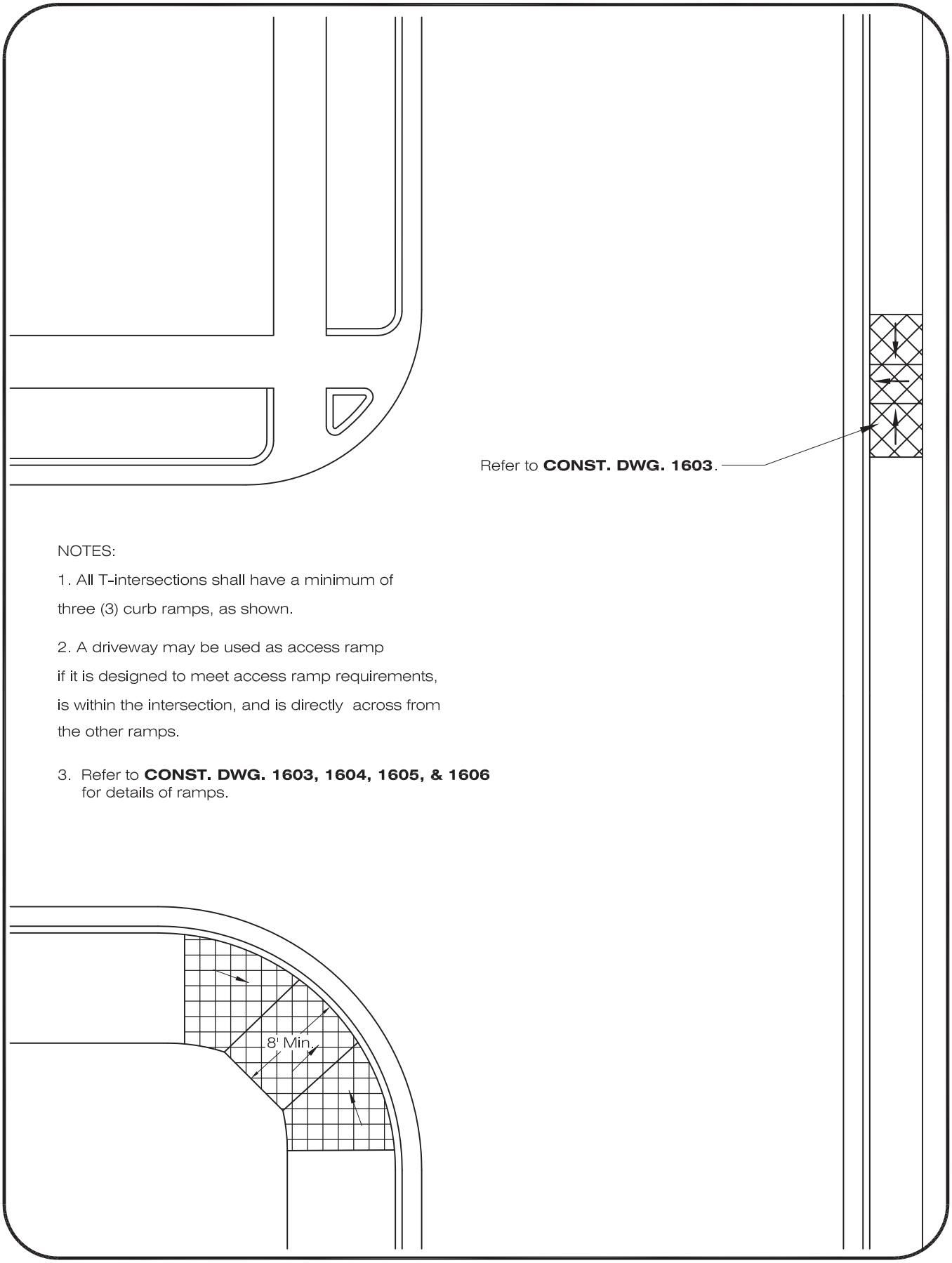
1. All above ground utilities or other features must be a minimum of 2' from sidewalk.

* The minimum horizontal clearance may be reduced by the Local Entity Engineer to zero feet in locations such as downtown, special pedestrian plazas and bridges, where bicycle traffic is restricted. In such locations the minimum clear path equal to the standard sidewalk width for the street classification shall be clear of all obstructions.

Objects & Materials	Minimum Horizontal Clearance
Trees	2.5'
Shrubs, Hedges Fences & Walls	2'
Solid Fixed Objects	1'
Movable Solid Objects	1'
Gravel, Rocks, or Material that may slough or land on the sidewalk	2'

VERTICAL & HORIZONTAL CLEARANCES FOR SIDEWALKS

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1	FIGURE
		DATE: 03/01/02	16-1



NOTES:

1. All T-intersections shall have a minimum of three (3) curb ramps, as shown.

2. A driveway may be used as access ramp if it is designed to meet access ramp requirements, is within the intersection, and is directly across from the other ramps.

3. Refer to **CONST. DWG. 1603, 1604, 1605, & 1606** for details of ramps.

ACCESS RAMP LOCATION (T-INTERSECTION)

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1 DATE: 03/01/02	FIGURE 16-2

CHAPTER 17 – BICYCLE FACILITIES DESIGN AND TECHNICAL CRITERIA
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CHAPTER 17 – BICYCLE FACILITIES DESIGN AND TECHNICAL CRITERIA

17.1 GENERAL

This chapter sets forth the minimum criteria to be used in the design of all bike lanes, bike paths, or other bicycles facilities within the Local Entity's rights-of-way or easements.

17.1.1 AASHTO, MUTCD and other reference Basis

In this chapter, the **AASHTO "Guide for the Development of Bicycle Facilities"** as published by the American Association of State Highway and Transportation Officials, and the Manual on Uniform Traffic Control Devices (MUTCD) as published by the Federal Highway Administration are used as a reference.

In addition, bike-specific references such as the **NACTO "Urban Bikeway Design Guide"** as Published by the National Association of City Transportation Officials are also an increasingly important resource for design options.

17.1.2 Bicycle Master Plan

This subsection was developed based on the **Master Plans** for each Local Entity. All projects shall optimize bicycle travel within the GMA by providing bicycle facilities in all new developments in accordance with the Local Entity's **Master Plan**.

17.1.3 Permitted Bicycle Travel Areas

On public streets, bicycle travel should use designated bike lanes whenever possible. Bicyclists may share vehicular travel lanes in cases where no designated bike lanes are provided, except in certain cases where bicycle travel may be prohibited.

17.1.4 Requirement for Other Accesses

Off-site improvements may be required to provide citizens with access to schools, and local commercial and other community facilities.

17.1.5 ADA Requirements

All designs for off-street bicycle paths are considered multi-use paths and shall conform to ADA requirements.

17.1.6 Use of Drainage System and Open Space

The bike path and pathway system may use the drainage and open space system in accordance with the Local Entity's requirements.

17.1.7 Access Easements

Where bike paths cross private land or coincide with private access facilities, the Developer shall provide a public access easement. This will ensure that bike paths or other access facilities become part of the overall Local Entity bike path plan.

17.1.8 Maintenance Responsibility

Maintenance and operation responsibility for new bike paths will be determined during the site/subdivision plan approval process. Public access/bike path easements shall be conveyed to the Local Entity. The easement width shall be clearly indicated on the site plan or construction plans.

17.1.9 Appurtenances Not Allowed

Manholes, utility poles or other appurtenances or obstructions, should not be located in bike lanes or bike paths.

17.2 ON-STREET BIKE LANES DESIGN REQUIREMENTS

17.2.1 On-Street Bike Routes

Specific streets are designated in the **Master Plans** as on-street bicycle routes. In Fort Collins, the current Bicycle Master Plan further designates a system of "low stress" bike routes. Bike routes are typically on streets with lower traffic volumes and speeds. Streets designated as on-street bicycle routes shall be designed with additional width for bike lanes. In Fort Collins, arterial roadways include protected bike lanes as a standard. Some streets within new developments or re-developments must also contain additional roadway width for bike lanes. See **Figures 7-1F** through **7-13F** and **7-1L** through **7-11L.**

17.2.2 Width and Cross Sections

The bike lane shall be designed with widths shown in standard street classification sections. Bicycle lanes on one-way streets shall be on the right side of the street, unless otherwise specified by the Local Entity. Refer to **Chapter 7, Street Design and Technical Criteria,** for the standard cross section requirements. Bike lane width shall not be less than 5 feet.

17.2.3 Signage and Striping

All designated bike lanes shall be signed and striped, as required by MUTCD and as required in **Chapter 14, Traffic Control Devices**.

17.2.4 Bicycle Detection

Bicycle detection is required in bike lanes at signalized intersections in accordance with current local agency practices and standards. In the City of Loveland, if loop detectors are used, Quadra pole-type loops are required. Loop size and installation shall be in

accordance with CDOT's latest requirements. In the City of Fort Collins, bike detection is typically accomplished through camera-based detection.

In rural road sections, the paved roads shall include not less than a 5-foot paved shoulder, and not less than a 6-foot paved shoulder in Fort Collins (city limits only), for bicycle travel.

17.2.5 Bike Facilities at Intersections

The configuration of intersections for bicyclists should take into consideration existing and anticipated bicyclist, pedestrian and motorist movements. The level of treatment required for bicyclists at an intersection will depend on the bicycle facility type used, whether bicycle facilities are intersecting, the adjacent street function and land use etc. Treatments may include elements such as bike boxes, intersection crossing markings, two-stage turn queue boxes, median refuge islands, through bike lanes to the left of right lanes, combined bike lane/turn lane, and protected bike lane approaches as applicable.

Protected Intersection designs may be considered (Fort Collins only) at intersections to create physically separated crossings that provide a high degree of comfort and safety for people of all ages and abilities. Design guidance for these type of intersections should be found the most current version of applicable references and the City's Bicycle Master Plan.

At the intersections where a separate right turn lane exists and is striped, per the MUTCD the bicycle lane shall transition and be placed between the through lane and the right turn lane. The bike lane width shall be 5' wide or remain the same as the approaching bike lane, whichever is wider. In cases where a buffer is provided, the buffer may be dropped at the beginning of the transition.

17.3 OFF-STREET BICYCLE PATHS DESIGN REQUIREMENTS

The Applicant should refer to the Local Entity's parks and recreation department for the recreation trail design requirements.

17.3.1 Bike Path Location

A. Location Criteria

Bike path locations shall be based on safety, circulation, and access considerations.

B. Easements

Where needed, a 12-foot minimum (20-foot minimum in Loveland) easement width shall be procured for a 10-foot wide bike path, in accordance with **Figure 7-14.**

17.3.2 Trees, Vegetation, and Other Obstacles

A. Preserving Trees

Where possible, bike paths shall be routed to minimize the loss of trees and disruption of natural environmental conditions per the Local Entity's latest requirements.

B. Distance from Obstacles

A minimum of 2 feet is required between the bike path edge and any vertical obstructions such as trees, utility poles, signs, fences, or other obstacles. Greater separation may be required by the Local Entity where grades exceed 4 percent.

C. Clearing of Vegetation

Regardless of bike path surface, all vegetative material within 4 feet of the bike path shall be removed prior to bike path construction. This requirement shall be specified by the Designer and included on the approved plans. See **Figure 17-1**.

D. Overhead Clearance

All bike paths shall have a minimum of 10 feet clear vertical distance above the path. See **Figure 17-1**.

17.3.3 Cross Section

Typical cross-sections shall be provided for all critical points (i.e. change in grade, direction) along the length of the bike path. See **Figure 17-1**

17.3.4 Grade

A. Profile

A profile of the proposed bike path construction shall be included in the construction plans or site plan. If the bike path profile is not consistent with the roadway profile, provide a separate profile for the bike path.

B. Minimum and Maximum Grade

Minimum grade shall be 0.60 percent except in sag curves where proper drainage is provided by cross slope. The minimum grade shall be waived if cross slope is 2 percent and good drainage is provided off the side and is unobstructed. Maximum grade shall be 5 percent or as allowed by ADA.

17.3.5 Design Speed

A. Paved Surfaces

For paved surfaces a minimum design speed of 20 mph shall be used. Where grades exceed 4 percent, a design speed of 30 mph shall be used.

B. Unpaved Surfaces

For unpaved surfaces, a minimum design speed of 10 mph shall be used. Where grades exceed 4 percent, a design speed of 20 mph shall be used.

17.3.6 Horizontal Alignment

A. Minimum Radius of Curvature

The minimum radius of curvature negotiable by a bicycle is a function of the superelevation rate of the bicycle path surface, the coefficient of friction between the bicycle tires and the bicycle path surface, and the speed of the bicycle.

B. Formula for Radius Calculation

The minimum design radius of curvature shall be based upon the following formula:

$$R = \frac{V^2}{15(e+f)}$$

where:

R = Minimum radius of curvature (ft)
V = Design speed (mph)
e = Rate of superelevation
f = Coefficient of friction

C. Rate of Superelevation

Bicycle path superelevation rate shall be a minimum of 2 percent (the minimum necessary to encourage adequate drainage) and a maximum of 3 percent.

D. Coefficient of Friction

The coefficient of friction depends upon speed, surface type, roughness, and condition; tire type and condition; and whether the surface is wet or dry. Friction factors used for design should be selected based upon the point at which centrifugal force causes the bicyclist to recognize a feeling of discomfort and instinctively act to avoid higher speed.

E. Coefficient of Friction Values

Extrapolating values used in highway design, design friction factors for paved bicycle paths can be assumed to vary from 0.27 at 20 mph to 0.22 at 30 mph. Unpaved surface friction factors are to be reduced by 50 percent to allow a sufficient margin of safety.

F. Minimum Radius

Based upon a superelevation rate (e) of 2 percent, the minimum radius of curvature to be used is 95 feet for 20 mph.

G. Substandard Radius Curves

When substandard radius curves must be used on bicycle paths because of Right-of-Way, topographical, or other considerations, standard curve warning signs and supplemental pavement markings shall be installed in accordance with the MUTCD. The negative effects of substandard curves can also be partially offset by widening the pavement through curves.

17.3.7 Sight Distance

Refer to **Figures 17-2** through **17-4** and Chapter 7, Street Design and Technical Criteria, for sight distance requirements.

17.3.8 Cross Slope

The cross slope shall be 2 percent.

17.3.9 Drainage

A. Requirements and Standards

All bike path designs shall satisfy the storm drainage requirements of the Local Entity's requirements and standards. Bike paths located within state Right-of-Way shall meet CDOT standards.

B. Ditch Placement

Where a bike path is cut into a hillside, a ditch shall be placed along the high side of the bike path to prevent sheet flow across it.

17.3.10 Safety Considerations

A. Consideration of all path users

The safety of pedestrians, and others who may use or travel on a bike path, shall be a prime consideration in the bike path design.

B. Clearance Between a Bike Path and a Street

A utility easement, as required in **Chapter 12, Utility Locations**, is required between the edge of the bike path and the back edge of curb and gutter. Two-way bike paths should not be constructed directly adjacent to street curb or street pavement without some type of protection or barrier unless otherwise approved by the Local Entity Engineer. Minimum separation without a barrier shall be 6 feet.

The Local Entity Engineer may require a larger distance of separation when it is feasible and would improve safety.

C. Barriers and Other Safety Devices

For bike paths adjacent to streets with speed limits over 25 mph, the Local Entity Engineer may require special safety measures. Examples include barriers or other safety devices between the roadway and bike path, or an increase in the distance between the bike path and highway.

D. Signs for Hazards and Regulatory Messages

Standard signing and pavement markings in the MUTCD shall be specified in the design of the bike path to alert bike path users to hazards and to convey regulatory messages.

E. Intersection Grade

Maximum grade of the bike path at intersections is 3 percent extending for 30 feet in each direction from the centerline of the intersection.

F. Access Ramps

Standard access ramps will be provided at all bike path curb crossings to allow continuity of bike path use by bicyclists and pedestrians. Curb depressions equaling the bike path width shall be used, with the bike path surface sloping to the pavement at 1:12 maximum slope.

17.3.11 Bicycle Path Crossings

A. Crossings of Water Courses

All bike paths require either a bridge or a fair weather crossing. See **Chapter 11, Structures**, for design requirements for bridges.

B. Railings, Fences, or Barriers

Railings, fences, or barriers on both sides of a bicycle path structure shall be a minimum of 4.5 feet high. Smooth rub rails should be attached to the barriers at handlebar height of 3.5 feet. Barriers should not impede storm water runoff from the path.

C. Bridge Requirements

See Chapter 11, Structures.

D. Bridge Underpass Lighting

All bike path bridge underpasses shall have lighting in accordance with Chapter 15, Street Lighting**.**

E. Pedestrian and Bicycle Crossings of Arterials

On all Local Entity arterials (or in locations specified by the Local Entity), wherever desirable and feasible, underpass or overpass (grade separated) pedestrian and bicycle crossings shall be provided for bike paths – especially regional trails.

In locations where grade separation is not desirable or feasible, bike path crossings of arterials shall be designed in accordance with current Local Entity policies and practices, or other adopted plans. This includes determination of the appropriate type of crossing treatment in terms of location, geometrics, and type of signalization.

In Fort Collins, the Bicycle Master Plan identifies Arterial crossing locations of the low-stress bicycle network.

17.3.12 Bicycle Path Underpasses

The minimum clearances for underpasses are as follows:

Horizontal:	10 feet from abutment to curb or edge of water, 12 feet if equestrian accommodation is required.
Vertical:	10 feet from trail surface to underside of bridge, 12 feet if equestrian accommodation is required.

The trail surface elevation shall be at or above the high water mark for the 10-year storm.

17.3.13 Signage and Pavement Marking

A. Basic Requirements

All signs, except locally adopted bike route signs, shall conform to MUTCD.

B. Painted Centerline on Curves

All curves with restricted sight distances are required to be painted with a centerline to separate traffic. The centerline shall be 4 inches in width and painted yellow with glass beads.

17.3.14 Lighting

See Chapter 15, Street Lighting.

17.3.15 Intersections

Bike paths at vehicular intersections shall be given careful consideration to support the safety and comfort of all road users. Design shall be reviewed and approved by the Local Entity engineer using the most current best practices, policies, and standards.

The following requirements apply to all bike path intersections with either streets or other bike paths:

A. Curb Ramps

Curb ramps the same width as the bike path shall be provided at each intersection and shall meet ADA requirements.

B. Sight Distance

Sight distance requirements shall be in conformance with AASHTO requirements. The Designer shall ensure sufficient stopping and intersection sight distance at all bike path intersections and curves, particularly where steep grades are proposed at bike path/ roadway intersections. Obstructions to the visibility of motorists or bike path users shall be removed or the bike path aligned around the obstruction to maximize visibility.

C. Turning Radius at Intersections

The minimum turning radius at bike path intersections shall be 20 feet.

17.4 BICYCLE PARKING AREAS

17.4.1 Bicycle Parking Area Requirement

A. U Type Bike Rack

The inverted U type bike rack is required for all bicycle parking racks. See **Construction Drawings 1701** through **1707.** Refer to Local Entity for latest requirements.

B. Bike Parking Spaces

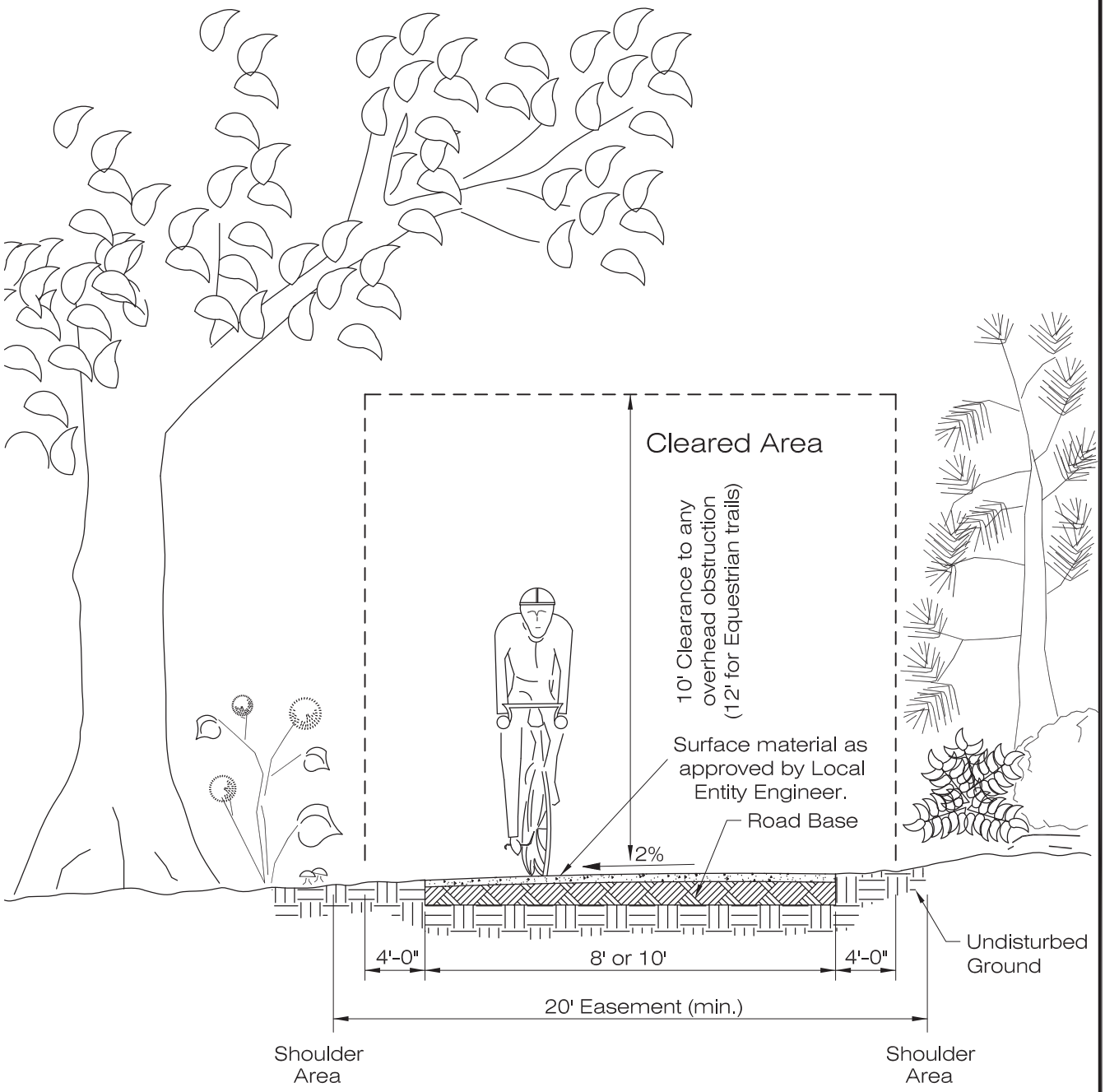
For proposed nonresidential land uses, bicycle parking shall be equivalent to 5 percent of the off-street vehicle parking requirement with a minimum of 2 spaces. Each inverted U rack provided will count as two bicycle parking spaces. Refer to Local Entity requirements for private facilities. For private bike parking facilities in Loveland, refer to Loveland Municipal Code.

17.4.2 Placement of Bike Racks

Racks shall be within 30 feet of building entrances. All bicycle parking provided shall be on concrete, and located a minimum distance as follows from any wall:

Bike Orientation	Min. Distance of Rack from Wall
Parallel to wall	24 inches
Perpendicular to wall	30 inches

Covered parking is encouraged where possible.



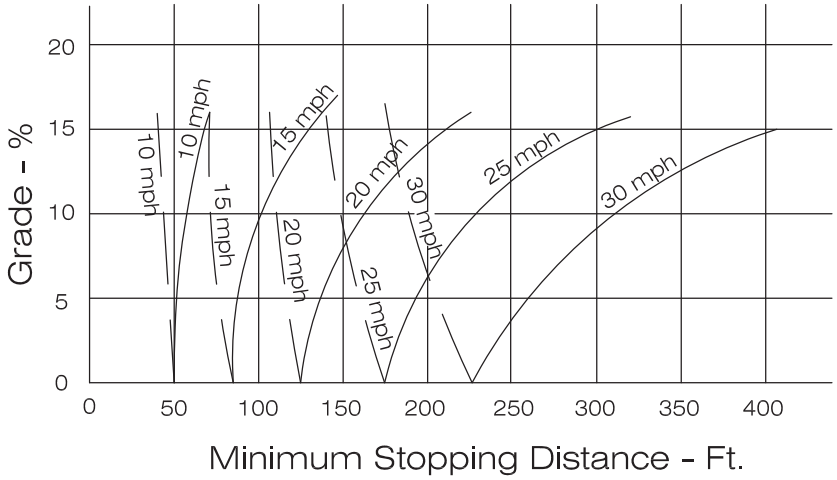
BIKE PATH CLEARING

NOTES:

1. Clear trail and shoulder areas of all vegetative matter and debris.
2. For bike paths 10 feet or greater in width, 4 feet in width more than the bike path shall be cleared.
3. 8' width (min.) for one way traffic, 10' width (min.) for two way traffic.

BIKE PATH

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	17-1



$$S = \frac{V^2}{30(f \pm G)} + 3.67\,v$$

Where: S = Minimum Sight Distance, Ft.
V = Velocity, mph
f = Coefficient of Friction (use 0.25)
G = Grade Ft./Ft. (rise/run)

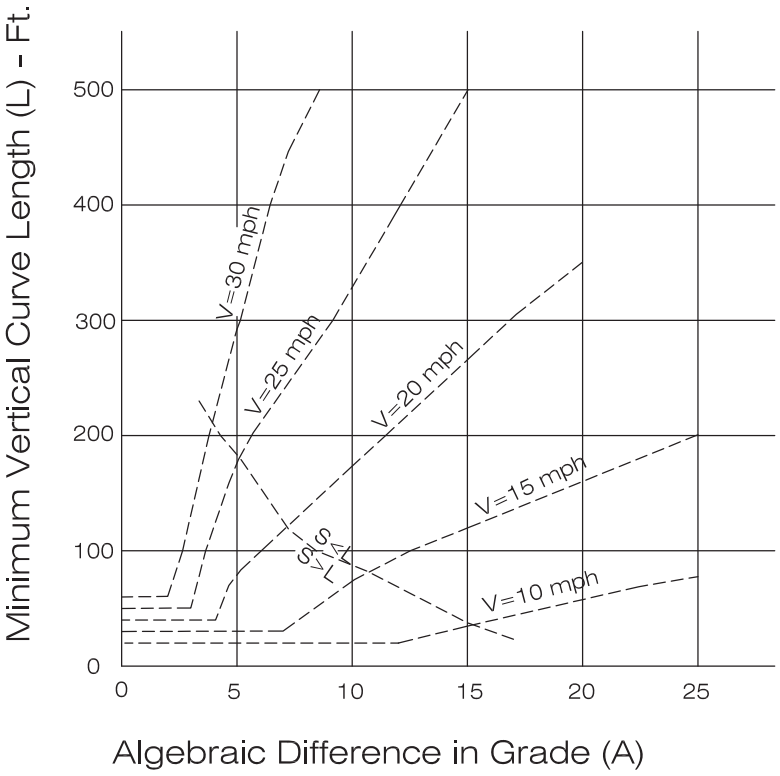
Descend (-G) ————
Ascend (+G) —— ——

(Metric Conversion: 1 FT. = 0.3 m. 1 mph = 1.6 km/h)

From AASHTO

MINIMUM STOPPING SIGHT DISTANCES

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	17-2



$$L = 25 - \frac{200(\sqrt{h_1}+\sqrt{h_2})^2}{A} \quad \text{When } S>L$$

$$L = \frac{AS^2}{100(\sqrt{2h_1}+\sqrt{2h_2})^2} \quad \text{When } S<L$$

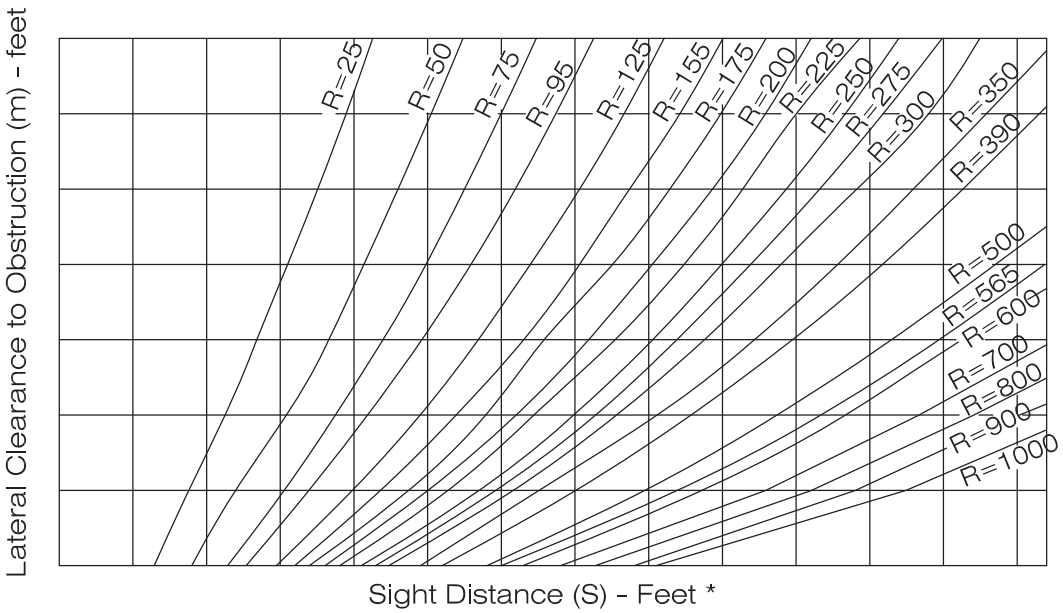
L (min.) = 2V

Where: S = Stopping Sight Distance (ft.)
A = Algebraic Difference in Grade
h_1 = Eye Height of Bicyclist (4.5 Feet)
h_2 = Height of Object (0 Feet)
L = Minimum Vertical Curve Length (ft.)

From AASHTO

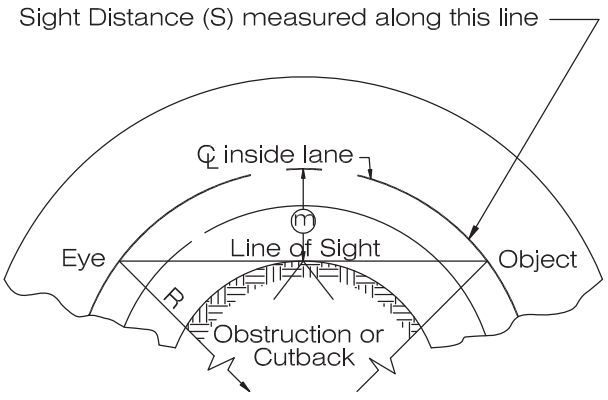
MINIMUM LENGTH OF VERTICAL CURVES

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	17-3



(Metric Conversion: 1 FT. = 0.3 m.)

* Lateral clearances on horizontal curves should be calculated based on the sum of the stopping sight distances for bicyclists traveling in opposite directions around the curve. See text for additional discussion.



Line of sight is 2.0' above ℄ inside lane at point of obstruction.

S = Sight distance in feet.
R = Radius of ℄ inside lane in feet.

m = Distance from ℄ inside lane in feet.

v = Design speed for 5 in mph.

Angle is expressed in degrees

$$m = R\left[\text{v or s}\left(\frac{28.655}{R}\right)\right]$$

$$S = \frac{R}{28.65}\left[\cos^{-1}\left(\frac{R-m}{R}\right)\right]$$

Formula applies only when S is equal to or less than length of curve.

From AASHTO

MINIMUM LATERAL CLEARANCES ON HORIZONTAL CURVES

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
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CHAPTER 18 – NEIGHBORHOOD TRAFFIC SAFETY
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CHAPTER 18 – NEIGHBORHOOD TRAFFIC SAFETY

18.1 GENERAL

This chapter presents acceptable methods of neighborhood traffic calming that are determined by the Local Entity to be necessary for existing Local and Minor Collector Roadways. This chapter also provides for specific design criteria for a number of traffic calming methods. All traffic calming shall be approved by the local fire authority.

18.1.1 Intended Use

The necessity or desire for traffic safety and calming stems from the perception that Local and Minor Collector Roadways, particularly in residential areas, do not always function as intended. These roadways should be low traffic volume roadways used for direct access to residences on the street. They are also intended as a multi-modal system that is shared by vehicular, bicycle, and pedestrian traffic equally, in a manner that minimally impacts residents in these areas.

18.1.2 Traffic Calming for New Street Design

The devices presented in this chapter are generally not intended for use on new roadways. New roadway design is addressed in **Chapter 7, Street Design and Technical Criteria.** New (local streets and minor collectors) are to be designed to minimize cut through traffic, high volumes, and high speed operation and to maximize the efficiency of the roadway to provide vehicular access and bicycle and pedestrian traffic.

18.1.3 Roundabouts and Mini Roundabouts

Roundabouts and Mini Roundabouts, considered traffic control measures, are included in **Chapter 8, Intersections and Appendix I**. These traffic control measures may be used in new or existing street design if the appropriate criteria are met.

18.2 TRAFFIC SAFETY PROBLEMS

Some residents in certain residential areas maintain that excessive speed, volume, or cut-through traffic is unacceptable. The resident believes the presence of too many vehicles traveling at high speeds diminishes that neighborhood's quality of life. Traffic calming measures are intended to minimize these issues and return the quality of life to the neighborhood. Care must be taken by the designer so that the installation of traffic calming devices does not create unintended hazards that delay emergency response or jeopardize the safety of bicyclists, pedestrians or motorists.

18.2.1 Speeding

Speeding may occur on roadways that allow the driver to feel safe while exceeding the posted speed limit. Factors that contribute to this perception include long, unbroken lines of sight, steep roadway grades, wide roadways, low density developments, low pedestrian

activity, and large building setbacks. In addition, speeding may occur when the street functions as a higher classification street than originally intended.

18.2.2 Measuring Speed of Roadway

The standard method of measuring speed on any street is the determination of the 85th percentile speed. The 85th percentile speed is the speed at which or below which 85 percent of the vehicles travel. If the 85th percentile speed is at or below the posted speed limit, a speeding problem does not exist. However, if the 85th percentile speed is over the posted speed limit by 5 miles per hour or greater, either the posted speed limit may be inappropriate or a speeding problem may exist. Many other factors must be evaluated for determining speed limit.

18.2.3 Intrusion (Cut-Through Traffic)

Intrusion is increased volume or excessive non-local traffic along a neighborhood street. This cut-through traffic is caused by drivers who use a Local Street to go through a neighborhood and save time on their trip. Local Streets that are less impeded than other local streets within the same neighborhood will often invite cut-through traffic. Routes that are perceived to be time-saving will attract more traffic. This increased cut-through traffic can cause a local street to function more like a Collector.

18.2.4 Pedestrian Safety

Pedestrian safety is a concern on streets experiencing speeding vehicles, cut-through traffic, or a combination of these problems. The high concern areas are in the vicinity of neighborhood schools and parks or mid-block pedestrian crossings, particularly on streets with on-street parking. These areas require special consideration for the mobility and safety of the pedestrian.

18.3 TRAFFIC CALMING DESIGN CRITERIA

For existing Local or Minor Collectors that are defined for Traffic Calming. Refer to the **City of Loveland's Traffic Calming Procedures**. Refer to the **City of Fort Collins' Traffic Calming Procedures.** This chapter describes design criteria for the engineered solutions. It does not state when or where these improvements are to be used.

18.3.1 Speed Limit Signs

Refer to Chapter 14, Traffic Signals, Signing, and Striping

18.3.2 Speed Humps

Refer to **Construction Drawing 1801F** and **1802F** for design criteria in Fort Collins (GMA and city limits).

18.3.3 Dips

Refer to **Chapter 8, Intersections,** for standard Crosspan design.

18.3.4 Mini Roundabouts

Refer to **Appendix I** for Mini Roundabout design requirements.

18.3.5 Neckdowns

When neckdowns are used they must be designed to maintain a constant cross fall in the pavement surface. Refer to **Figure 18-1** for design criteria.

18.3.6 Traversable Barriers

Refer to **Figure 18-2** for design criteria.

18.3.7 Deviations (Chicanes)

Refer to **Figure 18-3** for design criteria.

18.3.8 Raised Intersections

Refer to **Figure 18-4** for design criteria.

18.3.9 Neighborhood Identification Island

Refer to **Figure 18-5** for design criteria.

18.3.10 Drop Off Zone for Schools

Refer to **Figure 18-6** for design criteria.

18.3.11 Intersection Chokers

Refer to **Figure 18-7** for design criteria.

18.3.12 Turn Prohibitors

Refer to **Figure 18-8**for design criteria.

18.3.13 Semi-Diverters

Refer to **Figure 18-9**for design criteria.

18.3.14 Lane Eliminating Choker – Loveland (GMA and city limits)

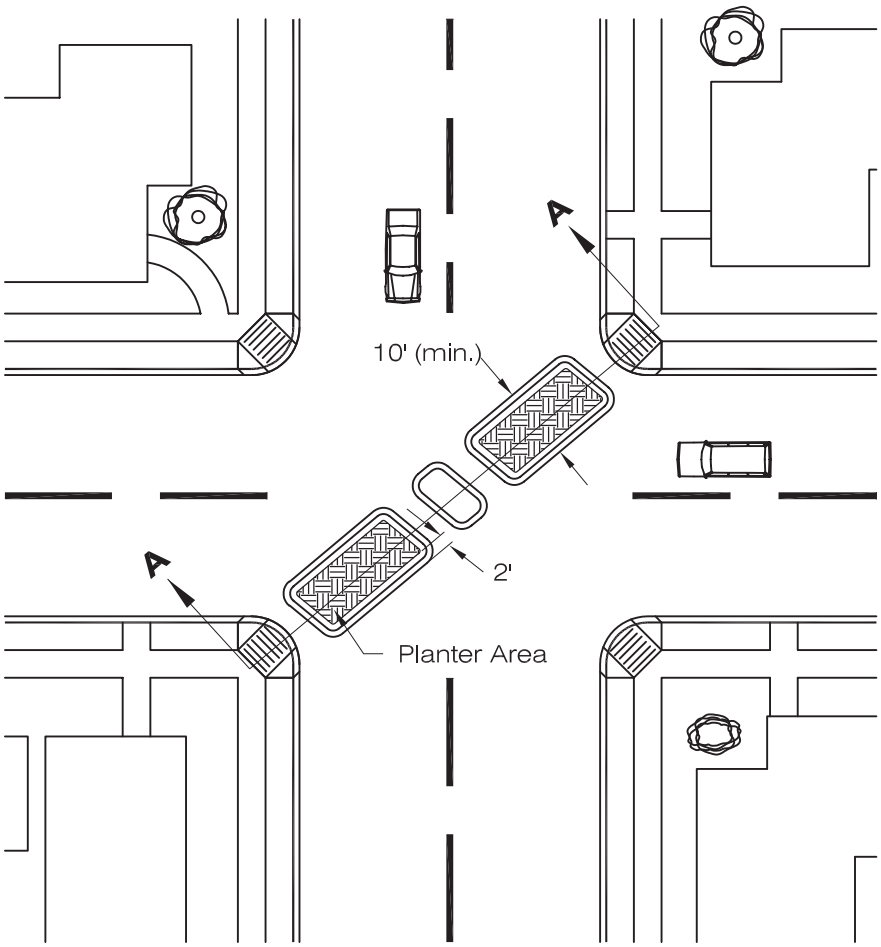
Refer to **Figure 18-10** for design criteria.

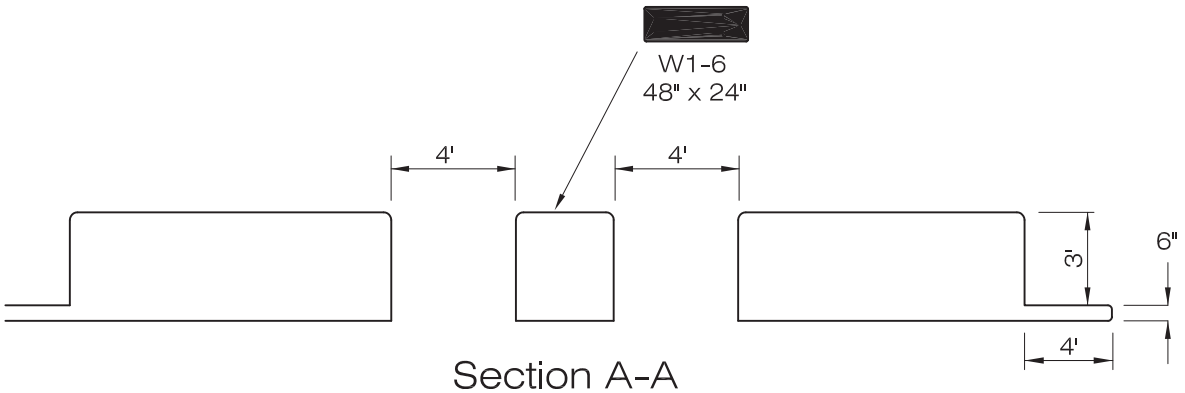
18.3.15 Diagonal Diverters

Refer to **Figure 18-11** for design criteria.

18.3.16 Realigned Intersections

Refer to **Figure 18-12** for design criteria.





Section A-A

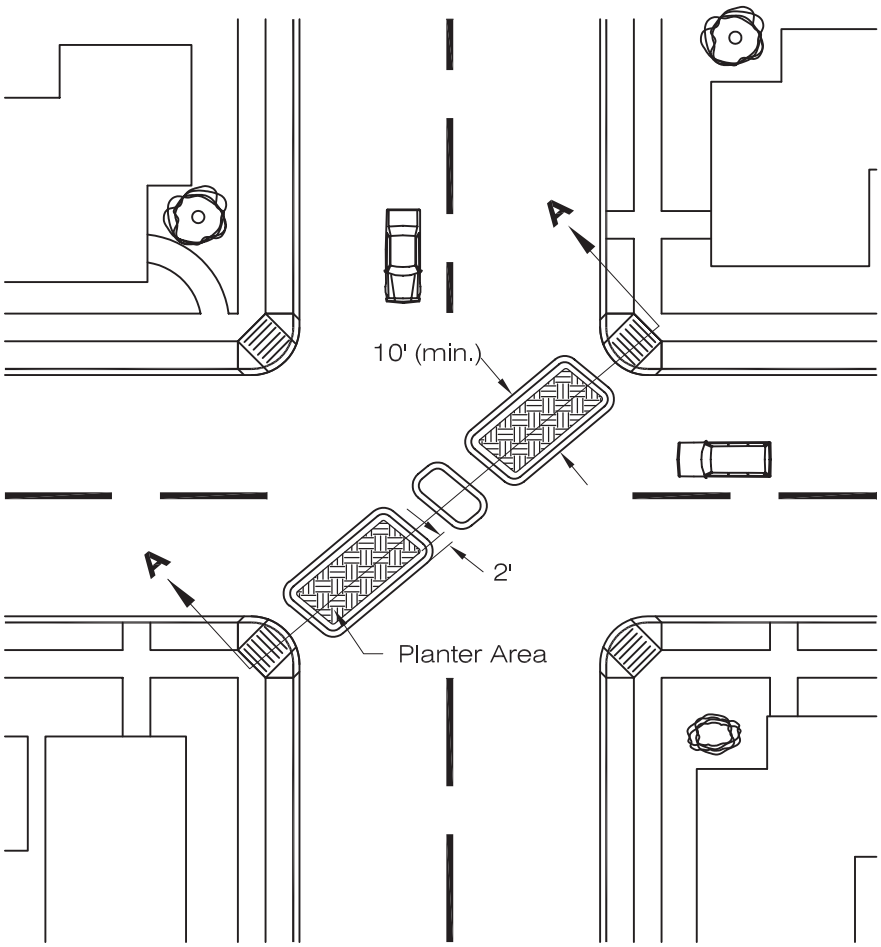
Not to Scale

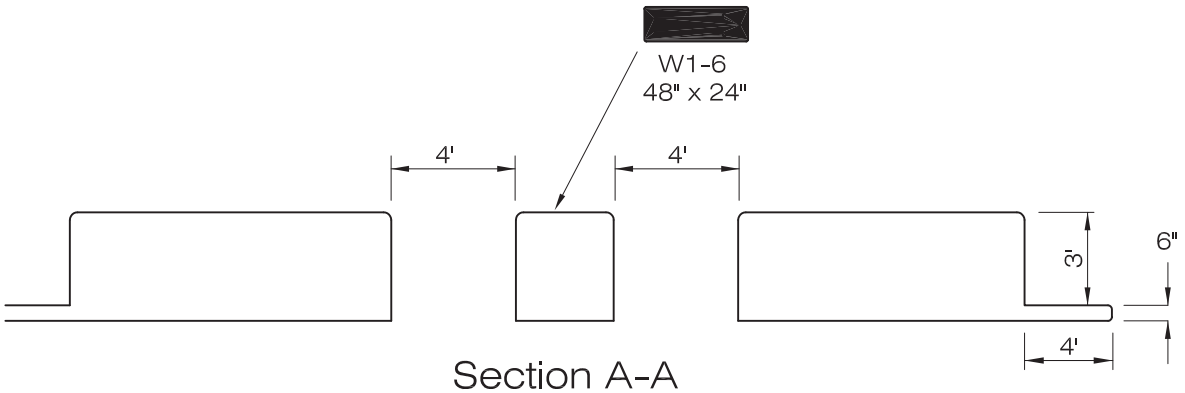
NOTE:

1. Jersey Barriers may be used as temporary Traversable Barriers upon approval.

TRAVERSABLE BARRIERS

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	18-2





Section A-A

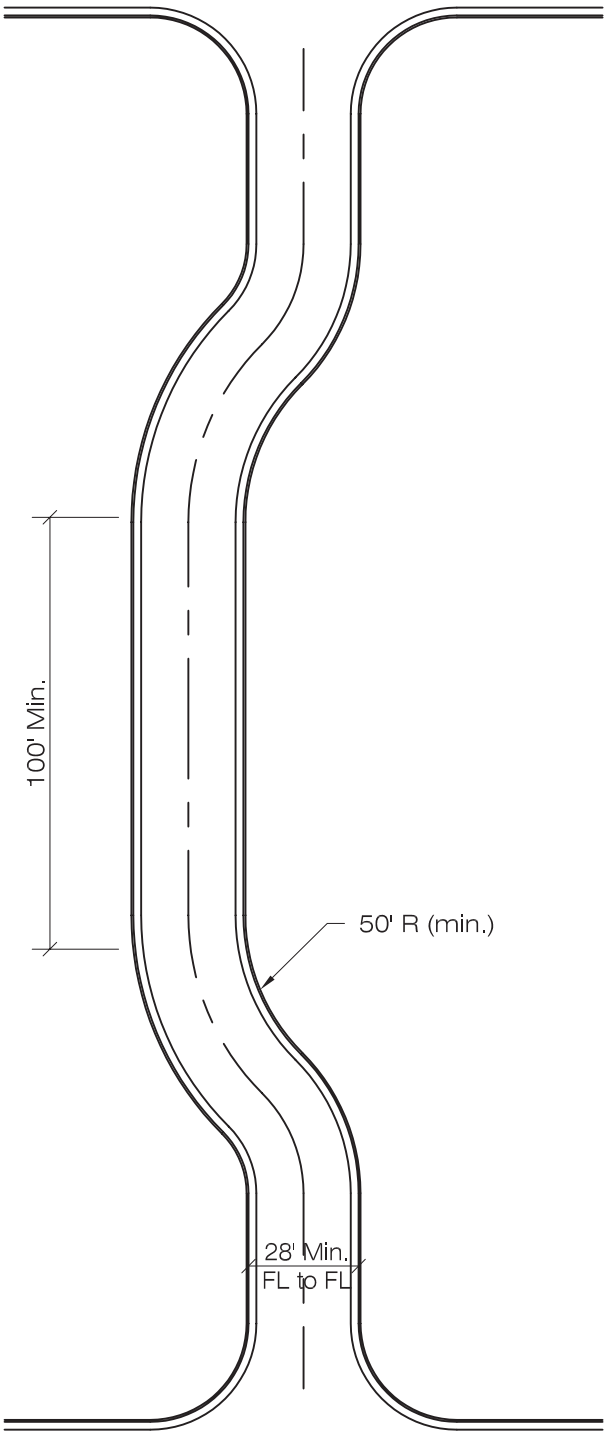
Not to Scale

NOTE:

1. Jersey Barriers may be used as temporary Traversable Barriers upon approval.

TRAVERSABLE BARRIERS

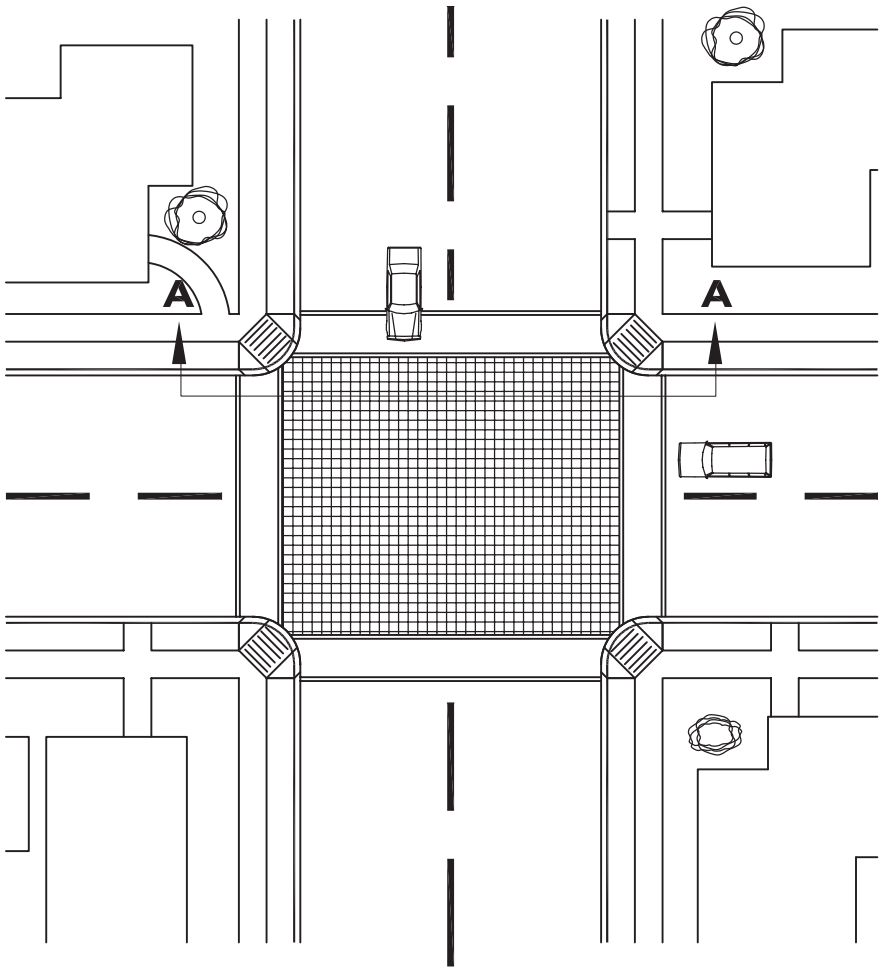
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	18-2



NOTES:
1. Deviations must cause driver to change directions.
2. Medians may be included in design to assist in the separation of traffic.
3. Narrow roadway wanders in a street right of way; requires wide ROW.
4. For min. curb radii, see Chapter 8, **Tables 8-1 & 8-2**.

DEVIATIONS (CHICANES)

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	18-3

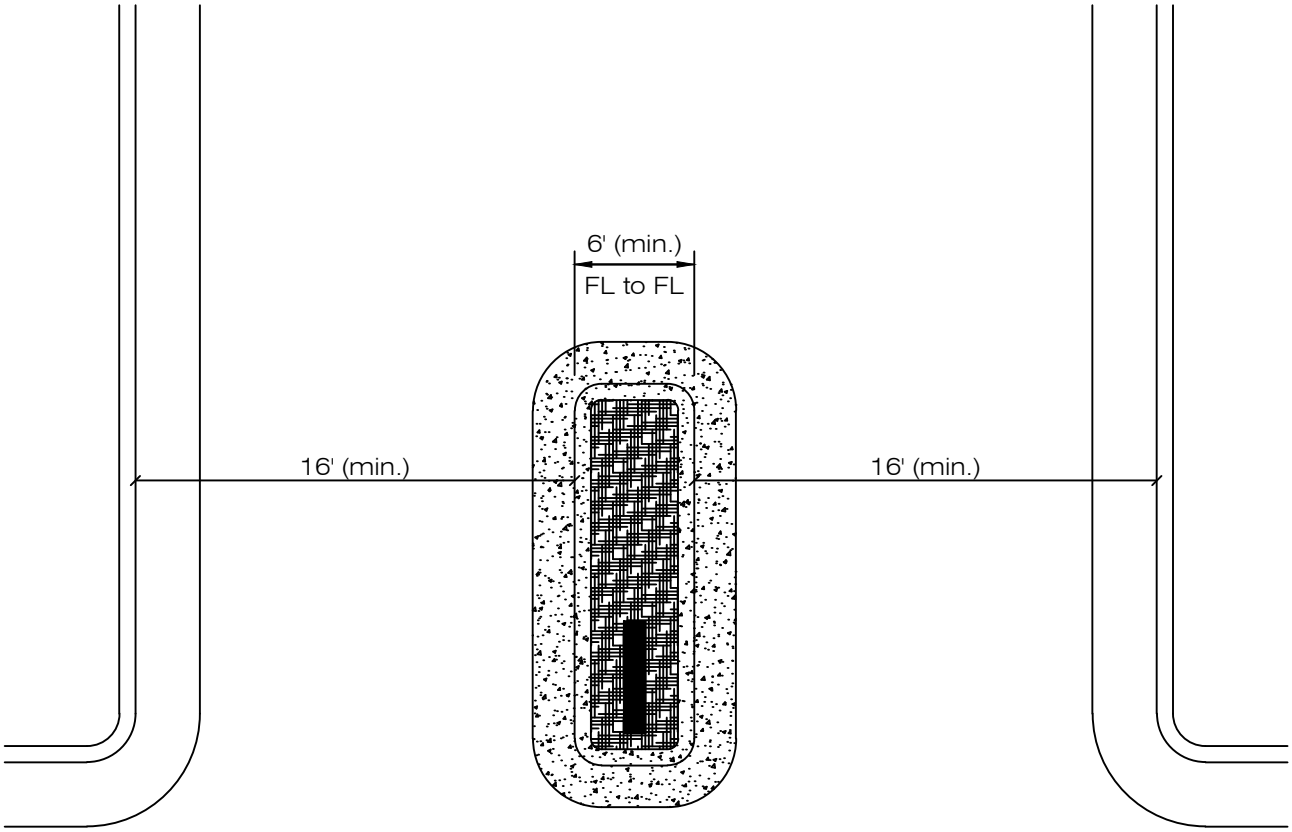


PLAN VIEW

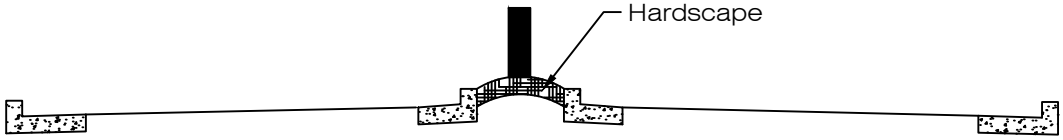
SECTION A-A

RAISED INTERSECTIONS

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	18-4



PLAN



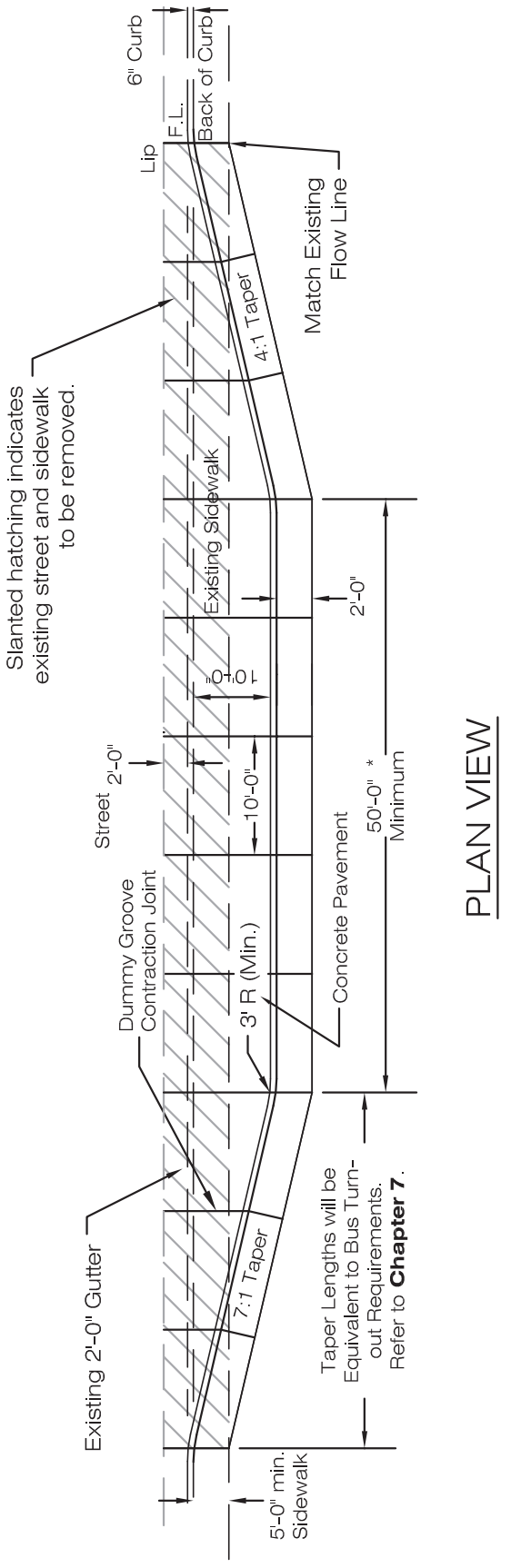
PROFILE

NOTE:

1. Sign cannot impair sight distance.
2. The sign (in Fort Collins) must meet the following criteria:
   - sign must have a max height of 5'.
   - sign surface area must be 24 square feet (max.)
   - The word "neighborhood" must be included in the signage lettering.

NEIGHBORHOOD IDENTIFICATION ISLAND

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	18-5



PLAN VIEW

DROP OFF ZONE FOR SCHOOL

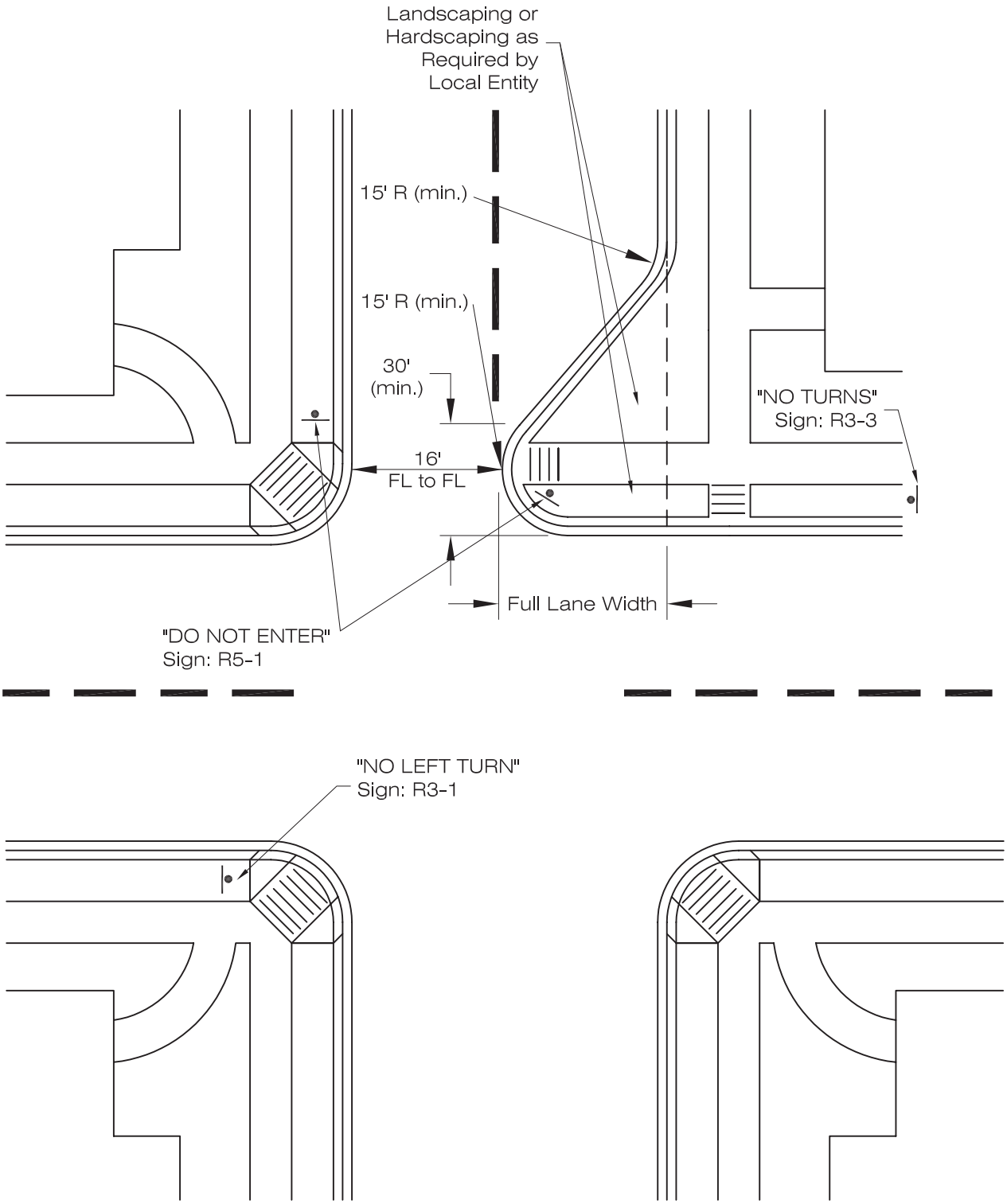
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1	FIGURE
		DATE: 04/01/07	18-6

PLAN

SECTION A-A

INTERSECTION CHOKER

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	18-7

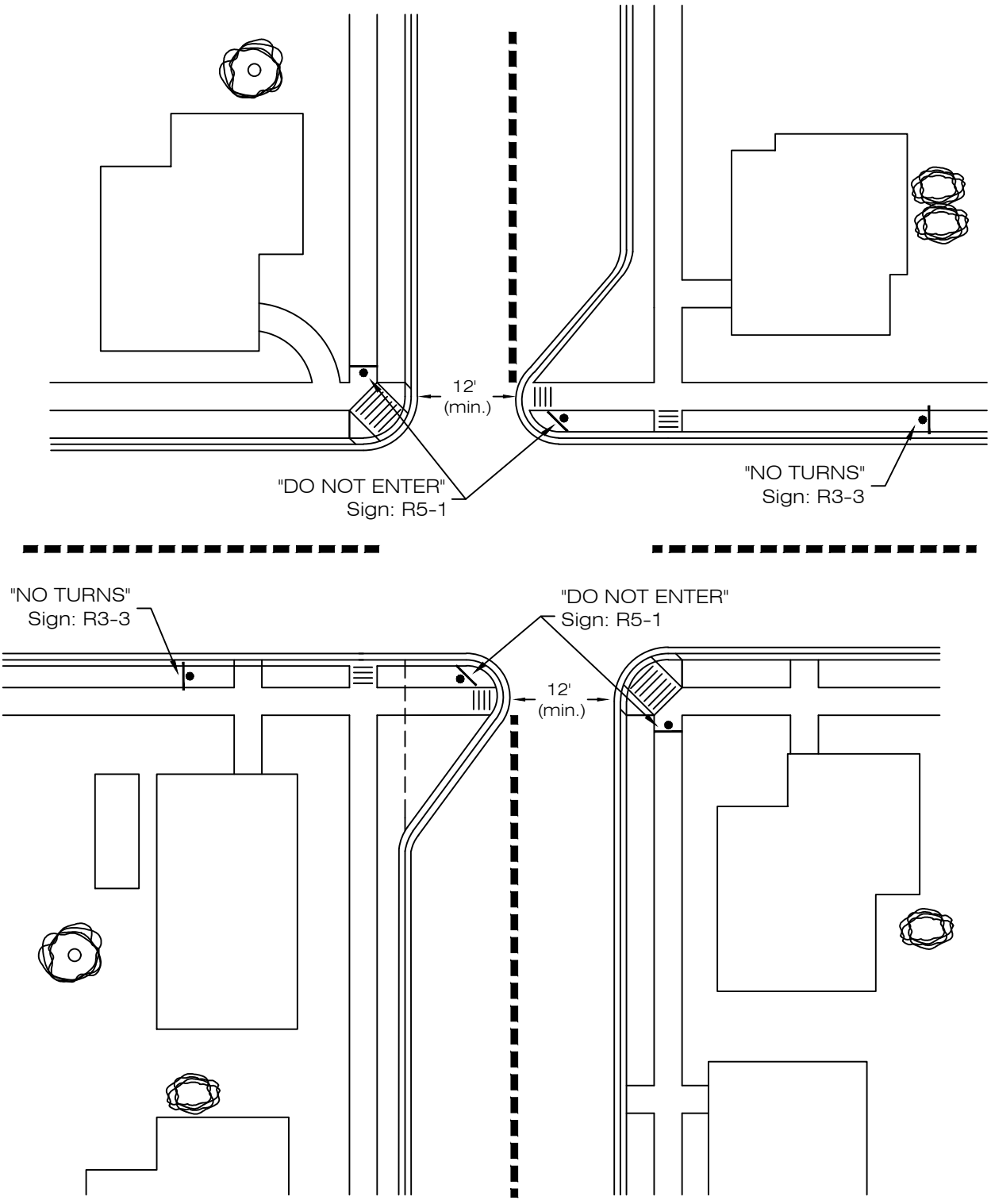


NOTE:

1. Any landscaping provided must be maintained by HOA City Forester or private owner; otherwise, area must be hardscaped.

TURN PROHIBITORS

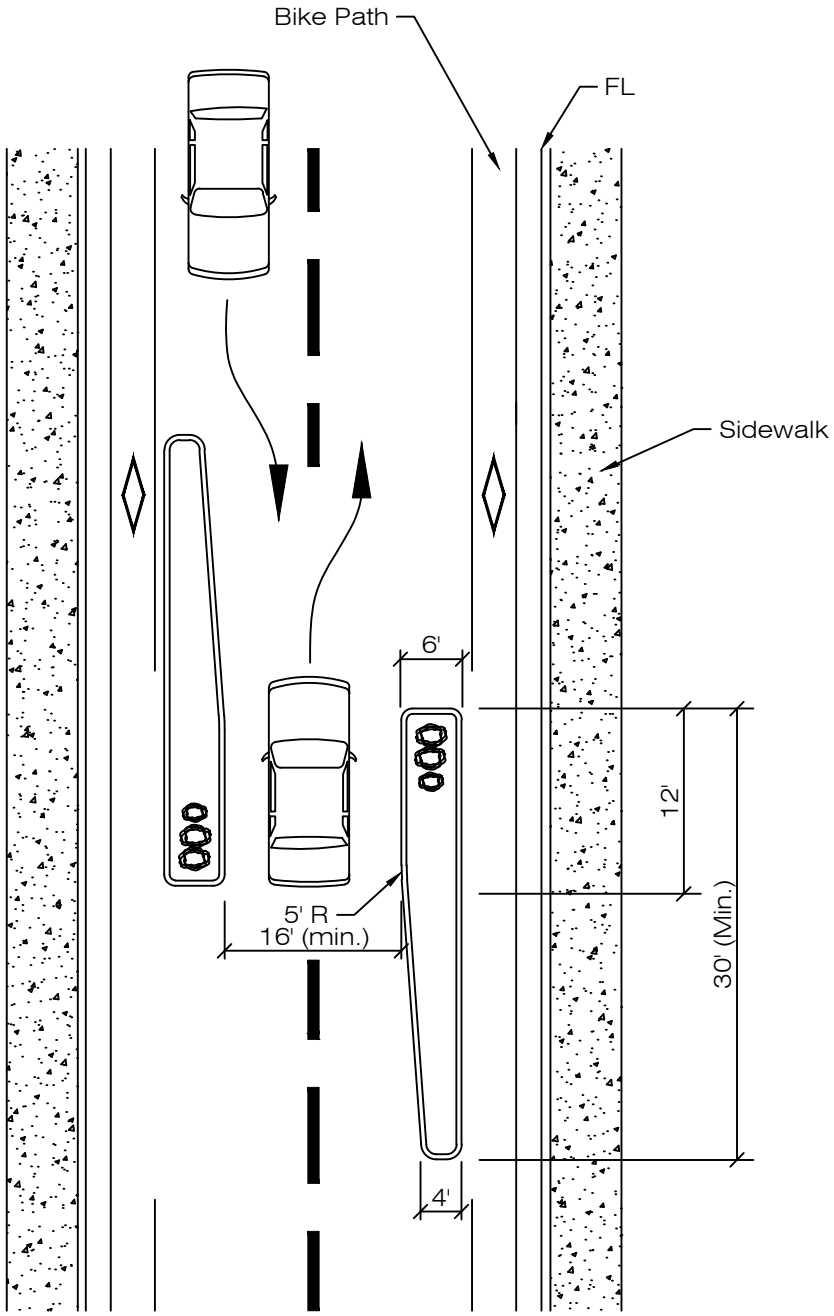
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	18-8



NOTE:
1. Any landscaping provided must be maintained by HOA, City Forester or private owner; otherwise, area must be hardscaped.

SEMI-DIVERTERS

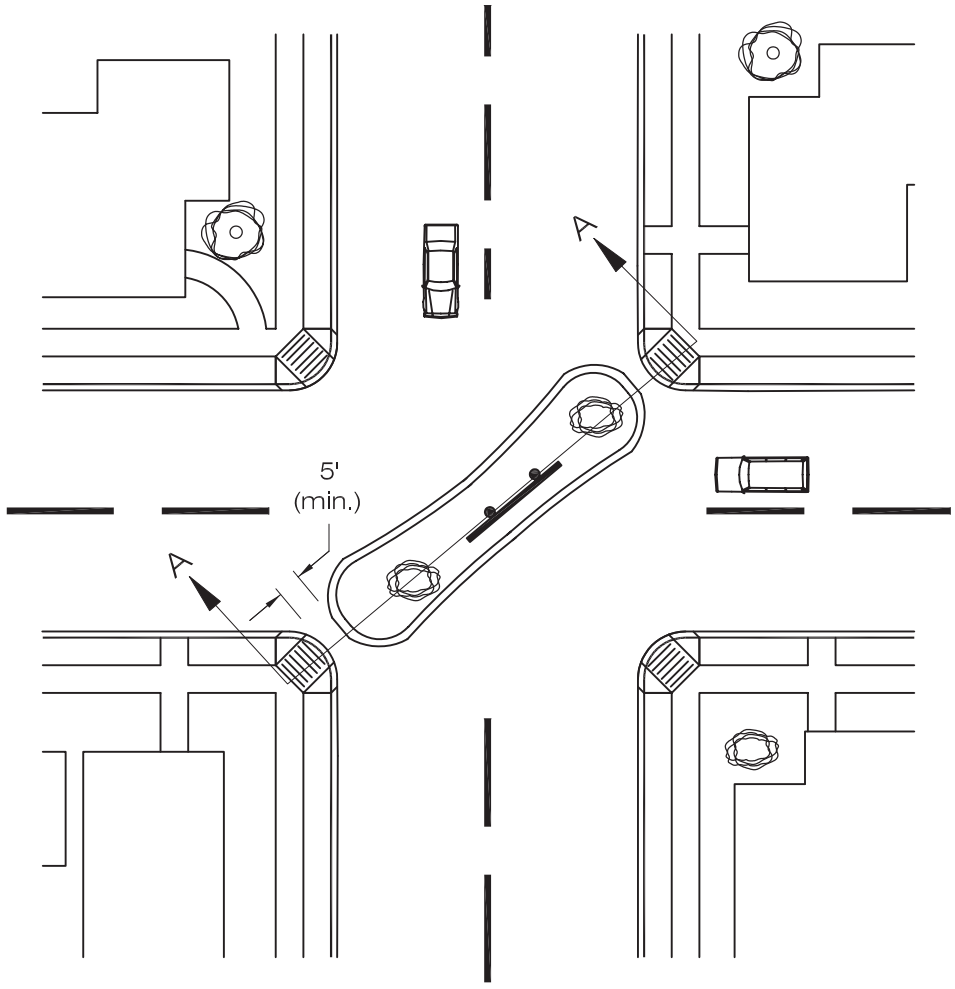
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	18-9



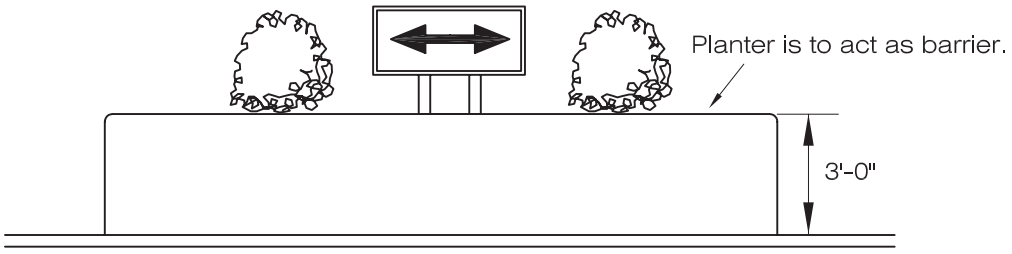
NOTE:
1. 2 lanes narrow to 1 lane. Cars must queue and take turns to travel through single lane.

LANE ELIMINATING CHOKER

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 07/01/21	18-10



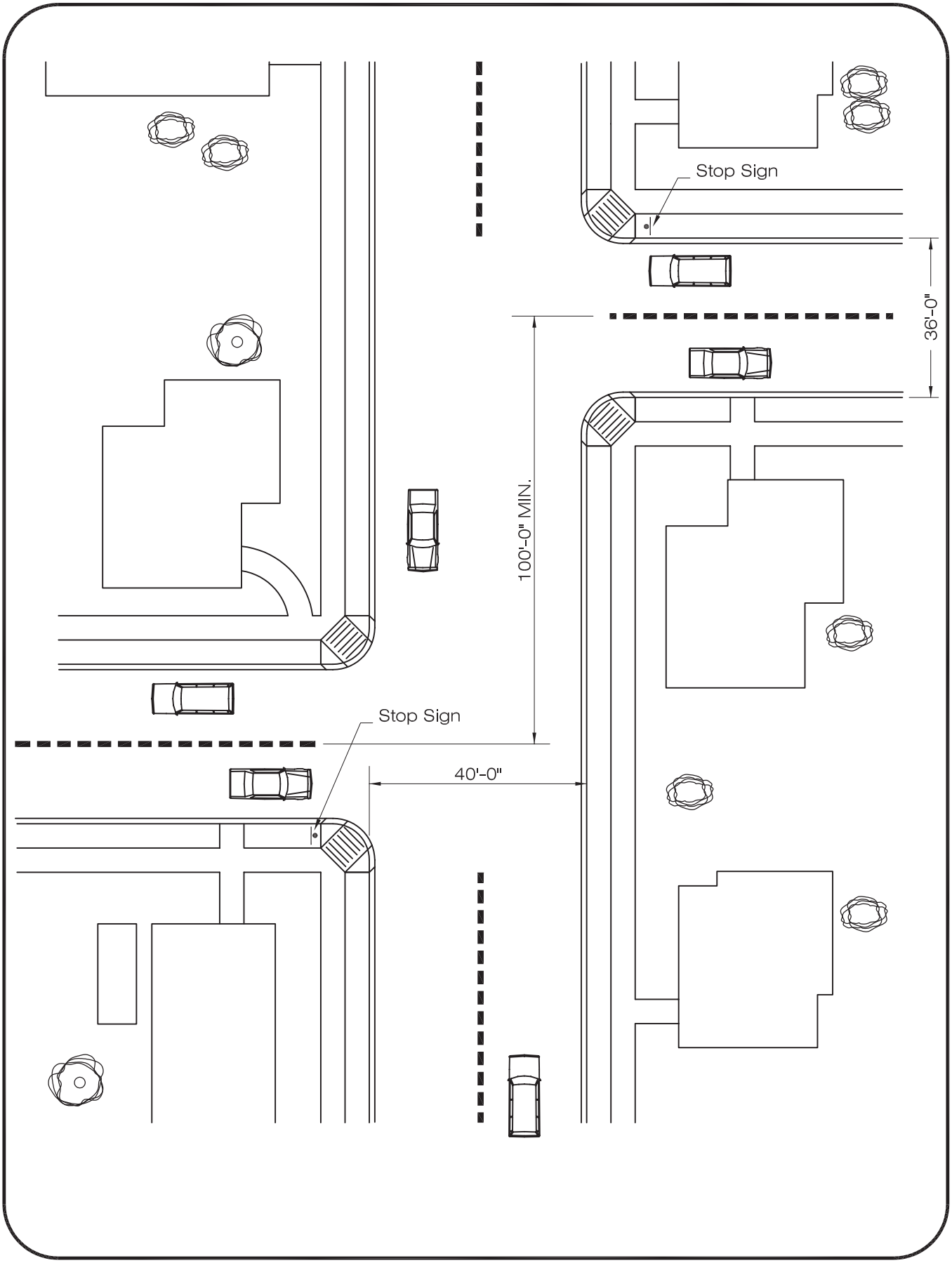
PLAN VIEW



SECTION A-A

DIAGONAL DIVERTERS

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	18-11



REALIGNED INTERSECTIONS

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	18-12

CHAPTER 19 – PARKING
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LIST OF TABLES

This Chapter Does Not Contain Tables

LIST OF FIGURES

Figures are Located at End of Chapter

CHAPTER 19 – PARKING

19.1 GENERAL

This chapter defines the parking criteria for on-street parking, including Downtown parking, parking on cul-de-sacs, and other special requirement areas. This chapter also establishes clearance requirements for off-street parking. Parking stall dimensions for various parking configurations shall be designed in accordance with **Standard Drawing 19-4.**

19.2 ON-STREET PARKING

19.2.1 Parallel Parking

Parallel parking is permitted on certain streets in accordance with the Construction Drawing cross sections in **Chapter 7, Street Design and Technical Criteria,** (**Chapter 7 Standard Details**).

A. No Parking Signs

For all streets in which parking is limited or not allowed, "No Parking" street signs shall be required in accordance with **Chapter 14, Traffic Control Devices**.

19.2.2 Non-Parallel Parking

In Downtown areas and other special designation areas, the Local Entity may permit perpendicular or diagonal parking. The Local Entity Engineer must specifically approve any on-street parking areas that are not designed as parallel parking. All parking shall be designed in accordance with **Figure 19-7**.

A. Diagonal Parking

All diagonal parking areas approved by the Local Entity Engineer shall be designed at an angle of thirty, forty-five, or sixty degrees.

19.2.3 Parking in Cul-de-Sacs

The Local Entity will require that at least one off-site parking space be provided for each residence that has frontage on a cul-de-sac bulb.

A. Design Methods

The on-street parking can be developed in the following three design methods:

1. Parallel Parking. Each space that is provided on the perimeter of cul-de-sac bulbs must be designed in accordance with **Figure 19-4**.

2. Center Island in the Cul-de-Sac Bulb. The center island for parking shall be designed in accordance with **Figure 19-1**. In Loveland (GMA and city limits), parking may be provided as shown in **Figure 19-2L**.

   a. Fort Collins (GMA and city limits). This island shall be limited to a total of 16 spaces, 8 on each side.

3. Off Street Perpendicular Parking Areas. The parking areas shall be designed in accordance with **Figure 19-3.** These areas shall be in easements. Off street parking areas shall be maintained by a private entity.

4. Off Street Parallel Parking Areas. In Loveland (city limits only), parallel parking may be allowed in accordance with **Figure 19-5L.**

B. Drainage

Cul-de-sac parking areas must be paved and designed for drainage to flow to the curb and into the drainage system.

C. Landscaped Areas

All landscaped areas within the center islands or off-street areas must be maintained by a private entity (i.e. Homeowner's Association). The Local Entity will not be responsible for maintenance. Any proposed irrigation should be designed as a drip system to minimize spray onto the pavement areas. In Fort Collins (GMA and city limits), the irrigation system shall be designed in accordance with streetscape standards in **Appendix C.**

19.2.4 On-Street Handicapped Parking Requirements

Streets within commercial areas that include parking may be required to provide at least two spaces per block (one on each side) specifically designated for handicapped parking. The parking area shall be appropriately signed in accordance with **Chapter 14, Traffic Control Devices**.

19.3 OFF-STREET PARKING REQUIREMENTS

The requirements for off-street parking shall be designed in accordance with the Local Entity's zoning requirements.

19.3.1 Minimum Distance

The minimum setback distance from the street curb face to the nearest parking space in an off-street parking area must be designed in accordance with **Figure 19-6**.

19.3.2 Off-Street Straight-In Cul-de-Sac Parking Requirements

Refer to **Figure19-3**.

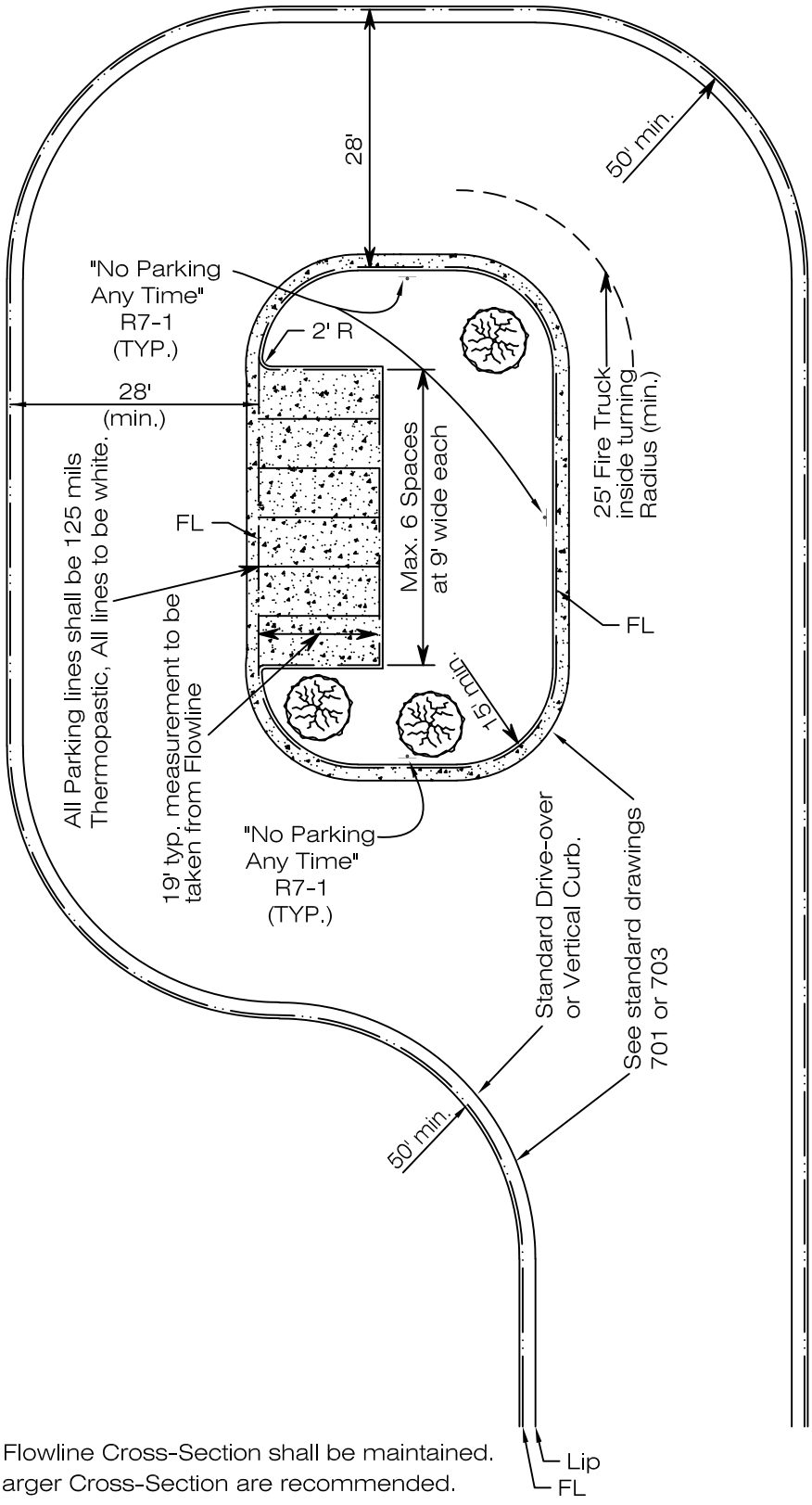
19.4 PARKING CLEARANCES

19.4.1 Driveway Clearance

A vehicular parking space within the roadway shall be designed with a minimum clearance of 6 feet from the edge of a driveway.

19.4.2 Intersection Clearance

A vehicular parking space in the roadway shall be designed with a minimum clearance of 35 feet from the intersection flowline. Depending on traffic conditions, the Local Entity may require a greater clearance.

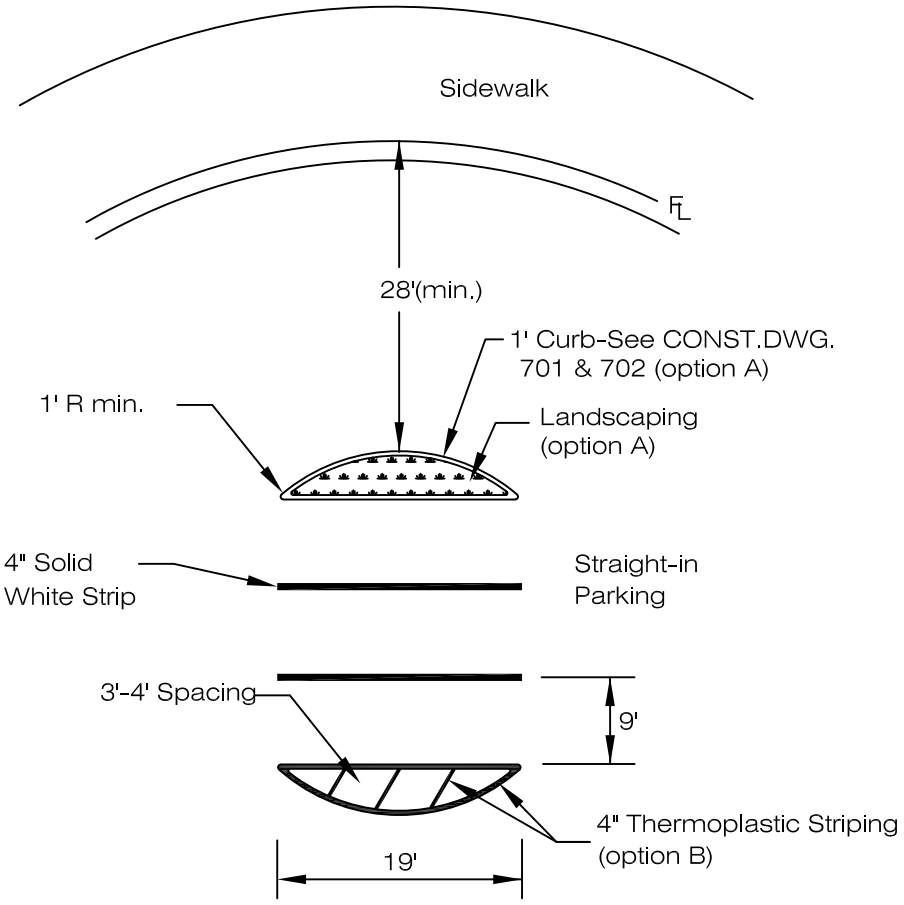


Note: 28' Flowline to Flowline Cross-Section shall be maintained.
For higher densities, larger Cross-Section are recommended.

CENTER ISLAND PARKING IN CUL-DE-SAC

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 3 DATE: 08/01/21	FIGURE 19-1

LOVELAND ONLY

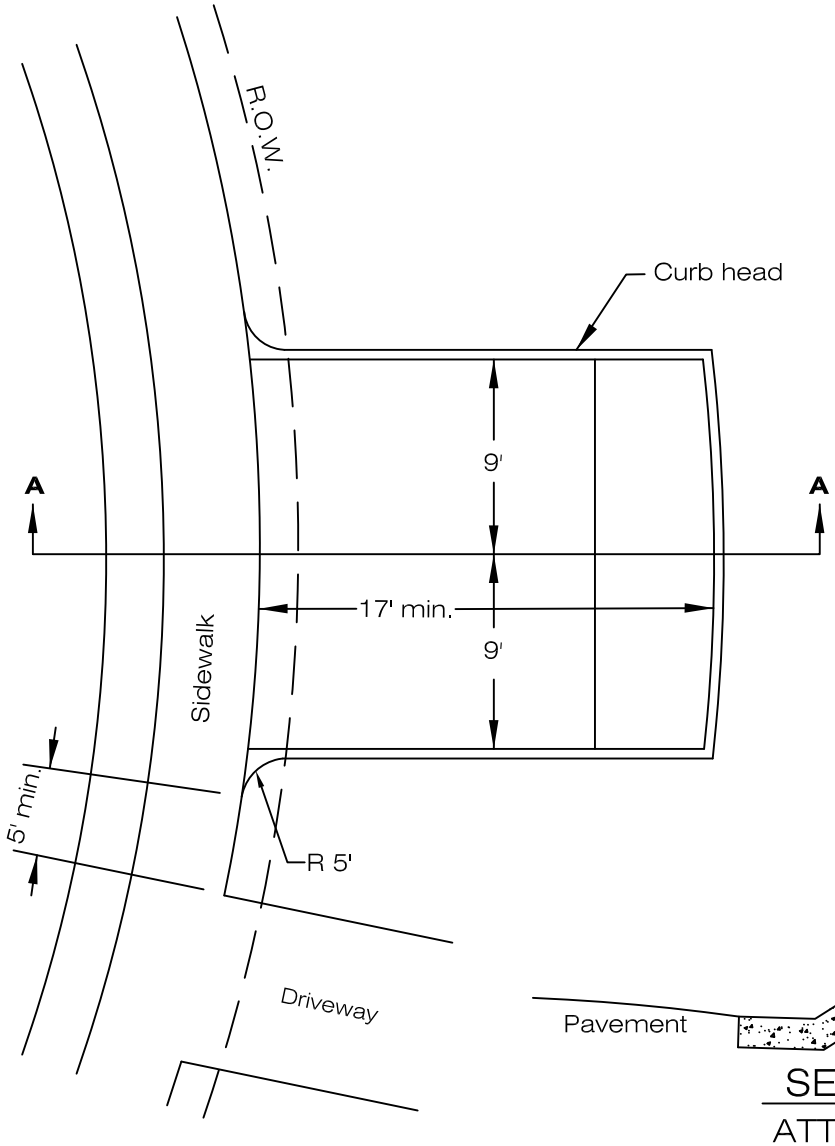


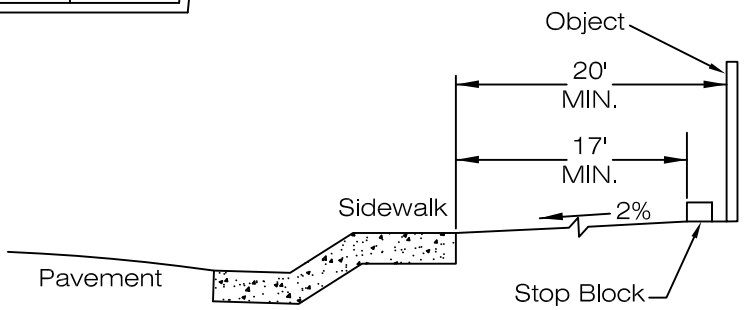
NOTES:

1. One space to be provided for every dwelling unit that fronts on the cul-de-sac. Refer to **Chapter 19** for exceptions.
2. The landscaping shall be maintained by the HOA or other private entity.
3. A clear distance of 28' must be maintained from edge of island to flow line.
4. For stripping materials and requirements, refer to **Chapter 14**.
5. All parking lines shall be 125 mils. All lines to be white.

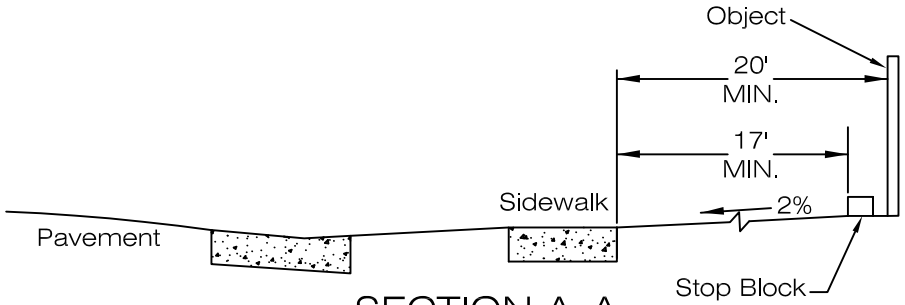
STANDARD CUL-DE-SAC CENTER PARKING AREA

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1	FIGURE
		DATE: 08/01/21	19-2L





SECTION A-A
ATTACHED WALK



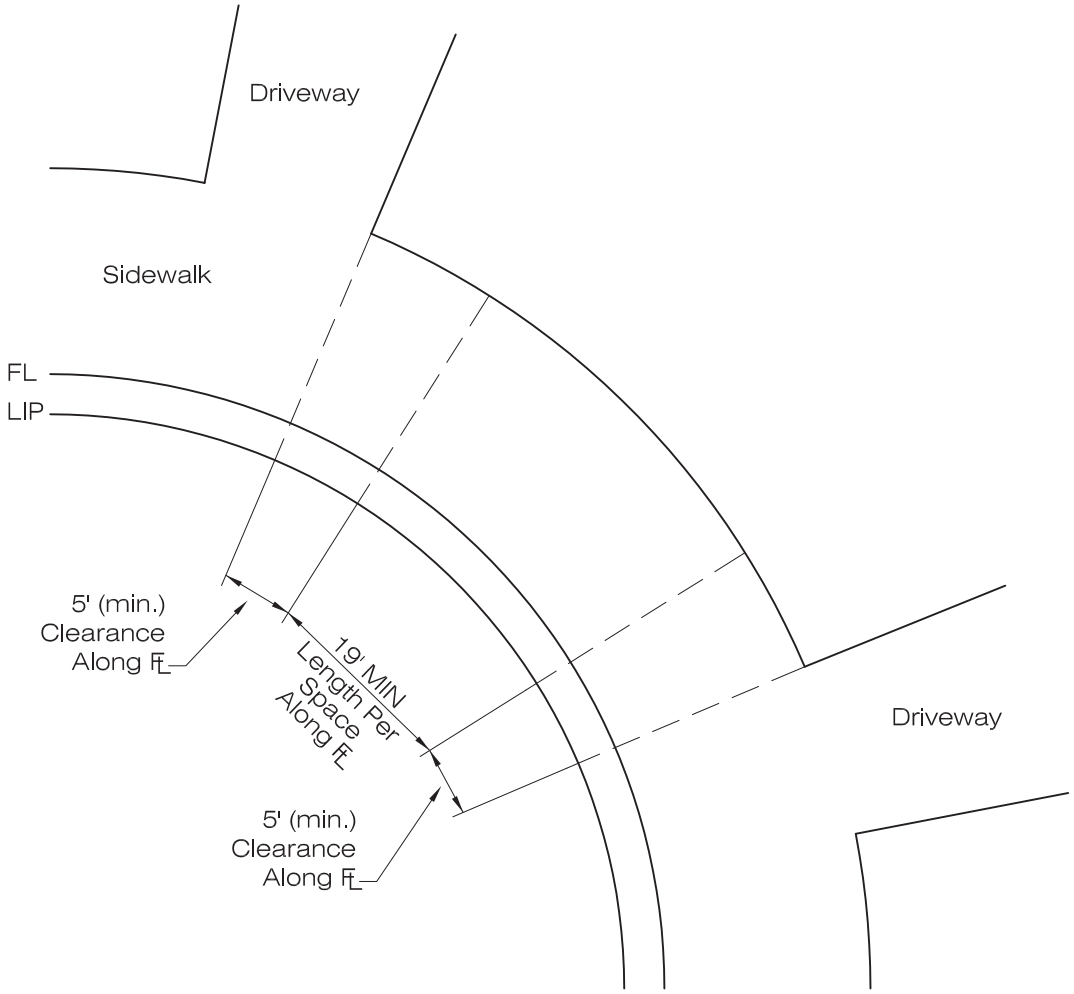
SECTION A-A
DETACHED WALK

NOTES:

1. The minimum width of the parking stalls are 9'; the minimum length is 17' (with stop block.)
2. A curb head must be provided along the outside edges of the parking area, not adjacent to the sidewalk.
3. The parking area must be paved with asphalt or concrete in an approved thickness according to **Chapter 10**
4. All Parking lines shall be 125 mils Thermoplastic, All lines to be white.

OFF STREET STRAIGHT-IN CUL-DE-SAC PARKING

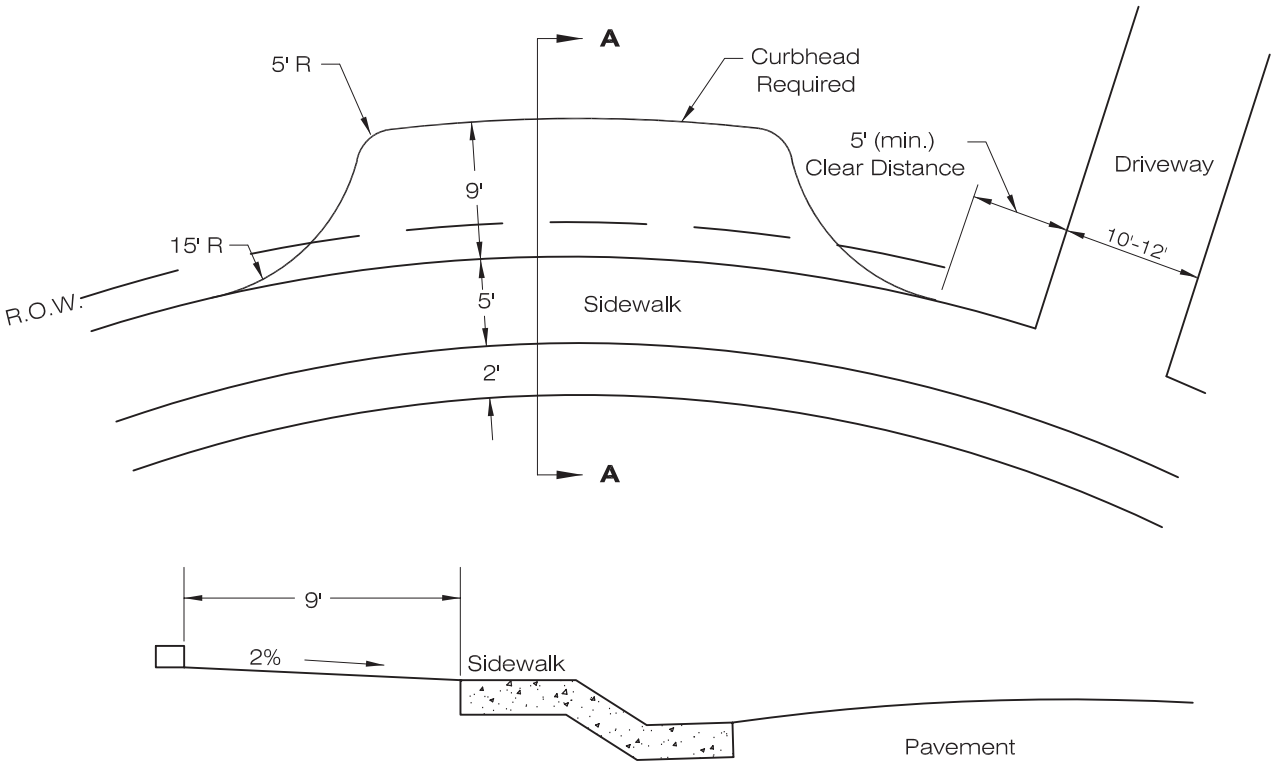
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 3	FIGURE
		DATE: 08/01/21	19-3



PARALLEL CUL-DE-SAC PARKING IN RIGHT OF WAY

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1 DATE: 03/01/02	FIGURE 19-4

LOVELAND ONLY



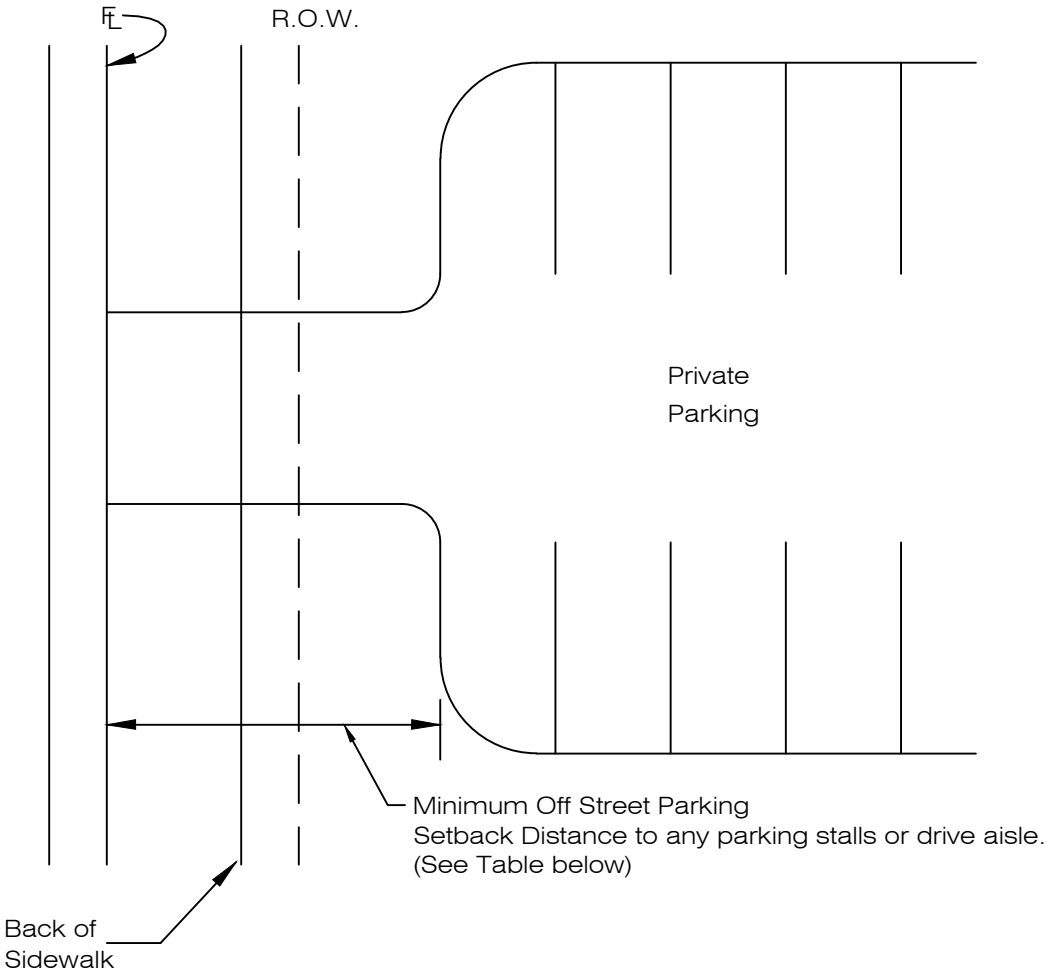
DETAIL A-A

NOTE:

1. Parking areas out of the right of way must be within easements.
2. The minimum width of the parking area is 9'.
3. Drainage shall be designed to flow to the street.
4. Parking area must be paved with asphalt or concrete, and thickness shall be in accordance with **Chapter 10, Pavement Design.**
5. Clear distance between end of parking area to edge of driveway is 5'.

OFF-STREET PARALLEL CUL-DE-SAC PARKING

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	19-5L



MINIMUM OFF STREET PARKING SETBACK DISTANCES (FT.)

PARKING LOT	STREET CLASSIFICATION				
Volume (ADT)	Local			Collector	Arterial
	<100 ADT	100-750 ADT	>750 ADT		
<100	20'	40'	40'	50'	50'
100-750	20'	40'	50'	50'	75'
>750	NA	50'	50'	60'	100'

NOTE: Local Entity Engineer can vary setback distance requirements on a case-by-case basis.

MINIMUM OFF STREET PARKING SETBACK DISTANCE

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO: 1	FIGURE
		DATE: 07/07/21	19-6

STANDARD VEHICLE

Dimension in feet

A	B ②	C ①	D	E	F *	G*
0°	8	23	8	23	20	12
30°	8.5	20	17.4	17	20	15
45°	8.5	20	20.2	12	20	15
60°	9	19	21	10.4	24	20
90°	9	19	19	9	24	NA

COMPACT VEHICLE

Dimension in feet

A	B	C	D	E	F *	G*
0°	7.5	19	7.5	19	20	12
30°	7.5	16.5	14.8	15	20	15
45°	7.5	16.5	17	10.6	20	15
60°	8	16	17.9	9.2	24	20
90°	8	15	15	8	24	NA

* Under special conditions, these dimensions could be varied with the Local Entity's approval.

① Stall length (only) can be reduced by 2' when overhanging is provided.

② For handicap spaces, width shall be 13' with ramp access to walks.

A - Angle of Parking

B - Stall Width

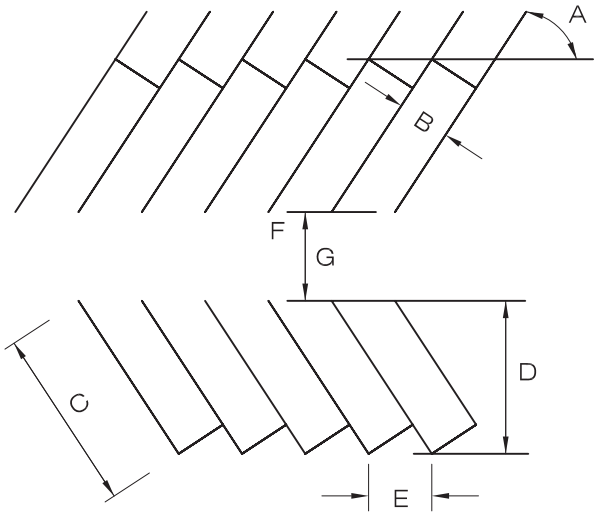
C - Stall Length

D - Stall Depth

E - Curb Length

F - Two-Way Drive Width or Double Loaded Drive Width

G - One-Way Drive Width or Single Loaded Drive Width



PARKING AREA DIMENSIONS

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 08/07/00	19-7

CHAPTER 20 – PUBLIC IMPROVEMENTS OPINION OF COSTS
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LIST OF FIGURES

This Chapter Does Not Contain Figures

CHAPTER 20 – PUBLIC IMPROVEMENTS OPINION OF COSTS

20.1 GENERAL

This chapter defines units for certain construction items used in the Opinion of Costs required with the submittal of Construction Plans. These costs will be the basis of the surety amount to be provided to the appropriate Local Entity by the Developer. The unit costs represent what the Local Entities would expect to pay for similar projects. The purpose is to cover the cost of the project in case the Local Entity is for any reason forced to take over constructing the project.

The Opinion of Costs shall be prepared and stamped by a Professional Engineer. The Opinion of Costs shall be broken down by the categories shown and shall provide the public improvement name, units of measure, unit cost, quantity included in the project, and total cost of each item and grand total. The Opinion of Cost shall be itemized by phase.

20.2 UNITS AND COSTS

Refer to the Local Entity for the latest version of applicable units and costs and current version of Public Improvements Opinion of Cost form. The Local Entity will approve unit costs used to determine the Opinion of Costs. There may be additional items that are not shown. The Developer should show each of those items, with their units, unit prices, quantities, and item cost. Separate summaries shall be provided for phases when applicable. In addition, separate summaries shall be provided for adjacent, on-site and off-site public improvements.

20.3 FINANCIAL CONTINGENCY

See Loveland Municipal Code for requirements for projects in Loveland (GMA and city limits). Refer to each Local Entity for latest requirements. Also see **Section 24.3, Surety, Insurance, and Security Requirements**.

CHAPTER 22 – MATERIALS AND CONSTRUCTION SPECIFICATIONS
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This Chapter Contains No Figures

CHAPTER 22 – MATERIALS AND CONSTRUCTION SPECIFICATIONS

22.1 Right-of-Way Grading

22.1.1 Site Remediation

A. Disposal of Waste Materials

1. **Burning on Developer's Property**
   Burning is not permitted on Developer's property except for training burns authorized and overseen by the local fire authority.

2. **Removal from Developer's Property**
   Removal of waste materials and unsuitable or excess topsoil from the Developer's property shall be legally disposed of.

A. Site Demolition

B. Removal of structures and Obstructions

1. General. The work shall consist of removal, salvaging, and backfilling according to **CDOT Specifications Section 202.01**. Refer also to **Ch. 25, Reconstruction and Repair.**

   Salvage
   Salvageable material shall be handled according to **CDOT Specifications Section 202.03** in locations designated by the Local Entity Engineer.

   A. **Disposal**

      1. **Developer Responsibility**
         The Developer shall make all necessary arrangements for securing legal and suitable disposal sites.

      2. **Unestablished Dump Site**
         If disposal is to be at other than established dump sites, the Local Entity Engineer may require the Developer to furnish written permission from the property owner on whose property the materials are placed.

      3. **Concrete and Asphalt**
         Broken concrete and asphalt, with no other waste material, may be taken to Local Entity's recycling yard. Asphalt and concrete must be separated. Mingling of materials is prohibited.

   B. **Backfill**
      Except in areas to be excavated, all cavities left by structure removal shall be cut to clean undisturbed material and backfilled with suitable material and compacted in accordance with **Section 22.2.3** of these Standards. Jetting or

ponding will not be allowed.

C. **Preservation of Property**
Existing improvements, adjacent property, utilities, trees, and plants that are not to be removed shall be protected from injury or damage resulting from the Developer's operations.

2. **Construction Requirements**

A. **Structures**
The Developer shall raze, remove, and dispose of all structures, according to **CDOT Specifications Section 202.02**.

B. **Demolition Permit**
Building demolition requires a demolition permit issued by the Local Entity.

C. **Abandoned pipelines/conduits**
Abandoned pipelines and conduits shall be removed or abandoned in place by plugging and filling with sand or appropriate alternative in accordance with direction from the Local Entity Engineer.

D. **Other Obstructions**

1. **Miscellaneous Obstructions**
The Developer shall remove miscellaneous obstructions and properly dispose of them.

2. **Traffic Signals and Signs**
Removal of traffic signals and related materials shall be per **CDOT Specifications Section 202.02.** All traffic signal equipment shall remain the property of the Local Entity. Contact the Local Entity Engineer for disposal instructions.

3. **Portions of Structures**
Removal of portions of structures shall be per **Section 22.3.2** of these standards.

4. **Detour Structures**
Materials used in detour structures for the project shall be removed according to **CDOT Specifications Section 202.06**.

22.1.3 Site Clearing and Grubbing

A. **General**

The work shall consist of clearing, grubbing, removing, and disposing according to **CDOT Specifications Section 201.01**. This work does not include objects designated to remain nor which are to be removed in accordance with other sections of these Standards.

B. **Construction Requirements**

Construction requirements for site clearing and grubbing shall follow those requirements outlined in **CDOT Specifications Section 201.02** with the addition of the following:

1. Construction Limits

The Developer will establish construction limits in accordance with the Local Entity requirements.

2. Buried Perishable Objects

Buried perishable objects shall be removed to a depth of 3 feet below the existing ground or subgrade, whichever is lower.

3. Burning

Burning of perishable material shall be done in accordance with **Section 22.1.1A.**

4. Disposal

Disposal of materials or debris shall be done in accordance with **Section 22.1.1 A.**

22.1.4 Embankment and Excavation

A. General Construction Requirements

Excavation and embankment operations shall be done in accordance with **CDOT Specifications Section 203.04**. Prior to beginning grading operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with **Section 22.1.3 .**

B. Embankment Material

Embankment material shall consist of approved material acquired from excavations, and shall be hauled and placed in embankments in reasonably close conformity with the line, grades, thicknesses, and typical cross-sections shown on the plans.

1. Compaction

The embankment shall be free of organic material, and shall be moisture treated to within 2% (or as specified on the plans or geotechnical report) of optimum moisture content and placed in 6-inch lifts compacted to 95% standard proctor.

2. Source of Material

When the source of embankment materials is not designated on the plans, approval of the source will be contingent on the material meeting the requirements of **Chapter 5, Soils Investigations**, and having a resistance value that matches or exceeds the R-value of the in-situ material or as shown on the plans when tested by the Hveem Stabilometer.

3. Unsatisfactory Material

Refer to the unacceptable soil classification groups from **ASTM** which apply for locally available material. No top soil shall be used for fill. In addition, no gap graded material nor material weighing less than 90 pounds per cubic foot shall be used for fill.

C. Excavation

1. General

This work shall consist of excavation, disposal, shaping, or compaction of all material encountered within the limits of the work, including excavation for ditches and channels.

a. Protection of Property and Workmen

Excavation shall be performed in a careful and orderly manner with due consideration given to protection of adjoining property, the public, and workmen.

b. Damage Repair Responsibility

Any damage to streets, parking lots, utilities, irrigation systems, plants, trees, building or structures or private property, or the bench marks and construction staking shall be repaired and restored to its original conditions by the Developer at the Developer's expense. Following completion of construction, should any of these trees, shrubs, or irrigation facilities, etc. require replacement, it shall be done at the Developer's expense.

c. Compliance with Standards

All excavation and the like shall comply with OSHA's "Construction Industry Standards" as well as all applicable Federal and State regulations.

2. Stockpile

Refer to Chapter 25, Reconstruction and Repair.

3. Disposal

Excess excavated material shall be disposed of outside of the Right-of- Way unless approval is given by the Local Entity Engineer to do otherwise.

4. Explosives

The use of explosives will not be permitted without a blasting permit issued by the local fire authority. Refer to **Chapter 6, Permits,** for permit conditions and procedures.

5. Unsanitary Materials

Unacceptable material defined as any earthen material containing vegetable or organic silt, topsoil, frozen material, trees, stumps, certain manmade deposits, or industrial waste, sludge, or landfill, or other undesirable materials will be removed from the site and disposed of in accordance with applicable Local Entity, State, and Federal requirements.

6. Unauthorized Excavation

Unauthorized excavation consists of removal of materials beyond specified elevations without the specific direction of the Local Entity Engineer. Unauthorized excavation shall be backfilled and compacted as specified for authorized excavations.

7. Rock

Rock shall be excavated and disposed of according to **CDOT Specifications Section 203.05(a)**, or Local Entity Requirements. Rock shall be removed to a level 3 feet below the subgrade surface within the right-of-way. Drainage facilities may be required by the Local Entity Engineer.

8. Excavation for Appurtenances

See **Section 22.4.4** .

22.1.5 Embankment Construction

A. General

Embankment construction shall consist of constructing roadway embankments within project areas where unsuitable material has been removed as well as in other areas as noted in **CDOT Specifications Section 203.06.**

1. Water in Material

Free running water shall be drained from the material before the material is placed.

2. Maximum Size of Solid Material

Rocks, broken concrete, or other solid materials more than 3 inches in greatest dimension shall not be placed in embankment, unless approved by Local Entity Engineer.

3. Archaeological Sites or Artifacts

When the Developer's excavating operations encounter remains of prehistoric peoples' dwelling sites or artifacts of historical or archaeological significance, the operations shall be temporarily discontinued. The Developer shall contact archaeological authorities to determine the disposition thereof. When directed, the Developer shall excavate the site in such manner as to preserve the artifacts encountered and shall remove them for delivery to the custody of the proper state or Local Entity authorities.

4. Protection of Existing Installations

The Developer shall at all times take precautions for the protection of culverts, irrigation crossings, mail boxes, driveway approaches, valve boxes, manholes, survey monuments, underground or overhead utility lines, and all other public or private installations that may be encountered during construction. The Developer

shall be responsible for the repair of any installations damaged due to their work. Manholes and valve boxes shall be observed by the Local Entity Engineer for displacements and introduction of foreign matter. It shall be the Developer's responsibility to correct any displacement and to remove any foreign matter resulting from the Developer's work.

22.1.6 Borrow Material

A. General

Provide approved borrow soil materials from off-site locations when sufficient approved soil materials are not available from excavations on-site. Borrow material shall be placed only after the approved excavation material has been replaced in the fill. Borrow areas shall be finished so that water will not collect or stand therein. The "R" value of the borrow shall be equal or greater than the design "R" value required for the existing subgrade soil. In addition, the LL and PI shall be equal to, or better than, the LL and PI of the subgrade material. Refer to **Chapter 10, Pavement Design and Technical Criteria**.

B. Satisfactory Borrow Materials

Borrow material must be free of rock or gravel larger than 3 inches, and free of debris, waste, frozen materials, vegetation and other deleterious matter. Refer to **ASTM** soil classification groups which apply for locally available material.

C. Unsatisfactory Borrow Materials

Refer to the unacceptable soil classification groups from **ASTM** which apply for locally available material. No top soil shall be used for fill. In addition, no gap graded material nor material weighing less than 90 pounds per cubic foot shall be used for fill.

22.1.7 Earthwork Grading

A. General

Grade all areas to a uniformly smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross-sections, lines, and elevations indicated. Provide a smooth transition between existing adjacent grades and new grades. Remove soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

B. Grading During Construction

Grading shall be done as necessary to prevent surface water from entering the excavation. Any other water accumulation therein shall be promptly removed.

C. Accessibility During Construction

Earthwork construction shall be performed in a manner that does not obstruct surface drainage or prohibit access to operational driveways, fire hydrants, manholes, and water valves.

D. Site Grading

1. Slope and Elevation of Grades

The ROW shall be sloped to direct storm runoff flow to the roadway, unless otherwise specified on the plans. Finish subgrades to required elevations within the following tolerances:

a. Lawn or Unpaved Areas

Plus or minus 0.25feet.

b. Walks

Plus 0 or minus 0.1 feet.

c. **Pavements**

Plus 0 or minus .04 feet.

2. Construction Stakes

The Developer shall provide all stakes necessary for curb, gutters, sidewalks and structures and furnish all necessary information relating to lines and grades. The Developer shall be held responsible for preservation of all such stakes.

a. Stake Removal

The Developer shall not remove stakes until three working days after placement of concrete unless approved by the Local Entity Engineer.

b. Vertical Curves

Curb stakes shall be placed at 25 foot intervals and at the lowest and highest elevations along the vertical curve. This is intended to minimize flat grades at the high and low points.

12.1.8 Erosion Control

A. Soil Protection

All disturbed soil, on or off-site and related to work at the project site, is required to be protected from wind and storm water erosion. To mitigate erosion, the contractor shall use standard erosion control techniques described in "Volume 3 – Best

Management Practices of the Urban Storm Drainage Criteria Manual," published by the Urban Drainage and Flood Control District.

B. Fort Collins (City Limits Only)

Erosion control standards for Fort Collins (city limits only) shall follow the **City of Fort Collins Storm Water Utility Specifications**.

C. Larimer County GMA

Erosion control standards are found in Larimer County Storm Water Management Manual, Section 10.

D. Loveland (City Limits Only)

Erosion control standards for Loveland (city limits only) shall follow the **City of Loveland Storm Drainage Standards**.

22.2 Trenching For Utilities

22.2.1 Excavation for Utility Trenches

A. General

All trenching activities shall comply with the requirements of OSHA's "Construction Industry Standards" as well as all applicable Federal and State regulations for safety.

Trenches shall be excavated, shored or graded, with sides sloped to conform to the requirements for the soil conditions.

No more than 300 feet of trench length shall be open at any time, unless approved by the Local Entity Engineer.

Repair of failed trenches, and all associated pavement patching and concrete repairs will be the responsibility of the party requiring the trench, and shall be repaired in accordance with Chapter 25. The Local Entity may require mill and inlay or overlay of the affected areas.

B. Tracked Vehicles

No tracked vehicles shall be permitted on streets unless approved by the Local Entity Engineer. When tracked vehicles are allowed, existing facilities will be restored to original condition at the Developer's expense.

C. Removal of Pavement

Refer to Chapter 25, Reconstruction and Repair.

D. Protection of Existing Underground Utilities

Refer to Chapter 25, Reconstruction and Repair.

E. Relocation of Utilities

Refer to Chapter 25, Reconstruction and Repair.

F. Subdrains

Subdrains shall only be installed where shown on, and in accordance with, the approved plans.

G. Trenching Through Existing Pavement

Refer to Chapter 25, Reconstruction and Repair.

22.2.2 Utility Crossings

A. Trenches

All utility trenches that must be in existing streets shall be backfilled with flowable fill after the utility line has been installed, unless otherwise directed by the Local Entity Engineer. Refer to **Section 22.2.3** for flow fill criteria.

B. Markings on Concrete Patches

Refer to the discussion on markings in **Section 22.4.3 A** about concrete finishing.

22.2.3 Backfill

A. Ordinary/Native Backfill

This shall consist of material excavated from the site except rubbish, frozen material, broken pavement, stones, or other consolidated material greater than 3 inches in diameter, organic muck, or other materials considered unacceptable by the Inspector.

B. Imported Backfill

See **Section 22.1.6** Borrow Material.

C. Structure Backfill

This material shall be Class I structure backfill, conforming to **CDOT Standard Specifications, Section 703**. Class I structure backfill shall be used on all bridges, box culverts, or where otherwise specified.

D. Flowable Fill

This material shall be required as utility trench backfill unless otherwise directed by the Local Entity Engineer. This requirement applies to all locations under existing pavement. Vibration of flowable fill shall be required unless otherwise approved by the Local Entity Engineer. The approved mix for flowable fill is shown below:

Flowable Fill

Ingredients	Pounds/Cubic Yard
Cement*	42 (0.45 sack)
Water	325 (39 gallons as needed)
Coarse Aggregate (No.57)	1700
Sand (ASTM C-33)	1845

*fly ash may be used if approved by the Local Entity Engineer.

The maximum desired 28-day strength is 60 psi. The combination of material listed above, or an equivalent, may be used to obtain the desired flowable fill. Flowable fill shall not be used as a temporary or permanent street surface.

Trenches shall be initially backfilled to the level of the original surface. After flowable fill has cured, the top surface of the flowable fill shall be removed to the depth necessary to allow repair of the permanent surface.

E. Conventional Backfill

Conventional backfill is "nonflowable fill."

1. **Backfill Lifts**
   Backfill material shall be placed in uniform loose lifts, not to exceed 8 inches prior to compaction. Alternate methods may be considered by the Local Entity Engineer.

2. **Compaction**
   Each layer shall be compacted to a density not less than 95 percent of maximum density, in accordance with **AASHTO T99** and at the moisture content as specified in the soils or pavement design report. If the moisture content is not specified, soils shall be compacted at +/- 2 percent.

3. **Categories of Conventional Backfill**
   Backfill lifts under existing or proposed streets, curbs, gutters, sidewalks, and alleys is divided into 3 categories: initial, intermediate, and final lifts as defined below.

   a. **Initial Lift (bedding)**
      This is designated as Class B and generally comprised of a washed, clean gravel material, consisting of the section from the bottom of the excavation to

a point 12 inches above the top of the underground structure installation (e.g. utility). Placement and compaction of the initial layer shall be as specified by the utility to protect their installation. Sections deeper than described above for class B will not be allowed. Check with each Local Entity for specific bedding requirements.

b. **Intermediate Lift**
This is generally comprised of native material, consisting of the section above the initial layer to a point within 6 inches of the ground level or the bottom of the pavement section, whichever is greater. Excavated material may be used in the intermediate layer provided that it is deemed suitable by the Local Entity Engineer.

c. **Final Lift**
This includes both road base and surfacing material. Road base material shall be CDOT class 5 or 6 aggregate course as specified in the pavement design report or as specified by the Local Entity Engineer.

22.2.4 Trench Cover

A. Subgrade

1. **Compaction**
After the backfill has been placed and compacted as specified, it shall be cut and trimmed to the required depth and cross section (see **Section 25.5**

Pavement). Trench cover subgrade shall be free of all rock over 3 inches in size. It shall be compacted to not less than the densities required for the given soil classification as listed in **Section 22.5.2 C**. This density requirement also applies to all utility trenches within the public Right-of-Ways. Compaction shall be evaluated by standard tests, (see **Table 23-1**), at the time of constructing curb, gutter, sidewalk, pavement, and/or other permanent trench cover structure.

2. **Excess Excavated Material**
All excess excavated material shall be removed and disposed of outside the legal limits of the Right-of-Way as the work progresses, unless the approval of the Local Entity Engineer is obtained for disposal of the material within the legal limits of the Right-of-Way.

3. **Condition Restored**
All parts of the roadway and various structures disturbed shall be restored in accordance with these Standards.

4. **Compaction Equipment**
Compaction equipment must be on the job site before excavation is started. Compaction equipment must be capable of compacting within the trench width limits to avoid bridging the ditch.

22.3 STRUCTURES

22.3.1 General

This section discusses the removal, excavation, and backfill for structures as well as specifications for materials and construction criteria.

22.3.2 Removal of Structures

Refer to **Chapter 25, Reconstruction and Repair**.

22.3.3 Excavation for Structures

A. Tolerance and Placement

Excavations shall be done in accordance with the designed elevations and dimensions within a tolerance of plus or minus 1.2 inches. Excavations shall be extended a sufficient distance from structures for placing and removing concrete form work, installing services, and other construction, and for inspections.

B. Excavations for Footings and Foundations

Do not disturb bottom of excavation. Excavate by hand, if needed, to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base for receiving other work.

C. Excavation for Underground Structures

Excavation for tanks, basins, and mechanical or electrical appurtenances shall be to elevations and dimensions indicated within a tolerance of plus or minus 1.2 inches. The bottom of excavations intended for bearing surface shall not be disturbed.

22.3.4 Structure Backfill Material

Refer to **Section 22.2.3** for backfill to be used for structures.

22.3.5 Markings

All bridges, retaining walls, and box culverts shall have the year of construction permanently impressed therein. The impression for bridges and box culverts shall be located on the downstream head wall face in legible numbers as per **Section 22.4.3 A**. The Local Entity shall determine the location of the indentured construction year for all retaining walls and the size of letters shall be per **Section 22.4.3 A**.

22.3.6 Materials

A. Concrete

1. Aggregate. Refer to **Section 22.4.2 A**.
2. Waterproofing Membrane. An approved waterproofing membrane shall be furnished according to these specifications. Refer to **CDOT Specifications Sections 515.01** and **515.02**.
3. Waterstops. Appropriate size and type of waterstop shall be furnished in accordance with these specifications and in conformance with the plans. Refer to **CDOT Specifications Section 518.02**.

B. Structural Steel

1. Structural Carbon Steel. Structural Carbon steel shall be furnished in accordance to these specifications and in conformance with the plans. Refer to **CDOT Specifications Section 509.03**.
2. High-Strength Low-Alloy Structural Steel. High-strength low-alloy structural steel shall be furnished in accordance to these specifications. Refer to **CDOT Specifications Section 509.04**.
3. Self Weathering Tubing. Self weathering tubing shall be furnished according to

12.2 CDOT Specifications Section 509.05.

4. Structural Tubing. Structural tubing shall be furnished in accordance with **CDOT Specifications Section 509.06**.
5. Bolts. Bolts shall be furnished in accordance to **CDOT Specifications Section 509.07**.
6. High Strength Bolts. High strength bolts shall be furnished in accordance with

12.3 CDOT Specifications Section 509.08.

7. Pins and Rollers. Pins and rollers shall be furnished in accordance with **CDOT Specifications Section 509.09**.
8. Anchor Bolts. Anchor bolts shall be furnished in accordance with **CDOT Specifications Section 509.10**.
9. Galvanized and Metallized Steel. Galvanized and metallized steel shall be furnished in accordance with **CDOT Specifications Section 509.11**.
10. Welded Stud Shear Connectors. Welded stud shear connectors are to be furnished in accordance with **CDOT Specifications Section 509.12**.

C. Steel Structural Plate

Steel plate structures shall consist of materials as specified on the plans and be in accordance with **CDOT Specifications Section 510.02.**

D. Timber

1. General Timber. Timber shall be furnished in accordance with **CDOT Specifications Section 508.02**.

2. Treated Timber. Treated timber shall be furnished in accordance with **CDOT Specifications Section 508.03**.

3. Hardware. Hardware for timber construction shall be furnished in accordance with **CDOT Specifications Section 508.05**.

E. Bearing Device

Bearing device materials shall be furnished in accordance with **CDOT Specifications Section 512.02**.

F. Pipe Railing

Pipe for railing shall conform to the plans and be furnished in accordance with

12.4 CDOT Specifications Section 514.02.

G. Concrete Reinforcement

1. Reinforcing Materials – General.

   a. Reinforcing Bars. ASTM A 615 Grade 60, deformed (unless otherwise specified on plans).

   b. Supports for Steel Reinforcement. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.

      1) For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

      2) For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

2. Shop Drawings.

   a. Drawings. Before fabrication of the reinforcement, the Developer shall prepare or have prepared complete bending, fabrication, and setting drawings and bar lists covering all required reinforcement steel.

   b. Review. Drawings and bar lists shall be submitted to the Local Entity Engineer for review of general conformity to specified requirements. The review of the Shop Drawings by the Local Entity Engineer in no way relieves the Developer of sole responsibility for correct placement of reinforcing steel.

3. Placing Reinforcement.

   a. General. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports, and as specified.

   b. Vapor Retarder/Barrier. Avoiding cutting or puncturing vapor retarder/barrier during reinforcement placement and concreting operations. Repair damages before placing concrete.

   c. Cleaning. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

   d. Positioning to Prevent Displacement. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by the Local Entity Engineer.

   e. Tie Bars, Bar Supports, and Wire Ties. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

   f. Wire Fabric. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

   g. Bending and Placing. Reinforcing steel, before being placed, shall be thoroughly cleaned of coatings that will destroy or reduce bond. A light coating of rust may be allowed by the Local Entity Engineer. Reinforcement shall be carefully formed to the dimensions indicated on the plans. It shall not be bent or straightened in a manner that will injure the material. THE USE OF HEAT IN BENDING BARS SHALL NOT BE PERMITTED. Bars with kinks or bends not shown on the plans shall not be used. Reinforcing steel shall be accurately placed and secured against displacement by using annealed iron wire of not less than No. 18 gauge, or suitable clips at intersections. Where necessary, reinforcing steel shall be supported by metal chairs or spacers, pre-cast mortar blocks, or metal hangers. Reinforcing bars shall not be spliced at points of maximum stress. Splices, where permitted, shall be placed in the position

   and at the spacing shown on the plans with the tolerances specified in **ACI 301, Section 5.4**.

   h. Preventing Displacement. All reinforcing bars shall be supported and wired together to prevent displacement by construction loads or the placing of concrete. On ground, and where necessary, supporting concrete blocks shall be used. Over formwork, approved bar chairs and spacers shall be furnished.

   i. Materials for Accessories. Where the concrete surface will be exposed to the

weather in the finished structure, the portions of all accessories in contact with the formwork shall be galvanized or shall be made of plastic. Where the concrete surface will be exposed to plant water, all accessories in contact with formwork shall be stainless steel or plastic.

j. Mesh. Mesh shall lap at least 1-1/2 meshes, plus end extension of wires, but not less than 12 inches in slabs and shall extend across supporting beams and walls. In lieu of adequate support for mesh, one worker shall be designated to lift the mesh during placing of concrete so that it is completely surrounded by concrete and not less than 2 inches above the bottom of slabs on ground or 1/2 inch above formwork.

k. Offsetting Bars. Vertical bars in columns shall be offset to permit the bars to be adjacent and in contact at splices.

l. Splices. All splices not shown on the drawings must have prior approval of the Local Entity Engineer.

m. No Bending. Reinforcement shall not be bent after being partially embedded in hardened concrete.

n. Splice Laps. Laps in tension splices shall be 36-bar diameters and 30-bar diameters in compression splices, or as noted.

o. Cover. The minimum clear cover for reinforcing steel shall be as specified in **ACI 301, Section 5.5**, and as shown below, unless otherwise shown on the plans.

Bottom bars on soil bearing foundations and slabs:	3 inches
Bars adjacent to surfaces exposed to weather on earth backfill:	
Bars more than 3/4 inch in diameter	2 inches
Bars 3/4 inch or less in diameter	1-1/2 inches
Interior Surfaces: Slabs, walls, joints with 1-3/8 inches diameter or smaller bars	3/4 inches

4. Reinforcement Fabrication and Placing Tolerances.

a. Bars used for concrete reinforcement shall meet the following requirements for fabricating tolerances:

Sheared length	+1 inch
Stirrups, ties	+1/2 inch
All other bends	+1 inch

b. Bars shall be placed to the following tolerances:

Concrete cover to formed surfaces	+1/4 inch
Minimum spacing between bars	+1/4 inch

c. Top bars in slabs and beams:

Members 8 inches deep or less	+1/4 inch
Members more than 8 inches but not over 2 feet deep	+1/2 inch
Members more than 2 feet deep	+1 inch

d. Crosswise of members spaced evenly within 2 inches:

Lengthwise of members	+2 inches

e. Bars shall be placed with the following minimum concrete cover, including tolerance unless noted on the drawings:

Concrete cast against earth	3 inches
Concrete exposed to earth or water	2 inches
Beams, girders, and columns	l-l/2inches
Inside face of walls not exposed to earth or water	1 inch
Structural slabs not exposed to earth or water	3/4 inch

5. Placing Welded Wire Fabric. Wire fabric in crosspans and curb cuts shall be placed as shown in the plans and details. The fabric shall be fully supported on precast mortar blocks or other approved supports prior to placing the concrete.

22.3.7 Construction Requirements

A. Structural Concrete

1. Design Mix. The design mix and approval shall be in accordance with **CDOT Specifications Section 601.05**.
2. Batching. Measuring and batching of materials shall be in accordance with **CDOT Specifications Section 601.06.**
3. Mixing. Concrete shall be mixed in various type mixers according to **CDOT Specifications Section 601.07**.
4. Structural Cast–in-Place Concrete Forms.
   a. General.
      1) Support of Loads. Design, erect, support, brace, and maintain form work to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads.
      2) Construction. Construct form work so concrete members and structures are of correct size, shape, alignment, elevation, and position.

3) Quality. Maintain form work construction tolerances and surface irregularities complying with ACI 347 limits.

b. Conforming to Plans. Construct forms to sizes, shapes, lines, and dimensions as shown on the plans and to obtain accurate alignment location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the Work. Use selected materials to obtain required finishes.

c. Joints. Butt all joints solidly and provide backup at joints to prevent cement paste from leaking.

d. Constructing for Removal. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like for easy removal.

e. Anchorage Devices. Set and build into form work anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.

f. Temporary Openings. Provide temporary openings for clean-outs and inspections where interior area of formwork is inaccessible before and during concrete placement. Securely brace temporary openings and set tightly to forms to prevent losing concrete mortar. Locate temporary openings in forms at inconspicuous locations.

g. Chamfering. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

h. Provisions for Other Trades. Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

i. Cleaning and Tightening. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment. All forms shall be oiled prior to each use.

j. Checking Alignment. Before concrete placement, check the lines and levels of erected formwork. Make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems. During

concrete placement, check formwork and related supports to ensure that forms are not displaced and that completed Work will be within specified tolerances.

k. Forms Material. Forms shall be of wood, metal, or other material as specified below or approved by Local Entity Engineer. Approved flexible forms shall be used for construction where the radius is 100 feet or less. Unexposed surfaces shall have forms of No. 2 common (or better) lumber.

1) Forms for Exposed Finish Concrete. Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable size to minimize number of joints.

2) Forms for Unexposed Finish Concrete. Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

3) Forms for Cylindrical Piers and Supports. Metal, glass-fiber-reinforced plastic, or paper or fiber tubes that will produce smooth surfaces without joint indications. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.

4) Carton Forms. Biodegradable paper surface, treated for moisture-resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

5) Form Release Agent. Provide commercial formulation form release agent with a maximum of 350 g/l volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

6) Form Ties. Factory-fabricated, adjustable length, removable, or snap-off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to the plane of the exposed concrete surface.
Provide ties that, when removed, will leave holes no larger than 1 inch in diameter in the concrete surface.

7) Maximum Deflection. The maximum deflection of facing materials reflected in concrete surfaces exposed to view shall be 1/240 of the span between structural members. Suitable moldings or chamfer strips shall be placed in the corners of column, beam, and wall forms, except where specifically directed otherwise by the Local Entity Engineer.

8) Compensating for Deflections. Where necessary to maintain the specified tolerances, the formwork shall be cambered to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and construction loads.

9) Bracing. Positive means of adjustment (wedges or jacks) of shores and struts shall be provided, and all settlement shall be taken up during the concrete placing operation. The shores and struts shall be securely braced against lateral deflections.

10) Temporary Openings. These shall be provided at the base of column and wall forms, and at other points where necessary, to facilitate cleaning and inspection immediately before concrete is deposited.

11) Accessories. Forming accessories to be partially or wholly embedded in the concrete, such as ties and hangers, shall be a commercially manufactured type. Wire is not acceptable. The portion remaining within the concrete shall leave no metal within one inch of the surface when the concrete is exposed to view. Spreader cones on ties shall not exceed 1 inch diameter. Embedded ties used in water containment structures shall have approved water seal washers.

l. Form Removal Timing. Forms shall not be disturbed until the concrete has adequately cured. The Developer or his superintendent shall be present at the time forms are removed and shall be responsible for the safety of this operation at all times. It is suggested that the minimum time between placing concrete and removal of forms be less than the following:

Item Poured	Minimum Time to Removal
Walks, Curb and Gutter	6 hours
Side forms for footings and slabs	12 hours
Side forms for walls, beam, and columns	24 hours

Forms under structural beams and slabs require shoring 7 days or when concrete has reached 2/3 of 28-day field design strength as indicated by compressive strength tests on field cured specimens.

m. Removal of Forms and Reshoring.

1) Non-Weight Bearing. Form work for columns, walls, sides of beams, and other parts not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations. See **Section 22.3.7 A.4.l**.

2) Weight Bearing. Form work for beam soffits, slabs, and other parts that support the weight of concrete shall remain in place until the concrete has reached its specified 28-day strength, unless otherwise specified or permitted.

3) Ability to Carry Loads. Forms shall not be removed in any case until the concrete has had time to set sufficiently to carry the deadloads and any construction loads it has to sustain, and in no case will the forms be removed until permission is obtained from the Engineer or his

representative.

4) Facing Material. When shores and other vertical supports are so arranged that the form-facing material may be removed without loosening or disturbing the shores and supports, the facing material may be removed at an earlier age as specified or permitted. The shores and supports shall remain in place until the concrete has reached its specified strength, unless otherwise specified or permitted. See **Section 22.3.7 A.4.l**.

5) Reshoring. Reshoring for the purpose of early form removal shall be performed, so that at no time will large areas of new construction be required to support their own weight. While reshoring is underway, no live loads shall be permitted on the new construction. Reshores shall be tightened to carry their required loads, but they shall not be over tightened so that the new construction is over-stressed. Reshores shall remain in place until the concrete has reached its specified 28-day strength, unless otherwise specified or permitted.

6) Removal Strength. This shall be based upon test cylinder strengths, as specified in **Chapter 23, Street Inspection and Testing Procedures**, or pullout tests in accordance with ASTM C900, and upon the approval of the Local Entity Engineer.

n. Refer to **Section 22.3.7 A.4** for construction, fabrication, type, cleaning, and removal of forms.

5. Permanent Steel Bridge Deck Forms. Permanent steel bridge deck forms shall be installed according to **CDOT Specifications Section 601.10**.

6. Falsework. Falsework shall be designed, constructed, and removed according to CDOT Specifications Section 601.11.

7. Placement. The placement of concrete, conditions, holes, and joints shall be in accordance with **CDOT Specifications Section 601.12**.

8. Curing Concrete Other Than Bridge Deck. Refer to **Section 22.4.3 C**.

9. Finishing.

   a. Ordinary Surface Finish. All concrete surfaces shall be given a Class 1 finish per CDOT's Class 1 Finish, **Section 601.14(b)** unless additional finish classes are specified by the plans for designated surfaces.

   b. Class 3, CDOT Class 5, Masonry Coating Finish. Refer to CDOT

   c. Specifications **Section 601.14(b).**

10. Bridge Deck Placing. Concrete shall be placed in accordance with **CDOT Specifications Section 601.12** except where there are conditions and procedures in accordance with **CDOT Specifications Section 601.15**.

11. Bridge Deck Curing. Concrete bridge decks, including bridge curbs shall be cured according to **CDOT Specifications Section 601.16**.

12. Waterproofing. Installation of waterproofing membrane over a prepared concrete bridge shall be in accordance with **CDOT Specifications Sections 515.03** through **515.07**.

13. Waterstops. Waterstops of appropriate size and type shall be installed according to **CDOT Specifications Section 518.03**.

B. Structural Steel

1. General. Welding, fabrication, and construction of steel structures shall conform to **AASHTO**'s **LRFD Bridge Construction Specifications,** latest edition, **AASHTO**'s **Standard Specifications for Highway Bridges**, latest edition, and **CDOT Specifications Section 509.02**.

2. Fabrication. General fabrication, welding, shop assembly, connections, cleaning and painting, galvanizing, and marking of steel structures shall conform to **CDOT Specifications Sections 509.19** through **509.25**.

3. Construction. Erection, connections, field cleaning, and painting of steel structures shall be in accordance with **CDOT Specifications Sections 509.27** through **509.29**.

C. Structural Plate

1. Fabrication. Fabrication of structural plate structures shall be in accordance with

   12.5 CDOT Specifications Section 510.03.

2. Construction. Erection of structural plate structures shall be in accordance with

   12.6 CDOT Specifications Section 510.05.

D. Timber

1. General. Treated and untreated timber shall be erected according to **CDOT Specifications Section 508.06**.

2. Holes and Bolts. Holes bored and drilled and bolt accessories shall be installed according to **CDOT Specifications Section 508.07**.

3. Painting. All old and new timber, handrails, posts, and parts shall be painted in accordance with **CDOT Specifications Section 508.08**.

E. Bearing Device

1. Fabrication. Fabrication of bearing devices shall apply to three types of devices and be in accordance with **CDOT Specifications Sections 512.03** through

512.05. Bearing devices shall include hardware and provide for movement in accordance with **CDOT Specifications Section 512.06**.

2. Construction. Bearing devices are to be installed, protected, certified, and approved according to **CDOT Specifications Sections 512.09** through **512.15**.

F. Pipe Railing

Pipe railing shall be installed and painted according to **CDOT Specifications Section 514.03**.

G. Cold Weather Requirements

Prior to placing concrete, ice, snow and frost shall be removed from the forms and subgrade. In no case shall concrete be placed against frozen ground or against ground containing frost. Except by specific written authorization, concrete shall not be placed unless the air temperature adjacent to the concrete placement is 30°F and rising and placing shall cease when the air temperature adjacent to the concrete placement falls below 40°F as determined by the Local Entity Engineer. When concrete placement is permitted during cold weather, the temperature of the mix shall not be less than 50°F nor more than 90°F at the time of placement. Aggregates or water shall not be heated to a temperature exceeding 150°F. Materials containing frost or lumps of frozen material shall not be used. If heated mixing water and/or an accelerator are used, the above limits may be waived only with written permission of the Local Entity Engineer. When concrete is placed in cold weather and the air temperature is expected to drop below 35°F, a suitable blanketing material shall be at the job site during placement. At any other time when the air temperature is expected to reach the freezing point for a period of 72 hours after placement, the work shall be blanketed for protection of the concrete.

22.4 Non-Structural Concrete

Non-structural concrete includes curb, gutter, walks, driveways, crosspans, and ramps.

22.4.1 General

A. Protection

It shall be the Developer's responsibility to protect new concrete from damage with appropriate methods. For areas exposed to vehicular traffic, the concrete shall be protected until 80% of required concrete strength is achieved.

B. Damaged Concrete

Damaged concrete shall be repaired, removed and/or replaced according to **Chapter 25, Reconstruction and Repair**.

C. Sequence of Construction

1. Water, Wastewater, and Storm Sewer. All curb, gutter, crosspans, and sidewalk (where attached) shall be constructed after installation of water wastewater, and storm sewer mains, laterals, and service lines have been installed and properly compacted in accordance with these specifications.
2. Water Mains. Water mains which cross curb, gutters, attached walks, and driveways shall also be installed and properly compacted prior to installation of said curb, gutter, attached walks, and driveway approaches.
3. Water Service, Valve Boxes, and Manholes. Water service lines may be installed after curb, gutter, and attached walks have been in place at least 7 days. Water valve boxes and manholes shall be adjusted to final grade after installation of curb and gutter.
4. Electrical Services. Electrical services shall be installed after water services but prior to installation of curb radii except where previous arrangements for use of conduit have been made and approved by the Local Entity's Light and Power department.

22.4.2 Materials and Methods

A. Concrete

Concrete shall be composed of cement, coarse and fine aggregate, water, and entrained air. The concrete shall contain a minimum of 6 sacks of cement per cubic yard or an equivalent cement/fly ash combination not to exceed 20 percent cement replacement (when approved), a maximum of 6 gallons of water per sack of cement, an air content between 5 percent and 8 percent by volume, and a maximum coarse aggregate size of 1-1/2 inches. Any admixture (except air entraining agent) must be approved by the Local Entity Engineer.

1. Concrete Strength. The finished concrete shall have a minimum 28-day compressive strength of 4000 psi.
2. Water/Cement Ratio. The concrete shall have a maximum water/cement ratio of 0.45.
3. Fine Aggregate.
   a. Composition. Fine aggregate shall be natural sand composed of clean, hard, durable, uncoated grains, preferably of siliceous materials.
   b. Deleterious Substances. The maximum percentage of deleterious substances shall not exceed the following values:

Substance	Maximum Percentage
Material finer than 200 mesh sieve	3% by weight
Shale	1% by weight
Coal and lignite	0.25% by weight
Clay lumps	1% by weight
Other deleterious substances	2% by weight
Sum of all above shall not exceed	5% by weight

All fine aggregate shall be free from injurious amounts of alkali and organic impurities.

c. Gradation. Fine aggregate shall be well graded and conform to **AASHTO M6** as shown in **CDOT Specifications Section 703, Table 703-1**.

4. Coarse Aggregate.

   a. Composition. Coarse aggregate shall consist of crushed limestone, trap rock, granite, washed gravel, or other approved inert materials having clean, hard, strong, durable pieces, free from adherent coating, and conforming to the requirements or these specifications.

   b. Deleterious Substances. The maximum percentage of deleterious substances shall not exceed the values listed in **Table 22-3**.

   c. Gradation. Course aggregate shall be well graded and conform to AASHTO M43 and as shown in **CDOT Specifications Section 703, Table 703-1**.

5. Fly Ash, Water, Admixtures. Refer to **Sections 22.5.5 A.3, 22.5.5 A.5, and 22.5.5 A.6**.

B. Job-Mixed Concrete

Job-mixed concrete shall be mixed in a drum-type mixer which shall conform to the Standards of the Mixer Manufacturers Bureau of the Associated General Contractors of America.

1. Mixing and Discharging. The mixer shall be capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specified time and discharge the material without segregation. The entire contents of the drum shall be discharged before recharging. The volume of the mixed materials per batch shall not exceed the manufacturer's rated capacity of the mixer. Mixers must be kept clean of hardened concrete.

2. Mixing Time and Rate of Revolutions. The mixing of each batch shall continue

for not less than one minute after all materials, except water, are in the drum. All mixing water shall be introduced before 1/4 of the mixing time has elapsed. The mixer shall rotate at the rate recommended by the manufacturer, but not less than 14 or more than 20 revolutions per minute. When additional water is added, another 30 revolutions of the drum will be required.

3. Cement Type. When concrete is mixed at the site, cement must be Type IA or IIA. The addition of any admixture at the job site is prohibited.

C. Ready-Mixed Concrete

Ready-mixed concrete shall be proportioned, mixed, and transported in accordance with the current ASTM Specifications for Ready-Mixed Concrete (Designation C-94). Delivery of central-mixed concrete shall not be made in non-agitating equipment.

22.4.3 Construction

A. Concrete Finishing

1. General.
   a. Exposed faces of curbs and sidewalks shall be finished to true line and grade as shown on the plans. The surface shall be floated to a smooth, but not slippery finish.
   b. After completion of finish and before concrete has taken its initial set, all edges in contact with the forms shall be edged with an edger.
   c. Sprinkling of the surface with water, to facilitate finishing, shall not be permitted.
2. Finish Types.
   a. Broom Finish. All concrete curb-gutter and sidewalk, unless otherwise specified.
   b. Float Finish. All access ramps and transitions shall be hand-finished, with a wood or magnesium float.
   c. Exposed Aggregate for median surface.
3. Markings.
   a. Appurtenances. In Ft. Collins (city limits), concrete used in curb-gutter, sidewalk, curb cuts, driveways, inlets, bicycle paths, retaining walls, and slope paving shall have the name of the Concrete Contractor and the year of construction impressed therein, using letters not less than 1 inch high and 3/8 inch deep. Impressions shall be made in concrete at the beginning and end of each pour.
   b. Utility. Impressions (similar to appurtenances) delineating the location of water and sewer, (S for sanitary sewer, C for clean out, + for water, with the top of

the + pointing to the water stop box), shall be located on the curb face at all service crossings.

c. Structures. Structures shall have the year constructed impressed therein, using letters 3 inches high, 1-1/2 inches wide and 3/8 inches deep.

B. Repairs

1. Defective Areas. If, after stripping of forms, any concrete is found to be not formed as shown on the drawings, or is out of alignment or level, or shows a defective surface, it shall be considered as not conforming with these Standards. The defective area shall be removed and replaced by the Developer at their expense.

2. Sidewalk Areas. For Loveland (GMA and city limits), bolt holes, tie-rod holes, and minor imperfections, for sidewalks only, as approved by the Local Entity Engineer, shall be filled with dry-patching mortar.

   a. Dry-patching Mortar shall be composed of one part Portland cement to two parts of regular concrete sand (volume measurement), and water. Use only enough water that the mortar will stick together upon being molded, after the ingredients are mixed thoroughly. These mortar mix proportions are approximate.

   b. Placing Mortar. Mortar repairs shall be placed in layers and thoroughly compacted by suitable tools. Care shall be taken in filling rod and bolt holes so that the entire depth of the hole is completely filled with compacted mortar.

C. Concrete Curing

1. General. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures as well as rain, flowing water, and mechanical injury. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material.
   Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing.

2. Materials. Refer to the Materials Specification in CDOT 601.13 for concrete curing methods.

3. Curing Methods. Cure concrete by one of the following methods:

   a. Liquid Membrane Curing Compound. Apply pigmented curing compound to exposed interior slabs and on exterior slabs, walks, and curbs as soon as final finishing operations are complete. Apply uniformly in continuous operation, according to manufacturer's directions, and at a rate of 150 sq ft per gallon for all concrete. The compound shall be kept agitated to prevent the pigment from settling.

   b. Moisture Retaining Cover Curing. This curing approach is optional in Loveland (GMA and city limits) only Cover concrete surfaces with moisture- retaining

cover (polyethylene sheets) for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

D. Cold Weather Requirements

Refer to **22.3.7 G**.

E. Joints

1. Tooled Joints. Transverse joints shall be located at intervals of 10 feet in curbs, gutters, and crosspans. When combination curb, gutter, and walk are used, the joint shall be continuous through all three elements with a maximum spacing of ten feet. The joints shall be initially cut a minimum of one-third the thickness of the concrete. For detached sidewalks, the tooled joint spacing shall equal the sidewalk width.

2. Expansion Joints. Expansion joint material shall be installed every 500' in long runs and between new structure slabs and existing concrete slabs, where called for and around fire hydrants, poles, inlets, sidewalk underdrains, midblock ramps, radius points at intersections, and

   other fixed objects, i.e. joins with existing sidewalk slabs and curbs. Expansion joint material must be set vertical and installed in accordance with the CDOT specification titled M&S Standards for Concrete Pavement Joints. The joint shall be edged with a suitable edging tool and sealed in accordance with **CDOT Section 412.18.**

F. Backfilling

The space adjoining the concrete shall be backfilled with suitable material, properly compacted, and brought flush with the surface of the concrete and adjoining ground surface no earlier than 7 days after concrete placement, unless otherwise approved by the Inspector.

In embankments, the backfill shall be level with the top of the concrete for at least 2 feet and then sloped to meet existing grade. Maximum slope shall be 4:1. For walks detached from the curb, the space between the curb and walk shall be backfilled on a straight line from the top of walk to the top of curb.

G. Opening to Traffic

It shall be the Developer's responsibility to protect new concrete and repairs from damage with appropriate methods. For areas to be exposed to traffic, the concrete shall be protected until 80% of required concrete strength is achieved.

H. Warranty

The Developer shall guarantee curb, gutter, walks, driveways, and crosspans after completion against defective workmanship, materials and vandalism. The determination of the necessity during such guarantee period for the Developer to repair said curb, gutters, walks, driveways or crosspans, or any portion thereof, shall rest entirely with the Local Entity Engineer whose decision upon the matter shall be final and binding upon the Contractor. Refer to **Chapter 24, Acceptance Procedures and Record Drawings/Warranty**, for additional information.

I. Initial and Final Acceptance

Upon substantial completion and upon written request of the Developer, the Local Entity Engineer shall, with the Developer, physically examine the work and/or phase of the work. The Local Entity Engineer shall issue written initial acceptance of the work with a "punch list" of deficiencies to be completed within 30 days and prior to final acceptance. If no deficiencies are found, the Local Entity Engineer shall issue a written final acceptance of the work. Refer to **Chapter 24, Acceptance Procedures and Record Drawings/Warranty**.

22.4.4 Tunneling or Boring Under Curb, Gutter, Walks, and Pavements

A. General

Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades on plans.

B. Borings

Boring for utilities shall be permitted if approved by the Local Entity Engineer. See Chapter 25 for more information.

22.5 PAVEMENT

22.5.1 Fill

Cavities that are a result of excavation and areas deficient in grade shall be brought to grade with fill material. All imported fill material shall be tested in accordance with **Chapter 23, Street Inspection and Testing Procedures**.

A. Engineered Fill

Subbase or base materials. See **Sections 22.5.3 and 22.5.4**.

22.5.2 Subgrade and Roadbed

A. General

Subgrade material shall conform to the lines, grades, cross-sections, and thickness shown on the approved plans and shall be finished and maintained in an acceptable condition at least one day's progress in advance of base construction.

B. Subgrade Approval

1. Notification. Notify the Local Entity Engineer when excavations have reached required subgrade.
2. Inspection. See Chapter 23, Street Inspection and Testing Procedures.
3. Reconstruction. See Chapter 23, Street Inspection and Testing Procedures.

C. Subgrade Preparation

1. Preparation Conditions. Work shall not occur on the subgrade in freezing conditions, or when the subgrade is frozen.
2. Compaction. The subgrade shall be free of organic material and shall be deep-plowed to a minimum depth of 12 inches, moisture-treated to within 2 percent (or as specified on the plans or geotechnical report) of optimum moisture content, thoroughly mixed, and replaced and compacted to 95% maximum standard proctor in 6-inch lifts.
3. Testing. See **Chapter 23, Table 23-1 Material Testing**.
4. Final Proof-Rolling. After the subgrade has been compacted, tested, and found to meet specifications, the entire subgrade shall be mechanically proof-rolled with a heavily loaded vehicle to ensure uniformity of the subgrade. The vehicle must have a loaded GVW of 50,000 pounds with a loaded single axle weight of at least 18,000 pounds and a tire pressure of 90 psi. Subgrade which is pumping or deforming under loading must be reworked, replaced or otherwise modified, to form a smooth, stable, non-yielding base for subsequent paving courses. The Local Entity Engineer shall be notified at least 24 hours before final proof-rolling. All proof rolls shall be observed and approved by an Inspector.
5. Preparation of Cut Subsurfaces and Undisturbed Areas. Subgrade surfaces below excavated areas such as cut areas and undisturbed areas require additional preparation. Unless otherwise approved by the Local Entity Engineer, said subgrade shall be scarified to a depth of 12-inches, wetted or aerated as needed, and compacted to 95% maximum standard proctor dry density (AASHTO T-99) at +/-2% of optimum moisture content for cohesive soils or +/-3% for non- cohesive soils.
    a. Expansive soils, refer to **Chapter 10**.
6. Acceptance. See **Chapter 23, Street Inspection and Testing Procedures**.

D. Subgrade Protection

During construction, subgrades and excavations shall be kept shaped and drained. Ditches and drains along the subgrade shall be maintained to drain effectively at all

times. Where ruts occur in the subgrade, the subgrade shall be brought to grade, reshaped, and recompacted prior to placing of subbase material. The storage or stockpiling of materials on the subgrade will not be permitted. No base course shall be laid until the subgrade has been inspected and approved. Under no circumstances shall base or pavement material be placed on a muddy or unstable subgrade.

E. Soil Stabilization

1. General. For new construction, soil stabilization shall extend to back of curb for detached walk and to back of walk for attached walk.

2. Lime Stabilization. This section specifies requirements for design, materials, and construction of lime-stabilized subgrades. This section is applicable to stabilizing fine-grained soils (clays and silts) only. It is not applicable to stabilizing sands and gravels used as bases or subgrades.

   a. General. The purpose of lime stabilization is to improve the subgrade quality of a clay soil by increasing its strength and reducing its swell-shrink potential during wet-dry cycles.

   b. Materials. The material for lime treated subgrade consists of a mixture of native or imported soils, hydrated or quick lime and water, as outlined by ASTM Specification C977. Hydrated lime shall conform to the requirements of ASTM C 207-79, Type N. In addition, the residue retained on a 200 mesh sieve shall not exceed 10 percent when determined in accordance with ASTM C 110. Drying of the residue in an atmosphere free from carbon dioxide will not be required.
   The materials to be used in construction shall be tested and a mix design submitted to the Local Entity Engineer for approval. See **Chapter 23, Street Inspection and Testing Procedures**, concerning mix design report.

   c. Preparation and Application. The surface of the roadbed shall be graded to the established lines, grades, and cross sections as shown on the plans. The prepared roadbed shall be scarified to the depth and width required for the subgrade stabilization. The material thus obtained shall be pulverized. Application, mixing, and finishing shall be in accordance with **CDOT Specification Sections 307.05 through 307.09.**

   d. Design and Testing. A site-specific lime-stabilization design is required prior to construction and based on a soil report with additional testing required. See **Chapter 5, Soils** Investigations **and Report**. The design shall be prepared by a Colorado Registered Professional Engineer competent in the field of geotechnical engineering and shall be included in the Pavement Design Report as required in **Chapter 10, Pavement Design and Technical Criteria**. Testing shall verify that projected "R" values were achieved.

   e. Mix Design Approval. To be approved, the mix shall have a minimum 7-day compressive strength of 160 psi. In addition, the plasticity index of the treated soil shall not exceed 6. The minimum acceptable hydrated lime content shall be

4 percent by weight.
Only mix designs approved by the Engineering Division shall be used. Approvals are required on a project basis prior to issuing construction permits. Minimum in-place thickness for this material shall be 8 inches.

f. Pavement Design.

1) Flexible Pavement Over Stabilized Subgrade. The **AASHTO Guide for the Design of Pavement Structures** is the basis of the Local Entity's design procedure. For lime-stabilized subgrades with a minimum compressive strength of 160 psi, a strength coefficient of 0.14 shall be used in the layer-thickness equation. Refer to **Chapter 10, Pavement Design and Technical Criteria,** for the flexible pavement design procedure and show calculations in the pavement design report.

2) Rigid Pavement Over Stabilized Subgrade. The appropriate design nomographs for rigid pavement referenced in **Chapter 10, Pavement Design and Technical Criteria** shall be used to determine slab thickness. Evidence supporting a total modulus of subgrade reaction for the untreated subgrade and the lime-stabilized layer shall be provided.

3. Fly Ash Stabilization. This item shall consist of treating the subgrade or existing base, by pulverizing, adding Class C fly ash, and mixing and compacting the mixed material to the required density. This item applies to natural ground or embankment and shall be constructed as specified herein and in conformity with the typical sections, lines and grades as shown on the plans or as established by the Engineer.

a. Materials.

1) Fly Ash. Fly Ash shall meet **ASTM C 618** for Class C Fly Ash.

2) Water. The water used in the stabilization mixture shall be potable.

b. Equipment.

1) The machinery, tools and equipment necessary for proper execution of the work shall be on the project and approved by the Local Entity Engineer prior to the beginning of construction operations.
All machinery, tools, and equipment used shall be maintained in a satisfactory and workmanlike manner.

a) Fly ash shall be furnished in trucks. Each truck shall have the weight of fly ash recorded on certified scales.

c. Construction Methods.

1) General. It is the purpose of this specification to secure a completed course of treated material which contains a uniform fly ash/soil mixture with no

loose or segregated areas, has a uniform density and moisture content, is well bound for its full depth, and has a smooth surface suitable for placing subsequent courses. It shall be the responsibility of the Developer to regulate the sequence of work; to process a sufficient quantity of material to provide full depth as shown on the plans; to use the proper amounts of fly ash; to maintain the work and to rework the courses as necessary to meet the above requirements.

2) Preparation of Subgrade. Before other construction operations have begun, the subgrade shall be graded and shaped to enable the fly ash treatment of materials in place, in conformance with the lines, grades, and thickness shown on the plans.

3) Application. The fly ash shall be spread by a method approved by the Local Entity Engineer at the rates shown on the plans or as directed by the Local Entity Engineer. Fly ash shall not be applied when wind conditions, in the opinion of the Local Entity Engineer, are such that blowing fly ash becomes objectionable to traffic or adjacent property owners.

During final mixing, the materials shall be sprinkled, as directed by the Local Entity Engineer, until the proper moisture content has been secured. However, initial mixing after the addition of fly ash will be accomplished dry, or with a minimum of water, to prevent fly ash balls.

Final moisture content of the mix, prior to compaction, shall not exceed the optimum moisture content of the mix by more than 2 percent, nor less than optimum by more than 2 percent. Should the natural moisture content of the soil be above the specified range, aeration of the soil may be required prior to addition of the fly ash.

4) Mixing. The soil and fly ash shall be thoroughly mixed by approved road mixers or other approved equipment. The mixing shall continue until, in the opinion of the Local Entity Engineer, a homogeneous, friable mixture of soil and fly ash is obtained, free from all clods or lumps.

Water required to achieve the specified moisture content for the mixture should be added after initial mixing. There shall be a 6 inch overlap between passes to assure a consistent mix.

5) Compaction. Compaction of the mixture shall begin immediately after mixing of the fly ash and shall be completed within two hours following addition of water to the fly ash. The material shall be sprinkled as necessary to maintain the optimum moisture.

Compaction of the mixture shall begin at the bottom and shall continue until the entire depth of mixture is uniformly compacted to the specified density. All non-uniform (too wet, too dry, or insufficiently treated) areas that appear shall be corrected immediately by sprinkling and rolling. The

surface of the course shall be maintained in a smooth condition, free from undulations and ruts, until work is placed thereon of the work is accepted.

The stabilized section shall be compacted to the extent necessary to provide the density specified in **Table 22-1**.

Table 22-1

Required Density for Stabilized Compaction

Description	Density
For fly ash treated subgrade, existing subbase or existing base that will receive subsequent subbase or base courses.	Not less than 95% maximum dry density (ASTM D 698)
For fly ash treated base that will receive surface course.	Not less than 97% maximum dry density (ASTM D 698)

In addition to the requirements specified for density, the full depth of the material shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests as necessary may be required by the Engineer.

If the material fails to meet the density requirements, the Engineer may require it to be reworked as necessary to meet those requirements or require the Developer to change construction methods to obtain required density on the next section. Throughout this entire operation the shape of the course shall be maintained by blading, and the surface, upon completion, shall be smooth and in conformity with the typical section shown on the plans and to the established lines and grades. Blading should be terminated within two hours after blending of the fly ash.

Should the material, due to any reason or cause, lose the required stability, density or finish before the next course is placed, or the work is accepted, it shall be reprocessed, re-compacted, and refinished at the sole expense of the Developer. Reprocessing shall follow the same pattern as the initial stabilization, including the addition of fly ash.

4. Finishing, Curing, and Preparation for Surfacing. After the final layer or course of the treated subgrade, subbase or base has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections.

   a. The resulting base surface shall be thoroughly rolled with a pneumatic tire roller and "clipped," "skinned" or "tight bladed" by a power grader to a depth of approximately ¼ inch, removing all loosened stabilized material from the section. Re-compaction of the loose material should not be attempted.

The surface shall then be thoroughly compacted with the pneumatic roller, adding small increments of moisture as needed during rolling. If plus No. 4 aggregate is present on the surface of the mixture, one complete coverage of the section with the flat wheel roller shall be made immediately after the "clipping" operation.

When directed by the Local Entity Engineer, surface finishing methods may be varied from this procedure provided a dense, uniform surface, free of surface compaction planes, is produced. The moisture content of the surface material must be maintained within the specified range during all finishing, and shall proceed in such a manner as to produce, in not more than two hours, a smooth, closely knit surface, free of cracks, ridges or loose material conforming to the crown, grade and line shown on the plans.

1) After the fly ash treated course has been finished as specified herein, the surface shall be protected against rapid drying in a thorough and continuously moist condition by sprinkling for a period of not less than three days, or until the surface or subsequent courses are placed.

5. Other Materials for Stabilization. Other methods of stabilization may be considered only with sufficient supporting data submitted by the Designer for the proposed method.

F. Subgrade Surface Tolerance

Variations from the subgrade shall not be more than 1 inch in soil. Where asphalt or Portland cement concretes are to be placed directly on the subgrade, the subgrade plane shall not vary more than 1/2 inch.

22.5.3 Subbase

A. Materials

Subbase material shall be well mixed, free of organic matter, and lumps or balls of clay, and shall consist of sound aggregate particles and suitable filler or binding materials which, when placed and compacted, will result in a firm, dense, unyielding foundation. Subbase material need not be crushed, but may be of the pit run variety, providing it is graded according to **CDOT Table 703-2, Class 1 Aggregate Base Course**. The plasticity index shall not exceed 6 when the aggregate is tested in accordance with **AASHTO T89** and **T90** respectively. "R" value shall be a minimum of 50 and the test loss for the Los Angeles Abrasion test **(AASHTO M147)** shall be less than 50 percent.

Deviations from the CDOT gradation limits will be permitted when approved by the Local Entity Engineer for unpaved roads, where it can be adequately demonstrated that the proposed subgrade material can fulfill the intent of these specifications.

B. Application

Subbase shall be deposited and spread, without particle segregation, in loose layers not to exceed 6 inches in depth. Each layer shall be thoroughly and individually compacted to 95 percent standard proctor (**AASHTO T 99**) density. Wetting or aerating and rolling of the material shall be required when ordered by the Engineer. Subbase shall not be placed on soft, spongy, or frozen subgrade or other subgrade, the stability of which, in the opinion of the Local Entity Engineer, is unsuitable.

C. Surface Tolerance

The prepared surface of the subbase shall not vary from the established grade by more than one inch.

22.5.4 Base Course

This section covers furnishing, placing, and watering gravel or stone to provide a firm and stable foundation for subsequent construction. The base course shall be constructed on a previously constructed subgrade in accordance with the lines, grades, quantity requirements, and the typical cross-sections shown on the plans.

A. General

Base material shall conform to the lines, grades, cross-sections, and thicknesses shown on the approved plans and shall be finished and maintained in an acceptable condition at least one day's progress in advance of placing prime coat or paving material.

B. Aggregate Base Course Material

Base material shall consist of hard, durable particles or fragments of stone or gravel crushed to the required sizes. Material shall contain an appropriate quantity of sand or other finely-divided mineral matter which conforms to the requirements of **AASHTO M 147**, and to **Section 703.03, CDOT Standard Specifications Class 5 or Class 6 Aggregate Base Course**. In addition, the material must have an R-value of 72 or greater, and must be moisture stable. When produced from gravel, not less than 60 percent by weight of the aggregate retained on a No. 4 sieve shall consist of particles having at least one fractured face. Base material shall be free from vegetable matter and lumps or balls of clay and when placed and compacted will result in a firm, dense, unyielding foundation. The Local Entity Engineer may approve recycled asphalt or concrete pavement.

Coarse aggregate shall show a loss of not more than 50 percent when tested in accordance with **AASHTO Standard Method of Test for Abrasion of Coarse Aggregate** by use of the Los Angeles Machine, Designation: AASHTO T-96 (AASHTO M 147).

1. Approval of Sources. Only aggregate from the Local Entity approved sources shall be used. Refer to **Chapter 23, Street Inspection and Testing Procedures**.

(Approval of sources will, at a minimum, consist of supplying documented gradation, Atterberg limits, and R-value testing on an annual basis).

C. Cement Treated Aggregate Base Course Material

This material shall consist of a mixture of aggregate materials, Portland cement, and water as outlined in **Section 308 of the CDOT Standard Specifications,** latest version. Acceptable aggregates include **CDOT Classes 4, 5,** and **6**. Other aggregates may be used, if previously approved by the Local Entity Engineer. The materials to be used in construction shall be tested and a mix design submitted to the Local Entity Engineer.

1. Mix Design Approval. To be approved, the mix shall have a 7-day compressive strength of at least 650 psi, and no more than 1000 psi. The minimum acceptable cement content shall be 5 percent by weight.

   Only mix designs approved by the Local Entity Engineer shall be used. Approvals are required on a project basis, or an annual basis for suppliers, prior to issuing construction permits.

D. Application

Base material shall be deposited and spread without particle segregation in loose layers not to exceed 6 inches in depth. Each layer shall be thoroughly and individually compacted to 95 percent standard Proctor (**AASHTO T-99**) density. Wetting or aerating and rolling of the material shall be required as ordered by the Local Entity Engineer, following review of all field test results. No base course shall be placed upon a soft, spongy, or frozen subgrade or other subgrade, the stability of which, in the opinion of the Local Entity Engineer, is unsuitable.

E. Surface Tolerance

The prepared surface of the base shall not vary above or below the established grade by more than 1/2 inch.

F. Soil Sterilization

Soil sterilization shall be applied under all new paving. The sterilization agent shall be a pre-emergent herbicide, soluble, dispersible, or mixable in water and nontoxic to humans when applied per the manufacturer's recommendations. The agent shall be active for one year after application. The applicator shall be certified by the U.S. Environmental Protection Agency and licensed in the State of Colorado as a pesticide applicator and shall be held responsible for any damage to plant growth outside of the roadway or to pavement where such damage is attributable to carelessness or improper application of the agent. Care shall also be taken to prevent contamination of surface waters.

22.5.5 Portland Cement Concrete Pavement

A. Materials

This material shall consist of a mixture of coarse and fine aggregates, Portland cement, water, and other materials or admixtures as required. Colorado Department of Transportation Class "P" or "AX" mix may be used. The only alternatives to "P" or "AX" shall be according to **Section 412.03 of CDOT Standard Specifications**. Other high-early strength concretes may be used only where special conditions warrant, subject to written approval by the Local Entity Engineer.

1. Portland Cement. Portland cement shall comply with the Colorado Department of Transportation requirements. The type of cement shall be Type II, unless sulfate conditions necessitate otherwise. **Table 2.2.3** in **Chapter 2.2** of **ACI 201** indicates recommendations for sulfate resistance.
2. Fine Aggregates. Fine Aggregates shall meet Colorado Department of Transportation **Section 703.01** requirements and gradation as shown in CDOT Table 703-1 and **Table 22-2.**
3. Coarse Aggregates. Coarse Aggregates shall meet Colorado Department of Transportation **Section 703.02** requirements and gradation as shown in **Table 22-3.**
4. Fly Ash. Fly ash shall comply with **Colorado Department of Transportation Section 701.02**.
5. Water. Water shall meet the requirements of **Colorado Department of Transportation Section 712.01**.
6. Air Entraining and Chemical Admixtures. Shall meet the requirements of **Colorado Department of Transportation Sections 711.02 and 711.03**. No additive manufactured with the purposeful addition of chloride shall be permitted. Water-reducing admixtures are used when concrete temperatures are as follows: Type A is used with ambient temperature range of 50 to 90 degrees inclusive; Type D is used when ambient temperature is over 90 degrees.

Table 22-2

Fine Aggregates for Portland Cement Concrete

Sieve Size or Test Procedure	Percent Passing or Test Requirement
Friable Particles, %	1.0, Maximum
Coal & Lignite, %	1.0, Maximum
Deleterious Material (AASHTO T-1 1), %	3, Maximum
Sand Equivalent (AASHTO T 176), %	80, Minimum
Fineness Modulus	2.50–3.50
Sodium Sulfate Soundness, %	20.0, Maximum

Table 22-3

Coarse Aggregates for Portland Cement Concrete

Sieve Size or Test Procedure	Percent Passing or Test Requirement
2"	100
1-1/2"	95–100
¾"	35–70
3/8"	10–30
#4	0–5
#200	1.0, Max. (1.5% if crusher fines)
% Wear	45, Maximum
Clay Lumps and Friable Particles, %	2.0, Maximum
Coal and Lignite, %	0.5, Maximum
Sodium Sulfate Soundness, %	12, Maximum

B. Concrete Forms

Refer to **Section 22.3.7 A.4.l**. Removal of forms shall occur at no less than 12 hours.

C. Construction

1. Placing. Concrete pavement may be placed using slipform methods or fixed forms. The concrete shall be deposited on moist subgrade in such a manner as to require as little re-handling as possible. Reasonable care shall be taken to prevent any segregation of the concrete materials. Workers shall not be allowed to walk in freshly mixed concrete with boots or shoes coated with earth or foreign substances.

2. Vibrating. Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. Vibrators shall not be used to move the concrete into place.

3. Consolidation and Floating. The concrete shall be struck off and consolidated with a mechanical finishing machine, vibrating screed, or hand finishing methods. A slipform paver may also be used. After the concrete has been struck off and consolidated and joints formed (if necessary), it shall be leveled with a bull float having a handle to permit operation from the edge of the pavement. Any excess water and latencies shall be removed from the surface of the pavement. The straightedge shall be operated at 90 degrees to the transverse joints and shall be overlapped 1/2 of its length after each pass. Irregularities shall be corrected by

adding or removing concrete. All disturbed places shall again be straight-edged. The use of hand tools shall be kept to a minimum. They may be used in areas not accessible to finishing equipment and for compacting concrete in the vicinity of formed joints.

4. Joints. Transverse and longitudinal joints shall be constructed to the dimensions and at the spacing shown on the plans. Transverse joints shall extend the entire width of the pavement and through the curbs. Joints may be formed in the plastic concrete or sawed after the concrete has hardened. Tooled joints may be constructed by depressing an approved tool into the plastic concrete cut a minimum of 1/3 the thickness of the slab.
   Sawing of joints shall begin as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling and before uncontrolled cracking occurs. If necessary, the sawing operations shall be carried on both day and night, regardless of weather conditions. At Contractor's option, tooled joints may be installed during initial placement to control cracking.

   a. Construction Joints. All longitudinal joints may be construction joints at the Contractor's option. Transverse construction joints shall be installed whenever the placing of concrete is suspended an excessive length of time as determined by the Local Entity Engineer.

   b. Joint Filling. Joints shall be filled in accordance with CDOT 412.18 before the pavement is opened to traffic. Prior to filling, all foreign material shall be removed from the joints and the joints shall be thoroughly dry. Where preformed compression-type sealers are used, they shall be lubricated to allow the sealer to be inserted the full depth of the joint. Liquid elastic type fillers shall be poured to within 1/4 inch of the top of the joint. Care should be taken to keep from over-filling the joint.

5. Curing. Refer to the Materials Specification in CDOT 601.13 for concrete curing methods.

6. Opening to Traffic. The Local Entity Engineer shall decide when the pavement shall be opened to traffic. It shall not be opened to traffic until the field-cured concrete has attained a flexural strength of 450 psi, and a compressive strength of 3,000 psi or .80 F_c', whichever is greater. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete is placed. Before opening to traffic, the pavement shall be cleaned.

D. Warranty

Refer to **Section 22.4.3 H** and substitute the word "street" for the words "curb, gutters, walks, driveways and crosspans."

E. Initial and Final Acceptance

Refer to **Section 22.4.3 I**.

22.5.6 Asphalt Pavement

This section specifies materials and methods to be used for constructing superior performing pavements for streets, or other miscellaneous areas within the Right-of-Way. This work shall consist of constructing one or more courses of plant mix hot asphalt pavement, overlay, or leveling course on a prepared foundation and to the finished dimensions shown on the plans, or as directed by the Local Entity Engineer. **(Reference CDOT 403)**

A. Materials

1. Aggregates. All Aggregates shall conform to the current Colorado Department of Transportation **"Standard Specifications for Road and Bridge Construction".**

Table 22-4

Design Mix Criteria

Property	Test Method	Value for All Gradings (gyrations) (75)	(100)	Reference
Air Voids, percent at: N (design)	CPL 5115	3.5 – 4.5	3.5 – 4.5	
Lab Compaction (gyrations): N (design)	CPL 5115	75	100	
Hveem Stability, minimum	CPL 5106	28	30	
Aggregate Retained on the 4.75mm (No. 4) sieve with at least 2 mechanically induced fractured faces, % minimum	CP 45	90	90	
Accelerated Moisture Susceptibility Tensile Strength Ratio (Lottman), minimum	CPL 5109; Method B	80	80	
Minimum Dry Split Tensile Strength, psi	CPL 5109; Method B	30	30	
Grade of Asphalt Binder, Top Layer		See Table 22-7		
Grade of Asphalt Binder, below Top Layer		See Table 22-7		
Voids in Mineral Aggregate (VMA), % minimum	CP 48	See Table 22-6		
Voids Filled with Asphalt (VFA), %	AI SP-2	65 - 80	65 - 75	
Aggregate Design Grading	CDOT	S or SX	S or SX	
Laboratory Design Temperatures		See Table 22-5		

Note:

1. **AI SP-2** = Asphalt Institute Superpave Series No. 2
2. The current version of CP (Colorado Department of Transportation) standards is available from the Region 4 Materials Engineer.
3. Warm mix asphalt is allowed as an alternate to Hot Mix Asphalt, provided all material requirements and specifications are met and approved by the Local Entity Engineer. The supplier and method of warm mix asphalt must be on CDOT approve list.
4. Gyration design revolution (Ndes) will be 75 unless otherwise specified by the Local Entity Engineer based upon project specific criteria and/or traffic levels.

Table 22-5

Laboratory Mix Design Temperatures

Superpave Binder Grade	Laboratory Mixing Temperature, °C (°F)	Laboratory Compaction Temperature, °C (°F)
PG 58 - 28	154 (310)	138 (280)
PG 64 - 22	163 (325)	149 (300)
PG 64 - 28	163 (325)	149 (300)

Warm Mix Asphalt is exempt from this table
*All temperatures in this table have a tolerance of + 2.8°C (+ 5°F)

Table 22-6

Minimum Voids in the Mineral Aggregate (VMA)

Nominal Maximum Size[1], mm (inches)	Design Air Voids[2]		
	3.5%	4.0%	4.5%
37.5 (1-1/2)	11.5	12.0	12.5
25.0 (1)	12.5	13.0	13.5
19.0 (3/4)	13.5	14.0	14.5
12.5 (12.5)	14.5	15.0	15.5
9.5 (3/8)	15.5	16.0	16.5

Notes:
1. The Nominal Maximum Size is defined as one sieve larger than the first sieve to retain more than 10%.
2. Interpolate specified VMA values for design air voids between those listed.
3. Air Void Criteria: A design air void range of 3.5 to 4.5% with a target of 4.0% will be used on all mixes. The air void criteria will be applied to the approval of the design mix.

Selection of Gyratory Design Revolutions. Gyratory Design Revolutions shall be as follows: for arterial roadways 100 gyrations; for collector and local roadways 75 gyrations.

2. Selection of Performance Graded Binders (Asphalt Cement) for Mix Design

a. Asphalt Binders Permitted

The Asphalt binder properties address pavement performance for the climate and traffic found in the specific area of the project. The high and low temperature properties required are then specified according to a percent reliability against rutting (high temperature properties) and thermal cracking (low temperature properties) found for a given pavement. The high and low temperatures used to select asphalt cement grades are pavement temperatures at 20 mm below the pavement surface and at the pavement surface respectively.

The physical properties that the asphalt cement are required to meet stay the same. What changes is the temperature at which these asphalt cement properties must be met.

Because of the many climate conditions, specifying asphalt cements based on climate conditions results in a very large number of asphalt cements nationwide. However, only a limited number of PG grades are needed for Colorado. Therefore, only three PG Graded Binders will generally be permitted in these specifications. PG 58-28, PG 64-22, PG 64-28

Asphalt Binders shall conform to the requirements listed in the current Colorado Department of Transportation **Standard Specifications for Road and Bridge Construction**.

b. Binder Grades

In an effort to simplify the binder selection process, the following binder grades have been specified for the various types of construction and road classifications. Refer to **Table 227.**

Table 22-7

Binder Grade Requirement

Top Lift		Lower Lift	
Local/Residential	PG 58-28	Local/Residential	PG 58-28
Minor Collector	PG 58-28	Minor Collector	PG 58-28
Major Collector	PG 64-28	Major Collector	PG 64-22
Industrial/Commercial	PG 64-28	Industrial/Commercial	PG 64-22
Arterial	PG 64-28	Arterial	PG 64-22

3. Anti-Stripping Additive. An anti-stripping additive shall be required and the following shall apply:

   a. Hydrated Lime. If additive is not added at refinery, a minimum of one percent hydrated lime by mass (weight) of the combined aggregate shall be added to the aggregate for all hot asphalt pavement. Hydrated lime shall meet the requirements of ASTM C207, Type N. The "F" factor used in calculating P values for lime gradation shall be 0.3.

   b. Liquid Additive

      1) The Developer shall use an approved anti-stripping additive. The amount of additive used shall be a minimum of 0.5 percent by mass (weight) of the asphalt cement.

      2) In-Line Blender. The additive shall be added at the refinery or at the hot plant. If liquid anti-stripping additive is added at the plant, an approved in-

line blender must be used. The blender shall be in the line from the storage tank to the drier drum or pugmill. The blender shall apply sufficient mixing action to thoroughly bmix the asphalt cement and anti-stripping additive.

4. Filler. Filler shall meet the requirements of **AASHTO M17**.

B. Job Mix

1. Testing Laboratory. See **Chapter 23, Job Mix for Asphalt Asphaltic Concrete Pavement**.

2. Composition of Mixtures. The Asphalt plant mix shall be composed of a mixture of aggregate, filler or additives if required and approved, asphalt material, and reclaimed material if permitted and used.

3. Mix Design. The Contractor shall submit the following to the Engineer for each proposed mix design:

   a. A proposed mix design job-mix gradation for each mixture certified by an AASHTO accredited laboratory complying with CDOT Field Materials Manual Colorado Procedure 10 shall be wholly within the Master Range Table, **Table 22-8**. The mass of lime shall be included in the total mass of the material passing the No. 200 sieve. The restricted zone boundaries given in the Asphalt Institute's Superpave Series No. 2 (SP-2) Manual, Appendix B, are to be used as guidelines in mix design development. However, the job-mix gradation is not required to pass above or below the restricted zone boundaries.

   b. The aggregate source, percentage of each element used in producing the final mix, the gradation of each element, and the proposed job-mix formula (JMF) gradation. The gradation used shall be based on the Contractor's JMF.

   c. The name of the asphalt cement supplier.

4. Sampling for JMF Testing. The contractor's proposed job-mix formula for each hot asphalt pavement grading will be tested utilizing materials actual produced and stockpiled.

5. JMF Target Values. The job-mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size, a single percentage of asphalt material to be added to the aggregate, and a single temperature for the mixture at the discharge point of the plant.

6. Aggregate Source Changes. Should a change in the sources of material be made, a new job-mix formula shall be established and approved in accordance with section 3 before the new material is used.

7. Recycle Asphalt Pavement. The hot asphalt pavement shall not contain more than 20 percent reclaimed asphalt pavement where allowed. The reclaimed asphalt pavement shall meet the requirements of **CDOT subsection 703.04**.

8. Aggregate Quality. Test for cleanliness, abrasion loss, and percent of fractured

faces will be made on representative samples of aggregate taken during production or from the stockpiles.

9. JMF Compliance. When laboratory tests indicate that a proposed job-mix formula complies with the specifications the JMF may be submitted for mix design approval in accordance with section 3.

10. Mix Design Approval. Mix designs will be approved on a Laboratory/Production approval system. Initial approval will be given based on laboratory design. Production approval will then be given based on testing conducted on plant mixed samples to verify the approved laboratory design.

    New mix design shall be submitted for approval for a two year period with a one point verification submitted and approved on an annual basis. Should a change in sources of materials be made a new mix design will be required & shall remain in effect for the remainder of the approval period.

    a. Laboratory Mix Design Approval. The Developer may receive preliminary mix design approval of a new asphalt mix design, based on the following procedure:

        1) The mix designs will be performed by an AASHTO accredited laboratory complying with CDOT Field Materials Manual Colorado Procedure 10 and approved by the Local Entity.

        2) Conditions. The following conditions shall apply to this preliminary approval:

            a) Written Request and Submittals. The Developer shall make a written request for preliminary mix design approval, and submit three copies of the independent lab mix design containing all the information required in Laboratory Mix Design checklist in Appendix E-7.

            b) Test Results. The results of all required tests shall meet the mix design specification requirements listed in Table 23.5.

            c) Asphalt Content. The Local Entity Engineer, only, shall approve the asphalt content based on the private lab mix design.

    b. Production Mix Design Approval. The Developer may receive and maintain production mix design approval of an HMA mix design, based on the following procedure:

        1) Following laboratory mix design approval verification of mix properties will be performed by an independent laboratory on plant-produced mix and approved by the Local Entity. This verification is to be performed on or before the first day of production within the GMA.

        2) To maintain production mix design approval verification of mix properties shall be performed by an independent laboratory on plant-produced mix and approved by the Local Entity every 10,000 ton of mix produced.

3) Conditions. The following conditions shall apply to production mix design approval:

a) Written Request and Submittals. The Developer shall make a written request for production mix design approval, and submit the results of the mix verification report performed by a independent lab.

b) Test Results. The results of all required tests shall meet the mix design specification within the tolerances listed in Table 22-8.

Table 22-8

Tolerances for Hot Mix Asphalt

Element	Tolerance
Asphalt cement content	+/-0.30%
Voids in Mineral Aggregate (VMA)	+/-1.2%
Air Voids (Va)	+/-1.2%
Lottman	Min. 80
Hot Mix Asphalt Gradation	
Passing the 3/8" and larger sieves	+/-6%
Passing the No. 4 and No. 8 sieves	+/-5%
Passing the No. 30 sieve	+/-4%
Passing the No. 200 sieve	+/-2%

c) Local entity shall have 5 days to review production mix design verification test results and approve or reject the mix design.

d) Stop Work. If the results of mix design verifications are not within the tolerances as determined by the local entity the contractor shall immediately stop paving within the GMA and submit a mitigation plan to the local agency for approval. If given approval paving may resume and a new mix design verification test will be performed on the first day of production. If after implementation of the mitigation plan the contractor in not capable of meeting the original mix design specifications he shall complete and submit a new mix design to the local entity for laboratory mix design approval.

22.5.7 Construction Requirements

1. Weather.

a. Placement Temperatures. Plant mix pavement shall be placed only on properly prepared unfrozen surfaces which are free of water, snow, and ice. The plant mix pavement shall be placed only when both the air and surface temperatures equal or exceed the temperatures specified in Table 22-9 and the Local Entity Engineer determines that the weather conditions permit the

pavement to be properly placed and compacted.

Table 22-9
Placement Temperature Limitations in ° F

Compacted Layer Thickness in Mm (Inches)	Minimum Surface and Air Temperature ° F	
	Top Layer	Layers Below Top Layer
2" – 3"	50	40
3 or more	45	35

Note: Air temperature is taken in the shade. Surface is defined as the existing base on which the new pavement is to be placed. If the temperature falls below the minimum air or surface temperatures, paving shall stop.

b. Temporary Pavement Layer. The Work shall be scheduled so that no planed or recycled surface is left without resurfacing for more than 10 calendar days from October 1 to March 1. The Developer shall immediately place a temporary hot asphalt pavement layer on any surface that has been planed or recycled and cannot be resurfaced in accordance with the above temperature requirements within 10 calendar days after being planed or recycled.

1) Thickness. The minimum thickness of the temporary hot asphalt pavement layer shall be 2 inches. The Developer shall perform the quality control required to assure adequate quality of the hot asphalt pavement used in the temporary layer.

2) Markings. All applicable pavement markings shall be applied to the temporary layer surface.

3) Maintenance. The Developer shall maintain the temporary layer for the entire period that it is open to traffic. Distress that affects the ride, safety, or serviceability of the temporary layer shall be immediately corrected to the satisfaction of the Local Entity Engineer.

4) Removal. The temporary hot asphalt pavement layer shall be removed when work resumes.

22.6 MISCELLANEOUS

22.6.1 Rebuilt Miscellaneous Structures

A. General

This section addresses removing, relaying, resetting, or adjusting structures, fences, guard rail, signs, pipe, end sections, traffic signals, and related materials. All designated items shall be carefully removed and every precaution taken to avoid damage. Coordinate relocation of permanent traffic devices with the Local Entity Engineer. The Developer will be required to replace or repair any material damaged

due to their operations at their own expense. The work shall include the back-filling of any resulting trenches, holes, or pits.

B. Construction

1. Pipe to be re-laid and structures to be re-set shall be thoroughly cleaned. Removal sites shall be neatly backfilled with suitable material and compacted in accordance with these Standards.
2. All material that is unserviceable shall be handled according to **CDOT Specifications Section 210.02.**
3. Fences and gates should be rebuilt or reset according to **CDOT Specifications Section 210.04.**
4. Mailboxes complete with supporting structures are to be removed and reset according to **CDOT Specification Section 210.06**. Reset height shall be 42 to 48 inches. The box face shall be no closer than 2 feet from the curb face or edge of sidewalk, whichever is applicable.
5. Re-setting of all traffic control signs and traffic signaling devices will conform to **Section 22.6.2** and be coordinated with the Local Entity Engineer.
6. Structures shall be adjusted according to **CDOT Specifications Section 210.10**.
7. At no time shall manholes and valve boxes be covered up or buried. Valve boxes and manholes are to be maintained fully accessible at all times for emergency and maintenance operation by the Local Entity personnel.

22.6.2 Traffic Signals, Signing, and Striping

A. General

This section addresses the material specifications for traffic control devices as well as requirements for their installation.

The specification and installation of all traffic control devices shall conform to the **Manual on Uniform Traffic Control Devices** and the **Colorado Standard Specifications for Road and Bridge Construction**, latest edition.

Permanent signing, striping, and traffic signals, shall be in place before new roadways are completely opened to the public.

1. Traffic Control Devices on Public Property. The Developer shall submit a striping

and signage plan approved by the Local Entity Engineer. The Developer shall install all traffic control devices, except signals. Devices shall be placed to conform to the drawing details.

2. Traffic Control Devices on Private Property.
   a. Responsibility. All traffic control devices on private property; i.e., pavement markings, regulatory signs, fire lane signs, and handicapped parking signs shall be installed and maintained by the property owner.
   b. Placement. A signage and striping plan specifying the various types and combinations of traffic control devices shall be submitted to the Local Entity Engineer for approval. Refer to **Chapter 3,** Information **Requirements for Construction Plans,** for requirements.

B. Traffic Signal

1. Signals. All permanently fixed traffic signals will typically be installed by the Local Entity.
2. Loop. For traffic loop installation, contact the Local Entity Engineer.

C. Traffic Signal Controller

All traffic signal controllers will typically be installed by the Local Entity.

D. Traffic Signing

1. Street Name Signs.
   a. Materials. Street name signs shall be fabricated reflective sheeting, on 0.80 gauge aluminum or approved equal in accordance with Chapter 14.
   b. Installation.
      1) Location. Street name signs shall be placed on diagonally opposite corners at each intersection at the point of curvature of the corner radius. Thus, they will be on the far right-hand side of the intersection for traffic on the major street. Tee intersections will also require two sign locations. Signs naming both streets shall be erected at each location. This requirement includes local and collector streets in residentially zoned areas.
      2) Placement/Setback. The street name assembly is usually combined on top of stop signs. Sign placement for the stop sign or other regulatory sign shall govern in these cases. In other instances, the street name assembly should be placed according to the following, as measured from the edge of the sign:
         a) Curb, Gutter and Sidewalk Combination. Two feet behind sidewalk.
            (1) Curb with no Sidewalk or Detached Sidewalk. Two to three feet behind curb on local streets. On Collector streets, 4 to 5 feet behind

curb, and on Arterial streets, 6 to 8 feet behind curb.

(2) No Curb or Gutter. Six to twelve feet from edge of pavement.

3) Mounting. Street name signs shall be mounted with two standard rivets (TL3806 EG, Drive Rivet) with nylon washers placed against the face. Typical installation includes four street name signs, two for each direction.

4) Post and Mounting Installation. Refer to **Sections 22.6.2 D.6.a** and **6.b**.

2. Traffic Control Signs. Traffic control signs are categorized as regulatory, warning, and guide signs.

   a. Materials. All regulatory signs shall be fabricated using reflective sheeting, on aluminum blanks in accordance with Chapter 14.

   b. Installation. These signs shall be placed generally as per the MUTCD and the Colorado Supplement.

   c. Mounting. Traffic control signs shall be mounted on existing sign posts, street lights, and utility poles where possible. Refer to **Section 22.6.2 D.6**.

3. Crosswalk Signs.

   a. Materials, Installation, and Mounting. Materials for and installation and mounting of signs for crosswalks shall be in accordance with the above **Section 22.6.2 D.2**. All pedestrian crossing and W16-7P signs shall use fluorescent yellow/green (diamond grade) sheeting.

   b. Placement. A crosswalk sign with the W16-7P "Arrow" placard shall be erected at the crosswalk and at a minimum distance before the crosswalk without placard per MUTCD requirements.

4. Roundabout Signs.

   a. Materials, Installation and Mounting. Materials for and installation and mounting of signs for Roundabouts shall be in accordance with the above **Section 22.6.2 D.2**.

   b. Placement. The in advance warning and regulatory signs (refer to Chapter 14, Traffic Control Devices) and "Yield" sign shall be placed in accordance with MUTCD. The "Arrow" signs shall be placed two feet outside the edge of the circulating roadway per MUTCD between each entrance and exit of the roundabout. Refer to **Figure 8-14** for general locations.

5. Bikeway Signs. "No Parking" signs (R7-9a) as shown in **Construction Drawing 1402** shall be installed, generally, at intervals of 250 feet, at an angle of 45 degrees to the roadway.

6. Posts and Mountings.

   a. Materials. The sign post system shall be comprised of three sections, an anchor, post, and sign. The anchor specification shall be Telespar 22F12A- 03PG-2-1/4 inch square x 3 feet, 12 gauge, Anchor Stub with holes. The post

specification shall be Telespar 20F12P-10PG – 2 inch square x 10 feet, 12 gauge, post with holes. Refer to **Section 22.6.2 D.2** for sign materials.

b. Installation. The anchor is driven into the ground 30 to 33 inches with 6 to 3 inches above the adjacent ground level. The square post section with holes is inserted into the anchor six to eight inches and bolted with two 2-1/2 inch long, 3/8 inch hex head bolts. These bolts are installed at the top two holes at 90 degrees to one another.

c. Mounting. The top of the sign shall be mounted with one TL3806 EG Drive Rivet with a nylon washer on the sign face. The bottom of the sign shall be mounted using one 5/16" hex bolt, one metal washer, and one nylon washer against the sign face. A 5/16" hex nut is used to secure the bolt on the backside of the post.

7. Sign Height. Signs shall be mounted at a height of 7 feet, measured from the bottom of the sign to the top of curb. The height to the bottom of a secondary sign mounted below another sign shall be 6 feet from the top of the curb. Where a traffic control sign is mounted on the same post with a street name sign, it shall be placed below the street name sign, with the bottom of the traffic control sign 7 feet from the top of curb.

E. Traffic Striping and Marking

1. General. Existing and temporary pavement striping and marking shall be removed prior to new installations according **CDOT Specifications Section 202.05**. Surfaces shall be thoroughly cleaned and prepared prior to application of striping and marking.

   On chip seals, changes to existing markings shall require removal of existing markings prior to new installations. Removal shall be according to **CDOT Specifications Section 202.05** which could include water blasting, sandblasting, or grinding.

   A Right-of-Way Work Permit is required prior to striping removals and installations. Refer to **Chapter 6, Permits,** for permits.

2. Striping.

   a. Striping Materials.

      1) Asphalt Pavement. All new striping on asphalt streets shall meet the minimum standards for latex applications. A minimum of 15 mils thick (when dry) of latex paint (Flint Trading Co.) specified in **CDOT Specifications Section 708.05** will be used. The paint will be used with standard moisture resistant beads specified in **CDOT Specifications Section 713.08** and designed for waterborne paint. The beads shall be applied at a minimum rate of 6.5 pounds per gallon of paint applied.

      2) Concrete Pavement. Striping on concrete streets shall meet the minimum

standards for latex waterborne paint per **CDOT Specifications Section 708.05.**

b. Pre-Striping Materials. Layout (spot taping) of striping shall be done using standard, reflective 3M Temporary (foil backed) roadway marking tape specified according to **CDOT Specifications Sections 713.14 and 713.15** or tabs (for chip seals or slurry seals only). Tape shall be 4 x 4 inches. Tabs and tape shall be the same color as the future striping and symbols.

c. Pre-striping. Prior to permanent installation of traffic striping, the contractor shall place temporary tabs or tape depicting alignment and placement of the same. Prior to the use of tape or tabs, a layout shall be done neatly using string or chalk line, inspected, and adjusted as necessary and must be in the center of the line.

d. Layout and Tab Installation. Installation of temporary marking tape shall be according to **CDOT Specifications Section 627.08**. There shall be a tab or tape for each line. Therefore, in the case of a double line, there will be two tabs, one for each line. To improve night visibility, protective tab covers shall be removed immediately after chip, slurry, or sand sealing.

A typical 25-foot spacing of tabs or temporary tape for each spot will be used. Breaks in each line shall be marked with a "T" (using tape) to define the end and beginning of lines.

e. Striping Application. Application rates and specifications for striping shall be according to **CDOT Specifications Section 627.04**. Striping on new asphalt and/or concrete pavement must receive two (2) full applications (two coats) of paint with beads. Refer to **Construction Drawings 1403 and 1404**.

1) Centerline. All centerline striping shall be double yellow, each 4 inch wide, with a 4-inch minimum gap between the two.

2) Parking Stalls and Angle Parking. All striping for parking conditions shall be white and 4 inches wide. All edge lines of parking areas shall also be white and a minimum of 4 inches wide.

3) Turn Bays. If a turn bay occurs on a curve, it shall be marked with an 8-inch wide dotted extension line, in accordance with **MUTCD** requirements.

3. Marking.

a. Materials. All pavement markings such as arrows, onlys, crosswalks, stopbars, and bike symbols shall meet minimum standards for preformed thermoplastic. Refer to **Chapter 14, Traffic Control Devices,** for specifications. A minimum thickness of 125 mil (Flint Trading Co.) or approved equal, shall be required. Markings on all concrete (and where required by manufacturer on asphalt) shall use correct 2 part primer. Other requirements from **CDOT Specifications Section 708.07** still apply.

b. Application. Application specifications shall be according to **CDOT**

Specifications Sections 627.06 and 627.07.

c. Stopbars. Stopbars are to be installed in accordance with the Local Entity Engineer. Refer to **Construction Drawing 1403**.

d. Crosswalks. Crosswalks will be marked using the continental/Denver style starting from the flowline (or extended flowline) then back from the intersection the standard 9 feet in Loveland (GMA and city limits),, or 12 feet in Fort Collins (GMA and city limits). Where a concrete pan is present the concrete surface cure shall be removed, the

specific manufacturer's 2 part primer must be applied as per manufacturer's specifications. Refer to **Construction Drawings 1403, 1404** and **1405**.

e. Roundabouts.

1) Yield Marking. The yield line shall be placed where the entry roadway meets the outer edge of the circulatory roadway (where the entering vehicles wait). Refer to **Figures 8-13** and **8-14**.

2) Crosswalk. The crosswalk shall be placed approximately one car length in advance of each entry point. Refer to **Figure 8-13**.

f. Bike Lanes. All on-street bike lanes shall be designated with bicycle arrow signs. See **Construction Drawings 1406 and 1408L**. The arrow designates the direction of recommended travel. The bike lane symbols shall be placed approximately 10 feet downstream from all intersections. Refer to **Construction Drawings 1403, 1404** and **1410**.

22.6.3 Bus Shelters

Shelters shall be placed on a 6-inch-thick concrete pad. The size and location of the pad as well as shelter criteria are discussed in **Chapter 16, Pedestrian Facilities**. The material and construction specifications are the same as those for concrete sidewalks. Refer to **Section 22.4**, concerning non-structural concrete.

22.6.4 Streetscape Standards - Fort Collins (City Limits Only)

See **Appendix "C" – City of Fort Collins Streetscape Standards**.

CHAPTER 23 – STREET INSPECTION AND TESTING PROCEDURES

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CHAPTER 23 – STREET INSPECTION AND TESTING PROCEDURES

23.1 GENERAL REQUIREMENTS

23.1.1 Quality Assurance

A. Inspection.

A Local Entity Engineer shall observe key steps of the construction process, including permit processing, key inspections, overall compliance with these Standards, and the approved plan set and acceptance procedures. Key inspection times will occur in the following phases: right-of-way grading, trenching for utilities, structures, non-structural concrete, pavement and traffic signs, striping and signals. Adequate construction inspections are also the basis for acceptance by the Local Entity.

Upon completion of the construction work, and prior to Local Entity's acceptance of work and issuance of Certificate of Occupancy, copies of the "Record Drawings," all required test reports, and the Designer's statement that the roads and appurtenances have been constructed in conformance with the approved lines, grades, specifications, and Standards shall be delivered to the Local Entity Engineer before a request for collateral release will be considered.

B. Qualifications for Local Entity Engineer and Tester.

All inspection and testing personnel shall be certified at the NICET Level II or above or appropriate Lab Cat level for work performed. Equivalent training and/or experience may be accepted by the Local Entity in lieu of the NICET Certification. All concrete field testers are required to have Level I, ACI field certification. Documentation of all qualifications for Local Entity Engineer and testers shall be submitted at the construction coordination meeting.

C. Testing.

During the construction process the Developer is required to provide testing from an independent laboratory on all infrastructure installation including soils, concrete, asphalt, and other applicable tests as described in **Table 23-1** of this chapter.

All testing laboratories engaged in testing for projects shall be pre-qualified by the Local Entity.

D. Developer Responsibility.

These Standards state the minimum requirements for materials sampling, testing, and inspection. All tests shall be made and certified by an approved independent testing laboratory. The Developer shall be responsible for retaining a licensed Geotechnical Engineer for material testing. All costs required and pertaining to testing, the work performed, and materials supplied to verify compliance with these Standards shall be the responsibility of the Developer. All retesting shall be at the Developer's expense.

Where certified test reports are required to be furnished by the manufacturer, the Developer shall furnish duplicate copies of the reports to the Local Entity Engineer before the material will be approved for use. The test data shall be delivered to Local Entity within 48 hours of the testing.

The use of the Geotechnical Engineer's services does not relieve the Developer of the responsibility to furnish the required materials and to perform the required construction in full compliance with these Standards. Passing test results do not constitute acceptance of the work or materials represented by the test. The Developer is responsible for quality control of their work.

In various sections of these Standards, specific testing or other data is required by the Local Entity to insure that the intent of these Standards is fulfilled. The costs of such tests or other specific data where required by these Standards or on the approved plans shall be borne by the Developer. When evidence indicates that the work performed may not comply with these standards or the approved plan, the Local Entity Engineer may require additional tests or data beyond that required in these Standards or on the approved plans. The costs of such tests shall be borne by the Developer. Should such tests or additional data show a failure to meet these Standards or the approved plans, the Developer shall be responsible for all costs associated with repair or replacement of said failure.

The costs of all inspections and oversight of the construction process shall be paid for by the Developer. Refer to **Section 23.8** for requirements and fees.

E. Use of Non-Approved Material.

In the event any material or equipment proposed to be used by the Developer is disapproved by the Local Entity Engineer as not meeting the requirements of these Standards, said materials or equipment shall not be used on the Project. If, after approval of the Plans, the Developer desires to change any materials or equipment from that previously approved by the Local Entity Engineer, said change shall be accomplished only by a written request to the Local Entity Engineer. The Local Entity Engineer must approve any change before any materials can be ordered.

All materials used on the project shall be approved by the Local Entity. The Developer shall submit the proper documentation and receive approval or denial from the Local Entity within 45 days.

F. Pavement Design Report.

The pavement design report required in these Standards shall be submitted and approved a minimum of 5 working days prior to any paving. Refer to **Chapter 10, Pavement Design and Technical Criteria**.

G. Geotechnical Engineer Access and Assistance.

The Developer shall allow the Geotechnical Engineer access to the job site at all times. The Developer shall furnish any labor required to assist the Geotechnical Engineer in obtaining and handling samples at the source of material and at the

Project. The Developer shall provide and maintain, for the sole use of the Geotechnical Engineer, adequate facilities for safe storage and proper curing of concrete test specimens on the Project site as required by **AASHTO T23**.

The Geotechnical Engineer personnel are not authorized to stop work, to revoke, alter, relax, enlarge, or release any requirements of the Standards, nor to approve, accept, or reject any portion of the Work on behalf of the Local Entity.

H. Mix Designs.

The Developer shall furnish to the Local Entity Local Entity Engineer pavement mix designs meeting the requirements of these Standards a minimum of 5 working days prior to intended use of the mix. The mix design shall be reviewed and accepted by the Local Entity Engineer prior to use. If a mix design not accepted by the Local Entity is used, the Local Entity may require removal of all improvements placed with the unaccepted material.

I. Test Reports.

Test reports submitted to the Local Entity shall include all tests performed on the project. Reports shall be reviewed by a Professional Engineer competent in the required testing practice. All test reports shall show the location where the test was performed or at which the work or batch represented by the test. Test reports shall include all information specified in the **AASHTO**, ASTM, or Colorado test procedure used. Improperly completed reports will not be accepted.

Prior to acceptance of each phase of a project, all final reports signed and sealed by a Professional Engineer shall be submitted to the Local Entity indicating compliance with these specifications.

J. Warranty Period.

The warranty period for the completed public street improvements cannot start until all required test reports, record drawings, inspection reports, and other documentation are submitted in the proper format and accepted by the Local Entity.

23.1.2 Quality Assurance Testing and Reporting

All testing methods and procedures performed by the Geotechnical Engineer personnel shall be done in accordance with the applicable **AASHTO**, ASTM, or Colorado Procedure requirements and procedures (see **Table 23-1**). Test reports shall include the **AASHTO**, ASTM, and Colorado Procedures (CP) test designations of all tests taken. All testing and retesting services shall be done at the expense of the Developer.

When changes in materials or proportions are encountered during construction, or when the work fails to pass tests or fails to meet the Standards, additional tests shall be taken as directed by the Local Entity Engineer. Failure of the Developer to furnish satisfactory test data shall be sufficient cause for rejection of the work in question.

Table 23-1
Material Testing

Soils	AASHTO	ASTM	Frequency
Sampling	T87	D420	
Soil Classification	M145	D3282 D2488/D2487	Per soil type encountered
Moisture-Density (Proctor)			Per soil type encountered
Standard	T99	D698	As specified in Geotechnical Report
Modified	T180	D1557	As specified in Geotechnical Report
Density and Moisture Content	T238 & T239	D2922 & D3017	"Right of Way"
-Grading			1/1000 cubic yards
-Embankment			1/500 lf/lane (min. of 1 per street) 1' vertical
-Subgrade			1/500 lf/lane (min. of 1 per street)
-Utility Trench			1/100 lf horizontal & 2 per service (vertical)
-Manhole/Fire Hydrants			1/2' vertical within 2' alternating directions (min. of 4)
Hot Mix Asphalt (HMA)			
Sampling	T168	D979	
Density			
-Nuclear	----	D2950	1/500 lane feet (min. of 1 per street) per lift
-Coring	T166	D2726	As required or directed
-Laboratory Theoretical	T209	D2041	As required or directed
Asphalt Content & Gradation		D5444 or C136 (Gradation)	1/500 tons
Solvent	T164	D2172	
Ignition Oven	T308	D6307	
Nuclear	T287	D4125	
Thickness		D3549	As required or directed
Aggregate Gradation	T27	D5444 or C136	As required or directed
Fractured Faces		D5821	As required or directed
Concrete			
Sampling	T141	C172	
Mold and Cure	T23	C31	
Transportation of Cylinders	T23	C31	
Physical Properties			1/75 cubic yards/One per day Min.
Slump	T119	C143	Refer to 23.4.1,I; 23.5.3,C and Table 23-2
Air Content	T152	C231	Refer to 23.4.1,I; 23.5.3,C and Table 23-3
Compressive Strength	T22	C39	Refer to 23.4.1,I; 23.5.3,C and Table 23-4
Obtaining Cores	T24	C42	As required or directed
Compressive Strength of Cores	T24	C42	As required or directed
Aggregate Base Course			
Gradation	T27	C136	Per source or as required or directed
Moisture-Density (Proctor)			Per source or as required or directed
Modified	T180	D1557	As specified in Geotechnical Report
Standard	T99	D698	As specified in Geotechnical Report
Density/ Moisture Content			1/1000 lf/Lane--Min. 1 per street

23.1.3 Material Specifications

A. General.

The Specifications presented in this section are performance oriented. The Local Entity's objective in setting forth these Specifications is to achieve an acceptable quality of roadway structures.

B. List of Materials to Be Annually Approved by Local Entity.

All sources for the mined or manufactured materials that are listed below shall be annually tested by the supplier and approved by the Local Entity Engineer for compliance with the appropriate materials performance specifications. No material sources shall be used for public improvement construction without approval of the Local Entity Engineer. For the purpose of these Standards, public improvements are all roadway improvements, driveways, sidewalks, curbs and gutters, crosspans, ramps, structures, and other public infrastructure within Local Entity right-of-way, or within a public access easement.

1. The following materials shall be annually approved:
    a. Concrete mix design
        1) Admixtures, water reducing agents, and accelerators
        2) Air-entraining agents
    b. HBP mix design
    c. Admixtures, water reducing agents, and accelerators
    d. Fly ash
    e. Aggregate base course material
    f. Flowable concrete fill
2. The following additional materials may be required to be tested and approved at the discretion of the Local Entity Engineer:
    a. Liquid membrane curing compound (white pigmented liquid linseed oil based curing compound) shall conform to **ASTM Specification C309-81 Type II, Class B**.
    b. Polyethylene sheets
    c. Expansion joint material
    d. Welded steel wire fabric
    e. Lime
    f. Aggregate
    g. Pipe materials

h. Geotextile/Fabric

i. Steel rebar

j. Signage materials

k. Striping materials

l. Traffic signal materials

m. Lighting types

C. Procedure for Material Source Approval.

On or before April 1 of each year, or a minimum of 14 calendar days before construction, a material supplier for any Local Entity public improvements shall supply written documentation and material test results from a competent materials testing laboratory that describes:

1. Material(s) being tested to meet Local Entity specifications
2. The test procedures employed
3. The supplier's manufacturing, mining, or treating process by which the tested materials were created
4. The material test results
5. A signed statement by the material supplier that the materials to be provided for public improvements in the Local Entity during the coming 365 day period have been tested within the last sixty days.

D. Violations of Approval Conditions

1. Random Testing. The Local Entity Engineer may order random tests of materials used in Local Entity public improvements to verify compliance with material specifications.

   Any and all material used to construct Local Entity public improvements that is not from a certified source, or that is from a certified source and fails one or more random material tests, may be subject to complete removal as a condition of Local Entity acceptance of that public improvement. Additional tests will be required to confirm the existence and extent of the substandard material prior to the initiation of remedial action. The extent of the material to be removed will be at the discretion of the Local Entity Engineer.

2. Materials Not Listed in **Section 23.1.3 B**. Other permitted materials include those deemed by the Local Entity to be the primary structural materials commonly or typically used in public improvements. Ancillary public improvement materials such as manufactured paints and coatings, bonding agents, sealers, gaskets, insulating materials, etc., should be in compliance with Colorado Department of Transportation material specifications for the appropriate material employed.

Decisions on acceptability of alternative materials will be made by the Local Entity Engineer.

23.2 RIGHT-OF-WAY AND PUBLIC EASEMENT GRADING

23.2.1 Soil Testing

A. Referenced Standards.

All testing shall be done in accordance with testing methods of **AASHTO** or **ASTM** as designated in **Table 23-1**.

B. Moisture-Density Determination.

A moisture-density determination shall be taken for each soil type encountered. For A-6 and A-7 soils, **AASHTO T99** shall apply.

C. Compaction.

Refer to **Chapter 22, Construction Specifications**, for compaction criteria. Also refer to **Table 23-1** for the material test method.

D. Imported Fill.

All imported fill material shall be tested and accepted in accordance with **Chapter 5, Soils Investigations and Report**, prior to placement of any fill material.

E. Frequency of Testing.

Refer to **Table 23-1**.

23.2.2 Erosion Control

A. Fort Collins (city limits only)

Refer to City of Fort Collins Storm Drainage Standards

B. Rip-Rap

1. Materials. For riprap, plastic filter cloth, and impervious plastic lining material criteria, refer to the discussion of erosion control in **Chapter 22, Materials and Construction Specifications**.

2. Construction Requirements.

   a. Plastic Filter Cloth. If, in the opinion of the Local Entity Engineer, field lap joints of plastic filter cloth or impervious plastic lining are necessary, refer to the discussion of erosion control in **Chapter 22, Materials and Construction Specifications**.

C. Plant Preparation.

Plant inspection and acceptance shall be done prior to installation according to **CDOT Specification Section 214.02**.

D. Lawns and Grasses (Sod and Seeding).

Inspection of materials will be limited to that shown by the submittals outlined in the erosion control discussion in **Chapter 22, Materials and Construction Specifications**.

23.3 TRENCHING FOR UTILITIES

23.3.1 Excavation for Utility Trench

A. Construction Inspection.

Inspection of construction shall be provided, as frequently as necessary, to confirm that the construction conforms to the plans and specifications. The Developer shall notify the Local Entity 24 hours prior to placement of trench backfill.

23.3.2 Bedding

Inspection of bedding material is the responsibility of the utility owner and is not governed by these standards. Refer to the utility standards.

23.3.3 Backfilling

A. Inspection.

Inspection of backfill materials shall be made prior to installation to determine compliance with these Standards. Refer to **Table 23-1** for compaction requirements. All backfill compaction shall meet the compaction requirements. Compaction testing shall be required for all utility trench backfill. Trench backfill placement within public easements, as well as the right-of-way, shall be observed and accepted by the Local Entity Engineer and shall meet these requirements.

23.4 STRUCTURES

23.4.1 Concrete Structure Inspections

This section delineates the testing, inspection, and related documentation requirements for all structures, including bridges, retaining walls, cast-in-place box culverts, and other concrete structures specified within.

A. Concrete Mix Design.

Concrete mix designs shall be performed according to **Section 23.5.1** .

B. Plan and Specifications Review.

It is the Developer's responsibility to familiarize the materials testing firm with the plans and specifications approved by the Local Entity Engineer prior to any construction.

C. Structural and Inspection Requirements.

The structural design Engineer or his representative, familiar with assumptions inherent in the structure design, shall inspect the construction in sufficient detail to confirm that the construction meets the requirements of the plans and specifications.

D. Specialty Inspection.

Specialty inspection of construction may be required, as frequent as necessary to confirm that the construction conforms to the plans and specifications, by qualified personnel experienced in the inspection of similar structures. A written log or report of all work shall be furnished to the Local Entity Engineer at or prior to the request for initial acceptance of the structure. These inspection costs shall be borne by the Developer in addition to any other inspection fees required in **Section 23.8**. All bridges and major drainage structures with a span greater than twenty feet shall be inspected and rated in accordance with CDOT bridge rating criteria, to meet proper rating for a new bridge, prior to the structure's acceptance by the L.E.

E. Material Testing Requirements

Testing of materials shall conform to the requirements of **AASHTO** "Standard Specifications for Highway Bridges," latest edition, and applicable interims, as well as applicable **CDOT** standards.

F. Foundation Testing and Inspection Requirements.

Unstable foundation material shall be removed to a depth approved by the Local Entity Engineer below the finish grade elevation and be replaced with a material and construction procedure as approved by the Local Entity.

G. Inspection of Forms and False Work

1. The forms shall be clean of all dirt, mortar, and all foreign material. Forms that will later be removed shall be thoroughly coated with an approved form oil.

2. The forms shall be mortar tight and of a quality (in addition to the bracing) to withstand the pressures from deposited concrete.

3. Unless otherwise specified, forms for exposed surfaces shall be constructed with triangular fillets 3/4 inch at all exterior corners.

H. Inspection of Reinforcing Steel

1. Material Grade and Size. The material grade and size shall be as specified by the Designer on the certified construction plans.

2. Tying.

   a. The intersections of all bars shall be tied in accordance with the following requirements: Slab bars shall be tied at every intersection around the periphery and at spacing according to bar sizes. Unless bar spacing is less than 12" in which case every other intersection shall be tied. However, in no case shall less than 30% of the intersections be tied.

   b. Wall bars should be tied sufficiently to prevent shifting, at least 3 times in any bar length at every third or fourth intersection and at spaces according to bar sizes, staggered:

#5 and smaller	- 3'0"
#6 to #9	- 4'0" to 5'0"
#10 to #11	- 6'0" to 8'0"

   Upper and lower mats shall be tied or otherwise fastened at 4 foot maximum spacing in each direction. Minimum splice length shall be 24 bar diameters.

   1) All reinforcing steel shall be supported with steel chair or precast mortar.

   2) Reinforcing steel shall be clean and free of all foreign material before concrete is placed.

   3) All clearances shall be in compliance with approved plans and specifications.

I. Concrete Testing and Inspections

1. Materials Specifications. The class of concrete used on structures shall be in accordance with **CDOT Specifications Section 601.02** and **CDOT Table 601-1**. Concrete that does not meet strength in 28 days is subject to removal.

2. Concrete Tests.

   a. All testing shall be done in accordance with **AASHTO** or **ASTM** as designated in **Table 23-1**.

   b. Sampling and testing shall be required on all concrete work including curb, sidewalk, crosspans, pavement, ramps, slope paving, retaining walls, inlets, manholes, or any other structures.

   c. Maximum time allowed between sampling and casting cylinders shall not exceed 15 minutes. If the concrete cannot be taken to the laboratory and cylinders cast within 15 minutes, the cylinders shall be cast in the field. Cylinders shall be transported to the laboratory within 24 hours of casting but after the concrete has hardened, (see **AASHTO T23 or ASTM C-31**).

   d. Concrete cylinders shall be load-tested and broken at the times listed on **Table 23-2**.

Table 23-2
Concrete Cylinder Breaks

Number of Cylinders	Break Interval (Days)
Series (4 Cylinders) *	
1	7
2	28
1	HOLD

NOTE: Additional cylinders may be required, as directed by the Local Entity Engineer. 56-day cylinder shall be used if 28-day cylinder strength is less than the required design strength.
* For high strength early concrete operations a minimum of one additional cylinder shall be poured for additional breaks.

e. The slump test shall be performed in accordance with **AASHTO T119**. The air test shall be performed in accordance with **AASHTO T196** or **T121**. Slump and air test measurements shall be taken with each cylinder series. Concrete slump and air content shall be done in accordance with **CDOT Table 601-1**.

f. Coring. Coring is not generally permitted unless approved by the Local Entity Engineer and if approved, the section cored shall be repaired to the satisfaction of the Local Entity Engineer.

g. Low Strength Test Results. If compressive strength of cylinders and beams does not meet the specified values, the Professional Engineer shall recommend and the Local Entity Engineer shall approve the necessary mitigation measures needed.

J. Testing Frequency and Related Inspections

1. At least 4 compressive strength cylinders shall be taken from the same concrete delivery truck to provide design compliance testing at the laboratory. Two of the four specimens will be tested at 28 days for acceptance and 1 shall be tested at 7 days for information. The fourth cylinder shall only be necessary if the 28-day fails. This is required for each pour per day with at least 1 strength test series for each 75 cubic yards of concrete placed. Note: Additional cylinders may be required, as directed by the Local Entity Engineer. Cylinder strength shall be 56-day if 28-day cylinder strength is insufficient for the required design strength.

2. Slump, air content, unit weight, and mix temperature shall be tested for each pour per day with at least 1 test for each 75 cubic yards of concrete placed. Standards in **Section 23.4.1 I** shall also apply.

K. Placement (Inspection)

1. Concrete placement shall be done in a manner such that the concrete is not segregated or altered before placing. It shall not be allowed to free fall more than 5 feet. Concrete shall be placed in lifts not to exceed 18 inches.

2. A sufficient number of vibrators shall be used to properly consolidate the concrete as required.

3. Weepholes and drainage systems should be installed in the structure at the locations noted on the plans or specifications.

4. Construction joints and expansion joints shall be constructed in conformance with approved plans and specifications.

5. Curing concrete other than bridge decks shall be done in conformance with **CDOT Specifications Section 601.13** with a minimum curing period of 7 days.

6. Curing of bridge decks shall follow **CDOT Specifications Section 601.16**.

7. When placing concrete next to recently constructed lane (bridge decks), refer to **Section 23.6.3 C.2.k**.

L. Finishing of Hardened Concrete Surfaces

1. Unless otherwise authorized, all formed surfaces shall be given a Class 1 finish immediately following curing, as defined by **CDOT Specification 601.14**.

2. Culvert headwall and wingwall surfaces above ground, where visible from a traveled way, shall receive a **CDOT** Class 2, Class 5 or approved structural concrete coating finish, as defined in **CDOT Specification Section 601.14(b)**, at the Developer's option.

3. A **CDOT** Class 5 or approved structural concrete coating finish shall be given to all bridge type surfaces as noted in **CDOT Specification Section 601.14(a)**.

M. Final Surface Test (Bridge Deck).

All work shall be true to line and grade as established by the Local Entity Engineer. Prior to acceptance of the work, the Developer shall test the surfaces with a 10-foot straightedge. Any areas higher than 1/4 inch, but not higher than 1/2 inch, above the correct surface thus indicated shall be ground to the correct surface by the Developer at his expense. When the deviation exceeds the foregoing limits, the Developer shall remove and replace that portion of the work at his expense, as directed by the Local Entity Engineer. Any depressions shall be mitigated according to **CDOT Specifications Section 601.15(d)**.

The following standards where relevant shall also apply:

1. **Section 23.5.2** , Inspection Criteria.

2. **Section 23.6.3** , Portland Cement Concrete Pavement.

N. Permanent Steel Bridge Deck Forms.

Inspection and testing of concrete placement shall be done in accordance with **CDOT Specifications Section 601.10f**.

O. Bridge Deck Concrete Placing

1. Straight Edge Testing. Refer to **Section 23.4.1 M** for testing of finished surface of concrete.

2. Moveable Bridge for Inspection. A moveable bridge or platform shall be provided for inspection in accordance with **CDOT Specifications Section 601.15e**.

P. Waterproofing Membrane.

Measurement of waterproofing membrane effectiveness shall be done in accordance with **CDOT Specifications Section 515.04(h)**.

23.4.2 Structural Steel

A. Material and Certification Testing.

Material mill test reports shall be furnished in accordance with **CDOT Specifications Section 509.13**. Suppliers test reports for fasteners and fastener requirements shall be in accordance with **CDOT Specifications Section 509.28**.

B. Fabrication Testing.

Fabrication notice, inspection and testing shall be submitted and/or implemented in accordance with **CDOT Specifications Sections 509.14, 509.17** and **509.18**.

C. Field Welding and Erection.

Inspection of field welding and erection of steel structures shall be in accordance with **CDOT Specifications Sections 509.26** and **509.27**.

23.4.3 Timber

A. Materials Inspection.

All treated and untreated timber furnished shall be inspected in accordance with **CDOT Specifications Section 508.04**.

23.4.4 Bearing Device

A. Fabrication Testing.

Completed bearings shall be tested and approved in accordance with **CDOT Specifications Section 512.09**.

23.5 NON-STRUCTURAL CONCRETE

Non-structural concrete includes curb, gutter, walks, driveways, crosspans, and ramps.

23.5.1 Concrete Mix Design

Concrete mix design shall be performed in accordance with the provisions of **CDOT Specifications 601.05**. A separate mix design shall be provided if pumped concrete is used. These shall be submitted no less than 5 working days prior to placement of any concrete.

23.5.2 Inspection Criteria

A. Tolerances for Repairs or Replacement of Work

1. Humps and Depressions. Any localized humps and/or depressions greater than 1/4 inch (as measured with a 10-foot straight edge) will require removal and replacement of the work in question.

2. Water Ponding. No ponding of water, according to **Section 23.5.3 B.3.a**, shall be allowed.

3. Flowline Depth. Combination curb, gutter, and walk and/or vertical curb and gutter flowline depth shall not vary from adopted standards by more than ± 1/4 inch, measured vertically from the top of curb to the gutter invert.

4. Cross Slope in Pedestrian Walks. Pedestrian walks shall have a minimum of 1.0 percent and a maximum of 2.0 percent cross slope, unless otherwise approved by the Local Entity Engineer.

5. Joint Spacing. Contraction and construction joints shall be placed at a maximum spacing of 10 feet in curb, gutter, sidewalks, crosspans, trickle channel, etc. A minimum spacing of 6 feet will be allowed.

6. Heave or Settlement of Sidewalk. Heave or settlement of sidewalk, relative to separate curb pour, greater than 1 inch in Loveland (GMA and city limits) and ½" in Ft. Collins (GMA and city limits), shall be cause for corrective action.

B. General Specifications

1. Utility Facilities Placement. No utility facilities shall be placed in curb, gutter, or walk, crosspans, etc., unless shown on the approved construction plans. This includes water curb stop box, manholes, power poles, fire hydrants, water valves, etc.

2. Concrete Cracks.

   a. At the time of preliminary or final acceptance inspection, no cracks outside of the control joint will be accepted and shall be removed to the nearest control joints. Time of replacement (preliminary acceptance) shall be decided by the Local Entity Engineer.

   b. At the time of final acceptance inspection, the repair of all cracks will be completed.

1) Any longitudinal cracked section of concrete will require complete removal and replacement of that section between joints.

2) Repair action for hairline cracks may be waived at the discretion of the Local Entity Engineer. For the purpose of this section, a hairline crack is one that is reasonably immeasurable and without separation as determined by the Local Entity Engineer.

3. Concrete Chips.

   a. One chip that penetrates into the gutter pan or back of walk 2 inches or more and is 5 inches or longer in one stone will require removal and replacement.

   b. Four or more chips that penetrate 1 inch or more and are 4 inches or longer in one stone will require removal and replacement.

4. Concrete Gouges (to any surface of the curb, gutter, and walk). The following requires removal and replacement of the damaged panel/stone:

   a. One gouge that penetrates 3/4 inch or deeper and covers an area of 10 square inches.

   b. Two gouges that penetrate 1/2 inch or deeper and cover a combined area of 15 square inches.

   c. Three gouges that penetrate 1/4 inch or deeper and cover a combined area of 25 square inches.

   d. Four gouges that penetrate 1/8 inch or deeper and cover a combined area of 35 square inches.

5. Other Imperfections in Concrete Surface. Stress cracking, D-cracking, pop-outs, spalling, rain damage, graffiti, and other surface defects will remain discretionary and will usually require removal and replacement.

6. Final Grade.

   a. A light broom finish (not to expose the aggregate) to all concrete shall be required.

   b. All concrete work shall have the proper finished grade. No reversal of the flow direction will be accepted by Local Entity.

   c. No abrupt changes in grade shall be allowed, i.e., curb returns from new to existing, driveway entrances, etc.

C. Additional Inspection Requirements for Repairs

Follow the guidelines in **Chapter 25, Reconstruction and Repair**, concerning repairs.

23.5.3 Concrete Testing and Inspections

A. Materials Specifications.

Compressive strength of non-structural concrete shall be 3500 psi at 28 days. For additional specifications refer to **Section 23.4.1 I**.

B. Concrete Tests

1. Testing and Sampling Standards. Refer to **Section 23.4.1 I** for the following standards:
   a. Sampling and Testing
   b. Sampling Time
   c. Slump and Air Tests
   d. Coring
2. Concrete cylinders shall be load-tested and broken at the times listed in **Table 23-2**.
   a. The testing laboratory and Local Entity Engineer shall determine the areas of concrete with potentially low strength and clearly denote the areas to the Developer.
   b. The Developer shall have an independent testing laboratory, acceptable to the Local Entity Engineer, obtain and cure core samples per **ASTM C 42** or **AASHTO T 24**. A minimum of 3 samples shall be taken for each 100 cubic yards or fraction thereof of concrete in question.
   c. Strength level of concrete in the area represented by core tests will be considered adequate when the average compressive strength of the cores are equal to at least 85% of specified compressive strength and if no single core is less than 75% of the specified compressive strength.
   d. If the concrete is determined not to have adequate strength, the Local Entity Engineer may require the Developer to replace low strength areas.
3. Grade Verification of Gutter Flowline.
   a. After completion of curb and gutter, including curb returns and crosspans, and prior to installation of asphalt, the new installation must be flow-tested with water to confirm that there are no areas that hold water. The Local Entity Engineer will confirm the results and accept or reject the work. The work will not be accepted if it holds water more than 1/4 inch deep for a distance greater than 5 feet. Unacceptable work must be removed and replaced.
   b. After completion of curb, gutter, radii, and crosspans, the Developer must provide to the Local Entity Engineer a field verification of critical elevations to ensure the construction complies with the approved plans. The verification

must include flowline elevations at intersections, high points, and inlets. The Developer must provide the Local Entity with the following:

1) A letter from a licensed Professional Engineer or Land Surveyor stating that the field verification has found the work conforms to the approved plans, and;

2) Mylar copies of the approved construction plans showing the actual spot elevations and profile grades must be provided. All deviations shall be noted in the letter and on the required drawings. If gutter profile grades are less than 0.4 percent, the work will not be accepted. Any field changes to the approved plans that change the profile grades by more than 0.5 of 1 percent will require revisions, by the Designer, to the original Mylar grading and street plans by the Developer and approval by the Local Entity Engineer prior to construction of improvements.

C. Testing Frequency

1. At least 4 compressive strength cylinders shall be taken from the same concrete delivery truck to provide design compliance testing at the laboratory. Two of the 4 specimens will be tested at 28 days for acceptance and one shall be tested at 7 days. The fourth specimen shall be tested at 56 days if the 28-day specimen does not conform to these specifications. This is required for each pour per day with at least 1 strength test series for each 75 cubic yards of concrete placed. Additional cylinders may be required to determine the rate of strength gain on high-early concrete mixes.

2. Slump, air content, unit weight, and mix temperature shall be tested for each pour per day with at least 1 test for each 75 cubic yards of concrete placed. Also refer to the slump and air testing requirements in **Section 23.4.1 I**.

D. Placement Standards

1. Refer to **Section 23.4.1 I** for the following.

   a. Free Fall and Lifts

   b. Vibrators

2. Refer to **Chapter 22, Construction Specifications,** concerning non-structural concrete curing for the following:

   a. Joints

   b. Curing Concrete

E. Finishing Standards for Hardened Concrete Surfaces.

Refer to **Section 23.4.1 L**.

F. Backfill.

Compaction of soil placed behind the curb in landscaped areas shall be compacted to 90 percent standard Proctor density.

23.6 PAVEMENT

23.6.1 Subgrade and Roadbed

A. Subgrade Approval

1. Inspection. When the Local Entity Engineer determines an unsatisfactory soil is present, excavate and replace with suitable material.

2. Reconstruction. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Local Entity Engineer.

B. Subgrade Preparation

1. Testing. Field moisture-density tests using acceptable methods will be required at random locations. Refer to **Chapter 22** for soil types and compaction percentages for **AASHTO T99** and **T180** tests.

2. Acceptance.

   a. Compaction. The results of field density tests shall be submitted and reviewed by the Local Entity Engineer prior to placing the next course. Should testing indicate results less than those specified, the necessary reworking, compaction, or replacement will be required prior to continuation of the paving process. The approval is valid only to a time when weather conditions may have changed the condition of the subgrade. Changes in weather such as freezing or precipitation, which may cause changes in the subgrade, will require re-approval of the subgrade. Refer to **Chapter 22, Construction Requirements**, concerning subgrade preparation for compaction criteria.

   b. Final Proof-Rolling. Final proof rolling of subgrade shall be required prior to placing base. Refer to **Chapter 22, Construction Requirements**, concerning subgrade preparation.

C. Soil Stabilization

1. Lime Stabilization. The field placement of lime must comply with design requirements in Chapter 5, Soils Investigation and Report and Chapter 22, Materials and Construction Specifications.

   a. Design Testing Summary. Tabulated summaries of laboratory test results for field samples, composite samples, and lime-soil mixes shall be provided to the Local Entity Engineer written 24 hours and include the following:

      Field Sample No. (also shown on map)
      Group No. (composite sample)

Soil description
#200 sieve analysis
Atterberg limits
AASHTO classification and group index
% soluble sulfates
pH value
Maximum dry density
% optimum moisture content
% stabilization agent content
% swell
Compressive strength

2. Fly Ash Stabilization. Consult the Local Entity's Engineer for requirements for this special case. Also see **Table 10-4, Pavement Strength Coefficients.**

   a. Kiln Dust Stabilization. Consult the Local Entity's Engineer for requirements for this special case. See **Table 10-4, Pavement Strength Coefficients**. Construction Requirements must be specified by the Designer and approved by the Local Entity Engineer.

23.6.2 Base Course

A. Aggregate Base Course Material

1. Testing Frequency. Aggregate base course shall be tested for compaction and moisture once every 1000 feet for each lane.

2. Approval of Sources. Approval of sources will, at a minimum, consist of supplying documented gradation, Atterberg limits, and R-value testing on an annual basis.

23.6.3 Portland Cement Concrete Pavement

A. Concrete Mix Design.

Refer to **Section 23.5.1** .

B. Concrete Testing and Inspections.

Concrete shall conform to the requirements for Class "P" (4200 psi) concrete as specified in CDOT subsections 601.02 and 601.03. When the quantity of pavement concrete is too small to make use of mechanical equipment practical, the contractor will be permitted to use **AASHTO M43** size 57 or 67 aggregate in lieu of coarse concrete specified in **CDOT Table 601.01**.

C. Concrete Roadway Inspection for Repairs or Replacement Work

1. Tolerances.

a. All manholes, water valves, range boxes, etc., shall be flush to 1/4 inch below the final surface roadway grade. Refer to **Section 23.7.1** for adjustments to final grade.

b. Where the constructed surface varies from the design cross slope by more than 1/2 inch in 10 feet, the pavement shall be removed and replaced. This technique may not apply in areas with less than 2% cross slope.

c. Areas showing high spots greater than 1/4 inch as measured with a 10-foot straight edge, but less than 1/2 inch, may be diamond ground to within the specification of 1/4 inch. High spots more than ½ inch may be permitted, if acceptable to the Local Entity Engineer.

d. Thickness Tolerance. The thickness of the pavement shall be determined by average caliper measurement of cores tested, if required by the Local Entity Engineer. A minimum of 2 cores per 1000 square yards will be taken at random. Should any deviation be found, additional cores may be taken to define the horizontal limits of the deviation. When measurement of the core from a unit is not deficient by more than 1/4 inch from the design thickness, the pavement thickness will be considered to be within acceptable tolerance. When such measurement is deficient more than 1/4 inch and not more than 1 inch from the design thickness, two additional cores at intervals not less than 300 ft will be taken and used to determine the average thickness for that area. When the thickness of pavement is deficient by more than 1 inch the Local Entity Engineer may require that the area be removed and replaced.

2. Specifications.

a. All panels with cracks wider than 1/8 inch shall be repaired by total removal of the panel and replacement as required by the criteria herein. At the time of initial acceptance no cracks will be allowed and shall be repaired on full panel basis.

b. All panel cracks 1/8 inch and narrower may be routed and sealed at the discretion of the Local Entity Engineer.

c. There shall be no more than one structural crack per panel. Panels with more than one structural crack shall be repaired by total panel removal and replacement.

d. All sections removed shall have edges parallel to adjacent panel joints.

e. All saw cuts for removal of slabs shall be full depth cuts.

f. No panel shall be allowed that has a crack meeting an adjacent panel at an angle more acute than 45 degrees to a finished edge or control joint.

g. All corner cracks to a panel shall be removed and replaced as required by the criteria contained herein.

h. Any vertical differential movement across a crack greater than 3/16 inch shall be repaired by either partial or total panel removal and replacement.

i. All panels with faulted joints resulting from settlement, pumping, and/or curling of the edges shall be repaired by removal and replacement, or in the case of curling, may be repaired by grinding at the discretion of the representative of the Local Entity.

j. All joint seal damage that allows the intrusion of water or foreign material shall be cleaned and replaced in accordance with **CDOT 412-18**.

k. Where concrete is to be placed adjoining a previously constructed lane of pavement and heavy equipment will be operated upon the existing lane, that lane shall have attained a 3000 psi compressive strength, prior to its use. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted when that lane has attained a 3000 psi compressive strength.

l. All compaction shall meet the requirements of these Standards.

m. Any other defect not mentioned but noted as a problem by the Local Entity Engineer shall be repaired or replaced per these specifications.

23.6.4 Hot Mix Asphalt (HMA)- Superpave Method

A. HMA Testing and Reporting

1. All testing shall be done in accordance with **AASHTO**, ASTM, or Colorado Procedures (CP), as designated throughout this chapter.

2. In addition to the requirements of **Table 23-1** all reports shall include elevation or depth below finish grade at which test was taken. Results shall report densities (maximum dry and relative) to nearest 0.1lb/ft^3, and compaction (relative and required) to nearest 0.1 percent, results of the daily standardization checks, and the most recent adjusted manufacturer's calibration curve. The manufacturer's calibration curve shall be adjusted as required by ASTM D2950 whenever a change in either the material to be tested or the testing equipment is made. If a nuclear device is used, the report shall contain the method used (i.e. back scatter, direct transmission, etc.)

3. In-place pavement thickness shall be determined as follows, if requested by Local Entity Engineer: The pavement shall be cored at 500 foot intervals, or fraction thereof, in each 12 feet lane (nominal), with a minimum of 3 cores in any area. The Local Entity Engineer may require additional cores to define deficient areas. Core samples shall be taken prior to final lift. Pavement section shall be within ¼" of design thickness.

B. Conformity with Plans and Specifications.

Conformity to the Standards for all hot mix asphalt, CDOT Item 403 will be determined by tests and evaluations of asphalt content, aggregate gradation, and in-place density.

C. PG Asphalt Binder Testing and Certification

Local Entity can sample and test binder from bank at plant. If requested, supply c.o.c. of binder properties and deliver tickets to plant.

1. If requested by the Local Entity, the developer shall provide the Local Entity a safe access to the binder storage tanks at the asphalt plant and shall provide information and assistance as required for the Local Entity to make a complete and detailed inspection; including sampling of the binder for acceptance testing. All costs associated with providing access and assistance as well as the cost of the binder sampled shall be considered subsidiary to the work and will not be paid for by the Local Entity. The costs of all acceptance testing performed on the PG binder will be paid for by the local entity. It shall be the responsibility of the developer to reimburse the Local Entity for the cost of all failed tests and be responsible for additional testing to assure that the binder is back in compliance.

   If the testing indicates that the binder is not in compliance with the requirements of Table 23-3 the developer shall correct the deficiencies at the direction of the Local Entity, including removal of the pavement if deemed necessary by the Local Entity.

2. If requested by the Local Entity, the developer shall supply copies of the "Certificate of Compliance" and "Certified Test Reports" from the binder supplier. These submittals shall meet all requirements of CDOT Standard Specifications for Road and Bridge Construction Section 106.09 and 106.10 respectively.

   Binder furnished on the basis of "Certificates of Compliance" and "Certified Test Reports" may be sampled and tested by the Local Entity to determine compliance with the applicable specifications.

3. If requested by the Local Entity, the developer shall provide the Local Entity with copies of the load delivery tickets for the binder supplied to the asphalt plant. These load delivery tickets shall include the following information:
   a. Date and time of delivery
   b. Address of delivery
   c. Type and grade of binder delivered
   d. Quantity of binder delivered
   e. Lot or batch number

D. Bituminous Pavement Inspection for Repairs or Replacement Work

1. Surface Tolerance. The finished surface of the bituminous pavement, when tested with a 10-foot straightedge parallel to the centerline or perpendicular across joints, will show variations as measured from the testing face of the straightedge to the surface of the pavement, which shall not exceed 1/4 inch. Areas that do not meet the required surface accuracy shall be clearly marked and if the Local Entity Engineer requires repair, the Developer shall repair the pavement.

2. Thickness Tolerance. Any deficiency in the total thickness of the asphaltic pavement shall not exceed 10 percent for any one sample with the average deficiency for all samples not to exceed 7.5 percent. Final decision for correction of deficiencies shall not be made until a pavement evaluation is made by an independent testing laboratory.

Table 23-3
SuperPave Performance Graded Binders

Property	Requirement For Pg Binder						AASHTO Test No.
	58-28	58-34	64-22	64-28	70-28	76-28	
Original Binder Properties							
Flash Point Temp., °C, minimum	230	230	230	230	230	230	T28
Viscosity at 235°C, Pa•s, maximum	3	3	3	3	3	3	TP 48
Dynamic Shear, Temp. °C, where G*/Sin δ @ 10 rad/s ≥ 1.00 kPa	58	58	64	64	70	76	TP 5
Ductility, 4°C (5cm/min.), cm minimum	-	-	-	50	-	-	T 51
Toughness, joules (inch-lbs)	-	-	-	12.4 (110)	-	-	*CP L-2210
Tenacity, joules (inch/lbs)	-	-	-	8.5 (75)	-	-	*CP L-2210
RTFO Residue Properties							T240
Mass Loss, percent maximum	1.00	1.00	1.00	1.00	1.00	1.00	T240
Dynamic Shear, Temp. °C, where G*/Sin δ @ 10 rad/s ≥ 2.20 kPa	58	58	64	64	70	76	TP 5
Elastic Recovery, 25°C, percent min.	-	-	-	-	50	50	*CP L-2211 Method A
Ductility, 4°C (5 cm/min.), cm minimum	-	-	-	20***	-	-	T 51
PAV Residue Properties, Aging Temperature 100°C							PP 1
Dynamic Shear, Temp. °C, where G*•/Sin δ @ 10 rad/s ≥ 5000 kPa	19	16	25	22	25	28	TP 5
Creep Stiffness, @60 s, Test Temperature in °C	-18	-24	-12	-18	-18	-18	
S, maximum, Mpa	300	300	300	300	300	300	TP 1
m-value, minimum	0.300	0.300	0.300	0.300	0.300	0.300	TP 1
**Direct Tension, Temperature in °C, @ 1 mm/min., where failure strain ≥ 1.0%	-18	-24	-12	-18	-18	-18	TP 3

* Colorado Procedure.
** Direct tension measurements are required when needed to show conformance to AASHTO MP 1.
*** If the PG 64-28 RTFO residue fails the ductility test, the binder will be accepted if the TFO residue (AASHTO T 179) has a ductility of 25 cm or more.

23.7 MISCELLANEOUS

23.7.1 Bituminous Pavement Inspection for Repairs or Replacement

A. Surface Tolerance. Refer to **Section 23.6.4 D.1**.

B. Thickness Tolerance. Refer to **Section 23.6.4 D.2**.

C. Rim Tolerance.

All manholes, water valves, range boxes, etc., shall be 1/4 inch to 5/8 inch below the final paved grade.

D. Cracks.

Individual and nondeflecting cracks in the asphalt shall, at the discretion of the Local Entity Engineer, be sealed with rubberized asphalt sealant approved by the Local Entity Engineer, to include cracks or open sawed joints at patch areas.

E. Additional Requirements for Repairs (Patching). Refer to **Chapter 25, Reconstruction and Repair**.

23.7.2 Manhole Frames and Valve Boxes

To provide proper protection to the public, manhole frames and covers and valve boxes shall be accessible no later than 24 hours after they have been buried by the work in progress. Prior to placement of the final lift of pavement, manhole frames and covers and valve boxes and all other similar devices that must be accessed from the surface should be raised to final grade. After final adjustment, the Developer shall notify the Local Entity Engineer who shall make an inspection to check for grouting of the manhole frame, cleanliness and proper alignment, elevation and slope of the grade ring. All valve boxes shall be inspected by applying a valve key to each operating nut to assure an acceptable alignment and depth.

After inspection and acceptance by the Local Entity Engineer of the manhole frames and covers and valve boxes, the Developer shall proceed with the final wearing surface.

All materials necessary for adjusting manholes or valve boxes as required by resurfacing must be on hand at the job site prior to placement of any asphalt or concrete pavement.

A. Adjustment for Asphalt Pavements.

If manhole frames and covers and valve boxes are adjusted to final grade between any two lifts of bituminous pavement or within 24 hours following placement of the placement of the final wearing surface as provided for above, complete the adjustment in accordance with requirements in **Chapter 25, Section 25.5.6J**.

B. Adjustment for Concrete Pavement.

After placement of the concrete and jointing has begun, a transverse joint will be placed at each manhole frame and at each water valve box. In the event that a

manhole frame or water valve box should be covered up during construction, the Developer will be responsible for raising the manhole frame or water valve box up through the concrete. This work will take place no later than 24 hours after completion of the work. The adjustment shall be made in accordance with requirements in **Chapter 25, Section 25.5.5F**.

23.7.3 Traffic Signs, Striping, and Signals

A. Materials.

All materials shall be tested and sampled according to **CDOT Specifications Sections 708.09** and **713.09**.

B. Installation/Application.

The Local Entity Engineer shall verify that traffic control devices are installed or applied at appropriate locations as shown on the approved signing and striping plans.

All striping layouts will be reviewed by the Local Entity Engineer prior to any installation of paint or markings. The Local Entity requires a 48-hour notice before any application for inspection or approval.

The Local Entity Engineer shall approve tabs and markings prior to permanent installation of striping and symbols.

23.7.4 Streetscape in Fort Collins (City Limits Only)

See **Appendix "C" – City of Fort Collins Streetscape Design Standards and Guidelines**.

23.8 INSPECTION FEES

23.8.1 Fees for Inspection by Local Entity's Staff

The inspection shall be performed by the Local Entity's staff. The fees for inspection shall be in accordance with current fees adopted by the Local Entity and shown in **Appendix "B"**.

23.8.2 Payment of Fees by Developer

The Developer is required to fund all costs associated with the inspection. In Loveland (city limits only), the inspection fees are paid in arrears by the builder at the time a building permit is issued. In Fort Collins (GMA and city limits) and Loveland (GMA only), the Developer pays all inspection fees in full prior to issuance of the Development Construction Permit.

23.9 STOP WORK ORDER

The Inspector is authorized to issue Stop Work Orders, as described in **Chapter 6, Permits**. In Fort Collins (city limits only) Construction Inspectors are authorized to issue

a municipal court summons for refusal by the Developer or any person who refuses to stop work.

CHAPTER 24 – ACCEPTANCE/WARRANTY PROCEDURES AND RECORD DRAWINGS

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CHAPTER 24 – ACCEPTANCE/WARRANTY PROCEDURES AND RECORD DRAWINGS

24.1 GENERAL

This chapter defines the requirements for approval and acceptance of the Public Improvements performed within the rights-of-way and easements. This chapter also covers warranty and record plan requirements.

24.1.1 Developer's Process

The Developer shall be required to meet the following process prior to the acceptance of the public improvements and maintenance:

A. Completion of Work.

Completion of all Public Improvements required in the Civil Construction Plans (Plans) and Agreements in accordance with these Standards.

B. Notification.

Developer notifies the Local Entity of the completion of the Project Completion.

C. Inspection.

Local Entity inspects the Public Improvements for compliance to the Plans, Standards, Specifications, and Agreements and develops a deficiency list.

D. Correction of Deficiencies.

Developer shall correct deficiencies.

E. Submittal of Record Plans.

Developer submits signed and sealed Record Plans in accordance with Section **24.5**. Electronic files of the Civil Construction Plans are required for Loveland (city limits only). Also refer to the Local Entity requirements for the Water and Wastewater Department requirements for the submittal of Record Plans.

F. Initial Acceptance.

After receipt of a written request from the Developer, the Local Entity shall inspect the corrections. Upon satisfactory completion and posting of warranty surety by the developer, Initial Acceptance shall be granted.

G. Start of Warranty Period.

Upon Initial Acceptance, the Warranty Period shall commence.

H. Inspection Before the End of Warranty Period.

The Developer may submit a written request for Final Acceptance no earlier than forty-five days prior to the completion of the Warranty Period. After receipt of such request, the Local Entity Engineer shall inspect all Public Improvements for defects in workmanship or material. The Local Entity shall develop a deficiency list and provide the list to the Developer. Normal wear and tear shall not be considered a deficiency.

I. Written Notification of Release.

Once the Developer has satisfactorily completed all repairs or replacements, a written notification from the Local Entity shall constitute Final Acceptance and release the Developer of all future repairs for the Public Improvements.

J. Release of Surety.

The Warranty Surety is released.

24.2 INITIAL ACCEPTANCE

24.2.1 Recommendation for Initial Acceptance

The Local Entity Inspector shall recommend granting or denial of Initial Acceptance based on re-inspection for compliance with the written deficiency list, which was previously provided to the Developer. If new deficiencies are found, either in quality or extent of construction, the Developer shall be notified in writing that these new deficiencies shall be corrected as a condition of Final Acceptance. Initial Acceptance will not be delayed by discovery of new deficiencies.

24.2.2 Initial Acceptance Letter

The Local Entity shall issue written notice either granting or withholding Initial Acceptance within ten working days of the acceptance re-inspection. The Initial Acceptance letter shall specify the date on which the Developer is eligible to request Final Acceptance.

24.2.3 Submittal of Record Plans

Prior to issuance of the Initial Acceptance, the Developer shall submit Record Plans that are completed, stamped, and signed by the Engineer of Record and submitted to the Local Entity. The Developer shall submit the Record Plans in electronic form (as specified by the Local Entity Engineer). Refer to **Section 24.5** for Record Drawing requirements.

24.2.4 Adjustment of Collateral

Upon written notification of Initial Acceptance, the financial security for Public Improvements may be reduced to the percentage required by each Local Entity of the

total required collateral for the project as defined in **Chapter 6, Permits**. The reduction of collateral may be adjusted if deemed appropriate by the Local Entity.

24.3 WARRANTY PERIOD

24.3.1 Definition of the Warranty Period

The Warranty Period for all Public Improvements shall be two years. The Warranty Period shall start the date of the Initial Acceptance Letter. The Warranty Period shall end with the Final Acceptance of the Public Improvements. If deficiencies are noted during the Local Entity's warranty inspection, the Developer shall repair the deficiencies. If approved by the Local Entity, the deficiencies may remain in place and the Warranty Period for the defective public improvements may be extended up to three additional years. Repair or acceptance of the deficiencies shall occur at the expiration of any such extension. A new warranty period shall not be applied to any repair work performed during the warranty period.

24.3.2 The Warranty Surety

A Warranty Surety shall be required for the entire Warranty Period. The Warranty Surety shall be in the form of a letter of credit, bond, escrowed funds, or cash deposit in accordance with the Local Entity's approved format. The Warranty Surety shall be in the amount of 15% of the total value of the Public Improvements for the project. In Fort Collins (city limits only) the amount shall be determined by the Local Entity Engineer and shall not exceed 25% of the total value of the Public Improvements for the project.

In addition, the amount of required Warranty Surety may be increased to the amount equal to 150 percent of the cost of any defective Public Improvements allowed to remain in place during the Warranty Period.

24.3.3 Time Frames for Completing Repair

At any time before the completion of the Warranty Period, the Local Entity may notify the Developer of needed repairs. If repair areas are considered to be an imminent danger to the public health, safety, and welfare, the Developer shall act within 24 hours to complete the repair. If the work is not considered a safety issue, the Developer has 10 working days to schedule the work, and 60 calendar days to complete the work. Extensions of time may be considered when necessary due to weather constraints.

24.3.4 Failure to Complete Repair

If the Developer has not completed the warranty repairs in the time frame specified, the Local Entity may choose to complete the necessary repairs. The Local Entity will invoice the Developer for all costs for the related work plus a 15% fee for the value of the work or $500.00 administrative fee whichever is greater. If the Developer does not reimburse the Local Entity within 30-days of being invoiced the Local Entity will collect from the Warranty Surety.

24.3.5 Responsibility for Maintenance

The Developer is responsible for maintaining all Public Improvements, including sweeping, throughout the Warranty Period.

24.4 FINAL ACCEPTANCE

24.4.1 Request for Final Inspection

During the Warranty Period, the Developer shall guarantee the work to be free of any damage or defects in workmanship and material. No earlier than 45 days prior to the end of the Warranty Period, the Developer shall request a final inspection and acceptance, in writing, to the Local Entity Inspector.

24.4.2 Preparation for Inspection

The Developer is responsible for sweeping and cleaning Public Improvements for inspection. If the Developer does not provide a clean site, including having curb flowlines clear of debris and dirt, then the Final Inspection may be postponed until the site is sufficiently clean.

24.4.3 Inspection and Punchlist

The Local Entity Engineer shall inspect all Public Improvements related to the project. If applicable, the Local Entity shall compile a written final punchlist listing any necessary repair or replacement of materials or workmanship. The punchlist shall be sent to the Developer. The Developer shall have 10-days to provide the Local Entity with a plan and schedule to complete the repairs. The plan shall include the start and completion dates. If the Developer does not complete the repairs as specified in the plan the Local Entity will have the authority to complete the repairs and recoup their fees as specified in 24.3.4.

24.4.4 Damage Caused by Local Entity Crews

If the Developer can demonstrate that the Local Entity maintenance crews (e.g., snow plows) caused damage to certain improvements, the Developer will not be held responsible for the replacement.

24.4.5 Re-Inspection

If repair or replacement of Public Improvements is required, the Developer shall complete repair or replacement within thirty calendar days of receipt of the final punchlist, unless otherwise agreed by the Local Entity. Upon completion of the final punchlist, the Developer shall contact the Local Entity Engineer for a re-inspection.

24.4.6 Release from Responsibility

Once all repairs or replacements are satisfactorily completed, the Local Entity shall provide the Developer with written notice that all Public Improvements are complete and the Local Entity releases the Developer from responsibility for all future maintenance and

repairs for the Public Improvements on this project. This written notice constitutes Final Acceptance of the Public Improvements.

24.4.7 Release of Warranty Surety

Upon the satisfactory completion of the punchlist and the receipt and approval of the Record Plans, the Local Entity will release the Warranty surety.

24.4.8 Failure to Complete Repair

If the punchlist is not completed within the thirty days, the Local Entity may withhold current plan reviews, additional permits, or start procedures to call the surety.

24.5 RECORD PLANS

24.5.1 Updating Plans with Design Changes

The Civil Construction Plans shall be updated with all design changes that occurred after plan approval. Record storm drainage drawings shall document the size and invert elevation of all pipes (including pipe class), inlets, riprap, headwalls, detention pond volumes, swale cross-sections and all other storm drainage infrastructure shown on the Civil Construction Plans, including those improvements located in areas outside of the public right-of- way if appropriate. Record drawings shall also show all pipe and/or drainageway/swale grade percentages.

Street construction record drawings shall identify the actual pavement type and grade or mix type used; if the subgrade was treated; and document all changes to widths and lengths for streets, sidewalks, curbs and crosspans. Record drawings shall identify all signage, striping and traffic signal controller locations as actually placed in the project.

Record drawings shall verify other information as specifically requested by the Local Entity Engineer.

24.5.2 Minor Design Changes

Minor changes are not required to be included on the Record Plans. Minor changes include incorrect references and grade changes less than 0.1 foot.

24.5.3 Submittal of Plans

A Colorado Professional Engineer shall update and stamp the Civil Construction Plans. A Colorado Professional Engineer shall submit the plans to the Local Entity and receive approval prior to the release of the Warranty Surety.

24.5.4 Form of Submittal

All Record Plans shall be submitted in the following formats as required by the Local Entity Engineer:

- Electronic whenever required by the Local Entity Engineer.

- Paper for Larimer County GMA projects, and/or
- Electronic or paper For Loveland (city limits only) and Fort Collins (city limits only) projects.

24.5.5 Bridge/Culvert Load Rating

A bridge/culvert inspection report certifying load rating in accordance with CDOT standards shall be submitted with the Civil Construction Plans.

CHAPTER 25 – RECONSTRUCTION AND REPAIR
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CHAPTER 25 – RECONSTRUCTION AND REPAIR

25.1 GENERAL

This chapter addresses reconstruction and repair of improvements within the public right-of-way and public easements.

25.1.1 Condition of Repair

All infrastructure elements that undergo reconstruction and repair shall be restored to a condition equal to, or better than, the condition prior to repairs.

25.1.2 Testing and Inspection

Street inspection and testing for all reconstruction and repair shall be performed according to **Chapter 23, Street Inspection and Testing Procedures**, unless otherwise identified in this chapter.

25.1.3 Completion Time for Work

Refer to **Chapter 6, Permits**.

25.1.4 Unsatisfactory Work

The Developer shall complete removal and replacement of unsatisfactory work within fifteen days of written notification from the Local Entity Engineer of the deficiency unless the condition is deemed an emergency requiring immediate correction. In the event the replacement work is not completed within the specified time period, the Local Entity Engineer may take action to complete the work and charge the Developer for all related costs.

25.1.5 Guarantee

The Developer shall warrant all work according to Chapter 24, Acceptance Procedures and Record Drawings/Warranty.

25.1.6 Verification of Existing Utilities

A. Responsibility.

The Developer is responsible for field locating and verifying elevations of all existing sewer mains, water mains, curbs, gutters, and other utilities at the points of connection shown on the Civil Construction Plans, and at utility crossings prior to any reconstruction or repair.

B. Design Modifications.

If a conflict exists and/or a design modification is required, the Developer shall have the Designer revise the plans. The revised plans shall be reviewed and approved by the Local Entity Engineer prior to their implementation.

25.1.7 Permit Requirements

Refer to **Chapter 6, Permits,** for all permit requirements.

25.1.8 Traffic Accommodations.

Timing of reconstruction and repair work may be restricted by the Local Entity Engineer to certain time periods to accommodate traffic and other public uses. The Developer shall make adequate provisions to assure that traffic and adjacent property owners experience a minimum of inconvenience.

The Developer shall not remove any bridges, culverts, and other drainage structures in use by traffic until arrangements have been made to accommodate traffic and an approved permit has been issued by the Local Entity Engineer.

25.1.9 Protection of Existing Improvements.

A. Surface Improvements.

The Developer shall at all times take proper precautions and be responsible for the protection of existing street and alley surfaces, driveway culverts, street intersection culverts or aprons, irrigation systems, mail boxes, driveway approaches, curb, gutter and sidewalks and all other identifiable installations that may be encountered during construction. Existing improvements to adjacent property such as landscaping, fencing, utility services, driveway surfaces, etc., that are not to be removed, shall be protected from injury or damage resulting from the Developer's operations.

B. Locates.

The Developer shall at all times take proper precautions for the protection of existing utilities, the presence of which are known or can be determined by field locations of the utility companies. The Developer shall contact the UNCC (One Call) at 1-800-922-1987 for utility locates, a minimum of two (2) working days prior to his proposed start of work. The Developer shall contact other unregistered utility entities (e.g. ditch companies) individually to arrange locating their utilities. Utility service laterals shall be located prior to beginning excavation or grading.

C. Survey Markers.

The Developer shall at all times take proper precautions for the protection of property pins/corners and survey control monuments encountered during construction. Any

damaged or disturbed survey markers shall be replaced by a registered land surveyor at the Developer's expense.

D. Repair and Responsibility.

The repair of any damaged improvements as described above shall be the responsibility of the Developer.

25.1.10 Equipment

A. Trenching Equipment

The use of trench digging equipment will be permitted in places where its operation will not cause damage to existing structures or features, in which case hand methods shall be employed.

B. Tracked Vehicles

No tracked vehicles shall be permitted on streets unless approved by the Local Entity Engineer. When tracked vehicles are allowed, damaged facilities will be restored to original condition at the Developer's expense.

C. Haul Routes

Haul routes for equipment and materials may be restricted as a condition of the Permit.

25.2 UTILITY EXCAVATION

25.2.1 Protection of Existing Underground Utilities

A. Types of Utility Excavation.

The Developer shall accomplish the construction of any repair activity within the street or alley rights-of-way by open cut, jacking, boring, or a combination of these methods, as approved by the Permit. The Local Entity Engineer must approve any change from the approved Permit. The Developer may make crossings under sidewalks or curbs by tunneling only when approved by the Local Entity Engineer.

B. Location of Underground Structures.

The Developer shall proceed with caution in the excavation of the trench, so that the exact location of underground structures, both known and unknown, may be determined. The Developer shall locate all existing underground utilities, by non-destructive means, before trench excavation. The Developer shall perform excavation and visual verification of the utility location when required by the Local Entity Engineer or the utility owner.

C. Open Trenches.

Once trenches are excavated, the Developer shall proceed diligently towards completion of the work and completion of the backfill. The Local Entity Engineer reserves the right to limit the length of open trench. Failure by the Developer to comply with these requirements may result in an order to stop the excavation in progress until compliance has been achieved.

D. Stockpiling. See the requirements of Section 25.2.3 D.

25.2.2 Relocation of Utilities

Relocation of utilities in an existing public right-of-way or public easement shall be done at the expense of the utility involved or the Developer.

25.2.3 Removal of Pavement

A. Open Pavement Cuts.

Open pavement cuts shall not be permitted on any street unless approved in writing by the Local Entity Local Entity Engineer Local Entity Engineer.

B. Placement of Pavement Cuts.

The pavement cut shall follow a line parallel to the roadway centerline and at least 2 feet beyond the trench side wall. All pavement cuts parallel to the direction of travel shall be placed on the lane line or at the center of the aligned travel lane. For bicycle lanes, the cut shall be at the line or the edge of the gutter. Longitudinal joints are not allowed in the wheel path.

C. Repair of Damage Beyond Original Cut.

If pavement adjoining the original pavement cut is damaged during construction, additional pavement shall be removed and repaired after trench backfilling. The additional pavement shall be removed with cuts, with the original cuts. The additional pavement damaged by the Developer shall be repaired at the Developer's expense.

D. Stockpiling and Disposal of Excavated Paving.

All excavated pavement material and concrete may be used as fill if the material meets requirements for borrow material. If the material is unacceptable, it shall be stockpiled separately and disposed of by the Developer off site at his expense and shall not be used as trench backfill material.

E. Excavation Near Failed Pavement.

When the proposed excavation falls within 3 feet of a section of failed pavement, the failed area shall be removed up to sound pavement and patched. Scarring, gouging, or other damaged pavement adjacent to a patch shall be removed and the pavement repaired.

25.2.4 Backfilling of Potholes and Trenches

Flowable fill shall be required in all voids and openings created by jetting, pumping, and pneumatic removal of the soil and where compaction equipment is unsuitable. Refer to **Chapter 22, Materials and Construction Specifications,** for criteria on flowable backfill. Flowable fill will be required on soft surface potholing per the discretion of the Local Entity Engineer.

25.2.5 Installing Dry Utilities Under Existing Pavement

A. Use of PVC Sleeving

The use of existing sleeves for method of installation shall be the first priority when installing utilities under existing sidewalks, curbs and pavement. Tunneling is discouraged in major intersections and will not be allowed if existing PVC conduits are available.

B. Location of PVC Sleeves

The location of PVC sleeves will be marked on the curb according to Standard Detail 12-3 and used on a first come, first serve basis. Ducts installed by, or for, the Local Entity Electric Utility, are reserved for Local Entity Electric Utility use only and are not available for use by other utility providers.

C. Boring and Casing

Utility crossings under sidewalks, curbs and pavement may be made by boring and casing and then installing the utility. However, boring and casing will not be allowed if existing PVC conduits are available. Boring for utilities shall be permitted if approved by the Local Entity Engineer.

1. Boring and Casing Materials

   a. Casing Pipe. The casing pipe shall be fabricated steel having a minimum yield strength of 35,000 psi. The size and wall thickness shall be shown below or as otherwise noted on the drawing.

Casing Diameter	Minimum Thickness
42” and larger	5/8 inch
36” and smaller	3/8 inch

   b. Casing placed by boring may be bare steel pipe unless otherwise noted on the plans.

   c. Carrier Pipe. The carrier pipe shall be approved PVC pipe, reinforced concrete pipe, vitrified clay pipe or other materials approved by the Local Entity Engineer.

2. Boring and Casing Installation

   a. Placement of Casing by Boring. Casing shall be kept on line and grade as required by the approved plans. Joints in casing shall be field welded and watertight. Welds shall be of a size to develop the full strength of the pipe materials. After welding, the joints of coated and wrapped pipe shall be primed and tarred.

   b. Placement of Carrier Pipe. Upon completion of the casing installation, the utility pipe shall be installed in the casing pipe at the designed grade. The utility pipe shall be installed by pushing the pipe into the casing on "skids" and subsequently supporting the pipe by placing a sand bed under the pipe and around the "skids."

   c. The voids between the carrier pipe and the casing shall be completely filled with flowable fill. Refer to **Bedding and Backfill in Chapter 22, Materials and Construction Specifications.**

3. Repair of Bore Holes

   a. Less than 6 Inches. For openings less than or equal to 6 inches in diameter, bore holes in asphalt pavement shall be filled with patching material (cold mix is not acceptable) to prevent entry of moisture. Patching material used shall be in all cases compatible with the existing surface. Subgrade shall be replaced with flowable fill and mechanically vibrated to provide necessary support to the surface. Bore holes in concrete pavement and structures shall be repaired in accordance with **Chapter 22, Materials and Construction Specifications**. The sealing of bore holes is the responsibility of the Developer.

   b. Greater than 6 inches. For openings greater than 6 inches in diameter, the limits of repair shall be identified in the field. Additionally, if there are multiple bore holes within and area the Local Entity may require the area to be sawcut, removed flow filled and patched.

   c. Finished Condition. The completed job shall be flush with the surrounding pavement and have no indentations, pockets, or recesses that may trap and hold water.

D. Open Cut.

In the event that the use of existing sleeves or boring and casing is not an option, an open cut may be made and repaired with flowable fill done in accordance with Chapter 22, Construction Specifications.

E. Gas Lines.

The installation of gas lines will not require the use of the existing PVC conduits.

25.3 STRUCTURES

25.3.1 Removal of Structures

When it is necessary to remove structures or portions of structures, care shall be taken to protect surrounding improvements.

A. General

1. Preparation for Construction. Where portions of structures are to be removed, remaining portions shall be prepared to fit construction. The work shall be done in accordance with plan details.

2. Partial Abandonment. Portions of structures may remain in place when approved by the Local Entity Engineer.

3. Damage to Structure. All damage to structures remaining in place shall be repaired by, and at the expense of, the Developer.

4. Cleaning and Preparing Structures. Reinforcing steel projecting from the remaining structure shall be cleaned and aligned to join with the new construction. Dowels required by plans shall be secure within drilled holes, with an approved grout.

B. Bridges, Culverts, and Drainage Structures

1. Removing Substructures. The substructures of existing structures shall be removed according to **CDOT Specifications Section 202.08**. Steel, pre-cast concrete, and wood bridges as specified shall be carefully dismantled without unnecessary damage.

2. Removal of Pipe. All pipe designated for removal and reuse within the project shall be carefully removed, cleaned, and care taken to prevent damage to the pipe.

3. Bypass Service for Sewers. In removing manholes, catch basins, and inlets, any active drainage or sanitary sewers shall be properly bypassed in order to maintain service during the repair operation.

25.3.2 Construction Requirements

All repairs and reconstruction of structures shall be evaluated and designed according to **Chapter 22, Construction Specifications**.

25.4 NON-STRUCTURAL CONCRETE

25.4.1 Removal of Concrete Curb, Gutter, Sidewalk, and Driveways

A. Saw Cut Edges

Concrete shall be removed to edges that are neatly sawed to a minimum of one-half the concrete thickness. Sidewalks and driveways shall be saw cut in straight lines either parallel to the curb or perpendicular to the alignment of the sidewalk or curb.

B. Minimum Replacement Dimensions

No concrete section to be replaced shall be less than 5 feet in either width or length for a driveway or crosspan, and 5 feet in length, for sidewalk, curb, and gutter.

C. Joints

If a proposed saw cut in the driveway falls within 5 feet of a construction joint, expansion joint, or edge, the concrete shall be removed to the joint or edge.

D. Fort Collins (GMA and city limits) Specifications

Sidewalk shall be removed joint to joint in Fort Collins (GMA and city limits).

25.4.2 Widening Existing Sidewalks

When existing walks are widened (a minimum width of 4.0 feet), they shall be edge thickened in accordance with **Construction Drawing 2501**.

25.4.3 Reconstruction or Repair of Apron, Radius, Ramp Area, or Pedestrian Crossing

Whenever construction, alteration, or repair to an existing street affects any part of the apron, radius, ramp area, or pedestrian crossing area, the entire apron, radius, ramp area, or pedestrian crossing area shall be removed and replaced with a pedestrian ramp. Work shall be done in accordance with these standards and as required by the **Americans With Disabilities Act Guidelines, and the Public Rights-of-Way Accessibility Guidelines.**

25.5 PAVEMENT

All street cuts shall be patched in accordance with the requirements of **Section 25.7.**

25.5.1 Temporary Patch

A. When to Use Temporary Patch.

All trenches across traffic lanes, where it becomes necessary to remove any existing surfacing or pavement, shall be provided with temporary trench cover if the pavement is not replaced within the same day.

Winter patching of Street Cuts, when temperatures are below what is appropriate for the placement of asphalt or when asphalt materials are not available for patching. A temporary concrete patch may be used until appropriate temperatures are consistent or until asphalt is available. The temporary concrete patch may be done with a low strength (2,500 psi) concrete placed 4-inches thick which will be replaced in the spring. Asphalt Cold patch material will not be allowed for more than three days.

B. Street Closure Period.

Trenches cut across traffic lanes that cannot be permanently patched within the approved time period shall be patched with a temporary material approved by the Local Entity Engineer.

C. Placing and Maintenance.

Refer to **Section 25.5.6 D** for placing and maintenance requirements.

D. Specifications for Asphalt.

Minimum requirements for temporary patching material shall be well-compacted surfacing material conforming to "Road Mixed Asphalt Surfacing Material" of the CDOT Standard Specifications. Patching material shall match flush with the existing pavement surface and shall not be less than 4 inches thick. The mineral aggregate shall conform to the grading specified for 3/8 inch maximum aggregate ±5 percent. Bituminous binder to be mixed with the mineral aggregate shall be liquid asphalt, Grade MC-3000, and shall be an amount between 5.5 percent and 6 percent by weight of the dry mineral aggregate.

E. Stockpiling.

Temporary patching material may be stockpiled on the job site.

F. Time Requirements.

Temporary patching material shall be placed in the time frame required by the permit.

G. Open to Traffic.

Trenches patched with temporary patching material may be opened to traffic immediately following completion.

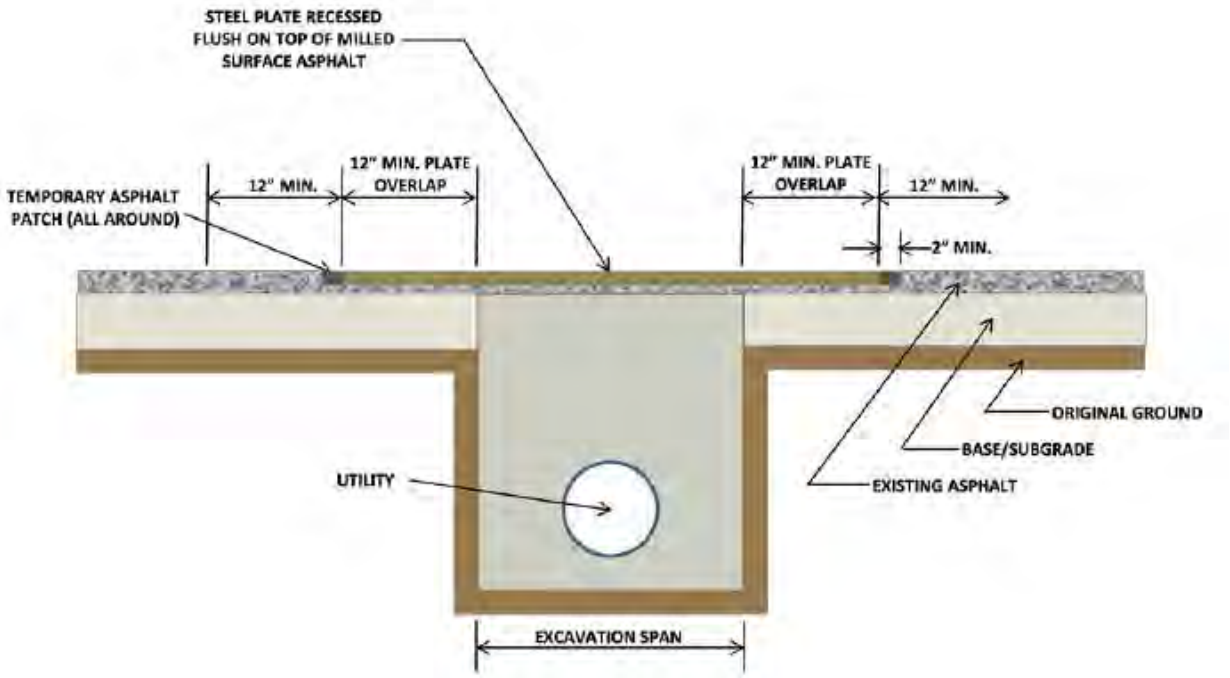
H. Surface.

The surface of the temporary patch shall provide a smooth driving surface.

I. Using Steel Plates.

Steel plates, with appropriate strength, may also be used for overnight temporary trench cover. The steel plates shall be placed such that traffic will not cause them to move. The use of steel trench plates maybe granted by the Local Entity. The asphalt shall be milled to the thickness of the steel plate and the plate shall be set flush with

the surrounding asphalt, any gaps surrounding the plate shall be filled with temporary asphalt and the plate fastened securely to prevent movement. A rubber bolt-down trench plate ramp may also be used as approved by the Local Entity Engineer.



25.5.2 Permanent Patch.

A. Patch Geometry.

Existing pavements should be removed to clean, straight lines parallel or perpendicular to the flow of traffic. Patches shall not be constructed with angled sides or irregular shaped edges.

B. No Patches within Existing Patches.

Patches within existing patches are to be avoided. Where this cannot be avoided, boundaries of the new patch shall match the existing patch.

C. Separation.

Strips of pavement greater than 6 feet in width from the edge of the new patch to the edge of an existing patch or the lip of the gutter may remain.

D. Series of Patches.

Where three or more pavement cuts are proposed within a 75-foot-long roadway section, the pavement between the patches shall be milled and inlaid with new pavement over the entire work area. In cases where the existing pavement is in poor condition and may require overlay within the next few years, this requirement may be modified or waived by the Local Entity Engineer. A series of patches may also be repaired with an overlay. Refer to **Section 25.5.6 G**.

E. Patch Widths.

Trenches shall be patched for the entire lane width for a distance of 2-foot minimum on all sides of the trench. Transverse patch lengths shall extend across the full width of the travel lane. Minimum width for transverse patches shall be as listed in the Minimum Patch Requirements table below.

F. Longitudinal Patches.

Longitudinal Patches on Major Collector and Arterial Roadways. Edges of patches shall not fall in existing wheel paths. The edges of patches parallel to the direction of traffic shall be limited to the boundaries of lanes or to the centerline of travel lanes.

G. Transitions.

Patches should have a smooth longitudinal grade consistent with the existing roadway. Patches should also have a cross slope or cross section consistent with the design of the existing roadway.

H. Older Pavement.

In the case of older pavement where the likelihood of cracking and potholes next to the patch is greater, extend the "shoulders" of the pavement beyond the 2-foot minimum, and reinforce this area with a geotextile fabric. "T" cutting is required for all repairs in accordance with **Section 25.7.5 A.4**.

I. Width Consistency.

The width of patches shall be consistent to simplify future maintenance.

J. Patch Thickness.

The thickness of asphalt patches in asphalt streets shall typically be the thickness of the existing asphalt plus one (1) inch with the minimums listed in **Table 25-1**, or as specified by the Local Entity Engineer.

Table 25-1
Minimum Patch Requirements

Minimum Asphalt Thickness (for full depth pavement only)		Minimum Widths (Transverse Patches)
Residential – 6 inches	2" grading S on 4" grading SG	Residential – 6 feet
Collector – 8 inches	2" grading S on 6" grading SG	Collector – 8 feet
Arterial – 10 inches	3" grading S on 7" grading SG	Arterial – 10 feet

25.5.3 Pavement Evaluation.

In most cases, and particularly in the cases of extensive excavation and repairs, it is desirable to survey the existing pavement condition with the Local Entity Engineer prior to the work. After completion of the work, the pavement condition again shall be surveyed to verify that the pavement condition has been maintained or improved.

A. Minor Repairs.

In the case of minor repairs, pavement surveys can be made by visual observation.

B. Major Repairs.

In the case of major projects that involve excessive haul of materials or unusually heavy construction equipment or activity, nondestructive testing of the pavement condition before and after construction may be required.

25.5.4 Base Course.

If the existing base course is untreated, it shall normally be replaced with CDOT Class 5 or 6 aggregate base course material and compacted in layers not to exceed 6 inches thick. The resulting total compacted base thickness shall be the thickness of the removed base plus 2 inches. Bituminous pavement may be used in lieu of aggregate base course in trench patches. If this option is used, the total pavement patch thickness shall match the minimum thickness for full depth pavement specified in **Section 25.6.1**, A-10 above.

25.5.5 Portland Cement Concrete Pavement

A. Removal of Concrete Pavement, Crosspans, and Alley Intersections

1. Concrete Cutting. Concrete that is to remain shall be cut in a straight, true line with a vertical face, unless otherwise specified. Concrete shall be cut with a saw in accordance with **CDOT Specifications Section 202.02**. Concrete that must be dowelled shall be sawed to the full depth of the concrete.

2. Depth. Concrete pavement shall be removed to full depth.

3. Removal at Joints. If the removed portion falls within 3 feet of a construction joint, cold joint, expansion joint, or edge, the concrete shall be removed to the joint or edge.

4. Responsibility for Over-Break. The Developer shall be responsible for the cost of removal and replacement of all over-break.

5. Determining Limits of Removal. In the case of damaged concrete, the limits of removal should be identified in the field by a representative of the Local Entity Engineer.

B. Concrete Surfacing and Patching

1. Strength and Thickness of Concrete. The concrete pavement shall be replaced with 4,000 psi concrete to match the finish and thickness of the existing

pavement, but not less than 8 inches thick. Mix design must meet the requirements of **Chapter 22, Materials and Construction Specifications.**

2. Curing. Concrete shall be coated and sealed with a uniform application of membrane curing compound applied in accordance with manufacturer's recommendations. Refer to **Chapter 22, Materials and Constructions Specifications**, for additional curing information.

3. Quick Curing Concrete. The use of quick curing concrete (3000 psi strength within 48 hours) shall be used on all Arterial and Collector streets when repair areas are less than 500 square feet or when temperatures are below 40° F. Quick curing concrete repairs may be opened to traffic within 2 days or when the concrete has achieved a minimum strength equaling 80 percent of the 28-day design strength. Concrete cylinders shall be taken and broken according to **Chapter 23, Street Inspection and Testing Procedures**. The mix design shall be designed in accordance with CDOT specifications.

4. Extending the Repair to Adjacent Damage. Where existing cracks or damage are adjacent to the area being repaired, the repair area shall include the cracked or damaged concrete. Pavement repairs shall include all areas of damage, including leak test holes, potholes, equipment, and/or material scarring of the existing surface.

C. Opening to Traffic

Refer to **Chapter 22, Construction Specifications**.

D. Connection Between Existing and New Pavements (Joints)

1. Grade Change. Where new construction abuts existing pavement, the work shall be accomplished so that no abrupt change in grade between the old and new work results.

2. Concrete Joint Filling. Expansion joint material shall be installed between new structure slabs and existing structure slabs. Joints shall be thoroughly cleaned of all foreign material, then filled with a hot-poured elastic type joint filler conforming to M 173, ASTM D1190-80, or ASTM D1751-83, D1752-84, D3405-78, D3406-78, D3407-78. Silicone sealants or other materials may be approved by the Local Entity Engineer. Joint material shall be filled to within 1/2 inch of the surface. Excess material shall be scraped off to provide a smooth riding surface.

3. Edge Treatment. When repairing concrete, the removal perimeter shall be saw cut full depth of the concrete, and dowels inserted into the existing concrete as directed by the Local Entity Engineer.

E. Reconstruction of Concrete

When pavement has been identified to require reconstruction, the pavement shall be removed and replaced in sections from joint to joint. Replaced sections may require doweling connections. Refer to **CDOT M-Standards** for details.

F. Manhole Frames and Valve Box Adjustments.

Manhole frames, covers, and valve boxes shall be adjusted using the following criteria: The concrete edges will be a full depth saw cut and be a minimum of 1.0 foot from the manhole frame or water valve box. After removal of the old concrete, the existing slab will be drilled 8 inches deep and a 16 inches long #4 bar will be placed at 12 inches on center. Concrete pavement shall be replaced to the existing depth or a minimum of 6 inches, whichever is greater, with a minimum mix design of 6 sacks of cement and a minimum 28-day compressive strength of 4200 psi. The concrete shall be protected from weather and rapid loss of moisture. Concrete shall be protected from vehicular traffic for a period not less than 7 days (three days with High/Early Concrete). Compressive strength of concrete shall reach 3000 psi prior to any traffic loading. Concrete patches shall be a minimum of 9 square feet. The same process of notification, inspection, and acceptance as outlined above shall apply to this method and shall occur prior to the application of the final wearing surface around these appurtenances.

25.5.6 Bituminous Pavement

A. Removal of Bituminous Pavement

1. Edges. Pavement designated for removal shall be cut vertically with square edges such that each edge of the finished patch will be parallel or at right angles to the direction of traffic. The edge for removal will be in a straight line set by a string line, chalk line, or other means to ensure a straight removal line.

2. Scoring Edge of Removal Area. Marking or scoring the asphalt pavement shall be done in such a way that damage to the adjoining mat is minimized. Use of a power cut-off saw is an approved method of scoring or precutting the perimeter of the asphalt removal area.

3. Damage Outside Removal Limits. Any overbreak, separation, gouging, or other damage to the existing asphalt mat outside of the designated removal limits shall be repaired at the Developer's expense.

B. Materials and Application for Tack Coat, Prime Coat, and Blotter

1. Preparing Existing Surface. If needed, this work shall consist of preparing and treating an existing surface with bituminous material, and blotter material if required, in accordance with these specifications and in reasonably close conformity with the lines shown on the approved Civil Construction Plans.

2. New and Existing Pavement Interface. This work shall be done prior to placing new pavement on top of existing pavement. Also, when new pavement is to abut existing pavement, the Developer shall cut the old pavement according to **Section 25.5.6 A** and as directed by the Local Entity Engineer. The Developer shall also paint the edge of the existing pavement with a tack coat. In this case, after placing

the new asphalt, all seams (joints) between the new and existing pavements shall be sealed with an asphalt tack coat or rubberized asphalt sealant.

3. Materials.

   a. Tack Coat and Prime Coat. The type and grade of bituminous material to be used for the tack and/or prime coats shall be as specified in the Pavement Design Report referenced in **Chapter 10, Pavement Design and Report**. This material shall meet all of the requirements of **CDOT Specifications Sections 407.02, 407.03,** and **702**.

   b. Blotter Material. Blotter material, if required, shall meet the gradation requirements shown in **Table 25-2**.

Table 25-2
Blotter Material

Standard Sieve Size	Percent by Weight Passing
1/2 inch	100
No. 4	90–100
No. 16	30–75
No. 200	0–12

   Blotter material shall be used in the amounts necessary to absorb excess bituminous material. Excess blotter material shall be removed prior to the placement of the subsequent courses. Blotter material shall be free from all organic matter, lumps or balls of dirt, and any other foreign matter that could cause adverse effects on the final product.

   c. Paving Fabric. Paving fabric may be used when approved by the Local Entity Engineer. Pavement thickness shall be a minimum of 2 inches over the fabric.

4. Construction. Construction will proceed as follows.

   a. Equipment. The Developer shall provide equipment for heating and applying the bituminous material and for applying blotter material. The equipment shall be capable of applying the materials in a uniform manner for the specified rates of application.

   b. Weather. Bituminous material shall not be applied when the weather conditions would inhibit the desired function. No bituminous material shall be applied to any surface that is wet, frozen, or in any other condition that the Local Entity Engineer or his authorized representative shall consider unsuitable. In any case, no bituminous material shall be applied when the atmospheric temperature is below 50° F for the top lift. Refer to the **CDOT** book for lowest temperatures (**Section 401**).

   c. Preparation of Surface. The surface upon which the bituminous tack and/or prime coat is to be placed shall conform to the established lines. Grades shall be smooth and uniform and shall be compacted to the required density. If the required density deteriorates between the time the gravel course was originally

compacted and the time the prime coat is placed, for any reason whatsoever, the surface shall be recompacted to the required density at the expense of the Developer.

d. Application.

1) General. Bituminous material shall be applied to the width of the section to be primed by means of a pressure distributor in a uniform, continuous spread. When traffic is maintained, not more than one-half the width of the section shall be treated in one application. Care shall be taken that the application of bituminous material at the junctions of spreads is not used in excess of the specified amount. Excess bituminous material shall be squeegeed from the surface. Skipped areas or deficiencies shall be corrected.

When traffic is maintained, one-way traffic shall be permitted on the untreated portion of the roadbed. As soon as the bituminous material has been absorbed by the surface and will not pick up, traffic shall be transferred to the treated portion and the remaining width of the section shall be primed.

2) Tack Coat. The tack coat shall be pressure sprayed in the form of a mist onto roadway surfaces at a uniform rate of 0.05 to 0.10 gallon residual asphalt per square yard. Emulsions shall be diluted in the ratio of 3 parts emulsion to 1 part water by volume prior to use.

Tack coat shall be applied sufficiently in advance so that a tacky surface exists at time asphalt surface mix is placed. After tack coat application, it shall be worked into the roadway surface by use of rubber-tired equipment approved by the Local Entity Engineer. Extra tack coat shall not be applied except with the specific approval of the Local Entity Engineer. The time interval between application of the tack coat and placement of the asphalt mix will be regulated by the Local Entity Engineer.

3) Prime Coat. The prime coat shall be pressure sprayed at the rate of 0.2 to 0.5 gallon per square yard. Emulsions shall be diluted as in tack coat above.

Prime coat application shall be made less than 12 hours prior to placing asphalt base course. Application methods and equipment shall be approved in advance by the Local Entity Engineer.

4) Temperatures. The temperature requirements pertaining to the application of liquid asphalts and asphaltic emulsions shall conform to the requirements of **Table 25-3.**

Table 25-3
Spraying Temperature of Liquid Asphalts

Grade & Type RC, MC & SC	Distribution Spraying Temperature			
	Minimum		Maximum	
Toss	Fº	Cº	Fº	Cº
70	120	49	180	82
250	165	74	220	104
800	200	93	255	124
3,000	235	113	290	143

e. Maintenance of Primed Surface. The primed surface shall be maintained by removing all loose sand prior to placing any pavement or surfacing material thereon. Immediately before placing asphalt concrete or asphalt concrete base, additional prime coat shall be applied as directed to areas where the prime coat has been damaged. Loose or extraneous material shall be removed.

C. Minimum Repair of Cracked or Damaged Asphalt

1. Cracks. Individual and non-deflecting cracks in the asphalt shall, at the discretion of the Local Entity Engineer, be sealed with rubberized asphalt sealant approved by the Local Entity Engineer.

2. Damage. Any damage, even superficial, to the existing asphalt surface shall be repaired at the expense of the Developer, including but not limited to gouges, scrapes, outrigger marks, backhoe bucket marks, etc. A slurry seal type covering will be considered the minimum repair. Patching may be required, at the discretion of the Local Entity Engineer. Refer to **Section 25.5.6 F** for Patching.

D. Temporary Surfaces

Temporary Patches. When the final surface is not immediately installed, it shall be necessary to place a temporary asphalt surface on any street cut opening immediately after backfilling. The temporary surface installation and daily maintenance shall be the responsibility of the Developer until the permanent surface is completed and accepted. The temporary surface shall be either a hot mix or cold mix paving material. Temporary surfaces shall be compacted, rolled smooth, and sealed to prevent degradation of the repair and existing structures during the temporary period. Winter patching of Street Cuts, when temperatures are below what is appropriate for the placement of asphalt or when asphalt materials are not available for patching. A temporary concrete patch may be used until appropriate temperatures are consistent or until asphalt is available. The temporary concrete patch may be done with a low strength (2,500 psi) concrete placed 4-inches thick which will be replaced in the spring. Asphalt Cold patch material will not be allowed for more than three days.

1.

2. Backfilling or Covering with Steel Plates. When required by the Local Entity Engineer, trenches within Arterials or Collectors shall be backfilled or covered with steel plates (4 feet x 8 feet, 1-inch thick minimum) at the conclusion of the work done in order to open the roadway to traffic. Asphalt material shall be placed at the edges of the plate to provide a ramp at a minimum 1:12 slope.

3. Permanent Patching. Permanent patching shall occur within 2 weeks unless approved in advance by the Local Entity Engineer. The temporary patch shall be removed prior to placement of the permanent patch. Refer to **Section 25.5.6 F** for patching.

E. Asphalt Joint Filling

After placing the new asphalt, all seams (joints) between the new and existing pavements shall be sealed with an asphalt tack coat or rubberized asphalt sealant.

F. Patching

1. Conventional Patch.

   a. Removal of Bituminous Pavement. Refer to **Section 25.5.6 A**.

   b. Tack Coat. For patches in asphalt, a tack coat shall be applied to all edges of the existing asphalt and to the subgrade before placing the new pavement. Refer to **Section 25.5.6 B** for additional information.

   c. Protection from Solvents and Oils. The Developer shall protect the asphalt (both existing and new) from solvents and oils. Any piece of equipment leaking any fluid shall be removed from the work site immediately and shall not return to the work site until all leaks are repaired. If any piece of equipment leaks any fluid a second time, it shall be removed from the work site immediately and shall not be allowed on the work site again for the remainder of the project. The Developer shall not use diesel or other solvents to remove or prevent the sticking of asphalt to the wheels of rubber-tired rollers or other equipment used on the asphalt. Remove and replace any asphalt damaged by solvents or oils.

   d. Base Material. Aggregate base course required for any areas that have been opened up during inclement weather (rain/snow) shall be replaced at the expense of the Developer. The Developer shall protect all excavated areas from water infiltration of any type and will be responsible for any dewatering or subgrade stabilization.

   e. Placement of New Asphalt. All patching shall be performed with Grading S or SG. Where the asphalt pavement is greater than 4 inches thick, the lower lifts shall be grading SG. The materials must conform to requirements of **Chapter 22, Materials and Construction Specifications**. A mix design may be required. In all cases, the pavement wearing course must match the grading of the surrounding pavement. The HBP must be placed with a self-propelled paver if patching widths are greater than 8 feet. For patch widths greater than

4 feet and up to 8 feet, the mixture must be placed with either a self-propelled paver or a box spreader. These machines may be used to patch areas wider than 8 feet with the use of a screed extension that will extend beyond the width of the proposed patch. Patches paved with a self-propelled paver shall conform with the requirements specified in **CDOT Specifications Section 401.1**. Rollers shall move at a uniform speed with the drive roll or wheels nearest the paver. Steel-wheeled rollers shall operate at a maximum speed of 3 mph. The use of plate type compactors will not be permitted except in areas not accessible to the roller. Areas wider than the machine screed may be patched with a box spreader only if the length of the patch is less than 50 feet. Areas as wide as the street or longer than 50 feet shall be patched with an asphalt lay down machine.

Where irregularities, unavoidable obstacles, or patch widths of less than 4 feet make the use of mechanical spreading and finishing equipment impractical, the mixture shall be spread, raked, and luted by hand tools. For such areas, the mixture shall be dumped, spread, and screeded to give the required compacted thickness. New HBP shall be added in compacted layers, until the patch thickness meets the requirements of **Section 25.5.2 J**.

2. Cold In-Place Recycling.

   Patching may be achieved by cold in-place recycling. This is also used for reconstruction of larger areas of pavement as well.

3. Adjoining Concrete Repairs. All asphalt removed for conventional patching shall be removed to a width of 24 inches minimum, as measured perpendicular from the face of the newly placed concrete. All patching shall be performed with grading C(S) HBP. Patching shall generally consist of placing the lower layers of HBP necessary to accomplish the roadway widening. In addition, the Local Entity Engineer may authorize patching of areas prepared by in-place recycling.

4. Wheel Path. The asphalt patch area for street excavations that fall within the wheel path of the vehicular travel lane shall be increased in size to the center of the lane or adjacent lane.

G. Overlays.

The determination of need for a complete milling and overlay shall be made by the Local Entity Engineer. In streets where more than one cut is made within a 75-foot long roadway segment, an overlay of the entire street width, including the patched area may be required. All overlay work shall be coordinated with adjacent landowners such that future projects do not cut the new asphalt overlay work.

1. Protection from Solvents and Oils. Refer to **Section 25.5.6 F.1.c**.

2. Preparation of Existing Surface.

3. Tack Coat. Refer to **Section 25.5.6 B**.

4. Materials. All materials must comply with **Chapter 22, Materials and Construction Specifications.** The Local Entity Engineer may require a mix design. All overlays may use Grading S or SX.

5. Placement of New Asphalt.

   a. General. The Developer shall construct the work for asphalt overlay such that all roadway pavement placed prior to the time paving operations end for the year shall be completed to the full thickness required by the plans.

   b. Procedure. There shall be no feathered edges on any type of street. When edge of existing pavement adjoins gutter, overlays should be placed by first removing the edge of existing pavement to the desired depth by grinding and then replacing the pavement with an asphalt lay down machine. Grinding shall be to a depth such that the top of overlay is no more than 1/4 inch from the top of the gutter lip.

6. Cooling to Prevent Rutting. Overlaying layers of HBP shall not be placed until the lower layer has cooled sufficiently to provide a stable material that will support the equipment without rutting, shoving, or moving in any manner. The temperature of the first asphalt layer shall be less than 150º F before applying the second asphalt layer. All paving on each street shall be completed in one continuous operation, weather permitting, unless otherwise approved in writing by the Local Entity Local Entity Engineer.

7. Tandem Paving. Refer to Chapter 22, Materials and Construction Specifications.

8. Temporary Pavement Layer. The Developer shall schedule the work so that no planed or recycled surface is left without resurfacing for more than 10 calendar days between October 1 and March 1.

   a. Application of Material. The Developer shall immediately place a temporary hot bituminous pavement layer on any surface that has been planed or recycled and cannot be resurfaced in accordance with the above temperature requirements within 10 calendar days after being planed or recycled. The minimum thickness of the temporary hot bituminous pavement layer shall be 2 inches.

   b. Quality Control. The Developer shall perform the quality control required to assure adequate quality of the hot bituminous pavement used in the temporary layer. All applicable pavement markings shall be applied to the temporary layer surface.

   c. Developer Responsibility. The Developer shall maintain the temporary layer for the entire period that it is open to traffic. The Developer shall immediately correct any distress that affects the ride, safety, or serviceability of the temporary layer to the satisfaction of the Local Entity Engineer. The temporary hot bituminous pavement layer shall be removed when work resumes.

H. Reconstruction

1. Hot In-Place Recycling.

   a. General. Hot in-place recycling is a mixture of RAP, rejuvenating agent, and virgin hot mix. The mixture is produced at the paving site by use of special in-place heating and mixing equipment.

   b. Projects Not Suited for Hot In-Place Recycling. Projects with the following characteristics are not recommended for hot in-place recycling:

      1) Unstable subgrades

      2) Asphalt stripping from aggregates

      3) Wide transverse thermal cracks

   c. Projects Appropriate for Hot In-Place Recycling. Two types of applications have been identified for hot in-place recycling: maintenance and Local Entity Engineering. Maintenance applications are those that are used to maintain the existing roadway in a usable condition. Local Entity Engineering applications are those where hot in-place recycling is part of the structural rehabilitation or reconstruction of the pavement. **Table 25-4** shows the types of possible distresses and the applications to treat the pavement.

   d. Mix Design. The design shall be performed by **CPL-5140**. For Local Entity Engineering applications, 55 to 110 pounds per square yard of additional HBP should be used, and for maintenance applications, a minimum of 55 pounds per square yard of additional HBP is recommended.

Table 25-4
Distresses Treated by Hot In-Place Recycling

Type of Distress	Maintenance Application	Local Entity Engineering Application
Narrow Cracks in a Thin Pavement	Yes	Yes
Narrow Cracks in a Thick Pavement	Yes	Yes
Leveling	Yes	Yes
Rutting	Yes	—
Corrugation or Ride Improvement	Yes	—

   e. Structural Design. The structural layer coefficient will be a minimum of 0.35 and a maximum of 0.44. For Local Entity Engineering applications, design structural requirements will be met, and a minimum 2 inch overlay will be used in conjunction with the hot in-place recycling. For maintenance applications, a chip seal coat may be used as a wearing surface, if needed.

f. Construction Considerations. The depth to be recycled will be a minimum of 1-3/4 inches for all applications. There should not be any hot in-place recycling done closer than 1 inch above the bottom of the existing mat. Hot in-place recycling is a good choice for treatment of the old pavement prior to an overlay and should be considered a better alternative than a leveling course. Hot in-place recycling can be performed either full width or in the driving lanes only. It should be noted that when 110 pounds per square yard of additional HBP is added to the recycled mix, the driving lane will be approximately 1 inch higher than the shoulder, and lane/shoulder drop off needs to be taken into consideration. Traffic control for a long paving train must be taken into consideration.

For Local Entity Engineering applications, the variability of the amount of virgin mix and rejuvenating agent will be determined by data from Developer supplied testing.

I. Inclusion of Adjacent Cracks or Damage

Where existing cracks or damage are adjacent to the area being repaired, the repair area shall include the cracked or damaged asphalt.

J. Manhole Frames and Valve Box Adjustments

Manhole frames and covers and valve boxes shall be adjusted using the following criteria: Excavate the pavement around the object to clear the object by at least 2 feet from the outside edge of the device and 8-inches deep. This area shall be filled with asphalt lifts and compacted to at least 95 percent density as determined by ASTM D 2041-78, D 2726-83, and D 2950-82. The same process of notification, inspection and acceptance as outlined above shall apply to this method and shall occur prior to the application of the final lift around these appurtenances.

25.6 OTHER RECONSTRUCTION AND REPAIR

25.6.1 Trenches in Gravel Streets or Alleys

A. Gravel Specifications.

When trenches are excavated in streets or alleys that have only a gravel surface, the Developer shall replace such surfacing on a satisfactory compacted backfill with gravel conforming to CDOT Class 5 or Class 6 aggregate base course.

B. Thickness and Grade.

The thickness of gravel replacement shall be 1 inch greater than the thickness of the original gravel surface, but not less than 4 inches. The surface shall conform to the original street grade.

C. Settling.

Where the completed surface settles, additional gravel base shall be placed and compacted by the Developer immediately after being notified by the Local Entity Engineer, to restore the roadbed surface to finished grade.

D. Special Surface Treatment.

Some streets may have been previously treated with a special surface treatment to control dust and/or bind the aggregates together. In these cases, the Developer is responsible for installing the gravel surface in the same manner. Such surface treatments shall be of the same chemical composition as what existed prior to the excavation work. The Local Entity Engineer shall note on the permit the surface treatment that will be required.

25.7 DEVELOPING A "QUALITY" APPROACH

25.7.1 General

Every street and street repair situation is unique. Design criteria and construction standards cannot address every situation but, in order to maintain some form of consistency, these standards have been developed. In most cases, they provide the minimum acceptable standards for construction or repair. Consequently, when strictly applied, they will provide the minimum acceptable product. Therefore, this criteria has been developed to maintain the same integrity of the street pavement and subsurface condition as existed prior to its being cut for utility installations or repairs.

To achieve the goal of "Quality" or "Excellence" in street repairs, these criteria shall be viewed as guidelines when used in conjunction with good planning and judgement. This will restore the street to an acceptable condition with minimal patching failures. In many cases, it will be necessary to **exceed** the minimum standards to achieve a quality repair.

Issues that shall be considered in a quality approach to street repairs are as follows (these criteria must all be balanced against the long-term maintenance needs of the utility):

25.7.2 Appearance

Does the final appearance of the street suggest the repairs were planned, or that they happened by accident?

A. Public Perception

Consciously or not, the driving public "rates" the appearance of the street system—including street repairs—every day. Street repairs which are satisfactory from a functional point of view may produce a negative reaction from the public if they give the appearance of being poorly planned or executed.

B. Appearance Guidelines

The public's perception of the street repairs is based primarily on shape, size, and orientation—the geometry of a patch. Refer to **Figure 25-1, Patching (Appearance)** for graphic illustrations of the following patching guidelines. for the geometry of a quality patch:

1. Existing pavements should be removed to clean, straight lines **parallel** and **perpendicular** to the flow of traffic. Do not construct patches with angled sides and irregular shapes. (See **Figure 25-1**, item A)

2. Avoid patches within existing patches. If this cannot be avoided, make the boundaries of the patches coincide. (See **Figure 25-1**, item B)

3. Do not leave strips of pavement less than one-half lane in width from the edge of the new patch to the edge of an existing patch or the lip of the gutter. (See **Figure 25-1**, item C)

4. Asphalt and concrete pavements should be removed by saw cutting or grinding. Avoid breaking away the edges of the existing pavement or damaging the remaining pavement with heavy construction equipment. (See **Figure 25-1**, item D)

5. In concrete pavements, sidewalks and other public use areas where the surface is in good repair**, remove sections to existing joints**. In damaged concrete, the limits of removal should be determined in the field by a representative of the Local Entity Engineer. (See **Figure 25-1**, item D)

6. In the case of a **series of patches** or patches for service lines off a main trench, repair the pavement over the patches by **overlay** shall be required when the spacing between the patches is less than 75 feet (in cases where the existing pavement is in poor condition and may require overlay within the next few years, this requirement may be modified or waived by the Local Entity Engineer). (See **Figure 25-1**, item E)

25.7.3 Rideability

Completed street repairs shall have rideability at least as good as, or better than, the pavement prior to the repairs being made. Street repairs may be visible but, should not be "felt" when driving over them.

A. Guidelines for Rideability

Refer to **Figure 25-2, Patching (Rideability)** for graphic illustrations of the following patching guidelines:

1. Do not construct asphalt overlays in such a manner that create a bump to the motoring public. If the leading edge of an overlay is substantially noticeable to a car it is likely to be significant to the snow plow trucks. The Local Entity Engineer shall determine whether or not the rideability of the overlay is acceptable. If the transition is not smooth, the Developer shall remove and replace

the pavement to provide a smooth leading edge to the satisfaction of the Local Entity Engineer. (See **Figure 25-2**, item A)

2. Surface tolerances for street repairs should meet the standard for new construction. That is, the finished surface of the street repair, when tested with a ten (10) foot straightedge parallel to the centerline or perpendicular across joints, will show variations measured from the testing face of the straightedge to the surface of the street repair which do not exceed one-quarter (1/4) inch. (See **Figure 25-2**, item B)

25.7.4 Pavement Management

Street repairs should leave a pavement in a condition at least as good as, if not better than, the condition prior to the repairs.

A. Pavement Management Guidelines

Refer to **Figure 25-3, Patching (Pavement Management)** for graphic illustrations of the following patching guidelines:

1. In most cases, and particularly in the cases of extensive excavation and repairs, it is desirable to survey the existing pavement condition with a representative of the Local Entity Engineer prior to the work. After completion of the work, survey the pavement condition again to verify that the pavement condition has been maintained or improved.

2. In the case of minor repairs, these pavement surveys can be made by visual observation. However, in the case of major projects that involve excessive haul of materials or unusually heavy construction equipment or activity, non-destructive testing of the pavement condition before and after construction is required.

3. Consideration of pavement management issues may also identify opportunities for joint efforts between the utilities and the Local Entity Engineer.

   For example, suppose the repair of a utility line requires an overlay on half of a street, and that the condition of the remaining half of the street might also warrant an overlay. We may decide at that point to overlay the entire street, with Local Entity Engineer's street authority and the utility splitting the cost of the overlay.

   In such a case, the utility may be able to save the cost of grinding half the street. The Local Entity Engineer's street authority will allocate a reasonable percentage of their annual overlay program to accommodate their share of these situations. This includes minor (2-3 block) maintenance projects and larger capital improvement projects (water main line extensions). Coordination for these types of cooperative repairs shall occur as far in advance of actual construction as possible.

4. Transverse patches shall be replaced across the entire street width for a distance of one (1) foot minimum on both side of the trench, thus creating a 'T' shaped patch above the trench. (See **Figure 25-3**, item A)

5. Do not allow the edges of patches to fall in existing wheel paths. The edges of patches parallel to the direction of traffic shall be limited to the boundaries of lanes or to the centerline of travel lanes. (See **Figure 25-3**, item B)

6. Patches should have a **smooth longitudinal grade** consistent with the existing roadway and crown. Patches should also have a cross slope or cross section consistent with the design of the existing roadway. (See **Figure 25-3**, item C)

25.7.5 Future Maintenance

Excavations and street repairs, even well constructed street repairs, shorten a pavement's life. Several types of street distress, settlement, alligator cracking, and potholes, often show up around patches. Quality street repairs should **attempt to include adjacent minor damage** and reduce the chances of associated growth out to these types of distress.

A. Future Maintenance Guidelines

Refer to **Figure 25-4, Patching (Future Maintenance)** for graphic illustrations of the following patching guidelines:

1. Avoid weakening or destroying the existing pavement around an excavation with heavy construction equipment, stockpiling or delivery of materials, etc. When damage does occur, remove the damaged pavement, extending the limits of the street repair, before replacing the pavement. Remember, no stockpiling of backfill or road building materials is permitted on the pavement. (See **Figure 25-4**, item A)

2. When the proposed excavation falls within three feet of a section of failed pavement, the failed area shall be removed to sound pavement and patched. Scarring, gouging, or other damaged pavement adjacent to a patch shall be removed and the pavement repaired. (See **Figure 25-4**, item A)

3. With older pavement where the likelihood of cracking and potholes next to the patch is greater, it shall be necessary to extend the "shoulders" of the pavement beyond the one-foot minimum. When the adjacent deterioration is less than 3' away, reinforce this area with a geotextile fabric. (See **Figure 25-4**, item B)

4. "T" cutting shall be required for all asphalt repairs in all streets.

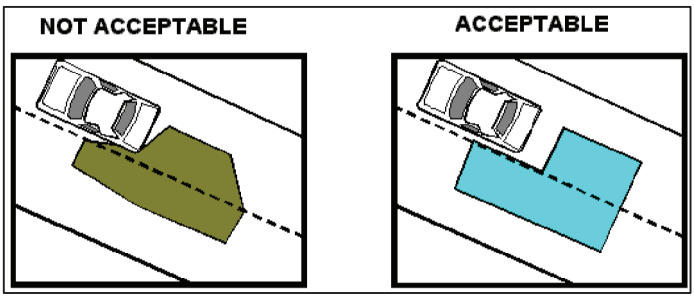
5. For patches in asphalt, a tack coat shall be applied to all edges of the existing asphalt before placing with the pavement.

6. After placing the new asphalt, all seams (joints) between the new and existing pavements shall be sealed with an asphalt tack coat or rubberized crack seal material.

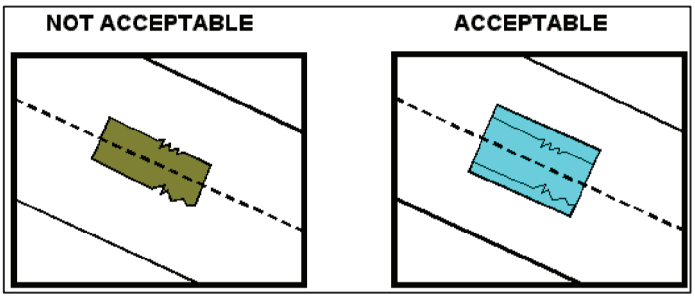
7. Avoid frequent changes in width of patches. For future maintenance, this simplifies removal of adjacent pavement failures. (See **Figure 25-4**, item C)

DESCRIPTION

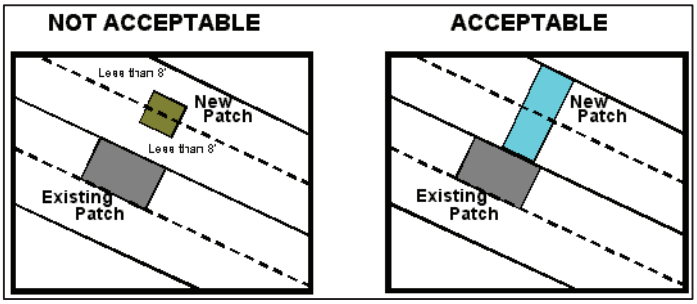
A. Parallel and Perpendicular



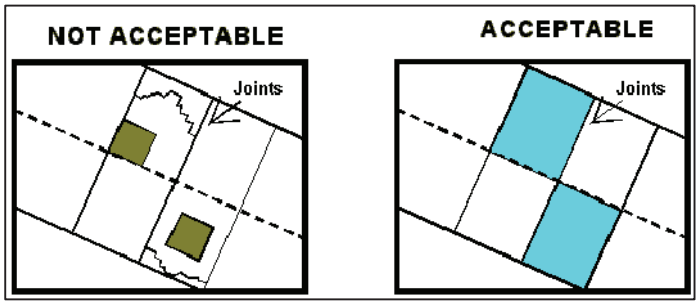
B. Avoid Patches Within Existing Patches



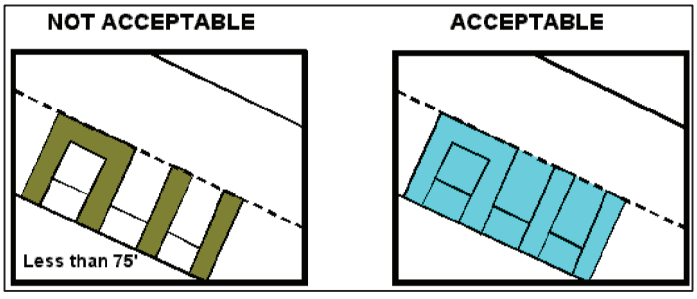
C. Strips Of Pavement < 1/2 Lane Width



D. Remove Sections To Existing Joints



E. Series Of Patches

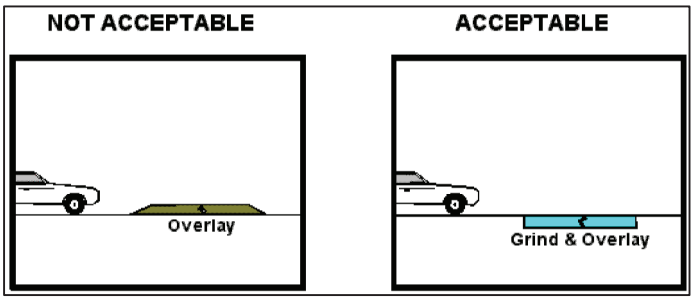


PATCHING (APPEARANCE)

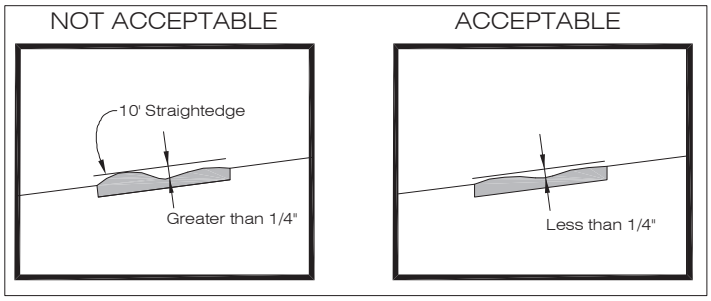
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 12/06/01	25-1

DESCRIPTION

A. Do Not Create A Bump With Overlay



B. Surface Tolerances

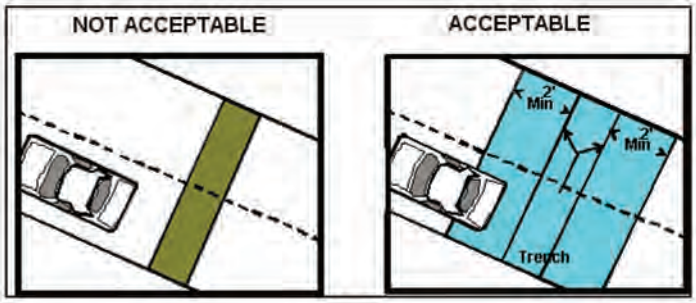


PATCHING (RIDEABILITY)

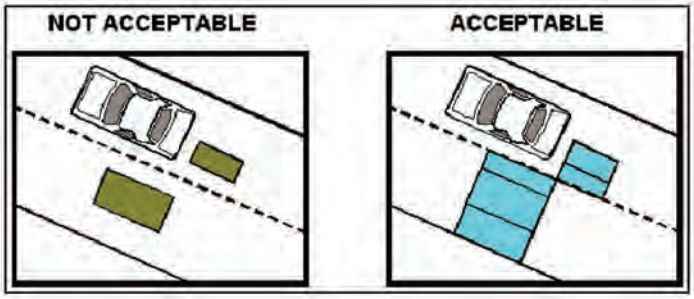
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 12/07/01	25-2

DESCRIPTION

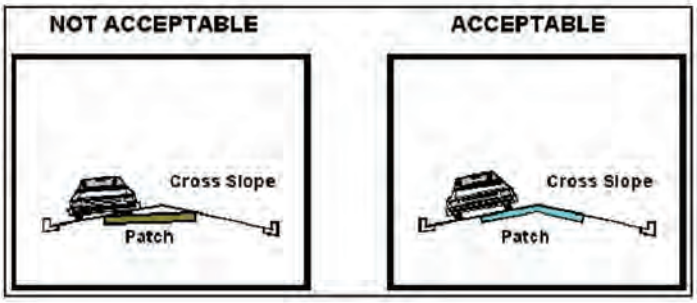
A. Transverse Patches



B. Existing Wheel Paths



C. Smooth Longitudinal Grade

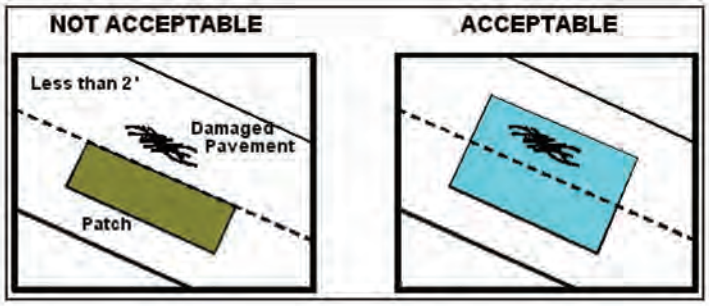


PATCHING (PAVEMENT MANAGEMENT)

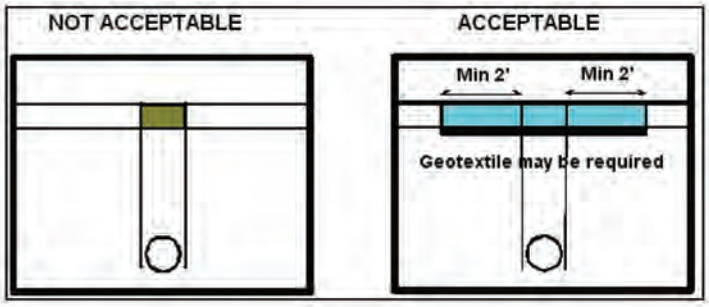
LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 12/07/01	25-3

DESCRIPTION

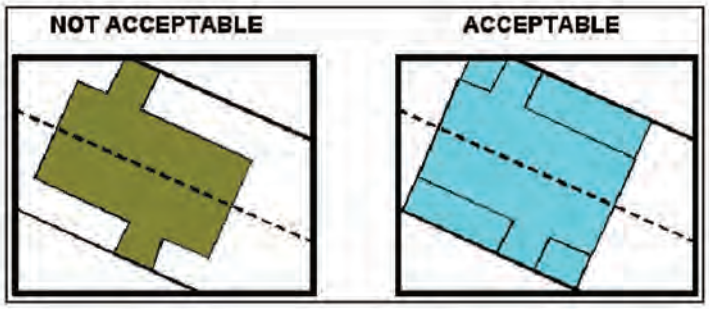
A. Include Adjacent Minor Damage



B. Extend The "Shoulders" Of The Pavement



C. Avoid Frequent Changes In Width



PATCHING (FUTURE MAINTENANCE)

LARIMER COUNTY URBAN AREA STREET STANDARDS	DESIGN FIGURE	REVISION NO:	FIGURE
		DATE: 12/07/01	25-4