



Bernalillo County Technical Standards



Photo: Bridge Blvd Phase I Construction (Photo Credit – Larry Gallegos)

March 28, 2023

BERNALILLO COUNTY
BOARD OF COUNTY COMMISSIONERS
ADMINISTRATIVE RESOLUTION NO. 2023 41

ADOPT TECHNICAL STANDARDS

WHEREAS, Technical Standards provide detailed guidance to County engineers and technical staff, developers, consultants, and contractors, in the design and construction of public infrastructure improvements as well as in permitting and procedures; and

WHEREAS, County ordinances related to the design and construction of public infrastructure reference Technical Standards (formerly called Street Standards), a standalone document originally approved in 1988; and

WHEREAS, since that time, the number and types of public infrastructure projects reviewed by the County have increased and become more complex, best practices have evolved, and federal and state regulations have changed. These changes have been incorporated into the latest version of Technical Standards; and

WHEREAS, Chapter 66, Roads and Bridges, Division 2, Permits and Approvals, Section 66-171 states “The county manager may issue such rules, standard details, and regulations as are required to enforce this article.”;and

WHEREAS, Bernalillo County is authorized to require the Technical Standards for construction activities under N.M. Const. art. X, § 10 (as amended Nov. 4, 2014) Urban Counties; NMSA 1978, § 4-37-1 (1975) General Powers of Counties; Bernalillo County Charter, art. XII.

1 **NOW, THEREFORE**, be it resolved by the Board of County Commissioners, the
2 governing body of the County of Bernalillo, adopts the Technical Standards.

3 **DONE**, this 28th day of March 2023.



BOARD OF COUNTY COMMISSIONERS

Barbara Baca
Barbara Baca, Chair

Adriann Barboa
Adriann Barboa, Member

Excused

Steven Michael Quezada, Member

Walt Benson
Walt Benson, Member

Eric C. Olivas
Eric C. Olivas, Member

23 APPROVED AS TO FORM:

24 *W. Ken Martinez*
25 W. Ken Martinez, County Attorney
26

27 ATTEST:

28 *Michelle S. Kavanaugh*
29 Linda Stover, County Clerk
30
31
32

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Appendix A - Bernalillo County Green Stormwater Infrastructure/Low Impact Development Standards

1. General Considerations

1.1 Introduction

The “Bernalillo County Technical Standards,” referred to throughout the text as the “Technical Standards,” are the technical requirements from the Bernalillo County Public Works Division (BCPWD) for transportation and drainage infrastructure related to public and private development. This document provides technical infrastructure details as well as the processes involved in BCPWD development review.

These Technical Standards build upon the Bernalillo County Street Standards, first published in 1988, and subsequent updates to the Bernalillo County Code. Further guidance is taken from state and federal laws and national best practices. This document was created and will be updated based on the following **guiding principles**:

- Protect and promote public health, safety, and general welfare of the public.
- Provide environmental, social, and economic benefits.
- Maintain consistency and fairness in development review.
- Ensure that infrastructure design adheres to applicable laws, land use and development regulations and current transportation planning and engineering standards.

1.2 Authority

The Technical Standards enabling authority is set forth in N.M. Const. art. X, § 10 (as amended Nov. 4, 2014); NMSA 1978, § 4-37-1 (1975) Counties: powers; ordinances; Bernalillo County Charter, art. XI.

The Technical Standards is written to provide standards for implementation by the authority of the **County Engineer**. The County Engineer is defined as the highest ranking employee in the BCPWD with a New Mexico Professional Engineer License. This individual is often the Deputy County Manager for BCPWD. The County Engineer may delegate any portion of his or her authority a designee if the County Engineer determines that the delegation will improve the delivery of services or serve the public health, safety and welfare. In delegating such authority, the County Engineer may reserve the right of final decision.

1.3 Purpose and Scope

The Technical Standards is intended for use by County staff, property owners, developers, and their agents, including planners, architects, and engineers. In order to achieve the broad goals of the guiding principles, the purpose of the Technical Standards is to:

- Provide the criteria necessary for a project to meet appropriate standards for safety, construction, and maintenance.
- Provide references to the **Bernalillo County Green Stormwater Infrastructure Low Impact Development Standards** for stormwater runoff reduction and water quality improvement for post construction conditions.
- Provide clear and consistent standards for construction of or modification of facilities in the public right-of-way by public or private entities.

- Implement and administer the development regulations related to transportation infrastructure contained in the **Bernalillo County Code** and the **Comprehensive Plan**.

The Technical Standards are limited to the BCPWD requirements, and this document is not a comprehensive guide to public and private infrastructure development. Private development processes have additional requirements that are imposed by Bernalillo County Planning and Development Services. Publicly funded projects have additional requirements as well.

1.4 Applicability

The Technical Standards shall apply to all public and private new construction, reconstruction, and maintenance of the road network, including drainage and utility facilities.

Situations may arise where the application of the individual standards from this document will not ensure the protection of public health, safety, and welfare. Accordingly, the County Engineer may impose additional or more stringent standards than those contained in this document, or require the modification of plans, specifications, or operations.

1.5 Administrative Interpretations

Administrative Interpretations are rendered as a result of a request by an applicant or any substantially affected interest to clarify the implementation or application of guidelines, standards, and/or rules of the Technical Standards. An applicant or any substantially affected interest may request an Administrative Interpretation of the County Engineer by completing and submitting a “Request for Administrated Interpretation Application” in the [BC Technical Standards Website](#).

Upon submittal of an application for Administrative Interpretation, BCPWD staff shall review the application for sufficiency. The County Engineer shall have 15 calendar days to respond to requests for Administrative Interpretations.

1.6 Revisions

The County Engineer is authorized to revise the Technical Standards. Such revisions will be issued as necessary to keep the document current and reduce the scope of subsequent changes. Each Technical Standards revision will incorporate the administrative interpretations that have been issued since the last revision. Suggestions for future revisions may be submitted using the “Technical Standards Comment/Change Request Form” found on the [BC Technical Standards Website](#).

Any material related to Bernalillo County Planning and Development Services (PDS) in the Technical Standards is revised through separate processes and subject to PDS’s procedures. Each revision of the Technical Standards shall include a review of current policies of other county departments to ensure consistency. If a department outside of BCPWD has approved a change a policy and the policy update is not reflected in the Technical Standards, the approved policy in the other department shall take precedent.

1.6.1 Public Notice

Prior to approval, amendment or repeal of any rule in the Technical Standards, the County Engineer shall publish a notice of the proposed rule and solicit comments as follows:

- Publish notice in a daily newspaper of general circulation in the county.
- Post the notice on the BCPWD website.
- Send the proposed rule change to applicable county departments and local agencies.
- Reasonably give public notice to interested persons.

The comment period shall be at least 21 days.

The notice shall include a summary of the proposed revision, the subjects and issues involved and where to obtain a copy of the full revision and how to submit written comments.

1.6.2 Approval of Revision and Public Notice

After reviewing and considering the comments submitted in response to the notice of the proposed rule, the County Engineer may approve the proposed rule, rule amendment, with or without changes or repeal proposed revisions.

The County Engineer shall provide notice of adoption of the rule, rule amendment, or repeal of the rule on the BCPWD website and send copies to any person who submitted written comments on the proposed rule.

1.6.3 Emergency Rule

In the event of an emergency, the chairperson of the board of county commissioners may direct that rules concerning procedures, criteria or standards take effect immediately upon public notice. The chairman's finding of an emergency and brief statement of the reasons for this finding shall be incorporated in the emergency and brief statement of the reasons for this finding shall be incorporated in the emergency rule change.

An emergency rule may not remain in effect longer than 120 days after the public notice without first being subject to the notice and approval procedures.

1.6.4 Bernalillo County Commission Review of Technical Standards Revisions

A rule approved by the County Engineer shall be reviewed by the Bernalillo County Commission (BCC) upon request by an interested person when such request is submitted in writing to the BCPWD no later than 120 days after the rule approval.

The BCC shall determine whether the adopted rule is consistent with the scope of BCPWD rule making authority.

After reviewing the rule, the commission may, upon motion, direct the BCPWD to retain, amend or repeal the rule.

The person requesting review shall be notified of the date, time and place of the BCC hearing review at least 14 days prior to commission review.

1.6.5 Public Inspection

The BCPWD shall maintain copies of all rules, and a current index of revisions, which shall be made available upon request for public inspection and copying.

1.7 Deviation from the Technical Standards

1.7.1 General

The Technical Standards represent appropriate practice under most conditions and are based on prior experience in Bernalillo County and other jurisdictions, as well as national best practices. They are intended to ensure that transportation, drainage, and other engineering-related facilities are safe and appropriate for use in Bernalillo County.

The Technical Standards are not intended to limit the introduction of new ideas. Situations will arise where alternatives to the Technical Standards may better accommodate existing conditions, overcome topographical challenges, or allow for more cost-effective solutions without adversely affecting vehicle or pedestrian safety, operation of road or drainage systems, maintenance, or environmental protection.

1.7.2 Basis for Deviation

The County Engineer will consider requests for deviations from the Technical Standards. All requests must be submitted using the “Request for Deviation Form” found on [BC Technical Standards Website](#) and must include supporting information demonstrating compliance with the following criteria:

- The deviation will comply with the intent of the Technical Standards.
- The deviation will not adversely affect traffic safety, maintenance or operations.
- The deviation will not adversely impact public health, safety, welfare, or environmental protections.

A separate request must be submitted for each proposed deviation from the Technical Standards, except where multiple deviations are related and should be evaluated as a single proposal. In such case, a single “Request for Deviation Form” may be submitted, but complete documentation and justification are required for each standard deviation to be considered. A deviation request is not required to approve a design that exceeds a Technical Standards specification.

1.7.3 Process/Schedule

The County Engineer shall have 15 business days to respond to deviation requests. The need for and the timing of a request for a deviation may not be predictable. Requests should be submitted as soon as the need becomes known. Any deviation request concerning a provision of the Bernalillo County Code *Ch. 34 Fire Prevention and Protection* requires concurrence by the Bernalillo County Fire Marshall prior to the final decision on the request.

Any affected persons may request a reconsideration of the County Engineer's decision on the deviation request within seven (7) business days of the date the County Engineer's exception decision using the "Exception Reconsideration Form" found on [BC Technical Standards Website](#). The grounds for seeking a reconsideration are limited to the following:

- The County Engineer's findings, conclusions, or conditions are not supported by the record.
- New evidence is discovered which could not reasonably have been produced and that is material to the decision.
- Changes in the application are proposed in response to deficiencies identified in the original request for exception.

1.7.4 Role of the County Engineer

The County Engineer has final authority on all requests for exceptions. The County Engineer reserves the right to approve, approve with conditions, or deny an exception from the Technical Standards, at any time, in the interest of public health, safety, and welfare.

1.7.5 ADA Structural Impracticable Determination

All pedestrian facilities that are new construction shall fully comply with ADA requirements except in the unusual case where a unique physical constraint makes full compliance structurally impracticable. The County Engineer considers requests to exceptions to ADA requirements due to structural impracticable. All exceptions must be approved before construction plans are approved.

1.8 Policies

These standards are intended to be consistent with the following federal and state laws, county codes, policies, and rules:

- Bernalillo County Code
- Bernalillo County Comprehensive Plan
- Bernalillo County Adopted Plans
- Bernalillo County Public Works Policies
- Metropolitan Transportation Plan
- New Mexico State Law and Codes
- Americans with Disabilities Act
- National Environmental Policy Act
- Federal Clean Air Act
- Federal Clean Water Act

1.9 References

A range of design manuals and resources are referenced within the Technical Standards. These documents may be updated over time. These Technical Standards are consistent with the most updated version of each reference document, as of 2022, with publication years listed below. Designers should use or reference the most recent version when following these design documents.

1.9.1 Road Design

- American Association of State Highway Transportation Officials (AASHTO), A Policy on Geometric Design of Highways and Streets, 7th Edition, 2019
- AASHTO, Roadside Design Guide, 2011
- Federal Highway Administration (FHWA), Manual on Uniform Traffic Control Devices (MUTCD), 2009
- National Association of City Transportation Officials (NACTO), Urban Street Design Guide, 2013
- Transportation Research Board (TRB), Highway Capacity Manual (HCM), 6th Edition, 2016

1.9.2 Drainage and Stormwater Quality

- Bernalillo County Green Stormwater Infrastructure Low Impact Development Standards, 2022
- Bernalillo County Green Stormwater Infrastructure Low Impact Design Strategies for Desert Communities, 2017
- New Mexico Department of Transportation (NMDOT) National Pollutant Discharge Elimination System Manual Stormwater Management Guidelines for Construction, MS4, and Industrial Activities, 2020
- City of Albuquerque, Development Process Manual, 2020
- U.S. Environmental Protection Agency, Green Streets Handbook, 2021

1.9.3 Pavement Design

- AASHTO, Guide for Design of Pavement Structures, 1993
- Bernalillo County Green Stormwater Infrastructure Low Impact Development Standards, 2021
- City of Albuquerque, Development Process Manual, 2020

1.9.4 Pedestrian Facilities

- U.S. Access Board, Public Rights of Way Accessibility Guide (PROWAG), 2011
- NMDOT Standard Drawings 608
- AASHTO, Guide for the Development of Pedestrian Facilities, 2021

1.9.5 Bikeways and Trails

- AASHTO, Guide for the Development of Bicycle Facilities, 2012
- NACTO, Urban Bikeway Design Guide, 2013

1.9.6 Public Transit

- City of Albuquerque, Development Process Manual, 2020
- NACTO, Transit Street Design Guide, 2016

1.10 Professional Qualifications

Professionals in the fields of engineering, architecture, or surveying who prepare or who are responsible for the preparation of plans, drawings, calculations, specifications, reports, and analyses submitted for the purpose of obtaining BCPWD permits, or approvals shall be registered or authorized to practice in the State of New Mexico. Registration or authorization to practice shall be in the specific technical area pertinent to the documents being prepared.

1.11 Inspection

Whenever an inspection is necessary to enforce any of the provisions of the Technical Standards, the County Engineer or his or her authorized representative may enter such premises at any reasonable time to inspect the premises, as allowed within the Bernalillo County Code.

1.12 Maintenance

BCPWD shall be responsible for maintenance of County-owned public facilities as directed by the County Manager and the Bernalillo County Commission. Maintenance of private property to these Technical Standards, including driveway access points, driveway culverts, and any approved encroachments, shall be the responsibility of the property owner.

1.13 Penalties

Failure to comply with the Technical Standards will be cause for withholding or withdrawing approval of plans or drawings, withholding of bonds, final inspection approval or occupancy certificates, and/or other penalties provided by the Bernalillo County Code or State of New Mexico law.

2. Development Processes & Permits Related to Public Works

Development is required to meet a range of requirements across several departments within Bernalillo County government. This chapter provides only Bernalillo County Public Works Division (BCPWD) requirements. Many of the permits and processes in this chapter involve departments outside of BCPWD. For example, Planning and Development Services Department oversees requirements related to planning, zoning and buildings. The vacation of public right-of-way involves the Real Estate Department. This chapter indicates when a permit or process involves departments outside of BCPWD. The applicant will need to coordinate with these departments for their current requirements.

2.1 Subdivision

2.1.1 General

Bernalillo County Code *Ch. 74 Subdivisions* is the Bernalillo County Subdivision and Land Development Ordinance.

Platting processes involve changes to the developable area of a parcel due to dividing property, consolidating multiple parcels, manipulating lot lines, encumbering a parcel with an easement or vacating an easement or right-of-way. These changes must meet requirements in Bernalillo County Code *Ch. 74 Subdivisions*. The County Development Review Authority (CDRA) is the board that reviews proposals for land to be platted or replatted in order to ensure compliance with Bernalillo County Code *Ch. 74 Subdivisions*. The CDRA is under Planning and Development Services (PDS) with committee members from other departments within Bernalillo County and other entities including, but not limited to the Albuquerque Bernalillo County Water Utility Authority (ABCWUA). Subdivision applications are accepted, distributed and approved through PDS. BCPWD performs a portion of the review, but does not administer the process.

This section is limited to BCPWD requirements for subdivision approval. Requirements and processes involving CDRA, Bernalillo County Zoning, Bernalillo Fire Department and ABCWUA are not included.

For BCPWD, the subdivider/developer is required to construct all necessary roads, trails, drainage, and utility improvements. Only replats are exempt from construction requirements.

All properties must demonstrate that they have legal as well as acceptable constructed access.

- **Legal access** is either directly from a County maintained road or via private access easements connecting to a County maintained road.
- **Acceptable constructed access** refers to a road that meets the requirements of the Bernalillo County Code and these Technical Standards and that allows emergency services to traverse the road in all-weather conditions.

These requirements apply to both Major and Minor Subdivisions as defined in Bernalillo County Code *Ch. 74 Subdivisions*. Generally, Minor Subdivisions are five (5) or fewer new lots and Major Subdivisions are six (6) or more new lots. The permit prefix for minor subdivisions is “SRP” and the permit prefix for major subdivisions is “SC.” Replats also use the “SRP” prefix.

Table 2-1: Subdivision Types

Subdivision Type	Permit Prefix	Number of Lots
Minor	SRP	5 or less
Major	SC	6 or more

2.1.2 Minor Subdivision Plat Requirements

For minor subdivision plats, after the sketch plat has been approved by the County Development Review Authority (CDRA), the following items are required to be submitted for review and approval prior to beginning construction:

- Water availability assessment (2.1.7.A)
- Sewer availability statement, if an existing utility will provide sewer service to subdivision (2.1.7.B)
- Construction plans that provide essential platting information to determine required rights-of-way and easements, unless exempted (2.5.5)
- Grading and drainage plans that provide essential information to determine the development will not create adverse flooding impacts, unless exempted (2.6.4)

All infrastructure improvements require a final inspection and approval prior to BCPWD signing the final plat, unless a Developer's Agreement (2.3) is utilized.

2.1.3 Major Subdivision Plat Requirements

For major subdivision plats, after the sketch plat has been approved by CDRA, the following items must be submitted for review and approval prior to approval of the preliminary plat:

- Traffic Impact Assessment for all subdivisions with 25 dwelling units or more or commercial subdivision (8.2)
- Water availability assessment (2.1.7.A)
- Wastewater disposal plan or sewer availability statement (2.1.7.B)
- Construction plans that provide essential platting information to determine required rights-of-way and easements, unless exempted (2.5.5)
- Grading and drainage plans that provide essential information to determine the development will not create adverse flooding impacts, unless exempted (2.6.4)

Construction shall not begin until the preliminary plat has been approved by the County Planning Commission (CPC). All infrastructure improvements require a final inspection and approval prior to BCPWD signing the final plat, unless a Developer's Agreement is utilized.

2.1.4 Submittal Requirements

2.1.4.A Application

The applicant shall submit a subdivision application to Planning and Development Services (PDS) according to the PDS procedures and submittal requirements. Submittals must follow the submittal deadlines to meet the CDRA schedule as prescribed by PDS. A separate submittal directly to BCPWD is not required to process a plat.

2.1.4.B Fees

PDS and BCPWD both assess a development review fee for all plats, which must be paid directly to each department. The BCPWD development review fee is described in the Fee Schedule, with a minimum fee amount of \$250. This fee payment must be made prior to BCPWD signing the plat.

2.1.5 Public Works Subdivision Review Process

PDS will distribute the subdivision application and attachments to the designated reviewer for the following BCPWD staff:

- Grading and Drainage
- Development Review
- Natural Resource Services

Subdivisions are reviewed by several Bernalillo County departments and outside agencies. The applicant is required to make all necessary corrections or revisions made in the CDRA review process.

BCPWD will sign the plat upon completion of all outstanding case comments and final construction approval of any required improvements. The applicant must secure all required plat signatures, pay the current taxes on the property, and record the plat with the County Clerk's office.

Upon recording of the plat, official copies and electronic plat files must be provided to PDS to complete the mapping necessary to revise the parcel lines. BCPWD requires a notification that the plat has been recorded.

2.1.6 Drawing Requirements for Plats

In addition to the requirements of Bernalillo County Code *Sec. 74-22 (b)* or *74-52*, plat drawings shall be required to include the following information.

2.1.6.A Wells and Wastewater Systems

A site plan showing any existing wells and wastewater systems, as well as any access easements for shared wells, must be submitted with the subdivision application.

2.1.6.B Road Right-of-Way and Access Easements

Adjacent right-of-way and access easement dimensions must be shown on the plat. If the road right-of-way or access easement is shown to vary, then a measurement at three or more locations (property line to property line) is required to be given on the plat. Typically, the three locations are from the two farthest end points and one at the midpoint; however, if the platted property has more than 300 feet of frontage on one road, additional intermediate points will be required.

The document which created the right-of-way or easement is required to be provided to BCPWD and/or the recorded Document Number or Book and Page Number must be placed on the plat.

If it is found that the constructed road is not contained within the provided easement or right-of-way, additional easement or right-of-way will be required to properly contain the constructed road. If an easement or additional right-of-way cannot be provided, then the road will need to be relocated.

2.1.6.C Private Road Additional Note

Additional notes are required if access to a development is by a private road or a private access easement that is not maintained by Bernalillo County. No mail shall be delivered on a private road that is not maintained by Bernalillo County, nor shall the private road be used as a school bus route. In such cases, a note shall be provided in the Disclosure Statement that states how mail delivery shall occur to the parcels created by this subdivision. An additional note shall be provided on the plat that this private road shall not be utilized as a mail delivery route or school bus route.

2.1.6.D Maintenance

If access is from a **private access easement or private road**, a road maintenance note must be added to the plat and to the Disclosure Statement concerning ownership and who is responsible for maintenance. For new private roads serving two or more new lots, a road maintenance agreement must be signed by all owners and provided prior to BCPWD signing the plat.

For **new landscape buffer/zones** constructed along local and collector roads, a landscape buffer/zone maintenance note must be added to the plat and to the Disclosure Statement. The note must reference a landscape buffer/zone maintenance agreement that specifies who is responsible for the landscape buffer/zone (i.e. adjacent property owners or homeowner's association). The agreement must address safety of contractor access for maintenance.

2.1.7 Water and Wastewater Submittal Requirements for Plats

2.1.7.A Water Availability Assessment

A water availability assessment is required prior to final plat approval for minor subdivisions, and prior to preliminary plat approval for major subdivisions. Requirements for the water availability assessment vary based on the source of water supply. See Table 2-2 and Bernalillo County Code Sec. 74-96 for additional information.

Table 2-2: Water Availability Assessment Requirements based on Water Supply

Source of Water Supply	Water Availability Assessment Requirements
Existing community water system	• A water availability statement from the utility stating it is ready, willing, and able to provide the maximum annual water requirements to the subdivision for at least 70 years, as defined in Bernalillo County Code Sec. 74-96(e). • At the discretion of the County, existing water utilities may be required to submit additional documentation as defined in Bernalillo County Code Sec. 74-96(e)(2). • For subdivisions to be served by the Albuquerque Bernalillo County Water Utility Authority: provide a residential water conservation summary specifying the water conservation measures that will be implemented in the subdivision to achieve the ABCWUA's 180 gallons per household per day standard.
New community water system	• A water supply plan and hydrologic report that meet the criteria in Bernalillo County Code Sec. 74-96(c) for new groundwater supplies and Sec. 74-96(d) for new surface water supplies. • Copy of New Mexico Office of the State Engineer permit indicating the subdivision has sufficient water rights to meet the maximum annual water requirements of the subdivision.
Individual domestic or multiple household wells	• Subdivisions with five or fewer lots: Information on wells within one-mile of the property as described in Bernalillo County Code Sec. 74-97. • Subdivisions with greater than five lots: Hydrologic report that meets the criteria in Bernalillo County Code Sec. 74-96(f).

Notes: The maximum annual water requirement for each parcel in a residential subdivision is 0.3 acre-feet per year. For nonresidential subdivisions and all water uses in a mixed-use development not related to residential uses, a detailed water demand analysis using the relevant New Mexico Office of the State Engineer Technical Report is required.

2.1.7.B Sewer Availability Statement

If a subdivision will be served by an existing sewer system, a sewer availability statement indicating the utility is ready, willing, and able to provide sewer service to the subdivision is required.

2.1.7.C Wastewater Disposal Plan

A wastewater disposal plan is required for major subdivisions prior to preliminary plat approval. Requirements for the wastewater disposal plan vary based on the type of wastewater system (see Table 2-3).

Table 2-3 Wastewater Disposal Plan Requirements

Type of Wastewater System	Wastewater Disposal Plan Requirements
Existing community wastewater system	Sewer availability statement (see 2.1.7.B above) and construction plans for the proposed extension of the existing wastewater system, per Bernalillo County Code Sec. 74-99(a) or (b).
New community wastewater system	Wastewater disposal documentation package that meets the criteria in Bernalillo County Code Sec. 74-99(c). Please see referenced code for criteria details. A brief summary is provided below: • Engineer's report and construction plans for the proposed community wastewater system • Maps showing the location of all water supply sources, floodplain and surface bodies within 1,000 feet of the proposed wastewater treatment and disposal site • Proof of New Mexico Environment Department discharge plan and permit
Individual or cluster wastewater systems	Wastewater disposal documentation package that meets the criteria in Bernalillo County Code Sec. 74-98(d). Please see referenced code for criteria details. A brief summary is provided below: Site evaluation for each soil series or association in the subdivision • Maps showing the location of all water supply sources, water courses, floodplain and surface bodies in the subdivision and within 500 feet of the subdivision. • Wastewater system feasibility map delineating allowable disposal sites

2.1.8 Subdivider's Responsibility

The subdivider is responsible for improvements to all roads within the subdivision, including any improvements deemed necessary by the County Engineer to ensure access to the subdivision and to mitigate offsite impacts. The subdivider must also improve all appropriate utilities and shall bear the cost of such improvements that serve the development. Required improvements may include, but are not limited to: water lines, sewer lines, storm drains, major drainage crossing structures, traffic lighting, street lighting, proper signage, and resurface or reconstruction of the road.

If improvements are not installed and approved, then BCPWD will not sign the final plat. If a Developer's Agreement has been issued, then the developer is liable for all costs according to terms of the Developer's Agreement.

2.2 Dedication and Vacation of Roads, Public Rights-of-Way, and Private Easements

2.2.1 General

This section applies to roads, trails, and other public rights-of-way that are to be added or removed from the County network. Subdivisions that include a dedication or vacation must follow this section, in addition to 2.1.3 as applicable. Not all subdivisions will include a dedication or vacation. Dedication and vacation of roads may be applied in other circumstances than a subdivision application; however, a plat is required for all dedications and vacations.

Questions regarding the dedication or vacation of a road or public right-of-way may be directed to the General Services Division – Real Estate Section. See the Technical Standards Contact List on the [BC Technical Standards Website](#) for the appropriate Bernalillo County staff person.

2.2.2 Dedication of Public Roads and Public Right-of-Way

2.2.2.A Plat Application

Dedication of public roads must be made through a subdivision plat application. The subdivision plat application provides the necessary processes for creating the right-of-way where the road will be located, road construction requirements, and the acceptance letter indicating the road will be maintained by Bernalillo County.

If a dedicated right-of-way exists without a County-maintained road, an acceptance letter is required after construction approval (a subdivision plat application is not necessary).

2.2.2.B Construction Standards

The road must be constructed to these Technical Standards and inspected and approved by the County Engineer. In cases where there is an existing road, the developer is required to provide evidence that the road construction or reconstruction meets these Technical Standards. The existing road is required to pass inspection and be approved by the County Engineer.

2.2.2.C Acceptance Letter

Once the road is constructed to standard, has passed inspection, and is approved by the County Engineer, the County Engineer must formally accept the road for maintenance via an acceptance letter. The acceptance letter is necessary for the road to be dedicated as a public road under County maintenance.

2.2.3 Vacation of Public Roads and Public Right-of-Way

2.2.3.A General Applicability

Alterations of County public roads must conform to Article II. 2011 New Mexico State Statutes, Chapter 67: Highways, Article 5: Vacation, Alteration and Establishment of the County Roads and Bridges, 67-5-1 through 67-5-21, Bernalillo County Code Sec. 74-63, Administrative Instruction #RE 01 and any other applicable codes or procedures.

2.2.3.B Preliminary Feasibility

The County Engineer shall determine if right-of-way is excessive. When the proposal to vacate may affect a road or intersection under the jurisdiction of another agency, the agency shall be notified about the proposal to vacate.

2.2.3.C Proposals to Vacate

Proposals to vacate County right-of-way must be made through a subdivision plat application and must be accompanied by proof of consent for property owners abutting the road and any other potential users of the road, as determined by the County Engineer. The applicant shall provide proof of consent through a "Statement of Vacation," as described in Bernalillo County Code Sec. 74-63.

The proposed subdivision plat must show an exact description of the area proposed to be vacated, abutting properties, and all connecting streets or easements, public and private, and must be approved by the County Engineer.

2.2.3.D Obtaining a Deed and Appraisal

The applicant must follow the General Services/Real Estate procedures (Administrative Instruction #RE 01) for obtaining a deed to the vacated right-of-way. This will typically include obtaining an appraisal of the area proposed to be vacated and purchasing the property. The appraisal must be conducted by an independent, general, certified appraiser. The adjoining property owners shall be offered 50 percent of the proposed property to be vacated. In circumstances where one property owner declines the offer to purchase the right-of-way to be vacated, a statement is needed that the offer was made, and they declined to purchase.

2.2.3.E County Review

The County Real Estate Committee will review the vacation submittal to determine its appropriateness based on location, applicable plans, and policies. If the vacation request is deemed appropriate, the committee will recommend approval to the appropriate approving authority based on appraised value, per Administrative Instruction RE-01.

2.2.3.F State Review

As required by NM Statute, vacation requests for properties appraised over \$25,000 need to be approved by the State Board of Finance. For properties appraised between \$5,000 to \$25,000, the vacation request must be approved by Local Governments Division of New Mexico Department of Finance. Properties appraised for less than \$5,000 only require County approval. Once the vacation request has been approved by the appropriate state and County review agencies, the final plat can be approved.

2.2.4 Private Roads and Private Access Easements

2.2.4.A Plat Application and Proof of Legal Access

Creation of private roads shall be made through a subdivision plat application. The County Engineer shall determine if a private access easement may be created where public right-of-way would not better serve public purposes and where private easements can adequately serve all identified transportation, utility, and storm water management requirements.

To demonstrate legal access, lots utilizing existing access easements that are not depicted on a plat for legal access shall be required to submit to the County a document that depicts the private access easement from the parcel to the connection to a public right-of-way. Acceptable documents include a plat, boundary survey, legal description with sketch, or another instrument acceptable to the County Engineer.

See 3.3.2 for required width.

2.2.4.B Construction Standards

Private roads must be constructed to the requirements of these Technical Standards and inspected and approved by the County Engineer. See 3.4 for construction requirements.

2.2.4.C Maintenance Required

Private roads shall not be maintained by the County. Maintenance shall be the responsibility of the owners of the property accessed by such roads. Proposed plats must state that road maintenance is the responsibility of property owners utilizing the easement. Private access easements shall be clearly defined as “Private” on the proposed plat and list the benefitting parcels by lot or tract number.

Private roads created by a subdivision plat that serve two or more new lots shall be accompanied by a recorded maintenance agreement. The maintenance agreement shall describe the required maintenance, the responsible properties for the maintenance by lot or tract number, the proportion of the maintenance burden by each responsible property, the method of accomplishing maintenance tasks, and the funding mechanism to pay for necessary maintenance. A Homeowner Association is an acceptable alternative to the recorded maintenance agreement.

2.2.4.D Approval Letter

The County Engineer must formally approve the completed construction of private roads required for subdivision access via an approval letter. The approval letter should list the approved road(s) by name. No Certificate of Occupancy for a building permit shall be issued until the private road providing access to that structure has been approved.

2.2.5 Utility Easement and Right-of-Way Agreements

All new construction by public and private utilities which will occupy the public right-of way shall be required to have an executed franchise agreement with Bernalillo County.

2.3 Developer's Agreement

2.3.1 General

Upon approval of plans and specifications by the County Engineer, the developer may enter into a Developer's Agreement which guarantees completion of required infrastructure improvements. Developer's Agreements are administrated through BCPWD.

2.3.2 Submittal Requirements

2.3.2.A Submittal

Submittals shall be made to BCPWD. See the Technical Standards Contact List for submittal instructions on the [BC Technical Standards Website](#).

2.3.2.B Submittal Fee

There is no submittal fee for a Developer's Agreement.

2.3.3 Public Works Review Process

2.3.3.A General

The Development Review Section of BCPWD will review the Developer's Agreement for adherence to the County template document and to ensure the financial guarantee amount and format are sufficient to meet the requirements of the Bernalillo County Code.

It is the applicant's responsibility to submit plans and cost estimates to other agencies, such as the ABCWUA or NMDOT. Where infrastructure for multiple agencies is required to be guaranteed, the applicant must secure a written confirmation of the guarantee amount of the agency responsible for the infrastructure.

2.3.3.B Review Cycle

The review cycle shall include acceptance and distribution of submittal documents, staff review time, and return of applicable comments to the applicant. The standard review time for Developer's Agreement is eight (8) business days. Resubmittals shall be allotted the same review time as initial submittals. The review time shall be 15 business days for large or complicated projects, such as plan sets over 25 pages, developments greater than 25 lots, or project areas greater than 25 acres.

2.3.3.C Revisions and Resubmittal

The applicant will be required to make all necessary corrections or revisions as noted on the documents. Upon completion of revisions, the applicant will resubmit all documents along with a written response explaining the disposition of all comments.

2.3.3.D Approval

The Development Review Section will notify the applicant once the Developer's Agreement and financial guarantee have been approved for format and amount. Referenced Construction Plans (permit prefix PWCO) must be approved as specified in 2.5.5 prior to County staff approval of the Developer's Agreement.

The County Engineer shall sign the approved Developer's Agreement upon receipt of the financial guarantee and a signed copy of the Developer's Agreement by the applicant. The applicant shall be notified and provided an electronic copy unless a hard copy is requested.

Release and partial release of the financial guarantee shall be as required in the signed Developer's Agreement. Partial releases are typically allowed for construction draws.

2.3.4 Drawing Requirements for Developer's Agreements

Plans for Developer's Agreements shall match those of the type of plan being refined, typically Construction Plans (permit prefix PWCO). See Section 2.5 for additional information on Construction Plans.

2.3.5 Format

Developer's Agreements, including exhibits, extensions, ratifications, bonding, and partial releases, shall follow an approved County format except as modified in consultation with the BCPWD and the County Attorney. At a minimum, the agreement shall reference applicable plats and plan sets.

2.3.6 County Liability

The Developer's Agreement shall hold the County harmless from liability resulting from negligent acts, errors, or omissions on the part of the developer until final acceptance of infrastructure by the County.

2.3.7 Financial Guarantee

The site developer shall agree to post a suitable financial guarantee or bank letter of credit with the Developer's Agreement. The guarantee shall be not less than 125 percent of the cost of completing the improvements. The format and amount of any financial guarantee shall be approved in draft form by the County prior to the developer acquiring the financial guarantee.

2.3.8 Extensions

Extensions to the original Developer's Agreement may be considered and approved by the County Engineer and must be accompanied by a corresponding extension of the financial guarantee.

2.3.9 Developer Costs

All improvements required in the Developer's Agreement shall be made by the developer unless cost sharing with the County or other governmental entity is consistent with County policy and agreed to in writing prior to entering into the Developer's Agreement.

2.3.10 Plat Signature

Completion of a Developer's Agreement and signature by all parties shall enable the Public Works Division Development Review Section to sign a plat requiring the improvements covered by the Developer's Agreement.

2.4 Building Permit

2.4.1 General

2.4.1.A Permit Types and Regulations

Bernalillo County Planning and Development Services (PDS) issues **residential building permits** (permit prefix BRBP) and **commercial building permits** (permit prefix BCBP). The Bernalillo County Building Official is responsible for building permits meeting all applicable codes including Bernalillo County Code *Ch. 10 Buildings and Building Regulations*.

2.4.1.B Role of the Public Works Department

Residential and commercial building permits are accepted, distributed, and issued by PDS. BCPWD performs a portion of the staff review, but does not administer the building permit process. BCPWD review of building permit requests involve the following:

- Access (3.1)
- Parking lot circulation (3.9)
- Grading and drainage (2.6)
- Water availability and wastewater disposal (2.7)
- Water conservation (2.8)
- Traffic impacts – (8)

2.4.1.C Potential Infrastructure Improvements

Building permit approval may require various infrastructure improvements upon this review. Such improvements may include but are not limited to: storm drains, major drainage crossing structures, traffic lighting, street lighting, proper signage, and resurfacing or reconstruction of the road.

2.4.2 Submittal Requirements

2.4.2.A Permit Application

The applicant shall submit a building permit application to PDS according to its procedures and submittal requirements. A separate submittal directly to BCPWD is not required to process a building permit.

2.4.2.B Building Permit Fees

PDS will assess and collect the review fee for building permits. There is no permit fee due to BCPWD for building permits. If additional permits are required, fees may be required as specified in those specific permits.

2.4.3 Public Works Review Process

2.4.3.A Relevant Reviewers

The Building Section of PDS will distribute the building permit and attachments to the designated reviewer for the following BCPWD Staff:

- Grading and Drainage

- Public Works Road Access
- Floodplain
- Water conservation and stormwater quality
- Water resources and wastewater disposal
- Barricading
- Transportation Planning (commercial and multi-family residential building permits only)

2.4.3.B Building Permit Review Cycle

A review cycle shall include receipt of distributed review materials, staff review time, and return of applicable comments to the County's Accela permitting system. The standard time for a review cycle is two (2) business days for the residential building permit review and five (5) business days for commercial building permit review. Resubmittals shall be allotted the same review time as initial submittals. In any event, the review time shall not exceed the review time set by PDS or ordinance.

2.4.3.C Revisions and Resubmittals

The applicant will be required to make all necessary corrections or revisions as noted in the case comments. Upon completion of revisions the applicant will resubmit all documents along with a written response explaining the disposition of all comments. Revised documents requested by BCPWD, such as a road maintenance form or access permit, may be submitted directly to BCPWD.

Upon completion of all outstanding case comments, PDS will issue the permit.

2.4.3.D Inspections and Certificate of Occupancy

BCPWD will perform required inspections of the construction. Approved work will be noted in Accela's inspection system so the next phase of construction or inspection may proceed. Upon completion of all required inspections, PDS will issue the Certificate of Occupancy for the project.

2.4.4 Drawing Requirements for Building Permits

Plans for building permits shall comply with the requirements of PDS for submittal. BCPWD prefers that all site plans feature an engineering scale, rather than an architectural scale.

2.4.5 Inspection Requirements

2.4.5.A General Requirements

BCPWD is responsible for inspecting the access, drainage, and water conservation features prior to the issuance of a Certificate of Occupancy for a building permit. The County Engineer shall ensure that the required improvements are properly inspected and tested during construction and upon completion. BCPWD will deny issuance of a Certificate of Occupancy until all required improvements are completed and pass inspection.

There are two required BCPWD inspections: 1) Natural Resources Services; 2) Development Review Final. The applicant is responsible for requesting inspection. Table 2-4: Notice Period for Inspections provides the number of days' notice when requesting inspections. Inspections with less days than those listed in Table 2-4 will be accommodated to the extent possible. See the Technical Standards Contact List

on the Technical Standards website on the [BC Technical Standards Website](#) for the appropriate staff contact.

Table 2-4: Notice Period for Inspections

Inspection Type	Before Construction Commences	Upon Construction Completion
Natural Resources Inspection	NA	Two (2) days' Notice
Development Review Final Inspection	Five (5) days' Notice	Two (2) days' Notice

Upon a determination by the County Engineer that all improvements have been satisfactorily completed, the inspector shall approve the building permit inspection in the electronic permitting system.

2.4.5.B Natural Resources Services Inspection

Natural Resource Services will conduct an inspection to verify compliance with the Water Conservation Ordinance and Stormwater Quality Ordinance prior to issuance of the Certificate of Occupancy:

- Natural Resource Services staff conduct inspections for compliance with Water Conservation Ordinance requirements for: 1) new commercial construction, 2) commercial remodels with five or more water closets/urinals or landscape modifications, and 3) new residential construction with five or more water closets/urinals.
- County Plumbing and Mechanical Inspectors conduct inspections on behalf of Natural Resource Services for compliance with Water Conservation Ordinance requirements for: 1) new residential construction with less than five water closets/urinals, and 2) commercial remodels with less than five water closets/urinals and no landscape modifications.
- Natural Resource Services staff conduct inspections for compliance with Stormwater Quality Ordinance requirements for: 1) projects that disturb one acre or more, or are less than one acre but part of a larger common plan of development.

2.4.5.C Development Review Final Inspection

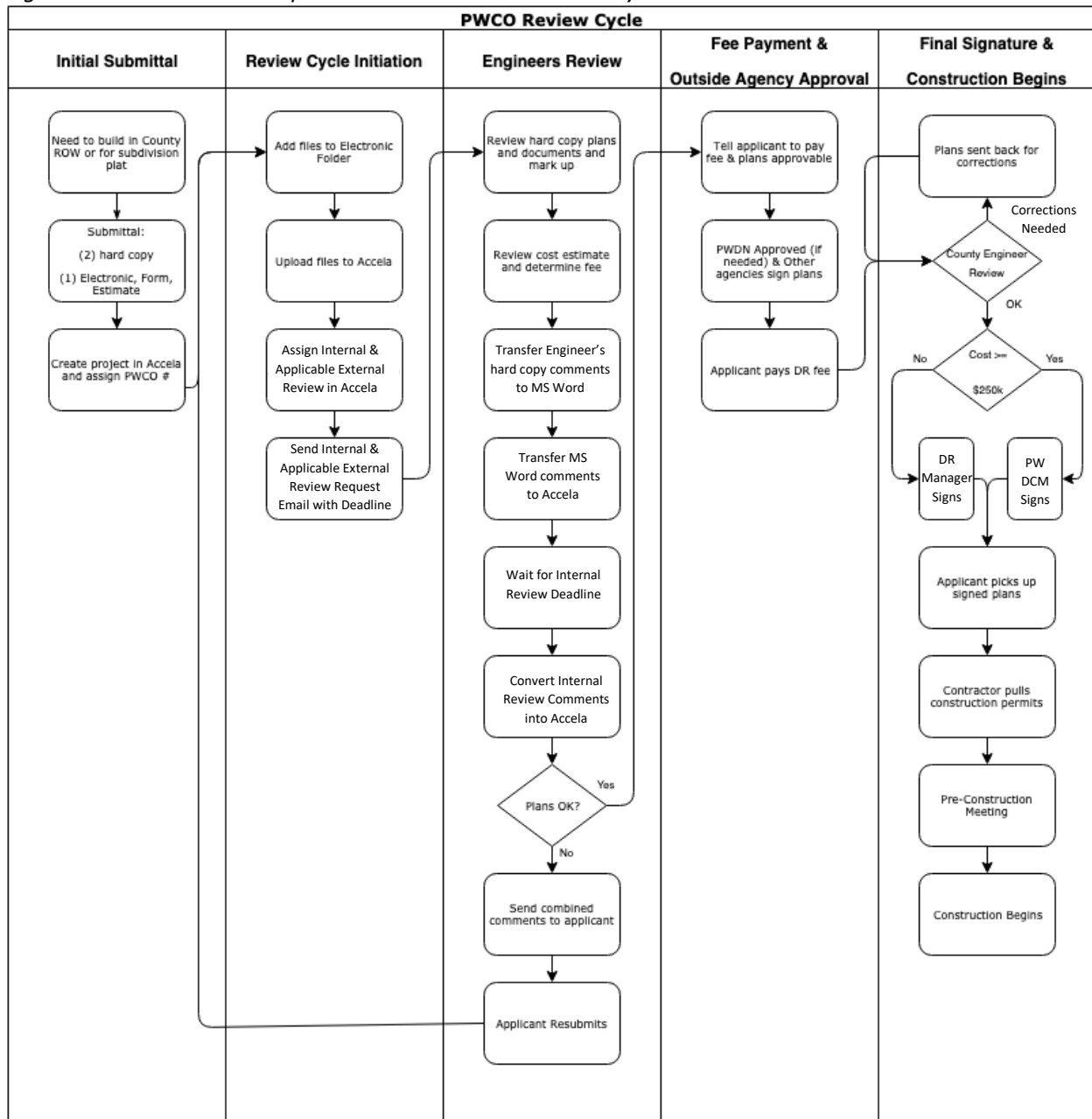
The Development Review Final Inspection is the second to last inspection for a building permit (followed by the final building inspection). The Development Review Inspector will conduct an inspection to verify that improvements related to grading, drainage, and access meet required standards.

2.5 Construction

2.5.1 General

Any form of construction in Bernalillo County right-of-way requires a **development review construction permit** (permit prefix PWCO). Bernalillo County Code *Ch. 66 Roads and Bridges* regulates construction in County right-of-way and describes the process involved in order to complete this type of construction. BCPWD Development Review administers construction permits. See Figure 2-1 for additional details.

Figure 2-1: Public Works Department Construction Review Cycle



2.5.2 Submittal Requirements

Submittals shall be made to BCPWD. See the Technical Standards Contact List for submittal instructions on the [BC Technical Standards Website](#).

2.5.3 Construction Review Fee

A Development Review Fee will be assessed and collected prior to issuing the permit, as described in Fee Schedule. The fee amount is a percentage of construction cost, with a minimum fee of \$250.

2.5.4 Public Works Review Process

2.5.4.A Relevant Reviewers

The Development Review Section will distribute the construction plans to the designated reviewer for the following County sections:

- Development Review
- Drainage
- Natural Resources Services
- Transportation
- Traffic
- Road Maintenance
- Storm Drain
- Solid Waste
- Parks and Recreation
- Fire Marshal
- Engineering and Construction

It is the applicant's responsibility to submit plans to other agencies, such as the ABCWUA or NMDOT. Where multiple agency approvals are required for a set of plans, the County shall make the final approval, unless this requirement is waived by the County Engineer.

2.5.4.B Construction Permit Review Cycle

A review cycle shall include acceptance and distribution of submittal documents, staff review time, and return of applicable comments to the applicant. The standard time for a review cycle shall be eight (8) business days. Resubmittals shall be allotted the same review time as initial submittals. The review time shall be 15 business days for large or complicated projects, such as plan sets over 25 pages, including development projects with more than 25 lots, or project areas greater than 25 acres.

2.5.4.C Revisions and Resubmittals

The applicant will be required to make all necessary corrections or revisions as noted on the plans. Upon completion of revisions the applicant will resubmit all documents along with a written response explaining the disposition of all comments.

2.5.4.D Development Review Fee

Upon resolution of all plan comments, the Development Review Section shall calculate the Development Review Fee in accordance with the Fee Schedule. The Development Review Section shall notify the applicant of the satisfactory completion of the review and of the required Development Review Fee. The applicant shall pay the Development Review fee and secure all other outside agency approvals.

2.5.4.E Approval and Issuance of Construction Permit

The County Engineer or designee shall sign the approved plan set cover sheet upon payment of the Development Review Fee and approval of outside agencies. The applicant shall be notified to pick up the signed approved plans. Construction permits shall be applied for by the applicant's contractor to cover the work or portions of the work as specified in the approved plans.

2.5.4.F Pre-construction Meeting

At the discretion of the County Engineer or upon the request of the applicant, a pre-construction meeting may be held to include the following:

- Applicant
- Property owner
- Design engineer
- Contractor
- County inspector
- Development Review Section engineer
- Other parties as necessary

2.5.5 Drawing Requirements for Construction Plans

The suggested plan sheet size is 11" x 17" with all sheets in a given set of plans being of the same size. Larger sheet sizes may be used if they can print to 11" x 17" at 50% scale without cutting off portions of the sheet. Plans shall be scaled to be legible without visual aids. A standard engineering scale shall be used (Horizontal 1"=10', 1"=20', 1"=30', 1"=40', 1"=50', 1"=60', 1"=100'). Plans shall not use an architectural scale.

All construction plans shall consist of the following minimum requirements:

- Project name
- Index of sheets
- Vicinity map
- Project control benchmark location and elevation
- Name, address, and telephone number of consulting engineer and owner/developer
- List containing name and telephone number of each utility company and public agency to review plans
- Bernalillo County Public Works Division and date signature line on the cover
- Project engineer's name and seal
- List of plan revisions
- Scale and north arrow for each plan sheet

2.5.6 Construction Completion and Certification

2.5.6.A Initial Acceptance Package

The applicant shall report the completion of construction in writing to the County Engineer. Upon receipt of the report, the County Engineer shall visually inspect the infrastructure improvements to verify completion of construction according to plan. Subsequent to verification, the applicant shall submit to the County Engineer an "Initial Acceptance package," which shall consist of the following documents:

- **"As-built" drawings** of reproducible quality, in a County approved format, depicting all construction of the infrastructure improvements as actually accomplished in the field and certified by a New Mexico Registered Professional Engineer or Land Surveyor, as appropriate.

- **Certified test reports** as necessary to demonstrate that compaction and pavement sections match approved plans.
- **List of any substantial deviations** from the approved plans with an explanation or justification for each.
- **Engineer's Certification** that the construction is in substantial compliance with the approved plans.

2.5.6.B Certificate of Initial Acceptance

Upon receipt of the applicant's "Initial Acceptance package," the County Engineer shall review it for completeness and accuracy. If the documentation has been satisfactorily completed, and applicable fees have been paid, the County Engineer shall approve the package and issue a Certificate of Initial Acceptance. This shall certify that the construction has been performed in substantial compliance with the final plans and specifications for infrastructure improvements approved by the Bernalillo County Public Works Division and in accordance with the construction plans as submitted to and approved by Bernalillo County.

2.5.6.C Applicable Fees

Prior to the issuance of a Certificate of Initial Acceptance by the County, the applicant shall pay any County fees which may have been incurred during the course of construction. The Design Review Fee for the project is based on an estimate for construction costs. Should design modifications alter the plans used to prepare the assessed Design Review Fee or alter the construction costs with no modified plans prepared, the County shall have the option to increase the Design Review Fee accordingly and the applicant shall be liable for such fee prior to Initial Acceptance.

2.5.7 Warranty Period

At the time of Initial Acceptance of the completed improvements or any portion thereof by the County, the applicant shall furnish or cause to be furnished a financial guarantee, in a form and with a surety satisfactory to the County, to guarantee the completed project against defective materials and workmanship for a period of one (1) year following the date of Initial Acceptance by the County.

If the County determines that the improvements suffer from defective materials and/or workmanship within the Warranty Period, the applicant shall be notified in writing of the defects. Within two weeks of the notification, the applicant shall provide a written response to the County either accepting or rejecting the findings of the County. If the applicant accepts the finding of defects, the developer shall correct the defects prior to the expiration of the Warranty Period or within two weeks, whichever is sooner. If the developer rejects the findings of defects or does not provide a written response within two weeks, the County may utilize the provided financial guarantee as necessary to correct the defects. The County may require extension of the Warranty Period and financial guarantee by one (1) year if a defect is found, to allow for resolution of the defect.

2.5.8 Final Acceptance

The County shall issue a Certificate of Final Acceptance for the Improvements upon final completion of the Warranty Period, including any required warranty repairs, to the County's satisfaction.

2.5.9 Requirements of Contractors in County Right-of-Way

All contractors working within County right-of-way must be licensed, bonded, insured, and approved by the County.

2.5.10 Plan Approval Expiration

Approvals are initially for two (2) years after the date of signature noted on the returned cover sheet. Upon the applicant's request, the County Engineer may extend the expiration of approved plans by up to 12 months without additional plan review. After the expiration date, the plans must be resubmitted in accordance with the procedures and requirements outlined in these Technical Standards.

2.5.11 Inspection

The developer shall ensure that the required improvements are properly inspected and tested during construction and upon completion of construction. The applicant shall bear the costs of all required testing and shall provide the County Engineer with all testing report results.

The applicant shall give the County two (2) days' notice when requesting County inspections. The applicant shall give the County five (5) days' notice before the construction is to commence. See the Technical Standards Contact List on the Technical Standards website for the appropriate staff contact.

Applicant's requirements during inspection(s) include:

- Provide County Engineer access to all construction activity and any assistance necessary during County inspections.
- Submit tests prior to proceeding to the next phase or layer of paving. If the developer does not do so, the developer shall be liable for any corrections or remedies necessary resulting from proceeding without approval.

2.5.12 Maintenance

Maintenance of all public infrastructure improvements and public areas shall be the responsibility of the developer until acceptance by the County or other governmental entity having jurisdiction.

2.6 Grading and Drainage Plan

2.6.1 General

Alterations to stormwater runoff potential of a site, such as paving or building construction and earthworks, that involve 200 or more cubic yards of material, typically require a Grading and Drainage Plan (permit prefix PWDN). Bernalillo County Code *Ch. 38 Floods* regulates grading changes that could impact offsite properties. BCPWD administers grading and drainage plan permits. This section describes the process involved in order to complete this type of construction.

2.6.2 Submittal Requirements

2.6.2.A Electronic Submittal Requirements

The applicant shall submit the Public Works Submittal Form with an electronic copy (PDF) of the completed Developer's Agreement template and the itemized construction cost estimate.

2.6.2.B Submittal

Submittals shall be made to BCPWD. See the Technical Standards Contact List on the Technical Standards website for submittal instructions.

2.6.2.C Submittal Fee

There is a submittal fee required for Grading and Drainage Plans that varies with the intensity of the project. Refer to the Fee Schedule for additional information. The fee for each resubmittal is \$50. The review cycle will not commence until a submittal is complete and the required fee has been paid.

2.6.3 Public Works Review Process

2.6.3.A Relevant Reviewers

The Development Review Section will distribute the Grading and Drainage Plan and attachments to the designated reviewer for the following County sections and outside agencies:

- Drainage
- Natural Resources Services (Stormwater quality)
- Storm Drain Maintenance
- Albuquerque Metropolitan Flood Control Authority (AMAFCA)

It is the applicant's responsibility to submit plans to other agencies, such as the NMDOT or City of Albuquerque, when stormwater runoff from a project flows into their facilities. Where multiple agency approvals are required for a set of plans, BCPWD shall be the final approval, unless this requirement is waived by the County Engineer.

2.6.3.B Grading and Drainage Plan Review Cycle

A review cycle shall include acceptance and distribution of submittal documents, staff review time, and return of applicable comments to the applicant. The standard time for a review cycle shall be six (6) business days for initial comments. Resubmittals shall be allotted the same review time as initial submittals. The review time shall be 11 business days for large or complicated projects, such as plan sets over 25 pages, projects with greater than 25 lots, or project areas greater than 25 acres. Submittals that involve outside agency review are subject to separate review timelines.

2.6.3.C Revisions and Resubmittals

The applicant will be required to make all necessary corrections or revisions as noted on the plans. Upon completion of revisions the applicant will resubmit all documents along with a written response explaining the disposition of all comments.

2.6.3.D Approval and Permitting

The County Engineer shall sign an approval letter that references the date of the approved Grading and Drainage Plan and provides conditions of approval, such as submittals of as-built plans following construction. The applicant shall be emailed the approval letter, if email is available, or otherwise contacted to pick up the approval letter.

Grading permits shall be applied for by the applicant's contractor to cover the work or portions of the work as specified in the approved plans. A Stormwater Pollution Prevention Plan (SWPPP), if required,

must also be submitted to BCPWD. See the Technical Standards Contact List on the Technical Standards website for the appropriate staff contact.

2.6.3.E Pre-Construction Meeting

At the discretion of the County Engineer or upon the request of the applicant, a pre-construction meeting may be held to include the following:

- Applicant
- Property owner
- Design engineer
- Contractor
- County inspector
- Development Review Section engineer
- Other parties as necessary

2.6.4 Drawing Requirements for Grading and Drainage Plans

The suggested plan sheet size is 11 x 17" with all sheets in a given set of plans being of the same size. Larger sheet sizes may be used if they can print to 11 x 17" at 50% scale without cutting off portions of the sheet. Plans shall be scaled to be legible without visual aids. A standard engineering scale shall be used (Horizontal 1"=10', 1"=20', 1"=30', 1"=40', 1"=50', 1"=60', 1"=100'). Plans shall not use an architectural scale.

All subdivision construction plans shall consist of the following minimum requirements:

- Project name
- Index of sheets
- Vicinity map
- Project control benchmark location and elevation
- Name, address and telephone number of consulting engineer and owner/developer
- Project engineer's name and seal
- List of plan revisions
- Scale and north arrow for each plan sheet

2.6.5 Floodplain Development Permit

BCPWD is responsible for local administration of the National Flood Insurance Program (NFIP). This includes a requirement for permit review of all structures built on a lot that contains a floodplain. The permit application may be completed with the County's floodplain administrator. In some cases, a Pre and Post Elevation Certificate is required to satisfy the regulations of the NFIP. A licensed surveyor is required to complete an Elevation Certificate. More detailed review of floodplain impacts are performed as part of the Grading and Drainage Plan. See Ch. 4 Drainage of the Technical Standards for additional discussion.

2.6.6 Stormwater Quality Volume and Post-Construction Evaluation

The stormwater quality volume (SWQV) calculation is required to be shown on the grading and drainage plan and the SWQV must be managed on-site for all projects that disturb one (1) acre or greater or are less than one (1) acre but are part of a larger common plan of development. Additionally, a GSI/LID

Stormwater Post-Construction Evaluation is required with the Grading and Drainage Plan submittal for these projects (4.4).

2.6.7 Stormwater Pollution Prevention Plan (PWSW)

Applicants are required to submit the Stormwater Pollution Prevention Plan (SWPPP) to BCPWD for review and approval. The Accela Automation permit type for the SWIPP is PWSW. BCPWD is the local agency responsible for compliance with the National Pollutant Discharge Elimination System (NPDES). This includes compliance with the requirement for construction sites over one (1) acre to provide erosion prevention best management practices (BMPs).

2.7 Water and Wastewater Disposal

2.7.1 General

All new development must be provided with an approved domestic water supply and method of wastewater disposal. Water/wastewater submittal requirements for subdivisions are outlined in 2.1.7. For building permits, the applicant must provide utility water and wastewater account numbers, or well and wastewater system permits with the building permit application.

2.7.2 Requirement to Connect to Utility Water/Wastewater

Requirements to connect to utility water and wastewater are found in the Bernalillo County Code *Ch. 74 Subdivision* and *Ch. 42, Article IV, Division 10, Wastewater Systems*.

2.7.3 Wells

All wells constructed in Bernalillo County must be permitted to ensure proper construction and water quality standards by Bernalillo County Natural Resource Services. This requirement includes private, multiple household (5 or more), public, and monitoring wells. Bernalillo County requirements for wells are provided in the Bernalillo County Code *Ch. 42, Article IV, Division 11 Water Wells*.

All wells constructed in the State of New Mexico must also be permitted for water rights by the Office of the State Engineer. Wells and water systems that serve at least fifteen (15) connections or twenty-five (25) people at least six (6) months of the year are also regulated by the New Mexico Environment Department and subject to requirements in the Safe Drinking Water Act and New Mexico drinking water regulations.

2.7.4 Wastewater systems

All wastewater systems constructed in Bernalillo County that receive 5,000 gallons of liquid waste per day or less must be permitted by Bernalillo County Natural Resource Services. Bernalillo County requirements for wastewater systems are provided in the Bernalillo County Code *Ch. 42, Article IV, Division 10 Wastewater Systems*.

Wastewater systems that receive more than 5,000 gallons of liquid waste per day are permitted by the New Mexico Environmental Department.

2.8 Water Conservation

All new development (i.e. new construction, remodels, and additions) is required to implement water conservation measures in accordance with the Bernalillo County Code *Ch. 30, Article VII - Water Conservation*.

2.9 Additional Construction Permits

2.9.1 Excavation Permit

An excavation permit (permit type PWEF) is required when digging in the County right-of-way, per Bernalillo County Code *Ch. 66 Article IV*. BCPWD Development Review administers excavation permits. The following considerations apply when seeking an excavation permit:

- **Contractor requirements:** All contractors working within County right-of-way must be licensed, bonded, insured, and approved by the County.
- **Fees and approval:** Receipt of the applicable fees shall constitute an excavation permit approval for excavation depicted on approved Construction Plans (permit type PWCO). Additional documentation of the proposed access may be required for projects not providing a site plan in this manner.
- **Inspection:** Upon construction completion, a BCPWD inspector will confirm that the restoration matches the County's requirements for project completion and at regular intervals following construction.
- **Excavation moratorium:** An excavation moratorium period that prohibits any invasive construction to a road applies to recent projects that utilized County or federal funds. The moratorium period follows new construction, reconstruction, or major rehabilitation (including milling and repaving) of a road pavement and applies for three (3) years if County-funded or five (5) years if federally funded. Projects that cannot meet this requirement may be charged additional fees as set forth on a fee schedule approved by the Bernalillo County Commission.

2.9.2 Barricading Permit

Barricading (permit type TRBA) is required when working in the County right-of-way. Bernalillo County Public Works Traffic Engineering administers barricading permits. A fee is required for barricading permits as specified in Fee Schedule. The following considerations apply when seeking a barricading permit:

- A barricade is required for the limits of a project, regardless of the class of street involved or how soon additional pavement will be placed beyond the current project limits. The only exception will be where the County Engineer determines that the unpaved portion of the street beyond the project limits has been and will continue to be open to and used by through traffic.
- The installation of the barricade must be provided in the construction plans.
- The contractor must notify County Traffic Engineering three (3) working days in advance of the placement of any barricade and/or any temporary traffic control signs or devices.

2.9.3 Driveway Permit

2.9.3.A Requirements

A driveway permit (permit type PWMP) is required for new or modified connections to a County maintained road. BCPWD Development Review administers driveway permits. A driveway permit shall include the following considerations, as applicable:

- **Access:** Required for all new access points and those that were constructed in the past five (5) years without benefit of a driveway permit.
- **Gates:** All gated access requires a driveway permit. See 3.6.4.G for appropriate gate setback from the public right-of-way.
- **Excavation:** For culvert installation on all projects, unless specifically exempted by the County Engineer.
- **Paving:** For all projects will 1,000 square feet or greater of new impervious or semi-impervious surfaces.
- **Barricading:** Required for all work within County right-of-way unless specifically exempted by BCPWD.

2.9.3.B Approval and Inspection

Receipt of the applicable fees shall constitute a driveway permit approval for access depicted on the site plan of a building permit. Additional documentation of the proposed access may be required for projects not providing a site plan in this manner.

Upon construction completion, a BCPWD inspector will confirm that the installed driveway matches the BCPWD's requirements during the final inspection.

2.9.4 Mobile/Manufactured Home Setup Permit

2.9.4.A General Requirements

Mobile/Manufactured Home permits (permit type ZNPH) are accepted, distributed and issued by PDS. BCPWD performs a portion of the staff review but does not administer the ZNPH permit process. BCPWD review involves the following:

- **Access:** The applicant must provide proof of legal access a county road, either directly or through recorded easements.
- **Driveway:** The applicant must have a sufficient existing driveway or apply for a new driveway permit. See 2.9.3 for new driveway permits.
- **Floodplain:** If the parcel contains any floodplain, a Floodplain Development Permit is required. See 2.6.5.
- **Drainage:** The proposed lot must comply with Chapter 38 of the Bernalillo County Code. Generally, lots with less than 30 percent impervious coverage do not require a Grading and Drainage Plan. The applicant must ensure water drains around the unit and does not allow for stormwater to sit under the unit.

2.9.4.B NRS Water

The applicant must have a County approved water source, utility account, or permit for well construction.

2.9.4.C NRS Wastewater

The applicant must have a County approved sewage disposal method, utility account, or permit for septic system construction.

2.9.5 Building Fence/Wall Permit

Building fence/wall permits (permit type BFWP) are accepted, distributed and issued by PDS. BCPWD reviews fence/wall permits for adequate sight distance (see 3.8.2) and appropriate gate setback from the public right-of-way (see 3.6.4.G).

2.9.6 Pool Permit

Pool permits (permit type BRPP) are accepted, distributed and issued by PDS. BCPWD review requires proof of an approved disposal location for any excavated materials and appropriate setbacks from wells and wastewater systems.

2.9.7 Fill Permit

A fill permit (permit type NRFM) may be required by BCPWD with excavation.

3. Access and Off-Street Parking

3.1 Access Requirements

3.1.1 General

This chapter establishes standards for access to and from public and private roads in order to promote pedestrian and vehicular safety, minimize congestion, promote road aesthetics, provide for safe ingress and egress for emergency vehicles, and maintain the functional capacity of roads in Bernalillo County. The applicable code requirements for roads and access are contained in Bernalillo County Code *Ch. 34 Fire Prevention and Protection*, Appendix D International Fire Code, *Ch.66 Roads and Bridges*, and *Ch. 74 Subdivision*.

3.1.2 Access Approval by Relevant Jurisdiction

3.1.2.A County Roads

For roads under Bernalillo County jurisdiction, no construction, alteration, or relocation of an access point is allowed without a valid permit. All access is required to meet Bernalillo County Code *Ch. 34 Fire Prevention and Protection* and Appendix D International Fire Code.

3.1.2.B NMDOT Roads and Other Jurisdictions

Access is regulated to public roads that are not under Bernalillo County jurisdiction. Permits and approvals for access to roads must be obtained from NMDOT or the applicable governmental agency.

3.1.3 Regional Access Management

See [MRCOG Roadway Access Control Policy](#) for a list of roads where access is limited. Roads on this list are subject to regional review and approval if additional access is to be granted.

3.1.4 Access Types

Property development must demonstrate that the site has legal as well as acceptable constructed access according to Bernalillo County Code *Sec. 66-216*.

- **Legal access** is either directly from a County maintained road or via private access easements connecting to a public road. Land where the road is located is legally intended for access travel is created with the Subdivision Plat Process (2.1).
- **Acceptable constructed access** refers to a road that meets the requirements of the Bernalillo County Code and these Technical Standards and that allows emergency services to traverse the road in all-weather conditions.

This section provides the various access types that provide legal access and acceptably constructed access to the regional road network. The size and location of the proposed development informs which access type is appropriate. Table 3-1 lists access types, descriptions, and location of associated requirements within these Technical Standards.

Table 3-1 Access Types

Legal Access Type	Status of Physical Road	Standards for Acceptable Construction and/or Associated Requirements
Dedicated Right-of-Way (Subdivision Plat Process 2.2.2) (Required Width 5.3.4)	County Road (public road maintained by Bernalillo County)	Local Roads and Collectors: 3.5 Arterials: Chapters 5 & 6
	Private Road (Privately Maintained)	3.3
	Substandard Road	3.1.6
Access Easement (Subdivision Plat Process 2.2.4) (Required Width 3.3.2)	Private Road (Privately Maintained)	3.3
	Alley	3.7
	Substandard Road	3.1.5

3.1.5 Substandard Access

When access to a development involves substandard width for a dedicated right-of-way or access easement or a substandard constructed road, the access shall be improved to meet the specifications of these Technical Standards to the extent feasible, as determined by the County Engineer.

Private roads are required to be maintained to meet the weight loading required for emergency vehicle access as defined in the Bernalillo County Code *Ch. 34 Fire Prevention and Protection*, Appendix D International Fire Code, as adopted by the County. The County may deny permit applications that utilize a substandard private road until such time as the road condition is corrected to meet the weight loading required for emergency vehicle access.

3.1.6 Access from a Private Road Located within a Platted Right-of-Way

The developer shall install and construct improvements, if any, as required by the County Engineer. The County Engineer shall determine if the private road will remain privately maintained with a maintenance agreement or if the developer is required to complete the processes necessary to convert the road into a public, county-maintained road (2.2.2).

3.2 Emergency Service Access

Fire and emergency access shall be provided per Bernalillo County Code *Ch. 34 Fire Prevention and Protection*, Appendix D International Fire Code.

3.3 Private Access Easements

Private access easements are allowed as legal access to properties. A private access easement gives a property owner the right to pass over someone else's land to access their property. Private access easements may be created where public right-of-way would not better serve public purposes and where private easements can adequately serve all identified transportation, utility, and storm water management requirements.

3.3.1 Private Easement Creation

Easements shall be provided in a form specified by the County Engineer or the applicable agency using the easement. Easements should be created through the subdivision platting process.

The length, width, permanent character, and maintenance responsibilities of the easement must be suitably and legally defined by the plat establishing the lots it serves and must be approved by the County Engineer.

3.3.2 Private Access Easement Required Width

3.3.2.A Minimum Width

Minimum private access easement widths are determined by the ultimate build-out of the lands they are to serve according to Table 3-2. Existing easements with insufficient width are required to be widened to the minimum standard during any subdivision action.

Table 3-2 Minimum Access Easement Width

Minimum Width	Number of Lots the Access Easement will Serve Upon Build Out
50 ft.	More than 10 lots
40 ft.	2- 10 lots
30 ft.	Single (1) lot

3.3.2.B Substandard Width Requirements

Easements with a substandard width may be utilized with an approved deviation, if the following two criteria are met:

- Requirements of the Bernalillo County Code *Ch. 34 Fire Prevention and Protection*, Appendix D International Fire Code are met
- Additional easement width to meet the minimum standards would either cause a violation of another County standard or impact a significant existing improvement

3.4 Private Road Construction

See Table 3-3 for private road construction requirements based on the type of development the private road serves.

All private roads shall provide an asphalt or concrete paved transition or driveway apron of sufficient length to include return radii, per these Technical Standards, when connecting to an existing paved road.

See 2.2.4 for necessary processes to legally establish a private road and the associated maintenance agreements.

Table 3-3 Private Road Standard Drawings and Requirements

Development the Access will Serve	Easement Width	Constructed Road Width	Road Surface	Standard Drawing
Access for one single-family residential lot OR one commercial/multi-family lot with less than 10 daily trips	30 ft.	20 ft.	Gravel allowed for access roads that are less than 1,320 ft. in length	RS-030-G
Access for 2-10 single-family residential lot or 2-10 commercial/multi-family lot with less than 100 daily trips	40 ft.	24 ft.	Gravel allowed for 5 or fewer lots and access roads that are less than 1,320 ft. Otherwise paved surface is required	RS-040-G RS-040-P
Access for 11 or more residential lots located in the East Mountains or rural development areas with A-1 or A-2 zoning	50 ft.	32 ft.	Paved Surface	RS-050-RL
Access for 11 or more residential lots for locations in urban development areas or the rural development area outside of A-1 and A-2 zones.	50 ft.	32 ft. (curb face to curb face)	Paved Surface, sidewalks, curb and gutter	RS-050-UL

3.5 Public Roads – Local & Collector

Collector and local commonly provide access for new development. See 2.2.2 for necessary processes to establish a public road and the associated maintenance agreements.

Section 5.2 discusses locations for rural and urban road design. See 5.2.1 for locations where rural roads may need to include pedestrian accommodation.

Table 3-4 provides the standard drawings for these public roads.

Table 3-4 Public Road Standard Drawings

Road Type	Right-of-Way	Constructed Road Width	General Context	Standard Drawing
Residential Local - Rural	50 ft.	32 ft.	Residential lots located in the East Mountains or rural development areas with A-1 or A-2 zoning. See 5.2.1 for possible additional pedestrian accommodation.	RS-050-RL
Residential Local – Urban	50 ft.	32 ft. (curb face to curb face)	Residential lots for locations in urban development areas or the rural development area outside of A-1 and A-2 zones.	RS-050-UL
Commercial/Industrial Local	60 ft.	36 ft.	M-1 and M-2 subdivision and other locations with high volumes of heavy vehicles.	RS-060-CL
Minor Collector	60 ft.	36 ft.	As required by Long Range Roadway System	RS-060-MINCOLL
Major Collector	74 ft.	50 ft.	As required by Long Range Roadway System	RS-074-MAJCOLL

3.6 Driveways

3.6.1 General

Site access points are commonly called driveways. Driveway location, spacing, and separation from intersections are critical for maintaining traffic flow and supporting road safety. The following considerations apply when determining the appropriate location for a driveway(s) to a site:

- Parcels with frontage to more than one road shall access from the minor road or the road with less traffic or slower speed limit.
- No driveways are to be constructed within intersections.
- Site access proposals shall be located so that new access points do not create conflicts with transit service and transit stops.
- No driveways are to be constructed within turn lanes or tapers unless no other access is available. In these cases, driveway access may be limited to right-in, right-out only.
- Site access points that warrant a traffic signal shall follow the intersection standards contained in 5.4.3.
- Driveways shall not impair the drainage of the road and rights-of-way, alter the stability of the road, or impair the drainage of adjacent areas.

3.6.2 Consolidation or Removal of Driveways

Upon development or redevelopment of a site, abandoned or no longer used driveways must be removed. In locations where the abandoned driveway is along a sidewalk, the driveway must be replaced with level sidewalk and curb and gutter at the time of building permit or subdivision. A development may also be required to consolidate or close driveways due to safety or traffic issues.

3.6.3 Number of Driveways

3.6.3.A Residential Driveways

The number of residential driveways is determined by the Development Area from the Comprehensive Plan:

- **Urban Development Areas:** Sites in Urban Development Areas (Central Urban, Established Urban, Semi-Urban, Developing Urban) are allowed one driveway per parcel.
- **Multi-family Residential:** Multi-family residential sites may be allowed two driveways provided the location, spacing, and corner clearance requirements are met.
- **Rural Development Areas:** Parcels in Rural Development Areas may be allowed up to two driveways per site provided the location, spacing, and corner clearances are met.

3.6.3.B Non-Residential Driveways

All sites are allowed one two-way driveway and may be allowed a pair of one-way driveways provided that the location, spacing, and corner clearances are met.

3.6.3.C Additional Driveways

Additional driveways may be approved by the County Engineer. Additional driveways are required to meet all minimum access spacing standards. A site circulation plan may also be required that shows that the additional driveway is needed for traffic flow and that adjacent roads will not be adversely affected.

3.6.4 Driveway Design

3.6.4.A Driveway Types

Driveway design shall conform to County Standard Detail Drawings. Table 3-5 provides driveway types and the associated County Standard Detail Drawing.

Table 3-5 Driveway Type and Standard Detail

Driveway Type	Figure Example	Standard Drawing
Rural-Type Driveway These driveways provide access to roads with no curb and gutter. The road they access may have a paved or unpaved shoulder.	The diagram illustrates a rural-type driveway layout. It shows a gravel driveway leading to a paved apron, which then meets a paved roadway shoulder. Key features labeled include: 'Dip Section or Culvert for Drainage', 'Unpaved Shoulder', 'Paved Roadway Shoulder', 'Paved Apron', 'Gravel Driveway', 'Width', 'Vertical Obstructions', 'Property Line', and 'Right-of-Way'. A dimension line indicates a 50 ft. width for the paved apron area.	DW-01-Rural
Drop Curb A drop curb driveway is any driveway where the curb is lowered to the gutter pan to provide access. The pedestrian access route and the driveway are built within the same structural design.	Drop Curb Driveway Example (Setback Sidewalk) Drop Curb Driveway Example (No Sidewalk Setback)	DW-02-Curb NMDOT 608-001 (Type 3A, 2B, 2C)
Curb Return and Valley Gutter A curb radius is provided instead of lowering the curb for this type of driveway. A valley gutter is provided in order for water run-off to be channelized along the road and not into the driveway.	The diagram shows a cross-section of a driveway with a curved curb and a valley gutter. The gutter is designed to channelize water runoff along the road, preventing it from entering the driveway.	VG-01-Driveway NMDOT 608-001 (Type 2, 2A)

3.6.4.B Pedestrian Routes

Upon development and redevelopment, all site driveways along roads with adjoining sidewalks shall include an accessible pedestrian route, as required in PROWAG. Driveways that are 40 feet or wider shall include detectable warning surfaces at their edges.

The design for a driveway with a pedestrian accessible route shall follow NMDOT Standard Drawings 608-001. See NMDOT Standard Drawing 608-001-9 and 608-001-10 for driveways.

3.6.4.C Single Family Residential Driveway Design

Single family residential driveways that access arterial and collector roads shall be designed such that maneuvers entering and exiting the site can be completed without vehicles backing up into the right-of-way. Single family residential driveways shall be designed so that no portion of the right-of-way, including the sidewalk, is used for parking.

Table 3-6 provides minimum residential driveway width at the right-of-way line. Additional width and structural strength may be required depending on the length of the driveway and the requirements of the Bernalillo County Code *Ch. 34 Fire Prevention and Protection*, Appendix D International Fire Code.

Table 3-6 Residential Driveway Width

Description	Residential Driveway Width*
Driveways without gateposts or other vertical obstructions	Preferred width: 14 ft. Minimum width: 12 ft.
Minimum clear width between gateposts or other vertical obstructions	20 ft.
Maximum driveway width to a single site	22 ft.
Maximum shared driveway for two sites	40 ft.
Maximum driveway width allowed through a deviation for large vehicles	30 ft.

*Additional width may be required depending on the length of driveway and the requirements of the Fire Marshal.

3.6.4.D Non-Residential and Multi-Family Driveway Design

Table 3-7 provides driveway widths and associated radii for non-residential and multi-family driveways. Radius requirements are not applicable on drop curb driveways. A larger radius may be approved by the County Engineer if the commercial development requires access by large delivery vehicles.

Non-residential and multi-family driveways shall be designed so that no portion of the right-of-way on arterials and collectors is used for parking maneuvers. Non-residential and multi-family driveways that access local roads should be designed so that completing parking maneuvers does not involve backing into the right-of-way.

Table 3-7 Driveway Width (Non-Residential and Multi-Family)

Type	Use	Road Classification	Allowable Radius Range	Minimum Width	Maximum Width
One-Way	Multi-Family, Commercial, Office	Arterial & Collector	10-20 ft.	20 ft.	25 ft.
		Local	10-15 ft.	12 ft.	20 ft.
Two-Way	Multi-Family, Commercial, Office	Arterial & Collector	15-25 ft.	22 ft.	30 ft.
		Local	10-20 ft.	20 ft.	24 ft.
Three Lane Driveway ¹	Commercial	Arterial & Collector	30-35 ft.	32 ft.	35 ft.
Two-Way	Industrial	Arterial & Collector	30-50 ft.	25 ft.	50 ft.
		Local	30-50 ft.	25 ft.	30 ft.

¹Three lane driveways have two exiting and one entering lane. The single entering lane shall have a minimum width of 12 feet.

3.6.4.E Curb Return with Valley Gutter

Curb returns with valley gutter (see Table 3-8) rather than drop curb driveways are recommended on arterials and collectors and under the following circumstances:

- For high volume traffic generators (i.e. over 25 vehicles entering or exiting per hour)
- Development with 50 or more required parking spaces

Curb returns with valley gutter are permitted on local roads when a site has more than 50 parking spaces.

3.6.4.F Driveway Median

Additional width may be provided for driveways with a median. Driveways with medians are required to provide curb return and valley gutter. Medians may be included for the following reasons:

- Separate entering and exiting entering and existing vehicles on three-lane driveways
- Discourage left turn maneuvers
- Driveway has a high volume of traffic and turn lane management is warranted
- Provide a pedestrian refuge

3.6.4.G Private Entrance Gates

Entrance gates at driveways accessing arterial and collector roads shall be placed outside of the adjacent road right-of-way so that no part of the vehicle accessing the gate is located in the travel lane or sidewalk of the adjacent road. For arterial roads, the gate setback area shall be designed so that a vehicle can return to the road without having to back into the right-of-way. Table 3-8 provides the required distances of entrance gates from the adjacent right-of-way edge.

Table 3-8 Minimum Entrance Gate Setback from Right-of-Way

Road Type and Vehicle Type	Minimum Distance from Edge of Adjacent Right-of-Way
Collector or Access for Passenger Vehicles Only	30 ft.
Arterial that Includes Access for Heavy Vehicles	60 ft.

3.6.5 Driveway Construction

The construction of a driveway shall conform to the County Standard Detail Drawings. Construction materials related to driveways shall be as specified in the NMDOT Standard Specifications for Highway and Bridge Construction, latest edition.

Damage to the existing road surface resulting from adjacent construction shall be repaired as directed by the County Engineer. Such repair shall be the responsibility of the applicant for the driveway permit.

3.7 Alleys

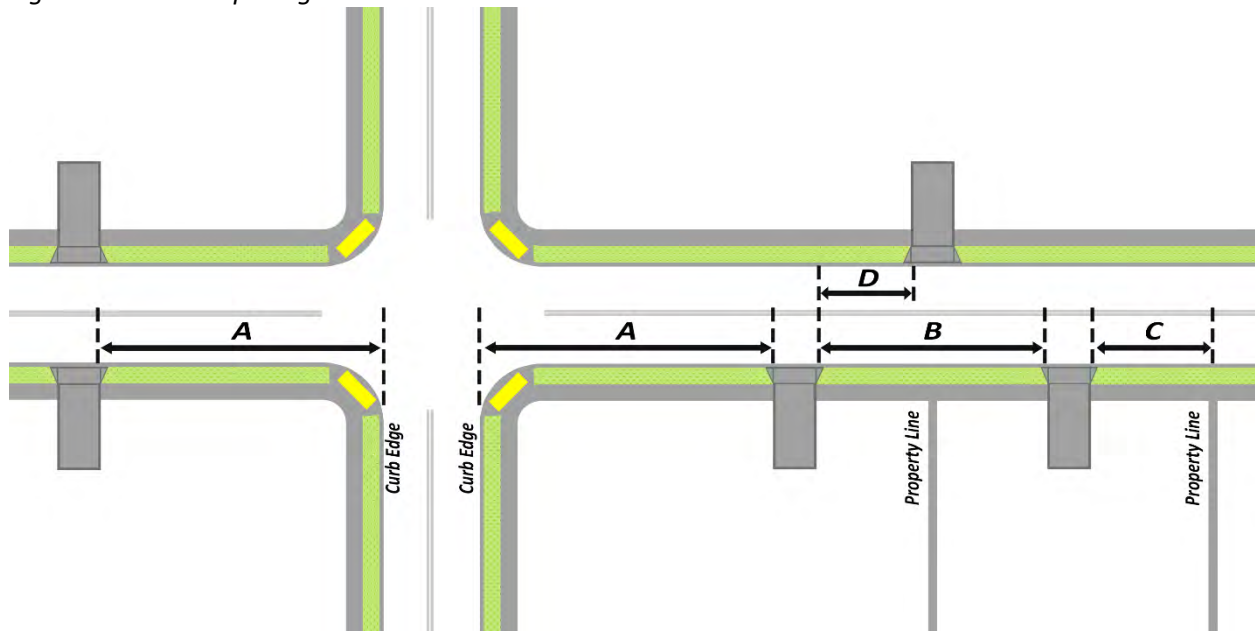
The County Engineer may allow secondary access through privately maintained alleys. Alleys shall meet access point spacing and sight distance requirements.

3.8 Access Point Requirements

3.8.1 Access Point Spacing Requirements

Access point spacing requirements are provided to ensure adequate traffic operations and safety among road users. Figure 3-1 illustrates spacing from driveways to intersections (corner clearance), distance between driveways and the distance between driveways to property lines.

Figure 3-1 Access Spacing



Notes: Measurements to the nearest driveway edge do not include the driveway's flares or radii.

- A – Corner clearance or minimum distance to the intersection measured from the nearest curb edge to the nearest driveway edge. For roads without curbs, this minimum distance is measured from the nearest vehicular driving lane edge to the nearest driveway edge.
- B – Minimum distance between driveways measured from nearest driveway edges.
- C – Minimum distance measured between the property line and the nearest driveway edge for driveways that are not shared.
- D – Minimum distance measured between the nearest edges of driveways on opposite sides of the road when driveway centerlines cannot be aligned, no raised median is present, and left turns overlap.

Figure 3-2: Left Turns for Unaligned Driveways



Table 3-9 provides the required minimum spacing for driveways (as shown in Figure 3-1). For roads without a raised median, driveways directly opposite of each other are most desirable. Where this is not possible, the minimum spacing for *Distance D* shown in Figure 3-1 and Table 3-9, shall apply.

In cases where access spacing is not attainable because existing frontages are too narrow, access points should be spaced according to Table 3-9 to the maximum extent possible. When existing frontages are too narrow to achieve the desired spacing, the County Engineer may require that access be limited.

Table 3-9 Access Spacing

Posted Speed where Access Point is Located	Residential – Single Family & Multi-Family with < 25 Dwelling Units	Non-Residential / Multi-Family with ≥25 Dwelling Units
Distance A - Minimum Distance to Intersection		
40-50 mph	250 ft. (Existing development only & multi-family)*	250 ft.
30-35 mph	150 ft. (Existing development only & multi-family)*	150 ft.
25 mph or lower	50 ft.	75 ft.
Distance B - Minimum Distance between Access Points		
40-50 mph	150 ft. (Existing development only & multi-family)*	150 ft.
30-35 mph	12 ft. (Existing development only & multi-family)*	90 ft.
25 mph or lower	12 ft.	20 ft.
Distance C - Minimum Distance to Property Line		
40-50 mph	20 ft. (Existing development only & multi-family)*	20 ft.
30-35 mph	6 ft. (Existing development only & multi-family)*	20 ft.
25 mph or lower	6 ft.	10 ft.
Distance D - Minimum Distance between Access Point Nearest Edges Across Roads where No Raised Median is Present and Left Turns Overlap		
40-50 mph	150 ft. (Existing development only & multi-family)*	150 ft.
30-35 mph	15 ft. (Existing development only & multi-family)*	75 ft.
25 mph or lower	15 ft. (Recommended)	50 ft.

*Access for new single family development is not allowed directly onto roads with posted speed limits above 30 mph.

3.8.2 Access Point Clear Sight Triangles

3.8.2.A Clear Sight Triangle for Vehicular Traffic

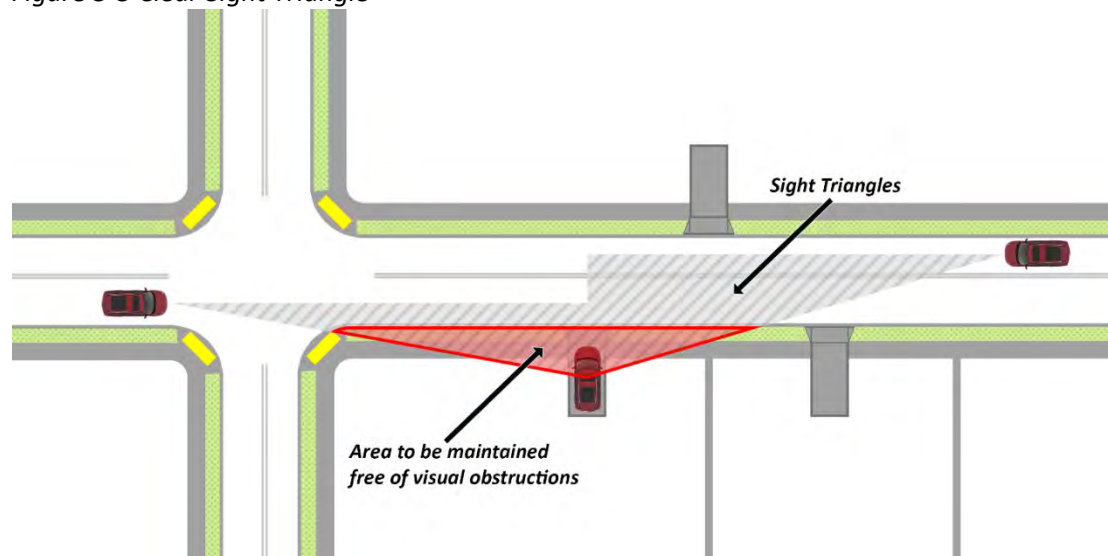
A clear sight triangle, as defined by *A Policy on Geometric Design of Highways and Streets* (AASHTO), shall be maintained by the property owner or occupant of the lot for vehicles exiting driveways onto the road (Bernalillo County Code Sec. 66-255). See 5.6.3 for additional explanation of clear sight triangle requirements based on AASHTO.

See Figure 3-3 for a depiction of the area to be maintained free of visual obstructions. Types of obstructions that are prohibited include, but are not limited to, the following:

- Vehicle parking
- Signs
- Posters
- Benches
- Walls
- Fences
- Landscaping

Landscaping over 3-feet above the travel lane or overhanging branches, signs, etc. under 8-feet shall not be allowed within the clear sight triangle. In no case shall trees, shrubs, or other landscaping, including branches from trees, be allowed to encroach either horizontally or vertically into the sight-distance triangle. It is the adjacent property owner's responsibility to maintain the clear sight triangle area (*Bernalillo County Code Sec. 66-225 (h)*).

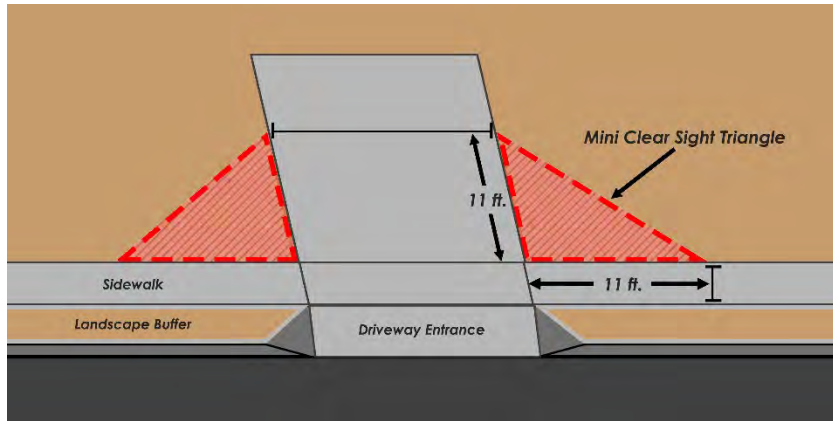
Figure 3-3 Clear Sight Triangle



3.8.2.B Clear Sight Triangle for Pedestrians

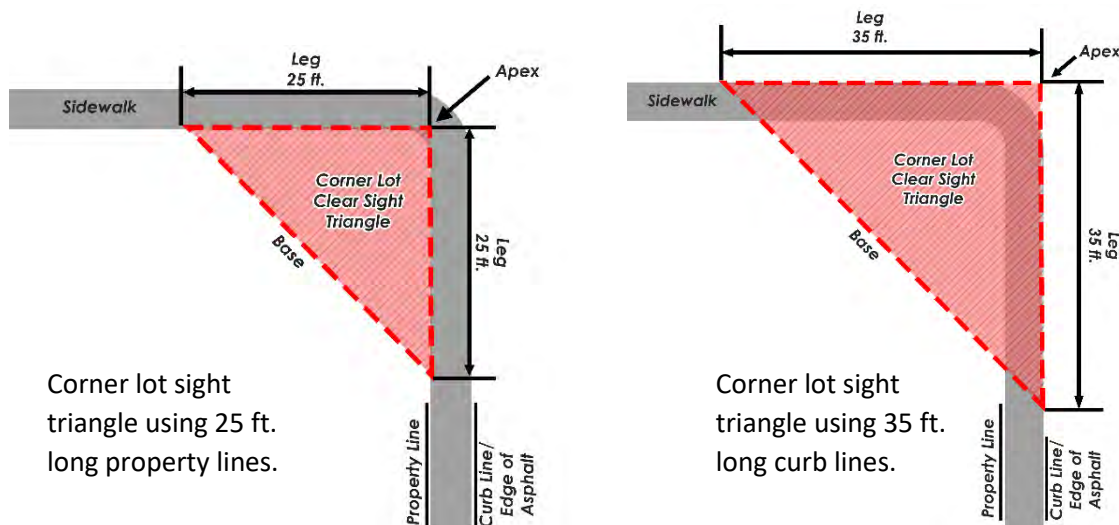
Pedestrian clear sight triangles shall not contain visual obstructions between the heights of 3 feet to 8 feet above the road surface. All access points shall maintain a mini pedestrian clear sight triangle with two 11-foot long legs as shown in Figure 3-4. It is the adjacent property owner's responsibility to maintain the clear sight triangle area (*Bernalillo County Code Sec. 66-225 (h)*).

Figure 3-4: Sight Distance Triangle for Pedestrians



For corner lots, requirements for clear sight triangles for pedestrians is depicted in Figure 3-5. The sight triangle may be bounded by the property line or the curb line, whichever is the lesser distance.

Figure 3-5: Corner Lot Clear Sight Triangles for Pedestrians



3.8.2.C Documentation of Clear Sight Triangle

To verify acceptable sight distance, the County Engineer may require a developer to evaluate and document an existing sight distance condition. The evaluation and documentation of the sight distance shall include the following, or such additional information as may be necessary to make a determination:

- Plan and profile drawing along the sight line
- Posted speed and/or speed study for operating speed
- Right-of-way and easement limits (existing and proposed)
- Appropriate photo documenting driver's view

If the County Engineer determines from the documentation presented that a location has insufficient sight distance, a plan to improve the sight distance to meet these standards will be required.

3.9 Off-Street Parking

Off-street parking is regulated in Bernalillo County Code *Appendix A, Sec. 21* as well as applicable sector development plans, design overlay plans, special use and conditional use permits. Additional recommendations that focus on circulation and layout are provided in these Technical Standards since off-street parking is the interface between public rights-of-way and private properties. The goal of this section is to:

- Ensure safe and efficient circulation when entering and exiting the public right-of-way and within the off-street parking area.
- Accommodate all modes of transportation and ADA accessibility.
- Provide resources and guidance for landscaping and drainage designs to incorporate GSI/LID.

3.9.1 Parking Space Requirements

3.9.1.A Total Parking Spaces Required

The total number of required off-street parking spaces for vehicles and bicycles is provided by the Bernalillo County Code *Appendix A, Sec. 21 – Off Street Parking, Loading and Unloading Regulations*.

3.9.1.B ADA Accessible Parking

ADA accessible parking spaces shall be provided in all parking facilities. ADA accessible parking spaces shall count as part of, not in addition to, the minimum required total spaces.

The location, design, and number of ADA accessible parking spaces should be consistent with Bernalillo County Code *Appendix A Sec. 21*, New Mexico Building Code – 2015 (NMBC-2015), State Statutes, and the Federal 2010 ADA.

3.9.2 Off-Street Parking Landscaping and Surface

Off-street parking provides a unique opportunity to incorporate Green Stormwater Infrastructure/Low Impact Development (GSI/LID) best management practices in order to help achieve requirements for drainage and landscaping. Appendix A GSI/LID Development Standards provides additional requirements and guidance on GSI/LID best management practices.

3.9.2.A Parking Lot Landscaping

Landscaping requirements for parking lots are provided in:

- Bernalillo County Code *Appendix A, Zoning Section 19, Landscaping and Buffer Landscaping*
- Bernalillo County Code *Chapter 30 Article VII Water Conservation Requirements*
- Regulations within the Sector Development Plan or Overlay Zone for the area

3.9.2.B Parking Lot Surface

General Considerations: Off-street parking areas shall be graded and surfaced to standards for asphalt concrete, Portland cement concrete, or, where allowed, alternative material surfacing sufficient to:

- Minimize dust and mud
- Provide for proper storm drainage
- Provide sufficient load requirements
- Reduce stormwater runoff and improve infiltration
- Allow for designation of parking stalls
- Allow for the installation of traffic control devices for circulation
- Meet drainage requirements in Bernalillo County Code *Chapter 38 Floods*

Surfacing Requirements for ADA: Required ADA accessible parking and accessible routes should be paved with Portland cement concrete or asphalt concrete.

Requirements for Pedestrian Circulation Surfacing: Designated paths for pedestrian circulation should be visibly delineated and surfacing shall be stable, firm, and slip resistant.

Alternative Material Surfacing: Alternative materials in parking areas are encouraged as a mechanism to reduce stormwater runoff and improve infiltration. See Bernalillo County GSI/LID Development Standards for further guidance. Alternative surface materials include, but are not limited to:

- Bricks
- Pavers
- Permeable or porous pavement
- Stamped concrete
- Gravel

Gravel Surfacing: Gravel surfacing may be provided for parts of off-site parking areas as long as certain conditions and maintenance obligations are met. All gravel surfacing requires regular seasonal maintenance in order to meet NM's fugitive dust control regulations (20.11.20 NMAC) and to provide a surface free of ruts.

Gravel surfaces are not recommended for routes that experience daily heavy vehicle trips. Gravel surfaces on designated emergency vehicle routes must be capable of supporting the weight and impacts of emergency vehicles.

Sites that generate 250 or more vehicles per day should pave higher traffic portions of the parking lot but may allow lower traffic portions to be gravel. For example, parking lots may provide separate areas for visitors and employees where the high traffic public visitor parking that is paved, but low traffic employee parking is gravel. An alternative is to pave drive aisles and allow the parking space to be gravel.

Connections Between Paved Roads and Gravel Parking Lots: All gravel non-residential and multi-family off-street parking requires an asphalt apron connection between paved roads and the gravel parking lot.

3.10 Internal Circulation and Parking Stalls

3.10.1 General

Circulation patterns should be as obvious and simple as possible and should be designed to avoid conflicts among vehicular, bicycle, and pedestrian traffic.

All off-street parking spaces should be reachable without requiring drivers to re-enter the public right-of-way. All parking spaces shall be designed so that vehicles are not forced to back out onto arterial and collector roads. BCPWD discourages backing out onto local roads for parking related to non-residential uses.

The design shall allow for appropriate landscaping of the parking area without conflicting with sight lines. See 3.8.2 for driveway sight distance requirements.

3.10.2 Pedestrian Circulation

3.10.2.A Internal Pedestrian Walkway Requirement

Proposed developments should provide a direct internal pedestrian walkway from the public sidewalk, adjacent transit stop, or right-of-way to the principal public entrance of the buildings at the site. At a minimum, walkways should connect focal points of pedestrian activity such as passenger loading zones, transit stops, road crossings, and entry points between buildings. The following uses are exempt from the above requirement:

- Single or two-family dwellings
- Agricultural use
- Cemetery
- Wireless telecommunication facility
- Minor utilities
- Other uses not containing a principal building on the premises (with the exception of a parking facility)

3.10.2.B Internal Pedestrian Walkway Design

Internal pedestrian walkways should meet current ADA Standards. Wheel stops should be provided in parking stalls where vehicle overhang can infringe on the pedestrian walkway.

3.10.3 Throat Length

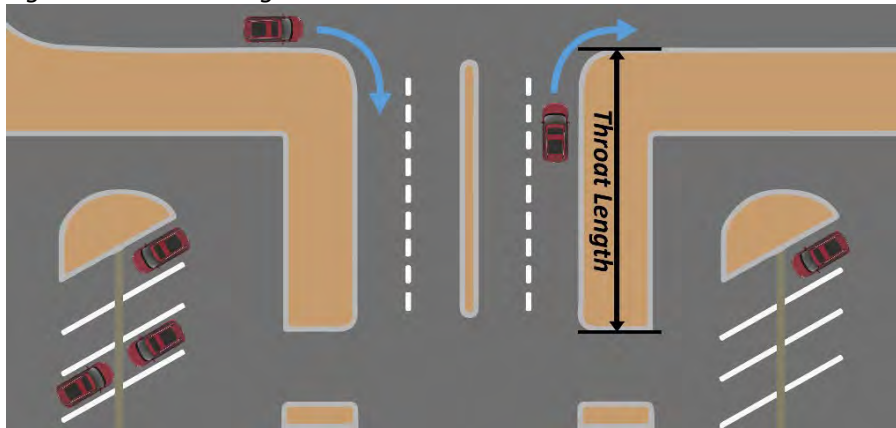
Non-residential and multi-family driveways should provide a minimum throat distance to any interior service drive or parking space, as measured from the street curb or edge of pavement (Figure 3-6). The minimum throat length for non-residential and multi-family driveways on local roads is 25 feet. See Table 3-10 for minimum throat lengths for other roads.

For applicable developments, the traffic impact (8) review includes evaluation of site access and may determine adequate provisions for throat length and number of lanes.

Table 3-10 Minimum Throat Length

Land Use	Size of the Development	Minimum Throat Length	
		Regional Principal Arterial	Other Arterials and Collectors
Industrial	Less than 100,000 S.F.	50 ft.	25 ft.
	100,000-500,000 S.F.	100 ft.	50 ft.
	Greater than 500,000 S.F.	150 ft.	100 ft.
Commercial	Less than 50,000 S.F.	50 ft.	25 ft.
	50,000-200,000 S.F.	100 ft.	75 ft.
	Greater than 200,000 S.F.	125 ft.	100 ft.
Multi-Family	Less than 100 dwelling units	50 ft.	25 ft.
	100-200 dwelling units	75 ft.	50 ft.
	Greater than 200 dwelling units	100 ft.	75 ft.

Figure 3-6 Throat Length



3.10.4 Vehicle Parking

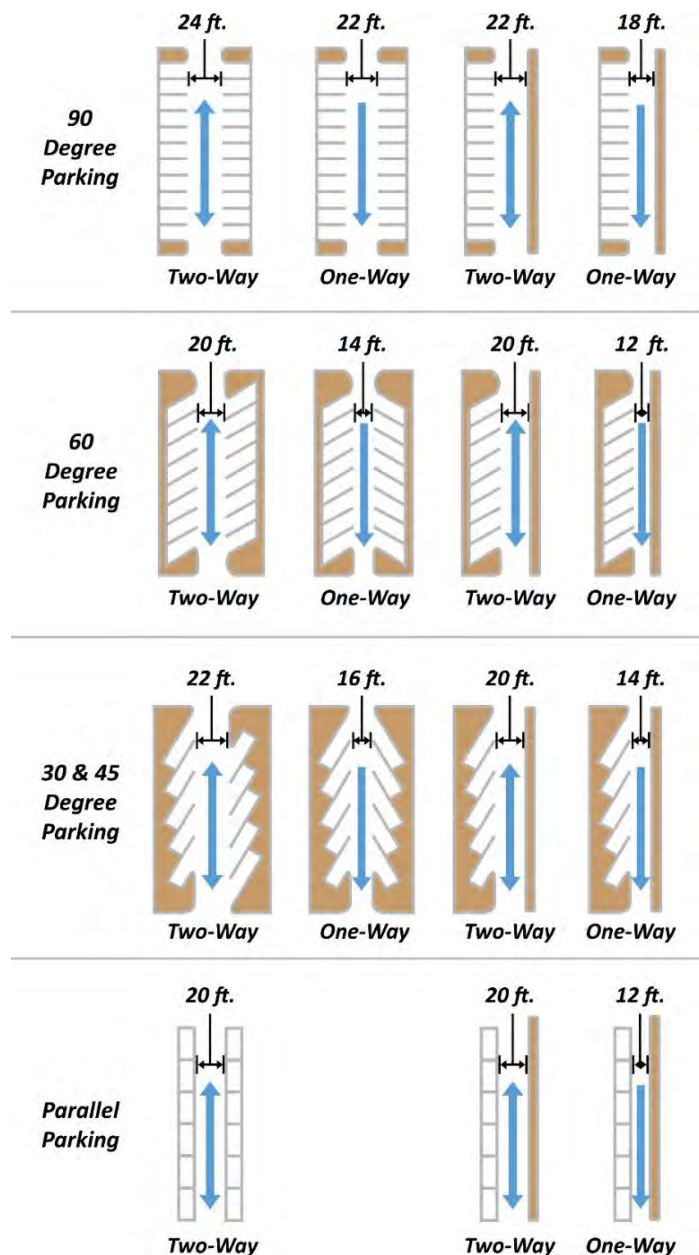
3.10.4.A Standard Parking Space Dimensions

The standard parking space is 8.5 feet wide and 20 feet long. Parking spaces may be up to 10 feet wide without requiring approval.

3.10.4.B Drive Aisle Width

Standard drive aisle width is based on parking stall angle and one-way or two-way circulation (see Figure 3-7). Drive aisles that are at least 20 feet wide may also serve as emergency vehicle lanes. See Bernalillo County Code *Ch. 33*.

Figure 3-7 Drive Aisle Width



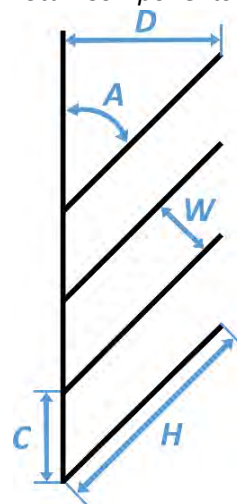
3.10.4.C Parking Stall Dimensions

Standard parking stall dimensions for the standard parking stall that is 8.5 ft. wide and 20 ft. long are provided in Table 3-11 and Figure 3-8.

Table 3-11 Parking Stall Dimensions

Layout	A Angle (degrees)	W Stall Width (feet)	C Curb Length (feet)	D Stall Depth to Curb/Wall (feet)	H Stall Stripe Length (feet)
Parallel	0	8.5	20	N/A	N/A
Angled	30	8.5	17	17.4	34.7
	45	8.5	12	20.2	28.5
	60	8.5	9.8	21.6	24.9
Perpendicular	90	8.5	8.5	20	20

Figure 3-8 Parking Stall Components



3.10.5 Motorcycle Parking

Motorcycle parking spaces are not required and the provision of motorcycle spaces does not count towards other required spaces. If a development chooses to provide motorcycle space the following design is recommended.

- Motorcycle parking shall be a minimum of 4 feet wide and 8 ft long.
- Motorcycle parking shall be located in a well-lit area that is visible from the primary building entrance on the site.
- Motorcycle parking spaces shall be designated with a posted upright sign, either free standing or wall mounted. Each sign shall be no smaller than 12 inches by 18 inches and shall have its lower edge no less than 4 feet about the ground.

3.10.6 Bicycle Parking

3.10.6.A General Considerations

The number of bicycle parking spaces required shall be in accordance with the Bernalillo County Code *Appendix A Sec. 21*.

Off-street bicycle parking location, layout, and rack options vary widely. The guidelines provided below should be considered when placing and designing bicycle parking areas and choosing rack options.

3.10.6.B Bicycle Rack Location

The placement of bicycle racks should adhere to the following:

- Bicycle parking spaces should be located in a well-lit area that is visible from the primary pedestrian entrance it serves. Where feasible, bicycle parking should be located within 50 feet of the entrance.
- Bicycle parking should be separated from vehicle parking areas and driveways by a barrier, such as a curb, rail, or bollard, or be located to minimize the possibility of vehicles striking parked bicycles.
- Bicycle racks should be placed in a designated area and shall not infringe upon the width of the required clear pedestrian access route.
- Bicycle racks should not be placed directly in front of entrances or in locations that impede pedestrian flow.
- Bicycle racks should be sturdy and anchored to a concrete pad.

3.10.6.C Bicycle Rack Selection and Stall Layout

BCPWD publishes a Quick Bicycle Rack Parking Guide for three different rack types. When using bicycle racks that differ from this guide, the following selection and layout criteria should apply:

- The rack is a minimum 30 inches tall and 18 inches wide.
- The bicycle frame should be supported horizontally at two or more places.
- Comb/toaster racks are not allowed.
- The rack is designed to support the bicycle in an upright position.
- The rack allows varying bicycle frame sizes and styles to be attached.
- The user is not required to lift the bicycle onto the bicycle rack.
- Each bicycle parking space is accessible without moving another bicycle.
- Each bicycle parking space is at least 6 feet long and 2 feet wide.

3.10.7 Interconnected Facilities and Dead Ends

3.10.7.A Interconnected Parking Facilities

Non-residential developments fronting arterial and major collector roads should provide driveway “stub-outs” to property lines to facilitate existing and future interconnected parking areas to adjacent sites. Parking lot access driveways and drive aisles should be designed and located to connect to adjacent properties or to access roads or easements that serve the subject site and adjacent properties.

All interconnections between sites need to be designed and constructed to accommodate efficient travel between adjacent sites. All interconnection improvements need to be paved according to applicable standards, including proper driveway widths, construction specifications, and treatment of transition grades.

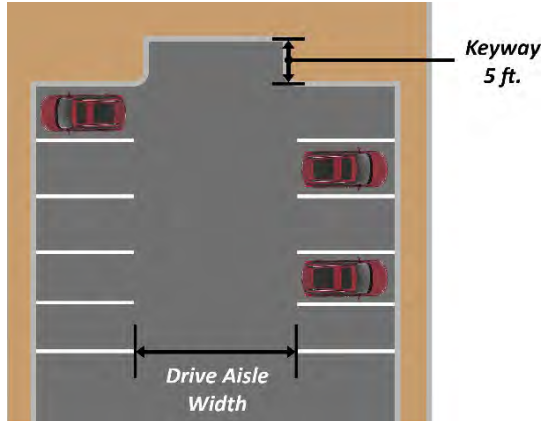
The interconnected parking areas at terminal points may be waived under the following circumstances:

- Where non-residential development abuts a residential district, or in circumstances where mixing different types of traffic (e.g. automobiles versus truck) is undesirable.
- Where separation of traffic necessary for traffic safety.
- Where physical design constraints preclude interconnection of adjacent sites.
- Where an adjacent property owner will not provide the necessary easement.

3.10.8 Keyways/Back-Up Spurs

Dead end parking aisles should include a 5-foot-deep keyway or back-up spur. See Figure 3-9 for additional details.

Figure 3-9 Back-Up Spur



3.10.9 Loading and Service Areas

Shall meet requirements in Bernalillo County Code *Appendix A Sec. 21*. Loading and service areas should provide adequate space for standing, loading, unloading, and servicing, and be located to avoid blocking or restricting public roads or site circulation.

3.10.10 Drive-Thru Facilities

Queuing of drive-thru facilities should not interfere with either the access to the site, parking and circulation aisle, or the public right-of-way.

Queueing lanes should be a minimum of 12 feet wide with a 25-foot minimum radius (inside edge) for all turns. A 15-foot inside radius may be used if the lane width is increased to 14 ft.

Table 3-12 provides the recommended minimum drive thru queue lengths for different land uses. These are the 85th percentile queue lengths based on *Spack Drive-Through Queue Study 2019*. A traffic impact assessment or a Vehicle Movement Plan may provide alternative queue lengths based on anticipated demand.

Table 3-12: Minimum Drive Thru Queue Length by Land Use

Land Use Type	Minimum Queue Length
Fast Food	260 ft. / 12 vehicles
Coffee Shop	240 ft. / 13 vehicles
Bank	140 ft. / 7 vehicles
Car Wash	140 ft. / 7 vehicles
Pharmacy	100 ft. / 5 vehicles

3.10.10.A Vehicle Movement Plan

See Bernalillo County Code *Appendix A Sec. 13, 14 and 15.5* for zones where a vehicle movement plan may be required for drive-thru facilities. The vehicle movement plan should include the following information:

- Drive aisle widths
- Inside turning radii
- Location where orders are placed and then collected
- Queue length
- Anticipated peak hour demand

3.10.11 Commercial Solid Waste Collection Bins

Any water used to clean commercial solid waste collection bins or surrounding area is required to be captured and released to the ABCWUA wastewater collection point. Storm drains are not allowed within the solid waste bin enclosures. Any storm drain needs to be a minimum of 10 feet away from the solid waste bin.

See Bernalillo County Code *Sec. 70- 38* for additional requirements related to commercial solid waste collection within off-street parking areas.

4. Drainage

4.1 Introduction

The chapter supports Bernalillo County Code Chapter 38 Floods and describes measures and processes to minimize private and public losses due to stormwater events and mitigate pollution associated with stormwater runoff. Specifically, this chapter provides standards and specifications for the design and construction of storm drainage facilities associated with private and public projects in unincorporated Bernalillo County. This chapter is intended to be used with:

- Bernalillo County Code Chapter 38 Floods
- Bernalillo County Green Stormwater Infrastructure (GSI)/Low Impact Development (LID) Standards
- City of Albuquerque's Development Process Manual's (DPM), Chapter 6 Drainage, Flood Control and Erosion Control

These criteria provide guidance for a large majority of design circumstances, but they are not intended as a substitute for good engineering judgment. It must be understood that situations will arise in which these criteria are not appropriate. The County Engineer, City of Albuquerque Engineer, or Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) Executive Engineer, as appropriate, may, in specific cases require more stringent criteria or allow relaxation of these criteria based on their judgment and sound engineering practices.

4.1.1 Basic Objectives

The purpose of the drainage system is to collect, transmit, and discharge stormwater consistent with the objectives described below.

4.1.1.A Adequate Space for Drainage Facilities and Maintenance Access

Adequate space and maintenance access shall be provided and properly allocated for drainage facilities to ensure that downstream impacts have been mitigated and that the functionality of drainage systems has been maintained.

4.1.1.B Multi-Use Resource

Stormwater runoff shall be treated as a multi-use resource and the design of storm drainage management facilities shall be planned to ensure that the multi-use aspects of drainage facilities are maintained. (See Bernalillo County Code Sec. 38-205.)

4.1.1.C Jurisdictional Boundaries and Master Planning

Drainage boundaries are non-jurisdictional and regional cooperation is required to receive approval of facilities that have potential multi-jurisdictional and regional impacts through the preparation of a new or use of an existing Master Grading and Drainage Plan. (See Bernalillo County Code Sec. 38-141(3)(d).) Bernalillo County Code requires that the County work cooperatively with the Middle Rio Grande Conservancy District (MRGCD), AMAFCA, the City of Albuquerque, and other Middle Rio Grande Municipal Separate Storm Sewer - MS4 permittees to best manage the discharge of storm runoff into MRGCD and MS4 permittee facilities, maximize efficient use of stormwater facilities, and minimize

impact on downstream water quality and storm drainage facilities. (See Bernalillo County Code Sec. 38-400(h).)

4.1.1.D Floodplain Management

The design of drainage facilities shall consider the general purposes of floodplain regulations and reduce the hazard of floods to life and property, protect and preserve the hydraulic characteristics of water courses used for the conveyance of floodwaters, protect the public from extraordinary financial expenditures for flood control and relief, and promote the multi-use resource concept for the intent to provide and preserve quality open space. (See Bernalillo County Code Sec. 38-141(3)(g).)

4.1.1.E Stormwater Quantity and Quality

Development activities shall properly manage and mitigate both stormwater quantity and quality-related impacts.

Quantity-related impacts shall be mitigated in a manner that controls possible damage caused by the amount of surface water being transported to any one design point, in accordance with Chapter 38 Floods of the Bernalillo County Code.

Quality-related impacts shall be mitigated in accordance with Bernalillo County Stormwater Quality Ordinance and applicable codes and ordinances from adjoining jurisdictions (See Bernalillo County Code *Article IV, Sec. 38-400*). For additional guidance see Bernalillo County GSI/LID Standards (Appendix A).

4.2 Grading and Drainage Plan

4.2.1 When a Grading and Drainage Plan is Required

Bernalillo County Public Works Department (BCPWD) addresses mitigation of stormwater runoff through a grading and drainage plan. A grading and drainage plan is required depending on the development action, the location of the development, and the extent of alterations associated with the development. In addition, a grading and drainage plan may be required at the discretion on the County Engineer.

This section provides a summary of actions that require a grading and drainage plan and additional documentation related to flood hazards and water quality. These requirements come from Bernalillo County Code *Ch. 38 Floods* and *Ch. 74 Subdivision*. The requirements and the various triggers are organized into four main categories.

- Development Actions Outside the East Mountain Area (Table 4-1)
- East Mountain Area Development Actions (Table 4-2)
- Requirements Related to Flood Hazard (Table 4-3)
- Requirements Related to Water Quality (Table 4-4)

All of these requirements, including key definitions, are provided in Figure 4-1.

Figure 4-1: PWDN Cheat Sheet

BCPWD Grading and Drainage Plan Requirements									

4.2.1.A Grading and Drainage: Development Actions Outside the East Mountain Area

Table 4-1 provides a summary of the development actions and associated alterations that require a grading and drainage study for locations within the unincorporated county and outside the East Mountain Area.

Table 4-1: Outside the East Mountain Area: Grading and Drainage Requirements

Development Action Outside the East Mountain Area		Conceptual G&D	Drainage Plan	Drainage Report
Residential Building Permit (BRBP) and Manufactured Mobile Home Placement Permit (ZNPB)				
In compliance with a previously approved grading and drainage plan with subdivision		<i>None Required</i>		
North Albuquerque Acres lot			X	
500 square feet or greater of new impervious surface AND 30% or greater total impervious (developed) area			X	
All Other Residential Building Permits (BRBPs)		<i>None Required</i>		
Commercial Building Permit (BCBP)				
Total impervious (developed) area is 30% or greater			X	
Projects altering 200 or more cubic yards of material			X	
Projects altering one acre (cumulative) or more surface area			X	
All other Commercial Building Permits (BCBPs)		<i>None Required</i>		
Subdivision				
Minor Subdivision (SRP), 5 lots or less		At Discretion of County Engineer or As Necessary		
Major Subdivision (SC), 6 lots or more		X		X
Sector Development Plans & Master Plans		X		
Special Use Permits (ZCSU)				
Projects altering 200 or more cubic yards of material, ZCSU Application		X		
Projects altering 200 or more cubic yards of material, ZCSU Condition of Approval			X	
All other Special Use Permits (ZCSUs)		<i>None Required</i>		

4.2.1.C Grading and Drainage: Development Actions in the East Mountain

Areas within the East Mountains have requirements related to grading and drainage for development actions. These requirements are described in detail in Bernalillo County Code Sec. 38-171 (i) (5) and are summarized in Table 4-2.

Table 4-2: East Mountain Grading and Drainage Requirements

East Mountain Area Development Action	Conceptual G&D	Drainage Plan	Drainage Report
Residential Building, Commercial Building and Manufactured/Mobile Home Placement and Special Use (BRBP, BCBP, ZNPH and ZCSU)			
Parcel is less than 5 acres		X	
Total impervious (developed) area is greater than 15%		X	
All other BRBP, BCBP, ZNPH and ZCSU	None Required		
Minor Subdivision (SRP), 5 lots or less			
Residential subdivision – Total area is greater than 40 acres	X	X	
Residential subdivision – Total area is less than or equal to 40 acres AND includes a parcel less than 5 acres		X	
All other minor residential subdivisions	At Discretion of County Engineer or As Necessary		
Major Subdivision (SC), 6 lots or more			
Residential subdivision – Total area is greater than 40 acres	X		X
Residential subdivision – Total area is less than or equal to 40 acres AND includes a parcel less than 5 acres	X		X
All other major residential subdivisions	At Discretion of County Engineer or As Necessary		
Sector Development Plans & Master Plans			
None Required			

4.2.1.D Requirements Related to Special Flood Hazard Areas

All construction within Special Flood Hazard Areas (flood zone area) as identified and defined by FEMA must comply with applicable local, state, and federal regulations. See *Ch. 38 Division 3 – Special Provisions for Flood Hazard Areas* of the Bernalillo County Code for definition and detailed requirements. Table 4-3 provides the required documentation based on the type of development action.

Table 4-3: Requirements Related to Special Flood Hazard Areas

Development Action in Special Flood Hazard Areas	Requirements and Associated Regulations
Any construction on parcels that touch the floodplain	• Drainage Report • Floodplain Development Permit (Bernalillo County Code Sec. 38-101 and Sec. 38-102)
Subdivision of parcels that touch the floodplain	
All subdivisions	• Drainage Report • Floodplain Development Permit (Bernalillo County Code Sec. 38-101 and Sec. 38-102)
Subdivisions involving 50 lots or more or 5 acres or more	Include base flood elevation determination in addition to other requirements. (Bernalillo County Code Sec. 38-101 (4)(d))
Projects that alter floodplain limits or elevations – The Floodplain Administrator shall be consulted prior to submitting any formal proposal that will alter floodplain limits or elevations.	Any map revision or amendment activities should be consulted with the County floodplain administrator. These may include, but are not limited to: • Letter of Map Amendment (LOMA) • Letter of Map Change (LOMC) • Conditional Letter of Map Revision (CLOMR) • Letter of Map Revision (LOMR) • Letter of Map Revision Based on Fill (LOMR-F) (<i>Federal regulations, see fema.gov</i>)
Septic systems – Developments relying on on-site wastewater systems	• Additional protections for tank and drain field are required. • Consultation with the County grading and drainage engineer and floodplain administrator is required. • Additional variances may also be required. (Bernalillo County Code Sec. 42-520)
Any platting or construction adjacent to a major arroyo – A major arroyo is any channel with a watershed over 320 acres in a 100-year design storm, whether such watershed is in its natural (unaltered) state or has been altered by development, runoff diversions or detention facilities. Definition from Bernalillo County Code Sec. 38-142.	• Drainage Report (Bernalillo County Code, Sec. 38-171, (i)(3))

4.2.1.E Requirements Related to Water Quality

Table 4-4 provides the development actions that require water quality improvements. See *Ch. 38 Article IV Stormwater Quality* for details on Bernalillo County requirements.

Table 4-4: Requirements Related to Water Quality

Development Action	Requirements and Associated Regulations
Construction: stormwater pollution prevention plan shall outline the best management practices (BMPs) for construction site stormwater runoff control for development and redevelopment projects disturbing equal to or greater than one acre, including sites that disturb less than one acre but are part of a larger plan of common development.	Stormwater Pollution Prevention Plan (SWPPP) in compliance with the Construction General Permit (CGP) <i>(Bernalillo County Code Article IV Stormwater Quality, Sec. 38-413)</i>
Post-Construction: post-construction water quality BMPs to manage the stormwater quality design volume are required for development and redevelopment projects disturbing equal to or greater than one acre, including sites that disturb less than one acre but are part of a larger plan of common development.	- Stormwater quality design volume (SWQV) calculation - Stormwater Post-Construction GSI/LID BMP Evaluation form (www.bernco.gov/gsi-lid) - Owners of private BMPs must provide regular maintenance and an inspection every 3 years, conducted by a New Mexico professional engineer or qualified stormwater person <i>(Bernalillo County Code Article IV Stormwater Quality, Sec. 38-414)</i>
Some industrial/business activities are subject to an EPA Multi-Sector General Permit (MSGP) <i>(See https://www.epa.gov/npdes/stormwater-discharges-industrial-activities for list of industrial activities)</i>	Multi-Sector General Permit (MSGP) <i>(Bernalillo County Code Article IV Stormwater Quality, Sec. 38-415)</i>
Placement of fill material in a private or public property	- Applicant must obtain a Fill Permit prior to placement of fill material. - Fill materials may only include soil types and minerals listed on approved fill materials list. - Fill Permit (Natural Resources Fill Material – NRFM - Permit) <i>(Bernalillo County Code Ch. 30 Article III)</i>

4.2.2 Summary Descriptions of Grading and Drainage Plans and Related Documents

Tables 4-5 to 4-7 provide summary descriptions of the different types of grading and drainage plans and related documents with references to county code for standards.

Table 4-5: Summary Descriptions of Grading and Drainage Plans

Plan	Summary Description
Conceptual Grading and Drainage Plan	A graphic representation of existing and proposed grading, drainage, flood control, stormwater quality, and erosion control information. The conceptual grading and drainage plan checks the compatibility of the proposed development with grading, drainage, flood hazard, stormwater quality, and erosion controls and constraints by on-site physical features as well as adjacent properties and public infrastructure. Information should be of sufficient detail to determine project feasibility. Plan must include required stormwater quality design volume (SWQV) retention calculations and BMPs as applicable. (Bernalillo County Code Sec. 38-171, (i) (1))
Drainage Plan	A short, detailed presentation required for approval of small, simple development approvals. Drainage plans are prepared with or on the detailed grading plan and address both on-site and off-site drainage control, flood control, stormwater quality, and erosion control issues. Drainage plans are required for building permits, minor subdivision with less than six (6) lots, site development plans, and landscaping plans for development involving less than five (5) acres. (Bernalillo County Code Sec. 38-171, (i) (1))
Drainage Report	A drainage report is a comprehensive analysis of the drainage control, flood control, stormwater quality, and erosion control constraints on and impacts resulting from a proposed platting, development, or construction project. Drainage reports are required for major subdivisions containing more than five (5) lots or constituting five (5) acres or more, platting or construction within a designated flood hazard area, and for any platting or development adjacent to a major arroyo. (Bernalillo County Code Sec. 38-171, (i) (1))
Grading Plan	Plan describing the existing topography and proposed grading including retaining wall locations and details, interfaces with adjacent properties referenced to mean sea level (1929 or 1988 datum) such as city benchmark or NMSHTD (NMDOT) benchmark and showing sufficient contours, spot elevations, and cross sections to allow a clear understanding by reviewers, contractors, and inspectors. (Bernalillo County Code Article III STORM DRAINAGE definition)
Drainage Management Plan	A plan prepared and adopted by Bernalillo County, the City of Albuquerque, or AMAFCA which details the drainage controls required within a particular watershed, arroyo corridor, or other designated drainage district. (Bernalillo County Code Article III STORM DRAINAGE definition)

Table 4-6: Summary Descriptions of Permits Related to Special Flood Hazard Zones

Plan	Summary Description
Floodplain Development Permit	Permit required for any development in a FEMA Special Flood Hazard Area. See Bernalillo County Code Division 3 Provisions for Flood Hazard Reduction.
Letter of Map Amendment (LOMA)	An amendment to the currently effective FEMA map which establishes that a property is not located in a Special Flood Hazard Area (SFHA). A LOMA is issued only by FEMA. A LOMA is an administrative procedure and does not change the FEMA maps.
Letter of Map Change (LOMC)	Letter of Map Change (LOMC) is a general term used to refer to the several types of revisions and amendments to FEMA maps that can be accomplished by letter. These revisions include a Letter of Map Amendment (LOMA), Letter of Map Revision (LOMR), and Letter of Map Revision based on Fill (LOMR-F).
Letter of Map Revision (LOMR)	A Letter of Map Revision is FEMA's modification to an effective Flood Insurance Rate Map (FIRM), Flood Boundary and Floodway Map (FBFM), or both. Letter of Map Revisions are generally based on the implementation of physical measures that affect the hydrologic or hydraulic characteristics of a flooding source and thus result in the modification of the existing regulatory floodway, the effective Base Flood Elevations (BFEs), or the Special Flood Hazard Area (SFHA).
Conditional Letter of Map Revision (CLOMR)	FEMA's comment on a proposed project that would, upon construction, affect the hydrologic or hydraulic characteristics of a flooding source and thus result in the modification of the existing regulatory floodway, the effective Base Flood Elevations (BFEs), or the Special Flood Hazard Area (SFHA). The letter does not revise an effective NFIP map; rather, it indicates whether the project, if built as proposed, would be recognized by FEMA. FEMA charges a fee for processing a CLOMR to recover the costs associated with the review. Refer to Federal Regulations 44 CFR 60.3 (c)(10) to determine if a CLOMR is required.
Letter of Map Revision Based on Fill (LOMR-F)	A Letter of Map Revision Based on Fill (LOMR-F) is FEMA's modification of the Special Flood Hazard Area (SFHA) shown on the Flood Insurance Rate Map (FIRM) based on the placement of fill outside the existing regulatory floodway.

Table 4-7: Summary Descriptions Related to Stormwater Quality

Plan	Summary Description
Erosion Control Plan	Plan for the mitigation of damages due to soil erosion and to deposition for all project phases from initial grading to final occupancy that is usually incorporated into the drainage plan or drainage report. The 10-year design storm shall be used to determine the treatment measures necessary for the prevention of damage due to soil movement for the on-site area of development. Where an arroyo or watercourse abuts or traverses the site of development, or a development or subdivision proposes to discharge to any arroyo or watercourse, a more stringent criteria, including determination of the prudent line, may be appropriate and will be determined on a case-by-case basis by the County Engineer. Phased projects require special attention. All construction projects, both public and private, within the jurisdiction of Ch 38 Article III, unless specifically excluded, require an approved erosion control plan prior to the start of construction. The erosion control plan must address stormwater quality where the land disturbance is one (1) acre or greater or is part of a larger common plan of development. (Bernalillo County Code Sec. 38-171, (i) (4))
Stormwater Quality Design Volume (SWQV)	Calculation of the SWQV and BMPs incorporated to treat stormwater runoff must be included on the grading and drainage plan. For guidance, see the Bernalillo County GSI/LID Standards (See Appendix A). (Bernalillo County Code Ch 38. Article IV)
Stormwater Pollution Prevention Plan (SWPPP)	Information and program required by EPA, NMED, and the County for construction phase stormwater management, in compliance with the EPA Construction General Permit. (Bernalillo County Code Ch. 38 Article III and IV)
Stormwater Post-Construction GSI/LID BMP Evaluation Form	Required form listing GSI/LID Best Management Practices (BMPs) that must be evaluated and any implemented BMPs selected as part of stormwater quality design volume treatment and retention. See the Bernalillo County GSI/LID Standards for specific guidance on implementation of BMPs (See Appendix A).
Multi-Sector General Permit (MSGP)	Proof of compliance with the EPA MSGP industrial sector permit for specific industrial/business activities. A few examples of sectors of industrial activity that are covered by the MSGP include: Land Transportation and Warehousing, Scrap Recycling and Waste Recycling Facilities, and Automobile Salvage Yards; please refer to EPA's website for additional information: https://www.epa.gov/npdes/stormwater-discharges-industrial-activities-epas-2021-msgp
Fill Permit	Proof that clean fill material is on the approved materials list and will not result in contamination of surface water or groundwater, will not impact stormwater flow or water quality, and will not impact the alignment and capacity of natural drainageways. (Bernalillo County Code Ch. 30 Article III)

4.2.3 Qualifications

All grading and drainage plan and related documents must be completed by a professional engineer currently licensed in the State of New Mexico. The Multi-Sector General Permit (MSGP) and Construction General Permit (CGP) notice of intent and related SWPPPs does not need to be completed by a professional engineer.

4.3 Hydrology

4.3.1 Design Runoff Methods

The Design Storm for Bernalillo County is the 100-year, 6-hour rainfall event. Storm discharge flows shall be based on the adopted drainage master plan for the project area. If no established storm discharge flows are available, the size of the tributary watershed area shall determine the design runoff method as follows:

- Design flows for watersheds 40 acres or less outside of the East Mountain area shall be developed using the Rational Method as described in Chapter 6 of the City of Albuquerque's Development Process Manual.
- Design flows for watersheds greater than 40 acres or within the East Mountain area shall be developed using the Soil Conservation Service (SCS) Methods, tabular or computer modeling, or HEC HMS computational methods.
- When determining design flows for floodplain management and flood proofing, design runoff shall be based on FEMA regulations.

4.3.2 Peak Volumes and Times of Concentration

Peak volumes and times of concentration shall consider fully developed land use scenarios to determine the runoff coefficients and changes in flow patterns (from the undeveloped site conditions). When properties adjacent to the study area are fully developed, stormwater analysis shall be based on current land usage and topographical features. When property adjacent to the study area is undeveloped, estimated times of concentration shall be based on the most probable future land use. Such land use shall be determined from the County Comprehensive Plan and County zoning map.

In areas with existing, well-defined drainage patterns and slopes, the actual slope shall be used to calculate runoff rates. Otherwise, average land slopes in both developed and undeveloped areas may be utilized to calculate runoff rates.

The proposed project or developed land use shall not change historical runoff values, cause downstream damage, or adversely impact adjacent properties.

4.3.3 Design Points

Basin delineation within a development or specific design area is problematic with relation to the design of proper drainage systems and the long-range management of discharge quantities. Therefore, specific design points shall be analyzed in the design process. Discharge volumes for minor and major storm events shall be calculated at key design points and as identified by the County Engineer. Typical design points may include, but are not limited to:

- Curb inlet, catch basin
- Area drains
- Discharge points, pipes, swales, channels, BMPs, detention basins and sedimentation basins to suitable outfall (existing or natural system)
- Transition points: pipe to channel or swale, or at any location where developed runoff exits the project boundary, and at any point where off-site runoff enters the project boundary
- Intersections

- Inflow and outflow from sedimentation basins and detention basins

4.4 Stormwater Quality Design Volume

4.4.1 General

The EPA MS4 Permit and the Bernalillo County Stormwater Quality Ordinance (Chapter 38), require that the stormwater quality design volume (SWQV) be managed on site. Best management practices (BMPs) prevent stormwater pollutants from reaching receiving waters and must be designed to collect runoff from the entire site. Green Stormwater Infrastructure / Low Impact Development (GSI/LID) BMPs that provide enhanced environmental benefits, including treatment to improve stormwater quality and supplemental irrigation for landscapes, are strongly encouraged and the Bernalillo County GSI/LID Standards (Appendix A) provides guidance for their implementation.

Stormwater BMPs to manage the stormwater quality design volume (SWQV) on site are required for all development and redevelopment projects with land disturbances equal to or greater than one acre, including sites which disturb less than one acre but are part of a larger common plan of development. Projects must evaluate for opportunities to implement GSI/LID BMPs, with submission of the Stormwater Post-Construction GSI/LID BMP Evaluation form required for verification.

4.4.2 SWQV Calculation Methods

The SWQV is the sum of the design storm volume generated from Land Treatment Areas C and D. The design storm rainfall depth parameter varies for new development and redevelopment. The contexts for development are defined in Table 4-8. (See Bernalillo County GSI/LID Standards in Appendix A).

Table 4-8 Context Definitions for SWQV

Context	Definitions
New Development	Proposed development on a site with little or no existing impervious cover. This can include an undeveloped property or a property that had previously been developed, but site improvements and impervious cover have been mostly or completely removed so that site constraint issues related to existing infrastructure no longer exist.
Redevelopment	Proposed development that alters the footprint of an existing site, building, or impervious area. Redevelopment projects have site constraints typically not found in new development projects.
Land Treatment C	• Soil compacted by human activity with minimal vegetation including unpaved parking, roads, and walkways. • Irrigated lawns and parks with slopes greater than 10 percent. • Native grasses, weeds, and shrub areas and soils uncompacted by human activity with slopes at 20 percent or greater. • Native grasses, weeds and shrub areas with clay or clay loam soils and other soils of very low permeability as classified by SCS Hydrologic Soil Group D
Land Treatment D	Impervious areas such as pavement and roofs. This area includes ponds, channels and wetlands, even if these areas are seasonally dry.

Note: Land Treatments C and D follow the definition from the City of Albuquerque Development Process Manual (DPM) with minor modifications to Land Treatment C.

The equation for SWQV (cubic feet, ft³) is:

$$SWQV = a[R_C * Area_C + R_D * Area_D]$$

Table 4-9 provides descriptions of the equation coefficients and variables.

Table 4-9 SWQV Equation Coefficients and Variables

Coefficient/Variable	Description	Quantity
<i>a</i>	Factor to convert rainfall depth from inches to feet	1/12 (feet/inch)
<i>R_C</i>	Rainfall depth for Land Treatment C. This factor is different for New Development and Redevelopment.	New Development: $R_C = 0.520 \text{ inches}$ Redevelopment: $R_C = 0.410 \text{ inches}$
<i>Area_C</i>	Surface area of Land Treatment C	Total Land Treatment C area (ft ²) based on project design
<i>R_D</i>	Rainfall depth for Land Treatment D. This factor is the 90 th percentile depth for New Development and 80 th percentile depth for Redevelopment.	New Development: $R_D = 0.615 \text{ inches}$ Redevelopment: $R_D = 0.48 \text{ inches}$
<i>Area_D</i>	Surface area of Land Treatment D	Total Land Treatment D area (ft ²) based on project design

4.4.3 Grading and Drainage Submittal Information

When SWQV BMPs are provided, the following are required for grading and drainage plan submittals:

- SWQV calculations must show rainfall depth and square footage for Land Treatment areas C and D used. The calculations must be clearly visible on the plan.
- All stormwater BMPs must be clearly identified on the plan, with applicable landscape areas identified. If the BMP contributes to the total SWQV provided in the design, it must be labelled with the treatment volume provided.
- In addition to the grading and drainage plan, a Stormwater Post-Construction GSI/LID BMP Evaluation form must be submitted. (www.bernco.gov/gsi-lid). This form may be used in Exhibit A of the “Covenant for Drainage and Water Quality Infrastructure” to document water quality facilities that will be constructed and maintained by Owner.

4.5 Drainage Facility Evacuation Time

The New Mexico Office of the State Engineer (OSE) Dam Safety Bureau regulation (19.25.12.11.B) related to water rights requires that flood control dams, including ponds, do not retain water longer than 96-hours. This is typically referred to as the NM OSE “96-hour” rule. All projects that retain or detain stormwater are subject to the OSE “96-hour” rule that all waters must infiltrate or must be released from detention within 96-hours. Additional information can be found in the [Green Infrastructure Implementation in New Mexico](#) document developed by the New Mexico Environment Department in coordination with the OSE.

4.6 Site Grading

4.6.1 Basic Objectives

The goal of site grading is to develop features that direct and/or store stormwater runoff in a manner consistent with the following objectives:

- Assist in directing surface flow away from existing and proposed structures and towards well-developed conveyance/storage systems to minimize property damage.
- Minimize the amount of surface erosion and sediment transport by limiting steep grades in excess of 4:1 (horizontal : vertical) through terracing and using applicable permanent BMPs. See the Bernalillo County GSI/LID Standards in Appendix A for additional details.
- Site grading shall be designed in a manner that minimizes the use of retaining walls and limits severe elevation transitions at property boundaries.
- Storing surface runoff on site to minimize downstream impacts and control discharge flows.
- Enhance surface water quality using BMPs designed to remove constituents of concern collected during smaller storm events. See the Bernalillo County GSI/LID Standards in Appendix A for additional information.

Site grading should imitate natural landforms, mimic predevelopment hydrology, and work effectively with the developed drainage plan to minimize erosion. The overall area being graded should be kept to a minimum. Once construction is complete, all disturbed areas must be immediately reseeded, monitored, and substantially revegetated within 3-years or other permanent BMPs must be installed.

4.7 Conveyance Systems

Conveyance systems are drainage facilities, both natural and artificial, that collect, contain, and convey stormwater runoff. Natural conveyance systems include, but are not limited to, arroyo drainage courses, streams, rivers, and wetlands. Artificial conveyance systems include, but are not limited to, gutters, ditches, pipes, catch basins, manholes, constructed wetlands, channels, and swales. Any requirement for artificial conveyance systems, where natural systems already exist, shall not eliminate or supersede any code requirements for protection of the natural systems.

4.7.1 Storm Water Management Model Updates (Isleta Drain and Alameda Drain)

Discharges to the Isleta Drain or Alameda Drain that are not reflected in the Bernalillo County Storm Water Management Model (SWMM) will require updating the model for these drains. If modeling is required, coordination with the engineering firm that controls the SWMM model will be needed.

4.7.2 AMAFCA Requirements

AMAFCA requires the use of HEC-RAS, or other software as approved by AMAFCA, for modeling in a floodplain.

4.7.3 Open Channels

4.7.3.A Building Setback

The minimum required distance between any building and the top of the bank or the 50-year inundation limits (whichever is wider) of an open channel is 30 feet.

4.7.3.B General Design

In general, open channels should be slow flowing, wide, shallow, and natural in appearance and function. Open channels shall be sized to adequately carry the design flow rate (100-year design storm) while maintaining channel stability. **Channel capacities** shall be computed and specified on the Grading and Drainage Plan and/or Drainage Report. Manning's Formula may be utilized to evaluate uniform flow conditions. HEC-RAS software or alternative software approved by the County Engineer shall be utilized when an assumption of uniform flow is not valid.

Freeboard Requirements: Design flow rates shall be carried within the confines of the open channel with a minimum freeboard of 1.0 foot measured from the water surface to the top of the bank or channel. For natural channels, freeboard requirements may be satisfied by dedication of an easement to the freeboard elevation plus 1.0 foot vertically.

For natural channels without lateral migration mitigation measures, the prudent line shall be considered. The County defines the Prudent Line as: "Prudent line (erosion limit line) means that line which will not be disturbed by erosion, scour or meandering of a natural (unlined) arroyo, channel or watercourse over a period of 30 years and which will not be disturbed by a 100-year storm occurring at any time during the 30-year period. The prudent line shall be so located as to include all freeboard required to contain the wave action of the 100-year design storm."

Channel design shall include lining or treatment of the invert and sides to minimize erosion. Channel inverts and sides shall be lined according to Table 4-10. Channel side slopes shall be as flat as possible; maximum allowable side slopes are 3:1 (horizontal : vertical). The channel side slopes may be steeper with concrete lining.

Pipes culverts, box culverts, and other structures discharging to open channels shall not protrude into the normal waterway area of open channels.

Table 4-10 Channel Lining Requirements

Velocity (feet per second)	Lining Type
Velocity < 3 fps*	Seeded lining
3 fps ≤ velocity < 5 fps*	Seeded lining or staked sod
5 fps ≤ velocity < 10 fps	Stone rip-rap
10 fps ≤ velocity < 15 fps	Grouted stone, wire tied rip-rap, gabion revetment, turf reinforcement mats, or concrete
Velocity ≥ 15 fps	Concrete

*Natural channels may be designed without lining for average velocities up to 5 fps.

4.7.4 Enclosed Systems

4.7.4.A General

Runoff from drainage areas outside of established or proposed right-of-way greater than three (3) acres shall be collected and transported in an enclosed system. The drainage system shall remain enclosed until the flow rate from the design storm (100-year design storm) for a development can no longer be contained within a 72-inch RCP or equivalent conduit and an open channel can be entered without negative impact.

4.7.4.B Location

Enclosed systems shall not extend outside the limits of established or proposed right-of-way for roads. Where storm drainage facilities are located along side property lines, such systems shall be enclosed to a point at least 30 feet beyond the rear corner of adjacent buildings.

4.7.4.C Depth

Storm drainage line shall have a minimum cover based on manufacturer's recommendation or 18 inches, whichever is greater.

4.7.4.D Velocity Design Requirements

All storm drainage systems shall maintain a minimum velocity of three (3) feet per second during the design storm. When flowing full the maximum velocity shall be 15 feet per second.

At the point of discharge to an open channel, an energy dissipating structure shall be provided to limit the discharge velocity from the enclosed system to no more than five (5) feet per second or the channel velocity, whichever is greater. Outlet scour protection shall be provided, as needed, to maintain the enclosed system and channel stability.

4.7.4.E Pipe and Inlet Sizing

The system of pipes and inlets shall drain stormwater at locations where the street capacity is exceeded or where there is the possibility of ponding.

Storm sewers and inlets shall have sufficient capacity to carry the anticipated runoff from the design storm. Capacity shall be rated at either the inlet or outlet control, whichever indicates the least capacity. Pipe sizes shall be determined using the Manning's Formula and the minimum pipe size shall be 18 inches in diameter.

4.7.4.F Curb Inlet, Junction Boxes, and Other Points of Entry

- **Location and Access:** In general, curb inlets shall be installed at intersections and as required at intermediate points to limit gutter flow width occurring from the design peak discharge from the tributary watershed area. Inlets shall be sized and located to limit the spread of stormwater runoff onto traffic lanes to tolerable widths.

Vehicular access shall be provided to accommodate maintenance activities. Any required maintenance facility shall be constructed upstream of the inlet so it will not obstruct the entrance.

- **Obstructions:** When determined or observed by the County Engineer that flows are likely to carry floating debris, sediment, or other abrasive materials in sufficient size to block or obstruct the conduit, a trash fence, rack, or deflector is required.
- **Capacity:** To reflect potential cross section changes due to resurfacing, inlet capacity shall be rated at 80 percent of the theoretical inlet capacity. In addition, a clogging factor of 25 percent should be used for inlet grates on grade and 50 percent for inlet grates in sag. Design shall provide that hydraulic gradient at any opening through which surface water may enter (or backflow from) the system is six (6) inches or greater below the opening elevation. Hydraulic gradient elevation shall be calculated at the entrance to the outlet line of each structure.
- **Pipe Crowns:** The crown(s) of pipe(s) entering a structure shall be at or above the crown of the pipe exiting from the structure to provide a minimum fall of the invert in the structure of 0.1 feet for straight flow through the structure and for all other types of flows such as bends more than 22.5 degrees deflection angle, multiple lines entering, enlargement transitions, etc.

4.7.5 Culverts

4.7.5.A General

The culvert, including inlet and outlet structures, shall properly take care of water, bed-load, and debris at all stages of flow. Culverts shall be sized to adequately carry the design flow rate (100-year design storm).

Culverts under arterials shall have sufficient capacity to pass the runoff from the design storm considering a 20 percent bulking and debris factor to account for clogging at the culvert inlet opening.

4.7.5.B Culvert Sizing

Culvert pipe size shall be a minimum 18-inches in diameter when installed under a driveway and a minimum 24-inches in diameter when installed under a roadway. Driveway culverts shall have a minimum 24-foot length and a minimum of 1' cover, or more per the pipe manufacturer specifications.

4.7.5.C Culvert Inlet

Culvert inlets shall be designed to minimize entrance and friction losses. Inlets shall include either flared-end sections or headwalls with wingwalls. Projecting ends are not acceptable. For large structures, provisions shall be made to resist the possible structural failure due to hydrostatic uplift forces.

4.7.5.D Culvert Outlet

Culvert outlets shall be designed to avoid sedimentation, undermining of the culvert, and erosion of the downstream channel. Outlets shall include either flared-end sections or headwalls with wingwalls. Projecting outlets are not acceptable. Additional outlet control in the form of rip-rap, channel shaping, etc., may be required where excessively high discharge velocities occur.

4.7.5.E Culvert Slope

Culvert slopes should not cause silting, excessive velocities, or scour. The minimum slope of culverts shall be 0.005 foot/foot.

4.7.5.F Culvert Headwater and Tailwater Criteria

Table 4-11 provides the headwater to diameter ratios that should not be exceeded by the given storm event. The depth of the tailwater at the outlet shall be subject to the headwater criterion.

Table 4-11 Headwater to Diameter Ratio

Storm Event	Headwater to Diameter Ratio (HW/D)
10-year	Less than 1.0
25-year	Less than 1.2
50-year	Less than 1.5
100-year	Less than 1.5

4.7.5.G Culvert Hydraulic Design

Culverts shall be analyzed to determine whether discharge is controlled by inlet or outlet conditions for design storm discharge.

4.8 Drainage Easements

Permanent drainage structures require easements sufficient for access, construction, inspection, and maintenance. See Table 4-12 for requirements by drainage conveyance system type.

Within the **East Mountains**, the centerline of any new arroyo, watercourse or storm drainage facility drainage easement or right-of-way shall be located by field survey prior to platting or development.

All new drainage easements that are in a **FEMA Special Flood Hazard Area (SFHA) within AMAFCA's jurisdiction** will be dedicated to AMAFCA unless otherwise agreed upon by Bernalillo County and AMAFCA. For existing easements, AMAFCA will only maintain existing easements if they are within a FEMA SFHA, per AMAFCA's current Drainage Policy adopted by the AMAFCA Board of Directors.

AMAFCA and the County, on a lot-by-lot basis, will assist in the process of transferring/releasing easements that do not meet AMAFCA's current easement requirements.

Table 4-12 Required Easement Width by Drainage Conveyance System

	Drainage Conveyance System	Easement Width
Outside the East Mountain Area	Enclosed Storm Sewer	Width of the conduit plus 12 feet on either side of the conduit. For example, easement width for a 36-inch conduit is 27 feet (3-feet plus 12 feet times two is 27 feet). Minimum easement width is 25 feet. A wider easement may be required if the depth of cover exceeds 4 feet.
	Improved Open Channel	Width shall include the top bank lines plus 10 feet on each side of the bank. The easement shall be continuous to the end of the channel.
	Natural Open Channel	County Engineer shall determine easement width which will include the area between the high bank lines plus additional width on each side. The easement shall be continuous to the end of the channel. Minimum easement width is 30 feet.
	Runoff flows greater than 30 cfs	Width shall be calculated by design engineer. Additional erosion setback distance may be required.
East Mountain Area	Upstream drainage basin of 10 acres or more	The minimum width of drainage easement or right-of-way for natural arroyos or watercourses shall include the top of each definable bank of the arroyo or watercourse and be set back from the top of each bank a horizontal distance equal to 1.2 times the difference in elevation between the top of each definable bank and the adjacent flowline of the greater. The minimum width shall be 50 feet. (Bernalillo County Code Sec. 38-171 (5 c.1))
	Upstream drainage basin less than 10 acres	The minimum width of drainage easement or right-of-way for natural arroyos or watercourse shall include the top of each definable bank of horizontal distance equal to 1.2 times the difference in elevation between the top of each definable bank and the adjacent flowline of the arroyo or watercourse, or the 100-year floodplain, whichever is greater. The minimum width shall be 25 feet for natural channels, arroyos or watercourses. It shall be ten feet for lined channels where adequate maintenance and vehicular access is available (Bernalillo County Code Sec. 38-171 (5 c.1))
	Improved drainage facility	Minimum width necessary to contain a trapezoidal concrete lined channel, having a bottom width of ten feet and 2:1 (horizontal : vertical) side slopes, designed to convey the full 100-year design storm, including necessary freeboard and also the outer limits of a maintenance road 12 feet wide on one side of the channel. (Bernalillo County Code Sec. 38-171 (5 c.2))

4.9 Maintenance

Property owners shall enter into a “Covenant for Drainage and Water Quality Infrastructure” with Bernalillo County for the construction and maintenance of private drainage facilities. Fully executed covenants shall be recorded with the County Clerk. The “Covenant for Drainage and Water Quality Infrastructure” can be found on the BCPWD website. Owners of private drainage facilities and BMPs must provide regular maintenance and an inspection every 3 years, conducted by a New Mexico professional engineer or qualified stormwater person.

5. Transportation Network

5.1 Purpose

Transportation network design involves determining the layout of roads and other transportation connections according to their various functions. The design the network affects the ability of travelers to efficiently reach their destinations. The transportation network guidance contained in these Technical Standards are intended to provide the following:

- Improved operation of the arterial network by dispersing local traffic across multiple roads and access points
- Reduced travel time and mileage traveled by individuals, with the additional benefit of improved air quality
- More direct routes for pedestrians, bicyclists, and transit users
- Reduced response time for emergency services

5.2 Public Road Type

5.2.1 Road Design Considerations Based on Land Use Context

5.2.1.A Definition and Purpose

Road design is informed by the surrounding land use context, including the current land uses and policies and designations from the Comprehensive Plan. Specifically, the guidance and requirements contained in these Technical Standards may vary depending on the project location. Through these Technical Standards, Bernalillo County strives to provide the features necessary to accommodate all road uses, as appropriate for the land use context.

The Comprehensive Plan designates a series of Centers where road design should support a range of transportation options. **Comprehensive Plan Centers** typically have higher concentrations of commercial and retail services and often include higher density residential land uses.

The Comprehensive Plan **Development Areas** include: Central Urban, Established Urban, Semi-Urban, Developing Urban and Rural. Each of these areas are relatively large and may contain a range of land use contexts and designated Centers. These Technical Standards define road types by Development Area, and design standards for drainage and pedestrian facilities, among others, vary depending on the Development Area.

The **Rural Development Area** has the widest range of land use contexts and includes areas as diverse as the entire East Mountains to the Las Estancias commercial center in the South Valley. **Urban Development Areas** are interspersed throughout the unincorporated County. In general, these areas have higher residential densities and more access to commercial services and retail. Urban Development Areas provide pedestrians opportunities to walk to nearby destinations. Although there are four different types of Urban Development Areas, for the purposes of these Technical Standards, they are all considered “Urban” with a higher need to accommodate pedestrian travel.

5.2.1.B Design Considerations by Road Type

Stormwater Infrastructure and Curb and Gutter: Underground stormwater infrastructure plays a critical role for road design. These Technical Standards, including the standard drawings, refer to “urban” roads as including curb and gutter and “rural” roads as including drainage swales or bar ditches without curb and gutter. See Figure 5-1 for two examples.

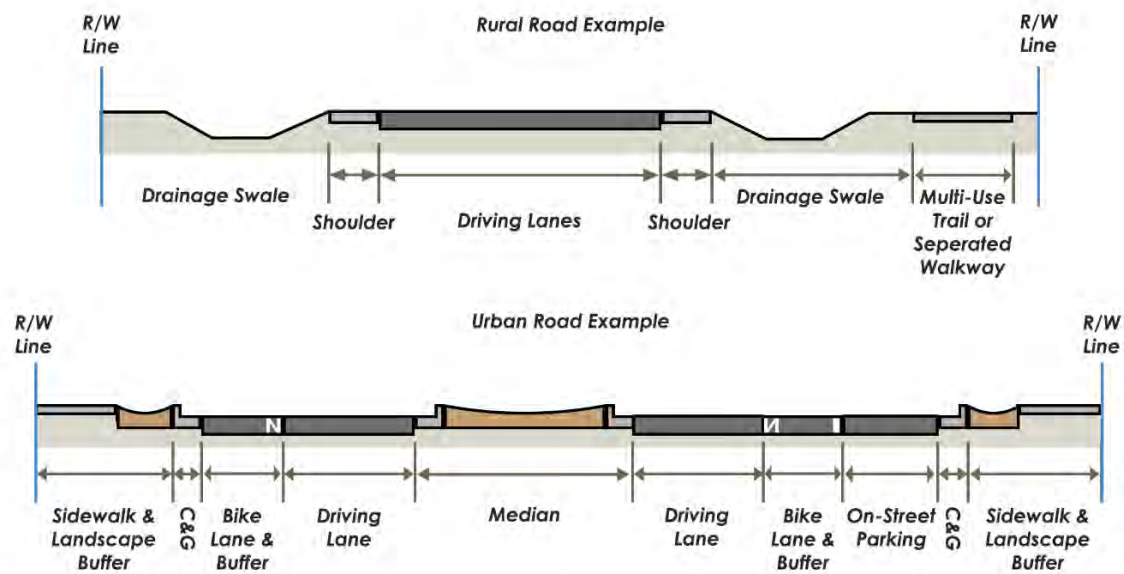
Curb and gutter are key to providing sidewalks for pedestrian travel, but requires underground stormwater infrastructure. Curb and gutter also provides the benefit of reducing road departure crashes. Although pedestrian travel is typically provided with sidewalks, a detached walkway or multi-use trail may also serve pedestrians.

Road Type versus Development Area: It is important to note that there may be an “urban” road with curb, gutter, and sidewalk in a Rural Development Area where there is commercial development, a school, or a collector road that supports longer distance trips. Conversely, some Urban Development Areas of Bernalillo County have legacy developments that did not include storm drainage when they were constructed and therefore are missing curb gutter and sidewalk. Bernalillo County is continually working towards prioritizing and addressing drainage and multi-modal needs in these areas. Table 5-1 provides the general applicability of urban and rural road types.

Table 5-1 General Applicability of Road Type

Road Type	Drainage Infrastructure	Pedestrian Accommodation	General Applicability
Urban	Curb and gutter with underground stormwater infrastructure	Sidewalks or multi-use trails. Pedestrian accommodation is required in both sides of the road.	Urban Development Areas, Activity Centers, areas that have high concentrations of commercial services, retail and or other pedestrian destinations such as schools, community centers and parks.
Rural	Roadside swales or bar ditches (generally above ground stormwater infrastructure)	Detached walkway, multi-use trail or shoulders. Detached walkways or multi-use trails may be provided on only one side of the road.	Rural Development Areas Urban Development Areas where no storm drain was provided at the time of development.

Figure 5-1 Rural and Urban Road Examples



5.2.2 Public Road Type Categories

Bernalillo County categorizes major public roads according to the **Long Range Roadway System (LRRS)**, a component of the Metropolitan Transportation Plan. This chapter provides right-of-way set-asides and typical design elements by road type.

The LRRS is the regional network consisting of all existing and proposed arterial and collector roads and should be considered the minimal future road network. Proposed facilities may be included in the LRRS regardless of whether funding is currently identified. The road types in the LRRS are based on federal functional classification and include additional designations for principal arterials (i.e. regional and community) based on the role of the facility.

The process for determining the appropriate road type for new and existing roads is an internal procedure completed by the County Engineer. Table 5-2 provides general descriptions of public road types. The design speed and average weekday traffic help to distinguish among the different road types; however, there are exceptions to these ranges.

Table 5-2 General Descriptions of Public Road Types

Public Road Type	Function and Access	Design Speed (mph) (See 0)	Average Weekday Traffic
Regional Principal Arterial	• Provide regional mobility between large subareas and serve predominantly "through trips" • Direct access to abutting land uses is discouraged	40 mph or higher	15,000 - 30,000
Community Principal Arterial	• Provide mobility across large subareas • Higher levels of access to the abutting land uses than regional principal arterials • Long and continuous routes	35-40	6,000 - 20,000
Minor Arterial	• Connect to and complement principal arterials • Typically shorter in length with higher levels of access than principal arterials	30-35	5,000 - 15,000
Major Collector	• Provide service and access to smaller subareas not accessed by higher class facilities • Usually longer than local roads	30	1,000-6,000
Minor Collector	• Distribute traffic within a subdivision or commercial node • Interface between the local network and arterial network	25-30	500 - 2,000
Commercial / Industrial Local	• Primarily provide access to adjacent land • Mostly serve commercial and industrial areas • Road design accounts for higher volumes of heavy vehicles	15-25	500-1,500
Residential Local	• Primarily provide access to adjacent land • Mostly serve residential areas	15-25	80 - 1,000

5.2.3 Typical Design Elements by Road Type

The design and elements of a road vary by road type, with higher functional class facilities requiring greater right-of-way to accommodate desired street elements. See Table 5-3 for additional information on road types.

Table 5-3 Typical Design Elements by Road Type

	Road Type						
Design Element	Regional Principal Arterial	Community Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Commercial/ Industrial Local	Residential Local
Directional Travel Lanes	4-6	2-4	2-4	2	2	2	2
Lane Width (6.8)	11-12 ft.	10-12 ft.	10-12 ft.	10-12 ft.	10-11 ft.	See 3.5	
Median or TWLTL (6.6)	Median	Median or TWLTL	TWLTL	TWLTL	Not in included in standard design, but a median may be included as special design		
Bicycle Lane Buffer/Bicycle Lane (6.4)	Buffer + Lane	Buffer + Lane	Buffer + Lane	Lane	Lane	Lane	Shared Lane
Shoulder (Rural Roads)	8 ft.	8 ft.	8 ft.	5-6 ft.	5-6 ft.	See 3.5	
On-Street Parking (6.10)	No	Within Centers	Within Centers	Within Centers	Within Centers	Yes	Yes
Landscape/Buffer Zone (6.1)	6-9 ft.	5-6 ft.	5-6 ft.	4-5 ft.	4-5 ft.	4-5 ft.	3-4 ft.
Drainage Swales	As Needed						
Sidewalk or Separated Walkway (6.2)	Min. 6 ft.	Min. 6 ft.	Min. 6 ft.	Min 5 ft.	Min 5 ft.	Min 5 ft.	Min 5 ft.
Multi-Use Trail (6.5)	See Long Range Bikeway System and Bernalillo County Pedestrian and Bicyclist Safety Action Plan to determine if a multi-use trail is planned along the road.					Not in included in standard design, but a multi-use trail may be included as a special design.	

5.3 Right-of-Way

5.3.1 Purpose

Right-of-way is typically dedicated by the property owner for transportation purposes and identified in the subdivision process. See 2.1 for additional information on the Bernalillo County subdivision process.

This section identifies the amount of land that must be set-aside for different road types. In developed and partially developed areas, Bernalillo County requires right-of-way to the extent that it is practical. For new developments, it is critical that sufficient right-of-way be set aside early in the land development process in order to provide for an adequate transportation network in the future. The following list provides the most common reasons why right-of-way is required.

- **Access to the public road network:** All land development requires legal access to the public road network through an access easement, private road, or public right-of-way.
- **Internal connectivity:** In addition to connecting to the public road network, subdivisions may require an internal network that will become public roads.
- **Road expansion:** The Bernalillo County Public Works Department (BCPWD) may require additional right-of-way for future planned improvements.
- **Regional network connections:** Right-of-way may be set-aside to support road connections, as indicated in the LRRS, and for connections between future developments.

5.3.2 Right-of-Way Requirement for Development along Existing or Proposed Roads

All development in Bernalillo County requiring a permit or approval may be required to provide right-of-way on existing and proposed roads adjacent to the development if the County Engineer determines that additional right-of-way can address **safety concerns** or provide a **critical access connection**.

- **Safety concerns** may involve, but are not limited to: documented crashes, insufficient sight distance, improved access safety, etc.
- **Critical access connections** may include but are not limited to: additional right-of-way to accommodate a sidewalk, multi-use trail, bicycle lane, transit stop or other multi-modal facility identified in an approved study or adopted plan.

5.3.3 Right-of-Way Held in Reserve

In some cases, right-of-way is required but the corresponding road improvement will not be constructed until a later date. In these cases, the plat will show the required right-of-way as “right-of-way held in reserve.”

New construction in the areas where right-of-way is held in reserve shall not include buildings, permanent physical structures, or site drainage facilities. Areas that are right-of-way held in reserve should not include zoning setbacks, landscape, or any required parking spaces.

5.3.4 Standard Right-of-Way Width

Standard right-of-way widths for public road types are shown in Table 5-4. These right-of-way widths ensure sufficient space is available for required road elements. See 5.2 for typical elements by road type and Chapter 6 for additional information on width and design of those road elements.

Table 5-4 Standard Right-of-Way Width by Road Type

Road Type	Standard Right-of-Way Width
Regional Principal Arterial	156 ft.
Community Principal Arterial	120 ft.
Minor Arterial	110 ft.
Major Collector	74 ft.
Minor Collector	60 ft.
Commercial/Industrial Local	60 ft.
Residential Local	50 ft.

5.3.5 Right-of-Way Width Determination

Any deviation from the standard right-of-way values provided in Table 5-4 requires appropriate documentation and is subject to review by the County Engineer. Wider right-of-way widths than the standard may be required at the discretion of the County Engineer. Requests for narrower right-of-way widths may be accepted by the County Engineer.

The following considerations may be used to determine right-of-way that deviates from the standard:

- Regional and local transportation planning considerations, including any special designations included in the Metropolitan Transportation Plan or Comprehensive Plan networks.
- Provision of adequate transit facilities, including but not limited to dedicated transit lanes, bus pullouts, or other identified transit infrastructure.
- Maintenance of sidewalks, walkways, trails, bikeways, and landscaping outside of the public right-of-way by a homeowner's association and guaranteed by covenants recorded with the plat.
- Plan adopted by the Bernalillo County Commission with road design and right-of-way specifications that call for a different right-of-way width than the standard.
- Nature of the right-of-way and road involved and its impact on neighboring properties, including width, slopes, cuts, fills, vertical and horizontal curvature, sight distance at intersections, and the nature of the development and the land upon which it is situated.
- Design report, road design, or right-of-way plan approved by BCPWD that calls for a different right-of-way width than the standard.
- BCPWD requirements including but not limited to land alteration, site access, traffic impact, road geometrics, road elements and roadside features such as drainage and utilities.

5.4 Network Layout and Connectivity

5.4.1 Purpose

This section provides guidance on the spacing of arterial and collector roads, the general layout of local roads, block lengths, pedestrian crossings, and connectivity from local and collector roads to the arterial network.

5.4.2 Arterial and Collector Network

5.4.2.A General

The **spacing of major roads** (i.e. arterials and collectors) is important for traffic circulation and connectivity. The distance between major roads varies by location and land use context. Major roads are interspersed with local roads to provide local land access and support pedestrian and bicycle travel. See 5.4.3.C for discussion on block length and local roads.

The **Long Range Roadway System** provides the location of future arterial and collector roads. In some cases, new development may require additional major roads beyond those provided in the Long Range Roadway System.

5.4.2.B Arterial and Collector Road Spacing

In **areas outside of the East Mountains**, arterials should be no more than one-mile apart and should be interspersed with a collector road(s) in order to create a redundant network with multiple route options. Arterials may be spaced as close as one-quarter mile apart in areas with high levels of pedestrian activity, including designated Centers. Arterials and collectors should be interspersed to create a system of thoroughfares and parallel facilities that collectively meet the needs of a range of users.

In the **East Mountains area**, larger spacing between major roads is appropriate. Redundant network connections should be provided where feasible.

Table 5-5 provides the spacing between two parallel major roads (i.e. arterials and collectors) recommended for new development. This table does not differentiate between principal and minor arterials and major or minor collectors since the most important consideration from a connectivity perspective are the frequency of major roads.

Table 5-5 Arterial and Collector Spacing by Location

Arterial / Collector Location	Recommended Arterial / Collector Spacing
Activity Center / Employment Center / Village Center	1,320 – 2,640 ft. (¼ to ½-mile)
Areas Outside of Centers and Outside of East Mountains	≤ 2,640 ft. (½-mile)
Areas Within East Mountains	As appropriate

5.4.3 Traffic Control and Intersection Spacing

5.4.3.A General

Traffic control devices manage the flow of vehicles, supports land access, and allow for designated pedestrian crossings. Traffic control is required for all intersecting roads and may be provided in the form of traffic signals, roundabouts, stop control, or pedestrian beacons. To support future development, and at the discretion of the County Engineer, right-of-way may be reserved or underground conduit and pull boxes may be required for future intersection control.

Traffic signal spacing recommendations are based on the arterial and collector spacing provided in Table 5-5. Traffic signals should be evenly spaced to ensure efficient flow of vehicles. Signal spacing of less than 1,320 feet (¼-mile) is discouraged.

5.4.3.B Intersection Control Type

Determination of intersection control type is based upon the evaluation of traffic conditions at an intersection in accordance with the warrants contained in the MUTCD. The determination of where and when traffic signals and roundabouts are to be installed shall be made by the County Engineer and is based on criteria that include, but are not limited to safety, efficiency, construction and operating costs, and available right-of-way. Except for intersections along regional principal arterials, roundabouts shall be considered for every location that meets or is anticipated to meet MUTCD criteria for a traffic signal.

5.4.3.C General Intersection Spacing and Block Design

Intersection spacing requirements are provided based on the posted speed to ensure adequate traffic operation and to support pedestrian travel. See Table 5-6 and Figure 5-2 for guidance in the calculation of intersection spacing distances. In general, shorter intersection spacing is desired to reduce the distances that pedestrians must walk to reach destinations and crossing opportunities. Recommended intersection spacing in designated centers is 400 feet or less.

In cases where the required intersection spacing is not attainable due to physical constraints or existing surrounding development, intersections should be spaced according to the requirements provided in Table 5-5 to the maximum extent possible. Where the required minimum spacing cannot be achieved, the County Engineer may require that access be limited.

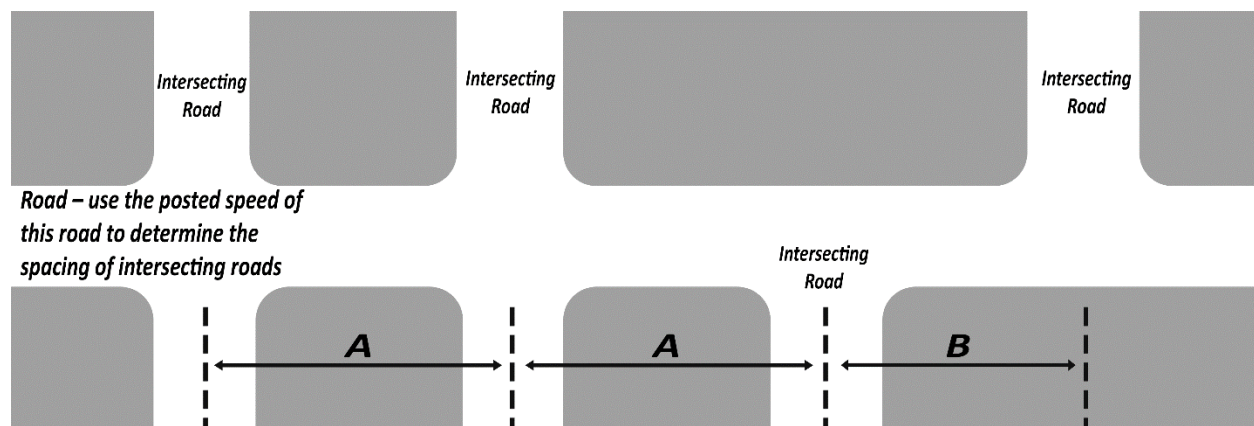
Blocks shall follow a generally square or rectangular grid system, where feasible. Alignments may vary depending on topography, to protect natural features, to respond to site constraints, or to meet the needs of a particular set of land uses.

Consecutive opposing T-intersections are discouraged. Where physical constraints or existing surrounding development prevent 4-leg intersections and left turns overlap, the minimum spacing for *Distance B* shown in Figure 5-2 and Table 5-6 shall apply. See Figure 3-3 for overlapping versus offset left turns.

Table 5-6: Minimum and Maximum Intersection Spacing

Posted Speed	Distance A – Minimum Intersection Spacing	Distance B – Minimum Offset for T-Intersection	Distance A and B – Maximum Intersection Spacing
40-50 mph	500 ft.	300 ft.	800 ft.
30-35 mph	300 ft.	150 ft.	660 ft.
25 mph	150 ft.	100 ft.	660 ft.
Less than 25 mph	125 ft.	75 ft.	660 ft.

Figure 5-2: Intersection Spacing



Notes:

A – Distance between consecutive, full access intersections, measured from centerline to centerline.

B – Offset distance or distance between two full access, consecutive, opposing T-intersections, measured from centerline to centerline.

5.4.4 Connectivity Requirements for Developments

5.4.4.A Purpose

Coordination between adjacent developments is key to providing an efficient transportation network. Roads and right-of-way within proposed developments shall be provided in a manner such that roads within future adjacent developments can connect between them. As areas fully build out, the ultimate goal is to provide a connected network as opposed to a series of adjacent subdivisions that only connect at the arterial and collector system.

5.4.4.B General Requirements

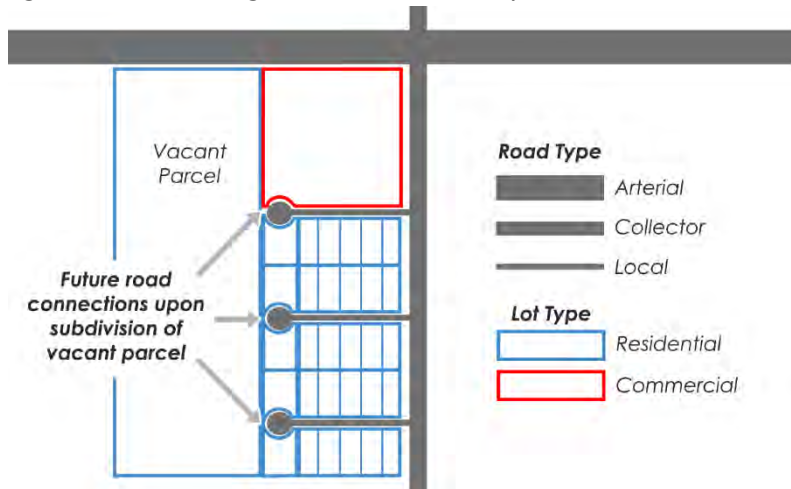
The following principles shall be adhered to when determining network connectivity during the subdivision process:

- The **subdivision internal road network** shall be provided in a manner that, where possible, will allow subsequent developments to meet these standards. The subdivision internal road network

shall be designed to promote the convenient circulation of traffic without reliance on the arterial road system.

- **Access to regional road network:** A public road or a private road serving 300 or more average daily trips shall connect in at least two locations with another public road or private road meeting the applicable standard(s) from the resulting traffic volume.
- **Required connections:** As adjacent parcels subdivide, the following requirements ensure network connectivity (see Figure 5-3 for an example):
 - New public roads within a development shall be constructed to a shared boundary of an adjacent parcel. The road end will be required to meet Bernalillo County Code *Ch. 34 Fire Prevention and Protection*, Appendix D International Fire Code requirements.
 - When public roads are constructed to a shared boundary, the land within the right-of-way shall be graded to within one foot of the finished grade required to construct a future public road connection to the adjacent parcel.
 - When a public road on an adjacent parcel has been constructed to a shared boundary, new subdivisions shall connect to the established public road end.
 - Network connectivity is required unless the County Engineer determines that topography, surrounding development, surrounding road network, soils, hydrology, or other factors make the connection impractical or infeasible.
 - The County Engineer may determine that a multi-use trail connection between developments is appropriate in place of a road.
- **Private roads:** Connectivity requirements for private road network elements will be evaluated and implemented as part of the development review process. BCPWD may require connectivity to adjacent landlocked parcels via a private road.

Figure 5-3: Preserving Network Connectivity in the Subdivision Process



5.4.4.C Cul-de-Sacs

Cul-de-sacs, dead end roads, and permanent stub streets are prohibited unless a connection is infeasible due to topography, surrounding development patterns, intersection spacing requirements, or the need to avoid protected lands. Where permitted, any cul-de-sac, dead end road, or permanent stub street shall meet Bernalillo County Code *Ch. 34 Fire Protection and Prevention*, Appendix D International Fire Code requirements.

The County Engineer may require a multi-use trail connection between the cul-de-sac turnaround to the nearest adjacent sidewalk, multi-use trail, park, open space, or public amenity.

5.4.5 Pedestrian Connectivity

5.4.5.A Pedestrian Crossings

Designated pedestrian crossing refers to the location where pedestrians are encouraged to cross a road as indicated by a signal device, signage, and/or pavement markings.

Within designated Centers, pedestrian crossings should be provided at regular intervals not exceeding 660 feet. Designated pedestrian crossings should also be provided in the following situations based on pedestrian crossing demand or expected pedestrian crossing need:

- Within 100 feet of a transit station area
- Within 400 feet of a transit stop; closer spacing is encouraged
- At special generators including schools, hospitals, recreational sites, event centers, or major shopping/retail sites
- Areas with identified safety concerns, as demonstrated through a Road Safety Audit, crash rates, or the results of other studies or data collection efforts
- Locations that meet MUTCD pedestrian crossing warrants
- At the discretion of the County Engineer

5.4.5.B Non-Motorized Connection Requirement

New **single family detached residential development** of 6 lots or more that abuts open space, a public park, multi-use trail, road with sidewalks, or a road with transit service shall provide non-motorized connections to these facilities. The non-motorized connections shall be spaced such that there is one connection on average for every 660 feet

New single family detached residential of 6 lots or more that abut a public school shall be required to extend the developments' pedestrian facilities 660 feet beyond the development or to the school property's officially designated entrance, whichever is closer, with ADA compliant pedestrian amenities unless the County Engineer determines such a connection is infeasible.

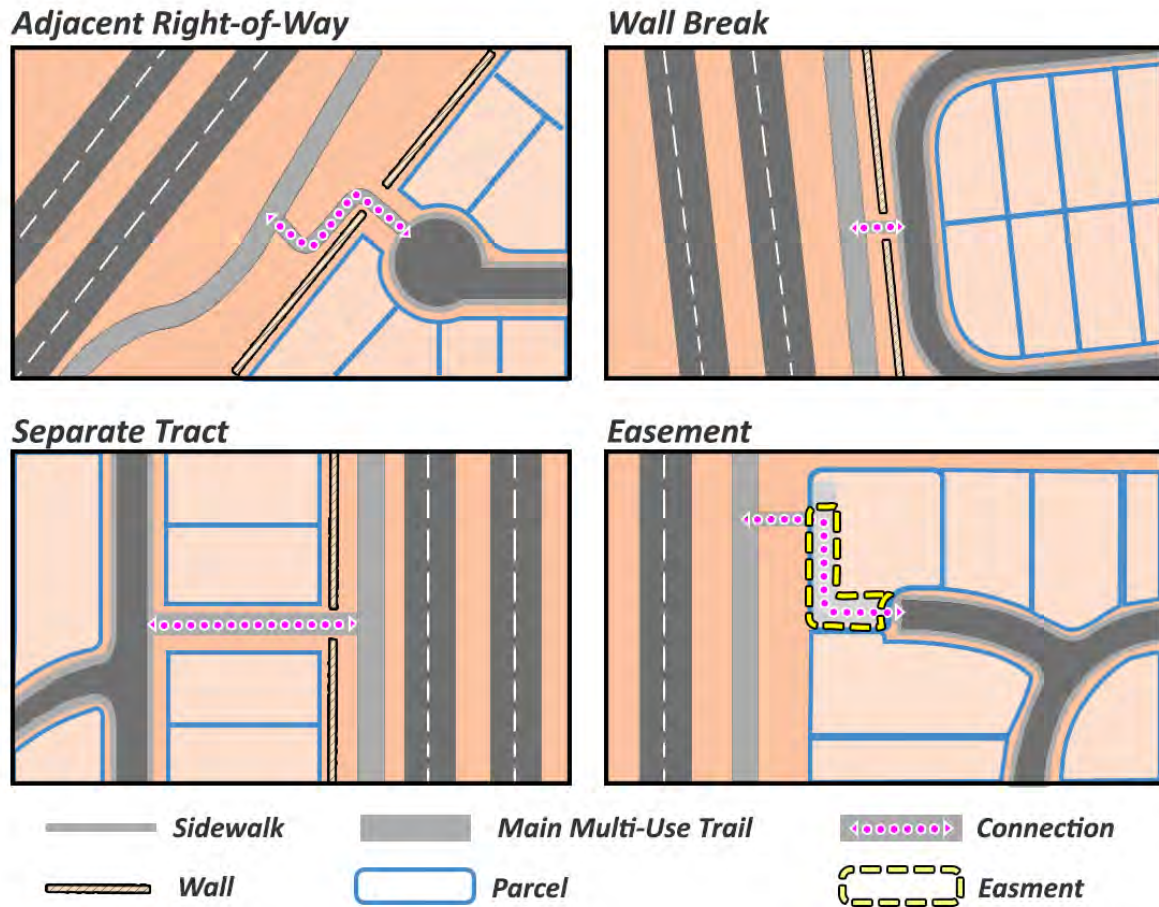
New **multi-family residential development** with 6 dwelling units or more that abuts open space, public park, multi-use trail, a road with sidewalks, or a road with transit service shall provide a non-motorized connection to these facilities or destinations.

5.4.5.C Non-Motorized Connection Options

The non-motorized connections listed above may be provided by road right-of-way, a wall break between two adjacent road rights-of-way, a public easement, or a separate tract. See Figure 5-4 for examples.

All non-motorized connections shall be comprised of a multi-use trail that is ADA compliant and a minimum of 10 feet wide. In addition, a clear line of sight shall be provided between either end of the connection to the greatest extent feasible. Public easements or separate tracts that contain the non-motorized connection shall be a minimum of 20 feet wide.

Figure 5-4: Examples of Non-Motorized Connections



5.5 Geometric Design

5.5.1 General

Geometric design criteria are major controlling factors in the design of roads. Many of the tables in this section are taken from the 7th edition (2018) of the AASHTO publication, *A Policy of Geometric Design of Highways and Streets*. These tables are intended to provide standards for the most common environments found in Bernalillo County. AASHTO's *A Policy of Geometric Design of Highways and Streets* provides further guidance on less common circumstances along with detailed methodologies. Subsequent updates to the AASHTO documents should be referenced as they become available. When unusual circumstances occur and additional guidance is needed, the designer should refer to the current version of publications from the following sources:

- American Association of State Highway and Transportation Officials (AASHTO)
- Institute of Transportation Engineers (ITE)
- National Association of City Transportation Officials (NACTO)

5.5.2 Design Speed

In these standards, the design speed determines four key geometric criteria:

- Stopping distance
- Intersection design
- Horizontal alignment
- Vertical alignment

A key characteristic of a road is the speed at which motorists travel along it. Selecting the design speed should take into consideration the anticipated operating speed, topography, adjacent land uses, modal mix, and the road type. Every effort should be made to attain a desired combination of safety, mobility, and efficiency within the constraints of the project.

5.5.2.A Design Speed for New Roads

Table 5-7 and Table 5-8 provide the design speed for new roads outside of or within the East Mountain area respectively. Design speed in these tables varies based on road type and location related to a center. Higher design speeds may be considered for access controlled roads.

Table 5-7 Design Speed (mph) for New Roads Outside the East Mountain Area

Road Type	Outside a Center	Within a Center
Regional Principal Arterial	45 mph	30 mph
Community Principal Arterial	40 mph	
Minor Arterial	35 mph	
Major Collector	30 mph	
Minor Collector		
Commercial/Industrial Local		
Residential Local	25 mph	25 mph

Table 5-8: Design Speed for New Roads within the East Mountain Area

Design Speed (mph) for New Roads Within the East Mountain Area	Outside of Village Centers			Within Village Center
	Level	Rolling	Mountainous	
Arterial	50-75 mph	50-65 mph	45-60 mph	30-45 mph
Collector (0 – 400 vehicles/day)	40 mph	30 mph	20 mph	30 mph
Collector (400-2,000 vehicles/day)	50 mph	40 mph	30 mph	
Local (under 50 vehicles/day)	30 mph	20 mph	20 mph	20 mph
Local (50-250 vehicles/day)	30 mph	30 mph	20 mph	
Local (250-400 vehicles/day)	40 mph	30 mph	20 mph	

Source: AASHTO Policy on Geometric Design of Highways and Streets (7th Ed.) Tables 5-1, 6-1, and Section 7.2.2

5.5.2.B Design Speed for Existing Roads

For existing roads, the determination of the design speed should take into consideration the operating speed along with design speed for new roads provided in Table 5-7 and Table 5-8. The operating speed is the 85th percentile observed speed of motorists using the road. As existing roads are reconstructed, the design should adapt to bring the operating speed, posted speed, and design speed all within a close range of each other. Existing non-arterial roads should have these speeds within a range of 5 mph and arterial roads should have these speeds within a range of 10 mph. Higher design speeds may be considered for access controlled roads.

5.5.3 Design Vehicle Determination

The appropriate design vehicle should be determined by vehicle classification counts and/or projections based on future land uses. Vehicle classification counts provide additional information about length and number of axels of vehicles using the road which aid in determining the design vehicle.

The baseline design vehicle for developed areas is a passenger vehicle. A passenger vehicle should be selected as the standard design vehicle in activity centers and on local roads within residential areas. For undeveloped areas the design vehicle may be determined by the surrounding land use or zoning.

Table 5-9 provides guidance on when to select a heavy vehicle as the design vehicle. For areas with existing development, a vehicle class count may be required as part of the traffic impact analysis. Table 5-9 should also be referenced during County-led reconstruction projects as part of the design analysis report and for new developments where the vehicle mix is known.

Table 5-9: Criteria for Selecting Heavy Vehicles as the Design Vehicle

Design Vehicle	Standard Vehicle Classification Count (24 hours)	East Mountain Area Standard Vehicle Classification Count (24 hours)	Surrounding Land Use / Zoning (Developing Areas)
Select a Single Unit Heavy Vehicle as the design vehicle if any of the associated selection criteria are met	At least 3.0% of the vehicle classification count are single unit heavy vehicles <i>OR</i> At least 200 single-unit heavy vehicles are observed during the 24-hour count period	At least 50 single-unit heavy vehicles are observed during the 24-hour count period	Industrial or Manufacturing
Select a Multi-Unit Heavy Vehicle as the design vehicle if any of the associated selection criteria are met	At least 1.5% of the vehicle classification count are multi-unit heavy vehicles <i>OR</i> At least 100 multi-unit heavy vehicles are observed during the 24-hour count period	At least 25 multi-unit heavy vehicles are observed during the 24-hour count period	Industrial or Manufacturing

5.5.4 Sight Distance

5.5.4.A General

Each new road, intersection, and driveway/site access point shall meet the stopping sight distance (SSD) and intersection sight distance (ISD) requirements set forth the Technical Standards.

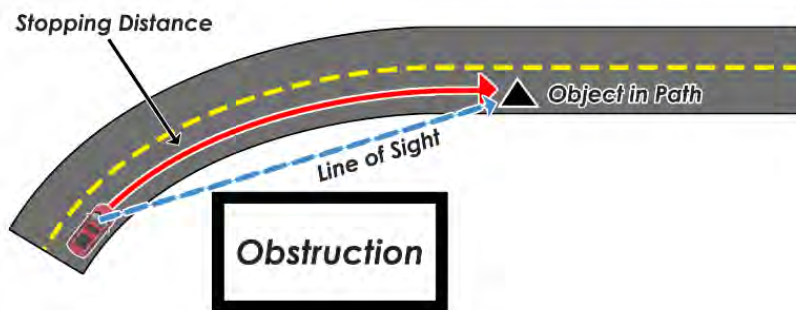
SSD and ISD must be maintained in accordance with the current version of AASHTO's *Policy Geometric Design of Highways and Streets*. Sight distance criteria established in this section is based on these AASHTO guidelines, 7th Edition (2018).

5.5.4.B Stopping Sight Distance

When traveling at or near the design speed, a driver must be able to see a sufficient length of road ahead in order to detect, react, and brake to bring a vehicle to a full stop before reaching a stationary object in the vehicle's path. SSD is the distance needed to both see and stop in time.

SSD is measured along the centerline of the vehicle's travel lane as shown in Figure 5-5. On horizontal curves, the driver's line of sight will not fall within the limits of the road. Figure 5-5 provides an example where the line of sight and the SSD are not on the same trajectory along a horizontal curve. In measuring SSD, the height of the driver's eyes is assumed to be 3.5 feet above the pavement, and the height of the object to be seen by the driver is 2.0 feet above the pavement.

Figure 5-5: Stopping Sight Distance



Minimum SSD, as shown in Table 5-10, shall be provided in both the horizontal and vertical planes for all new and reconstructed roads as related to the assumed driver's eye height and position. Grades other than those shown in the table may require interpolation.

Where there are sight obstructions (such as walls, cut slopes, buildings, or other hazards) on the inside of curves, changes in road alignment may be required to obtain sight distance if the sight obstruction cannot be removed.

Table 5-10 Minimum Stopping Sight Distances (ft.)

Design Speed (mph)	Upgrade			Flat	Downgrade		
	9%	6%	3%	0%	9%	6%	3%
15	73	74	75	80	80	82	85
20	104	107	109	115	116	120	126
25	140	143	147	155	158	165	173
30	179	184	200	200	205	215	227
35	222	229	237	250	257	271	287
40	269	278	289	305	315	333	354
45	320	331	344	360	378	400	427
50	375	388	405	425	446	474	507

Table based on AASHTO Policy on Geometric Design of Highways and Streets (7th Ed.) Tables 3-1 and 3-2

5.5.5 Horizontal Alignment

5.5.5.A General

Horizontal curves provide a transition between two tangent lengths of a road and are necessary for a gradual change in direction when a direct point of intersection is not feasible or warranted. The design speed of road curves should be based on an appropriate relationship between design speed and curvature and on their joint relationships with superelevation and side friction [AASHTO, 2018].

Figure 5-6 and Figure 5-7 provide the main parameters of horizontal curves and general horizontal curve types. See the AASHTO guide *A Policy of Geometric Design of Highways and Streets* for additional guidance.

Figure 5-6: Horizontal Curve Parameters

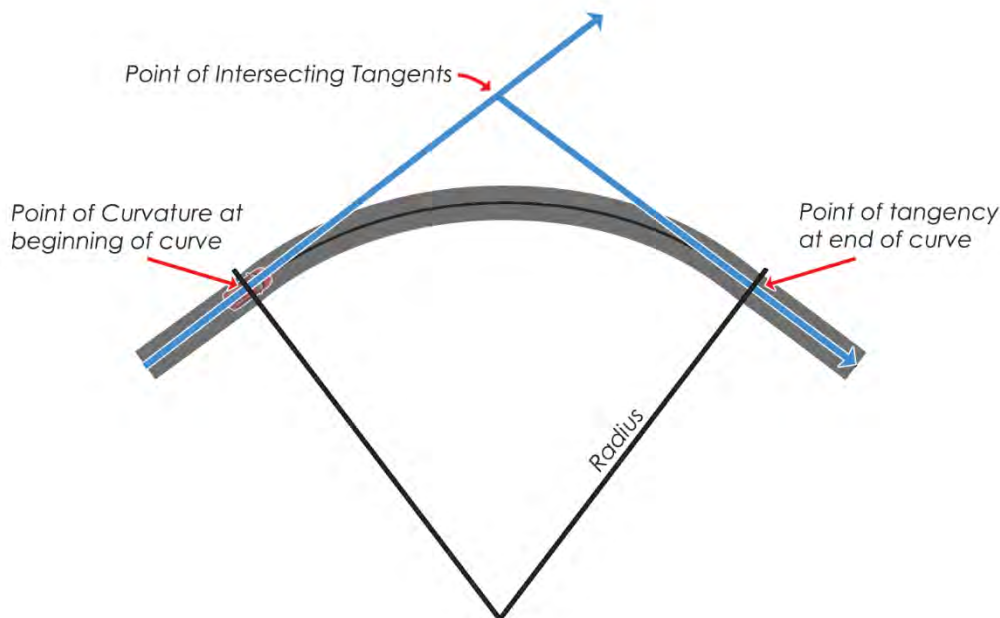
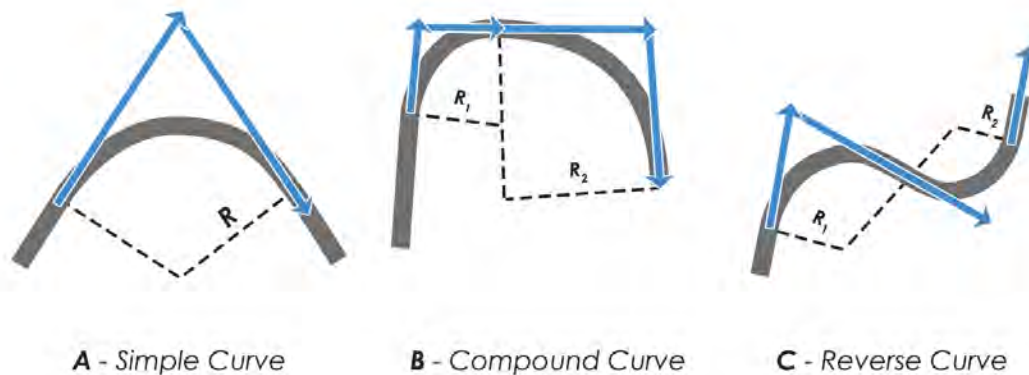


Figure 5-7: General Horizontal Curve Types



5.5.5.B Superelevation

Superelevation is the tilting of the road to help offset centripetal forces created as the vehicle goes around a curve. Superelevation, along with friction, are what keeps the vehicle from going off the road. Although superelevation is beneficial for traffic operations, various factors often combine to make its use impractical on lower-speed roads (i.e. 45 mph or less).

Factors that *limit* superelevation in urban areas include:

- Wide pavement areas
- The need to meet the grade of adjacent property
- Surface drainage considerations
- The desire to maintain low-speed vehicle operations
- Frequency of intersecting cross streets and driveways

The factors that often make superelevation impractical on low-speed roads in urban areas also make marginal superelevation improvements impractical when reconstructing low-speed roads. Low-speed roads in urban areas may retain their existing cross slope unless the curve has an unacceptable history of curve-related crashes. In such cases, consideration should be given to providing superelevation and, if practical, providing high-friction surfacing [AASHTO, 2018].

Section 5.5.5.C provides minimum radius standards for low speed, urban roads. For roads with superelevation, cross slopes greater than 2% or with design speeds greater than 45 mph, refer to Chapter 3 of the AASHTO guide *A Policy of Geometric Design of Highways and Streets*.

5.5.5.C Minimum Centerline Radius on Urban, Low Speed Roads with Two-Percent Crown

A normal crown with 2% cross slope is generally preferred in urban roads to promote the control of drainage and nuisance stormwater flows. This preference leads to the use of longer radius horizontal curves in most circumstances. Table 5-11 provides the minimum centerline radius for a road with a normal crown or 2% cross slope.

Additional pavement may be required on horizontal curves to provide for vehicle maneuvers where no superelevation is used and the minimum radius criteria in Table 5-11 is not met. Widening shall comply with Chapter 3 of AASHTO's *A Policy of Geometric Design of Highways and Streets*.

Table 5-11 Minimum Centerline Radius on Urban, Low Speed Roads with 2% Crown

Design Speed	Minimum Radius
15 mph	50 ft.
20 mph	107 ft.
25 mph	198 ft.
30 mph	333 ft.
35 mph	510 ft.
40 mph	762 ft.
45 mph	1,039 ft.

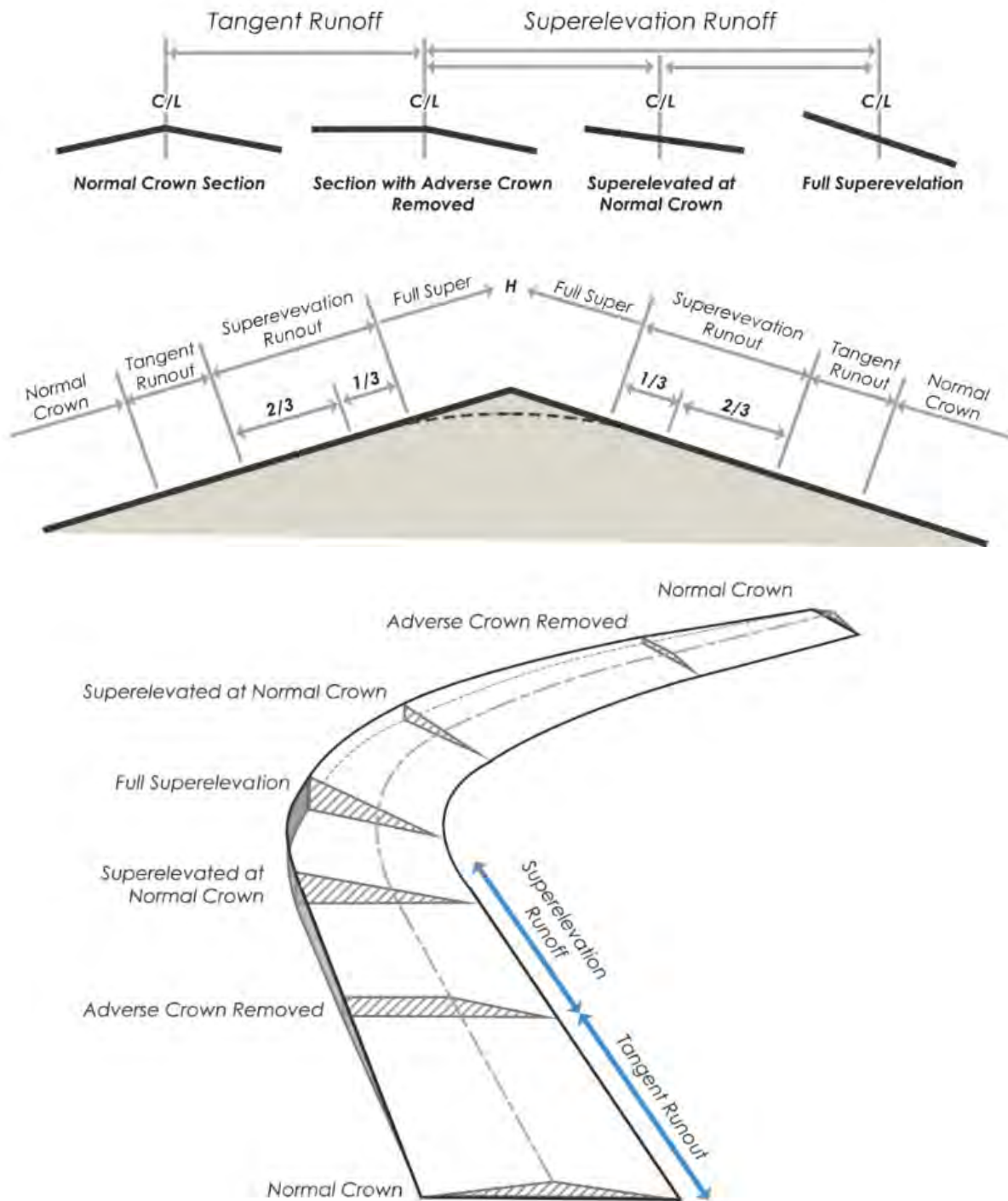
Source: City of Albuquerque Development Process Manual. Values come from AASHTO A Policy Geometric Design of Highways and Streets 7th Ed., Table 3-13

5.5.5.D Superelevation Transition

The use of superelevation requires the careful design of transitions leading to/from normal crown sections to/from superelevated sections. Superelevation transition plans shall comply with Chapter 3 of AASHTO's *A Policy of Geometric Design of Highways and Streets*. Designs involving such transitions should show sufficient detail to demonstrate that drainage is being accommodated (i.e. no low points) and to provide sufficient information for adequate construction staking to ensure the desired result.

Vertical profile lines for all curb lines as well as detailed superelevation runout and runoff plans shall be provided for superelevation design. See Figure 5-8 for a visual representation of a superelevation runout/runoff plan.

Figure 5-8: Profile and Angled View of a Superelevation Runout/Runoff Plan



5.5.6 Vertical Alignment

5.5.6.A Minimum Grade for Drainage

Long, flat grades are undesirable because of poor drainage characteristics. The minimum grade consistent with desirable drainage is 0.5%.

5.5.6.B Maximum Grade

The maximum grade on any new or reconstructed road shall not exceed the limits in Table 5-12

Table 5-12: Maximum Road Grade

Design Speed (mph)	Maximum Road Grade
50 mph	6%
40-45 mph	7%
25-35 mph	8%
15-20 mph	12%

Source: City of Albuquerque Development Process Manual

5.5.6.C Maximum Grade Change without a Vertical Curve Design

Grade transitions greater than the values shown in Table 5-13 shall be designed and constructed as vertical curves. When grade changes without vertical curves are used, as allowed in Table 5-13, a minimum of 50 feet must be maintained between the vertical point of intersections.

Table 5-13: Maximum Grade Change Allowed Without Vertical Curve Design

Design Speed	Maximum Grade Change Allowed Without Vertical Curve Design
40-50 mph	0.4%
35 mph	0.7%
30 mph and below	1.0%

Source: City of Albuquerque Development Process Manual

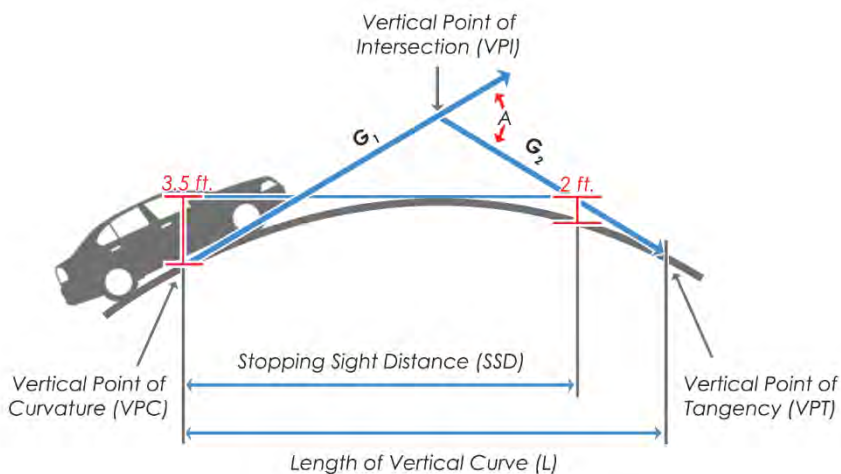
5.5.6.D Simultaneous Horizontal and Vertical Changes

Vertical changes occurring simultaneously with changes in horizontal alignment shall be required to meet the sight distance consistent with the design speed of the road. Horizontal curvature should not be introduced at or near the top of a crest or the bottom of a sag vertical curve.

5.5.6.E Crest Vertical Curves and Stopping Sight Distance

The major design control for crest vertical curves is the provision of sight distance, which is based on the design speed. Figure 5-9 provides the parameters for determining the length of a crest vertical curve needed to provide the stopping sight distance (SSD). Table 5-14 provides the design controls for crest vertical curves based on SSD and design speed. All crest vertical curves shall meet the overall minimum length and minimum value of K , length in feet per percent change in grade.

Figure 5-9: Crest Vertical Curve Parameters



G_1 and G_2 = Tangent Grades in Percent

A = Algebraic Difference in Grade

L = Length of Vertical Curve (ft.)

SSD = Stopping Sight Distance

$$K = \frac{L}{A} \text{ (length of vertical curve per percent change in } A \text{)}$$

Table 5-14: Design Controls for Crest Vertical Curves

Design Speed	Stopping Sight Distance (SSD)	Minimum K $K = L/A$ (ft/percent change in grade)	Minimum Length of Crest Vertical Curve
15 mph	80 ft.	3	45 ft.
20 mph	115 ft.	7	60 ft.
25 mph	155 ft.	12	75 ft.
30 mph	200 ft.	19	90 ft.
35 mph	250 ft.	29	105 ft.
40 mph	305 ft.	44	120 ft.
45 mph	360 ft.	61	135 ft.
50 mph	425 ft.	84	150 ft.

Source: Table based on AASHTO A Policy on Geometric Design of Highways and Streets (7th Ed.) Table 3-35 and Section 3.4.6.2

5.5.6.F Sag Vertical Curves

The major design controls for sag vertical curves are headlight sight distance comfort and drainage control. Figure 5-10 provides the parameters for determining the length of a sag vertical curve needed to provide the SSD. Table 5-15 provides the design controls for sag vertical curves.

All crest vertical curves shall meet the overall minimum length and the minimum value of K for the SSD. For roads with curb and gutter, in order to accommodate the minimum grade needed for drainage, the maximum value of K is 167 feet per percent change in grade.

Figure 5-10: Sag Vertical Curve Parameters

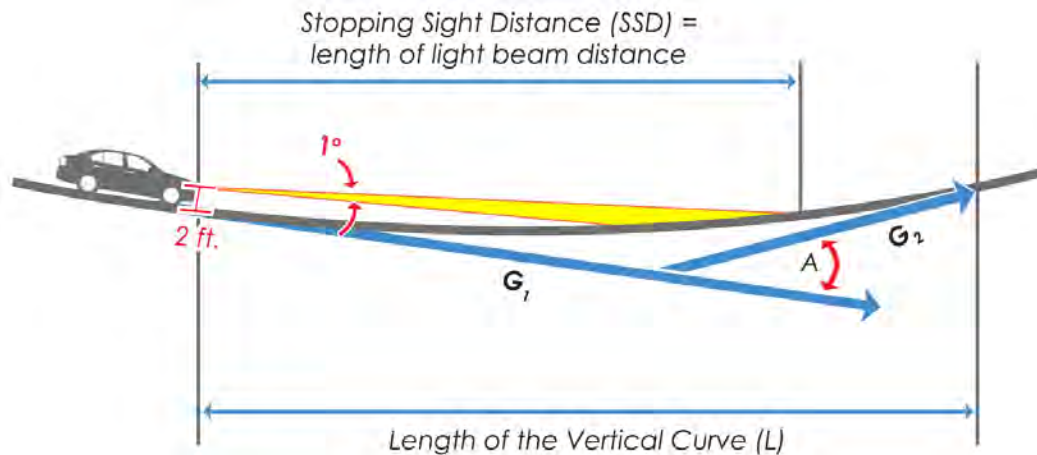


Table 5-15: Design Controls for Sag Vertical Curves

Design Speed	Stopping Sight Distance (SSD)	Minimum K for Stopping Sight Distance – $K = L/A$ (ft/percent change in grade)	Minimum Length of Sag Vertical Curve
15 mph	80 ft.	10	45 ft.
20 mph	115 ft.	17	60 ft.
25 mph	155 ft.	26	75 ft.
30 mph	200 ft.	37	90 ft.
35 mph	250 ft.	49	105 ft.
40 mph	305 ft.	64	120 ft.
45 mph	360 ft.	79	135 ft.
50 mph	425 ft.	96	150 ft.

Table based on AASHTO A Policy on Geometric Design of Highways and Streets (7th Ed.) Table 3-37 and Section 3.4.6.3.

5.6 Intersection Design

5.6.1 General

The requirements of this section are minimum standards. The results of traffic studies may indicate the need for a higher standard of intersection construction but shall not enable lower standards than the minimum requirements.

5.6.2 Angle of Intersections

New intersections shall be designed so that the intersecting roads meet at a 90-degree angle, plus or minus 5 degrees. The centerline angle of the intersection shall be maintained for a distance of at least 20 feet beyond the ultimate right-of-way of the intersecting road without angle points or horizontal curvature.

Intersections angles between 85 and 75 degrees (i.e. skewed intersections) require approval from the County Engineer. Under no circumstances shall the angle of a new intersection be less than 75 degrees. Skewed intersections require consultation with the latest edition of AASTHO *A Policy on Geometric Design of Highways and Streets* for guidance related to the sight triangle and curb radii.

5.6.3 Intersection Sight Distance

5.6.3.A Requirements

Intersection Approach: New intersections shall be located so that when drivers are approaching an intersection they are able to see the control device and respond appropriately (i.e. come to a stop if required).

Intersection Departure: New or modified intersections shall be designed and constructed such that when a driver is stopped at the intersection they can see the distance necessary to decide when to enter or cross the intersecting road.

Horizontal Curves: New intersections of local roads with roads classified as a collector or arterial shall not be located at or near horizontal curves without special evaluation of ISD. Locating an intersection on the inside of a horizontal curve may result in poor visibility and requires the approval of the County Engineer. The location of any property lines, fences, or other obstructions will need to be evaluated to ensure that the minimum sight distance is maintained.

Responsibility: When provision of a clear line of sight is a condition of application approval, it shall be the applicant's responsibility to accomplish any activities necessary to provide adequate sight distance, such as trimming or removal of vegetation or regrading. If the obstruction is in private property not owned by the applicant, the intersection may need to be relocated.

Maintenance: Per Bernalillo County Code Sec. 66-255, clear sight triangles shall be maintained free of visual obstructions by adjacent property owners.

5.6.3.B Intersection Clear Sight Triangle

At any intersection, there must exist a clear sight triangle to allow a driver stopped on an approach to be able to see oncoming traffic far enough down the road in order to depart the minor road and enter or cross the major road. The clear sight triangle is defined by the line of sight from the vehicle stopped on the minor road to a vehicle approaching on the major road back to the intersection. The minimum required clear sight triangle is defined in the AASHTO guide *A Policy on Geometric Design of Highways and Streets*. See The vertex or decision point of the sight triangle on the minor road shall be 14.5 feet from the outside edge of the major road's nearest directional travel lane. On major roads without outside edge striping, the outside edge is measured 12 feet from the road's centerline. Where practical, it is desirable to increase the distance of 14.5 feet to 18 feet from the outside edge of the major road's nearest directional travel lane to the vertex of the clear sight triangle. In measuring ISD, the height of the driver's eye is assumed to be 3.5 feet above the pavement. The height of the object to be seen is assumed to be another vehicle and is also assumed to be 3.5 feet above the pavement.

Objects in Clear Sight Triangle: The clear sight triangle must be clear of obstructions that might block the driver's view of potentially conflicting vehicles. Landscaping, signage, walls, fences, trees, and shrubbery between 3 feet and 8 feet tall (as measured from the road pavement) shall not be allowed within the clear sight triangle. Objects that may be located in the sight triangle include, but are not limited to, fire hydrants, utility poles, utility junction boxes, and traffic control devices, provided these objects are located to minimize visual obstructions. Objects under 8 inches wide may be allowed.

See Figure 5-11 for a depiction of the clear sight triangle.

Stopping Sight Distance: Table 5-16 summarizes the required SSD along a two-lane major road for a passenger vehicle on the minor road preparing to enter or cross the major road with less than 3% grade. If a road is divided with a median width of 20 feet or more for passenger vehicle crossings, or 40 feet or more for truck crossings, the required sight distance may be based on a two-stop crossing and consideration may be given to the width of each one-way section at a time.

Clear Sight Triangle Drawing: The vertex or decision point of the sight triangle on the minor road shall be 14.5 feet from the outside edge of the major road's nearest directional travel lane. On major roads without outside edge striping, the outside edge is measured 12 feet from the road's centerline. Where practical, it is desirable to increase the distance of 14.5 feet to 18 feet from the outside edge of the major road's nearest directional travel lane to the vertex of the clear sight triangle. In measuring ISD, the height of the driver's eye is assumed to be 3.5 feet above the pavement. The height of the object to be seen is assumed to be another vehicle and is also assumed to be 3.5 feet above the pavement.

Figure 5-11: Components of Intersection Sight Distance

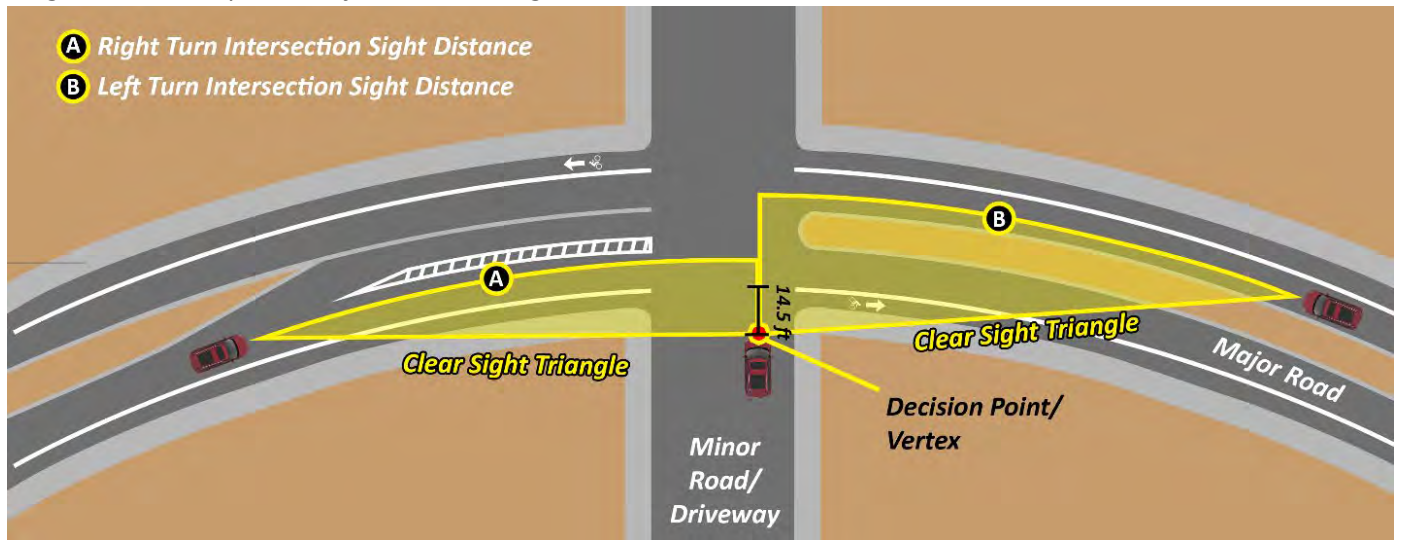


Table 5-16: Intersection Sight Distance for a Stopped Passenger Car to Enter a Two-Lane Road (with no median) and with Grades of 3% or Less

Design Speed	Right Turn (A)	Left Turn (B)
15 mph	145 ft.	170 ft.
20 mph	195 ft.	225 ft.
25 mph	240 ft.	280 ft.
30 mph	290 ft.	335 ft.
35 mph	335 ft.	390 ft.
40 mph	385 ft.	445 ft.
45 mph	430 ft.	500 ft.
50 mph	480 ft.	555 ft.

Source: Table based on AASHTO *A Policy on Geometric Design of Highways and Streets* (7th Ed.) Tables 9-7 and 9-9

5.6.3.C Intersection Sight Distance Adjustments

Adjustments to ISD must follow AASHTO's *A Policy on Geometric Design of Highways and Streets*, latest edition. Common adjustments include:

- Entry onto major roads wider than roads described in Table 5-16
- Intersecting legs with an upgrade or downgrade of more than 3%
- High volumes of heavy vehicles approaching the intersection
- Skewed intersections

5.6.3.D Documentation of Sight Distance

To verify acceptable sight distance, the County Engineer may require a developer to evaluate and document an existing sight distance condition. The evaluation and documentation of the sight distance shall include the following, or such additional information as may be necessary to make a determination:

- Plan and profile drawing along the sight line
- Posted speed and/or speed study for operating speed
- Right-of-way and easement limits (existing and proposed)

When the County Engineer determines from the documentation presented that a location has insufficient sight distance, a plan to improve the sight distance to meet these standards will be required.

5.6.3.E Sight Distance Note for Site Plans

The following note is required on all site plans: "Landscaping, signage, walls, fences, trees, and shrubbery between 3 feet and 8 feet tall (as measured from the road pavement) are not allowed within the clear sight triangle."

5.6.4 Grades at Intersections

Intersections must be graded to provide characteristics consistent with the design speed of the through road. Projected curb flowline profiles through the intersection will be required for design review of intersections involving arterial and collector roads. Alignment of arterial roads through intersections must be continuous without breaks in grade and meet the criteria for vertical curvature in 5.5.6.

Design considerations to ensure appropriate grades at intersections include:

- Grades should be between 0.5% minimum and 3% maximum. Grades within the intersection need to be flat enough to minimize problems with turning vehicles and to keep stopping distances reasonable. Grades should also be steep enough to ensure that proper drainage occurs.
- For safety reasons, a landing or safe stopping area must be provided before the intersection. Minor leg approach tangent gradients to intersections should not exceed 4% for at least 50 feet from the projected curb flowline of the through road.
- Road grade transitions shall be designed using vertical curves wherever the grade change exceeds 1%. This includes the transition from the slope of the intersecting road to the cross-slope for the road being intersected. See vertical curve standards provided in 5.5.6.
- Road crown points should be reduced to promote driver comfort. Crown reduction should not exceed one half of a standard crown. Intersection grading must provide for rapid drainage. See CABQ Standard Drawing 2401 for additional guidance.
- Grades intended to serve as water blocks may only be designed on minor approach legs of intersections. Design of water blocks shall be pursuant to an approved grading and drainage plan.
- The designer should specifically investigate intersection design to assure that design flows will not overtop curbs resulting in damage outside of the right-of-way.
- Curb returns should be designed to prevent ponding.
- Drop inlets shall be located away from curb ramps.
- Intersections should be located so as to avoid road segments that are highly superelevated. Intersection grading for superelevated roads needs to account for issues of grade compatibility, cross-over crown, etc. to ensure that the intersection will operate properly.
- For all roads approaching a stop sign controlled intersection, a 20 mph design speed with a minimum vertical sag curve length of 60 feet may be used for the final curve at the intersection. If using the reduced sag curve length results in a stopping sight deficiency, then the connection will not be allowed unless adequate improvements and provisions have been made.

5.6.5 Intersection Curb Return Radii

5.6.5.A General

Curb return radii should be designed for safe movement for all road users. The primary factors for determining the size of curb return radii include road type and location (see Table 5-17). Larger curb return radii may be necessary to accommodate the design vehicle. See 5.5.3 for the selection of the design vehicle.

5.6.5.B Curb Return Radii in High Pedestrian Activity Areas

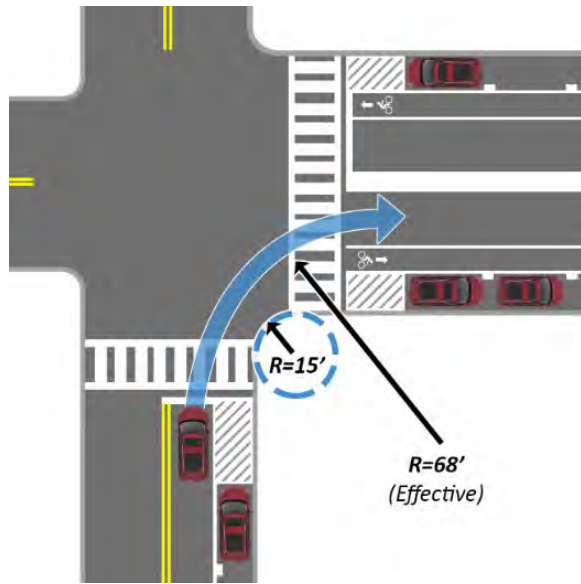
The following guidance applies to areas with high pedestrian activity, including designated Activity Centers, Village Centers, schools, and roads with multi-use trails, transit service and/or sidewalks:

- The design shall strive to meet the minimum curb return radii provided in Table 5-17.
- The design shall consider the presence of bicycle lanes, bicycle buffers, shoulders and/or on-street parking that can increase the “effective” radius, which accounts for the available space for a turning movement rather than just the curb return itself (see Figure 5-12).
- Potential encroachments described in 5.6.5.D shall be used in an effort to achieve the minimum curb return radii.

Table 5-17: Minimum Curb Return Radius by Intersecting Road Types

To: From:	Regional Principal Arterial	Community Principal Arterial or Minor Arterial	Commercial / Industrial Collector	Residential Collector	Commercial / Industrial Local	Residential Local
Regional Principal Arterial	35 ft.	35 ft.	35 ft.	30 ft.	35 ft.	30 ft.
Community Principal Arterial / Minor Arterial	35 ft.	30-35 ft.	30-35 ft.	25-30 ft.	30-35 ft.	25-30 ft.
Commercial / Industrial Collector	35 ft.	30-35 ft.	30-35 ft.	25-30 ft.	30-35 ft.	20-25 ft.
Residential Collector	30 ft.	25-30 ft.	25-30 ft.	25 ft.	25 ft.	25 ft.
Commercial / Industrial Local	35 ft.	30-35 ft.	30-35 ft.	25 ft.	25 ft.	20 ft.
Residential Local	30 ft.	25-30 ft.	20-25 ft.	25 ft.	20 ft.	20 ft.

Figure 5-12: Effective Curb Radius Example



5.6.5.C Curb Return Radii along Fire Access Routes

For fire access routes the minimum effective centerline turning radius is 45 feet (Bernalillo County Code Sec. 34-76). Figure 5-13 shows Case A and B encroachments are allowed for emergency vehicles and shall be used when ensuring the minimum 45-foot centerline turning radius.

5.6.5.D Potential Encroachments

Encroachments by vehicles are allowed and may be accounted for in the design to minimize the curb return radius and accommodate the design vehicle. See Figure 5-13 for a visual depiction of the encroachment.

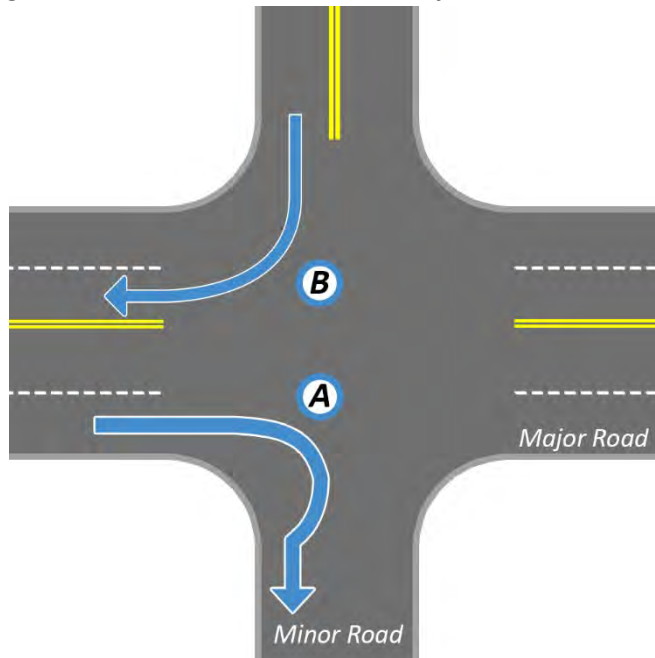
Case A Encroachment – swinging wide – is allowed under the following circumstances:

- For emergency vehicles
- When the minor road average daily traffic is 2,500 or less

Case B Encroachment – turning into middle or far lane when more than one receiving lane is available – is allowed under the following circumstances:

- For emergency vehicles
- Within activity centers and village centers
- At signalized intersections
- At unsignalized intersections where the major road posted speed is 35 mph or under and the major road average daily traffic is 20,000 or lower

Figure 5-13: Potential Encroachments for Intersections



5.6.5.E Other Considerations

The following considerations affect the radius of a curb return:

- The presence of a **raised median or pedestrian refuge island** may require larger radii to allow vehicles to make appropriate turning movements without encroaching onto the median.
- **Skewed or oddly shaped intersections** may dictate larger or smaller radii than provided in this section.
- For intersection corners where radii of 40 feet or more are needed, three-center curves or simple curves with tapers to fit the paths of large truck combinations shall be provided. See AASHTO for additional design information.

5.6.6 Turn Lanes at Intersections

5.6.6.A Left Turn Lane Required

An exclusive left turn may be required at intersections or access points based on the results of an approved traffic impact assessment or safety analysis.

In general, left-turn lanes mitigate congestion and provide a significant safety counter measure. An exclusive left-turn lane should be installed in the following circumstances at **signalized intersections**:

- Where exclusive left turn signal phasing is provided
- Where left-turn design hour volumes are 100 vehicles per hour or greater
- On legs of the intersection that are classified as major collector or above
- Double left turn lanes should be considered where left-turn design hour volumes exceed 300 vehicles per hour

At **unsignalized intersections and at site access points**, the following may be used to determine that an exclusive left turn lane is required:

- The County Engineer determines that an exclusive left turn lane will lead to a reduction in crashes
- The decision sight distance for traffic approaching a vehicle stopped at the intersection to make a left turn is insufficient
- For regional principal arterials, the NMDOT State Access Management Manual may be used to determine if a left turn lane is required
- Table 5-18 provides criteria that may be used to require a left turn lane

Table 5-18: Left Turn Lane Volume Criteria

Major Road Posted Speed	Roads outside East Mountain Area	Roads within East Mountain Area where the Major Road has 6,000 ADT or higher
25 mph	50 Left Turns / Design Hour	NA
30-40 mph	40 Left Turns / Design Hour	25 Left Turn Volume / Design Hour
45-55 mph	30 Left Turns / Design Hour	15 Left Turn Volume / Design Hour

5.6.6.B Right Turn Lane Required

For all intersections and access points, an exclusive right turn lane may be required based on the results of an approved traffic impact assessment.

In general, right turn lanes provide a safety counter measure and mitigate congestion. An exclusive right-turn lane should be installed under the following conditions at **signalized intersections**:

- Where the right-turn design hour volume (DHV) equals or exceeds 300 vehicles per hour and the volume in the outside general purpose travel lane equals or exceeds 300 vehicles per hour
- Where the right-turn DHV equals to or exceeds 150 vehicles per hour and the volume-to-capacity (V/C) ratio for the adjacent through movements is expected to be 0.85 or greater based on accepted methodologies

At **unsignalized intersections and site access points**, Table 5-19 provides criteria to require an exclusive right turn lane.

Table 5-19: Right Turn Lane Volume Criteria at Unsignalized Intersections

Major Road Posted Speed	Roads outside East Mountain Area	Roads within East Mountain Area
25 mph	N/A	N/A
30-40 mph	50 Right Turns / Design Hour	N/A
45-55 mph	45 Right Turns / Design Hour	N/A

5.6.6.C Turn Lane Components

Turn lanes consist of a combination of elements shown in Figure 5-14. Turn lanes should be 11 feet wide; however, the lane width may be adjusted to be compatible with the adjacent road lane width. The minimum turn lane width is 10 feet.

5.6.6.D Deceleration Lanes

Deceleration lanes typically consist of three components: transition taper, deceleration distance and queue storage. See Figure 5-15 for an overview of right and left turn lanes.

Deceleration lanes should be designed so there is a speed differential of 10 mph or less at the point the auxiliary lane clears the through traffic lane. The length of the deceleration lane should allow the vehicle to come to a comfortable stop prior to reaching the end of the expected queue. The queue storage should be based on site-specific conditions.

Figure 5-14: Turn Lane Overview

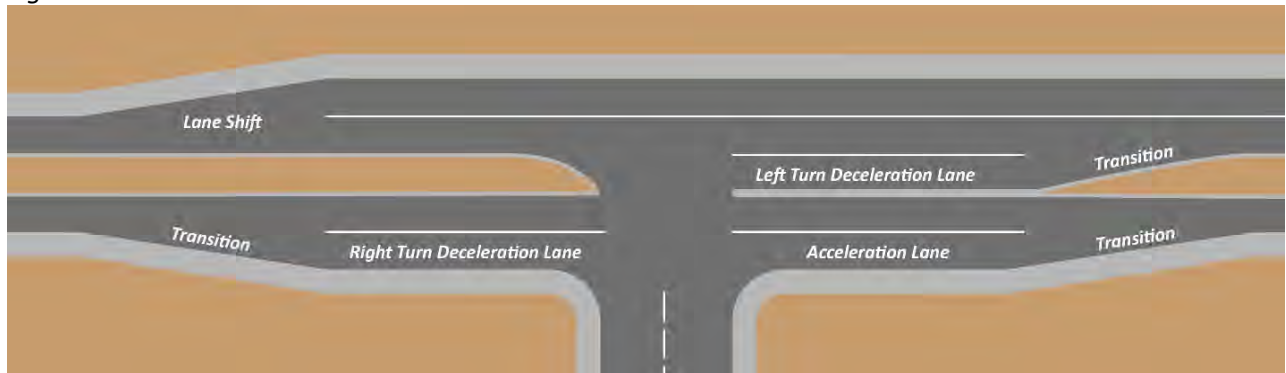
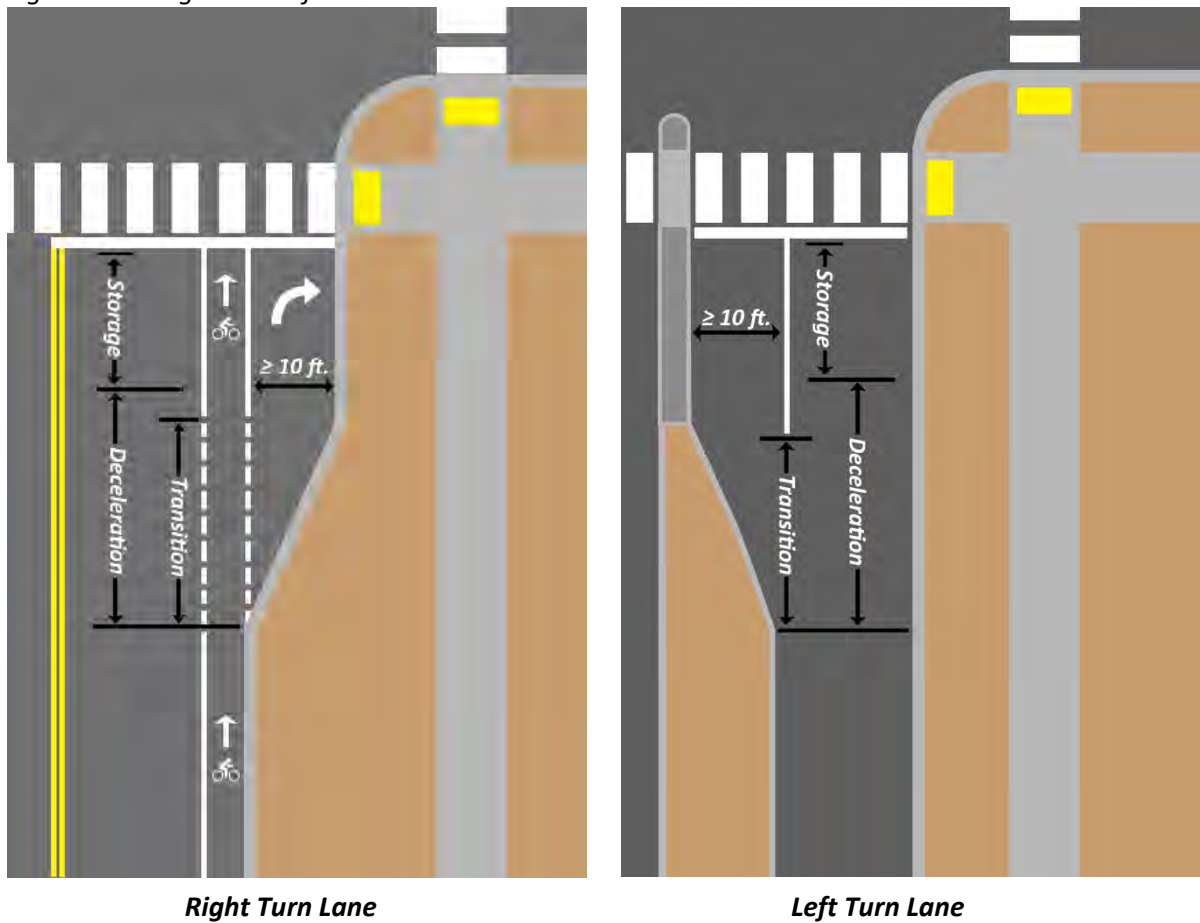


Figure 5-15: Right and Left Turn Lanes



5.6.6.E Transitions

Transitions, or deceleration tapers, should be reverse curves with rounded beginning and end points. Deceleration taper lengths and ratios depend on the posted speed (see Table 5-20 and Table 5-18). Deceleration taper lengths do not require adjustment for grade. For right turns, the use of taper in lieu of a turn lane is strongly discouraged.

Table 5-20: Transition Design

Posted Speed	Reverse Curve (Outside of East Mountain)	Taper Ratio (East Mountain Area)
< 35 mph	150 ft. -150 ft. Reverse Curve	6:1
35-40 mph	300 ft. - 150 ft. Reverse Curve	8:1
45-55 mph	600 ft. - 300 ft. Reverse Curve	15:1

Source: City of Albuquerque Development Process Manual

5.6.6.F Deceleration Distance

Design considerations for deceleration distance include:

- Right turn deceleration lengths at an uncontrolled access point should include sufficient distance to slow to 15 mph. The corresponding right turn radius should be adequate for a 15 mph right turn.
- For left turns and for right turns controlled by a sign or signal, the deceleration length should be sufficient to slow to a stop.
- Deceleration lengths should be adjusted for grades over 3%.
- Constrained conditions may necessitate eliminating all or part of the deceleration distance and providing only the taper and queue storage length.

5.6.6.G Queue Storage

Design considerations for queue storage include:

- Left turns and right turns at controlled locations should provide adequate length for the 95th percentile queue.
- Queue storage should take into consideration larger vehicles in locations with high volumes of turning heavy vehicles.
- Under constrained conditions, the minimum storage is 50 feet.

5.6.6.H Acceleration Lanes

Acceleration lanes should be included on regional principal arterials with posted speeds of 45 mph and above. They may be included for improving safety at other locations. See NMDOT State Access Management Manual for acceleration lane design criteria.

5.6.6.I Channelized Right Turn Lanes

Channelized right turn lanes should not be a standard design feature in locations with high levels of pedestrian activity, such as: activity centers, near schools, near multi-family housing, along roads with frequent transit service, multi-purposed trails, and other areas that generate pedestrian travel.

If a channelized right turn lane is considered necessary, the designer should consult a federally recognized national design manual, including ITE Designing Walkable Urban Thoroughfares, to ensure the design adheres to national best practices.

5.6.6.J Shoulders

Where shoulders are present along a road and speed change lanes are required, the shoulders should be continued along the speed change lanes. A minimum shoulder width of 4 feet should be provided adjacent to a right turn speed change lane.

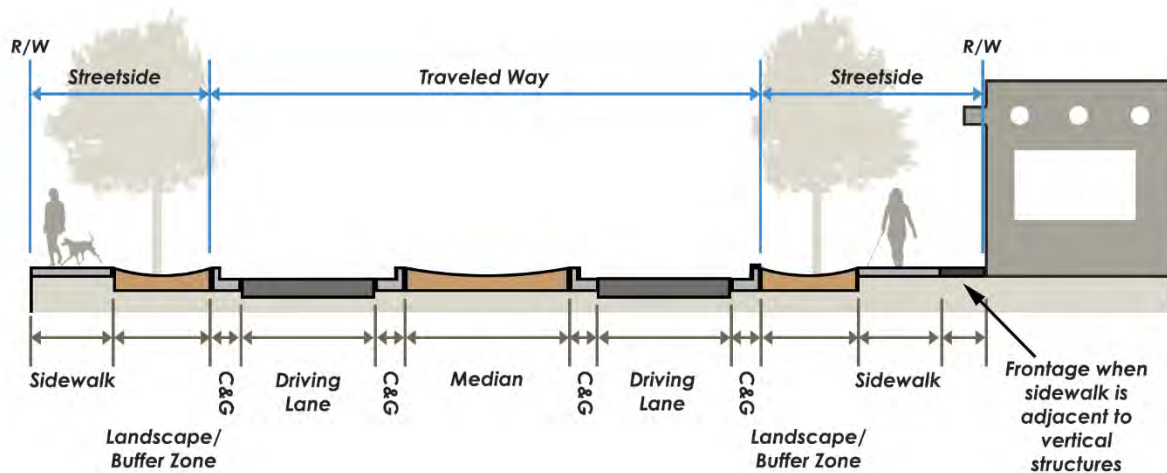
5.6.6.K Bicycle Lanes and Right Turn Deceleration Lane

Guidance for accommodating a bicycle with a right turn lane can be found in See Figure 5-15 for a general depiction of a bicycle lane in a right turn lane.

6. Road Element Design

This chapter provides guidance and standards for the various individual road elements. These elements may vary on based on a range of circumstances. Figure 6-1 provides breaks apart road elements for the urban road cross-section example.

Figure 6-1: Road Elements for Urban Roads Example



6.1 Landscape/Buffer Zone

The landscape/buffer zone is the part of the streetside area that provides space for space for utilities, traffic control, and various other elements that may need to be located in the road right-of-way (see Figure 6-1). Locating utilities, traffic signs, etc. within the landscape/buffer zone allows the sidewalk to be free of obstructions helping with ADA compliance.

In addition to providing space for utilities, the landscape/buffer zone can serve functions related to drainage and community aesthetics using landscaping and street trees. The recommend location for the landscape/buffer area is between the back of curb and the sidewalk. This location improves pedestrian comfort by providing a buffer from vehicle travel. The additional space also helps to provide a wider range of ADA compliant curb ramps at corners and can provide stormwater management benefits when the landscaping is designed with GSI/LID best management practices (BMPs). See Appendix A Bernalillo County Green Stormwater Infrastructure Low Impact Development Standards for additional discussion.

6.1.1 Landscape/Buffer Zone Locations Required

A landscape/buffer zone is required in combination with a sidewalk for all new development outside of the Rural Development Area.

For reconstruction of collector and arterial roads in developed areas that are outside of the Rural Development Area, a landscape/buffer zone shall be included in combination with a sidewalk. Exceptions may be granted by the County Engineer for constrained locations.

6.1.2 Landscape/Buffer Zone Design

6.1.2.A Width

The width of the landscape/buffer zone varies by functional class and the arterial designations from the Long Range Roadway System. See Table 6-1 for minimum landscape buffer widths.

Table 6-1: Minimum Landscape/Buffer Zone Widths

Roadway Type	Minimum Landscape/ Buffer Zone Width
Regional Principal Arterial	6 ft.
Community Principal Arterial	5 ft.
Minor Arterial	5 ft.
Major Collector	4 ft.
Minor Collector	4 ft.
Commercial/Industrial Local	4 ft.
Residential Local	3 ft.

6.1.2.B Materials and GSI/LID Best Management Practices

Landscape/buffer zone may consist of plantings, mulch, and hardscape materials (e.g. pavers, decorative concrete, etc.). Landscape/buffer zones shall be designed using BMPs identified in the Bernalillo County GSI/LID Standards document. Using native and drought tolerant plants is encouraged in this area.

For rural roads, the landscape/buffer zone may include a bar ditch, which may also be required by the County Engineer for road drainage purposes.

6.1.2.C Street Trees

Street trees are recommended in landscape/buffer zones that are at least 5 feet wide. The width of excavation for the tree trench is approximately 9 feet, and the final tree planting area must be a minimum of 5 feet wide.

Each tree trench section should be constructed with a maximum of three street trees with an overall length of 66 to 86 feet, depending on tree spacing. The tree trench section can be constructed back-to-back for any length desired; however, an inlet and water control structure is recommended for every three trees. Street trees require an uncompacted rooting volume of 750 to 1000 cubic feet per tree.

6.1.3 Landscape/Buffer Zone Maintenance

When a new residential subdivision includes a landscape/buffer zone along local roads, the subdivision shall be required to create a homeowner's association that enters into an agreement to maintain the landscape/buffer zone along local roads and selected, low-volume collector roads.

For new arterial roads and high-volume collector roads within residential subdivisions, design plans including the landscape/buffer zone shall be reviewed by the Bernalillo County Public Works Department (BCPWD) to be accepted for public maintenance responsibility for the landscape/buffer zone.

All new commercial and multi-family developments are required to provide professional, insured maintenance of any landscape/buffer zone along all arterial, collector, and local roads within their subdivisions.

6.2 Pedestrian Facilities

6.2.1 General

Providing dedicated facilities for pedestrians, such as sidewalks and walkways, is an important multi-modal accommodation that offers a transportation alternative to motor vehicles. Multi-use trails may be implemented in place of sidewalks. See 6.5 for guidance.

During development or redevelopment, additional right-of-way or easements may be required if any portion of the pedestrian facility is located outside the existing right-of-way.

6.2.2 Pedestrian Facilities Requirements: Outside of the Rural Development Area

6.2.2.A New Roads and New Developments

Outside of Rural Development Areas, pedestrian facilities are required on all new arterial, collector, and local roads on both sides of the road. New developments are required to provide pedestrian facilities along their frontage.

6.2.2.B Pedestrian Facilities and Roadway Reconstruction

Roadway reconstruction, defined in this section as any project that includes the construction of new curbs or the horizontal relocation of the curb line, shall include sidewalks and the landscape/buffer zone along arterials and collectors outside Rural Development Area.

6.2.2.C Exceptions

Exceptions to pedestrian facility requirements may be granted in historic neighborhoods where sidewalks or other pedestrian facilities have traditionally not been present, or to match the surrounding character of the residential area. Cul-de-sac bulbs where there is no further connectivity and alleyways are not required to provide pedestrian facilities. Exceptions may also be granted by the County Engineer within developed areas that predominantly lack pedestrian facilities and where existing right-of-way widths are insufficient to add them.

6.2.3 Pedestrian Facilities Requirements: Within the Rural Development Area

Pedestrian facilities are required in the Comprehensive Plan Rural Development Area depending on the location. See the Bernalillo County Pedestrian and Bicyclist Safety Action Plan for locations of future planned pedestrian facilities. Pedestrian facilities may be limited to one side of the road.

6.2.4 Pedestrian Facility Options

Standard design options for pedestrian facilities and general guidance on context and provisions for these facilities are listed in Table 6-2. Project developers are encouraged to contact BCPWD prior to design to determine the appropriate facility type.

Table 6-2: Bernalillo County Pedestrian Facilities

Facility	Example	Context	Provisions
Sidewalk: Raised sidewalk separated by curb and gutter; may include landscape / buffer zone. Sidewalks are the preferred pedestrian facility.	 <i>Isleta Blvd. (Near Bridge Blvd.)</i>	Acceptable in all contexts due to safety benefits. Most desirable in Centers, near schools, and along roads with transit service.	Storm sewer infrastructure is necessary to provide the curb and gutter that elevates the sidewalk.
Walkway: At-grade walkway that may be separated by a ditch, gravel, or planter strip.	 <i>Dona Elena Dr. SW</i>	Acceptable, but not preferred, on local and collector roads. Additional landscape / buffer zone width may be required to avoid parking on the walkway.	Storm sewer infrastructure is not necessary for walkways and shoulders. In some cases, these facilities may serve as interim pedestrian connections when future sidewalks are anticipated.
Shoulder: At-grade paved shoulder; when applied in rural areas and small towns, this concept may be called a pedestrian lane. Pedestrian markings could apply.*	 <i>Isleta Blvd. (Near Gun Club Rd.)</i>	Acceptable in rural development areas, where sidewalk is historically not present and other areas where there is 1 DU/acre or less.	

*https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/fhwahep17024_lg.pdf

6.2.5 ADA Compliance

Title II of the Americans for Disabilities Act (ADA) requires that state and local governments ensure that facilities in the public right-of-way are readily accessible to, and usable by, individuals with disabilities. Any new construction or alteration projects in the public right-of-way that affect the access, circulation, or use of pedestrian facilities must install new facilities or improve existing facilities to meet ADA accessibility standards. These improvements include alternate pedestrian access routes during construction.

The Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (2011 PROWAG, U.S. Access Board) shall be used as the ADA accessibility standards until final federal regulations are issued. BCPWD uses NMDOT Standard Drawings (NMDOT 608-001) or successor documents for ADA/PROWAG compliance of public sidewalks, curb ramps, and pedestrian refuge islands.

Alterations and new construction that do not fully meet the accessibility standards due to existing physical constraints must do so the “maximum extent feasible” as approved by the County Engineer.

6.2.6 Frontage Zone

A frontage zone is required when the outside edge of the sidewalk abuts a vertical structure. The frontage zone is additional sidewalk width. See Figure 6-1 for a depiction of the frontage zone within the urban road cross-section.

Table 6-3: Frontage Zone Width

Vertical Structure	Required Frontage Zone Width
Wall or Fence	1 ft.
Building	2.5 ft.

6.2.7 Sidewalks and Walkways Design

6.2.7.A Minimum Width

Table 6-4 provides minimum sidewalk/walkway width by roadway type. Additional width is encouraged within designated Centers.

Table 6-4: Minimum Sidewalk or Walkway Width

Road Type	Minimum Sidewalk or Walkway Width
Local and Collector	5 ft.
Arterial	6 ft.

6.2.7.B Standard Drawings

BCPWD uses NMDOT standard drawings (NMDOT 608-001) for ADA compliance of pedestrian facilities.

6.2.7.C Cross Slope

Sidewalk/walkway cross slope shall not exceed 2%. To ensure ADA/PROWAG compliance, it is recommended that cross slopes be designed at 1.5% to allow for tolerance in construction.

6.2.7.D Running Slope

The sidewalk/walkway running slope may match but not exceed the general grade established by the adjacent roadway or right-of-way easement.

6.2.7.E Objects in Sidewalk/Walkway

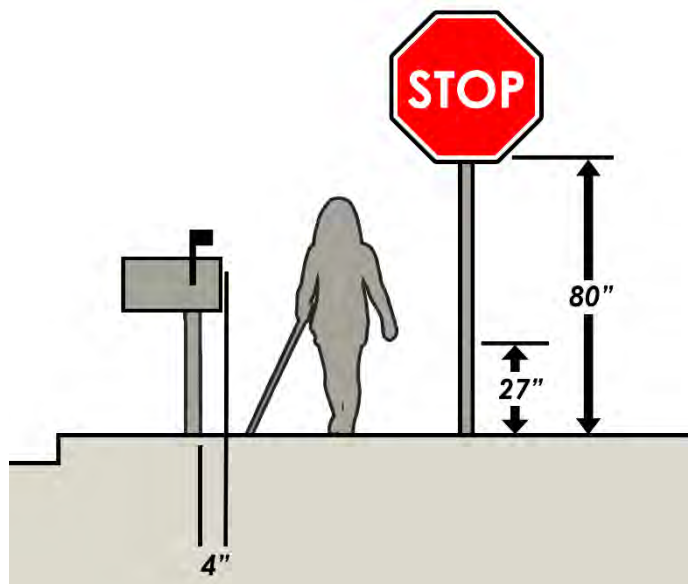
If it is necessary to locate objects such as hydrants, signposts, etc. within a sidewalk, then the sidewalk/walkway shall be widened to provide a minimum pedestrian access route of 4 feet around any part of the obstruction.

6.2.7.F Protrusions

If an object protrudes farther than 4 inches into a pedestrian access route at a height that is greater than 27 inches and less than 80 inches above the sidewalk surface, it must include a warning device that is

detectable by a vision-impaired person who navigates with a cane. The minimum 4-foot pedestrian access route must still be provided around the object.

Figure 6-2: Protruding Objects and Frontage Zone along a Pedestrian Facility



6.2.7.G Requirements for Altered Sidewalks

Trenching or saw-cutting in a sidewalk stone requires full stone replacement. The altered sidewalk segment shall be constructed to fully comply with ADA requirements.

A transitional stone is required to blend between existing sidewalk and altered sidewalks when the existing sidewalk exceeds 2% cross slope. The transitional stone shall be warped to provide flush joints between the fully ADA compliant replacement stone/altered sidewalk and the existing sidewalk with over 2% cross slope. BCPWD shall be responsible to update the ADA Transition Plan to include improvements and note any areas that are not ADA compliant.

6.2.8 Curb Ramps

6.2.8.A Definition and Required Locations

Curb ramps are required to provide access between elevated pedestrian facilities and road surfaces at pedestrian crossings. Ramps shall be installed at all intersections unless pedestrian crossing is prohibited. The County Engineer may require a curb ramp to the road surface where a sidewalk ends. Curb ramps are required at designated mid-block crossings for pedestrians.

For the purposes of this section, the following definitions apply:

- **Intersections:** The location where two roadways (public or private) intersect.
- **Intersection crosswalk:** The extension of a sidewalk or shoulder across an intersection, whether it is marked or not.

6.2.8.B Curb Ramp Design

Curb ramps are categorized by their design and position relative to the pedestrian facility and road. Standard drawings NMDOT 608-001 provide guidelines and illustrate examples of common ramps that can be used in different situations. The following considerations apply during the design of curb ramps:

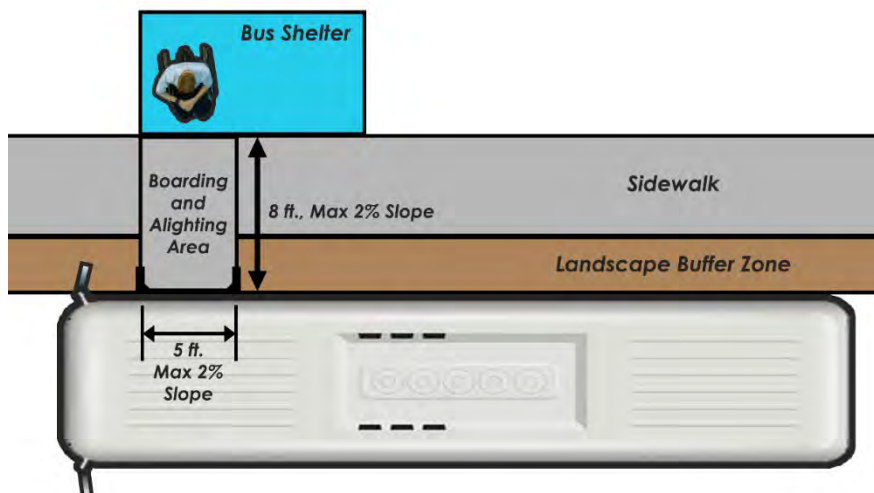
- Curb ramps shall be aligned to fall within the boundaries of crosswalks, marked or unmarked, so that pedestrians who have vision or mobility impairments are not directed outside the crosswalk or into a vehicle travel lane.
- As much as possible, curb ramps shall be aligned in-line with the direction of pedestrian travel.
- Ramps for crossings at intersections shall be located as close to the intersection as practicable to make pedestrians more visible to turning vehicles.
- Drainage low points or inlets are not allowed within the curb ramp or crosswalk.
- Utility covers should not be located in the curb ramp area.
- Ramps should be as wide as the adjoining sidewalks. The minimum ramp width is 4 feet.
- Decorative surface materials, such as bricks or tiles, should not be used in curb ramps or crosswalks because of the uneven surfaces they create for pedestrians.

6.3 Transit Stops

Developments that require a traffic impact assessment may be required to provide transit stop improvements. Transit stop improvements typically include pedestrian crossings, boarding and alighting areas, benches, and/or shelters. All transit stop improvements, including pedestrian route connections, shall be ADA compliant (PROWAG R308). Transit stop improvements shall be made in collaboration with ABQ Ride and/or Rio Metro Regional Transit District.

All transit stops are required to include a boarding and alighting area. This area is 5 feet wide parallel to the road and 8 feet long perpendicular to the road. BCPWD requires this area to be constructed of concrete. The slope parallel to the road may match the road grade. The slope perpendicular to the road shall be no more than 2%. Figure 6-3 provides an illustration of the transit boarding and alighting area.

Figure 6-3: Transit Stop Boarding and Alighting Area



Transit stop amenities, such as benches or shelters, are also required to be ADA compliant (PROWAG R308 and ADAAG 903). The amenities are required to be connected by a pedestrian access route to the boarding and alighting area and to any adjacent sidewalks.

See 6.9 for discussion on bus stops, bus pull outs, and dedicated transit lanes.

6.4 Bikeways

6.4.1 General

Guidance for the development of bikeways is rapidly evolving with new designs being explored, tested, and incorporated into national guidance. This section builds upon guidance provided by national design manuals and identifies locally preferred standards and procedures.

For additional detail and guidance, refer to the latest version of the following guides: the AASHTO Guide for the Development of Bicycle Facilities, the NACTO Urban Bikeway Design Guide, the Manual on Uniform Traffic Control Devices (MUTCD), and the Bernalillo County Pedestrian and Bicyclist Safety Action Plan.

See NACTO or AASHTO for guidance on pavement markings intended to improve the visibility of bicycle lanes, striping of lanes and buffers, including use of dashed lines to mark driveway access points, traffic merging areas, and transit stops. See the MUTCD for standards related to bike lane symbols, pavement markings, and signage.

6.4.2 Locations of Future Bikeways

New bicycle infrastructure should be included as part of all reconstruction and new collector and arterial roads.

The location of planned future bikeways and trails is shown on both the Long Range Bikeway System (LRBS), maintained by MRCOG, and the Bernalillo County Pedestrian and Bicyclist Safety Action Plan. These future system maps show the facilities necessary to provide an integrated bikeway and trail network. The most recently updated future system map, either in the Bernalillo County Safety Action Plan or the LRBS, shall be used to require planned bikeways and trails as part of new development.

In locations not identified in a Bernalillo County adopted plans, bikeways and/or trails may be required if they connect or close a gap in the existing system.

Multi-use trails may be provided in addition to bicycle lanes but multi-use trails should not take the place of bicycle lanes.

6.4.3 Bicycle Lanes and Bicycle Lane Buffers

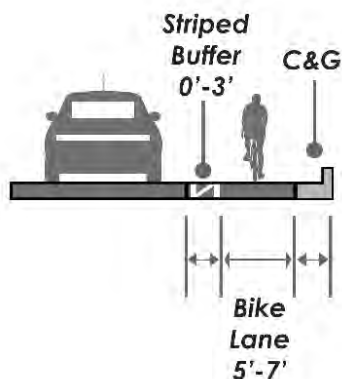
6.4.3.A Definitions

A **bicycle lane** is a lane on the roadway that has been designated by striping and pavement markings for preferential or exclusive use by bicyclists.

Bicycle buffers are the physical space that separates bicyclists from motorists. Buffers may consist of pavement markings or some form of vertical separation. See the NACTO Urban Bikeway Design Guide for guidance on bicycle buffer design options.

See Figure 6-4 for an example of a bicycle lane with a striped buffer. See Table 6-5 for information on widths of bicycle lanes and buffers and how they vary based on design speed.

Figure 6-4: Bicycle Lane with Striped Buffer



6.4.4 Bicycle Lane Design

6.4.4.A New Roads

On all new collector and arterial roads, bicycle lanes and the appropriated bicycle lane buffer should be provided. Bicycle lane and buffer widths are provided in Table 6-5.

6.4.4.B Existing Roads

Bicycle lanes and the appropriate bicycle lane buffer should be evaluated during road reconstruction and restriping projects. Bicycle lanes may be implemented on existing roadways by reducing automobile travel lane and median widths and/or by reducing the number of travel lanes. In some circumstances, separated bicycle lanes should be evaluated and implemented. See 6.4.5 for guidance on separated bicycle lanes.

6.4.4.C Local Roads

Bicycle lanes are not required on local roads with speeds of 25 mph or less, low traffic volumes, narrow right-of-way, or that provide access to single-family residences. On these roads, bicyclists should share lanes with vehicle travel. Common treatments to facilitate shared lanes include signage, pavement markings, and bike route and bicycle boulevard designations. See 6.4.6. and 6.4.7 for guidance on bicycle routes and bicycle boulevards.

6.4.4.D Bicycle Lane Width Considerations

Bicycle lane widths by design speed and road type are shown in Table 6-5. Bicycle lane width does not include the gutter pan.

Wider bicycle lanes and/or striped buffers are desirable on roads that provide connections to designated Centers, schools, and/or roads with heavy vehicles or on transit routes with all day service. Bike lanes narrower than those shown in Table 6-5 may be considered where bike lanes are desirable but available

right-of-way is insufficient. In constrained right-of-way situations, the widths of bicycle lanes, general purpose travel lanes, and medians shall meet minimum national guidance recommendations.

Table 6-5: Bicycle Lane and Buffer Width by Road Type and Design Speed

	Urban Road Section (includes curb & gutter)		Rural Road Section (no curb & gutter)
Design Speed	Bicycle Lane Buffer Width	Bicycle Lane Width	Shoulder/ Bicycle Lane
40 mph and above	3 ft.	7 ft.	8 ft.
35 mph	0-3 ft.	6 ft.	6 ft.
30 mph	0-3 ft.	5-6 ft.	5 ft.

6.4.4.E Bicycle Lane Construction Considerations

Bicycle lanes shall be constructed or reconstructed level and flush with roadside gutter pans with no more than 5/8-inch vertical difference. Bicycle lanes shall be constructed to avoid hazardous conditions that might force awkward or unsafe bicycle movements. Storm drainage facilities and other utilities shall be designed and located to minimize impacts.

6.4.4.F Intersections

Improvements to intersections with bicycle lanes shall include bicycle-sensitive signal actuation where feasible. See NACTO's *Urban Bikeway Design Guide* for marking detection area and detection operations.

Discontinuing bicycle lanes at intersections is discouraged. Intersection designs should incorporate bicycle treatments at intersections to reduce conflicts between bicyclists and motorists. Options include bike boxes, intersection crossing markings, median refuge islands, dashed lines at the entrance to right turn lanes, and the use of sharrows for shared bicycle lane and right turn only lanes. Vertical delineators at intersections should be considered in situations where the bike lane is used as a turning bay for vehicles.

Figure 5-15 provides a depiction for a right turn lane and bicycle lane. See AASHTO's *Guide for Development of Bicycle Facilities* and NACTO's *Urban Bikeway Design Guide*, or other approved design manual, for additional guidance on treatments of bicycle lane approaches to intersections.

6.4.4.G On-street Parking Considerations

Where on-street parallel parking is present and bicycle lanes are located to the left of automobile parking, a minimum combined width of 13 feet is required, with a recommended 7-foot wide parallel parking stall and a 6-foot wide bike lane. The gutter pan may be included in the parking stallwidth. See Figure 6-11.

6.4.5 Separated Bicycle Lane Design

6.4.5.A Definition

Separated bicycle lanes, also called protected bicycle lanes or cycle tracks, include some form of vertical element to separate the bicycle lane from automobile travel lanes. The vertical element may include tubular markers, moveable planters, raised curb, or vehicle parking. Without the vertical element, the bicycle lane is a buffered bike lane (See 6.4.4 and 6.4.5).

6.4.5.B Location and Appropriateness

Separated bicycle lanes may be located at the street level, raised to an intermediate level between the roadway and the sidewalk, or at the same level as the sidewalks. Separated bicycle lanes at the sidewalk level should have some form of buffer or visual means of differentiating between the bicycle lane and the sidewalk. See NACTO's *Urban Bikeway Design Guide* for additional information on raised bicycle lanes at intermediate levels.

Separated bicycle lanes are most appropriate along roadways with higher travel speeds and for connections between and within designated Centers.

6.4.5.C Design Considerations

The recommended dimensions for a separated bicycle lane are 6.5-foot lane and a 3-foot buffer. Separated bicycle lanes are most appropriate on roads with limited driveways and other forms of access. Two-way cycle tracks are discouraged on Bernalillo County roads. See NACTO's *Urban Bikeway Design Guide* for separated bicycle lane/cycle track design guidance.

6.4.6 Bicycle Routes

6.4.6.A Definition

Bicycle routes are designated roadways in which bicyclists share roadway space with motorists. There is no designated infrastructure, though bicycle routes should have appropriate directional and informational signing.

6.4.6.B Location and Appropriateness

Bicycle routes are most appropriate on low-volume (i.e. below 3,000 average daily traffic), low-speed roadways (i.e. posted speeds of 25 MPH or below). Bicycle routes may feature some traffic calming elements and may be marked with sharrows. Bicycle route designations may be an appropriate option for existing roadways with constrained rights-of-way and where existing bicycle lanes do not meet the minimum design standards.

6.4.6.C Signage and Markings

The sign "Bicycles May Use Full Lane," (*MUTCD* sign number R4-11) or alternate sign, as approved by the County Engineer, is the preferred signage to indicate shared-lane facilities. Sharrow lane markings also improve the visibility of cyclists on a shared roadway.

See NACTO's *Urban Bikeway Design Guide* and AASHTO's *Guide for the Development of Bicycle*

Facilities for further guidance on wayfinding and shared lane markings along bicycle routes.

6.4.7 Bicycle Boulevards

6.4.7.A Definition

Bicycle boulevards are enhanced bicycle routes designed to encourage the through-movement of bicycles while maintaining local access for motor vehicle travel.

6.4.7.B Locations and Appropriateness

Bicycle boulevards are most appropriate on low-volume (i.e. below 3,000 vehicles per day), low-speed roadways (i.e. posted speed of 25 MPH or below) with direct access to destinations. Ideally, they should be at least two miles long. Bicycle boulevards may be parallel to roadways with bicycle lanes to provide lower-stress alternative routes.

6.4.7.C Signage and Traffic Calming

Traffic calming devices are used to control motor vehicle speeds and discourage through-vehicle trips. These devices may include diverters, speed humps, traffic circles, or planters that allow through-access by bicycles only. See 6.7 for additional information.

If an existing roadway is designated as a bicycle boulevard, signal timing and stop control should be evaluated to prioritize bicycle movements.

6.5 Multi-Use Trails

6.5.1 General

Multi-use trails, also called shared-use paths or paved trails, are facilities that are dedicated for pedestrians and bicyclists. They are designed for use by people of all abilities for transportation and recreational purposes. Trails are physically separated from vehicular traffic and are either within the roadway right-of-way or within an easement.

6.5.2 Locations

See the Bernalillo County Pedestrian and Bicyclist Safety Action Plan and the Long Range Bikeway System (LRBS) Map for the location of future planned multi-use trails.

6.5.3 Multi-Use Trail as a Means of Multi-Modal Accommodation

Where future trails are planned, a sidewalk is not required in addition to the multi-use trail on the same side of the road. A sidewalk is required on the side of the road opposite of the multi-use trail unless multi-use trails are provided on both sides.

Where a multi-use trail and a bicycle lane are proposed on the same road, the bicycle lane is required on the same side of the road as the multi-use trail. The multi-use trail does not take place of the bicycle lane.

Where future trails and bicycle lanes are shown in combination on the Bernalillo County Pedestrian and Bicyclist Safety Action Plan or LRBS, a protected bicycle lane in combination with a sidewalk may be provided instead. See City of Albuquerque Development Process Manual for guidance on protected bicycle lanes.

6.5.4 Multi-Use Trail Cross-Sectional Elements

6.5.4.A Width

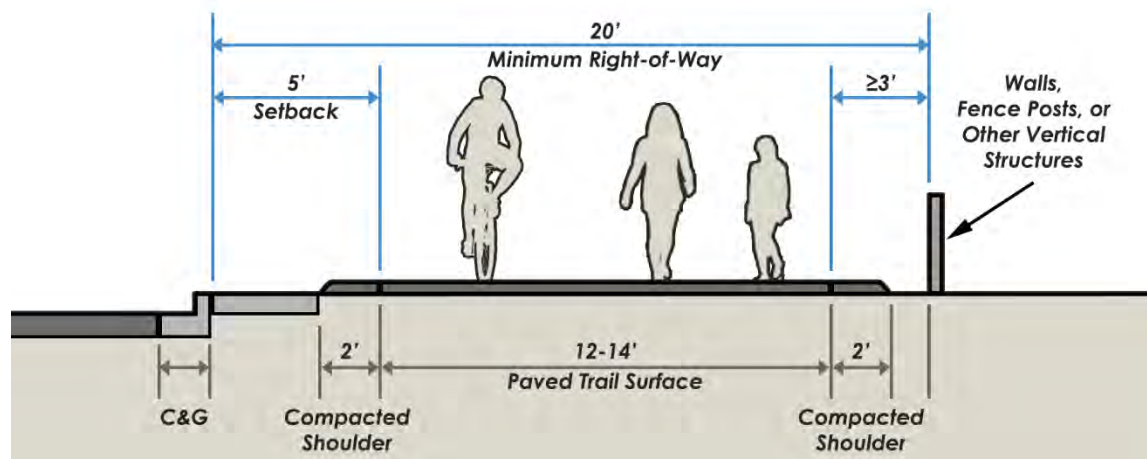
The standard trail width is 12 feet, with 14 feet desired for high-use areas. The minimum multi-use trail width shall be 10 feet excluding shoulders. Changes to the standard trail width shall be approved by the County Engineer. See AASTHO Guide for the Development of Bicycle Facilities for further guidance on multi-use trail design.

6.5.4.B Right-of-Way

For right-of-way determination, the minimum width required for a trail along a roadway is 20 feet. This allows for 5 feet setback from curb, 12 feet trail width, and 3 feet from property line. The setbacks from the curb and the property line may include the shoulders (see Figure 6-5).

Right-of-way determination for a road involves checking the LRBS and Bernalillo County Pedestrian and Bicyclist Safety Action Plan to see if a future multi-use trail is planned along the roadway. If a future trail has been identified in either of these documents, a minimum of 20 feet shall be added to the standard right-of-way for the road.

Figure 6-5: Multi-Use Trail Elements



6.5.4.C Shoulders and Buffers

A minimum 2-foot shoulder adjacent to both sides of the trail is required to be constructed of compacted base course, subgrade, or crusher fines, with a maximum 1H:6V slope.

A minimum 3-foot buffer is required between the private property line or any vertical structures and the trail, which may include the compacted shoulder. Follow AASHTO's Guide for the Development of Bicycle Facilities for protection requirements for trails next to steep slopes.

6.5.5 Multi-Use Trail Running Slope and Cross Slope

Multi-use trail running slope may match but not exceed the general grade established for the adjacent road when the trail is located within a road right-of-way or easement. Multi-use trails not located within a constructed road right-of-way or easement shall have a maximum running slope of 5%.

Advance warning signs shall be used to identify trail locations with slopes that greatly exceed ADA guidelines, due to the slope of the road or other unavoidable topographic constraints. Trail cross slope shall not exceed 2%. To ensure ADA compliance, a maximum grade of 1.5% to allow for tolerance in construction.

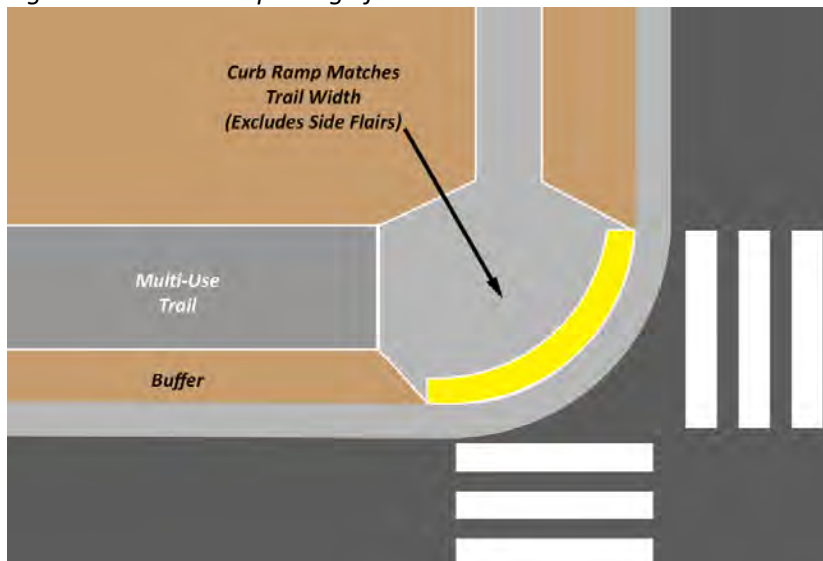
Landings and rest areas shall be provided on extended grades to allow users to stop and rest, particularly for steep trails and high-use trails.

6.5.6 Curb Ramps and Multi-Use Trails

For multi-use trails that are at least 10 feet or wider, the minimum curb ramp width is 10 feet, not including any side flares. In the cases where the multi-use trail is less than 10 feet wide, the curb ramp width should match the multi-use trail width. A slip ramp may be used to connect an on-street bike facility to an off-street multi-use trail.

Curb ramps at multi-use trails shall be ADA/PROWAG compliant. See standard drawings NMDOT 608-001 for additional curb ramp details.

Figure 6-6: Curb Ramp Design for Multi-Use Trails



6.5.7 Private Trails

All private trail design requires approval by the County Engineer. The minimum width for a private trail is 8 feet.

Private trails require a maintenance agreement. Signage shall be provided indicating maintenance responsibilities for private trails.

6.6 Medians and Center Turn Lanes

Medians frequently incorporate features to improve safety and operations by managing access and providing space for turning vehicles. Medians may also function as pedestrian and bicyclist refuge islands, provide space for landscaping, or serve as stormwater catchment systems. Typical median cross section types are provided in Figure 6-7.

Figure 6-7: Median Types



6.6.1 Median Location

Outside of the East Mountain area: Some form of median is desirable on roads with posted speeds of 30 mph or more and with average daily traffic of 10,000 vehicles or more.

Within the East Mountain area: A striped median is desirable on all arterial roads.

6.6.2 Roads with Four or More Lanes

Any new or reconstructed road with four directional lanes shall include some form of median (striped or raised). Any road with more than four directional lanes shall include a raised median.

6.6.3 Striped Medians

6.6.3.A Two-Way Left Turn Lane

Two-way left turn lanes (TWTLs) are continuous center lanes that allow motorists traveling in both directions to pull out of through lanes into a shared lane for left turns. TWTLs offer spatial separation between opposing lanes of traffic and provide additional roadway capacity without adding general purpose lanes in each direction by allowing turning vehicles to exit the general purpose travel lane. guidance.

6.6.3.B Two-Way Left Turn Lane Criteria

TWTLs are recommended on roads with a high degree of land access, including frequent intersections with local roads. The recommended criteria for a TWLTL are provided below. If the road has a higher posted speed, traffic volume, or more lanes than the following criteria, a raised median should be provided instead of a TWLTL.

Table 6-6: Recommended Criteria for a Two-Way Left Turn Lane

Criteria	Appropriate Characteristics
Maximum ADT	Three lane road: 18,000 vehicles per day Five lane road: 24,000 vehicles per day
Posted speed	40 mph or less
General purpose travel lanes	No more than two through lanes adjacent to the TWLTL

6.6.3.C Two-Way Left Turn Lane Design

TWLTL width is measured from the middle of the stripe on either side of the lane. Standard TWLTL width is provided in Table 6-7. Approval from the County Engineer is required if the proposed TWLTL width is below the standard provided in Table 6-7.

Table 6-7 Standard Two-Way Left Turn Lane Width based on Posted Speed and Design Vehicle

Posted Speed and Design Vehicle	Standard TWLTL Width
25 mph and Passenger Vehicles	11 ft.
30-35 mph and Passenger Vehicles	12 ft.
40 mph and above or Heavy Vehicles	14 ft.

TWLTLs may transition to turn lanes (either striped or raised) as they approach intersections. They may also transition to raised medians to provide access management in targeted locations, or to provide refuge islands for pedestrians and bicyclists at designated crossings.

6.6.4 Striped Median Left Turn Lanes

Left turn lanes may be provided through striping or with a raised median. Striped left turn lanes are appropriate on roads where there are no driveways within the storage area or taper of the left turn lane. See Table 6-7 for widths for striped median left turn lanes. Striped median left turn lanes are measured from the middle of the stripe on either side of the lane.

6.6.5 Raised Curb Medians

Raised curb medians address safety and operations by providing access management, separating oncoming traffic, and through the provision of pedestrian and bicyclist refuge islands. Raised medians with curbs may also include landscaping and serve as stormwater catchment systems.

6.6.5.A General

All raised curb medians shall be designed so that neither sight distance nor vehicle turning radii are limited. Raised curb median widths are measured from curb face to curb face.

6.6.5.B Raised Median Left Turn Lanes

Table 6-8 provides the standard widths for raised or striped left turn lanes. Proposed left turn lane widths that are less than the standard provided in Table 6-8 require approval from the County Engineer. The minimum left turn lane width is 10 feet for roads with posted speed of 35 mph and 11 feet for roads with posted speeds of 40 mph or higher. The minimum traffic separator width for all speeds is 2 feet. See Figure 6-8 and Table 6-8 for additional guidance.

Requirements for left turn lane lengths are found in Section 5.6.6.D Turn Lane Length.

Figure 6-8: Center Turn Lane Elements

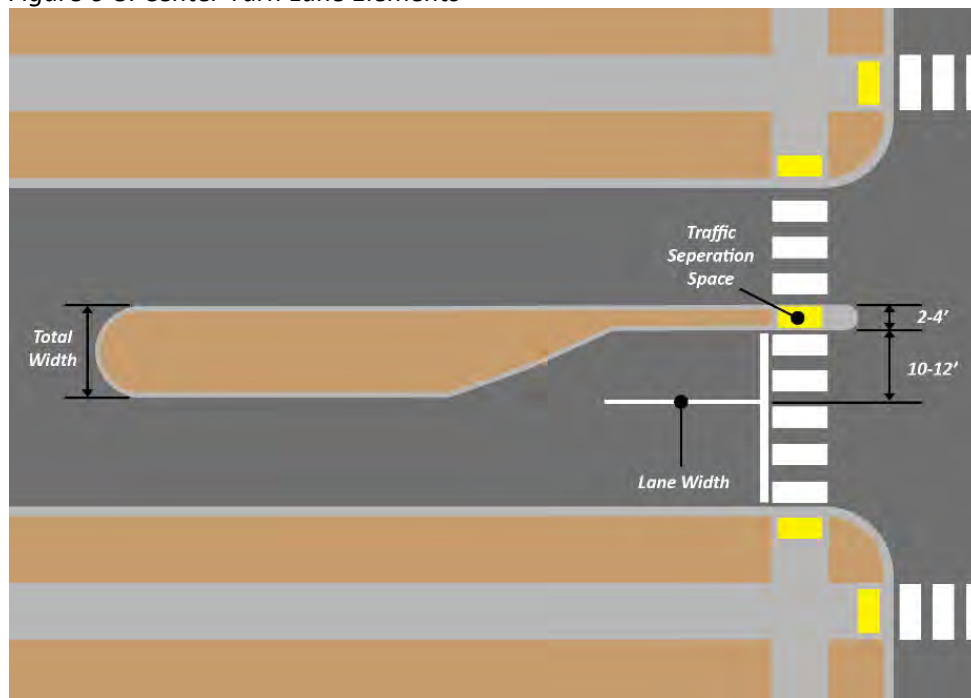


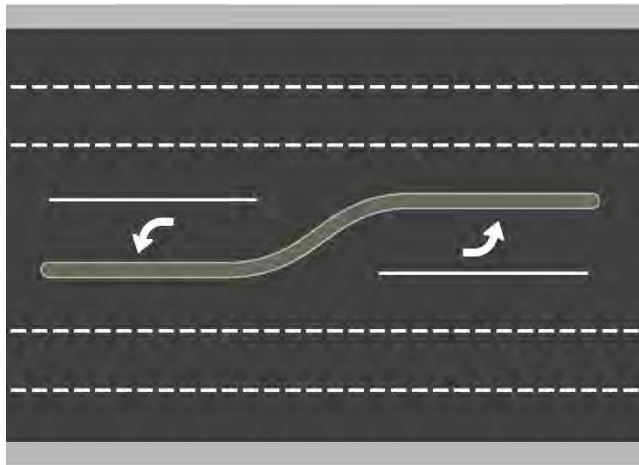
Table 6-8 Standard Widths for Raised or Striped Left Turn Lanes

Posted Speed	Standard Widths for Raised or Striped Left Turn Lanes Including Dual Left	
	Left Turn Lane Width	Traffic Separator
35 mph and below	11 ft.	3 ft.
40 mph and above	12 ft.	4 ft.

6.6.5.C Traffic Separation Raised Median Width

Medians may serve to restrict turning movements and separate opposing traffic. Table 6-8 provides the standard widths for raised median traffic separators. See Figure 6-9 for additional guidance.

Figure 6-9: Example Traffic Separation Raised Median



6.6.5.D Pedestrian and Bicyclist Median Refuge Islands

The standard width for a pedestrian and bicyclist median refuge island is 8 feet. Proposed refuge islands with widths less than the standard require County Engineer approval. The minimum pedestrian and bicyclist refuge island width is 6 feet. See standard drawings NMDOT 608-001 for design guidance.

When possible, pedestrian and bicyclist refuge islands should zig-zag to orient the user to face oncoming traffic. All refuge islands serving pedestrians shall meet PROWAG requirements.

Refuge islands may be located at signalized or unsignalized intersections or at mid-block crossings. See 5.4.5 for pedestrian crossings locations.

6.6.5.E Trees and Landscaping in the Median

Placement and maintenance of street trees and other median landscaping should ensure adequate clear zone recommendations. See AASHTO's Roadside Design Guide for clear zone requirements.

See the Bernalillo County Green Stormwater Infrastructure / Low-Impact Development Standards for additional guidance on landscaping treatments in medians. See 6.1.2.C for guidance on street trees.

Maintenance responsibility will need to be identified prior to installation. All medians with landscaping shall be designed to accommodate maintenance vehicles.

6.6.5.F Traffic Signals and Illumination

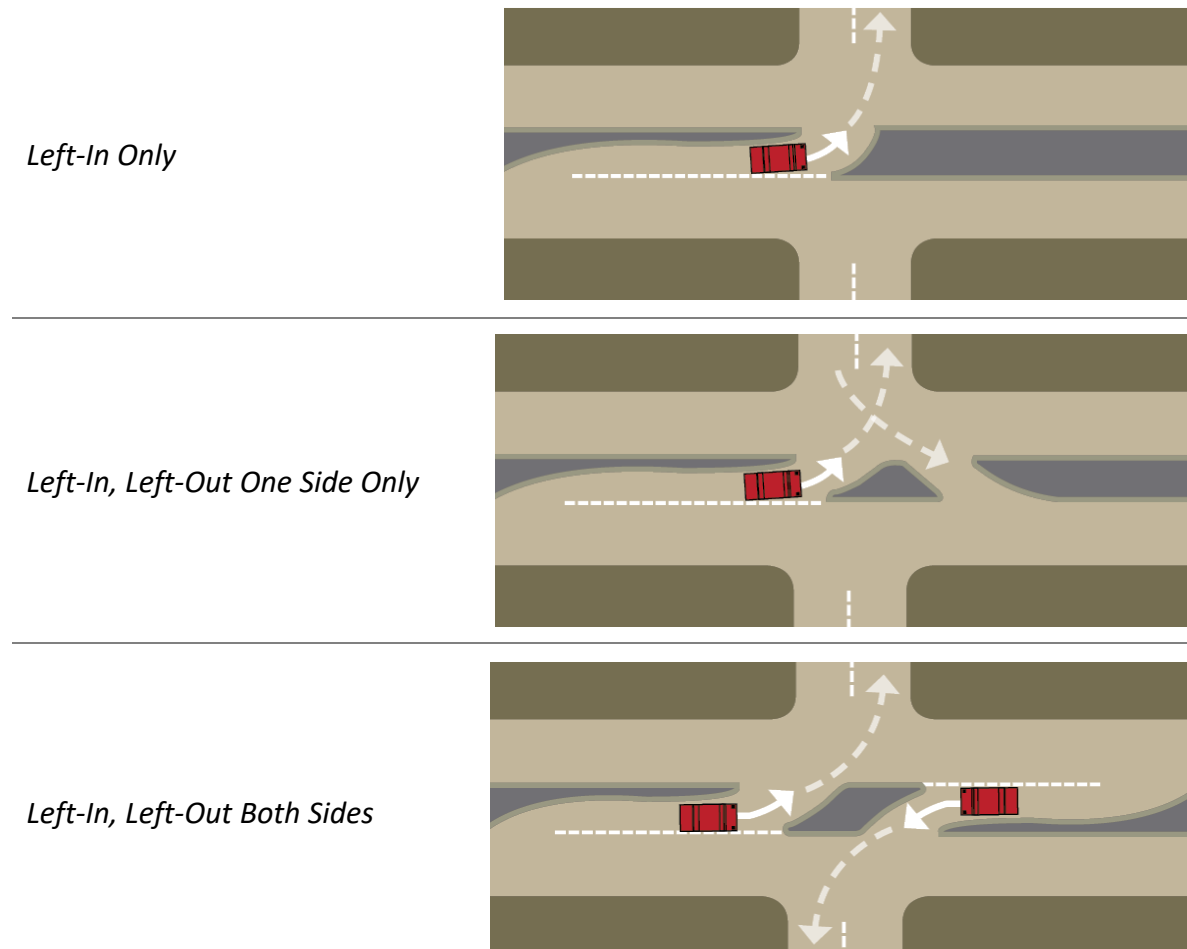
Medians that are to be utilized for the placement of traffic signals and road illumination should be a minimum of 6 feet wide.

6.6.5.G Raised Median Openings and Partial Access

Median opening spacing shall meet the intersection and driveway spacing requirements found in 5.4.3.C and 3.8. Consolidation of median openings should be considered during roadway reconstruction projects.

Left turn movements may be restricted based on insufficient spacing or other operation or safety factors. Figure 6-10 illustrates options for providing access as part of a raised median.

Figure 6-10: Forms of Raised Medians and Access Control



6.7 Traffic Calming

6.7.1 Neighborhood Traffic Calming

Bernalillo County Public Works Division's [Traffic Calming Policy for Neighborhood Streets](#) provides a list of speed reduction features that may be included in road design for new development as well as for retrofitting existing roads. The policy applies to local road and some collector roads and indicates how roads are evaluated and prioritized for implementing these designs. In most cases, a standard drawing is not provided for these traffic calming techniques since the design is unique and may take a variety of forms. See the City of Albuquerque's Development Process Manual for traffic calming techniques for higher classified roads.

Traffic calming features provide an opportunity for green stormwater infrastructure. See the Bernalillo County Green Stormwater Infrastructure / Low Impact Development Standards for best management practices that may be appropriate as part of traffic calming features.

Some traffic calming features may reduce the hydraulic capacity of the road and may cause nuisance flows. A hydraulic analysis and/or the implementation of Green Stormwater Infrastructure may be required by the County Engineer prior to construction.

Table 6-9: Traffic Calming Options on Local and Some Collector Roads

Speed humps are a common, effective traffic calming device located away from intersections. *(Image from Barcelona Rd. SW)*



Raised medians in the center of the road create a pinch point for traffic. *(Image from Ranchitos Rd. NE)*



Traffic circles are raised islands placed at the center of stop controlled intersections. *(Image from Raymac Rd. SW)*



Bump outs are created by extending the curb to create a pinch point. See Appendix A GSI/LID Development Standards for stormwater catchment opportunities. *(Image from Manzano St. NE)*



Diverter/Barriers limit access and can be used to discourage cut-through traffic while maintaining access for pedestrians and bicyclists. See the Appendix A for stormwater catchment opportunities. *(Image from Marquette Ave NE)*



6.8 Arterial and Collector Travel Lanes

Table 6-10 provides directional lane widths based on the Development Area, design speed, and design vehicle.

Table 6-10 Arterial and Collector Travel Lane Widths

Factors for Lane Width Determination			Directional Travel Lane Width
Comprehensive Plan Development Area	Design Speed 5.5.2	Design Vehicle 5.5.3	
Urban: Central Urban, Established Urban, Semi-Urban, Developing Urban	35 mph or less	Passenger	Lane widths 10 ft. wide are appropriate on urban roads with vertical curb, design speeds of 35 mph or less and for passenger cars as the design vehicle. In constrained conditions, 10 ft. is the general minimum lane width.
Urban: Central Urban, Established Urban, Semi-Urban, Developing Urban	40 mph or less	Transit bus and single unit heavy vehicles	Lane widths 11 ft. wide are the recommended minimum to provide for transit.
Urban: Central Urban, Established Urban, Semi-Urban, Developing Urban	45 mph or higher	Multi-Unit Heavy Vehicles	Lane widths 12 ft. wide are preferred for transit and multi-unit heavy vehicles.
Rural	35 mph and above	Passenger	On rural roads without vertical curbs, wider lanes, from 11-12 ft. wide are most appropriate. Minimum for constrained conditions is 11 ft. Recommended width is 12 ft.

6.9 Transit

6.9.1 General

Land development applications and County-led projects along roads with transit service shall be reviewed by local transit agencies for the provision of appropriate transit facilities. Required facilities may include pedestrian accessibility, bus stops, bus pullouts, or other transit related facilities.

A more durable pavement design may be required by the County Engineer for high frequency bus routes.

6.9.2 Bus Stop Locations

Bus stops should be placed on the far side of both signalized and unsignalized intersections. Placement immediately following the intersection is preferred. Bus stops should be constructed on both sides of a two-way street in a complementary pair, if possible.

6.9.3 Bus Pullout Locations

Required bus pullout locations shall be determined by the County Engineer in collaboration with local transit agencies. Bus pullout locations are most appropriate along corridors where the speed limit is 40 mph or greater, or locations where traffic flow may be greatly hindered by in-lane stopping.

Bus pullout locations may be designed as a bus turnout or a bus bay. See the City of Albuquerque Development Process Manual for bus pullout design.

6.9.4 Dedicated Transit Infrastructure

Dedicated transit infrastructure refers to a portion of the road or right-of-way allocated exclusively for transit vehicles. This may be a dedicated transit only lane, queue jump, or other elements that improve transit travel time reliability. See the City of Albuquerque Development Process Manual for additional guidance on dedicated transit infrastructure.

6.10 On-Street Parking

6.10.1 On-Street Parking Location

On-street, parallel parking is generally permitted on local roads unless prohibited or restricted by signage. On-street parking is generally discouraged on roads with functional classification as collector and above, though the County Engineer may consider designated on-street parking on such roads on a case-by-case basis. The County Engineer may require studies of parallel routes, operating speeds, traffic volume, drainage, sight lines, and available right-of-way.

6.10.2 Types of On-Street Parking

6.10.2.A Reverse Angle Parking

Reverse angle (also referred to as back-in angle) parking is recommended by Goal 7.4 Context-Sensitive Parking of the Comprehensive Plan. Reverse angle parking offers the clearest sightlines for motorists to see approaching bicyclists and other vehicles and should be utilized where right-of-way permits

Where practical and where sufficient right-of-way exists, reverse angle parking should be used on bicycle routes, bicycle boulevards, roadways with bicycle lanes, and within designated Centers. Reverse angle parking is most appropriate on roads with posted speeds of 25 mph or less.

6.10.2.B Parallel Parking

Parallel on-street parking is recommended in locations with limited right-of-way. Parallel parking is prohibited on streets with speed limits above 35 mph and may be applied on a case by case basis on roads with posted speeds of 30 mph.

6.10.2.C Head-In Angle Parking

Head-in angle parking is the least preferred option, but may be used on roads with speeds of 25 mph and without bicycle facilities or bikeway designation.

6.10.2.D Accessible On-Street Parking

Where on-street parking is provided, a portion of that parking should be accessible for use by persons with disabilities. Depending on the number of on-street parking provided, accessible parking may be required. Accessible parking needs should be assessed early in project design. See the *Public Right-of-Way Accessibility Guidelines* (PROWAG) for additional guidance.

6.10.3 On-Street Parking Design

6.10.3.A General

Designated on-street parking should be combined with curb extensions. Where applicable, curb extension design should support Green Stormwater Infrastructure, pedestrian crossings, and/or transit stops.

6.10.3.B Parallel Parking Design Guidance

Stall Width: Parallel parking stall width ranges from 7 to 8 feet, with wider stall preferred on commercial roads with higher levels of parking turnover and on roads with posted speeds greater than 25 mph. The gutter pan shall be used as part of the stall width. The combined width of a parallel on-street parking stall and the adjacent travel lane should be a minimum of 18 feet.

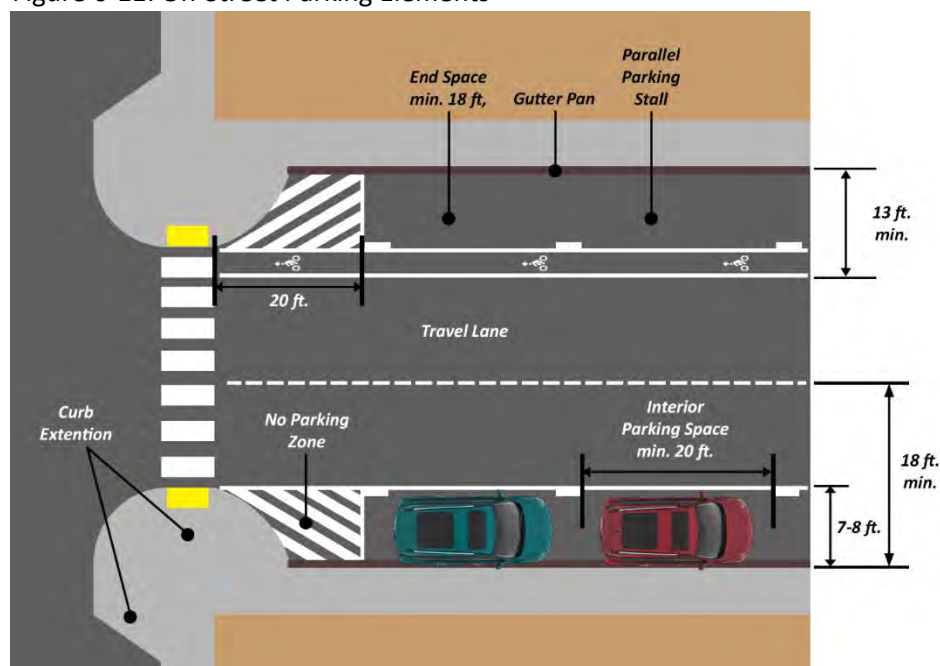
Stall Length: Individual stalls may be marked to increase the parking capacity. The minimum stall length for interior spaces shall be 20 feet, and all end spaces shall be a minimum 18 feet long. Per MUTCD, there shall be a 20-foot long space between the crosswalk or pedestrian crossing and the nearest on-street parking space. A curb extension may be used within that 20-foot area.

Parking and Bike Lanes: Where parallel on-street parking is adjacent to a bicycle lane (and there is insufficient space for reverse angle parking), the minimum combined width for the bike lane and the parallel parking stall is 13 feet (with a recommended 7-foot wide parallel parking stall and a 6 foot-wide bicycle lane).

Other Design Considerations: The following considerations also apply to parallel parking design:

- A 1.5-foot wide shy zone space or offset shall be provided between the curb edge and any vertical elements in the landscape/buffer zone.
- Adequate clear sight triangles must be provided for all on-street parking.

Figure 6-11: On-Street Parking Elements



6.10.3.C Reverse Angle Parking Design Guidance

Reverse angle parking shall be implemented for roads where angled parking is planned and the road includes bicycle lanes or bicycle routes. See the City of Albuquerque Development Process Manual for guidance on reverse angle parking.

6.10.3.D Head-In Angle Parking

Head-in angle parking is allowed on local roads with sufficient width and no bikeways. See off-street parking section for head-in angle parking striping requirements. Additional requirements include:

- Sufficient right-of-way is required to ensure 20 feet of clear roadway located between the end of the parking stall and the face of curb or the parking stall on the opposite side of the street.
- Wheel stops and/or extended shy zones in the landscape buffer zone are recommended to ensure that vehicles do not overhang the pedestrian access route or strike streetside elements.

6.10.3.E Bicycle and Motorcycle Parking

See the City of Albuquerque Development Process Manual for on-street parking for motorcycles and bicycles.

6.11 Curb and Gutter

BCPWD accepts approved curb and gutter drawings from NMDOT (609-01) and City of Albuquerque standard drawings 2415A and 2415B. For curb opening design see Appendix A GSI/LID Development Standards in Appendix A.

6.12 Road Illumination - Lighting

Road illumination plans prepared by the developer's engineer are reviewed by the BCPWD to optimize public illumination for traffic safety purposes, without imposing undue public maintenance and energy costs. A well-designed public streetlight system enhances public safety while contributing to community quality of life.

The City of Albuquerque Development Process Manual Ch. 7-4(M) Street Lighting is a resource that may be used for road illumination.

New road illumination in the North Albuquerque Acres and Sandia Heights Areas shall follow Bernalillo County Code *Ch. 30 Article VI* for light pollution requirements in these areas.

6.13 Utilities

Table 6-11 provides a summary reference for Bernalillo County Code requirements related to utilities.

Table 6-11 Bernalillo County Code Requirements for Utilities

Chapter	Section	Title/Summary Material
<i>Ch. 42 Health and Sanitation</i>	<i>42-491</i>	Liquid waste disposal systems
	<i>42-541</i>	Individual water supply systems
	<i>42-657</i>	Water supply for mobile home parks
<i>Ch. 74 Subdivision Article VII Required Improvements</i>	<i>74-75</i>	Sewer systems
	<i>74-76</i>	Water systems
	<i>74-165</i>	Utility connection requirement
<i>Ch. 66 Roads and Bridges Article IV Excavation</i>	<i>Division I</i>	Definitions, penalties, insurance, warranty & restrictions, routing of traffic, maintenance of traffic and pedestrian flow, abandonment of substructures, protection of adjoining property, care of excavated material, cleanup, protection of watercourse, breaking through pavement, depth of substructures, backfilling, restoration of surface, trenches and pipelaying, prompt completion of work, urgent work, dust debris and working hours, preservation of survey monuments, inspection, advance notice of improvements
	<i>Division II</i>	General requirements, no cost excavation permit for grading in public space, application, issuance and revocation, fees
<i>Ch. 86 Utilities</i>	<i>Article I</i>	General – definitions and scope
	<i>Article II</i>	Water systems – requirements for water system outside of the ABCWUA service area
	<i>Article III</i>	Taxpayer protection and right-of-way ordinance

7. Pavement Structural Design

7.1 Surfacing and Subgrade Requirements

7.1.1 General

All materials and workmanship shall be in accordance with the City of Albuquerque Development Process Manual for paved roads, the NMDOT Design Manual for gravel roads, or as approved by the County Engineer. Variations submitted for approval to the County Engineer shall conform to the AASTHO Guide for Design of Pavement Structures (including enhancements).

7.1.2 Minimum Surfacing Requirements

Minimum surfacing requirements are provided in the Standard Detail Drawings and in Table 7-1. The County Engineer may require a thicker road section.

Table 7-1: Minimum Surfacing Requirements

Facility	Standard Drawing	Surfacing Requirements
Arterial Roads: Regional Principal Arterial Community Principal Arterial Minor Arterial	CABQ DWG. 2407 (ART./COLL. ST. SECTIONS WITHOUT MEDIAN) CABQ DWG. 2408 (ART./COLL. ST. SECTIONS WITH MEDIAN)	Asphalt Concrete 6 inches COA SP-III Asphalt 8 inches Gravel Base Course, 95% Compaction (T-180) Portland Concrete Cement Per specific COA DPM and/or NMDOT and/or AASHTO Design
Collector Roads: Major Collector Minor Collector	RS-060-MINCOLL RS-060-MAJCOLL	Asphalt Concrete 6 inches COA SP-IV Asphalt 8 inches Gravel Base Course, 95% Compaction (T-180)
Local Road: Commercial/ Industrial	RS-060-CL	Portland Concrete Cement Per specific COA DPM and/or NMDOT and/or AASHTO Design
Local Road: Residential Paved Private Road/ Easement	RS-050-RL RS-050-UL RS-040-P	Asphalt Concrete 3 inches COA SP-C or D Asphalt 6 inches Gravel Base Course, 95% Compaction
Private Road / Easement (Gravel)	RS-040-G RS-030-G	Gravel 6 inches Gravel Base Course, 95% Compaction
Road Shoulders - Including bikeways and shoulders for pedestrian travel		Same as Arterial, Collector, and Local Roads above

Facility	Standard Drawing	Surfacing Requirements
Sidewalks		Portland Cement Concrete 4 inches P.C.C. 6 inches for driveways and where driveway passes over sidewalk
Multi-Use Trails and Separated Walkways		Asphalt Concrete 3 inches A.C. 4 inches crushes surfacing top course
Paved Medians		Portland Cement Concrete 4 inches P.C.C.

7.1.3 Minimum Subgrade Requirements

Minimum subgrade depth is 12 inches with 95% compaction for all elements in the public right-of-way, private road, or access easement, except the following elements: public ROW landscape/buffer zone, swales, and/or bar ditches. See the standard drawings for the interfacing design along subgrade edges.

7.1.4 Evaluation

Subgrade materials evaluation and a pavement structural design report shall be submitted for review and approval by the County Engineer.

7.1.5 Off-Street Parking

Off-street parking where 90% or more of trips to the site are made with passenger vehicles may use local road pavement standards. Otherwise collector/arterial road standards apply. Additional pavement may be required for sites that service high volumes of heavy vehicles.

8. Traffic Review

8.1 Purpose and Intent

The purpose of a traffic review is to identify the potential impacts of new development and mitigation measures (i.e. improvements) to be provided by the developer to address the impacts of additional traffic associated with the development.

Traffic review varies in complexity based on the scale, location, and type of development. The traffic review process is intended to provide an equitable, consistent, and systematic means of determining mitigation measures and ensure the proposed development can be integrated into Bernalillo County's transportation system. Design solutions and mitigation measures should be appropriate for the situation, financially reasonable, and balance the needs for site access, through traffic, and the safety of all travelers.

8.2 When Traffic Review is Required

Bernalillo County Code *Ch. 74* describes development actions that require a traffic review. These Technical Standards identify further actions that require a traffic review to examine impacts to the public right-of-way. Actions that require a traffic review include:

- Non-residential development abutting and/or accessing a County or state-maintained road
- Residential development with 25 or more dwelling units
- Subdivisions containing 25 or more parcels
- Master Development Plan
- Change in land use to a higher trip generation
- Development that requires a change in access to an arterial or collector road
- Developments that impact a road or intersection with identified safety or capacity deficiencies

The Bernalillo County Public Works Department (BCPWD) may also seek to require a traffic review from a development in a neighboring jurisdiction if the development has the potential to impact the operation and/or safety of the Bernalillo County transportation system.

8.3 Types of Traffic Review and Warranting Criteria

There are two levels of traffic review that may be required, depending on the size and location of the development:

- A **traffic scoping report** is a preliminary evaluation document that is used to determine the general impacts of the site development.
- Based on the review of the traffic scoping report, a **traffic impact analysis** may be required to consider the full impacts of the development on the transportation system and propose mitigation measures.

8.3.1 Traffic Scoping Reports

8.3.1.A Warranting Criteria

A traffic scoping report is required for all developments that meet the criteria identified in 8.2. A traffic scoping report *only* is required if the increase in the number of trips generated is fewer than 500 daily weekday trips and fewer than 50 peak hour trips.

8.3.1.B Traffic Scoping Report Waiver

A traffic scoping report may be waived in the following circumstances:

- Development of utilities at sites with approved access.
- Development provides evidence that no additional customer, visitor, or employee capacity is being added to the site.
- Information required for the traffic scoping report is provided in other Bernalillo County permit submittals (e.g. Zoning Administrator Conditional Use Permit Application, etc.).
- Development begins the traffic review process with a traffic impact analysis.

8.3.2 Traffic Impact Analysis

8.3.2.A Warranting Criteria

A traffic impact analysis (TIA) is required under the following circumstances:

- The site development results in 500 or more daily weekday trips or 50 or more peak hour trips. For sites where a prior land use was present and operating within two years of the proposed development opening, trips from the prior land use may serve as a credit. The prior land use trips are subtracted from the proposed development trips to determine if the TIA threshold is met.
- The County Engineer determines that a TIA is required.

8.3.2.B Development Incentive Area Warranting Criteria

Alternative thresholds for designated development incentive areas may be identified in the sector development plan process and corridor plan process. The development incentive area designation generally applies to Main Street and Major Transit Corridors. Traffic scoping reports are still required for developments in these areas below the alternative thresholds.

For the Bridge Boulevard Corridor Designated Development Area from Hartline Road to Coors Boulevard, the threshold for a TIA is 1,000 or more daily weekday trips or 100 or more PM peak hour trips.

8.3.2.C Referrals to Affected Governmental Agencies

When a development is within a half mile of a road or intersection under the jurisdiction of a governmental agency, the agency shall be notified by BCPWD staff and asked to participate in the TIA process. Comments from the affected agencies shall be addressed in the TIA process.

8.3.2.D Traffic Impact Analysis Waiver

If the County Engineer determines that a road abutting and surrounding a project site is fully constructed and that auto-oriented mitigation measures are impractical, a traffic scoping report may be required instead of a TIA. In these circumstances, the project may still be subject to non-auto-oriented mitigation measures determined by the County Engineer, such as improvements to sidewalks, transit amenities, etc.

8.3.3 Other Analysis

The County Engineer may require other evaluations such as pavement structural analysis based on truck usage.

8.4 Traffic Scoping Report

8.4.1 Purpose

The traffic scoping report is a preliminary evaluation of the size and impact of the development on the surrounding transportation system. The traffic scoping report may be completed by the applicant and does not require the participation of a traffic engineer.

The information provided in the traffic scoping report serves two purposes:

- To allow the County Engineer to identify reasonable modifications that can be made to the site plan that support the transportation system and ensure safe and efficient access to and from the site to the adjacent road.
- To determine if the site's impacts will meet the thresholds requiring a TIA.

8.4.2 Traffic Scoping Report Required Information

8.4.2.A Weekday Commuter Traffic Impact

In general, the traffic review focuses on the traffic impacts during weekday peak commute times. The information required in the traffic scoping report provides a broad view of trips generated throughout the week, along with detailed information that is used to estimate AM and PM peak hour trips based on the land use.

The applicant must complete the Traffic Scoping Report Form to the best of their abilities. The form can be found at: <https://www.berncounty.gov/public-works/traffic-impact-analysis.aspx>

The fundamental information needed in the traffic scoping report includes but is not limited to:

- Site plan that is to scale showing access details and internal circulation
- Description of the project indicating if it is a new use, change of use, site expansion, or remodel
- Description of the proposed and existing land uses on the site
- Size of each of the land uses in terms of building square footage, number of dwelling units, number of students, acreage, or some other appropriate unit for the use
- Anticipated average number of daily visitors, employees, deliveries, etc.
- Hours of operation
- Expected number of large vehicles (beyond a weekly delivery or refuse truck) visiting the site

8.4.2.B Special Events

Developments that include special events are required to complete a special event traffic scoping report. The information for special events includes:

- Site plan that is to scale showing access details and internal circulation
- Description of events
- Days, hours, and event time of year
- Presold tickets, open entry, and event arrival and departure patterns
- Number of likely people at event and corresponding number of vehicles

8.4.3 Traffic Scoping Report Review

BCPWD staff will review submittals of the traffic scoping report to determine if further actions by the developer are required, including a TIA. Based on the findings of the traffic scoping report, the County Engineer may require mitigation measures for road improvements or investments in transit, bicycle, or pedestrian infrastructure.

8.5 Traffic Impact Analysis

8.5.1 Qualifications

A TIA must be completed by a professional engineer licensed in the State of New Mexico, preferably with a PTOE certification and experience in preparing traffic impact analyses or studies. In the following sections, this individual is referred to as the “TIA preparer.”

8.5.2 TIA Process

8.5.2.A Project Description

The first step in the TIA process is for the TIA preparer to submit a project description or a completed traffic scoping report to BCPWD. At a minimum, the project description includes the following information:

- Site plan showing access, internal circulation and proposed land uses including size of uses
- Site trip generation
- Build out phase(s)

8.5.2.B Scoping Meeting

BCPWD will review the project description and schedule a TIA scoping meeting with the TIA preparer and the affected agencies to confirm the parameters of the TIA. The topics to be discussed at the scoping meeting are listed in Table 8-1.

Table 8-1: TIA Scoping Meeting Topic List

TIA Scoping Meeting Topic
Site Plan Access Points and Internal Circulation
Site Trip Generation Source and Assumptions
Trip Distribution Methodology
TIA Analysis Phases and Horizon Year
Study Intersections
Study Segments
Multi-Modal Considerations/Analysis
Crash Considerations/Analysis
Other Planned or Programmed Road Improvements
Other Planned Developments with Background Traffic
Background Traffic Growth Estimation
Neighborhood Concerns
Other Issues Identified by Bernalillo County Public Works

8.5.2.C TIA Scoping Letter

Within five (5) working days of the scoping meeting, BCPWD will provide a TIA scoping letter summarizing the expectations from the scoping meeting for the TIA preparer and the affected agencies. The TIA Scoping letter serves as a confirmation of the parameters of the TIA.

8.5.2.D Draft TIA Submittal

Based on the TIA Scoping Letter or approved scoping meeting notes, the draft TIA will be prepared for review and comment by BCPWD and the affected agencies, consistent with the Bernalillo County Code and these Technical Standards. The draft TIA shall be submitted in both electronic and hard copy format. BCPWD strives to provide comments on the draft TIA within 20 working days.

8.5.2.E Final TIA Submittal

The TIA preparer shall address comments from all reviewing agencies and incorporate changes in the final TIA. BCPWD reviews the final TIA to see if comments were incorporated. BCPWD and other reviewing agencies may require additional conditions of approval. The applicant may request negotiation of the mitigation measures.

The final TIA submittal shall be in electronic form. An additional hard copy may be requested.

For satisfactory TIAs, BCPWD issues a letter providing conditions of approval and outlining the mitigations measures.

8.5.2.F Revisions and Updates

An approved TIA that has been prepared in the last three years may be revised or updated to reflect changes in access or changes in the development that result in new trip generation rates. An amendment letter addressing the changes may be accepted by BCPWD. The amendment letter shall include:

- Original TIA trip generation and site plan
- Revised trip generation and corresponding site plan
- Differences between the previously approved TIA and new proposed trip generation and site plan
- Proposed changes to bicycle and pedestrian facilities

If the original TIA is older than three years, an entirely new TIA shall be prepared.

8.5.3 Traffic Counts

8.5.3.A Duration of Traffic Counts Data

Traffic count data are considered acceptable if they were collected within the last three years and there have been no significant changes in nearby land uses.

8.5.3.B Data Collection

Days of the Week: Traffic data for most TIAs should be collected on non-holiday Tuesdays through Thursdays to represent typical weekday traffic. Project trip generation characteristics that require traffic monitoring on other days of the week may be proposed in the scoping meeting for approval by BCPWD prior to data collection and analysis. Education-related developments and developments near schools are required to conduct traffic counts when school is in session.

Time of Day: The peak hours are the primary interest in the TIA. Turning movement counts can generally be limited to four hours of data, with two (2) hours in the AM peak period and two (2) hours in the PM peak period. Longer count times are necessary if a signal warrant analysis is required.

Turning Movements: Turning movement count data will include the 15-minute volume for each movement by approach lane. Intersection turning movement should at a minimum report passenger cars, trucks, bicycles, and pedestrians. BCPWD will share all available turning movement data collected over the last three years with the developer. At intersections where counts are not available, the applicant will be required to collect traffic count data. Road segment data for arterials and collectors may be requested from the MRCOG Traffic Monitoring Program.

8.5.4 Growth Rate for Future Traffic Estimation

Projected levels of growth in traffic are required to understand changes in baseline traffic in the project area. For projects that are expected to be completed within five years, the growth estimates should be based on MRCOG published average annual weekday traffic flow for the previous six (6) years.

For development to be completed in six (6) to 10 years, the MRCOG travel demand model is preferred to estimate the growth factor. This typically requires interpolation between the model's base and horizon years.

Where traffic counts are flat or declining, a traffic growth rate of 0.05% shall be used.

Percent growth is calculated as follows:

$$\text{Future Volume} = \text{Growth Factor} * \text{Current Volume}$$

$$\text{Growth Factor} = (\text{Annual Growth Rate})^{\text{Future year} - \text{current year}}$$

Where the *Annual Growth Rate* is expressed as a fraction.

When using the MRCOG published average annual weekday traffic, the *Annual Growth Rate* is calculated as an average of each year's annual growth. When using the MRCOG travel demand model, the percent growth between the base year and horizon year is divided by difference between these two years to find the average annual growth rate.

8.5.5 Trip Generation

8.5.5.A Trip Generation Source

The source of trip generation rates shall be the current edition of the ITE Trip Generation Manual. The TIA shall include a trip generation table listing each land use within the site at build out with the applicable ITE land use code, size of the use or facility, unit of measure, and trip generation rates for daily, AM, and PM peak hour traffic.

When data is not available for the proposed land use, the applicant must conduct a trip generation study following procedures prescribed in the ITE Trip Generation Manual and provide sufficient justification for the proposed trip generation rate.

All trip generation, including rates for different trip types and trip reductions, require approval prior to the development of the draft TIA.

8.5.5.B Trip Type

The rates for pass-by, diverted, and internal capture trips shall conform to the current edition of the ITE Trip Generation Handbook. A technical appendix, table, or map that illustrates the different trip types is required.

8.5.5.C Trip Reduction due to Travel Demand Management

Support documentation of non-single occupancy auto trips and travel demand management (TDM) actions shall be provided to show how trip adjustments are derived. These estimates shall follow the current edition of the ITE Trip Generation Handbook and are subject to review by Bernalillo County staff. Assumptions regarding public transit, carpooling, and other TDM strategies 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. Projects may require a follow-up evaluation to determine the effectiveness of the TDM program.

8.5.6 Trip Distribution and Assignment

Trip distribution must be documented in the TIA and shall be based on the professional engineer's judgement applied to one or more the following: 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.

Project traffic will be assigned to the road system according to the trip distribution. Figures shall be provided showing trip assignment and total traffic for the AM and PM peak hours.

8.5.7 Phasing

8.5.7.A Non-Phased Development Analysis Years

The TIA analysis years to be evaluated for non-phased developments are:

- Existing year conditions
- Implementation year without the proposed development
- Implementation year with the proposed development
- Horizon year without the proposed development
- Horizon year with the proposed development

The existing year should be defined as the year the existing condition traffic counts are obtained. The implementation year should be defined as the calendar year the proposed development is expected to open.

Horizon year analysis is based on development size. Table 8-2 provides the recommended horizon years based on AM or PM peak hour trips.

Table 8-2 Horizon Year Requirements

Horizon Year	Site AM or PM Peak Hour Trips Generated
Horizon Year Analysis Not Required	Fewer than 100 trips
Implementation Year Plus 5 years	100-300 trips
Implementation Year Plus 10 years	Over 300 trips

8.5.7.B Phased Development Analysis Years

A phased development should involve the same TIA analysis years as described for the non-phased development described above. The TIA's horizon year shall not be greater than MTP's horizon year. Depending on the type and scale of the proposed phased development, and considering the study area conditions, additional implementation years may be identified at the TIA scoping meeting.

The total number of analysis years for a phased development should not exceed four phases. An example of a four phased development is provided in Table 8-3 below. Each of the phases 1-4 examine conditions with and without the proposed development.

Table 8-3: Example Analysis Periods for Phased Developments

Example of Four Phase Development for with over 300 AM or PM peak hour trips
Existing year conditions
Phase 1: Implementation phase
Phase 2: Intermediate phase
Phase 3: Full build out, or where the development will be after 10 years
Phase 4: Horizon year

8.5.8 Intersection Analysis

8.5.8.A Purpose and Methodology

The principal objective of the intersection level of service (LOS) analysis is to determine how the intersection is currently operating and to measure the impact of the project traffic. Intersection analysis will be performed on the study intersections identified in the scoping meeting and all site driveways. In addition, a signal warrant analysis may also be required.

Intersection analysis shall follow the latest edition of the Highway Capacity Manual (HCM). HCM intersection analysis provided in the TIA main body for comparison shall include AM and PM peak hour delay, LOS, V/C ratios, and 95th percentile queue lengths.

8.5.8.B Mitigation Measures

Potential mitigation measures need to be developed if the intersection analysis shows that the LOS does not meet the standard either with the project traffic or without it. Existing LOS will be considered by BCPWD when determining appropriate mitigation measures.

8.5.8.C Signal Warrant and Auxiliary Lane Analysis

Signal warrant analysis shall follow the MUTCD. Auxiliary lane analysis shall follow the SAMM for intersections with NMDOT roads. For all other intersections, auxiliary lane analysis shall follow these Technical Standards.

8.5.9 Segment Analysis

A segment analysis may be required as part of the TIA based on the size of the development and the conditions of the road. The segment analysis will help determine if an additional directional lane is warranted.

The segment analysis is particularly important in developing areas where roads are constructed in phases. Segment analysis shall follow the latest edition of the Highway Capacity Manual. Table 8-4 provides recommended thresholds for segment analysis.

Table 8-4: Recommended Thresholds for Segment Analysis

Current Configuration	Average Weekday Traffic Threshold for Segment Analysis
Four directional lanes with center turn lane	30,000
Four directional lanes without a center turn lane	25,000
Two directional lanes with a center turn lane	15,000
Two directional lanes, no center turn lane	5,000

8.5.10 Level of Service Standards

LOS standards are provided in *Table 8-5*. These standards vary based on the location and the surrounding development.

Table 8-5: LOS Standard by Location and Context

Surrounding Development	Location	LOS Standard
Primarily undeveloped and partially developed areas and new (i.e. previously not existing) roads and intersections	Intersection & Road Segment	LOS C
Developed Areas	Intersection & Road Segment	LOS D
Roads designated as Main Streets in the Comprehensive Plan within developed areas	Intersection & Road Segment	LOS E

8.5.11 Safety Analysis

8.5.11.A Sight Distance Analysis

At the scoping meeting, sight distance analysis for specific access points or intersections may be required. See 3.8.2 and 5.6.3.B within these standards for sight distance analysis requirements.

8.5.11.B Crash Evaluation

At the scoping meeting, intersection and road segments may be selected for a crash evaluation. The evaluation is based on the most recent five years of available crash data. BCPWD annually requests crash data from NMDOT Traffic Safety Bureau and makes these data available for analysis and TIA development.

8.5.12 Recommendations and Mitigation Measures

8.5.12.A General

When a project's vehicular impacts do not meet the minimum acceptable LOS standard, the TIA shall include feasible measures that mitigate the project's impacts. The intersection LOS shall 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. In the cases where LOS does not meet standards without project traffic, the proposed mitigation measures shall minimize delay and queue deficiencies to the greatest extent possible and not deteriorate safety conditions.

8.5.12.B Fair Share Cost Analysis

In circumstances where multiple developments require the same off-site improvements within the same time frame, the contributory costs should be identified. Bernalillo County offers a pro-rata option for cost sharing of local roads (Bernalillo County Code *Ch. 47*). Pro-rata allows a developer to recover costs incurred when a local road is constructed to the site that will also be needed for additional sites.

8.5.12.C Alternative Mode Mitigation Measures

The goal of alternative mode mitigation measures is to reduce the demand for trips by single-occupancy vehicles and to increase opportunities for travel by alternative modes. Mitigation measures may be related to the Bernalillo County Pedestrian and Bicyclist Safety Action Plan or the Long Range Bikeway System. Alternative mode mitigation measures may be required by the County Engineer in lieu of a roadway improvement.

Alternative mode mitigation measures are commonly required along the corridor fronting the site and at adjacent intersections. In addition, for schools, shopping centers, public transportation, and community facilities within 660 feet of the development's property line, bikeways, multi-use trails, and sidewalks identified in the Pedestrian and Bicyclist Safety Plan and other adopted plans should be extended in the right-of-way in order to provide connections to these nearby facilities. Common alternative mode mitigation measures include:

- Providing sidewalks or bringing existing sidewalks into compliance with the Bernalillo County Technical Standards and PROWAG requirements
- Landscape buffer zone with GSI/LID
- Transit stop improvements
- Bicycle infrastructure, including bicycle lanes and buffered bicycle lanes
- Multi-use trail

8.5.13 Content Organization

The TIA should use the following outline to organize the study content. Some points in the outline will not be applicable to all proposed developments.

- Executive Summary
 - Site location and study area
 - Development description and timeframe for completion
 - Summary of findings
 - Recommendations and mitigation measures
- Table of Contents
- Introduction
 - Study purpose
 - Study procedures
- Proposed Development
 - Land use and intensity
 - Development phasing and timing
- Study Area Conditions
 - Adjacent roadways
 - Study area

- o Site accessibility
 - o Transit service, bikeways, trails, and sidewalks
 - o Other known developments
 - o Other known transportation projects
 - o Data sources and analysis methods
- Projected Traffic
 - o Trip generation
 - o Trip distribution and assignment
 - o Existing, growth, baseline, and total traffic
 - o Other developments
- Analysis of Existing Conditions
- Analysis of Implementation Year Conditions and Phases
- Analysis of Horizon Year
- Crash Analysis
- Summary of Findings
- Recommendations and Mitigation Measures
- Appendices
 - o Site plan, vicinity map
 - o Documentation of any assumptions used in the analysis
 - o Turning movement counts, plus documentation to determine total traffic volume
 - o Printouts and worksheets for all analyses performed

9. Glossary

Acceleration/ Deceleration Lane	An auxiliary lane, including taper areas, primarily for the acceleration or deceleration of vehicles entering or leaving the traffic lanes.
Access	A way of approaching or entering property from a public street, highway, or to a private street or legal and acceptable access easement. Access includes ingress and egress. (Bernalillo County Code <i>Appendix A Sec. 5</i>)
Alley	A minor way which is used primarily for vehicular service access to the rear or side of properties otherwise abutting on a street. (Bernalillo County Code <i>Appendix A Sec. 5</i>)
Arterial	A street which primarily delivers large volumes of through traffic from local and collector streets to freeways and between urban centers at the highest level of service possible. Typically, arterial streets are limited-access and prohibit residential access. There are major (principal) and minor arterials. Typically, major arterial streets are longer in distance and have a greater volume of traffic than minor arterial streets.
Asphalt Apron	A paved section, generally on rural roads, that ties a graveled road to a paved road. The purpose is to prevent the tracking of dirt and gravel onto a paved road to prevent pavement degradation.
Clear Sight Triangle	A triangular space located at the intersection of two roads which must meet AASHTO's requirements for sight distance and which must remain clear of visual obstructions. The Technical Standards includes requirements for clear sight triangles for pedestrians in addition to motor vehicles.
Collector	A street which carries traffic from local streets to the major system of arterial streets which may include the principal entrance street of a residential development and streets for circulation within such a development. (Bernalillo County Code <i>Sec. 74-10</i>)
County Development Review Authority (CDRA)	County Development Review Authority - The purpose of the CDRA is to enforce the Bernalillo County Subdivision Ordinance (County Code Ch. 74). The CDRA reviews proposals for land to be platted or replatted so as to constitute a subdivision within jurisdiction of the county.

County Engineer	The County Engineer is the highest-ranking employee in the public works division with a state professional engineer license. This individual is often the deputy county manager for the public works division. The county engineer may delegate any portion of his or her authority to a designee if the county engineer determines that the delegation will improve the delivery of services or serve the public health, safety and welfare. In delegating such authority, the county engineer may reserve the right of final decision.
County Planning Commission (CPC)	County Planning Commission - This commission performs a variety of duties related to planning and zoning. See County Code Ordinance No. 212; amended by Ordinance No. 84-16.
Curb Return	The radius for an intersection or driveway opening; also referred to as radius return
Dedication	Dedication for the Technical Standards refers to the formal approval of the land and the roadway structure becoming a public property under Bernalillo County's jurisdiction.
Developer's Agreement	General, legal, agreement between developer (private or public) and Bernalillo County that allows a specified phase of the development to move forward based on the agreement that required construction or financial contribution will be realized at a specific date or development phase.
Disclosure Statement	Statement including relevant information about a property in order to make an informed decision about the purchase, lease or conveyance of the land. See County Code Ch. 74 Article VIII.
Driveway Access Permit	A permit obtained from Bernalillo County Public Works Division, or the appropriate Authority (i.e., City of Albuquerque, NMDOT, etc.), authorizing access to a public right-of-way from adjoining property
Easement	A right, liberty, privilege or advantage with or without profit which the owner of one parcel of land may have in the lands of another. A right in the owner of one parcel of land, by reason of such ownership, to use the land of another for a special purpose not inconsistent with a general property right of the owner.
Pedestrian	Any individual on foot or in a wheelchair or other mobility assistance device.

Pedestrian Access Route	A public right-of-way or easement for the purpose of pedestrian, bicycle and/or non-motorized access that is typically located between two lots and connects a cul-de-sac, stub street, bikeway and/or trail to an adjoining street, bikeway or trail.
Public Right-of-Way	The total area of land deeded, reserved by plat, defined by Statute, declared by court order, or otherwise acquired by a public agency for the use of the public for purposes of access, utilities, and drainage.
Public Rights-Of-Way Accessibility Guide (PROWAG)	ADA access guide for pedestrian facilities in the public right-of-way. Bernalillo County has adopted this guide.
Queuing Lane	Lane provided for stacking of vehicles temporarily waiting to proceed, generally located at intersections
Refuge Island	A raised median to allow for a pedestrian to wait for traffic crossing
Stone	A stone in a sidewalk is the concrete panel or slab poured as a single, flat unit and is separated by other stones with expansion joints.
Street Classification	A classification of street types as established by County policy or by the Long-Range Roadway System Map adopted by the Metropolitan Transportation Board of the Mid-Region Council of Governments. These street types include local, collector and arterial.
Swale	Drainage bar ditches located along the shoulders of a rural roadway
Transit Corridors	A roadway connecting concentrations of land uses and economic activities which generate a high volume of travel demand and in which transit vehicles can carry a significant proportion of trips as identified in the Albuquerque/ Bernalillo County Comprehensive Plan.
Trip	A one-way vehicle movement from one location to another
Turnaround	An area of sufficient dimension to enable cars and emergency vehicles to turn around – usually at the end of a dead-end street
Vacation	The removal of dedication for either public or multiple private uses.

***Bernalillo County
Green Stormwater Infrastructure/
Low Impact Development
Standards***





GREEN STORMWATER INFRASTRUCTURE
LOW IMPACT DEVELOPMENT STANDARDS

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Introduction

Overview

Green Stormwater Infrastructure (GSI) and Low Impact Development (LID) are approaches to stormwater management. These approaches mimic natural processes to improve water quality and to mitigate environmental impacts, as well as to provide other benefits. The fundamental goal, and a direct benefit, in implementing GSI/LID Best Management Practices (BMPs) is to reduce the amount of stormwater runoff and pollution reaching surface waters and thereby, adversely impacting the watershed. GSI/LID practices are designed to address smaller rainfall events by creating a “break” in directly connected impervious areas (DCIA). DCIAs account for the majority of stormwater runoff in developed areas; by breaking up impervious areas, such as parking lots, with landscape areas that feature GSI/LID BMPs, stormwater runoff from smaller rain events can be reduced or eliminated.

The *Green Stormwater Infrastructure/Low Impact Development Standards* document identifies BMPs for GSI/LID appropriate for the arid environment of the Middle Rio Grande Valley.

The *Green Stormwater Infrastructure/Low Impact Development Standards* also support Bernalillo County’s Stormwater Quality Ordinance and Water Conservation Ordinance and represent an increased commitment on the part of the County toward the goal of broad implementation of GSI/LID. GSI/LID is a direct means of complying with the

County’s Federal Municipal Separate Storm Sewer System (MS4) National Pollutant Discharge Elimination System (NPDES) Permit. Though guidelines for the use of GSI/LID BMPs have been provided in the past, this document contains additional guidance and best practices for design and maintenance. It also provides detailed drawings approved by the County. Users should note this document constitutes an update to the December 2017 [Bernalillo County Green Stormwater Infrastructure: Low Impact Strategies for Desert Communities.](#)

Additionally, this document provides guidance to make it easier for design professionals to reference and to implement BMPs. In addition to the locations and contexts in which GSI/LID BMPs are appropriate, this document outlines Bernalillo County regulatory requirements and provides detailed information to support sound GSI/LID BMP design and construction in Bernalillo County’s arid environment. The guidance should be applied to new development and to redevelopment projects, as well as to roadway corridors.

Key Definitions

Green Stormwater Infrastructure (GSI) is a method of sustainable stormwater management that focuses on treating stormwater runoff prior to it entering rivers, streams, aquifers, and other waterways by leveraging the ecological functions of living, natural systems.

Low Impact Development (LID) refers to design and development practices that work with nature to reduce the stormwater runoff volume generated and to minimize or to eliminate adverse impacts to stormwater quality.

Best Management Practices (BMPs) refers to a set of methods that detain, disperse, attenuate, infiltrate, and/or filter stormwater runoff from impervious surfaces such as streets, sidewalks, rooftops, and parking areas. These practices are designed to manage stormwater runoff and to improve water quality by preventing or reducing pollutants in stormwater runoff.

Purpose of GSI/LID Standards

The following describe the key reasons for implementing GSI/LID standards:

To Advance Best Management Practices in Stormwater Management and Pollution Reduction: GSI/LID practices, as reflected in this document and in the Bernalillo County Technical Standards, are an approach to stormwater management that leverages both engineering and ecosystem services. The intent of GSI/LID practices is to mimic predevelopment hydrology by managing stormwater as close to where it would naturally fall as possible.

To Improve Quality of Life: Implementation of GSI/LID practices makes Bernalillo County an increasingly desirable place to live. It contributes to better quality of life by improving community aesthetics, mitigating impacts from changing climate, conserving potable water, improving air quality, increasing tree canopy, and improving stormwater quality.

To Meet Federal Requirements: Bernalillo County also encourages use of GSI/LID practices as a means of meeting the MS4 Permit requirements.

To Meet Bernalillo County Requirements: Bernalillo County requires GSI/LID BMPs be considered as part of all site development plans. These plans are subject to review by Bernalillo County staff (who are also available to provide guidance during the site plan development process). Per the MS4 Permit requirements, developers **must** manage the stormwater quality design volume on-site. GSI/LID BMPs can be used to meet those requirements. Developers also are required to submit a **Stormwater Post-Construction Green Stormwater Infrastructure/Low Impact Development Best Management Practices Evaluation Form** as part of the Grading & Drainage Plan. This form documents the opportunities to implement GSI/LID BMPs for a project, further emphasizing that GSI/LID BMPs manage stormwater quality design volume as required by the Bernalillo County Stormwater Quality Ordinance.

The process and procedures developers and project designers must follow in the implementation of GSI/LID BMPs are described in **Section 3: Regulatory Requirements for Implementing GSI/LID**.

To Integrate with Bernalillo County Technical Standards: This document was developed in conjunction with the update to the Bernalillo County Technical Standards, completed in 2022. The Technical Standards provide design requirements and considerations for transportation and site infrastructure in unincorporated areas of Bernalillo County. Whereas the Technical Standards provide guidance on appropriate locations for GSI/LID BMPs, this document provides direction on the specific application of GSI/LID BMPs within those appropriate locations.

To Enhance Public Understanding and To Increase Application of GSI/LID: An important objective of this document is to improve the public's understanding and expectations about what GSI/LID is and what it looks like, as ecologically responsible designs may differ from people's expectations. Bernalillo County strives to be a leader in sustainable design and infrastructure, and the County intends for the techniques and the guidance provided in this document to be utilized by other agencies and developers in the Middle Rio Grande Valley.

Intended Users of This Document

This document is a guide for both private development and publicly-funded projects in the installation of GSI/LID BMPs. For **private developers**, the GSI/LID Standards serve to explain the County review process and to provide guidance on appropriate BMPs. For **Bernalillo County staff** and consultants, this document is specifically intended as a resource for inclusion of GSI/LID BMPs in publicly-funded projects.

Contents of the GSI/LID Standards Document

Regulatory Requirements: Bernalillo County regulatory environment and review process.

BMP Technical Guidance Sheets: Definitions, general design, and maintenance guidance, as well as appropriate locations for GSI/LID BMPs.

BMP Standard Drawings: Detailed guidance on the design and construction of BMPs.

Treatment Train Guidance: Examples of how BMPs can be used in combination (i.e., treatment trains).

General Considerations: Appropriate GSI/LID BMP selection, maintenance considerations, and other best practices for design and construction.

Mulch: Guidance on types, preferred use, and best practices for mulch in GSI/LID BMPs.

Plant Selection: Identification of native and drought-tolerant plants appropriate for GSI/LID BMP locations across Bernalillo County.

1 | Locations for GSI/LID BMPs

General Application for GSI/LID BMPs

GSI/LID BMPs included in this document can be used in various applications, including in public infrastructure projects, in roadway rights-of-way and medians, in parking lots, and as part of public and private site developments. The application of GSI/LID BMPs may vary depending on site conditions and on project needs.

Commercial applications include GSI/LID BMPs that manage stormwater runoff from impervious surfaces, such as parking lots, roadways, sidewalks, and rooftops, as well as incorporation into on-site landscaping and stormwater management facilities (e.g., stormwater harvesting ponds, bioswales, etc.). Projects in the **public right-of-way** also produce runoff from impervious surfaces and should incorporate GSI/LID BMPs into roadway medians, landscape/buffer zones, open spaces, and alongside trail facilities.

GSI/LID practices are also appropriate in **residential settings**, and Bernalillo County offers incentive programs for the use of rain barrels and cisterns. See the Bernalillo County Water Conservation Incentive Program webpage (www.bernco.gov/waterconservation) for additional information. For more information on rainwater harvesting on a residential scale go to www.bernco.gov/rainwater.

The typical applications listed in the following sections are not intended to be an exhaustive set of practices, and other techniques may be approved by Bernalillo County upon review. As examples, stormwater planters, tree boxes, and infiltration chambers are typically manufactured proprietary GSI/LID BMP solutions; as such, these are not detailed in the

Bernalillo County GSI/LID Standard Drawings and technical guidance sheets. These are, however, techniques Bernalillo County encourages project designers to consider.

Considerations by Road Type

Urban type roads typically manage stormwater through curb and gutter. They may include medians and landscape buffers. As such, a variety of opportunities exist for the application of GSI/LID BMPs in urban type roads.

Figure 1: Example of Urban Type Road with Depressed Median



Source: K. Bronson | Location: Tucson, AZ

Rural type roads do not typically feature curb and gutter. Opportunities to utilize GSI/LID BMPs in rural type roads include bioswales and stormwater harvesting basins. See the Bernalillo County Technical Standards for additional information on road types.

Figure 2: Example of Rural Type Road with Bioswale



Source: K. Bronson | Location: Bernalillo County

Typical Locations for GSI/LID BMPs

Roadway Median

Medians may be landscaped to increase roadway aesthetics, to improve safety, and to provide traffic calming benefits. Medians are conducive to GSI/LID practices, as they can easily be modified into low points where stormwater can be collected and treated. By modifying the curb and by lowering the grade, stormwater can enter the basin from the roadway. Given their linear characteristics, medians are also conducive to providing conveyance to other stormwater management installations.

Typical GSI/LID BMPs for roadway medians include:

- Bioswale
- Stormwater Harvesting Basin
- Check Dam
- Depressed Median
- Curb Openings with Sediment Traps
- Infiltration Trench

Landscape/Buffer Zone

Landscape/buffer zones are generally located between the sidewalk and the curb along a roadway. Examples include bumpouts and curb extensions at intersections or at mid-block locations. They provide safety and traffic calming benefits, improve aesthetics, and enhance the pedestrian experience. These zones are conducive to GSI/LID BMPs, because they can easily be modified as low points where stormwater can be collected. By using curb openings and by lowering the grade, stormwater can enter the landscape/buffer zones from the roadway or other impervious areas. Given their linear characteristics, landscape/buffer zones are also conducive to providing conveyance to other stormwater management installations.

Typical GSI/LID BMPs for landscape/buffer zones include:

- Bioswale
- Infiltration Trench
- Stormwater Bumpout
- Curb Openings with Sediment Traps
- Stormwater Tree Box*
- Stormwater Planter*

**Not included in GSI/LID Standards document since the designs are proprietary.*

Figure 3: Examples of Landscape/Buffer Zones with GSI/LID BMPs



Source: K. Bronson | Location: Bernalillo County (left)
Albuquerque, NM (right)



Source: J. Luna | Location: Albuquerque, NM

Landscaped Parking Areas

Parking areas offer opportunities for stormwater management, as they typically include landscape strips and basins utilized for on-site stormwater management. Similar to roadway medians and buffers, landscaped areas in parking lots can easily be modified as low points where stormwater can be collected. By using curb openings and by lowering the grade, stormwater can enter the BMPs from drive aisles and from parking stalls. Additionally, angled parking can be used to reduce impervious areas, because it can accommodate more parking spaces within a smaller area.

Typical GSI/LID BMPs for landscaped parking areas include:

- Stormwater Harvesting Basin
- Stormwater Bumpout
- Bioswale
- Infiltration Trench

Figure 4: Example of a Landscaped Parking Area with GSI/LID BMPs



Source: S. Osterman | Location: Bernalillo County

Site Development Applications

GSI/LID BMPs can be applied on most development and redevelopment sites, both public and private, to enhance community aesthetics and to manage stormwater as close as possible to where it falls naturally.

Typical GSI/LID BMPs for site development applications include:

- Stormwater Harvesting Basin
- Bioswale
- Infiltration Trench
- Check Dam
- Permeable Pavement

Figure 5: Examples of Site Development Applications with GSI/LID BMPs



Source: BHI/MRWM (left), S. Osterman (right)
Location: Albuquerque, NM (left), Bernalillo County (right)

2 | Benefits of Implementing GSI/LID BMPs

The fundamental goal in implementing GSI/LID BMPs is to reduce the amount of stormwater runoff and pollution reaching surface waters and thereby, adversely impacting the watershed. In this way, GSI/LID is a direct means of complying with the County's MS4 Permit.

GSI/LID practices are designed to address smaller rainfall events by creating a "break" in directly connected impervious areas (DCIA). DCIAs account for the majority of stormwater runoff in developed areas; by breaking up impervious areas, such as parking lots, with landscape areas that feature GSI/LID BMPs, stormwater runoff from smaller rain events can be reduced or eliminated.

Adverse Effects of Stormwater Runoff

During rainstorms, stormwater runs from impervious surfaces, such as streets and parking lots, picking up contaminants, such as sediment, trash, debris, oil, grease, PCBs, pesticides, bacteria (E. coli), and other chemicals.

Concentrated stormwater runoff from impervious surfaces can also cause erosion, increasing the sediment load in stormwater runoff. Sediment in stormwater runoff holds on to contaminants like oil and grease, PCBs, and pesticides, and may increase the temperature of the water in the river, negatively impacting the animals and insects living there.

Direct Benefits

Direct benefits of GSI/LID include stormwater management and pollution reduction. GSI/LID BMPs slow the flow of water during and after rainfall events (i.e., peak flow attenuation), therefore reducing erosion and promoting sediment capture to ensure that landscaping and stormwater management areas remain durable and functional over the long-term. GSI/LID BMPs also improve surface water quality by filtering and removing pollutants and by capturing floatables, trash, and other debris.

By adding landscaped areas that mimic natural conditions, GSI/LID increases infiltration and groundwater recharge. Collectively, BMPs promote healthier waterways and improve overall stormwater quality, thereby meeting MS4 Permit requirements.

Co-Benefits

In addition to stormwater management and pollution reduction, GSI/LID provides a range of co-benefits that positively affect sustainability and overall quality of life in communities. These co-benefits include:

Encouraging Water Conservation

A sustainable landscape design in an arid region like Bernalillo County needs to include GSI/LID. By harvesting rainwater and using native/drought-tolerant plants, GSI/LID BMPs conserve potable water. Incorporating GSI/LID in landscaping can provide significant long-term water savings.

Reducing Urban Heat Island and Climate Change Impacts

The presence of landscaped areas can reduce the impacts of climate change and the urban heat island effect by minimizing paved surfaces that absorb and re-emit heat from

the sun. Landscaped areas that include trees provide shade and cooling in urban areas.

Increasing Tree Canopy and Improved Air Quality

Trees used in GSI/LID features contribute to improved air quality and mitigate urban heat island effect. They also increase shade, create wildlife habitat, and improve general livability for residents.

Creating Wildlife Habitat

GSI/LID installations replicate native ecosystems outside of the urban area; as such, they can create small pockets of wildlife habitat inside of urban areas. The use of native plant species in landscaping support local fauna and improve biodiversity.

Providing Traffic Calming

GSI/LID techniques can be integrated into medians and buffer areas to provide traffic calming and safety benefits. Landscape areas between the sidewalk and roadway travel lanes can provide a buffer between motorists and pedestrians, while street trees and vegetation can reduce travel speeds and accidents.

Improving Physical and Mental Health Outcomes

At a neighborhood scale, GSI/LID can provide opportunities for physical activity, which can lead to improved mental health by reducing stress and by promoting cognition.

Addressing Environmental Justice

Environmental Justice means all people, regardless of race, color, national origin, or income, are entitled to equal protection from environmental risks. Communities with environmental justice issues often face a disproportionate share of adverse environmental impacts from industrial and governmental operations and policies. This can result in impacts from urban heat islands, industrial pollution, and air

pollution and impacts to health. GSI/LID can provide social, environmental, and economic benefits to communities and can address social inequity within these communities by providing access to parks and to green spaces and by creating a healthier environment where people live and work.

Figure 6: Examples of Traffic Calming Applications: Landscaped Area Between Sidewalk and Roadway



Source: NACTO, *Urban Street Stormwater Guide*

Increasing Aesthetics

Well-designed GSI/LID BMPs can create visually interesting pockets of green space to enhance community aesthetics. GSI/LID can also provide social benefits when BMPs are integrated into outdoor recreation areas and other gathering places.

3 | Regulatory Requirements for Implementing GSI/LID BMPs

Regulatory Context

The US Environmental Protection Agency (EPA) issued the Middle Rio Grande NPDES MS4 Permit in 2014. In addition to general requirements to mitigate the presence of pollutants in stormwater runoff, the MS4 Permit **requires all new development and redevelopment projects that disturb greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale, to manage the stormwater quality design volume on-site.** The MS4 Permit also requires evaluating opportunities for use of GSI/LID sustainable practices in site design and encouraging projects to incorporate such practices. These requirements apply to both public projects and to private developments.

In 2016, Bernalillo County followed and passed the Stormwater Quality Ordinance, Chapter 38, Article IV, to establish stormwater management requirements for the unincorporated area of Bernalillo County. In accordance with the MS4 Permit requirement, the ordinance requires all new development and redevelopment projects above the requirement threshold (disturbing one acre or more, or part of a common development) to implement post-construction water quality BMPs to manage the stormwater quality design volume on-site (refer to **Section 4**). The Stormwater Quality Ordinance also requires that GSI/LID practices be evaluated by applicants and that determination and inclusion of viable GSI/LID BMPs be implemented within projects.

In addition, the Bernalillo County Water Conservation Ordinance, Chapter 30, Article VII, requires all new development to implement indoor and outdoor water

conservation measures. These requirements vary based on the type of development. New commercial development on properties greater than or equal to one acre in size must implement four outdoor water conservation measures. One of the options specified in the Ordinance is to implement passive water harvesting on 45 percent of the landscape area. Passive water harvesting is a type of stormwater quality and GSI/LID BMP; examples of passive water harvesting features include stormwater harvesting basins, bioswales, stormwater bumpouts, and depressed medians. Therefore, incorporating GSI/LID BMPs into commercial development serves to meet Bernalillo County's requirements in both its Stormwater Quality and Water Conservation Ordinances. As maintenance of GSI/LID BMPs is essential to ensure long term functionality, projects that implement passive water harvesting features are also required to submit a Landscape Water Management Plan that communicates routine maintenance requirements.

Finally, all projects that retain or detain stormwater are subject to the Office of the State Engineer rule (NMAC 19.25.12.11.B) that all waters must infiltrate or must be released from detention within 96 hours. Additional information can be found in the [Green Infrastructure Implementation in New Mexico](#) document developed by the New Mexico Environment Department in coordination with the Office of the State Engineer.

Bernalillo County Review Process

Bernalillo County requires submittal of the *Stormwater Post-Construction Green Stormwater Infrastructure/Low Impact Development Best Management Practices Evaluation Form* for new development and redevelopment projects above the requirement threshold (disturbing one acre or more, or part of a common development). The County's *Stormwater Post-Construction Green Stormwater Infrastructure/Low Impact*

Development Best Management Practices Evaluation Form is used to document and track the County's compliance with MS4 Permit and ordinance requirements and to ensure that maintenance requirements for GSI/LID BMPs are transmitted to the facility owner. The form is available on the [Bernalillo County website](http://www.bernco.gov/gsi-lid) (www.bernco.gov/gsi-lid).

When is GSI/LID Required?

All new development and redevelopment projects that disturb one acre or more, including projects less than one acre that are a part of a larger common plan of development or sale, must evaluate for opportunities to implement GSI/LID to manage the stormwater quality design volume on site. GSI/LID BMPs are encouraged for all new development and redevelopment projects, regardless of size.

In addition to the guidance contained in this document, Bernalillo County staff is available to consult with developers and project designers on the appropriate application of GSI/LID BMPs. Bernalillo County encourages developers to consider GSI/LID BMPs early in the site development process and that GSI/LID and stormwater quality BMPs be incorporated into the **grading and drainage plan**.

Applicants should maintain communication with Bernalillo County staff throughout the design process to ensure that goals are met in the final design. Early consideration of GSI/LID can also provide savings and benefits for developers and project designers, as it can be more complicated and expensive to integrate GSI/LID BMPs after the grading and drainage plan and the landscaping plans have been submitted for County review. Additional information on the County review process can be found in **Section 6: GSI/LID BMP Design and Construction**.

4 | Stormwater Quality Design Storm and Design Volume

The EPA MS4 Permit and the Bernalillo County Stormwater Quality Ordinance (Chapter 38, Article IV), require that the stormwater quality design volume (SWQV) be managed on site. The SWQV is derived from the stormwater quality design storm event and calculated using the rainfall depth from the 90th percentile storm event for new development projects and the 80th percentile storm event for redevelopment projects.

Key Definitions

New Development, in relation to the retention of the stormwater quality design volume, is defined as a project that is developed on a site with little or no existing impervious cover. This can include an undeveloped property or a property that had previously been developed, but site improvements and impervious cover have been mostly or completely removed so that site constraint issues related to existing infrastructure no longer exist.

Redevelopment, in relation to retention of the stormwater quality design volume, is defined as a development project that alters the footprint of an existing site, building, or impervious area. Redevelopment projects have site constraints typically not found in new development projects.

SWQV Calculation:

The entire site contributes to the SWQV, which is calculated using the appropriate land treatment types for the planned development (whether existing, new development, or redevelopment). The SWQV is derived from the stormwater quality design storm event and is calculated as follows. Stormwater quality design storm rainfall depths for development types and land treatments are summarized in Table 1.

- **SWQV Calculation for New Development** – The 90th percentile new development rainfall depth for Land Treatment D (0.615 inches) multiplied by the new development impervious (Land Treatment D) areas plus the new development rainfall depth for Land Treatment C (0.52 inches) multiplied by the new development Land Treatment C areas:

$$\begin{aligned} \text{SWQV (cubic feet)} = & \\ & [(0.615 \text{ inches}) \times (\text{Land Treatment D areas in sq. ft.}) \\ & + (0.52 \text{ inches}) \times (\text{Land Treatment C areas in sq. ft.})] / 12 \end{aligned}$$

- **SWQV Calculation for Redevelopment** – The 80th percentile rainfall depth for Land Treatment D (0.48 inches) multiplied by the redevelopment impervious (Land Treatment D) areas plus the redevelopment rainfall depth for Land Treatment C (0.41 inches) multiplied by the redevelopment Land Treatment C areas:

$$\begin{aligned} \text{SWQV (cubic feet)} = & \\ & [(0.48 \text{ inches}) \times (\text{Land Treatment D areas in sq. ft.}) \\ & + (0.41 \text{ inches}) \times (\text{Land Treatment C areas in sq. ft.})] / 12 \end{aligned}$$

All stormwater runoff from a site must receive stormwater quality treatment, and all BMPs must be sized for the SWQV for the tributary area. If a BMP is sized for the SWQV for the entire site, then the project designer must ensure that it collects runoff from the entire site and is not limited to a portion of the site. More often, site runoff is collected at multiple locations, requiring multiple properly sized BMPs.

See the Standard Drawings and Table 3 for stormwater quality design volume data required for project plans for GSI/LID BMPs.

Table 1: Stormwater Quality Design Storm Rainfall Depths by Development Type & Land Treatment

Development Type	Land Treatment	Rainfall Depth for SWQV Calculation
New Development	D	0.615"
New Development	C	0.52"
Redevelopment	D	0.48"
Redevelopment	C	0.41"

Source: [Estimating Predevelopment Hydrology in the Middle Rio Grande Watershed, New Mexico](#) (EPA Publication Number 832-R-14-007, Tetra Tech, 2014)

Key Definitions

Land Treatment C:

- Soil compacted by human activity with minimal vegetation including unpaved parking, roads, and walkways.
- Irrigated lawns and parks with slopes greater than 10 percent.
- Native grasses, weeds, and shrub areas and soil uncompacted by human activity with slopes at 20 percent or greater.
- Native grasses, weeds, and shrub areas with clay or clay loam soils and other soils of very low permeability, as classified by SCS Hydrologic Soil Group D.

Land Treatment D: Impervious areas such as pavement and roofs. This area includes ponds, channels, and wetlands, even if these areas are seasonally dry.

Note: Land Treatments C and D follow the definition from the City of Albuquerque Development Process Manual (DPM) with minor modifications to Land Treatment C.

5 | GSI/LID BMPs

General Overview

This section highlights the most common and most appropriate GSI/LID BMPs for application in unincorporated Bernalillo County, given the arid environment and the desire to conserve water.

Table 2 presents the GSI/LID BMPs described in this document, along with typical benefits associated with these techniques. Each BMP is profiled on a following page in a **technical guidance sheet**. Each sheet contains a graphic depiction, design considerations, maintenance needs, appropriate locations and context, and complementary techniques, along with a **Standard Drawing** that indicates preferred design specifications and construction methods.

It is important to note the appropriate GSI/LID BMP may vary from the provided guidance depending on site specific conditions and the site location within the Middle Rio Grande region. Site features and conditions, as well as design considerations, should inform the selection of appropriate GSI/LID BMPs.

The BMPs presented in this section are not intended to be an exhaustive set of practices. Other techniques may be approved by Bernalillo County upon review. As examples, stormwater planters, tree boxes, and infiltration chambers are typically manufactured proprietary GSI/LID solutions; these are not detailed in the Bernalillo County GSI/LID Standard Drawings and technical guidance sheets but are techniques Bernalillo County encourages project designers to consider. Project designers may consult the December 2017 document [Bernalillo County Green Stormwater](#)

[Infrastructure: Low Impact Design Strategies for Desert Communities](#) for additional techniques and guidance.

GSI/LID BMPs designed in accordance with the Standard Drawings in this document, as well as properly located/applied, will be approved by Bernalillo County. Any design modifications to the Standard Drawings will be reviewed and evaluated on a project-by-project basis.

Table 2: Summary of Benefits by GSI/LID BMP

		Reduces or Regulates Runoff Rate or Volume	Filters Out Pollutants	Increases Infiltration	Captures Debris, Floatables & Sediment	Reduces Urban Heat Island Effect	Promotes Evaporation/ Transpiration
	Curb Opening				✓		
	Stormwater Harvesting Basin	✓	✓	✓	✓	✓	✓
	Stormwater Bumpout	✓	✓	✓	✓	✓	✓
	Bioswale	✓	✓	✓	✓	✓	✓
	Depressed Median	✓	✓	✓	✓	✓	✓
	Infiltration Trench	✓	✓	✓	✓		
	Check Dam	✓		✓	✓		
	Outlet Control Structure	✓			✓		
	Permeable Pavement	✓	✓	✓		✓	

Application of BMPs and Treatment Trains

GSI/LID BMPs can be used alone or in conjunction with other treatments. However, GSI/LID BMPs are most effective when used in various combinations – called treatment trains – tailored to a given site. A stormwater treatment train helps to maximize infiltration of stormwater and to capture pollutants in stormwater runoff before they reach the downstream receiving waters. This provides better overall results compared to the use of a single BMP. A treatment train can consist of multiple installations of one type of GSI/LID BMP (e.g., stormwater harvesting basins) or multiple BMPs (e.g., bioswales and check dams).

Examples of treatment trains that show how BMPs can function together to manage stormwater runoff can be found on pages 36-37. The treatment train on page 36 illustrates how permeable pavement, curb openings with sediment traps, a stormwater bumpout, and an infiltration trench collectively provide an effective GSI/LID installation adjacent to a roadway or to a parking lot. The treatment train on page 37 shows a combination of a bioswale, check dam, and stormwater harvesting basin as a GSI/LID solution that could fit into many development designs.

Considerations for ADA Compliance

All GSI/LID BMP installations should meet the Americans with Disabilities Act (ADA) Standards for Accessible Design requirements. Project designers should review and consider the intent of the ADA requirements when selecting BMPs for locations where pedestrians may be present.

CURB OPENING



CURB OPENING

An opening in a curb to allow stormwater from an impervious surface, such as roads, parking lots, or hardscape areas, to flow into an infiltration area. Typical design includes a sediment trap located behind the curb opening.

DESIGN CONSIDERATIONS

- Can be used to retrofit existing projects, as well as can be constructed with new projects. Retrofit application will require sawcut and removal of existing curb and gutter.
- Recommend minimum curb opening length of 2-feet to prevent clogging.
- Recommend sediment trap to facilitate maintenance. There are many designs for sediment traps, and the County will consider alternatives to the Curb Opening Standard Drawing.
- Recommend minimum 2-inch elevation drop be provided from the curb opening flowline to the finished grade at back of curb to ensure positive drainage.
- Erosion protection must be provided downstream of the sediment trap.
- Size and place erosion protection as needed for design storm velocity and slope stabilization.
- Utilize the AASHTO Roadside Design Guide when placing and designing curb openings adjacent to travel ways.

MAINTENANCE

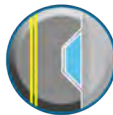
- Inspect after storms > 0.25-inches; recommend a minimum of two inspections per year.
- Remove debris, trash, and accumulated sediment from curb opening and sediment trap. The accumulated sediment should be removed if it reduces the curb opening capacity.
- Check for and repair erosion issues.
- Routinely check curb opening for damage from vehicle strikes and repair, as necessary.
- Remove vegetation that obstructs flow into the infiltration area.

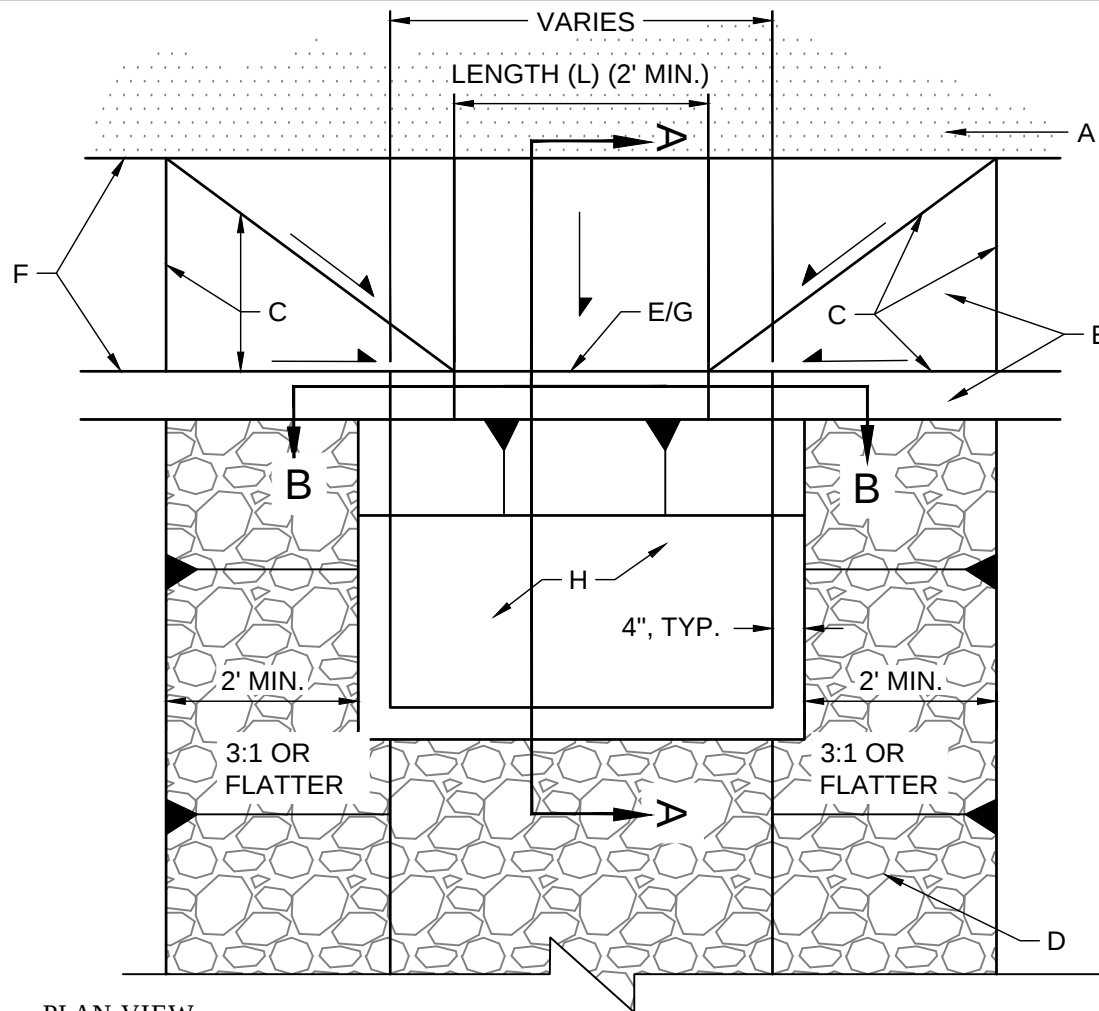


WHERE TO USE

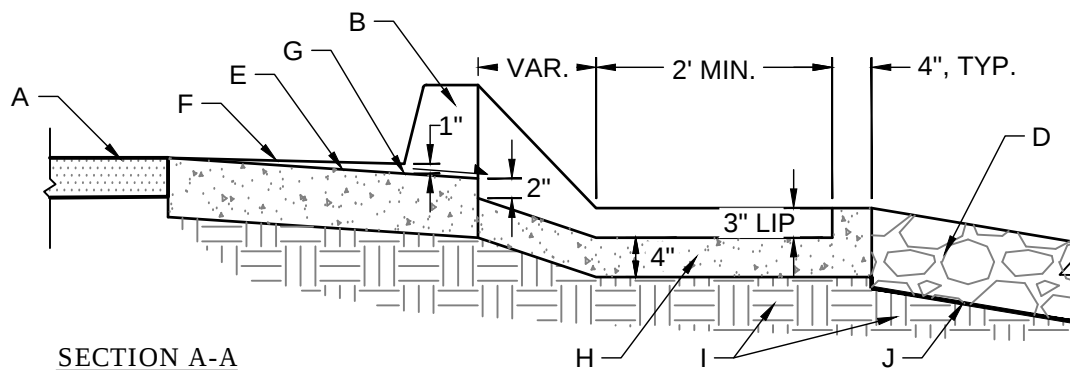
✓	Urban Type Road
	Rural Type Road
✓	Streetside
✓	Parking
✓	Residential Development
✓	Commercial/Institutional Development

FUNCTIONS WITH

		
STORMWATER BASIN	STORMWATER BUMPOUT	BIOSWALE
		
DEPRESSED MEDIAN	INFILTRATION TRENCH	PERMEABLE PAVEMENT



PLAN VIEW



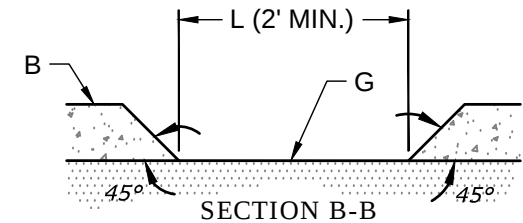
SECTION A-A

GENERAL NOTES:

1. SEE TECHNICAL GUIDANCE SHEET FOR DESIGN GUIDANCE AND CONSIDERATIONS.
2. CURB OPENING LENGTH (L) SHALL BE PROVIDED ON PROJECT PLANS (2' MIN.).
3. SEDIMENT TRAP SHOULD BE DESIGNED FOR CONTRIBUTING WATERSHED/SEDIMENT LOAD AND DESIGN HYDRAULIC CONDITIONS. DIMENSIONS SHOWN ARE FOR TYPICAL APPLICATION AND MAY BE MODIFIED BY PROJECT PLANS.
4. DETAIL AS SHOWN ASSUMES NEW CONSTRUCTION. MAY BE MODIFIED FOR RETROFIT CONSTRUCTION OF CURB OPENING.

CONSTRUCTION NOTES:

- A. ADJACENT ROADWAY/PARKING SURFACE.
- B. CURB OR CURB AND GUTTER PER PROJECT PLANS. STANDARD C&G PER COUNTY STANDARD DWG 2415A SHOWN.
- C. GUTTER TRANSITION PER COUNTY STANDARD DWG 2207 OR AS MODIFIED PER PROJECT PLANS.
- D. RIPRAP RUNDOWN OR EROSION PROTECTION. LAYOUT, DIMENSIONS, AND RIPRAP SIZE/THICKNESS PER PROJECT PLANS.
- E. DEPRESSED GUTTER AT CURB OPENING.
- F. NORMAL GUTTER.
- G. POINT OF MEASUREMENT FOR CURB OPENING FLOWLINE ELEVATION.
- H. CONCRETE SEDIMENT TRAP, 4" THICK. DIMENSIONS (LENGTH, WIDTH, AND DEPTH (IF DIFFERS FROM 3")). PER PROJECT PLANS.
- I. SUBGRADE BELOW SEDIMENT TRAP AND RIPRAP COMPACTED TO 95% MAX DENSITY.
- J. NON-WOVEN GEOTEXTILE FILTER CLOTH BETWEEN RIPRAP AND SUBGRADE.



SECTION B-B



COUNTY OF BERNALILLO	
CURB OPENING	
REVISIONS	
GSI-01	JULY 2022



STORMWATER HARVESTING BASIN

A stormwater harvesting basin is designed for capture and infiltration of stormwater runoff to support vegetation, to regulate discharge rates, and to improve water quality.

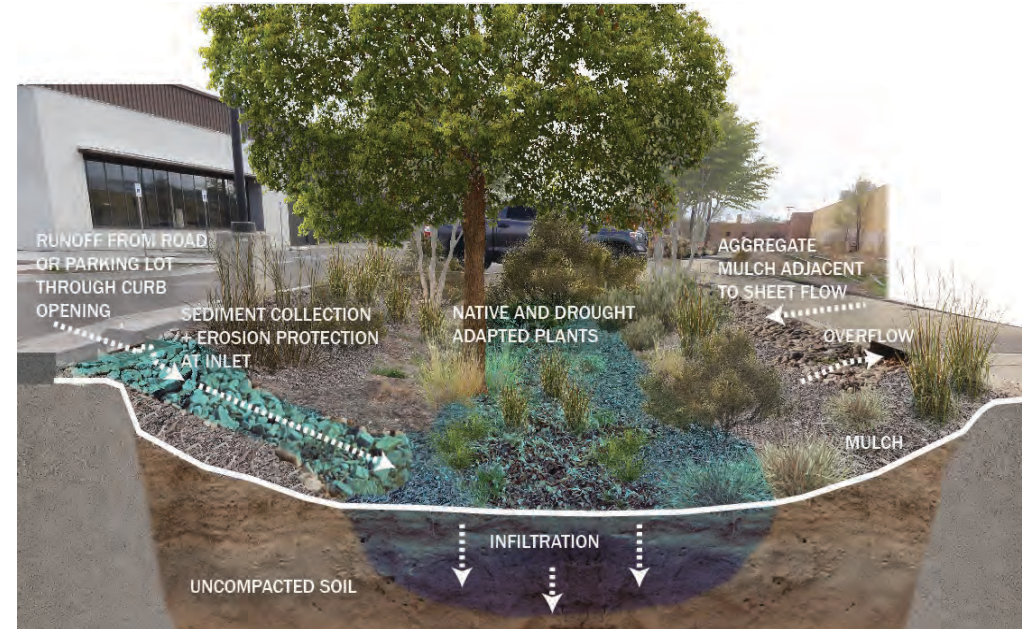
STORMWATER BASIN

DESIGN CONSIDERATIONS

- Consider depth to the groundwater table and bedrock; refer to Section 6, General Design Principles.
- Recommend infiltration rate greater than 0.5-inch/hr. Infiltration testing should be conducted at the proposed basin bottom elevation. An underdrain may be required if the infiltration rate is less than 0.5-inch/hr.
- Ponded surface water shall infiltrate or be released from detention within 96 hours or less, if required by local ordinances.
- To maximize infiltration, do not compact bottom during or after construction and ensure that the bottom is scarified per the standard drawing.
- Size and place erosion protection as needed for design storm velocity and slope stabilization.
- Overflow structure required and shall be sized for the 100-yr. discharge, or design report shall demonstrate the basin retains the 100-yr., 24-hr. contributing runoff.
- Consider a sediment trap at concentrated inflows.
- Place plants according to elevation zone and inundation zone. Do not place plants where inlet(s) or overflow will be impacted.
- Include an irrigation system for plant establishment.

MAINTENANCE

- Inspect after storms > 0.25-inches; recommend a minimum of two inspections per year.
- Remove debris, trash, and accumulated sediment. The accumulated sediment should be removed if it reduces the basin capacity.
- Check for and repair erosion issues.
- Add and redistribute organic mulch as needed.
- Prune and replace plants as needed.
- Leave organic debris in place to biodegrade.
- Remove invasive species.

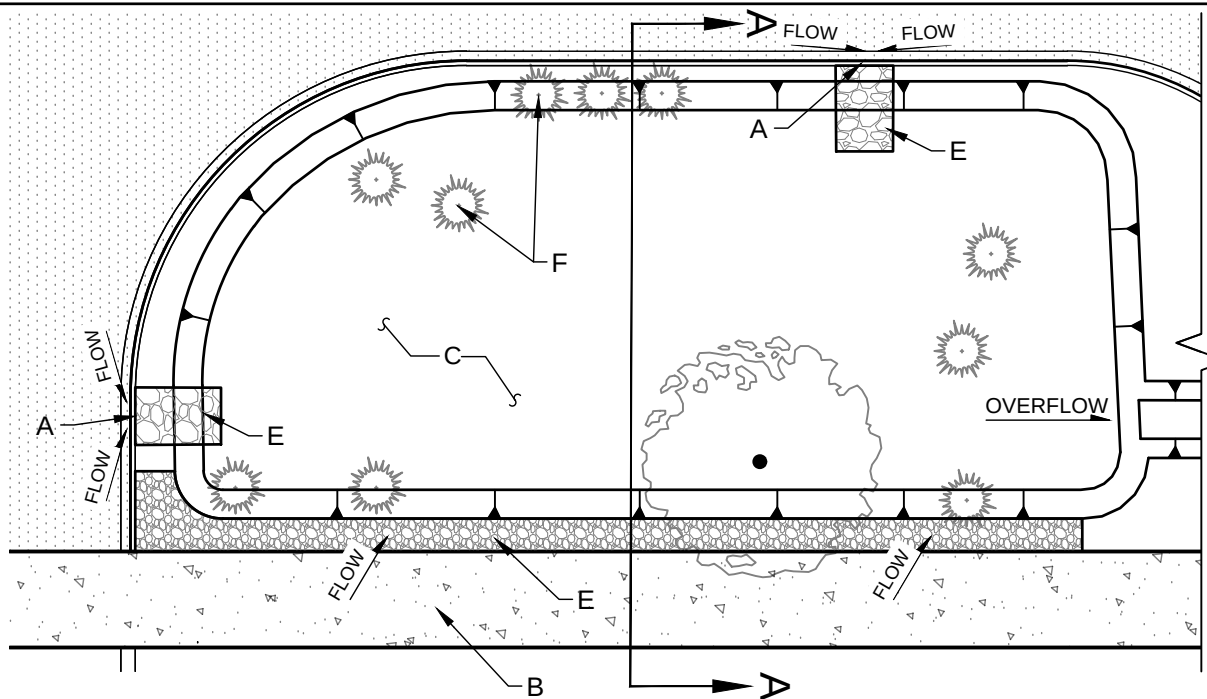


WHERE TO USE

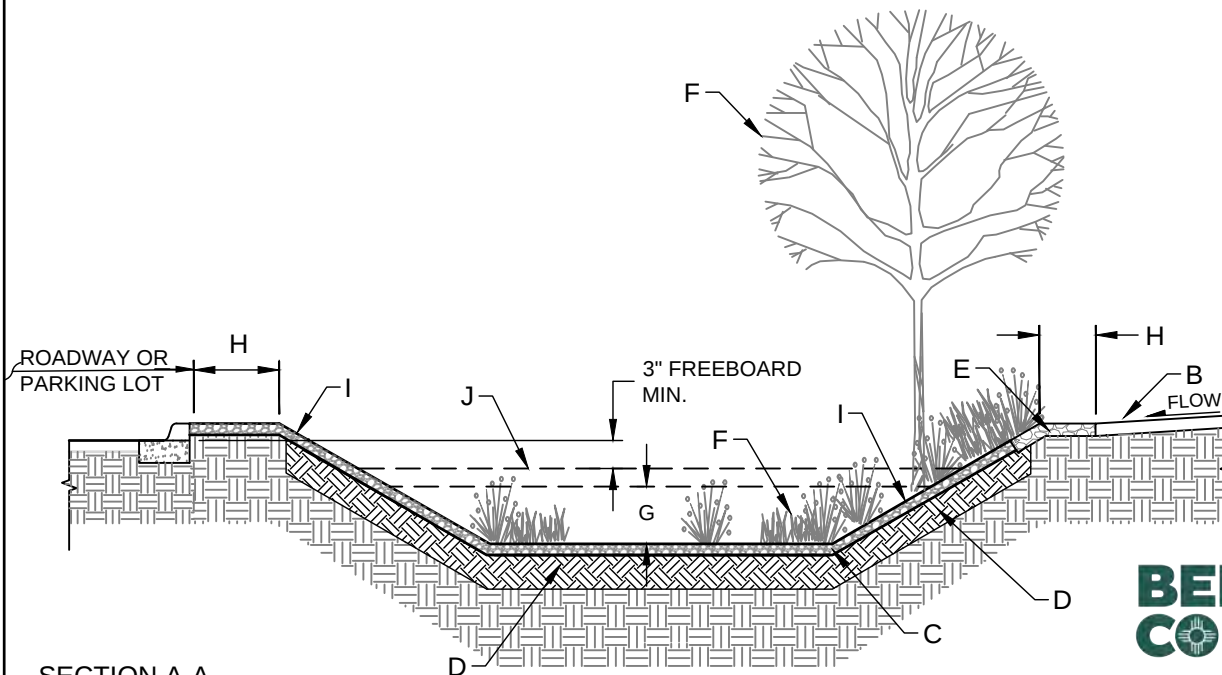
✓	Urban Type Road
✓	Rural Type Road
✓	Streetside
✓	Parking
✓	Residential Development
✓	Commercial/Institutional Development

FUNCTIONS WITH

		
CURB OPENING	BIOSWALE	DEPRESSED MEDIAN
		
INFILTRATION TRENCH	OUTLET CONTROL STRUCTURE	PERMEABLE PAVEMENT



PLAN VIEW



SECTION A-A

GENERAL NOTES:

1. SEE TECHNICAL GUIDANCE SHEET FOR DESIGN GUIDANCE AND CONSIDERATIONS.
2. OVERFLOW REQUIRED & SHALL BE SIZED FOR 100-YEAR PEAK DISCHARGE OR DESIGN REPORT SHALL DEMONSTRATE BASIN RETAINS 100-YEAR, 24-HOUR CONTRIBUTING RUNOFF.
3. NO PLANTINGS IMPACTING FLOW CAPACITY SHALL BE PLACED AT CONCENTRATED FLOW INLETS OR OVERFLOW.
4. TREES AND SHRUBS SHOULD BE LOCATED IN ACCORDANCE WITH INUNDATION ZONE AND ELEVATION ZONE. SEE BERNALILLO COUNTY GSI PLANT LIST FOR GUIDANCE.
5. MULCH TYPE AND LOCATION PER PROJECT PLANS SHALL BE INFORMED BY EVALUATION OF HYDRAULIC CONDITIONS AND MAY BE USED FOR EROSION PREVENTION, SLOPE STABILIZATION, OR DESIGN PREFERENCE. ORGANIC MULCH MAY BE USED WHERE DESIGN VELOCITY IS LESS THAN 1 FPS.
6. AVOID COMPACTION OF BASIN BOTTOM DURING AND AFTER CONSTRUCTION TO MAINTAIN INFILTRATION RATE

CONSTRUCTION NOTES:

- A. CURB OPENING PER COUNTY STD DWG GSI-01.
- B. SIDEWALK, PATH, OR OTHER HARDSCAPE DRAINING TO BASIN.
- C. ORGANIC OR INORGANIC MULCH PER PROJECT PLANS. PLANS SHALL SPECIFY MULCH TYPE, THICKNESS, AND LOCATION.
- D. SCARIFY SUBGRADE TO DEPTH OF 12", MIN.
- E. EROSION PROTECTION AT FLOW INLET. TYPE & DIMENSIONS PER PROJECT PLANS. COMPACT SUBGRADE BELOW EROSION PROTECTION TO 95% OF MAX DENSITY.
- F. PLANTS PER PROJECT PLANS.
- G. 9" MAXIMUM PONDING DEPTH & DEPTH FOR CALCULATING STORMWATER QUALITY VOLUME (SWQV). MEASURED FROM BASIN BOTTOM TO OVERFLOW ELEVATION.
- H. 2' STEP OUT WHEN BASIN ALONG ROADWAY. 1' SETBACK ALONG OTHER PEDESTRIAN ROUTES.
- I. 3H:1V SIDE SLOPE OR FLATTER TYP.
- J. WATER SURFACE AT 100-YEAR OVERFLOW DEPTH. FREEBOARD MEASURED FROM OVERFLOW WATER SURFACE TO TOP OF BASIN OR LOWEST INFLOW ELEVATION (WHICHEVER IS LOWEST).



COUNTY OF BERNALILLO	
REVISIONS	STORMWATER HARVESTING BASIN
	GSI-02
	JULY 2022

STORMWATER BUMPOUT



An area for infiltration and green infrastructure interventions created when the curb and gutter are moved out into the portion of the roadway normally reserved for parking. Otherwise known as 'bulbouts' or 'chicanes.'

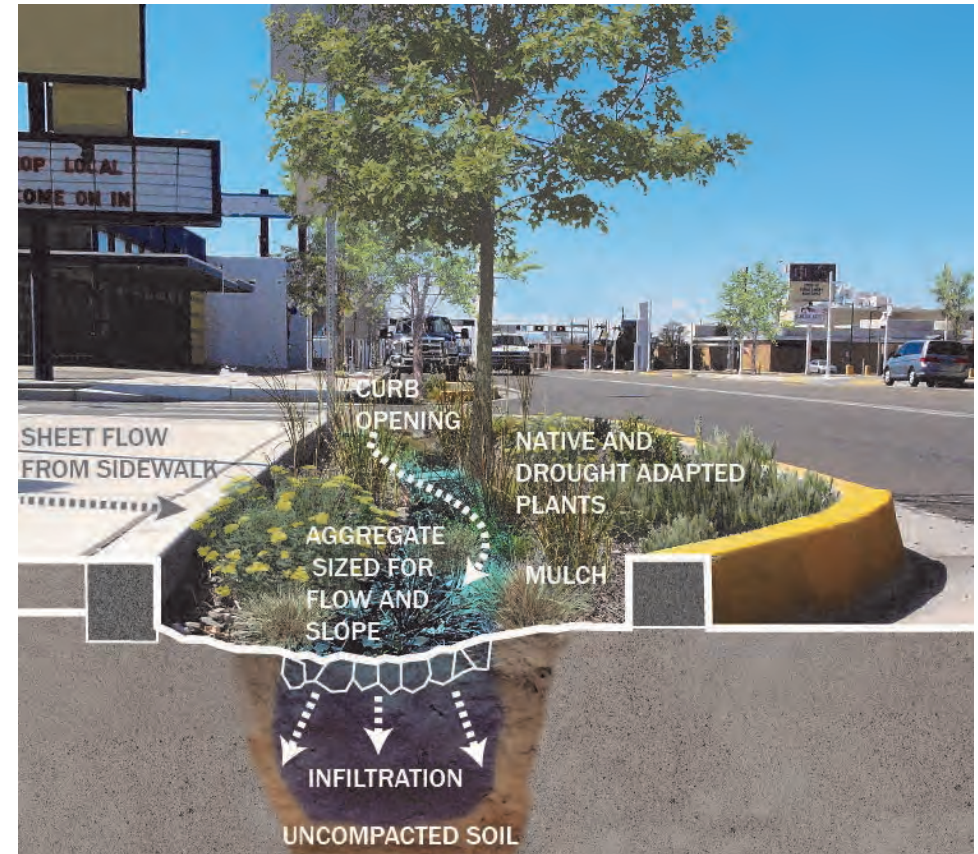
STORMWATER BUMPOUT

DESIGN CONSIDERATIONS

- Can be used to retrofit existing projects, as well as can be constructed with new projects. Retrofit application will require sawcut and removal of existing curb, gutter, and pavement.
- Stormwater bumpouts can function as mid-block traffic calming structures.
- To maximize infiltration, do not compact bottom during or after construction and ensure that the bottom is scarified per the standard drawing.
- Place sediment trap at inlet as shown in curb opening GSI-01 standard drawing.
- Size and place erosion protection as needed for design storm velocity.
- Place plants according to elevation zone and inundation zone. Do not place plants where inlet(s) or outlet will be impacted.
- Include an irrigation system for plant establishment.
- Select plants that allow for vehicle clearances and sight triangles.
- Utilize the AASHTO Roadside Design Guide when placing and designing stormwater bumpouts adjacent to travel ways.

MAINTENANCE

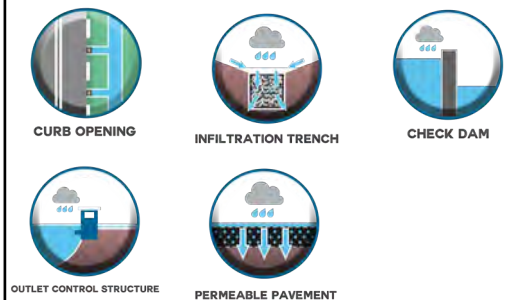
- Inspect after storms > 0.25-inches; recommend a minimum of two inspections per year.
- Remove debris, trash, and accumulated sediment. The accumulated sediment should be removed if it reduces the bumpout capacity.
- Check for and repair erosion issues.
- Add and redistribute organic mulch as needed.
- Prune and replace plants as needed. Prune plants to maintain vehicle clearances and sight triangles.
- Leave organic debris in place to biodegrade.
- Remove invasive species.

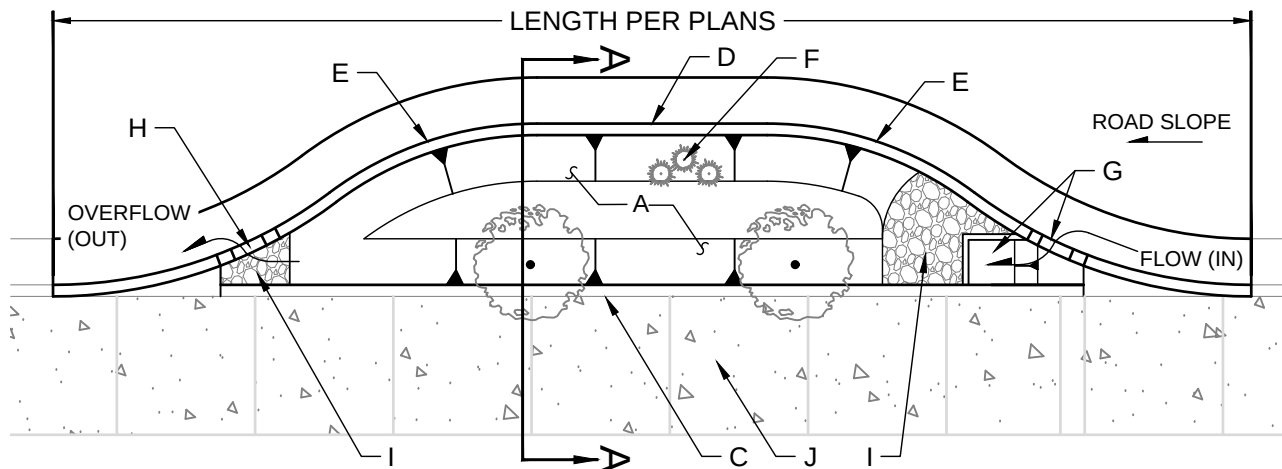


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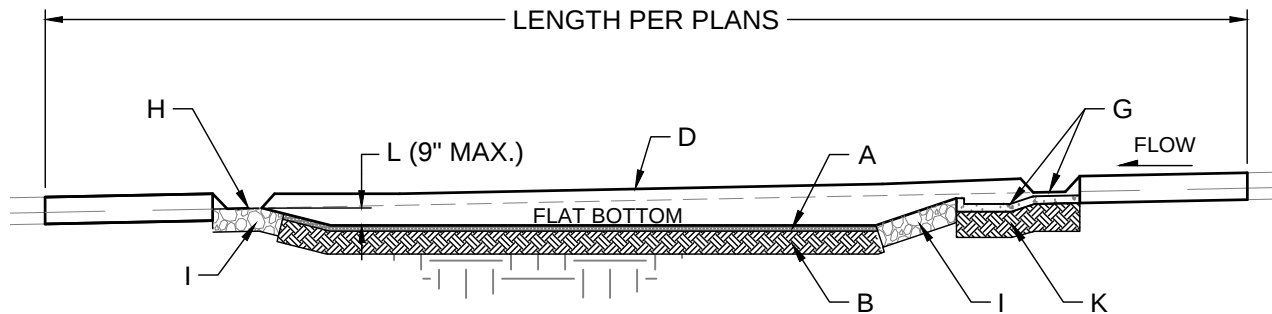
✓	Urban Type Road
✓	Rural Type Road
✓	Streetside
✓	Parking
	Residential Development
✓	Commercial/Institutional Development

FUNCTIONS WITH

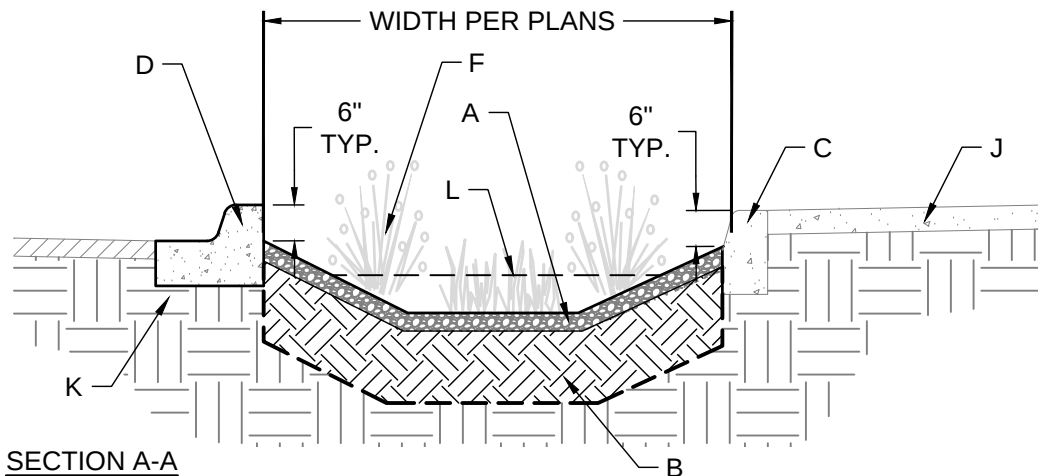




PLAN VIEW



PROFILE VIEW



SECTION A-A

GENERAL NOTES:

1. SEE TECHNICAL GUIDANCE SHEET FOR DESIGN GUIDANCE AND CONSIDERATIONS.
2. PLANTS SHOULD BE LOCATED IN ACCORDANCE WITH INUNDATION ZONE AND ELEVATION ZONE. SEE BERNALILLO COUNTY GSI PLANT LIST FOR GUIDANCE.
3. MULCH TYPE AND LOCATION PER PROJECT PLANS SHALL BE INFORMED BY EVALUATION OF HYDRAULIC CONDITIONS AND MAY BE USED FOR EROSION PREVENTION, SLOPE STABILIZATION, OR DESIGN PREFERENCE. ORGANIC MULCH MAY BE USED WHERE DESIGN VELOCITY IS LESS THAN 1 FPS.

CONSTRUCTION NOTES:

- A. ORGANIC OR INORGANIC MULCH PER PROJECT PLANS. PLANS SHALL SPECIFY MULCH TYPE, THICKNESS, AND LOCATION.
- B. SCARIFY SUBGRADE TO DEPTH OF 12", MIN.
- C. HEADER CURB OR EXISTING CURB (SAWCUT AND REMOVE GUTTER PAN FLUSH WITH CURB FACE).
- D. STANDARD CURB AND GUTTER PER COUNTY STANDARD DRAWING 2415A.
- E. RADIUS PER PROJECT PLANS, 10' MIN.
- F. PLANTS PER PROJECT PLANS.
- G. CURB OPENING AND SEDIMENT TRAP PER COUNTY STD DWG GSI-01.
- H. CURB OPENING AT OVERFLOW PER COUNTY STD DWG GSI-01 (NO SEDIMENT TRAP).
- I. RIPRAP EROSION PROTECTION. COMPACT SUBGRADE BELOW EROSION PROTECTION TO 95% OF MAX DENSITY. REFER TO PROJECT PLANS FOR DIMENSIONS.
- J. SIDEWALK AT BACK OF CURB.
- K. COMPACTED SUBGRADE BELOW C&G AND PAVEMENT.
- L. 9" MAXIMUM PONDING DEPTH & DEPTH FOR CALCULATING STORMWATER QUALITY VOLUME (SWQV). MEASURED FROM BASIN BOTTOM TO OVERFLOW ELEVATION.



COUNTY OF BERNALILLO	
REVISIONS	STORMWATER BUMPOUT
	GSI-03
	JULY 2022

BIOSWALE



A shallow, linear, or curvilinear feature designed to improve water quality by conveying, slowing, and treating runoff; allows pollutants to settle out and promotes infiltration.

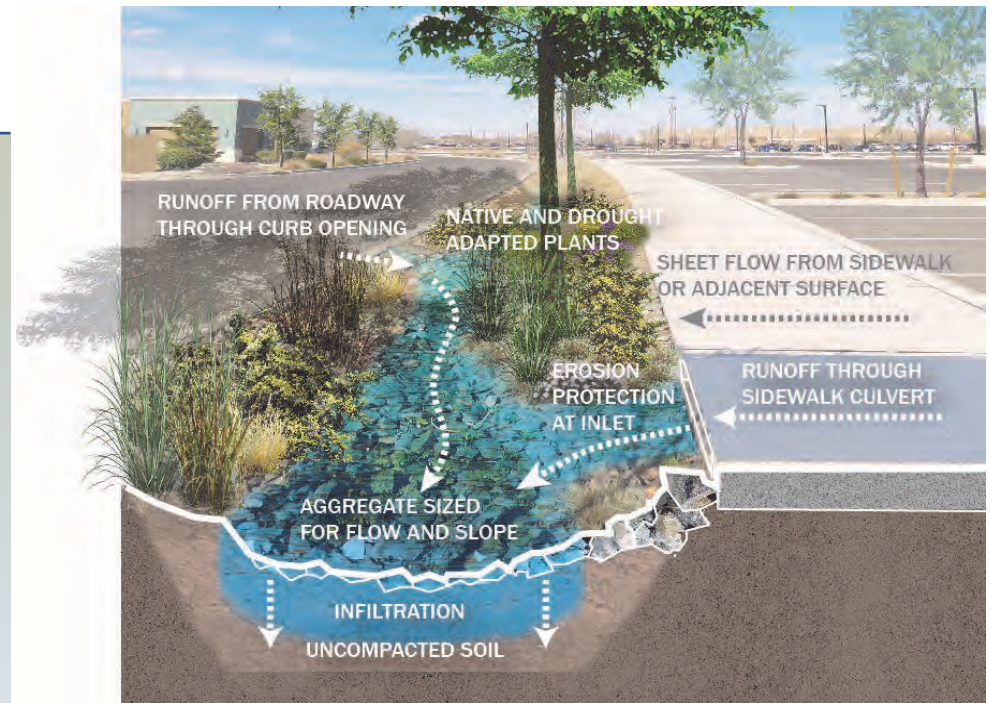
BIOSWALE

DESIGN CONSIDERATIONS

- Meandering swale design encouraged.
- Consider depth to the groundwater table and bedrock; refer to Section 6, General Design Principles.
- Recommend infiltration rate greater than 0.5-inch/hr. An underdrain may be required if the infiltration rate is less than 0.5-inch/hr.
- To maximize infiltration, do not compact bottom during or after construction and ensure that the bottom is scarified per the standard drawing.
- Size and place erosion protection as needed for design storm velocity and slope stabilization.
- Recommend max. longitudinal slope of 5% to minimize potential for erosive flow velocities.
- Consider a sediment trap at concentrated inflows.
- Place plants according to elevation zone and inundation zone. Do not place plants where inlet(s) or outlet will be impacted.
- Include an irrigation system for plant establishment.

MAINTENANCE

- Inspect after storms > 0.25-inches; recommend a minimum of two inspections per year.
- Remove debris, trash, and accumulated sediment. The accumulated sediment should be removed if it reduces the bioswale capacity.
- Check for and repair erosion issues.
- Add and redistribute organic mulch as needed.
- Prune and replace plants as needed.
- Leave organic debris in place to biodegrade.
- Remove invasive species.

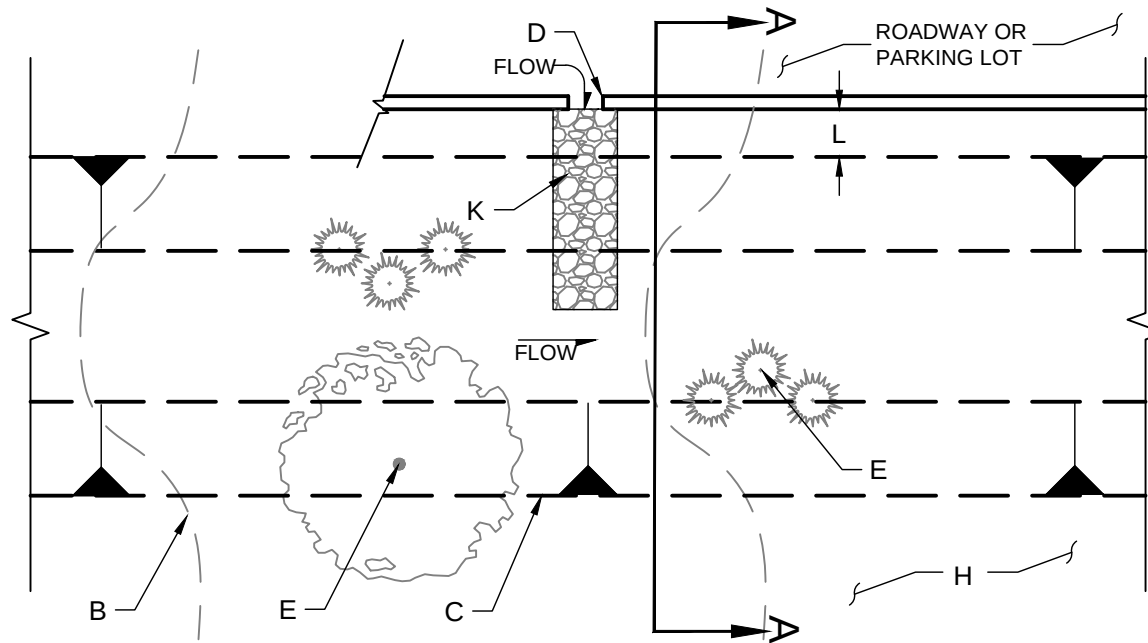


WHERE TO USE

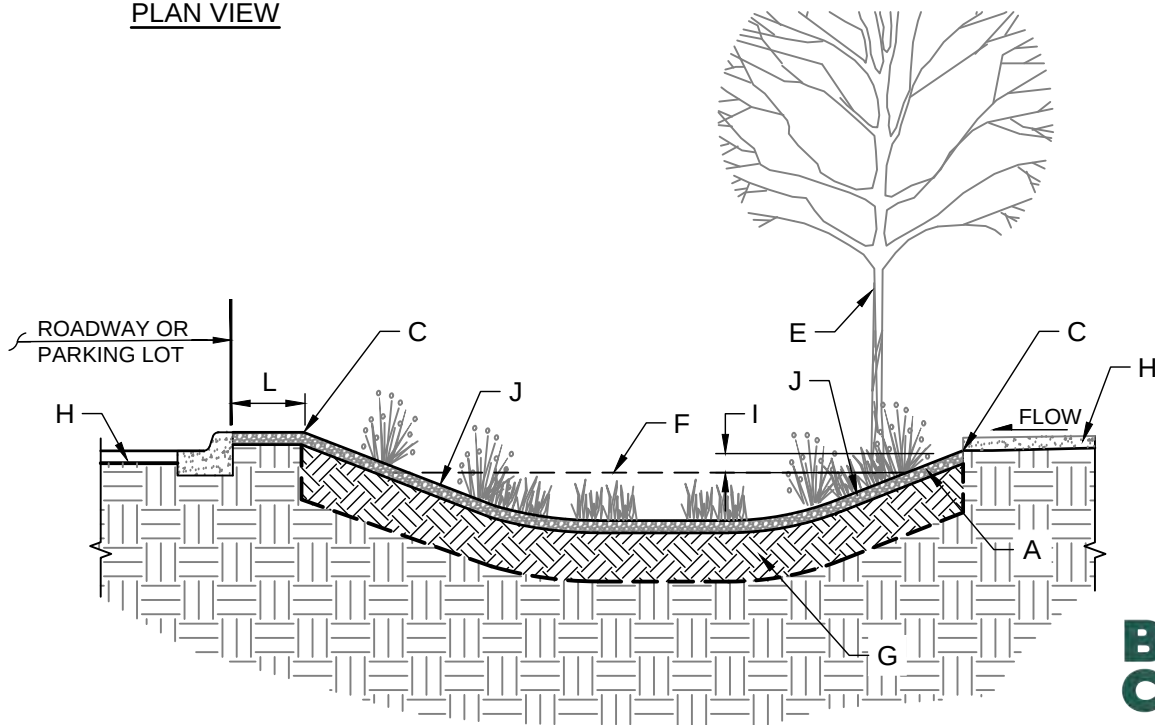
✓	Urban Type Road
✓	Rural Type Road
✓	Streetside
✓	Parking
✓	Residential Development
✓	Commercial/Institutional Development

FUNCTIONS WITH

		
CURB OPENING	STORMWATER BASIN	DEPRESSED MEDIAN
		
INFILTRATION TRENCH	CHECK DAM	OUTLET CONTROL STRUCTURE



PLAN VIEW



SECTION A-A

GENERAL NOTES:

1. SEE TECHNICAL GUIDANCE SHEET FOR DESIGN GUIDANCE AND CONSIDERATIONS.
2. TREES AND SHRUBS SHOULD BE LOCATED IN ACCORDANCE WITH INUNDATION ZONE AND ELEVATION ZONE. SEE BERNALILLO COUNTY GSI PLANT LIST FOR GUIDANCE.
3. CHECK DAMS PER COUNTY STD DWG GSI-07 SHALL BE PROVIDED WHEN DESIGN STORM VELOCITY EXCEEDS 3 FPS. REFER TO PROJECT PLANS.
4. MULCH TYPE AND LOCATION PER PROJECT PLANS SHALL BE INFORMED BY EVALUATION OF HYDRAULIC CONDITIONS AND MAY BE USED FOR EROSION PREVENTION, SLOPE STABILIZATION, OR DESIGN PREFERENCE. ORGANIC MULCH MAY BE USED WHERE DESIGN VELOCITY IS LESS THAN 1 FPS.
5. STABLE GRASS LINING MAY BE USED IN PLACE OF MULCH PER PROJECT PLANS.
6. AVOID COMPACTION OF BIOSWALE BOTTOM DURING AND AFTER CONSTRUCTION TO MAINTAIN INFILTRATION RATE.

CONSTRUCTION NOTES:

- A. ORGANIC OR INORGANIC MULCH PER PROJECT PLANS. PLANS SHALL SPECIFY MULCH TYPE, THICKNESS, AND LOCATION.
- B. CONCEPTUAL DESIGN CONTOUR.
- C. TOP OF BIOSWALE/CHANNEL/DITCH.
- D. CURB OPENING PER COUNTY STD DWG GSI-01.
- E. PLANTS PER PROJECT PLANS.
- F. WATER SURFACE AT DESIGN STORM FLOW DEPTH
- G. SCARIFY SUBGRADE TO DEPTH OF 12", MIN.
- H. ADJACENT SURFACES MAY VARY.
- I. 3" FREEBOARD, MIN.
- J. 3H:1V SIDE SLOPE OR FLATTER, TYP.
- K. EROSION PROTECTION AT FLOW INLET. COMPACT SUBGRADE BELOW EROSION PROTECTION TO 95% OF MAX DENSITY. REFER TO PROJECT PLANS FOR DIMENSIONS AND DETAILS.
- L. 2' STEP OUT WHEN BIOSWALE ALONG ROADWAY. 1' SETBACK ALONG OTHER PEDESTRIAN ROUTES. CROSS SLOPE SHALL MATCH SHOULDER OR 2% MAX.



COUNTY OF BERNALILLO	
REVISIONS	BIOSWALE
	GSI-04
	JULY 2022

DEPRESSED MEDIAN



A linear or curvilinear shallow depression located in the roadway median designed to improve water quality by conveying, slowing, and treating runoff; allows pollutants to settle out and promotes infiltration.

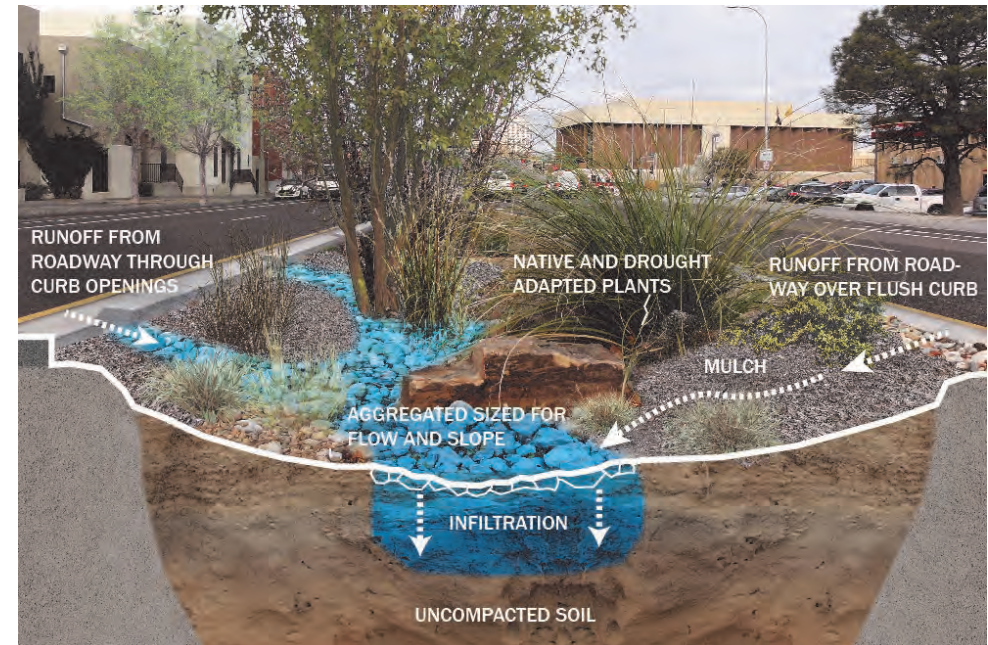
DEPRESSED MEDIAN

DESIGN CONSIDERATIONS

- Consider depth to the groundwater table and bedrock; refer to Section 6, General Design Principles.
- Recommend max. longitudinal slope of 5% to minimize potential for erosive flow velocities.
- Recommend infiltration rate greater than 0.5-inch/hr. An underdrain may be required if the infiltration rate is less than 0.5-inch/hr.
- To maximize infiltration, do not compact bottom during or after construction and ensure that the bottom is scarified per the standard drawing.
- Size and place erosion protection as needed for design storm velocity and slope stabilization.
- Consider a sediment trap at concentrated inflows.
- Place plants according to elevation zone and inundation zone. Do not place plants where inlet(s) or outlet will be impacted.
- Include an irrigation system for plant establishment.
- Select plants that allow for vehicle clearances and sight triangles.
- Utilize the AASHTO Roadside Design Guide when placing and designing depressed medians adjacent to travel ways.

MAINTENANCE

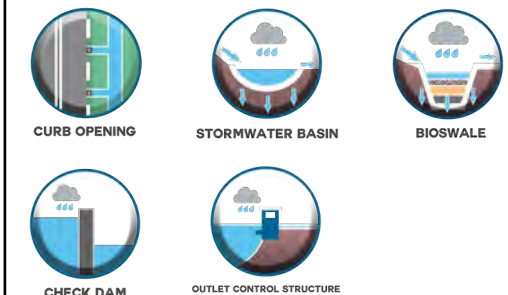
- Inspect after storms > 0.25-inches; recommend a minimum of two inspections per year.
- Remove debris, trash, and accumulated sediment. The accumulated sediment should be removed if it reduces the median capacity.
- Check for and repair erosion issues.
- Add and redistribute organic mulch as needed.
- Prune and replace plants as needed. Prune plants to maintain vehicle clearances and sight triangles.
- Leave organic debris in place to biodegrade.
- Remove invasive species.

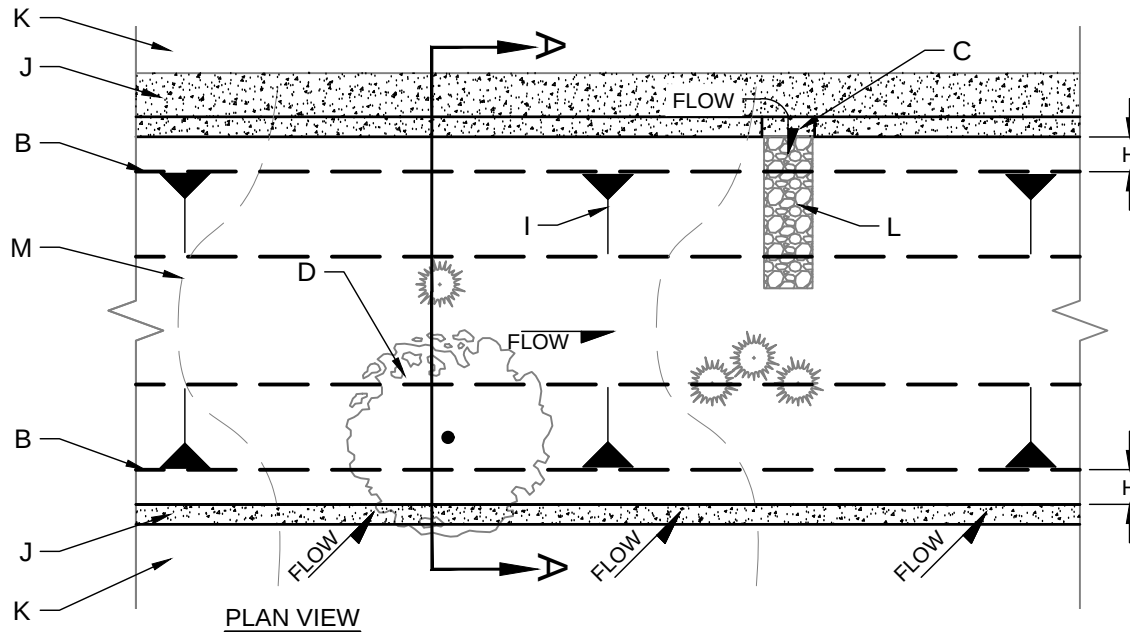


WHERE TO USE

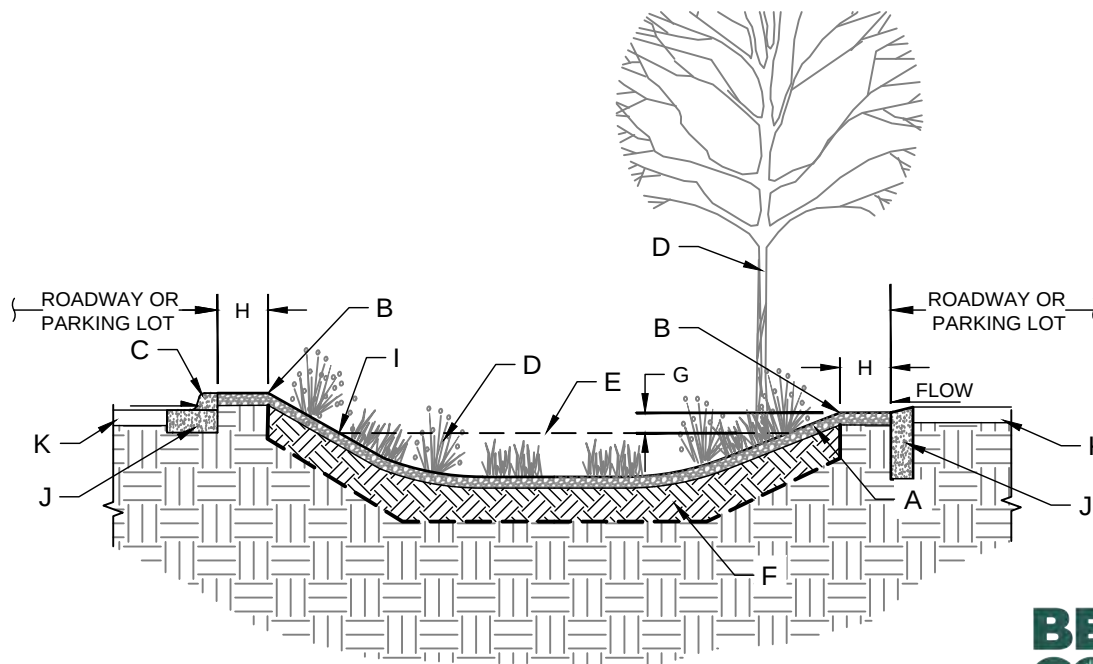
✓	Urban Type Road
✓	Rural Type Road
✓	Streetside
✓	Parking
✓	Residential Development
✓	Commercial/Institutional Development

FUNCTIONS WITH





PLAN VIEW



SECTION A-A

GENERAL NOTES:

1. SEE TECHNICAL GUIDANCE SHEET FOR DESIGN GUIDANCE AND CONSIDERATIONS.
2. TREES AND SHRUBS SHOULD BE LOCATED IN ACCORDANCE WITH INUNDATION ZONE AND ELEVATION ZONE. SEE BERNALILLO COUNTY GSI PLANT LIST FOR GUIDANCE.
3. CROSS SLOPE OF SHOULDER BEHIND FLUSH CURB SHOULD BE STEEPER THAN LONGITUDINAL SLOPE TO DIRECT FLOW TO DEPRESSED MEDIAN.
4. CHECK DAMS PER COUNTY STD DWG GSI-07 SHALL BE PROVIDED WHEN DESIGN STORM VELOCITY EXCEEDS 3.0 FPS. REFER TO PROJECT PLANS.
5. MULCH TYPE AND LOCATION PER PROJECT PLANS SHALL BE INFORMED BY EVALUATION OF HYDRAULIC CONDITIONS AND MAY BE USED FOR EROSION PREVENTION, SLOPE STABILIZATION, OR DESIGN PREFERENCE. ORGANIC MULCH MAY BE USED WHERE DESIGN VELOCITY IS LESS THAN 1 FPS.

CONSTRUCTION NOTES:

- A. ORGANIC OR INORGANIC MULCH PER PROJECT PLANS. PLANS SHALL SPECIFY MULCH TYPE, THICKNESS, AND LOCATION.
- B. TOP OF BIOSWALE/CHANNEL/DITCH.
- C. CURB OPENING PER COUNTY STD DWG GSI-01.
- D. PLANTS PER PROJECT PLANS.
- E. WATER SURFACE AT DESIGN STORM FLOW DEPTH.
- F. SCARIFY SUBGRADE TO DEPTH OF 12", MIN.
- G. 3" FREEBOARD, MIN.
- H. 2' STEP OUT WHEN USED ALONG ROADWAY. 1' SETBACK ALONG OTHER PEDESTRIAN ROUTES. CROSS SLOPE PER PROJECT PLANS.
- I. 3H:1V SIDE SLOPE OR FLATTER, TYP.
- J. CONCRETE STANDARD CURB AND GUTTER OR FLUSH HEADER CURB PER COUNTY STANDARD DWG 2415A/B. REFER TO PROJECT PLANS.
- K. ADJACENT PARKING/ROAD SURFACES.
- L. EROSION PROTECTION AT FLOW INLET. COMPACT SUBGRADE BELOW EROSION PROTECTION TO 95% OF MAX DENSITY. REFER TO PROJECT PLANS FOR DIMENSIONS AND DETAILS.
- M. CONCEPTUAL DESIGN CONTOUR.



REVISIONS

COUNTY OF BERNALILLO

DEPRESSED MEDIAN

GSI-05

JULY 2022

INFILTRATION TRENCH



A linear excavated area that is lined with filter fabric and filled with rock in order to create additional space for runoff to collect and infiltrate into adjacent permeable soils.

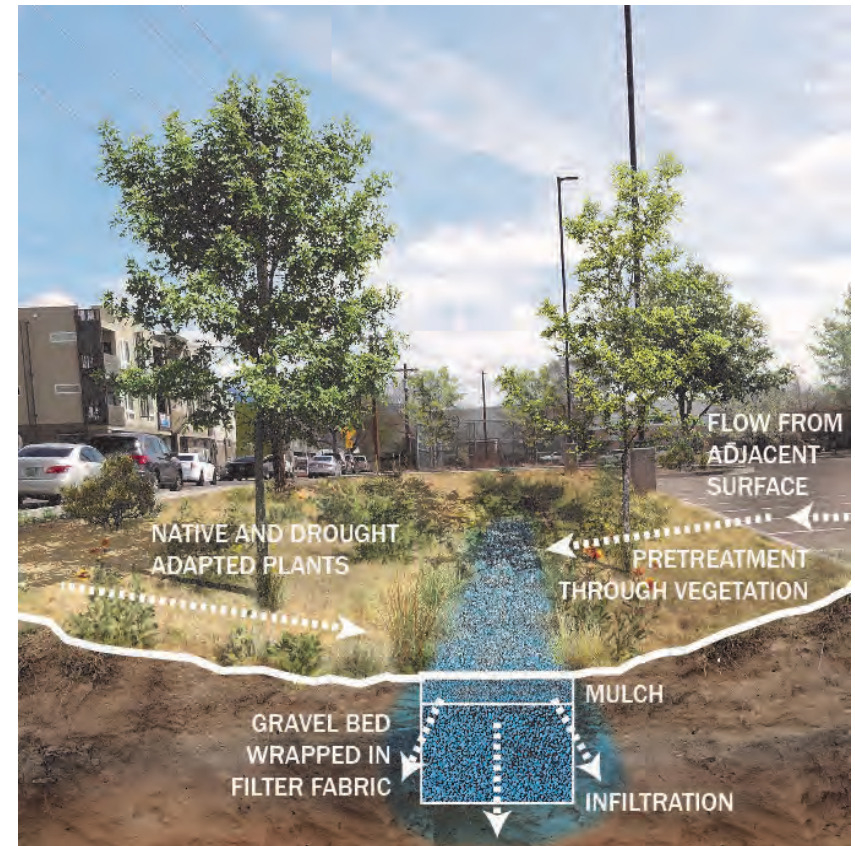
INFILTRATION TRENCH

DESIGN CONSIDERATIONS

- Recommend using where soils have low infiltration rates or where there is limited width for implementing GSI BMPs.
- Recommend stormwater runoff pretreatment (filter strips, sediment traps, etc.) to prevent sediment from clogging the infiltration trench.
- Porous gravel material provides additional retention capacity prior to infiltration into the subsurface.
- Consider depth to the groundwater table and bedrock; refer to Section 6, General Design Principles.
- Recommend infiltration rate greater than 0.5-inch/hr. An underdrain may be required if the infiltration rate is less than 0.5-inch/hr.
- To maximize infiltration, do not compact bottom during or after construction and ensure that the bottom is scarified per the standard drawing.
- Vegetation may not be grown on the infiltration trench. Plantings adjacent to the infiltration trench are encouraged so vegetation may utilize the infiltrated stormwater; plants should not inhibit maintenance of the infiltration trench.

MAINTENANCE

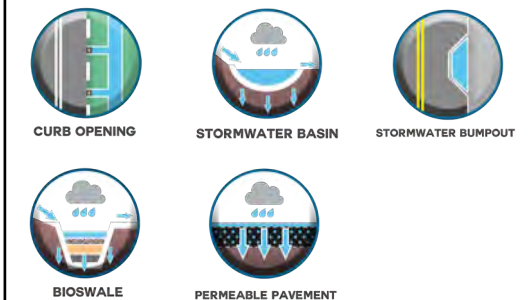
- Inspect after storms > 0.25-inches; recommend a minimum of two inspections per year.
- Remove debris, trash, and accumulated sediment, especially at pretreatment locations.
- Prune and replace adjacent plants as needed.
- Remove plants from trench. Vegetation within the trench can reduce the infiltration.
- If infiltration rates have decreased substantially, major maintenance may be performed by removing, cleaning, and replacing the top gravel layer or by removing the gravel and replacing any clogged filter fabric.

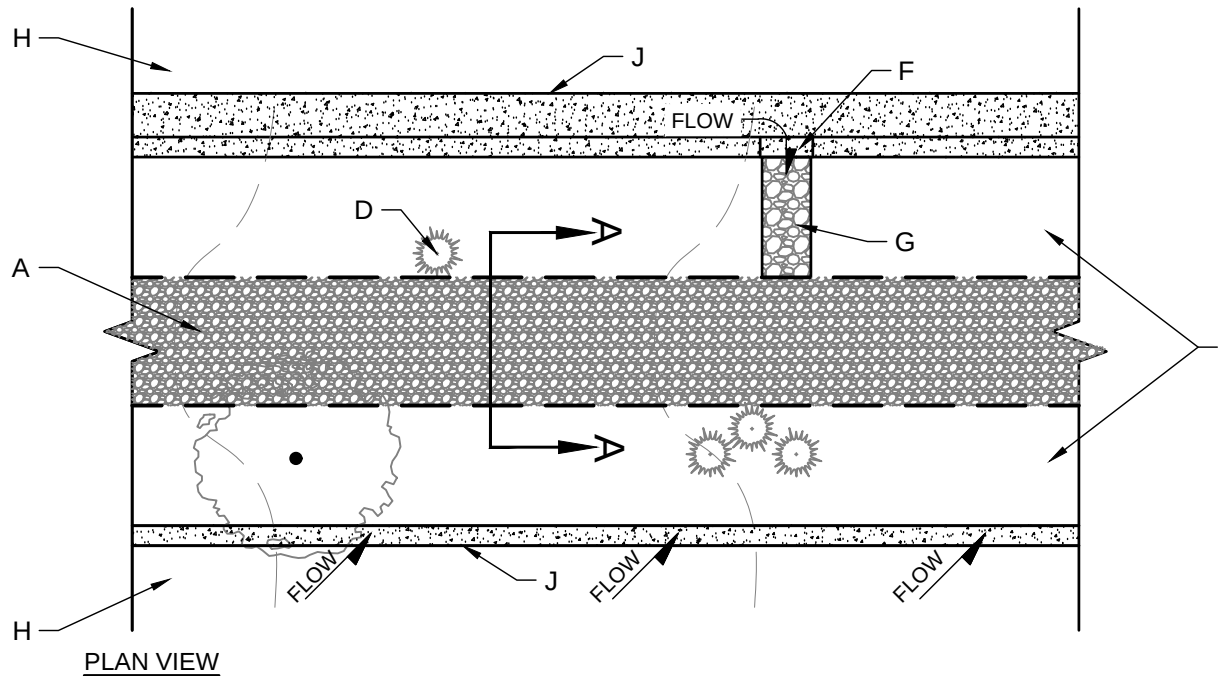


WHERE TO USE

✓	Urban Type Road
✓	Rural Type Road
✓	Streetside
✓	Parking
✓	Residential Development
✓	Commercial/Institutional Development

FUNCTIONS WITH



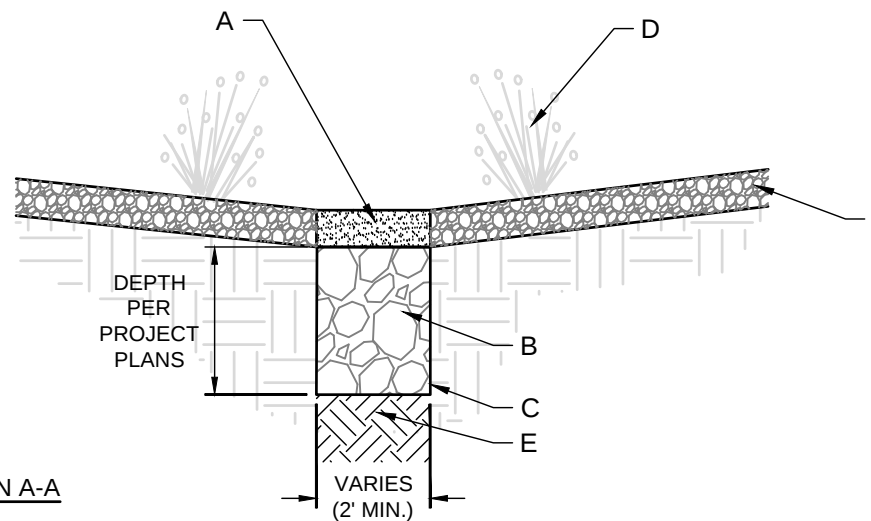


GENERAL NOTES:

1. SEE TECHNICAL GUIDANCE SHEET FOR DESIGN GUIDANCE AND CONSIDERATIONS.
2. RESERVOIR LAYER WIDTH AND DEPTH SHALL BE PROVIDED ON PROJECT PLANS. CONSIDER IN-SITU SUBSURFACE CONDITIONS AND OTHER SITE CONSTRAINTS.
3. ALL STONE SHALL BE DOUBLE-WASHED, SUFFICIENT TO REMOVE DUST AND OTHER COATINGS.

CONSTRUCTION NOTES:

- A. FILTER LAYER, CLEAN GRAVEL PER PROJECT PLANS. 3" THICK MINIMUM.
- B. RESERVOIR LAYER, ASTM #2 OR AS SPECIFIED ON PROJECT PLANS.
- C. NON-WOVEN GEOTEXTILE FILTER CLOTH AROUND GRAVEL RESERVOIR LAYER, ALL SIDES (INCLUDING BETWEEN RESERVOIR LAYER AND FILTER LAYER).
- D. PLANTS PER PROJECT PLANS.
- E. SCARIFY SUBGRADE BELOW RESERVOIR LAYER TO DEPTH OF 12", MIN.
- F. CURB OPENING PER COUNTY STD DWG GSI-01.
- G. EROSION PROTECTION AT FLOW INLET. COMPACT SUBGRADE BELOW EROSION PROTECTION TO 95% OF MAX DENSITY. REFER TO PROJECT PLANS FOR DIMENSIONS AND DETAILS.
- H. ADJACENT PARKING/ROAD/ HARDSCAPE SURFACES.
- I. ORGANIC OR INORGANIC MULCH PER PROJECT PLANS. PLANS SHALL SPECIFY MULCH TYPE, THICKNESS, AND LOCATION.
- J. CURB OR CURB AND GUTTER PER PROJECT PLANS.



COUNTY OF BERNALILLO	
REVISIONS	INFILTRATION TRENCH
	GSI-06 JULY 2022

CHECK DAM



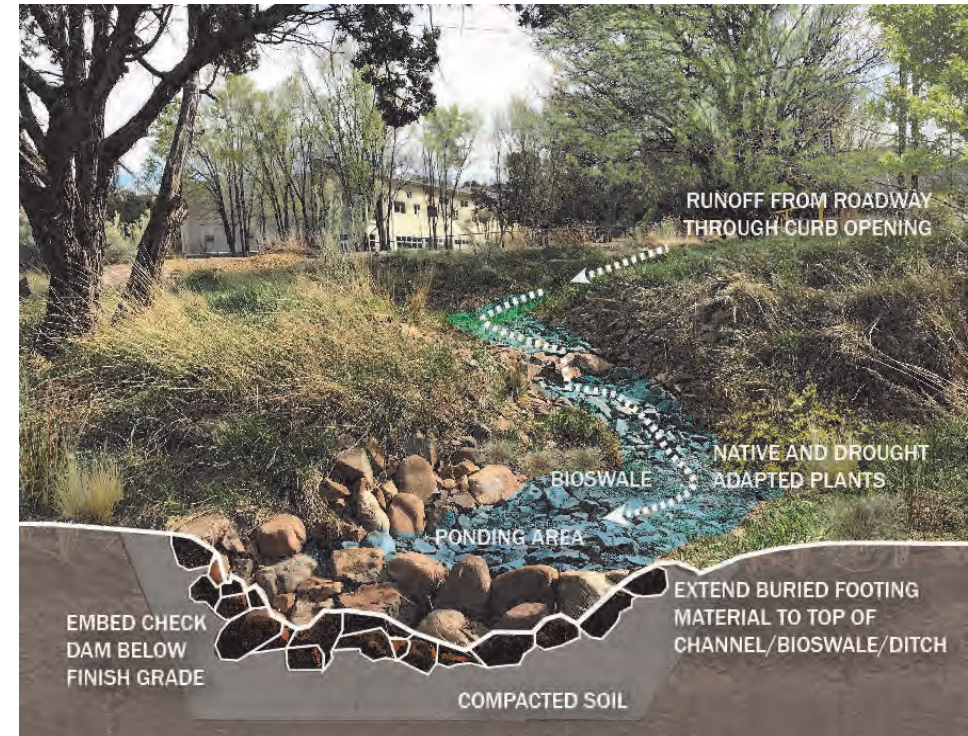
CHECK DAM

DESIGN CONSIDERATIONS

- Check dams shall be installed when the design storm velocity exceeds 3 feet-per-second (fps).
- Most effective when used in series, spaced at regular intervals.
- Recommend check dam max. height of 18-inches.
- Recommend max. longitudinal slope of 5% to minimize potential for erosive flow velocities.
- Check dams can be comprised of angular gravel or stone or other aggregates, such as clean broken concrete, wood, metal, or compacted soil. The standard drawing is specific to gravel, cobble, clean broken concrete, or other suitable aggregate; if other materials are used, the design will vary from the standard drawing.
- Size and place check dam materials as needed for the design storm velocity and slope stabilization per project plans. Typically constructed of 8-12-inch rock and may be graded such that smaller diameter rock is located on the upstream side of larger rock.
- This standard drawing is for a shallow, permeable, rock check dam designed for smaller flows, typical for GSI/LID BMPs. Larger structures designed for larger flows or steeper slopes could use wire-tied rip rap or concrete.

MAINTENANCE

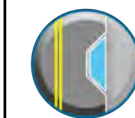
- Inspect after storms > 0.25-inches; recommend a minimum of two inspections per year.
- Remove debris, trash, and accumulated sediment. Remove sediment if over half of the original check dam height.
- Check for and repair erosion issues; look for flanking and scour issues.
- Restore dislodged or washed out check dams to their original configuration.
- Remove invasive species and vegetation growing near the check dam whose roots could damage the structure.



WHERE TO USE

✓	Urban Type Road
✓	Rural Type Road
✓	Streetside
✓	Parking
✓	Residential Development
✓	Commercial/Institutional Development

FUNCTIONS WITH



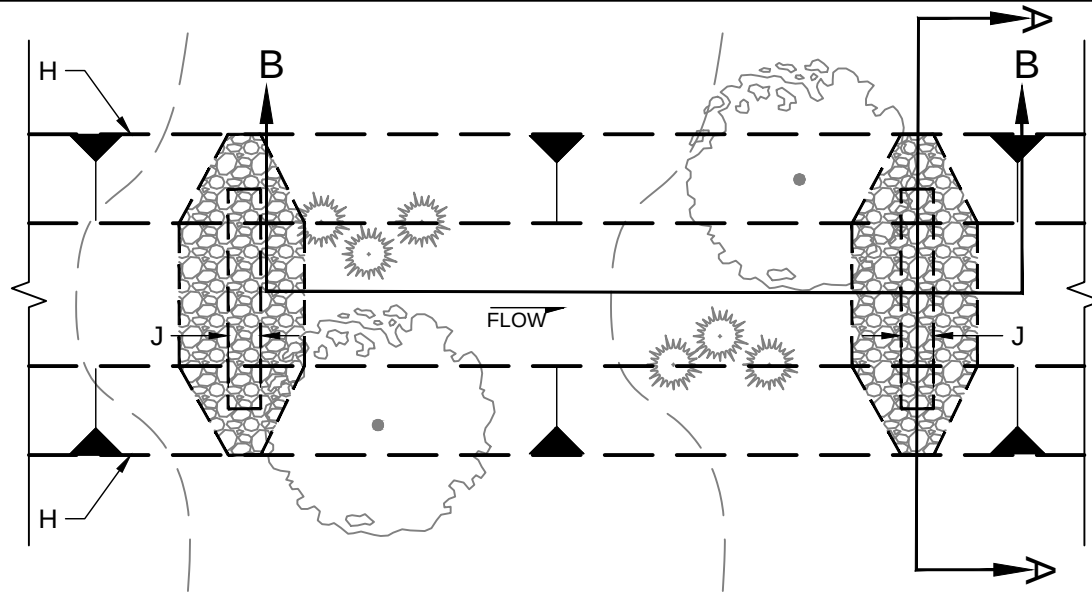
STORMWATER BUMPOUT



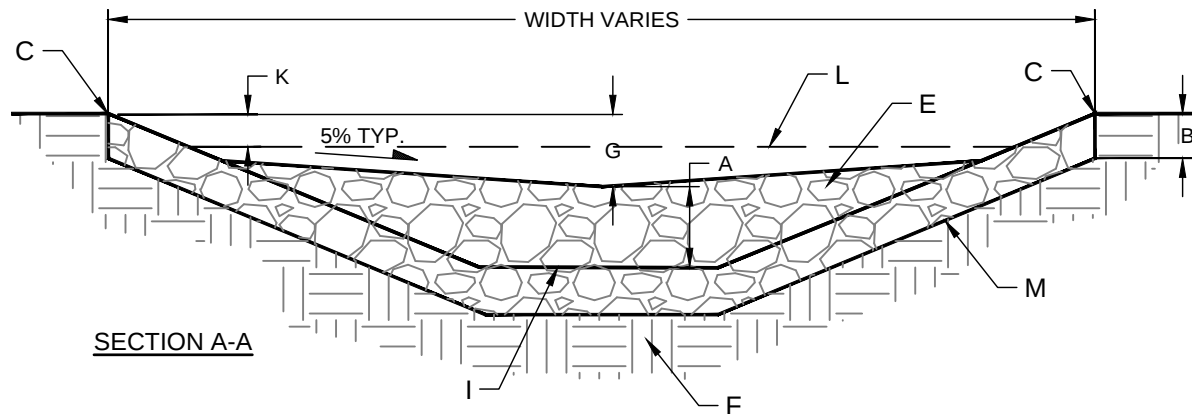
BIOSWALE



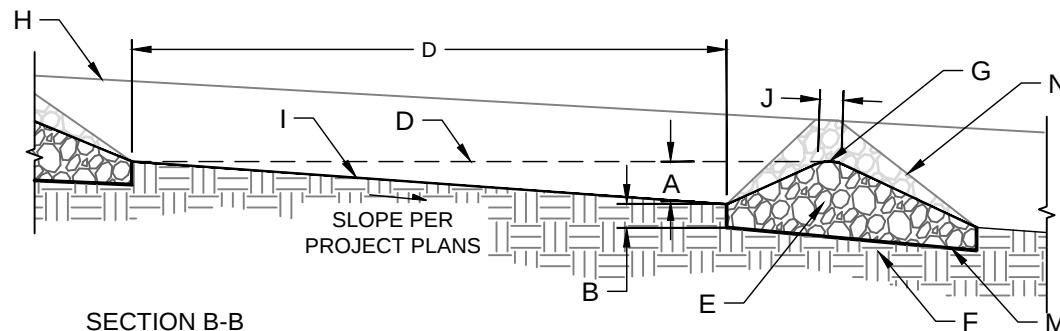
DEPRESSED MEDIAN



PLAN VIEW



SECTION A-A



SECTION B-B

GENERAL NOTES:

1. SEE TECHNICAL GUIDANCE SHEET FOR DESIGN GUIDANCE AND CONSIDERATIONS, INCLUDING DISCUSSION OF OTHER ALLOWABLE MATERIALS.

CONSTRUCTION NOTES:

- A. HEIGHT PER PROJECT PLANS.
- B. CHECK DAM EMBEDDED BELOW FINISHED GRADE, 6" MIN.
- C. EXTEND CHECK DAM TO TOP OF CHANNEL/BIOSWALE/DITCH TO PREVENT FROM BEING FLANKED.
- D. SPACE CHECK DAMS SUCH THAT THE DOWNSTREAM WEIR ELEVATION IS AT OR ABOVE THE TOE ELEVATION OF THE NEXT UPSTREAM WEIR.
- E. GRAVEL, COBBLE, CLEAN BROKEN CONCRETE, OR OTHER SUITABLE AGGREGATE, SIZED TO WITHSTAND DESIGN STORM FLOW CONDITIONS.
- F. COMPACT SUBGRADE BELOW CHECK DAM BASE TO 95% OF MAX DENSITY.
- G. WEIR ELEVATION, 9" (MIN) BELOW ADJACENT TOP OF BIOSWALE/CHANNEL/DITCH.
- H. TOP OF BIOSWALE/CHANNEL/DITCH.
- I. DESIGN FLOWLINE ELEVATION OF BIOSWALE/CHANNEL/DITCH.
- J. 12" WIDE SHELF, MIN.
- K. 3" FREEBOARD, MIN.
- L. WATER SURFACE AT DESIGN STORM FLOW DEPTH OVER CHECK DAM.
- M. NON-WOVEN GEOTEXTILE FILTER CLOTH BETWEEN RIPRAP AND SUBGRADE.
- N. 3H:1V SIDE SLOPE OR FLATTER, TYP.



REVISIONS

COUNTY OF BERNALILLO

CHECK DAM

GSI-07

JULY 2022

OUTLET CONTROL STRUCTURE



A structure placed at the discharge point from a BMP or detention pond designed to regulate the release of stormwater and to facilitate capture of sediment and floatables.

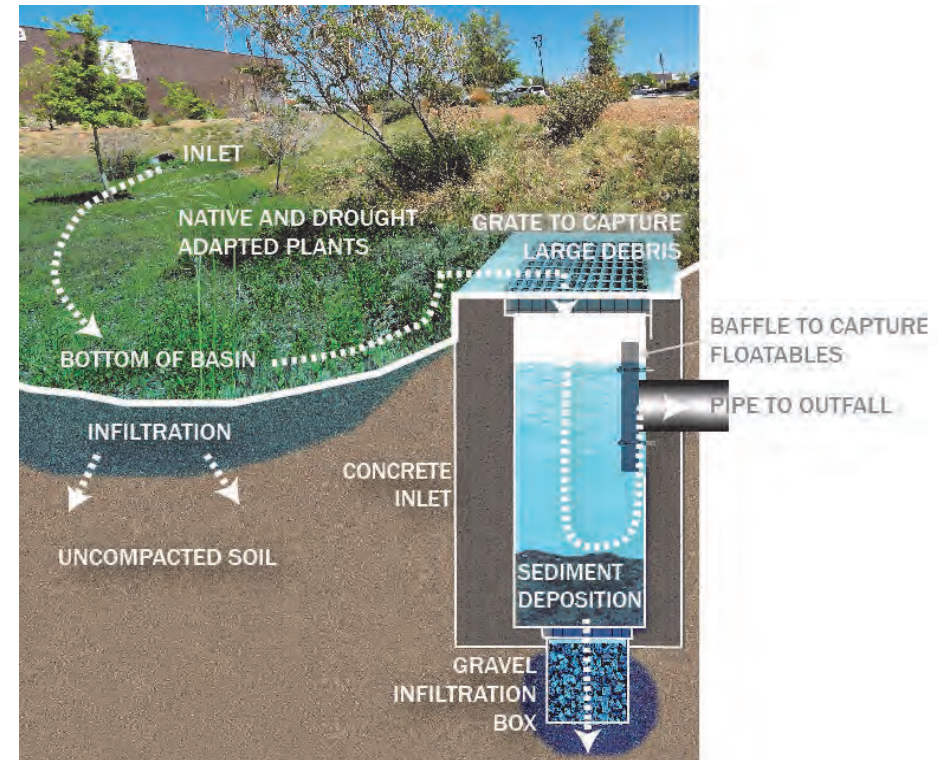
OUTLET CONTROL STRUCTURE

DESIGN CONSIDERATIONS

- Outlet control structures allow for ponding within multiple GSI BMPs and should be designed to provide an outlet for larger storm events that exceed the capacity of the BMP.
- The raised outlet structure, as well as the sump/baffle design, allow trash, debris, and sediment to drop out of the stormwater within the BMP.
- The structure should be located at the downstream end of a drainage facility, and the outfall must connect to a downstream collection system, such as a storm drain, basin, channel, or arroyo.
- Maintenance access to the outlet control structure should be considered and provided during design.

MAINTENANCE

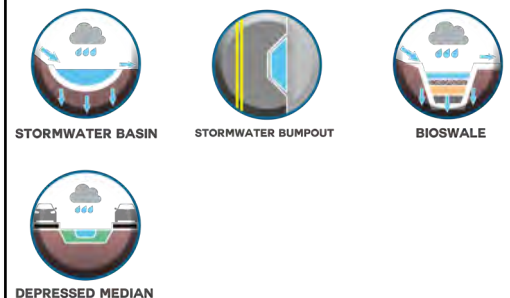
- Inspect after storms > 0.25-inches; recommend a minimum of two inspections per year.
- Remove debris, trash, and accumulated sediment from the grate and structure sump. A vacuum truck may be needed for the structure sump maintenance.
- Encroaching vegetation should be pruned or removed to maintain a min. of 2-foot landscape buffer from the structure.

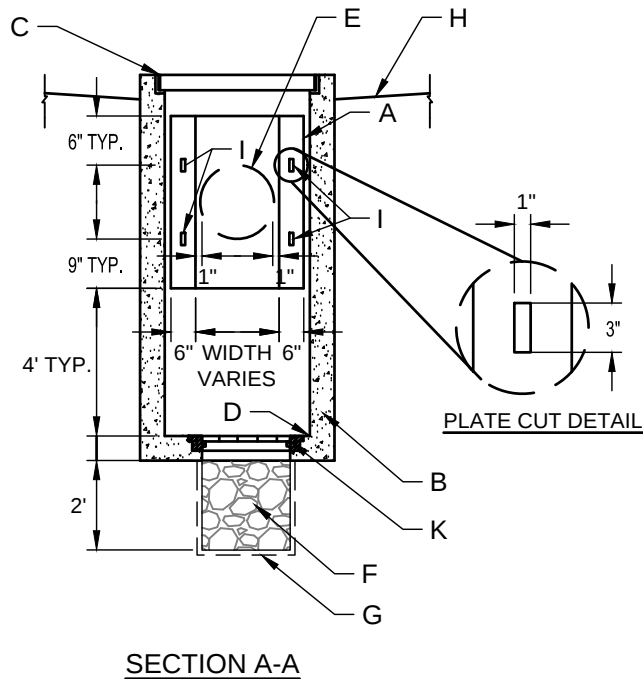
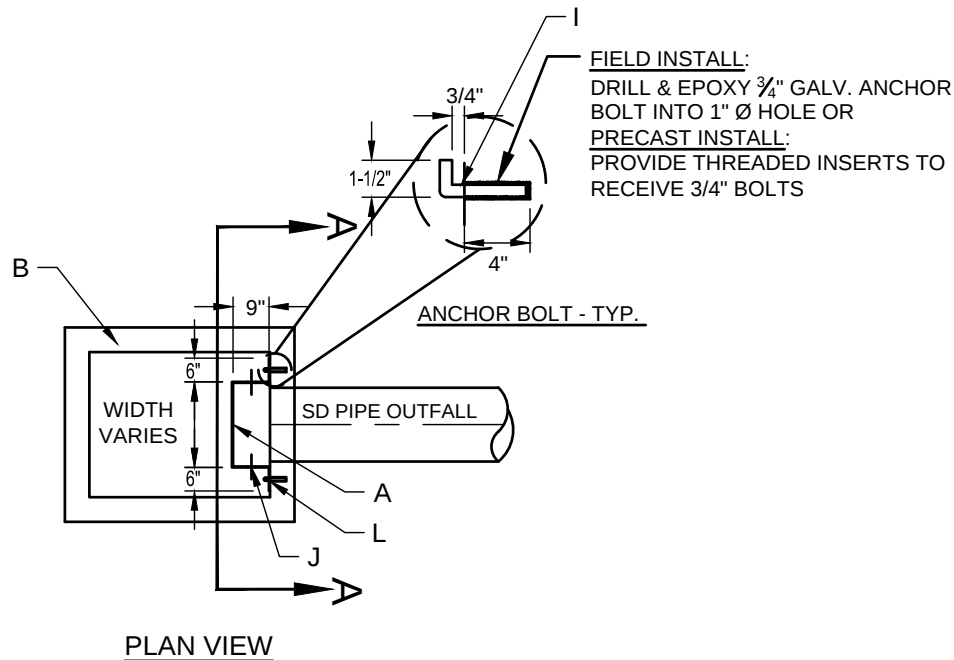


WHERE TO USE

✓	Urban Type Road
✓	Rural Type Road
✓	Streetside
✓	Parking
✓	Residential Development
✓	Commercial/Institutional Development

FUNCTIONS WITH





GENERAL NOTES:

1. SEE TECHNICAL GUIDANCE SHEET FOR DESIGN GUIDANCE AND CONSIDERATIONS.
2. OUTLET CONTROL PLATE DIMENSIONS AND INLET SUMP DEPTH SHOULD BE DESIGNED FOR CONTRIBUTING WATERSHED/SEDIMENT LOAD AND DESIGN HYDRAULIC CONDITIONS. DIMENSIONS SHOWN ARE FOR TYPICAL APPLICATION AND MAY BE MODIFIED BY PROJECT PLANS.
3. AS APPROVED BY ENGINEER, ALTERNATIVE MANUFACTURED BAFFLE MAY BE USED.

CONSTRUCTION NOTES:

- A. 3/16" ALUMINUM BAFFLE. WIDTH PER PLAN.
- B. CONCRETE DROP INLET. TYPE AND SIZE PER PROJECT PLANS.
- C. INLET GRATE ELEVATION PER PROJECT PLANS.
- D. INLET SUMP ELEVATION PER PROJECT PLANS.
- E. STORM DRAIN OUTFALL PIPE. SIZE AND INVERT ELEVATION PER PROJECT PLANS.
- F. GRAVEL INFILTRATION BOX, ASTM #57 STONE.
- G. NON-WOVEN GEOTEXTILE FILTER CLOTH AROUND GRAVEL, ALL SIDES.
- H. FINISHED GROUND AT INLET. ELEVATION PER PROJECT PLANS.
- I. RECTANGULAR CUT INTO PLATE TO HANG ON ANCHOR BOLT.
- J. LIFTING HOLE, BOTH SIDES OF BAFFLE. 2" DIA. HOLE CUT INTO PLATE 4.5" FROM WALL, 2" (MIN.) FROM TOP OF BAFFLE.
- K. ROUND STEEL GRATE AND FRAME (12" DIAMETER MIN.) IN BOTTOM OF INLET SUMP. GRATE TYPE/MANUFACTURER PER PROJECT PLANS.
- L. 1/8" THICK NEOPRENE WASHER AT ANCHOR BETWEEN PLATE TO CONCRETE WALL CONTACT AREA.

PERMEABLE PAVEMENT



Paving material that allows stormwater to move through the pavement's surface to a storage layer below, allowing infiltration into the underlying soil. Includes, but is not limited to, permeable interlocking pavers, asphalt, and concrete.

PERMEABLE PAVEMENT

DESIGN CONSIDERATIONS

- Other pavement types than shown on the standard drawing may be considered, such as permeable gutter systems or porous asphalt, pending approval by the County.
- Control of sediment is important to maintain pavement permeability; stormwater run-on should not be sediment laden.
- Consider concrete curb for edge support and to help keep unwanted sediment off the pavement.
- Pavement design shall address both stormwater retention, geotechnical, and structural pavement design requirements.
- Consider depth to the groundwater table and bedrock; refer to Section 6, General Design Principles.
- Recommend max. longitudinal slope of 5%. Slopes greater than 2% require subsurface check dams.

MAINTENANCE

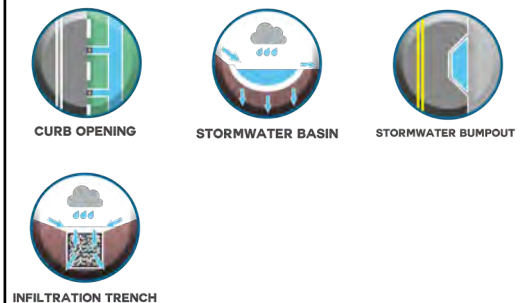
- Inspect after storms > 0.25-inches; recommend a minimum of two inspections per year. Watch for sediment washout or deposition on the pavement.
- Remove accumulated sediment and debris from pavement using manufacturer's recommended maintenance approach and schedule. Surficial dirt does not necessarily clog the pavement; however, dirt ground in by repeated vehicle use can lead to clogging.
- Routine and long-term maintenance, using high performance, regenerative air vacuuming to maintain the hydraulic function, are typically required. Mechanical broom type sweepers are typically not recommended.
- Pavements should not receive regular winter salt or sanding.
- Seal coating or repaving are not appropriate for permeable pavements.

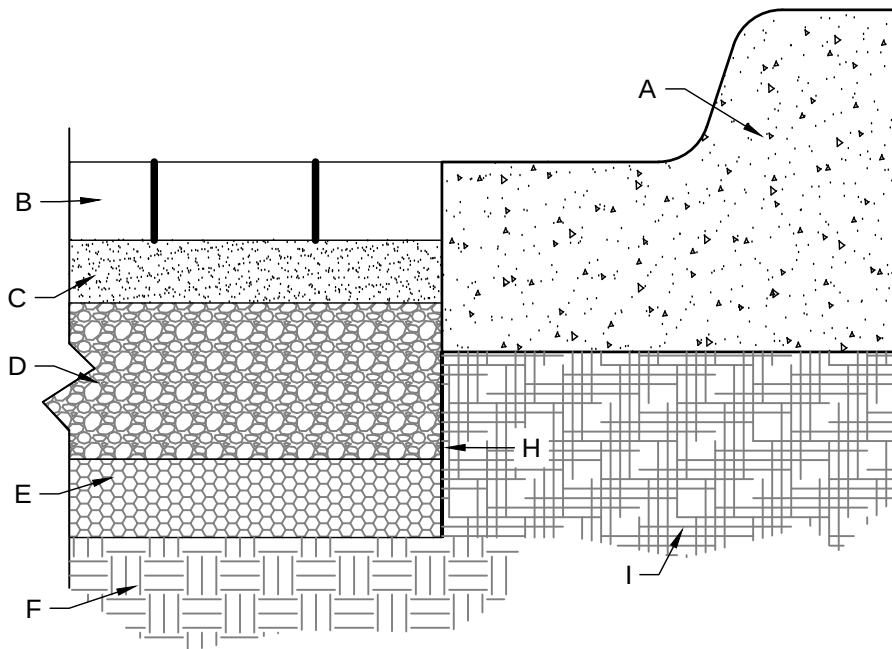


WHERE TO USE

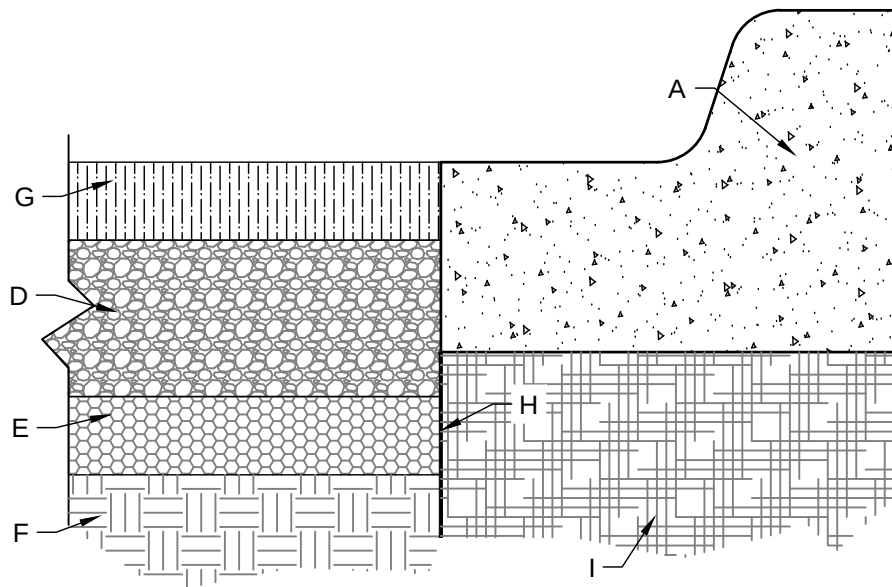
✓	Urban Type Road
	Rural Type Road
✓	Streetside
✓	Parking
✓	Residential Development
✓	Commercial/Institutional Development

FUNCTIONS WITH





PERMEABLE PAVERS - TYPICAL SECTION



PERVIOUS CONCRETE - TYPICAL SECTION

GENERAL NOTES:

1. SEE TECHNICAL GUIDANCE SHEET FOR DESIGN GUIDANCE AND CONSIDERATIONS.
2. TYPICAL SECTIONS ARE PROVIDED FOR GENERAL GUIDANCE. LAYER DEPTHS ARE PROJECT/SITE SPECIFIC AND SHALL BE DESIGNED BASED ON GEOTECHNICAL RECOMMENDATIONS AND LOADING/STRUCTURAL REQUIREMENTS.
3. RESERVOIR LAYER THICKNESS SHALL BE PROVIDED ON PROJECT PLANS. THICKNESS SHALL BE DETERMINED BASED ON STORMWATER QUALITY VOLUME (SWQV) RETENTION REQUIREMENTS AND STRUCTURAL PAVEMENT DESIGN REQUIREMENTS.
4. SYSTEM SHALL BE DESIGNED TO DRAIN THE DESIGN STORM WITHIN 96 HOURS. UNDERDRAIN MAY BE CONSIDERED IF IN-SITU SOILS ARE NOT CONDUCTIVE TO INFILTRATION (GENERALLY LESS THAN 0.2 IN/HR).
5. BOTTOM OF RESERVOIR LAYER SHOULD BE DESIGNED AS FLAT AS POSSIBLE (0% PREFERRED). SUBSURFACE CHECK DAMS IN RESERVOIR LAYER REQUIRED IF SURFACE SLOPE EXCEEDS 2%.
6. ALL STONE SHALL BE DOUBLE-WASHED, SUFFICIENT TO REMOVE DUST AND OTHER COATINGS.
7. NON-WOVEN GEOTEXTILE FILTER FABRIC SHALL BE PLACED ON THE SIDES OF OPEN-GRADED STONE LAYERS AT THE EDGES OF SYSTEM (WHERE NO OTHER EDGE RESTRAINT PROVIDED) TO PREVENT MIGRATION OF ADJACENT FINE MATERIAL.
8. AGGREGATE SIZES IN CONSTRUCTION NOTES ARE PER ASTM D448-STANDARD CLASSIFICATION FOR SIZES OF AGGREGATE FOR ROAD AND BRIDGE CONSTRUCTION.

CONSTRUCTION NOTES:

- A. CONCRETE CURB OR OTHER EDGE RESTRAINT PER PROJECT STANDARD CURB AND GUTTER PER COUNTY STANDARD DRAWING 2415A SHOWN
- B. CONCRETE PAVER (MIN. THICKNESS IS 3-1/8" FOR VEHICULAR TRAFFIC, 2-3/8" FOR PEDESTRIAN AREAS). JOINTS SHALL BE FILLED WITH ASTM #8 STONE OR AS RECOMMENDED BY MANUFACTURER.
- C. BEDDING/FILTER LAYER, 2" THICK ASTM #8 STONE OR AS RECOMMENDED BY MANUFACTURER.
- D. RESERVOIR LAYER, ASTM #2 PER PROJECT PLANS. THICKNESS PER PROJECT PLANS (6" MIN.).
- E. SUBBASE LAYER, ASTM #57 STONE. WHEN OMITTED, PROVIDE GEOTEXTILE FILTER FABRIC BELOW RESERVOIR LAYER.
- F. UNCOMPACTED SUBGRADE.
- G. PERVIOUS PORTLAND CEMENT CONCRETE, THICKNESS PER PROJECT PLANS (6" MIN.).
- H. NON-WOVEN GEOTEXTILE FABRIC ALONG SIDE OF STONE LAYERS WHERE NO OTHER EDGE RESTRAIN PROVIDED.
- I. COMPACTED SUBGRADE



REVISIONS		COUNTY OF BERNALILLO	
		PERMEABLE PAVEMENT	
		GSI-09	JULY 2022

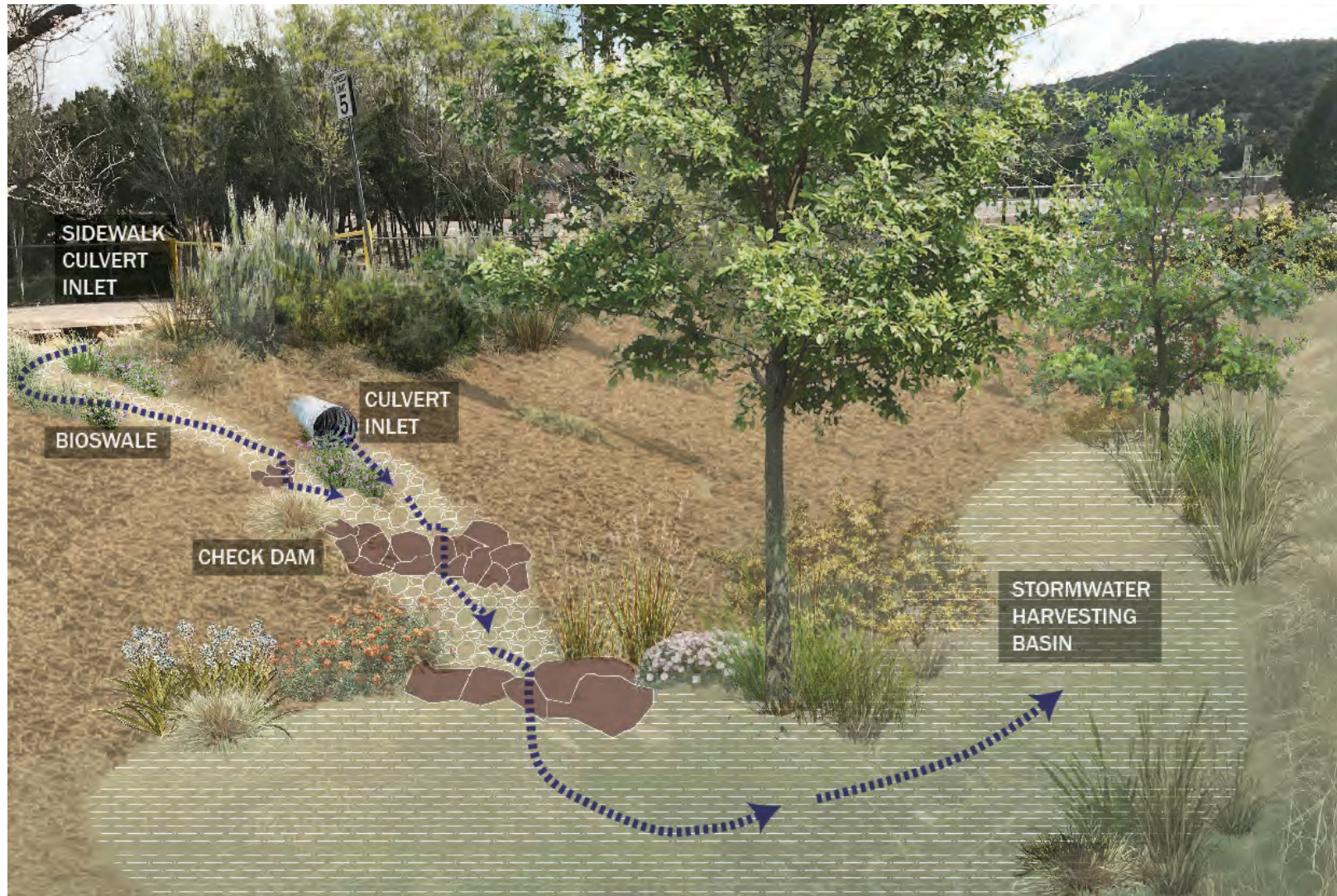
TREATMENT TRAIN EXAMPLE

Example of a GSI/LID BMP Treatment Train with Permeable Pavement, Curb Opening with Sediment Trap, Stormwater Bumpout, and Infiltration Trench



TREATMENT TRAIN EXAMPLE

Example of a GSI/LID BMP Treatment Train with Bioswale, Check Dam, and Stormwater Harvesting Basin



6 | GSI/LID BMP Design and Construction

Though the appropriate GSI/LID BMPs may vary based on location, common design considerations and construction practices apply whenever GSI/LID BMPs are implemented. This section outlines various considerations developers and project designers should consider prior to design, project approval, and construction.

County Review Process

Private developers and project designers are encouraged to meet with Bernalillo County staff as part of a **pre-application meeting** early in the site development process regarding the incorporation of GSI/LID BMPs into their projects. The applicant should contact the Planning staff at Planning and Development Services to request the pre-application meeting. Planning staff will set up the meeting with applicable staff from the following: Bernalillo County Planning, Zoning, Building, Public Works Development Review, Transportation, and Natural Resources, as well as the Water Authority.

Bernalillo County requires that stormwater quality controls be incorporated into the **grading and drainage plan**. Applicants should maintain communication with Bernalillo County staff throughout the design process to ensure that stormwater quality goals are met in the final design. Early consideration of GSI/LID BMPs can also provide savings and benefits for developers and project designers, as it can be more complicated and expensive to integrate GSI/LID BMPs after the grading and drainage plan and the landscaping plan have been submitted for County review.

Frequent communication within the project team (i.e., project owner(s), engineers, landscape designers/architects, general contractors, landscape maintenance practitioners, etc.) from the beginning of the project through design and construction, is an integral component in the development process and can ensure successful and cost-efficient outcomes for the project.

Steps in the Bernalillo County Review Process Associated with GSI/LID

1. Hold pre-application meeting (recommended).
2. Submit grading and drainage plan and *Stormwater Post-Construction Green Stormwater Infrastructure/Low Impact Development Best Management Practices Evaluation Form*.
3. County Natural Resource Services and Development Review staff review proposed GSI/LID and stormwater quality BMPs.
4. Receive recommendations/revisions from existing plans; hold optional meetings with County staff.
5. Receive approval of grading and drainage plan.
6. Submit building permit application inclusive of landscape plan.
7. County Natural Resource Services staff review proposed landscaping to ensure it aligns with approved grading and drainage plan, Stormwater Quality and Water Conservation Ordinances, and GSI/LID Standards.
8. Receive recommendations/revisions from existing plan.
9. Receive approval of landscape plan.
10. Receive building permit after plans are approved by all County departments.
11. Construct project.
12. All County departments conduct project inspections. County Natural Resource Services and Development Review staff inspect GSI/LID and stormwater quality BMPs.
13. Submit notarized Covenant for Drainage and Water Quality Infrastructure to Public Works.
14. Receive Certificate of Occupancy.
15. Engineer / Landscape Architect informs facility owner of responsibility for ensuring stormwater quality BMPs are maintained. BMPs must be inspected by a professional engineer or qualified stormwater person every three years, and documentation of maintenance activities and inspections must be provided to the County upon request.

General Design Principles

The following general principles should be applied in the design of GSI/LID BMPs:

- Design GSI/LID conveyances to slow down runoff, to promote infiltration, and to provide filtration to remove pollutants. Meandering designs, that lengthen the flow paths, are encouraged.
- Reduce impervious surfaces to the greatest extent practicable. Impervious surfaces collect and retain pollutants, such as oil and grease, and increase the urban heat island effect.
- Consider access for maintenance during design. Communicate with maintenance personnel during the design process to ensure maintenance requirements are met.
- When sediment and debris accumulation is anticipated in the GSI/LID BMP, incorporate an upstream sediment trap, trash/debris screen, and/or planning for additional required maintenance.
- Design appropriately sized erosion protection, especially at concentrated flow locations.
- Design GSI/LID BMPs to ensure infiltration by avoiding soil compaction of pervious areas and around vegetation, by performing on-site infiltration rate tests, and by using soil amendments, if needed, to improve infiltration.
- Conduct infiltration testing at the proposed bottom elevations of the BMP. In general, infiltration rates greater than 0.5 inches/hour are recommended for BMPs. An underdrain may be needed if the infiltration rate is less than 0.5 inches/hour.
- Consider the depth to the groundwater table and bedrock below each BMP; an underdrain may be needed if the groundwater table and/or bedrock are shallow and will impact infiltration within the BMP.
- Consider the location of existing utilities.
- Avoid inlets or outlets to GSI/LID BMPs flowing directly through ADA compliant ramps or parking spaces.
- Maintain appropriate setbacks from adjacent pedestrian routes and parking spaces where vehicle doors open adjacent to GSI/LID BMPs.
- Follow setback requirements from property lines, as indicated in the County zoning code.
- Coordinate with the project design team and utility owners on required setbacks from buildings/foundations, septic tanks, utility lines, etc.
- Consult the AASHTO Roadside Design Guide when placing and designing BMPs immediately adjacent to travel ways.

Maintenance Requirements and Responsibilities

It is important to consider and define irrigation and maintenance requirements prior to the design of GSI/LID BMPs, as these requirements differ from typical landscaping. The pre-application meeting is an opportunity for developers and project designers to meet with Bernalillo County staff to learn about maintenance requirements associated with different BMPs. Additional information on maintenance can be found in **Section 7: GSI/LID BMP Inspection and Maintenance**.

BMP Overflow Control Design Requirements

GSI/LID BMPs should be designed to accommodate larger, higher-intensity storm events that exceed their storage capacity. The following should be incorporated into BMP overflow design:

- Design the overflow structure with capacity for the 100-year peak outflow rate.
- Consider erosion protection for the overflow structure/emergency spillway during design; it must be sufficient for the flow velocity and flow expansion downstream of the overflow structure.
- Design overflow structures to safely convey flows to downstream drainage facilities or other County approved discharge locations.

Plant Selection Considerations

Project designers should consider the plant selection and location during the design process, as plants are a key element to successful GSI/LID applications. Regionally adapted plants should be selected based on temperature tolerance, soil types, and water needs. Arid region applications that incorporate vegetation as part of the BMP may require supplemental irrigation to support the vegetation during its establishment period. See **Section 9** for guidance on plant selection.

Soil Protection During Construction

It is important to maintain soil permeability and to limit compaction during construction. Best practices to protect soil conditions during construction include:

- Protect the GSI/LID BMP installation area, landscaped areas, and remaining undeveloped areas from

construction equipment that could compact soils and could reduce soil permeability.

- Reserve existing topsoil and reuse it to maintain a healthy growth medium for plant establishment.
- Remove excess sediment that results from construction activities. Accumulated sediment limits infiltration and is a primary reason GSI/LID BMPs fail to operate as designed.
- Scarify soils after construction (recommended) to reduce compaction and to promote infiltration.
- Complete impervious area construction and stabilize pervious areas before runoff is allowed to enter an infiltration BMP.

Standard Drawings

The County review process includes comparison of proposed designs against the Standard Drawings in this GSI/LID Standards document to ensure that the designs are buildable and are appropriately selected and located. Table 3 lists the typical design data the County requires on project plans for each GSI/LID BMP included and described in this document. See **Section 5** for Standard Drawings for each BMP recommended by Bernalillo County.

County Construction Inspections

All County departments inspect construction projects. County Natural Resource Services and Development Review staff inspect GSI/LID BMPs and stormwater quality controls after construction and prior to the applicant receiving a Certificate of Occupancy.

Table 3: Typical Design Data Required for GSI/LID BMPs

BMP	Standard Drawing Number	GSI/LID Standard Drawing	Typical GSI/LID BMP Design Data Required on Project Plans
 CURB OPENING	GSI-01	Curb Opening	• Curb opening length (L) – recommend 2-ft. minimum. • Identify if sediment trap is required. • Sediment trap dimensions, if required. • Riprap rundown/erosion protection dimensions, stone size, and riprap thickness. • Elevation of flowline at curb opening and elevation at bottom of sediment trap or adjacent BMP. • Gutter transition, if different from County Standard Drawing 2207.
 STORMWATER BASIN	GSI-02	Stormwater Harvesting Basin	• Erosion protection type and dimensions; if riprap, provide stone size and riprap thickness. • Ponding depth for SWQV – recommend 9-in. maximum. • Water surface elevation at 100-year overflow depth. • Freeboard measurement – recommend 3-in. minimum. • Mulch type, thickness, and location.
 STORMWATER BUMPOUT	GSI-03	Stormwater Bumpout	• Bump out radius – recommend 10-ft. minimum. • Bumpout dimensions. • Riprap/erosion protection dimensions, stone size, and riprap thickness. • Design storm velocity. • Ponding depth for SWQV – recommend 9-in. maximum. • Mulch type, thickness, and location.
 BIOSWALE	GSI-04	Bioswale	• Design storm velocity; if velocity is greater than 3 fps, check dam(s) required. • Freeboard measurement – recommend 3-in. minimum. • Erosion protection type and dimensions; if riprap, provide stone size and riprap thickness. • Mulch type, thickness, and location.

BMP	Standard Drawing Number	GSI/LID Standard Drawing	Typical GSI/LID BMP Design Data Required on Project Plans
 DEPRESSED MEDIAN	GSI-05	Depressed Median	- Design storm velocity – if velocity greater than 3 fps, check dam(s) required. - Freeboard measurement – recommend 3-in. minimum. - Erosion protection type and dimensions; if riprap, provide stone size and riprap thickness. - Mulch type, thickness, and location.
 INFILTRATION TRENCH	GSI-06	Infiltration Trench	- Filter layer and reservoir layer dimensions. - Filter layer and reservoir layer stone size. Specify aggregate size per ASTM D-448 – Standard Classification for Sizes of Aggregate for Road and Bridge Construction. - Erosion protection type and dimensions; if riprap, provide stone size and riprap thickness. - Mulch type, thickness, and location.
 CHECK DAM	GSI-07	Check Dam	- Check dam height. - Check dam shelf width. - Depth embedded below grade – recommend 6-in. minimum. - Elevations for top of check dam weir. - Elevation at top of bioswale/channel/ditch at check dam location. - Aggregate type and size or specification (sized for design storm flow conditions). - Freeboard measurement – recommend 3-in. minimum.
 OUTLET CONTROL STRUCTURE	GSI-08	Outlet Control Structure	- Concrete drop inlet type and size. - Outlet control plate dimensions. - Elevations for inlet grate and inlet sump. - Storm drain outfall size and invert elevation.
 PERMEABLE PAVEMENT	GSI-09	Permeable Pavement	- Pavement type and thickness. - Bedding/filter layer thickness, if applicable. - Reservoir layer thickness – recommend 6-in. minimum. - Subbase layer thickness, if applicable. - Stone size for all layers. Specify aggregate size per ASTM D-448 – Standard Classification for Sizes of Aggregate for Road and Bridge Construction.

7 | GSI/LID BMP Inspection and Maintenance

Inspection and Maintenance Responsibilities

Inspection and maintenance for GSI/LID on **private property** is the responsibility of the facility/property/landowner. As required by Bernalillo County's Stormwater Quality Ordinance, periodic inspection and certification of private BMP facilities by a state licensed professional engineer or by an otherwise qualified stormwater person (as determined by the county engineer) are required of the facility/property/landowner and shall occur not less than once every three years from the date of final construction inspection. Additional information on the Post-Construction Inspection Program requirements can be found at www.bernco.gov/gsi-lid.

Inspection and maintenance for GSI/LID along **roadways and in the public right-of-way** that are installed by a developer as part of a site improvement project are generally the responsibility of Bernalillo County, unless agreements are in place with a homeowners association or other entity. When GSI/LID BMPs are located in the public right-of-way, the Bernalillo County review process will determine whether the proposed applications are consistent with the County's maintenance practices.

Maintenance Approach for GSI/LID BMPs

For green stormwater infrastructure to function properly and allow water to soak into the ground over time, maintenance is needed. Routine maintenance on vegetated green stormwater infrastructure is similar to general landscape maintenance: removing invasive species, picking up trash and debris, and keeping plants healthy. In addition, GSI/LID BMPs also require periodic removal of accumulated sediments and adhered pollutants.

Some maintenance benefits of GSI/LID BMPs over traditional landscape installations include:

- Native and arid-adapted plants use less fertilizers, herbicides, and pesticides.
- Native and arid-adapted plants use less water.
- Native and arid-adapted plants have increased survivability rates and tend to be more resistant to disease and drought. Increased survivability rates decrease the time and resources needed for replacing plants.

Source: Arid LID Coalition, *Middle Rio Grande Green Stormwater Infrastructure Maintenance Manual*, 2022.

Inspection and Maintenance Best Practices

The following are best practices to ensure proper maintenance of GSI/LID BMPs:

- Conduct inspections of GSI/LID BMPs at a recommended minimum of once per year or more, as well as after storms greater than 0.25 inches.
- Remove debris, trash, and accumulated sediment regularly from pretreatment structures and GSI/LID BMPs. Accumulated sediment limits infiltration and is a primary reason GSI/LID BMPs fail to operate as designed. The accumulated sediment should be removed if it reduces the BMP capacity or if it impacts the inflow or outlet locations.
- Inspect and repair erosion issues. Areas subject to erosion include side slopes, riprap rundowns, concentrated flow locations, areas of high velocity flow, or areas where human traffic may disturb the vegetation.
- Some GSI/LID BMPs may require use of specialized equipment for maintenance, such as permeable pavement and outlet control structures. See the technical guidance sheets for maintenance guidance.
- Prune and replace plants as needed. Remove invasive plant species.
- Irrigate regularly during the plant establishment period (see **Section 9** for establishment period guidance). Once plants are established, irrigate only as necessary.
- Leave organic debris in place whenever feasible to biodegrade. This practice promotes healthy soils.
- If a neat or uniform appearance is desired, the surface can be lightly raked or a 1-inch layer of replacement

organic mulch can be applied. See **Section 8** for additional guidance on the use of mulch.

- BMPs that are seeded and that feature grass cover typically should not be mowed more than once a year.

Other Maintenance Considerations

Signs may be posted within or adjacent to the BMP to clarify maintenance requirements and to ensure that no equipment is used that might compact the soils within the BMP.

The owner of the BMP may also consider including educational information regarding the function and benefits of GSI/LID for the general public. GSI/LID native plantings often generate calls from the public concerned about the perceived lack of maintenance; educational information signs may be appropriate to educate the public about GSI/LID features.

8 | Mulch in GSI/LID BMPs

Benefits and Preferred Materials

Mulch serves to stabilize the surface and to reduce evaporation from the soil. It is also a critical component of GSI/LID installations. **Organic mulch**, which contributes to pollutant treatment and to containment through filtration and development of a healthy soil microbiome, should be used wherever possible. By contrast, rock and inorganic mulch materials, such as gravel, gravel mulch, pebbles, lava rock, or crushed rock, contribute less to the treatment of runoff and less to the biological health of soil and plants. They also store and release heat. In addition, staining from runoff is not as apparent on organic mulch as it is on rock and inorganic mulch.

Key Definition: Soil Microbiome

The soil microbiome is the dynamic community of microorganisms associated with plants and soil. This community includes bacteria, archaea, and fungi. The composition of any particular microbiome is influenced by myriad factors, including environmental, soil physical properties, nutrient availability, and plant species.

Preferred mulch materials are shredded, partially composted wood mulch, installed at a 3-inch depth. Shredded wood mulch locks together, making it more resistant to floating or to blowing away.

Partially composted mulch contains healthy bacteria and fungi that contribute to soil health. Runoff from storms will

activate soil fungi, causing it to “glue” the soil to the mulch, making it non-floatable under moderate slope conditions.

Best Practices in the Use of Mulch

Below are best practices to follow when using mulch with GSI/LID BMPs:

- Organic mulch 3-inch deep should last at least three years; mulch may be top-dressed annually to freshen its appearance. If the BMP receives frequent or high-volume flows, mulch may need to be refreshed more frequently.
- Leaf litter does not need to be removed from the surface of areas with organic mulch.
- Avoid organic mulch products containing bark chips or products likely to blow away.
- Keep all mulch at least 4 inches away from the base of new trees and plants.
- If seeding an area, hydromulch or a thin layer of small rock mulch (less than 1.5 inches deep) is recommended over drill seeding or hand broadcast seeding. Follow Section 632 of the [NMDOT Standard Specifications for Highway and Bridge Construction](#).

Use of Rock and Inorganic Mulch

Inorganic mulch is not preferred, although, it may be appropriate in some contexts. If inorganic mulch is necessary, install a 3-inch depth of organic chipped wood mulch below the inorganic mulch wherever possible or install weedblock fabric. Other considerations include:

- Use rock and inorganic mulch materials where velocity exceeds 1 foot-per-second (fps). Inorganic mulch requirements (e.g., rock size and thickness) shall be

informed by evaluation of hydraulic conditions for the GSI/LID BMP.

- Chipped, non-composted wood mulch is recommended to be used under rocks and under inorganic mulch materials, as it degrades more slowly than shredded, partially composted wood mulch.
- If using rock or inorganic mulch, double-washing the materials to sufficiently remove dust and other coatings is recommended. Rock and inorganic mulch contains fine grains which can create additional sediment accumulation around infiltration BMPs, clogging soils and decreasing infiltration.
- If rock and inorganic mulch is used, plan for maintenance to remove sediment and debris from the mulch; weeds will grow in sediment that accumulates in the rock and inorganic mulch.
- Dark-colored rock and inorganic mulch materials, such as basalt, are preferred for areas that will be stained by urban runoff. Light-colored rock and inorganic mulch materials are preferred for other areas, because it attracts less heat than dark colored materials.

Figure 7: Preferred Mulch Type: Shredded, Partially Composted Wood Mulch

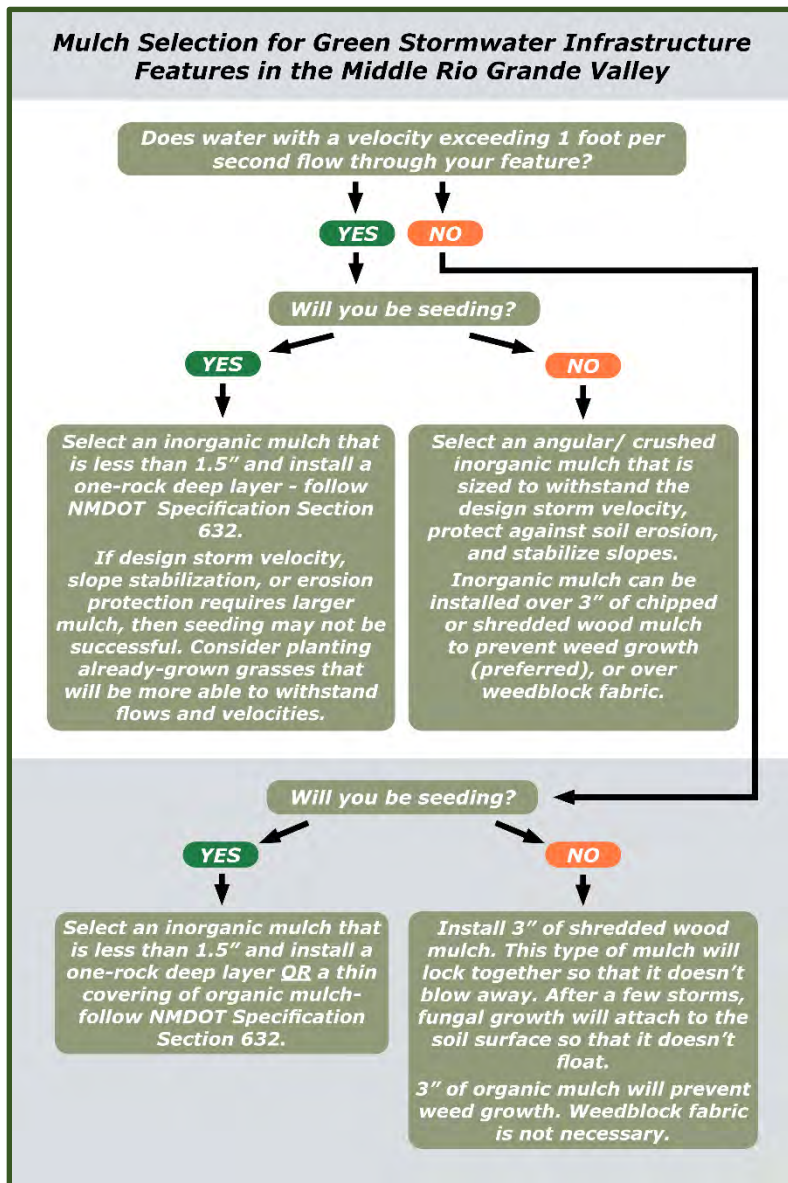


Photo source: Soilutions

Use of Weedblock

Use of weedblock (geotextile) fabric for weed control is not a preferred practice in GSI/LID features because it separates the stormwater runoff from the soil and plant roots which need direct contact with mulch for pollutant treatment. Most weedblock fabrics are only permeable when fully saturated; as such, runoff from small storm events may not reach plant roots and soil microbes. In addition, weedblock fabric can become ineffective when sediment accumulates on top of the fabric, allowing weeds to grow. Weedblock fabric is not necessary under a 3-inch depth or greater of organic mulch. Rather than using weedblock, appropriately applied shredded wood mulch is effective for preventing weed growth, while also effective for supporting healthy soils and plants.

Figure 8: Mulch Selection for GSI/LID BMPs



9 | GSI/LID Plant Selection

General Considerations

Plants in GSI/LID features are an important part of an engineered system. Soil pore space and organic material created by plant roots maintain and improve infiltration rates for stormwater. Plant roots stabilize soil and reduce erosion. Plants provide shade and habitat, while making the GSI/LID feature more attractive and regionally unique. This increases public acceptance. The Appendix provides a list of plants appropriate for use in and around GSI/LID BMPs in the Middle Rio Grande Valley.

GSI/LID BMPs should include at least three species within each plant type (i.e., tree, shrub, perennial, grass) to ensure that some species will live in the event of extreme drought or insect infestation. Species diversity is also critical for wildlife habitat.

Steps in Plant Selection Process

1. Identify ecological biome
2. Determine elevation zone
3. Identify planting location in GSI/LID BMP (inundation zone, transition zone, or high ground zone)

Plants must be appropriately selected and be maintained for the GSI/LID BMP to function properly. To aide in plant selection, the plant list is organized by ecological biome, elevation zone, planting locations (or infiltration zones), and plant type (trees, shrubs, perennials, and grasses). The Plant

List Components and Selection section below provides steps on using the plant list during GSI/LID BMP design.

Figure 9 provides a flow chart outlining how to use the plant selection criteria in the plant list in the Appendix to identify appropriate plants for the GSI/LID BMP.

Criteria for Plant List

- Can survive without irrigation after establishment in a GSI/LID BMP
- Has the ability to stabilize soil
- Is heat, drought, and cold tolerant
- Is non-invasive
- Is appropriate for GSI/LID infiltration zones

Plant List Components and Selection

Ecological Biome

The **first step** in using the plant list is to determine the ecological biome location of the GSI/LID BMP. See Figure 9 and Table 4 to determine the ecological biome for the project.

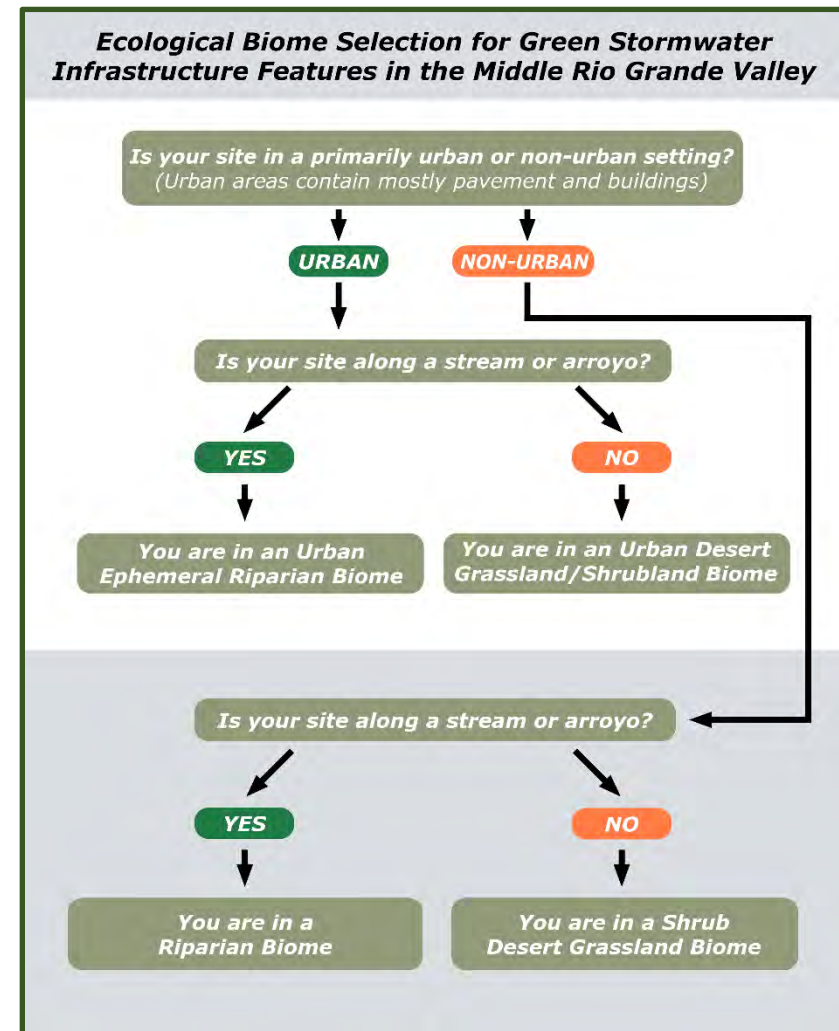
Across all elevation zones, four general biome categories are recognized for simplified plant selection: two are urban and two are non-urban. Within *urban areas*, the two biomes are **Urban Ephemeral Riparian**, which is the biome in and around unpaved arroyos, and **Urban Desert Grassland/Shrubland**. In *non-urban areas*, the two primary biomes are **Riparian** and **Shrub Desert Grassland**. Riparian biomes occur along acequias, ditches, the Rio Grande, and Tijeras Creek, while other areas can generally be classified as Shrub Desert Grassland. Non-urban locations include the East

Mountains, North Albuquerque Acres, the North and South Valleys, and other areas of unincorporated Bernalillo County.

Table 4: Ecological Biomes in the Middle Rio Grande Watershed

Biome	Urban	Non-Urban	Stream or Arroyo
Urban Ephemeral Riparian	✓		✓
Urban Desert Grassland/Shrubland	✓		
Shrub Desert Grassland		✓	
Riparian		✓	✓

Figure 9: Ecological Biome Selection Flow Chart



Elevation Zone

The **second step** in using the plant list involves identifying the elevation zone, which can be determined by locating the project area within one of the five zones depicted in Figure 10 and Figure 11.

Elevation, soil types, and annual precipitation amounts vary within the Middle Rio Grande watershed. This affects plant species selection. There are five elevation zones, or areas of similar elevation and climate, across the Middle Rio Grande watershed:

1. West Mesa (west of Coors Blvd.)
2. Valley (between Coors Blvd. and Edith Blvd.)
3. East Mesa (from Edith Blvd. to Juan Tabo Blvd.)
4. Foothills (Juan Tabo Blvd. to the National Forest)
5. East Mountains (along NM 14 and NM 337)

Figure 10: Elevation Zones across Bernalillo County

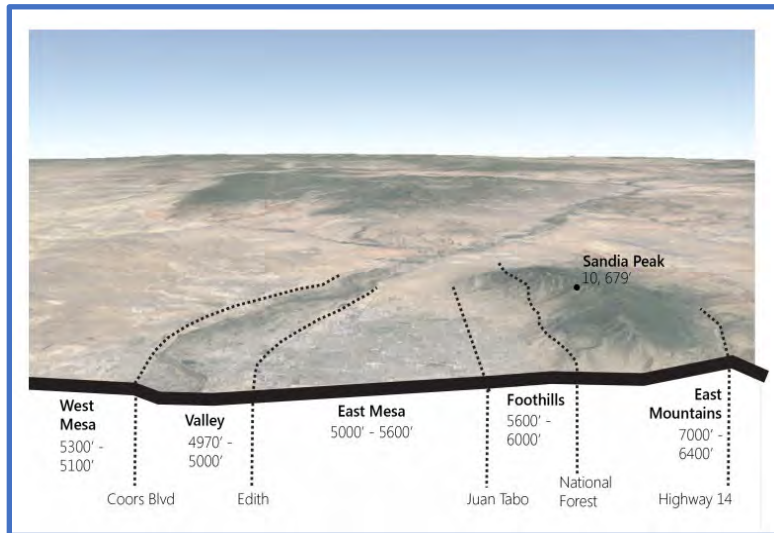
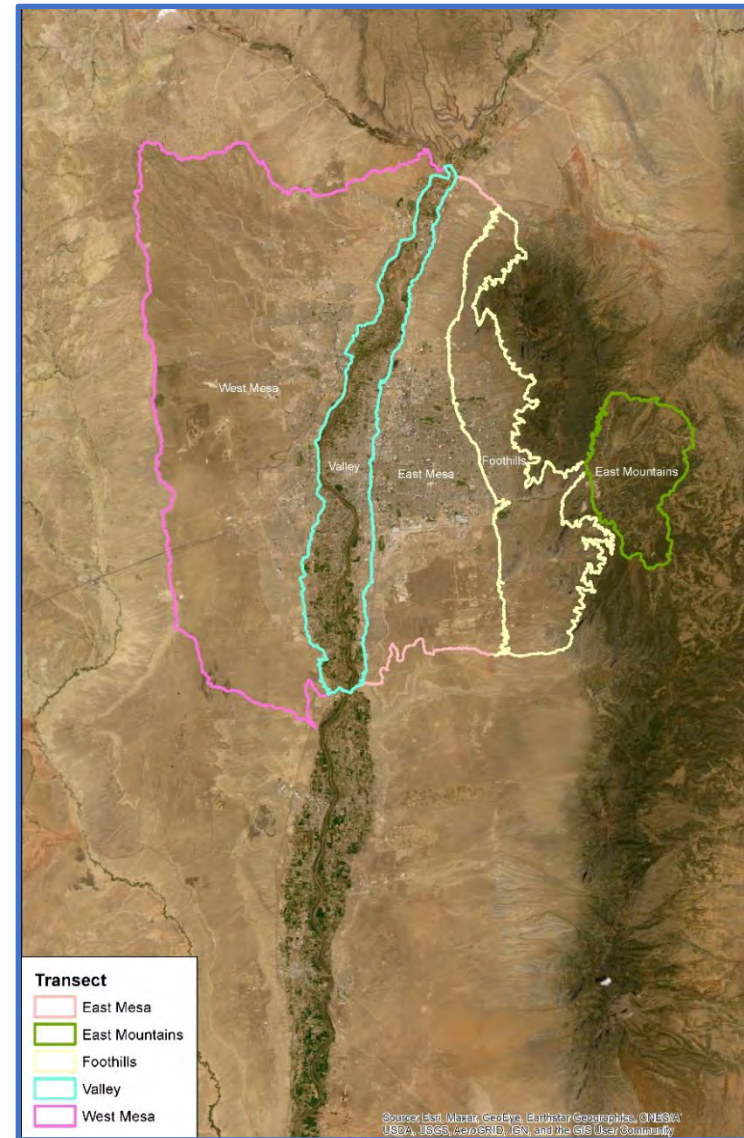


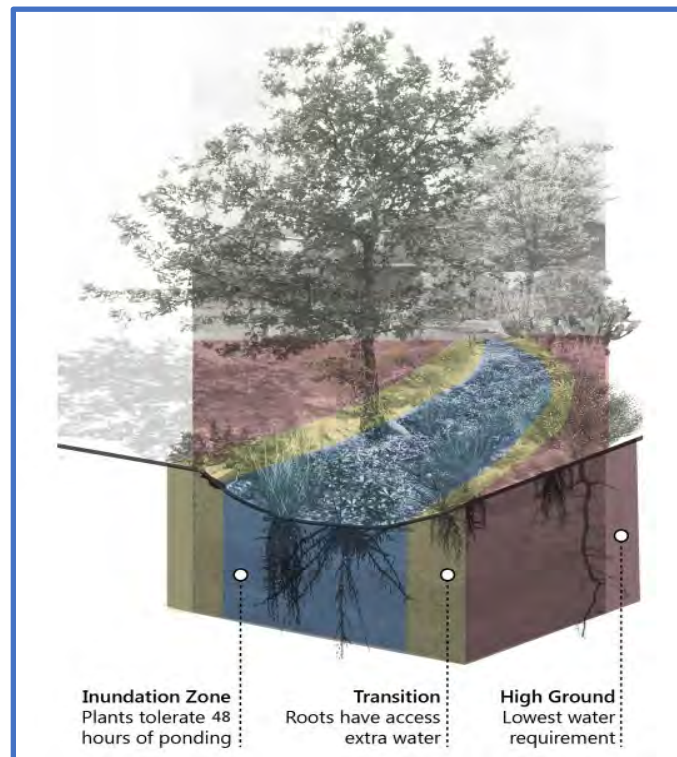
Figure 11: Geographic Area for Elevation Zones



Planting Locations (or Infiltration Zones)

The **third step** for using the plant list is determining the planting location within the BMP. Plant selection must be appropriate for the varying moisture conditions in the GSI/LID feature. The planting locations for a GSI/LID BMP include the inundation zone at the bottom of the basin or swale, the transition area along the side slopes, and high ground at the top of the GSI/LID BMP (see Figure 12).

Figure 12: Planting Locations within GSI/LID BMPs



Inundation Zone

The inundation zone is located at the base of a GSI/LID BMP and is where water pools in heavier rainfall events. The depth of the inundation zone will be determined by the unique hydraulics of the GSI/LID BMP. The capacity, drainage outfall, and permeability of the soils will all impact how deep the water ponds within and how quickly it drains from a BMP. Most drought-adapted plants require good drainage, including those that can tolerate temporary inundation. If an infiltration BMP does not drain within 48 hours, even inundation-tolerant plants may not survive.

Transition Zone

The transition zone is typically located on the side slopes of the GSI/LID BMP, above the inundation zone and below the top of the slope for the BMP. It refers to the non-saturated area where capillary rise moves water upwards through the soil from the inundation zone.

High Ground Zone

The high ground zone typically is located above and surrounds the transition zone and is sloped as needed to tie the GSI/LID BMP to the surrounding landscape. This area is not typically inundated and can support a variety of upland and drought-tolerant plants.

Plant Species Diversity

GSI/LID features should include at least three species within each plant type (i.e., tree, shrub, perennial, grass) to ensure that some species will live in the event of extreme drought or insect infestation. Species diversity is also critical for wildlife habitat.

Runoff Requirements for Trees

Each tree on the plant list should receive runoff from at least 1,500-3,500 sq. ft. of impervious surface (e.g., concrete or asphalt) to survive without irrigation after establishment. Lower water use trees, such as desert willow and mesquite, require closer to 1,500 sq. ft., while higher water use trees, such as cottonwood and Arizona sycamore, require upwards of 3,500 sq. ft.

Planting Recommendations

The following procedures should be followed to promote plant growth with GSI/LID BMPs:

- Protect soil from compaction or scarify soil before planting.
- Nursery-grown plants should be planted in the fall (i.e., October and November) to promote root establishment and to minimize irrigation needs. Fall planting of nursery-grown plants is preferred, as it gives them five to six months for root growth before they are stressed by warm temperatures and winds.
- In general, seeds should be planted in early fall, because the soil is still warm, soil moisture is present, and intense storms that wash away seeds are less likely. Seeding guidance can be found in Section 632 of the [NMDOT Standard Specifications for Highway and Bridge Construction](#) for weather limitations for seeding.

Establishment Periods

To achieve water conservation benefit from GSI/LID, plants in GSI/LID features should be drought-adapted and generally able to survive without irrigation, once established. Depending on species selection and site factors, continued irrigation may be needed for trees. Although in some conditions, tree species may not need irrigation beyond establishment, some trees merit continued, efficient irrigation due to the multitude of benefits they provide to the community. The irrigation system placement will likely change as the landscape matures. Supplemental irrigation for all plant types may also be required during periods of prolonged drought. Table 5 outlines establishment periods by plant category under normal precipitation conditions. Table 6 provides guidelines for plant establishment for GSI/LID features.

Table 5: Arid Environment Establishment Periods

Plant Type	Establishment Period
Trees	10-15 years
Shrubs	3-5 years
Perennials/grasses	1-2 years

Table 6: Establishing Guidelines for GSI/LID Features

Are you planting trees?
Yes
You will need to irrigate for 10 to 15 years to establish a healthy tree. This range depends on available precipitation, selected species, soil health, reflected heat, and time of planting. This range assumes each tree receives runoff from between 1,500 to 3,500 sq. ft. of impervious surface. A durable irrigation system is recommended, such as PVC pipe and bubblers or netafim. Drip systems generally do not last more than 8 years. If you are also planting shrubs/smaller plants in addition to the tree(s), consider putting them on a separate irrigation zone so the shrub zone can be turned off while the tree zone continues to be on. It is also possible to cap bubblers for shrubs after they are established (3-5 years), while leaving on bubblers for trees for at least 10-15 years.
No
Shrubs require at least 3-5 years of irrigation for establishment. This range depends on available precipitation, selected species, soil health, reflected heat, and time of planting. A drip system may be sufficient to meet established irrigation needs for shrub perennials, although it will require consistent maintenance to ensure functionality for 3-5 years. If you are seeding, installing a temporary spray irrigation system will greatly improve results. Depending on available precipitation, spray irrigation may only be needed for 1 year. Wildflowers and grasses respond to precipitation but may go dormant without soil moisture. If continuous growth/blooms are desired, irrigation will be necessary.

Glossary

Best Management Practices (BMPs): Set of methods that detain, disperse, attenuate, infiltrate, and/or filter stormwater runoff from impervious surfaces such as streets, sidewalks, rooftops, and parking areas. These practices are designed to manage stormwater runoff and to improve water quality by preventing or by reducing pollutants in stormwater runoff.

Bioswale: A shallow, linear, or curvilinear feature designed to improve water quality by conveying, slowing, and treating runoff; allows pollutants to settle out and promotes infiltration.

BMP Standard Drawings: Detailed guidance on the design and construction of BMPs.

BMP Technical Guidance Sheets: Definitions, general design, and maintenance guidance, as well as appropriate application locations.

Check Dam: A shallow, typically permeable control placed perpendicular to the flow of water within a drainage feature that slows the flow, increasing infiltration as well as retaining sediment and debris.

Curb Opening: An opening in a curb to allow stormwater from an impervious surface, such as roads, parking lots, or hardscape areas, to flow into an infiltration area. Typical design includes a sediment trap located behind the curb opening.

Depressed Median: A linear or curvilinear shallow depression located in the roadway median designed to improve water quality by conveying, slowing, and treating runoff; allows pollutants to settle out and promotes infiltration.

Green Stormwater Infrastructure (GSI): A method of sustainable stormwater management that focuses on treating stormwater runoff prior to it entering rivers, streams, aquifers, and other waterways by leveraging the ecological functions of living, natural systems.

High Ground Zone: The planting location (or infiltration zone) area that is typically located above and surrounds the transition zone and is sloped as needed to tie the GSI/LID BMP to the surrounding landscape. This area is not typically inundated and can support a variety of upland and drought-tolerant plants.

Hydromulch: A thin layer of small rock mulch (less than 1.5 inches deep) which can reduce erosion and provide protection for grass seed.

Infiltration Trench: A linear excavated area that is lined with filter fabric and filled with rock in order to create additional space for runoff to collect and infiltrate into adjacent permeable soils.

Inundation Zone: The planting location (or infiltration zone) area that is located at the base of a GSI/LID BMP and is where water pools in heavier rainfall events.

Land Treatment C: Follows the definition from the City of Albuquerque Development Process Manual (DPM) with minor modifications: Soil compacted by human activity with minimal vegetation, including unpaved parking, roads, and trails. Irrigated lawns and parks with slopes greater than 10 percent. Native grasses, weeds, and shrub areas, and soil uncompacted by human activity with slopes at 20 percent or greater. Native grasses, weeds, and shrub areas with clay or clay loam soils and other soils of very low permeability, as classified by SCS Hydrologic Soil Group D.

Land Treatment D: Follows the definition from the City of Albuquerque Development Process Manual (DPM): Impervious areas such as pavement and roofs. This area includes ponds, channels, and wetlands, even if these areas are seasonally dry.

Low Impact Development (LID): Design and development practices that work with nature to reduce the stormwater runoff volume generated and to minimize or to eliminate adverse impacts to stormwater quality.

New Development: In relation to the retention of the stormwater quality design volume, is defined as a project that is developed on a site with little or no existing impervious cover. This can include an undeveloped property or a property that had previously been developed, but site improvements and impervious cover have been mostly or completely removed so that site constraint issues related to existing infrastructure no longer exist.

NPDES MS4 Permit: The National Pollution Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit is issued by the EPA and requires permittees to develop and implement a comprehensive Storm Water Management Program to control the quality of storm water discharged into waters of the United States.

Organic Mulch: A type of mulch derived from material that was once living. The preferred mulch type for GSI/LID BMPs is shredded, partially composted wood mulch, installed at 3-inch depth, minimum. Shredded wood mulch locks together, making it more resistant to floating or to blowing away. Partially composted mulch contains healthy bacteria and fungi that contribute to soil health. Runoff from a few storms will activate soil fungi which will “glue” the soil to the mulch, making it non-floatable.

Outlet Control Structure: A structure placed at the discharge point from a BMP or detention pond designed to regulate the release of stormwater and to facilitate capture of sediment and floatables.

Permeable: Refers to anything permitting fluid to pass through. Synonym for pervious.

Permeable Pavement: Paving material that allows stormwater to move through the pavement’s surface to a storage layer below, allowing infiltration into the underlying soil. Includes, but is not limited to, permeable interlocking pavers, asphalt, and concrete.

Plant List: Identification of native and drought-tolerant plants appropriate for GSI/LID locations across Bernalillo County.

Predevelopment Hydrology: In general, the rainfall volume at which runoff would be produced from an area in its natural condition, prior to development disturbances. For the purposes of stormwater quality, this means managing the stormwater runoff volume generated by a storm event prior to discharge to mimic the release of runoff volumes which would have occurred prior to site disturbance.

Redevelopment: In relation to retention of the stormwater quality design volume, is defined as a development project that alters the footprint of an existing site, building, or impervious area. Redevelopment projects have site constraints typically not found in new development projects.

Regulatory Requirements: Bernalillo County regulatory environment and review process.

Riparian: Defined by its relative location to a watercourse. Riparian biomes occur along acequias, ditches, the Rio Grande, and Tijeras Creek.

Rural Type Roads: Roads that do not typically feature curb and gutter. Some GSI/LID BMP techniques, such as bioswales and stormwater harvesting basins, are appropriate for rural type roads.

Shrub Desert Grassland: Transitional vegetation type that separates the deserts of lowlands from the higher elevation shrublands and woodlands.

Soil Microbiome: The dynamic community of microorganisms associated with plants and soil. This community includes bacteria, archaea, and fungi. The composition of any particular microbiome is influenced by myriad factors, including environmental, soil physical properties, nutrient availability, and plant species.

Stormwater Bumpout: An area for infiltration and green infrastructure interventions created when the curb and gutter are moved out into the portion of the roadway normally reserved for parking. Otherwise known as 'bulbouts' or 'chicanes'.

Stormwater Harvesting Basin: A stormwater harvesting basin is designed for capture and infiltration of stormwater runoff to support vegetation, to regulate discharge rates, and to improve water quality.

Stormwater Quality Design Storm/Event: The 90th percentile storm event for new development and the 80th percentile storm for redevelopment using the methodologies specified in EPA publication number 832-R-14-007, or developed for site-specific application using methodology described therein, or based on a site-specific predevelopment hydrology and associated storm event discharge volume specified therein. *(Note: The storm event, as just defined and taken from the MS4 Permit, is used to determine the rainfall depth above which measurable runoff first occurs under natural conditions.)*

Stormwater Quality Design Volume: The discharge volume associated with the stormwater quality design storm/event. The amount of stormwater from any given event that should be captured and treated in order to remove a majority of stormwater pollutants on an average annual basis before it is transported to receiving waters.

Transition Zone: The planting location (or infiltration zone) area that is typically located on the side slopes of the GSI/LID BMP, above the inundation zone, and below the top of the slope for the BMP. It refers to the non-saturated area where capillary rise moves water upwards through the soil from the inundation zone.

Treatment Train Guidance: Examples of how BMPs can be used in combination (i.e., treatment trains).

Urban Type Roads: Roads that typically manage stormwater through curb and gutter and may include medians and landscape buffers. Urban type roads have a variety of opportunities for the application of GSI/LID BMPs.

Urban Ephemeral Riparian: The biome in and around unpaved arroyos.

Urban Grassland/Shrubland: The biome that encompasses meadows and lawns in domestic gardens, parks, vacant land, remnants of rural (non-urban) landscape, and areas along transportation corridors.

Appendix: Plant List

Bernalillo County's plant list is located on its website: www.bernco.gov/plantlist. The plant list reflects preferred plants by biome and elevation zone and planting location (or infiltration zone) for the following plant types:

- Trees
- Shrubs
- Perennials
- Grasses

Trees

Botanical Name	Common Name	Mature Size (Height x Spread)	Biome				Elevation Zone and Infiltration Zone (I = inundation, T = transition, H = high ground)					Evergreen / Semi-	Notes
			Urban Ephemeral Riparian	Urban Grassland/ Shrubland	Shrub Desert Grassland	Riparian	West Mesa	Valley	East Mesa	Foothills	E. Mntn		
TREES													
<i>Acacia syn Senegalia greggii*</i>	Catclaw acacia	10' x 15'	X	X	X	X	I, T	I, T	I, T	-	-		Fast grower, good barrier plant, marginally cold hardy
<i>Celtis laevigata</i> - <i>reticulata</i>	Netleaf hackberry	25' x 25'	X	X	X	X	I, T	I, T	I, T	I, T,H	I, T,H		Small red fruits in fall
<i>Cercis mexicana</i>	Mexican redbud	20' x 15'	X	X		X	-	I, T	-	-	-		May be difficult to transplant.
<i>Chilopsis linearis</i>	Desert willow	20' x 25'	X	X	X	X	I,T,H	I,T,H	I,T,H	I,T,H	-		Blooms summer and fall
<i>Crataegus ambigua</i>	Russian hawthorn	15' x 20'	X			X	-	-	-	-	I		May require supplemental water
<i>Juniperus chinensis</i> 'Keteleeri'*	Keteleeri juniper	15' x 10'	X	X	X		T	T,H	T	T,H	T,H	E	A more heat-tolerant Juniper
<i>Juniperus monosperma</i> *	One-seed juniper	15' x 20'		X	X		T,H	T,H	T,H	T,H	T,H	E	Only plant female of species
<i>Koeleruteria paniculata</i>	Golden rain tree	20' x 20'	X			X	-	I,T	I	I,T	I,T		Attracts box elder bugs
<i>Maclura pomifera</i>	Osage orange	25' x 25'	X	X	X	X	-	I,T	I,T	I,T	I,T		Orange-size green fruits on female trees
<i>Pinus eldarica</i> *	Afghan pine	40' x 20'	X	X	X		T	T	T	T	-	E	Protect from inundation
<i>Pinus pinea</i> *	Italian stone pine	60' x 50'	X	X			T	T	T	-	-	E	Protect from inundation
<i>Pistacia chinensis</i>	Chinese pistache	40' x 20'	X			X	I	I	I	I,T	I,T		
<i>Platanus mexicana</i>	Mexican sycamore	50' x 30'				X	-	I	-	I	-		Included on this list on a trial basis
<i>Platanus wrightii</i>	Arizona sycamore	60' x 70'				X	-	I	-	I	I		Requires plentiful and consistent runoff
<i>Populus deltoides</i> var. <i>wisliczenii</i> *	Rio Grande cottonwood	50' x 60'				X	-	I	-	-	I,T		Premier wildlife habitat
<i>Prosopis glandulosa</i>	Honey mesquite	25' x 30'	X	X	X	X	I,T,H	I,T,H	I,T,H	-	-		Yellow flowers in summer
<i>Prosopis pubescens</i>	Screwbean mesquite	20' x 20'	X	X	X	X	I,T,H	I,T,H	I,T,H	-	-		
<i>Quercus arizonica</i>	Arizona white oak	25' x 25'	X			X	-	I,T	I,T	-	-	E	Included on this list on a trial basis
<i>Quercus fusiformis</i>	Escarpment live oak	25' x 30'	X			X	-	I,T	I,T	I,T	-	E	Texas native
<i>Quercus gambelii</i>	Gambel oak	25' x 25'	X			X	-	I,T	-	I,T	I,T,H		Requires supplemental water during drought
<i>Quercus muhlenbergii</i>	Chinquapin oak	40' x 50'	X			X	-	I,T	-	I,T	I,T		Texas native
<i>Quercus turbinella</i>	Scrub live oak	18' x 20'	X			X	-	I,T	I,T	I,T	I,T	E	Native in Sandia Mountains
<i>Rhus lanceolata</i> *	Prairie flameleaf sumac	15' x 20'	X			X	-	I,T	I	I,T	I,T		Fast growing, can form thickets
<i>Robinia neomexicana</i> *	New Mexico locust	25' x 15'	X	X	X	X	-	I,T	I,T	I,T	I,T		Thorny, thicket forming, requires consistent runoff, poisonous seeds, pink flowers in Spring
<i>Salix gooddingii</i>	Goodding's willow	25' x 25'				X	-	I	-	-	-		Riparian only, high water needs
<i>Sapindus saponaria</i> var. <i>drummondii</i>	Western soapberry	30' x 30'	X			X	-	I,T	I	I,T	I,T		Slow grower, white flowers in summer followed by inedible fruits
<i>Styphnolobium japonicum</i>	Japanese pagoda tree	35' x 25'	X			X	I,T	I,T	I,T	I,T	I,T		White flowers in summer
<i>Ulmus parvifolia</i> (and hybrids)	Lacebark elm	40' x 30'	X			X	-	I,T	I	I,T	I,T		Non-invasive, elm beetle resistant
<i>Vitex agnus castus</i>	Chaste tree	20' x 20'	X			X	I,T	I,T	I,T	-	-		
<i>Ziziphus jujuba</i> *	Jujube	25' x 25'	X	X	X	X	I,T	I,T	I,T	I,T	I,T		Thicket-forming barrier plant

Notes: More testing is needed on *Gymnocladus dioica* (questionable drought tolerance) and *Ulmus propinqua* (potentially invasive). Several additional trees were considered for this list and were not included due to concerns with heat and-or drought tolerance, including *Celtis occidentalis*, *Gleditsia triacanthos*, *Juglans major* and *nigra*, *Juniperus scopulorum*, *Prunus cistena*, and *Quercus buckleyi*. In general, trees provide important habitat for birds and pollinators. Conifers (pines and junipers on this list) do not provide the same benefit to pollinators as most deciduous trees.

* Indicates tree is not recommended as street trees because of growth habit, thorns, fruit production, and/or root development.

Shrubs

Botanical Name	Common Name	Mature Size (Height x Spread)	Biome				Elevation Zone and Infiltration Zone (I = inundation, T = transition, H = high ground)					Wildlife Value		Evergreen / Semi-	Notes
			Urban Ephemeral Riparian	Urban Grassland/ Shrubland	Shrub Desert Grassland	Riparian	West Mesa	Valley	East Mesa	Foothills	E. Mtn	Pollinator	Bird		
SHRUBS															
<i>Amorpha canescens</i>	Leadplant	3' x 3'	X	X	X	X	I	I	I	I	LT	X			
<i>Amorpha fruticosa</i>	False indigo	10' x 10'	X			X	-	I	-	-	LT	X			Phytoremediator for lead and perchlorate
<i>Anisacanthus wrightii</i>	Desert honeysuckle	5' x 4'	X	X	X	X	LT	LT	LT	LT	-	X	X		Bright red-orange flowers in early summer and when well watered
<i>Arctostaphylos x coloradoensis</i>	Chieftain or Panchito manzanita	2' x 4'	X	X	X		T,H	T,H	T,H	T,H	T,H	X	X	E	Requires good drainage
<i>Artemisia filifolia</i>	Sand sage	4 x 4'	X	X	X		T,H	T,H	T,H	T,H	T,H		X	E	Requires good drainage, only give one year establishment irrigation
<i>Artemisia tridentata</i>	Big sage	4' x 4'	X	X	X		LT,H	-	LT,H	LT,H	LT,H	X	X	E	
<i>Atriplex canescens</i>	Four-winged saltbush	5' x 7'	X	X	X	X	T,H	T,H	T,H	T,H	T,H		X	E	Allergen-producing, use sparingly, will reseed, salt tolerant
<i>Atriplex lentiformis</i>	Quail bush	8' x 8'	X	X	X	X	T	T	T	T	-		X	E	Good for large spaces
<i>Baccharis salicifolia</i>	Mulefat	8' x 6'	X			X	LT	LT	LT	-	-	X		SE	Sticky foliage
<i>Baccharis salicina</i>	Seep willow	6' x 6'	X			X	-	LT	-	-	-	X	X	SE	Locally native
<i>Baccharis sarothroides</i>	Desert broom	10' x 10'	X	X		X	LT,H	T,H	LT,H	-	-	X	X	SE	
<i>Baccharis 'Starr Thompson'</i>	Starr Thompson broom	4' x 5'	X	X	X	X	-	LT	-	LT	-			E	Sterile cultivar
<i>Buddleia marrubifolia</i>	Wooly butterfly bush	4' x 4'	X	X	X	X	T,H	T,H	T,H	-	-	X	X	SE	
<i>Caesalpinia gillesii</i>	Yellow brd of paradise	5' x 5'	X	X	X	X	T,H	T,H	T,H	T,H	-	X	X		
<i>Caryopteris x clandonensis</i>	Blue mist spirea	4' x 4'	X	X		X	I	I	I	LT	LT	X			
<i>Cercocarpus breviflorus</i>	Hairy mountain mahogany	10' x 8'	X	X		X	-	-	T	T,H	T,H	X	X	SE	Slow growing
<i>Cercocarpus ledifolius</i>	Curleaf mountain mahogany	10' x 12'	X	X		X	-	-	T	T,H	T,H	X	X	E	Slow growing
<i>Cercocarpus montanus</i>	Mountain mahogany	8' x 10'	X	X		X	-	-	T	T,H	T,H	X	X	SE	Slow growing
<i>Chamaebatiaria millefolium</i>	Fernbush	6' x 8'	X	X	X	X	LT	LT	LT	LT	LT,H	X	X		
<i>Dalea capitata</i>	Sierra gold dalea	1' x 3'	X	X	X	X	T	T	T	-	-		X	SE	Very heat tolerant
<i>Ephedra nevadensis</i>	Nevada jointfir	4' x 4'	X	X	X		T,H	-	T,H	T,H	-	X	X	E	
<i>Ephedra viridis</i>	Green ephedra	2' x 4'	X	X	X		T,H	-	T,H	T,H	-	X	X	E	
<i>Ericameria larcifolia</i>	Turpentine bush	3' x 4'	X	X	X		LT,H	LT,H	LT,H	LT,H	LT,H	X		E	Fall-blooming, important late-season nectar source for bees
<i>Ericameria nauseosa</i>	Chamisa- Rabbitbrush	5' x 8'	X	X	X		LT,H	LT,H	LT,H	LT,H	LT,H	X	X	E	Flowers have foul odor
<i>Eriogonum fasciculatum</i>	Flat-top buckwheat	1' x 2'	X	X	X		T,H	-	T,H	T,H	-	X	X		
<i>Eriogonum wrightii</i>	Wright's buckwheat	1' x 2'	X	X	X		T,H	-	T,H	T,H	-	X	X		
<i>Fallugia paradoxa</i>	Apache plume	6' x 7'	X	X	X	X	LT,H	LT,H	LT,H	LT,H	LT,H	X	X	SE	
<i>Forestiera neomexicana</i>	New Mexico olive	12' x 12'	X	X		X	-	LT	LT	LT,H	LT,H	X	X		
<i>Garrya wrightii</i>	Wright's silktassel	6' x 6'	X	X		X	T,H	T,H	T,H	T,H	T,H			E	
<i>Hesperaloe parviflora</i>	Red yucca	3' x 3'	X	X	X		T,H	T,H	T,H	T,H	T,H	X	X	E	
<i>Krascheninnikovia lanata</i>	Winterfat	3' x 3'		X	X		LT,H	LT,H	LT,H	LT,H	LT,H			X	SE
<i>Laurea tridentata</i>	Creosote bush	6' x 6'	X	X	X		T,H	-	T,H	-	-	X	X	E	Yellow flowers in spring and winter
<i>Leucophyllum spp</i>	Texas ranger	3-6' x 3-6'	X	X	X	X	T,H	T,H	T,H	-	-	X		SE	Best species: <i>L. langmaniae</i> 'Lynn's Legacy' and 'Rio Bravo', <i>L. frutescens</i> 'Compacta' and 'Green Cloud', <i>L. revolutum</i> 'Houdini'
<i>Lycium andersonii</i>	Anderson wolfberry	6' x 6'	X	X	X	X	LT,H	LT,H	LT,H	LT,H	-	X	X	E	Salt tolerant
<i>Mahonia haematocarpa</i>	Red mahonia- barberry	6' x 5'	X	X	X	X	LT,H	LT,H	LT,H	LT,H	LT,H	X	X	E	Yellow flowers in spring followed by red berries
<i>Mahonia trifoliata</i>	Algerita	6' x 8'	X	X	X		LT,H	LT,H	LT,H	LT,H	LT,H	X	X	E	Yellow flowers in spring followed by red berries
<i>Nolina microcarpa</i>	Beargrass	5' x 7'		X	X		T,H	T,H	T,H	T,H	-	X	X	E	
<i>Nolina nelsonii</i>	Blue nolina	8' x 4'		X	X		T,H	T,H	T,H	-	-	X		E	
<i>Nolina texana</i>	Beargrass	3' x 3'		X	X		T,H	T,H	T,H	T,H	T,H	X	X	E	Locally native
<i>Prunus americana</i>	Wild plum	10' x 10'	X			X	I	I	I	I	LT	X	X		
<i>Prunus besseyi</i>	Western sand cherry	5' x 5'	X	X	X	X	T,H	T,H	T,H	T,H	T,H	X	X		
<i>Prunus besseyi 'Pawnee Buttes'</i>	Pawnee Buttes sand cherry	2' x 6'	X	X	X	X	T,H	T,H	T,H	T,H	T,H	X	X		Groundcover variety of Western sand cherry
<i>Prunus virginiana var melanocarpa</i>	Western choke cherry	10' x 10'	X	X		X	-	LT	I	LT	LT	X	X		Select from local provenance
<i>Purshia mexicana</i>	Cliff Rose	8' x 8'	X	X	X		T,H	-	T,H	T,H	T,H	X	X	E	Fragrant
<i>Purshia tridentata</i>	Antelope bitterbrush	5' x 5'	X	X	X		T,H		T,H	T,H	T,H	X	X	SE	
<i>Rhus glabra 'Cismontana'</i>	Compact smooth sumac	5' x 7'	X	X		X	-	LT	LT	LT,H	LT,H	X	X		Thicket-forming
<i>Rhus microphylla</i>	Littleleaf sumac	8' x 9'	X	X	X	X	LT	LT	LT	LT,H	LT,H	X	X		
<i>Rhus trilobata</i>	Three leaf sumac	6' x 6'	X	X	X	X	LT,H	LT,H	LT,H	LT,H	LT,H		X		Locally native
<i>Rhus trilobata 'Autumn Amber'</i>	Prostrate three-leaf sumac	2' x 6'	X	X	X	X	LT,H	LT,H	LT,H	LT,H	LT,H		X		Groundcover variety of Three leaf sumac (locally native)
<i>Salix exigua</i>	Coyote willow	5' x 3'				X	-	I	I	I	I	X	X		Root sprouts, bank stabilizer
<i>Salvia chamaedryoides</i>	Mexican blue sage	1' x 2'	X	X			-	T	T	T	-	X		SE	Does well in clay
<i>Salvia greggii</i>	Autumn or Cherry sage	2' x 3'	X	X	X	X	LT	LT	LT	LT	LT	X	X	SE	Brittle, blooms from spring to fall
<i>Salvia officianalis</i>	Culinary sage	2' x 3'	X	X	X	X	LT	LT	LT	LT	LT	X		SE	Can be used for cooking
<i>Salvia pachyphylla</i>	Mojave sage	2' x 3'		X	X		-	T	T	T,H	T,H	X		SE	
<i>Salvia rosmarinus</i>	Rosemary	3' x 3'	X			X	T	T	T	-	-	X		E	
<i>Santolina chamaecyparissus</i>	Grey santolina	2' x 3'	X	X			T	T	T	T	T			E	
<i>Santolina virens</i>	Green santolina	2' x 3'	X	X			T	T	T	T	T			E	
<i>Teucrium araanium</i>	Gray creeping germander	4' x 2'	X	X		X	T	T	T	T	T	X		E	
<i>Teucrium chamaedrys</i>	Wall germander	2' x 2'	X	X		X	LT	LT	LT	LT	LT	X		E	
<i>Vauquelinia californica ssp</i>	Arizona rosewood	12' x 10'	X	X			T,H	T,H	T,H	T,H	-	X	X	E	Does well with high winds

Notes: Several additional shrubs were considered for this list and were not included due to concerns with heat and/or drought tolerance, including *Rhus aromatica* 'Gro-Low', *Buddleia davidii*, and *Lavandula* spp.

Perennials

Botanical Name	Common Name	Mature Size (Height x Spread)	Biome				Elevation Zone and Infiltration Zone (I = inundation, T = transition, H= high ground)					Wildlife Value		Notes
			Urban Ephemeral Riparian	Urban Grassland/ Shrubland	Shrub Desert Grassland	Riparian	West Mesa	Valley	East Mesa	Foothills	E. Mntn	Pollinator	Bird	
HERBACEOUS PERENNIALS AND ANNUAL WILDFLOWERS														
<i>Achillea millefolium</i>	Common yarrow	1' x 1'	X	X	X	X	-	I,T	I,T	I,T	I,T	X		
<i>Artemisia frigida</i>	Fringed sage	1' x 1'	X	X	X		I,T,H	I,T,H	I,T,H	I,T,H	I,T,H		X	
<i>Artemisia ludoviciana</i>	Prairie sage	2' x 3'	X	X	X	X	-	I,T,H	I,T,H	I,T,H	I,T,H	X		Spreads by rhizomes
<i>Asclepias speciosa</i>	Showy milkweed	3' x 1'	X			X	I	I,T	I,T	I,T	I,T	X	X	
<i>Asclepias subverticillata</i>	Horsetail milkweed	2' x 2'	X	X	X	X	I	I	I	I	I,T	X		
<i>Baileya radiata</i>	Desert marigold	1' x 1'	X	X	X		T,H	T,H	T,H	T,H	T,H	X	X	Biennial, prolific reseeder
<i>Berlandiera lyrata</i>	Chocolate flower	1' x 2'	X	X	X	X	T,H	-	T,H	T,H	T,H	X	X	Will reseed
<i>Calylophus hartwegii</i>	Sundrops	1' x 2'	X	X	X		T	-	T	T,H	T,H	X		
<i>Centranthus ruber</i>	Red Valerian	2' x 2'	X	X	X	X	I,T	I,T	I,T	I,T	I,T,H	X		Tolerant of a variety of conditions, will reseed
<i>Cirsium neomexicanum</i>	New Mexico thistle	6' x 2'	X	X	X		I,T,H	I,T,H	I,T,H	I,T,H	I,T,H	X	X	Locally native, non-invasive
<i>Cleome serrulata</i>	Rocky Mountain beeplant	3' x 3'	X	X	X	X	I,T	I,T	I,T	I,T	I,T,H	X	X	Annual, available as seed
<i>Datura wrightii</i>	Sacred datura	2' x 6'	X	X	X	X	I,T,H	I,T,H	I,T,H	I,T,H	I,T,H	X	X	All parts of plant are toxic, only plant in inaccessible basins.
<i>Epilobium canum</i>	Hummingbird trumpet	1' x 3'	X			X	-	I,T	-	I,T	I,T	X	X	
<i>Euphorbia rigida</i>	Gopher spurge	2' x 3'	X	X	X		T	T	T	T	-	X		Handle with caution- sap can burn skin. Will reseed
<i>Gaillardia aristata</i>	Blanketflower	1' x 1'	X	X	X		T,H	T,H	T,H	T,H	T,H	X		Reseeds readily
<i>Glandularia gooddingii</i>	Goodding's verbena	1' x 1'	X			X	T	T	T	T	T	X		Requires water to bloom
<i>Glandularia rigida</i>	Sandpaper verbena	2' x 4'	X	X	X	X	T	T	T	-	-	X		
<i>Helianthus annuus</i>	Common sunflower	4-6' tall	X	X	X	X	-	I,T,H	-	-	I,T,H	X	X	Annual, great for birds, bees, and butterflies (available as seed), phytoremidator of hydrocarbons and metals
<i>Helianthus petiolaris</i>	Prairie sunflower	4' x 4'	X	X		X	I,T,H	I,T,H	I,T,H	I,T,H	I,T,H	X	X	Annual, great for birds, bees, and butterflies (available as seed)
<i>Hymenoxys acaulis</i>	Angelita daisy	1' x 1'	X	X	X		T,H	T,H	T,H	T,H	T,H	X		Reblooms throughout spring and summer
<i>Linum lewisii</i>	Blue flax	2' x 2'	X	X		X	I,T,H	I,T,H	I,T,H	I,T,H	I,T,H	X		
<i>Melampodium leucanthum</i>	Blackfoot daisy	1' x 2'		X	X		T,H	-	T,H	T,H	T,H	X	X	Long-lived, will reseed
<i>Mirabilis multiflora</i>	Desert four o'clock	2' x 3'	X	X	X	X	T,H	-	T,H	T,H	T,H	X		Will reseed
<i>Monarda fistulosa</i>	Wild beebalm	2' x 2'	X	X	X	X	-	-	-	I,T,H	I,T,H	X		
<i>Nepeta racemosa</i>	Catmint	2' x 2'	X	X		X	T	T	T	T	T	X		Blooms spring to fall
<i>Oenothera caespitosa</i>	White tufted evening primrose	1' x 2'	X	X	X	X	T,H	T,H	T,H	T,H	T,H	X		Short-lived, but reseeds readily
<i>Oenothera speciosa</i>	Mexican evening primrose	1' x 2'	X	X	X	X	I,T	I,T	I,T	I,T	I,T	X	X	Needs some water and sunlight to bloom
<i>Oenothera lindheimeri</i>	Gaura	3' x 3'	X			X	I,T	I,T	I,T	I,T	I,T	X		
<i>Penstemon ambiguus</i>	Sand penstemon	2' x 2'	X	X	X		I,T,H	I,T,H	I,T,H	I,T,H	I,T,H	X	X	Usually available as seed
<i>Penstemon thurberi</i>	Thurber's penstemon	2' x 2'	X	X	X		I,T,H	I,T,H	I,T,H	I,T,H	-	X	X	
<i>Psilotrophe tagetina</i>	Wooly paperflower	1' x 2'		X	X		T,H	T,H	T,H	T,H	T,H	X		
<i>Ratibida columnifera</i>	Mexican hat	1' x 1'	X	X	X	X	I,T,H	I,T,H	I,T,H	I,T,H	I,T,H	X	X	
<i>Salvia darcyi</i>	Vermillion Bluffs sage	3' x 3'	X	X		X	-	T	T	T	T	X	X	Great for hummingbirds
<i>Sphaeralcea spp</i>	Globeamallow	2' x 2'	X	X	X	X	I,T,H	I,T,H	I,T,H	I,T,H	I,T,H	X	X	Short-lived, reseeds
<i>Symphotrichum ericoides</i>	White heath aster	2' x 2'	X	X	X	X	-	I,T,H	-	I,T,H	I,T,H	X		Bosque native
<i>Zinnia acerosa</i>	Desert zinnia	1' x 1'	X	X	X		T,H	-	T,H	T,H	-	X	X	
<i>Zinnia grandiflora</i>	Prairie zinnia	0.5' x 1'	X	X	X		T,H	-	T,H	T,H	T,H	X	X	

Notes: Penstemons require well-drained soils and do not tolerate inundation. The Penstemons listed above (*ambiguus* and *thurberi*) are the exceptions that have been observed to tolerate some inundation. However, many Penstemons (including *eatonii*, *parryi*, *pinifolius*, *pseudospectabilis*, *strictus*, and *superbus*) may do well in areas around GSI features. If conditions are favorable, they will reseed themselves into wetter soil.

Grasses

Botanical Name	Common Name	Mature Size (Height x Spread)	Biome				Elevation Zone and Infiltration Zone (I = inundation, T = transition, H= high ground)					Wildlife Value		Notes
			Urban Ephemeral Riparian	Urban Grassland/ Shrubland	Shrub Desert Grassland	Riparian	West Mesa	Valley	East Mesa	Foothills	E. Mtn	Pollinator	Bird	
GRASSES														
<i>Andropogon gerardii</i>	Big bluestem	4' x 2'				X	-	I,T	-	I,T	I,T	X	X	Salt tolerant , phytoremediation of hydrocarbons, some heavy metals, and PCBs (through accumulation)
<i>Aristida purpurea</i>	Purple three-awn	1' x 1'		X	X		T,H	T,H	T,H	T,H	T,H	X	X	Available as seed, good for erosion control and reclamation
<i>Bouteloua curtipendula</i>	Sideoats grama	2' x 2'	X	X	X		T,H	T,H	T,H	T,H	T,H	X	X	
<i>Bouteloua gracilis</i>	Blue grama	2' x 2'	X	X	X		T,H	T,H	T,H	T,H	T,H	X	X	Helps to break down hydrocarbons
<i>Distichlis spicata</i>	Desert saltgrass	2' tall, spreading				X	I	I	I	I	I	X	X	Available as seed, high salt tolerance, higher water needs, mat forming
<i>Elymus elymoides</i>	Squirreltail	1' x 1'	X	X	X		T,H	T,H	T,H	T,H	T,H			Seed heads can be dangerous for pets, good for reclamation
<i>Elymus lanceolatus</i> ssp <i>psammophilus</i>	Streambank wheat	1' x 2'	X	X	X	X	-	I,T	-	I,T	I,T			Sod-forming
<i>Eragrostis trichodes</i>	Sand lovegrass	3' x 3'	X	X	X		T,H	T,H	T,H	T,H	T,H	X		
<i>Festuca glauca</i>	Blue fescue	1' x 1'					-	-	-	-	T			
<i>Muhlenbergia asperifolia</i>	Alkali muhly/Scratchgrass	2' x 2'	X	X	X	X	-	I,T	-	-	-			Salt tolerant
<i>Muhlenbergia capillaris</i>	Regal mist	3' x 3'	X			X	I,T	-	I,T	I,T	I,T		X	High salt tolerance
<i>Muhlenbergia emersleyi</i>	Bull grass	3' x 3'	X			X	I,T	I,T	I,T	I,T	-	X	X	
<i>Muhlenbergia lindheimerii</i>	Autumn glow muhly	5' x 5'	X			X	I,T	I,T	I,T	I,T	-		X	
<i>Muhlenbergia porteri</i>	Bush muhly	1' x 3'	X	X	X		T,H	T,H	T,H	T,H	T,H		X	Usually available as seed
<i>Muhlenbergia rigens</i>	Deer grass	4' x 4'	X	X	X	X	I,T	I,T	I,T	I,T	I,T	X	X	
<i>Muhlenbergia rigida</i>	Nashville muhly	2' x 3'	X	X	X	X	I,T	I,T	I,T	I,T	I,T	X		
<i>Nassella tenuissima</i>	Mexican feather grass	2' x 2'	X	X	X	X	I,T,H	I,T,H	I,T,H	I,T,H	I,T,H			Will reseed. Only plant where spreading is desired.
<i>Panicum obtusum</i>	Vine mesquite	2', spreading	X	X	X	X	I,T	I,T	I,T	I,T	I,T	X		Available as seed, mat forming
<i>Panicum virgatum</i>	Switchgrass	3' x 2'	X			X	-	I	-	-	I,T	X	X	
<i>Pascopyrum</i> - <i>Agropyron smithii</i>	Western wheat grass	2' x 2'	X			X	-	I,T	-	I,T	I,T,H		X	Helps to break down hydrocarbons, can crowd out wildflowers, tolerates poor drainage
<i>Pleuraphis jamesii</i>	Galleta grass	1' x 1'	X	X	X		T,H	T,H	T,H	T,H	T,H	X	X	
<i>Schizachyrium scoparium</i>	Little bluestem	2' x 2'	X	X	X	X	I,T,H	T,H	I,T,H	I,T,H	T,H	X	X	Helps to break down hydrocarbons
<i>Sorghastrum nutans</i>	Indiangrass	4' x 2'	X			X	I,T	I,T	I,T	I,T	I,T	X	X	Helps to break down hydrocarbons, tolerates poor drainage
<i>Sporobolus airoides</i>	Alkali sacaton	2' x 2'	X	X	X	X	I,T,H	I,T,H	I,T,H	I,T,H	I,T,H	X	X	Tolerates salinity and inundation
<i>Sporobolus cryptandrus</i>	Sand dropseed	2' x 2'		X	X		T,H	T,H	T,H	T,H	T,H	X	X	
<i>Sporobolus wrightii</i>	Giant sacaton	5' x 5'	X			X	I,T	I,T	I,T	I,T	I,T	X	X	Tolerates salinity and inundation

