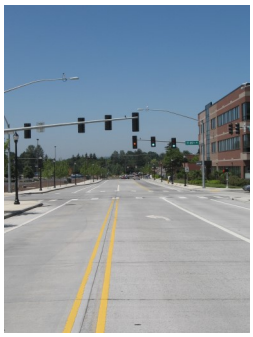
Clackamas County Roadway Standards

Updated June 1, 2020



Department of Transportation and Development
Engineering, Development Services,
and Transportation Maintenance
http://www.clackamas.us/transportation/

CLACKAMAS COUNTY

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FROM THE DIRECTOR

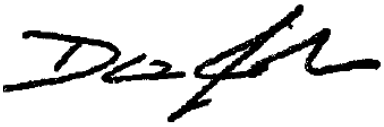
The *Clackamas County Roadway Standards* (hereafter referred to as the "*Standards*") provides a handbook for both roadway design and construction of public and private roadway improvements, alteration of drainage on private property in the unincorporated areas and outside of a storm water district and site design standards for required site improvements related to land use approvals. The purpose of these *Standards* is:

1) To provide specific, consistent and acceptable road design and construction elements for applicants, developers and other private parties constructing or modifying road right-of-way facilities or on-site improvements which require County permits.
2) To establish uniform criteria that still provide context sensitive flexibility in guiding the County's design and construction of County facilities.
3) To allow for practical approaches to road design and construction challenges that provide the best fit solution given the realities of financial constraints and community context.

Roadway designs in Clackamas County strive to achieve sustainable outcomes when safety, convenience, aesthetics, resource protection, ease of maintenance, and community livability are considered.

These *Standards* provide the minimum criteria for design and construction of roadways, accesses, site development, and integrated drainage facilities under the jurisdiction of Clackamas County.

It is not the objective of this handbook to limit the creative efforts of Engineers in providing alternate solutions to specific problem areas or relieve the responsibility for professional engineering judgment. Practical designs that preserve the function and safety of the roadway system and promote sustainability by offering benefits to aesthetics, resource protection, ease of maintenance, and livability are encouraged.



Dan Johnson, Director
Clackamas County Department of Transportation and Development
June 1, 2020

DEFINITIONS

ADA: Americans with Disabilities Act of 1990.
ADA standards: Requirements and standards resulting from the Americans with Disabilities Act of 1990 and adopted by Clackamas County as standards for accessible design within Clackamas County rights-of-way.
Alteration: A change to a facility that affects or could affect pedestrian access, circulation, or use. Alterations include, but are not limited to, resurfacing, rehabilitation, reconstruction, historic restoration, or changes or rearrangement of structural parts or elements of a facility.
Applicant: Property owner or person designated by the property owner to be the representative for an application for a development proposal, permit or approval, or their successors or assigns. As this pertains to utilities, see *County Code* Section 7.03.020.
Average daily traffic ("ADT"): The number of vehicles traveling in both directions over a given time period greater than one day but less than one year, divided by the number of days in that time period. Commonly, traffic counts completed at various times of year are adjusted for time of year to account for seasonal and day of week variations. For the purposes of determining whether a roadway is "very low volume", ADT's shall be based upon a 20 year projected ADT.
Backfill: Replacement of excavated material with suitable material compacted as specified.
Blended transition: A connection between the pedestrian access route at the level of the sidewalk or pedestrian path and the level of the pedestrian street crossing that has grade in the direction of pedestrian travel of 5 percent or less.
Breakaway: A structure that is designed to yield when impacted by a vehicle and has been tested and found acceptable in accordance with NCHRP Report 350.
Clear zone: See *County Code* Section 7.03.020.
Clackamas County ("County"): The political subdivision of the State of Oregon providing statutory authority administered through its Board of County Commissioners ("BCC").
Commercial: Shall include industrial, multi-family and institutional development.
Compaction: The densification of a fill by mechanical means.
County: See "Clackamas County".
County Road Official: See *County Code* Section 7.03.020.
County Surveyor: See ORS 209.005 (2).
Cross slope: The slope perpendicular to travel of a road or pedestrian facility.
Crosswalk: Under ORS 810.220 a crosswalk is a legally defined area for pedestrian crossing of the surface of a roadway and may be marked or unmarked.
Cul-de-sac: A short street having one end open to traffic and the other temporarily or permanently terminated by a vehicle turnaround at or near the terminus.
Curb ramp: A ramp that cut through or is built up to the curb. Curb ramps can be perpendicular or parallel to the curb or a combination of parallel and perpendicular ramps.
Dead end: A road without an exit.
Dedication: The designation and gift of land by its owner. In the context of this document, it is the perpetual easement for right-of-way purposes to the public.
Design speed: The speed approved for the geometric and roadside design of the physical features of a road.
Developer: See "Applicant."
Development Permit: A permit issued to address major work or activities in a right-of-way under the jurisdiction of Clackamas County and/or to address improvements on private property that are required as part of land use.
Ditch: An excavation dug in the earth used to convey water.
Drainage facilities: The physical elements used to convey, absorb, or store runoff such as pipes or channels, and detention or retention ponds or bio-swales.
Driveway ("entry", "entrance", or "access"): A private road on private property that is maintained with private funds.
Driveway, shared access: A road which is on private property in an easement and which is maintained with private funds, generally considered to provide practical and legal access to multiple properties.
Easement: See *ZDO*.
Engineer: A Professional Engineer with Civil Engineering expertise holding a valid license from the State of Oregon.

Engineering: The County Department of Transportation and Development ("DTD") office of Engineering formed by the Board of Commissioners and administrating the DTD ordinances and related issues within unincorporated Clackamas County.
Engineering Geologist: A registered Professional Geologist holding a valid license from the State of Oregon.
Entrance Permit (aka "Entry Permit", "Driveway Permit"): See "Entry Permit" of *County Code* Section 7.03.020.
Fixed object: See *County Code* Section 7.03.020.
Frontage improvements: Required improvements along an applicant's property frontage.
Functional classification: The hierarchy of roadways in descending order of mobility, traffic volume and design speed, and ascending order of access: Freeway/Expressway, Major Arterial, Minor Arterial, Collector, Connector, and Local. Functional classifications of individual roadways can be found on Maps V-2a and V2-b of the *Clackamas County Comprehensive Plan*. Descriptions of each functional classification can be found on Table V-2 and Table V-3 of the *Comprehensive Plan*.
Grade: See *ZDO*.
Grade break: The line where two surface planes with different grades meet.
Intersection: The point where a public roadway or private roadway intersects with a public roadway, private roadway or driveway.
Intersection sight distance ("ISD"): The distance that a motorist can see approaching traffic when entering or exiting a roadway at an intersection.
Landing: A generally flat road or driveway approach to any public or private road. Also, the generally flat area at the back of the sidewalk ramp, typically four feet wide for sidewalk ramps.
Landscape screening: Plantings, shrubbery, bushes or other foliage intended to screen the base of a wireless telecommunication facility from public view.
Land Surveyor: A Professional Land Surveyor holding a valid license from the State of Oregon.
Low impact development (LID): An innovative ecosystem based approach to storm water management that results in fewer environmental impacts.
Pedestrian access route: A prepared surface provided for pedestrian travel within the public right-of-way, including sidewalks and multiuse paths.
PROWAG: *Public Right-of-Way Accessibility Guidance* as set forth under Section 1190.1 of the Americans with Disabilities Act of 1990 and adopted by federal agencies for implementing the Americans with Disabilities Act of 1990, Section 504 of the Rehabilitation Act and the Architectural Barriers Act.
Public utility: See *ZDO*.
Public utility easement ("PUE"): An easement for the use of a Public Utility. The use of the PUE shall include telecommunications as per ORS 758.035.
Ramp slope: The grade of a curb ramp parallel to the direction of pedestrian travel.
Recoverable slope: A slope on which the driver of an errant vehicle can regain control of the vehicle. Slopes of 4H:1V or flatter in the foreslope and 3:1 in the backslope are considered recoverable.
Right-of-way ("ROW"): See *ZDO*.
Right-of-Way Permit: A permit issued to address minor work or activities in a right-of-way under the jurisdiction of Clackamas County.
Road: See *ZDO*.
Road, county: See *ZDO*.
Road, private: See *ZDO*.
Road, public: See *ZDO*.
Roadway: See *ZDO*.
Road Official: See County Road Official
Running slope: The grade of a Pedestrian Access Route that is parallel to the direction of pedestrian travel. In reference to a curb ramp the term Ramp Slope is also used.
Rural: Those unincorporated County areas outside the current designated Urban Growth Boundary (UGB).
Shoulder: The paved or compacted graveled portion of the roadway outside the traveled portion of the roadway that is available for emergency parking or non-motorized use.
Sidewalk: See *ZDO*.
Stopping sight distance ("SSD"): The minimum sight distance available on a roadway to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path.

Storm drainage system: A means to control storm water through natural or constructed elements by conveyance, absorption, or storage.
Street: See *ZDO*.
Temporary: Lasting for a limited time.
Traffic Engineer: A Professional Engineer with traffic engineering expertise or a Professional Traffic Engineer holding a valid license from the State of Oregon.
Traveled portion of the roadway: See *County Code* Section 7.03.020.
Trip generation: The number of vehicle trips generated by a particular land use.
Urban: Those areas within the current designated Urban Growth Boundary ("UGB") as designated by Metro.
Utilities: Any water, gas, sanitary or storm sewer, electrical, telephone, drainage way, wire, or television communication service and all persons, companies, districts or governmental agencies supplying the same.
Utility Permit: See *County Code* Section 7.03.020
Very low volume: A roadway with a 20 year projected volume of 400 ADT or less or an intersection with a 20 year projected entering volume of 400 ADT or less.

ABBREVIATIONS

AASHTO:	American Association of State Highway and Transportation Officials
ADA:	Americans with Disabilities Act
ADT:	Average daily traffic
APWA:	American Public Works Association
ASTM:	American Society for Testing and Materials
BCC:	Clackamas County Board of County Commissioners
CRC:	Clackamas Regional Center
DTD:	Clackamas County Department of Transportation and Development
EOR:	Engineer of Record
FHWA:	Federal Highway Administration
ISD:	Intersection sight distance
ITE:	Institute of Transportation Engineers
MPH:	Miles per hour
MUTCD:	Manual on Uniform Traffic Control Devices
ODOT:	Oregon Department of Transportation
PI:	Point of intersection
PC:	Point of curvature
PT:	Point of tangency
SSD:	Stopping sight distance
UGB:	Urban Growth Boundary

STANDARD DRAWINGS

The Standard Drawings are available in two formats, pdf and as AutoCAD drawing (dwg), online at http://www.clackamas.us/engineering/roadway.html

CHAPTER 1 - GENERAL CONSIDERATIONS

Chapter 1 establishes general requirements, applicability and process and procedures for plan review, permitting and inspection, sureties, and project close-out.

The remainder of the chapters address technical requirements.

SECTION 110 - GENERAL PROVISIONS

a) These *Clackamas County Roadway Standards* will commonly be referred to as the "*Standards*".
b) The *Standards* are available online at http://www.clackamas.us/engineering/roadway.html. This website will contain the most recently adopted *Standards*, the Standard Drawings in both pdf and dwg formats, ADA design and inspection checklists, Design Modification Request form, Developer Engineer Agreement, Certification of Compliance and Completion and other materials.
c) The *Standards* apply to all improvements in right-of-ways easements under the jurisdiction of Clackamas County (including public utility easements and some trails), public and private storm drainage & erosion control as well as some onsite improvements related to development through a land use approval. Additionally, these *Standards* apply to certain structures on private property and private improvements related to the adequacy of fire access, and grading required in conjunction with private and public roadway development. Grading associated with structures shall be addressed per Title 9.03 of the *County Code* and are administered by the Building Codes Division.
d) In the unincorporated area, when there is no identified district for stormwater management and erosion control, DTD has jurisdiction.
e) Additional requirements are also imposed upon federally funded projects and supersede the requirements of these *Standards*.
f) These *Standards* shall be used in conjunction with the *Clackamas County Comprehensive Plan* ("*Comprehensive Plan*") and the *Clackamas County Zoning and Development Ordinance* ("*ZDO*").
g) These *Standards* shall be used to implement and be used in conjunction with the policies and standards adopted by the Board of County Commissioners ("BCC").

SECTION 115 – OTHER STANDARDS, GUIDELINES & REFERENCES

These *Standards* are intended to be consistent with the most recent versions of the following references. It is the Engineer's and/or applicant's responsibility to comply with federal, state, and local regulations, particularly with respect to wetland and environmental regulations and other development requirements. If conflicts arise, the most restrictive regulation shall apply.

a) *Clackamas County Comprehensive Plan*
b) *Clackamas County ITS (Intelligent Transportation System) Action Plan*
c) *Clackamas County Active Transportation Plan* ("*ATP*")
d) *Clackamas County Transportation Safety Action Plan* ("*TSAP*")
e) *Clackamas County Zoning and Development Ordinance* ("*ZDO*")
f) *Clackamas County Capital Improvement Plan* ("*CIP*")
g) *Clackamas County Code* ("*County Code*")
h) Clackamas County Service District#1 *Stormwater Standards*
i) Water Environment Services *Erosion Prevention and Sediment Control Planning and Design Manual*
j) *Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way* ("*PROWAG*")
k) Technical requirements of *Oregon Standard Specifications for Construction*
l) Other state and federal laws

If these *Standards* do not address a specific design issue, the most recent version of the following documents should be referenced. In all situations, Engineering shall determine the appropriate design reference and its applicability.

a) American Association of State Highway and Transportation Officials ("AASHTO") - *A Guide for Achieving Flexibility in Highway Design*
b) AASHTO - *Guide for the Development of Bicycle Facilities*
c) AASHTO - *Guide for the Planning, Design, and Operation of Pedestrian Facilities*
d) AASHTO - *Guidelines for Geometric Design of Very Low-Volume Local Roads*
e) AASHTO - *LRFD Bridge Design Specifications*
f) AASHTO - *A Policy on Geometric Design of Highways and Streets*
g) AASHTO - *Roadside Design Guide*
h) AASHTO - *Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals*
i) *American Society for Testing and Materials* (ASTM)
j) The Asphalt Institute - *The Asphalt Handbook*
k) The Asphalt Institute - *Thickness Design - Highways and Streets*
l) Federal Highway Administration (FHWA) - *Manual on Uniform Traffic Control Devices* (*MUTCD*)
m) FHWA - *Standard Highway Signs*
n) FHWA - *Roundabouts: An Informational Guide*
o) ITE - *Traffic Control Devices Handbook*
p) ITE - *Traffic Engineering Handbook*
q) ITE - *Trip Generation Manual*
r) ITE - *Trip Generation Handbook*
s) *International Building Code* ("*IBC*")
t) *International Plumbing Code* ("*IPC*")
u) National Association of City Transportation Officials - *Urban Bikeway Design Guide*
v) National Association of City Transportation Officials - *Urban Street Design Guide*
w) ODOT - *Highway Design Manual*
x) ODOT - *Hydraulics Design Manual*
y) ODOT - *Oregon Temporary Traffic Control Handbook for Operations of Three Days or Less*
z) ODOT - *Traffic Control Plans Design Manual*
aa) ODOT - *Traffic Line Manual*
bb) ODOT - *Traffic Manual*
cc) ODOT - *Traffic Signal Policy and Guidelines*
dd) ODOT - *Sign Policy and Guidelines*
ee) ODOT - *Oregon Standard Drawings*
ff) ODOT and American Public Works Association ("APWA") - *Standard Specifications for Construction*
gg) *Oregon Fire Code* Appendices B and D
hh) Oregon Fire Code Metro Code Committee *Fire Code Applications Guide*
ii) *Oregon Supplement to the MUTCD*
jj) Other local fire codes
kk) Transportation Research Board (TRB) - *Highway Capacity Manual*
ll) Tri-Met *Bus Stops Guidelines*

SECTION 120 - DEVELOPMENT RELATED IMPROVEMENTS

In certain instances, the provisions of the *ZDO* may require a developer to make improvements and/or dedicate right-of-way for the improvement of roadways in connection with a development that has received land use approval. The *ZDO* and subsequent land use conditions of approval shall dictate the nature and extent of those improvements. When improvements are made, they shall be compliant with these *Standards* and the roadway cross sectional elements of the *Comprehensive Plan* and the *ZDO*.

SECTION 130 - PERMIT REQUIREMENTS

130.1 General Requirements

Improvements, activities or the placement of permanent objects in the right-of-way under County jurisdiction require a permit prior to the start of work. The County will issue a permit when it is established that the proposed activity is compliant with requirements. The County is not liable for errors or omissions of an applicant submittal.

Per *County Code* 7.03.030, the Road Official "may take any action deemed to safeguard the best interests of the traveling public." This includes objects within the right-of-way, permitted or otherwise, are subject to relocation or removal at the adjacent property owner's expense at such time that the Road Official deems it necessary to relocate or remove such things due to public need, safety, or violation of standards.

The privileges granted and obligations created by virtue of a permit issued shall be binding not only upon the applicant, but also upon the successors and assigns of the applicant. The applicant shall give Engineering written notice of any such assignment or transfer within 90 days after assignment.

130.2 Exceptions to Requirements for Permit

The following work/placements within the right-of-way under the jurisdiction of Clackamas County do not require a permit:

a) Work performed by the County Department of Transportation and Development or its contractors. However, a Right-of-way Permit is required for road closures when work is performed by DTD contractors.
b) Unless traffic control is required per Section 290, certain activities including:
    1) Vegetation installation, maintenance, and removal that is compliant with the *County Code* and not related to street trees.
    2) Street tree removal and installation not related to development. Land use requirements may dictate replacement when street trees are removed. The Clackamas County Planning and Zoning Division provides guidance in the installation of street trees on their website. See Section 255 regarding street tree installation when related to development.
    3) Roadway and sidewalk cleaning.
    4) Driveway culvert maintenance.
    5) Driveway maintenance including the spreading of gravel, repair of asphalt deterioration if the pavement edge of the roadway is not impacted, and sealing pavement.
    6) Minor grading and placement of gravel on graveled roadways that does not significantly impact the existing drainage in the judgment of the Road Official.
    7) Some utility work per *County Code* Section 7.03.099.
c) Certain right-of-way encroachments may be installed without a permit if maintained by the adjacent property owner or by agreement and are compliant with *County Code* Section 7.03.090, sight distance standards of Section 240, clear zone standards of Section 245, do not hinder access or maintenance of the constructed roadway or to utilities within an easement, do not constitute a road hazard and do not necessitate traffic control upon installation or maintenance per Section 290. These encroachments include:
    1) Private irrigation systems not installed within a roadway median or island.
    2) Mailboxes installed per the Standards for Installing Mailboxes on County Roads.
    3) Fences.
    4) Other objects compliant with *County Code* Section 7.03.
d) Under any other conditions determined by the Road Official.

130.3 General Permit Requirements

The following provisions apply to Development Permits, Entrance (Entry) Permits, Utility Permits, and Right-of-Way Permits.

130.3.1 Responsibility

Issuance of permits by the County does not in any way relieve an applicant of their responsibility to meet all requirements of the County or other affected jurisdictions, or the obligation to protect life, health and/or property. The issued permit for any project may be revised, supplemented, or revoked at any time if it is determined by the Road Official that the requirements of the County may not have been met or life, health and/or property are jeopardized. An applicant is responsible for the safety and maintenance of the roadway within their work area.

130.3.2 Application Submission

a) Utility Permit applications shall be submitted online at https://accela.clackamas.us/citizenaccess/ where permit instructions and submittal requirements can be found.
b) Other permit applications may found and submitted via methods described at https://www.clackamas.us/engineering/forms.html.

130.3.3 Fees

a) Fees will be charged per the Clackamas County fee schedule found at https://www.clackamas.us/transportation/engineeringfees.html. Fees not paid online may be paid via cash, check or credit card. Credit card payment requires an additional fee. Engineering staff will contact applicants for applications that are not accompanied by the appropriate fee for payment prior to permit processing.
b) Development Permit fees are typically based upon a percentage of the Engineer's estimate or a Contractor's estimate or bid and subject to Engineering approval. Sureties will be based upon an Engineer's estimate per Section 190.
    1) All work in the public right-of-way under the jurisdiction of Clackamas County shall be included in the estimate.
    2) Work on private property related to access and circulation under Engineering review shall be included in the estimate.

130.3.4 Contractor Requirements for Licensing, Bonding, & Insurance

Contractors performing work within the right-of-way under the jurisdiction of Clackamas County shall:
a) Maintain a valid license with the Oregon Construction Contractors Board.
b) Comply with the insurance requirements of Clackamas County's Insurance for Permitted Work policy.

Contractors performing work without compliance with these requirements are subject to Code enforcement per the *County Code*.

130.3.5 Property Owner Requirements for Insurance

a) Property owners may perform limited work in the right-of-way per the Insurance for Permitted Work policy.
b) Property owners performing work without compliance with these requirements are subject to code enforcement per the *County Code*.

130.3.6 Permit Approval

Work subject to a permit may not proceed until Engineering issues the permit. Work without a permit is subject to code enforcement. When a permit is issued, a copy of the issued permit will be provided to the applicant. Permit numbers are assigned at the time of your application and are displayed on the permit. Applicants should refer to these numbers when communicating with staff about their project.

130.3.7 Application Period, Approval Period & Extensions

Permit applications that are not issued within a certain timeframe will expire. Issued permits will display a permit expiration date. Work may not occur after the expiration date unless the work is in surety or warranty. Permits not completed by the expiration date and work that takes place after the expiration date that is not in surety or warranty is subject to code enforcement. Any surety that is in place may be utilized by the County to complete the work at the date of expiration or at the end of the surety period. Expiration dates are determined as follows:

a) **Development Permits**
   1) Eighteen (18) months from the Development Permit application date if not issued.
   2) Two (2) years from the date of issuance or the date of the expiration of the land use permit.
   3) Under special circumstances, up to one (1) year extensions may be granted if it complies with land use requirements, the required surety is in place, and any required extension fee is paid.

b) **Entrance Permits**
   1) Two (2) years from the application date if not issued.
   2) Two (2) years from the date of issuance.
   3) When associated with a residential Building Permit, the Entrance Permit expires at Building Permit final.
   4) When not associated with a residential Building Permit, the permit expiration may be extended for up to one (1) additional year when any required extension fee is paid.

c) **Utility Permits**
   1) Six (6) months from the application date if not issued.
   2) Six (6) months from the date of issuance except:
      i. Minor work such as potholing, which shall expire at conclusion of the proposed activity.
      ii. Permits that involve pole removal work expire one (1) year from the date of issuance.
      iii. The ongoing occupation of the right-of-way is not subject to expiration unless the utility is no longer being utilized.
      iv. The permit may be extended for up to an additional three (3) months if approved by the Road Official.

d) **Right-of-Way Permits**
   1) Six (6) months from the application date if not issued.
   2) One (1) year from the date of issuance except:
      i. Revocable encroachments may expire per the revocable encroachment agreement.
      ii. Permits addressing filming, races or events, block parties, road closures, or traffic control only will expire at the conclusion of the proposed activity.
      iii. When not associated with a residential Building Permit, the permit expiration may be extended for up to one (1) additional year when any required extension fee is paid.

Timelines for work that is subject to code enforcement action per Section 7.03 of the *County Code* will vary depending upon the timeline of the code enforcement action and is subject to an extension fee or a new or revised permit. No work subject to a permit per Section 130.4 may occur without a valid permit per these *Standards*.

130.3.8 Revocation or Modification of Permits

Per County Code Section 7.03.030, "The Road Official or the Board may take any action deemed to safeguard the best interests of the traveling public." The Road Official may stop work, revoke, suspend, modify or reissue a permit at any time if the permitted activities:

a) Violate these *Standards*;
b) Violate the permit conditions;
c) Violate the approved plans;
d) Violate and use requirements including the conditions of approval;
e) Require the consideration of new information not considered in the original permit approval; or
f) Do not protect health, safety, property or environment.
g) Any other situation as determined by the Road Official.

130.3.9 Notification

The applicant shall coordinate construction activities with the adjacent property owner (if not the applicant), tenants, local public agencies, utilities and service providers during construction to avoid damage to property or utilities and to prevent the interruption of services. Applicants shall be responsible to notify adjacent property owners of work occurring along that property owner's roadway frontage to protect their property, access and minimize disruption. The adjacent property owner is entitled to delivery of private property permitted to be removed from the right-of-way.

130.3.10 Construction Noise

Construction noise shall be within the hours and decibel level limits established in the County Noise Control Ordinance located in Title 6.05 of the *County Code* or other applicable local noise control ordinances.

130.3.11 Inspection

Comply with requirements of Section 180.

130.3.12 Final Inspection/Project Close-out

Comply with requirements of Section 190.

130.4 Permit Types & Requirements; Stormwater & Erosion Control Reviews

130.4.1 Development Permit

A Development Permit will be required for:

a) Work in the public right-of-way under the jurisdiction of Clackamas County that creates, modifies, widens or extends a roadway or trail, involves a structure per Chapter 5, or significantly modifies drainage in the judgment of the Road Official.
b) Work in a right-of-way under county jurisdiction that exceeds the parameters of an Entrance or Right-of-Way Permit.
c) Dedication of public right-of-way or easements as part of a development.
d) Work on private property that involves:
    1) Land use approval related to access and circulation.
    2) The construction of private roadways.
    3) Structures per Chapter 5 when not subject to a Building Permit.
    4) A culvert 12 inches in diameter or greater that may alter the surface water runoff in the public right of way.
    5) An environmental resource involving land use or environmental permitting, outside a surface water management district.

6) Structural fill, fills greater than one foot in depth, or site improvements on slopes greater than 10%, outside a surface water management district.
7) Access on existing slopes greater than 10%.

d) Utility work related to a development shall be issued via a Development Permit. Utility work not related to a development shall be issued via a Utility Permit.
e) Any other situation as determined by the Road Official.

On a case-by-case basis, the County may reduce the requirement for a Development Permit to an Entrance and/or Right-of-Way Permit (i.e. providing access to four of less residential properties where the required improvements could be acceptably constructed to meet residential, agricultural, or logging driveway requirements, an entrance permit may suffice).

130.4.2 Entrance (Entry) Permit

An Entrance Permit will be required under the following conditions:
a) New driveways to a right-of-way under County jurisdiction except in the case of industrial, commercial and multi-family developments where a Development Permit has sufficiently addressed the entrance requirements.
b) Modification to portions of existing driveways located in the right-of-way not meeting the exemption requirements of *County Code* Sections 7.03.240-7.03.290.
c) As part of a residential subdivision or partition to address access to each lot of record.
d) When required per the Entrance Permit Matrix.
e) Any other situation as determined by the Road Official.

130.4.3 Utility Placement Permit

A Utility Permit will be required for work in the public right-of-way under the jurisdiction of Clackamas County under the following conditions:
a) Utility work not related to a development shall be issued via a Utility Permit. Utility work related to a development shall be issued via a Development Permit.
b) Potholing for utility location.
c) Other work not addressed by the exemption of *County Code* Section 7.03.099.
d) Any other situation as determined by the Road Official.

130.4.4 Right-of-Way Permit

A Right-of-Way Permit is required for work in the public right-of-way under the jurisdiction of Clackamas County under the following conditions:
a) Sidewalk grinding or panel replacement.
b) Improvements to the public right-of-way that does not require a Development Permit.
c) Right-of-way encroachments not exempt per Section 130.1. Special requirements to address revocable encroachments are found at https://www.clackamas.us/engineering/forms.html. Privately owned installations require a Right-of-Way Permit.
d) Any activities that require traffic control not related to other permits. These activities commonly include races, filming and block parties.
e) Temporary road closures.
f) Dust control application.
g) Gates or other obstructions that restrict access to a right-of-way.
h) Minor paving or grading work that does not involve significant drainage changes.
i) Any other situation as determined by the Road Official.

130.4.5 Stormwater Review

Engineering is responsible for ensuring the adequate drainage of public roadways and developed properties in unincorporated areas outside of established stormwater districts within the County. Engineering regulates the construction of public and private roads and other site improvements to ensure adequate drainage of storm/surface water to an appropriate discharge point.

Stormwater management review and requirements for work in a public right-of-way or on private property may be added to an Engineering permit for work proposed outside a stormwater district under the following conditions:

a) When 5,000 square feet or more of new or reconstructed impervious surface is proposed within the UGB.
b) When 10,000 square feet or more of new or reconstructed impervious surface is proposed outside the UGB.
c) When grading or any new or reconstructed impervious surface is proposed or replaced within 50 feet of a perennial creek or stream or within 10 feet of a property line.

See Chapter 4 for stormwater management standards when required by this section.

130.4.6 Erosion Control Review

An erosion control review and inspections may be added to an Engineering permit when 800 square feet or greater of soil disturbance is proposed outside a stormwater district whether the disturbance occurs in the right-of-way or on private property. In addition to the erosion control review from Engineering, disturbances of one acre or more require a 1200-C permit from DEQ. When applicable, Engineering requires a copy of the 1200-C permit prior to issuance of a permit. See Section 470 for requirements.

SECTION 140 – PERMIT AND PLAN SUBMITTAL REQUIREMENTS

140.1 Development Permit Submittal

Permit applications shall contain documents submitted in support of a Development Permit application and shall be prepared in accordance with the following requirements:

a) Submitted via one of the methods described in Section 130.3.2.
b) Electronic plans are preferred to paper plans and shall follow the same requirements as paper plans.
c) Plans submitted on paper shall be submitted on 22" x 34", 24" x 36" or 11"x17" sheets. Traffic signal plans shall be submitted on 11" x 17" sheets. Acceptable scales are 1" = 10', 20', 30', 40' or 50' horizontal (1:10 ratio) and 1" = 1', 2', 3', 4', or 5' vertical. The scale shall be shown for each plan. Engineer scale shall be required. Depending on the plan, engineering may allow other scales upon request.
d) Plans shall include the following:
    1) The land use case file number on the cover sheet (if applicable)
    2) Project contacts on the cover sheet
    3) A north arrow shall be included on each sheet and point to the top or right side of the plan.
    4) The location and elevation of a temporary benchmark shall be shown on the plans, or if the benchmark is not within the proposed area of work it shall be referenced by number and location and the plans shall also provide a local benchmark. When practicable, elevations shall be based on the NAVD88 datum. Alternatively, another datum may be acceptable as the basis of elevations for engineering drawings.
    5) Whenever practicable, utilize the Oregon Coordinate Reference System – PDX zone (OCRS-PDX) international feet as the coordinate base for projects. Alternatively, another geodetic plane system may be acceptable as the basis for engineering drawings.
    6) Plans shall have a vicinity map showing the location of the project, surrounding roadways, nearby driveways, and major intersections. The stamp and signature of the Engineer responsible for preparation of the plans shall be on all sheets.

7) Plans shall include a topographic survey of existing conditions. The stamp and signature of the Surveyor responsible for preparation of the existing topographic conditions shall appear on the existing conditions plan. The Engineer's stamp is not required on the existing conditions plan.
8) Detail sheets shall show all Standard Drawings and special drawings needed for the project. *Oregon Standard Drawings*, as applicable, should be incorporated into the plans.
9) Detail sheets shall be submitted for all ADA accessibility features including blended transitions, curb ramps, crosswalks, medians/traffic islands, sidewalks/paths, pedestrian push buttons and clear spaces. The detail sheets shall contain the level of detail similar to that found in *ODOT Standard Detail* DET1720.
10) Plans shall include existing and proposed locations of utility poles, pedestals, vaults, fire hydrants, signs, mailboxes, fencing, and any other structures within the right-of-way.
11) General notes shall be shown together on one page, preferably the first sheet in the set. The County's standard general notes are provided in Standard Drawings N100-N300.
12) Plans shall include any additional information the County deems necessary.

140.1.1 Plan View Sheets

Plan views shall contain the following items (as applicable). Plan and profile views shall include the items below, extending 200 feet from project boundaries adjacent to and beyond the proposed improvement:

a) Plan and profile views may be stacked one above the other if desired. Plan horizontal scale shall match the profile horizontal scale.
b) Right-of-way, property lines, right-of-way centerline, and existing and proposed easements. The plans shall identify any offset crowns from centerline of the right-of-way.
c) Construction shall not occur within two feet of adjacent property lines unless approved by the County.
d) Right-of-way centerline stationing of existing and proposed roadways. Stations shall be based on existing stationing if available. Show stationing for centerline-centerline of intersections.
e) Subdivision name, approved roadway names, subject property tax lot numbers and adjacent property tax lot numbers.
f) Existing utilities and structures, including hydrants, pedestals, signs (public and private), mailboxes, light poles, structures, manholes, drainage structures, valves, meter boxes, power poles, fences, curb ramps, pavement markings, trees, etc.
g) On both sides of the street across the property frontage and within 200 feet of each property line include the edge of pavement, shoulders, curb, sidewalk, ditch line, culverts and existing driveways.
h) Horizontal alignment and curve data for roadway centerline and non-parallel curb lines. Curve data shall include radius, length, and delta.
i) Curve data (radius, length, and delta angle) for all curb returns, with gutter elevations at the P.T., P.C., and quarter deltas. Top of curb elevations may be shown. Show the location of existing and proposed survey monument boxes per Section 150.3.
j) Minimum stationing callouts at 100 foot increments, with tick marks at 50 foot increments.
k) Location, station, and size of all existing and proposed storm drains, sanitary sewers and water systems. Stationing shall be based on roadway stationing, except where specifically required otherwise by sewer or water district.
l) Grading plans shall show existing and proposed contours, and high and low points. Contours shall be at a maximum two (2) foot interval.
m) Placement, elevations, dimensions and slopes shall be shown for ADA accessibility features in accordance with *Oregon Standard Drawings* and *ODOT Standard Detail* DET1720.
n) Location and description of existing and proposed survey monuments.
o) Typical sections of all roadway sections and drainage channel sections.
p) Pavement restoration considering the impacts of each utility associated with the development. The location of the saw cut line. Pavement restoration and saw cut line location shall be based upon Standard Drawings U270 through U290.
q) Pavement tapers as defined in Section 250.6.4.
r) Signing and pavement marking plan as necessary per Sections 270 and 280.

140.1.2 Profile View

Profile views shall contain the following items (as applicable):

a) Stationing, elevations, vertical curve data and slopes for proposed roadway centerline. Existing centerline elevations shall be shown. Estimate and label existing vertical curve data.
b) Gutter elevations shall be shown when gutter slope does not parallel the centerline profile.
c) Where super elevation is employed, both curbs shall be profiled. As an alternative, a super elevation diagram or table may be acceptable.
d) Existing ground line at proposed roadway centerline. Existing ground line shall extend a minimum of 200 feet beyond the proposed improvement.
e) All existing and proposed storm drains, sanitary sewers, and water systems. Include pipe size, material, length, slope, manholes, inlets, invert and rim elevations, and outfalls.
f) All existing and proposed storm, sanitary, and water lines, and utility crossings.
g) Existing and proposed flowlines of ditches and drainage ways. Flowlines shall extend a minimum of 200 feet beyond the proposed improvement or to the nearest acceptable outfall.

140.1.3 Half Street/Cross Section Views

Half street/cross section views shall contain the following items (as applicable):

a) Half street design shall include the information required in Sections 140.1.1, 140.1.2 and 225.6.
b) Half street designs require full street cross sections at 25 feet on center extending 200' beyond the property lines and across the frontage. The cross slopes shall be labeled with the stationing, and indicate the existing cross slope beyond the centerline to the opposite edge of pavement, the pavement width, elevations at centerline, crown, saw cut line, and gutter line or existing edge of pavement. The maximum allowed grade break within the transition between existing and proposed cross slopes is 2%.
c) Additional cross sections may be required by the County when warranted by the complexity of the road design.

140.1.4 Stormwater Report & Drainage Calculations

a) All stormwater reports and drainage calculations shall be stamped and signed by an Engineer. Complete calculations shall contain, at a minimum, the following:
    1) Map of the drainage basin showing areas contributing to each inlet.
    2) Design assumptions and parameters.
    3) Nomographs and charts used to determine time of concentration and rainfall intensity.
    4) Calculations for conveyance systems, water quality facilities and detention facilities as applicable.
    5) Downstream analysis as applicable.
    6) Provide an executive summary that references the design elements included in the report.
b) For full criteria and requirements for drainage, see Chapter 4 of these *Standards*.

140.1.5 Other Requirements

Design elements and assumptions used for roadway design shall be included on the plans or submitted in memorandum form to the County. The following information shall be provided, as required:

a) Geotechnical or Soils report (see Section 252 for requirements).
b) Pavement design.
c) Structural plans and calculations shall be submitted for all proposed structures that are not under the purview of the Building Codes Division. Comply with the requirements of Chapter 5 of these *Standards*.
d) Other required technical data and reports including traffic engineering analysis, etc.
e) Environmental reports and permits as required by law.

140.1.6 Other Reviewing Agencies

The design and construction of public and private improvements within the County may involve numerous federal, state and local agencies, utility districts, and private utilities. It shall be the applicant's responsibility to coordinate the design, permit process, and construction with the applicable agencies, districts, and private utilities.

140.1.7 As-Built Plans

The applicant shall be responsible for providing as constructed drawings for all improvements including all construction changes, added and deleted items, location of utilities, etc. The as-built plans shall be submitted to the County at the time of initial paving or prior to building occupancy, and shall include at a minimum, the following.

a) As-built plans shall include and address the requirements of Section 140.
b) As-built plans shall include field survey data by a Land Surveyor that provides the actual invert and rim elevations of all sanitary and storm sewer systems within the project.
c) As-built elevations that vary from plan elevations shall be shown on the plan by striking a line through the plan elevation and listing the field verified elevation adjacent to the plan elevation. Elevations shall be as-built at a tolerance of 0.05± feet.
d) Applicant shall submit one set of as-built plans stamped and signed by an Engineer. The as-built plans shall include the entire approved plan set. As-built plans shall be submitted as dwg and pdf format via one of the methods of Section 130.3.2.

140.2 Entrance, Utility and Right-of-Way Permit Submittals

Comply with individual permit requirements found at https://www.clackamas.us/engineering/forms.html.

SECTION 150 - SURVEYING

150.1 General

These *Standards*, the *Oregon Standard Specifications for Construction*, and ORS 209.140155, define the requirements for protection of existing survey monuments during any construction and setting new survey monuments following construction of new roadways.7,

150.2 Existing Survey Monuments

a) Anyone who notices or causes an existing section corner, quarter corner or donation land claim corner monument or accessory, to be in danger of damage or destruction by any construction, shall notify the County Surveyor in writing, not less than ten (10) working days prior to construction. The County Surveyor shall reference the monument prior to construction and replace it following construction. The County Surveyor shall be reimbursed by the applicant for all expenses from said replacement.
b) In accordance with ORS 209.150, any person or public agency removing, disturbing or destroying any survey monument of record in the office of the County Surveyor or County Clerk shall cause a registered professional Land Surveyor to reference and replace the monument within 90 days of the removal, disturbance or destruction. The registered professional Land Surveyor referencing and replacing the monument shall do so in the same manner that is provided for public land survey corners according to ORS 209.140 and shall notify the County Surveyor of that action within two business days. The costs of referencing and replacing the survey monument shall be paid by the person or public agency causing the removal, disturbance or destruction.
c) Any project that involves the reconstruction or realignment of all or a portion of a public road shall be required to comply with ORS 209.155.

150.3 New Survey Monuments

a) New roadways and where new roadways connect to existing roadways shall provide monumentation as follows:
    1) Centerline monuments shall be installed at all centerline intersections of roadways (including intersections with existing roadways), P.C.'s and P.T.'s of each curve, and at all centers of cul-de-sacs, turnarounds or as required by the County Surveyor to sufficiently monument the right-of-way or a required easement.
    2) Monuments shall be set under the direction of a Land Surveyor.
    3) When monuments are set, the Land Surveyor shall file a record of survey complying with ORS 209.250 and any additional requirements set forth by the County Surveyor.
    4) The County requires centerline monument boxes to be used meeting the requirements of the County Surveyor. Requirements can be found at the Surveyor's website. Any monument box used that has not been approved by the County Surveyor will be required to be removed and replaced at the expense of the applicant.
b) Monument boxes shall comply with Standard Drawings M100 or M200.

SECTION 160 - DEDICATION OF PUBLIC RIGHT-OF-WAY AND EASEMENTS

160.1 Requirement for Public Easement

As a condition of approval for a development, the County may require that additional road right-of-way or other public easements be dedicated in support of the proposed development to meet standard cross sectional elements. The determination of the right-of-way and easement widths and types will be made upon review of the development with the requirements for dedications identified via land use requirements or as identified in the dedication review processes.

160.2 County Approval Required

State law and County policy require evidence of County approval before a dedication instrument of a public easement can be recorded per ORS 92.014.

160.3 Development Permit Required

A Development Permit is required to ensure County acceptance of any required improvements with a dedication.

160.4 Minimum Width Requirements for Rights-of-Way and Easements

Definition of standard road right-of-way widths by roadway functional classification are provided in Standard Drawings C110 to C140. However, there are special districts and projects that require road designs specific to those areas. Details specific to these areas can be found in the *Comprehensive Plan*.

a) In the case of the requirement to dedicate a Permanent Public Utility Easement (PUE) or combination of another easement that includes a PUE, an eight (8) foot wide easement along the entire abutting right-of-way of all front lot lines. It should be noted that storm and sanitary lines are not permitted within a PUE.
b) Additional easements for signing, slopes, and pedestrian facilities may be required via land use requirements or during construction plan review.

160.5 Public Easement Dedication Process

a) Typical easements that may be required for dedication by plat or by a separate instrument (standard easement form) may include, but are not limited to:
    1) Permanent Right-of-way Easement for Road Purposes
    2) Permanent Public Utility Easement
    3) Permanent Sign, Slope, Public Utility and Sidewalk Easement
    4) Permanent Storm Drainage Easement

b) Depending upon the requirements of the project, one or more of the above easement dedications may be required.
c) In addition to the aforementioned easements, an applicant may be required to provide proof of recorded access from a public road through the proposed development to an abutting parcel as noted in Section 220.2.
If proof of said access easement cannot be proved or has not previously been created, then an applicant will be required to dedicate a permanent for the benefit of the abutting parcel on the face of the plat. If created by separate document, this form may be obtained from Engineering and reference the process below in Section 160.8.

160.6 Dedication of Public Right-of-Way and Easements On the Plat

a) Dedications of right-of-way and easements on a plat shall meet all requirements of Sections 160.1 through 160.5.
b) Dedications of easements shall be shown on the plat and meet the requirements of the *ZDO*.

160.7 Dedication of Public Right-of-Way and Easements Outside of the Plat

a) Dedication of right-of-way and easements created by separate document outside of the plat shall follow Sections 160.1 through 160.5.
b) Easement dedications that are required to allow for development should be acquired and recorded prior to issuance of a Development Permit.
c) Prior to acceptance of right-of-way or public easements, plans may be reviewed by the DTD Planning and Zoning Division to determine if a land use approval is required. The design and construction of the resultant roadway may proceed pursuant to the requirements of these *Standards* and in conformance with all applicable land use conditions.
d) The easement forms are available for use from Engineering.
e) When requested by Engineering, each easement shall be accompanied by an appropriate Exhibit "A" and "B." Exhibit "A" is the written legal description of the easement area, and Exhibit "B" is the map depicting the area of the legal description. Both exhibits shall be stamped and signed by a Land Surveyor.
f) If the applicant's representative has not previously provided Exhibits "A" and "B" to the County, Engineering can provide copies of previously recorded exhibits that were acceptable to the County.
g) The applicant will be asked to provide documentation supporting the easement signer's authority to execute land rights documents on behalf of the corporation or other representative organization. The applicant may also be required to provide a copy of the owner's current vesting deed.
h) Easement forms, with exhibits, shall be submitted to Engineering for review and approval, prior to obtaining signatures on the easement forms.
i) Acceptance and recording of documents will be provided free of charge by the County.

SECTION 170 - DESIGN MODIFICATIONS & ADA EXCEPTIONS

170.1 Design Modifications

a) It is not the objective of these Standards to limit the creative efforts of engineers in providing alternate solutions to specific problem areas or to relieve the responsibility for professional engineering judgment.
b) Practical design modifications that preserve the function and safety of the roadway system and offer benefits to aesthetics, resource protection, ease of maintenance, and livability are encouraged.
c) Approval of non-compliant or alternate specifications and standards under the purview of these *Standards* may be requested utilizing the following process. This process does not apply to land use requirements or Conditions of Approval generated through the *ZDO* or the *Comprehensive Plan.* The ADA exception process follows the procedures detailed below in Section 170.2.

170.1.1 Modification Request Submittal

a) Requests to modify design standards shall utilize the Clackamas County Design Modification Request form. Design Modifications are typically submitted prior to land use application approval or early on in the design process when related to capital construction.
b) Land use conditions of approval are commonly written so that there is little, if any, flexibility after land use approval. For this reason, it is imperative that design modification requests be addressed prior to land use approval. If a design modification is requested after the land use conditions of approval are issued, additional application for a modification of the conditions of approval or a new land use application through the Planning and Zoning Division may be required.

170.1.2 Criteria for Modification of *Standards*

The County may grant a modification when the use thereof does not compromise public safety or the intent of the County's standards and any one of the following conditions are met:
a) The subject standard is deemed not applicable in the particular circumstance.
b) Topography, right-of-way or other geographic conditions impose an environmental concern or provides a constraint for constructability and an equivalent alternative, which can accomplish the same design intent, is available.
c) A minor change to the standard and the modification is required to address a specific design or construction constraint which, if not enacted, will result in an undue hardship.
d) The proposed modification does not compromise safety, function, appearance and maintainability based upon sound engineering and technical judgment.
e) The modification is not in conflict with land use requirements.

170.1.3 Review

a) Type I modifications shall include, but not be limited to, geometric design and the modification or omission of standard roadway cross section elements. A Type 1 modification requires a higher level of scrutiny than a Type II modification.
b) Type II modifications shall include, but not be limited to, sight distance, access spacing, number of accesses, intersection angle, etc.
c) The request to modify design standards shall be reviewed first by Engineering technical staff who shall make one of the following decisions:
    1) Approve as proposed,
    2) Approve with changes, or
    3) Deny with an explanation.
d) Design Modification approval shall not constitute a precedent for use at other locations.

170.1.4 Appeal

Applicants may appeal the Engineering technical staff's decision to the Transportation Engineering Manager. The Transportation Engineering Manager's decision may be appealed to the Road Official, whose decision shall be final.

170.2 ADA Exceptions

The County has adopted the *PROWAG* standards for ADA accessibility within the public rights-of-way and easements under the jurisdiction of Clackamas County. *PROWAG* provides justifications for exceptions to the standards for new construction and for alterations to existing ADA accessibility features. Exceptions are required for any accessibility feature that cannot meet the requirements due to a physical constraint identified in the following sections. Crosswalk closures are also reviewed under the ADA exceptions process.

170.2.1 Exceptions for New ADA Accessibility Features

Exceptions to full compliance with *PROWAG* standards can only be granted for a limited number of physical constraints preventing full compliance. If an exception is required for a particular feature, efforts must be

made to ensure that other elements are accessible. Exceptions for non-compliance with the *PROWAG* standards for new ADA accessibility features can only be approved when full compliance cannot be achieved due to terrain or historic features. Where the State Historic Preservation Officer or Advisory Council on Historic Preservation determines that compliance with a requirement would threaten or destroy historically significant features of a qualified historic facility, compliance shall be required to the extent that it does not threaten or destroy historically significant features of the facility (*PROWAG* R202.3.4).

170.2.2 Exceptions for Alterations to Existing ADA Accessibility Features

Where existing physical constraints make it impracticable for altered facilities to fully comply with the ADA requirements, compliance is required within the scope of the project. Existing physical constraints include, but are not limited to, underlying terrain, right-of-way availability, underground structures, adjacent developed facilities, drainage, or the presence of a notable natural or historic feature (*PROWAG* R202.3.1).

170.2.3 ADA Exception Request Submittal

a) Exception requests shall be submitted on the ADA Exception Request form. Exception requests should only be submitted at the following points in the process:
    1) Requests for exceptions to waive the requirement for a new ADA accessibility feature as part of a development should be submitted and acted upon prior to land use approval since land use conditions are typically written with little or no flexibility.
    2) Requests for exceptions to requirements for a particular element should be submitted during plan review and must be acted upon prior to permit issuance.
    3) Requests for exceptions to requirements may be submitted during construction if physical constraints are identified that were not included in the design. In such situations, the project Engineer shall prepare a revised design that maintains accessibility to the greatest extent practicable, and that exception must be acted upon prior to construction of the accessibility feature.
    4) Exceptions should not be provided for noncompliant features after construction.
b) Exception requests that are submitted shall be reviewed by Engineering. The Transportation Engineering Manager will make the decision to approve or deny the requested exception. The Transportation Engineering Manager's decision may be appealed to the Road Official, whose decision shall be final.

SECTION 180 - CONSTRUCTION INSPECTION

180.1 General

The applicant shall provide the County with access and be furnished with every reasonable facility for inspection of the work, is in accordance with the requirements and intent of the plans, specifications, permit conditions and land use requirements (collectively known as "the permit").

180.2 County Inspector Authority and Duties

A County inspector will be assigned to each project to inspect materials and work performed. Such inspection may extend to any or all parts of the work and to the preparation and/or manufacture of the materials to be used.

The County inspector is not authorized to:
a) Revise, alter, or relax requirements of the permit.
b) Direct how the work is to be performed.

The County inspector has the authority to:
a) Inspect work performed and materials furnished, including without limitation, the preparation, fabrication, or manufacture of materials to be used.
b) Reject deficient materials or work. The inspector may advise the applicant or contractor of any faulty work

or materials; however, failure of the inspector to advise the applicant or contractor does not constitute acceptance or approval.

c) Temporarily suspend the work for safety deficiencies for safety issues, lack of compliance with the permit, or if the requirements of a private primary inspector are not being fulfilled per Section 180.3.
d) Recommend revisions or revocation of the permit per Section 130.3.8.
e) Allow work to proceed after deficiencies have been corrected.
f) Exercise additional delegated authority.

180.3 Primary Inspector

In the case of larger projects, additional inspection services are required beyond County provided inspection services. These inspection services are more comprehensive and intensive than County inspection services and are the responsibility of the applicant and Engineer of Record ("EOR"). In those cases, the applicant shall provide a primary inspector at their cost.

A primary inspector's duties may be performed by a qualified representative of the engineering firm or other qualified third party inspector. The applicant shall be responsible for primary inspection services of all improvements permitted by Engineering at no cost to the County. A primary inspector ("PI") shall not have a corporate ownership or have real property interest in the development for which the improvements are required.

Utility Permit work proposed by a public utility may provide qualified public utility engineering staff or a qualified third party to satisfy the requirements of a PI with the approval of Engineering.

180.3.1 Developer Engineer Agreement

When a primary inspector (PI) is required as part of a development project, the applicant shall enter into a Developer Engineer Agreement prior to Development Permit issuance to have the EOR responsible for primary inspection services.

180.3.2 Certificate of Compliance and Completion

At the completion of a project, the EOR shall be responsible for providing a Certificate of Compliance and Completion to establish that the project was completed as required by the permit.

180.3.3 When a Primary Inspector is Required

A PI is required in the following cases:

a) Development Permit: all commercial, industrial, institutional, multi-family development and residential subdivisions and partitions that will result in more than three parcels.
b) Utility Permit:
    1) More than 1,000 longitudinal feet of disturbance within the UGB.
    2) More than 2,500 longitudinal feet of disturbance outside the UGB.
    3) Night or weekend work is involved.
    4) Trench plowing.
    5) Installation of a utility suspended from a bridge under County jurisdiction.
c) When a Development Permit requires a PI and an Entrance Permit is required, the PI shall assume inspection for the Entrance Permit if the Development Permit has not been finalized.
d) Even when a PI is required, the permit is still subject to certain County inspections as dictated in the permit and herein.

180.3.4 Primary Inspector Authority and Duties

The PI shall perform the following duties:

a) Monitor construction activity and inspect work and materials furnished to ensure construction per the permit, and to reject defective materials or workmanship.
b) Provide inspection reports to the County on a weekly basis during periods of active construction. Inspection reports for each weekly period may be submitted by the end of the following week. Confidential or sensitive material on inspection reports may be redacted. If the reports become more than four weeks in arrears, or are significantly lacking information, the County may temporarily stop work until such time as the inspection reports are submitted. The permit will not be closed out without receipt of inspection reports. The inspection report shall include at a minimum:
    1) Permit number
    2) Name of inspector
    3) Date and time of arrival and departure
    4) Weather conditions, including temperature
    5) Description of construction activities
    6) Statements of direction to stop work, reject materials, or other work quality actions
    7) Perceived problems and plan of action taken
    8) Final and staged inspection results
    9) Record of all material and soil types and conditions
    10) Record of locations of cement amended base and cement amended soils within the project (these locations shall be shown on the as-built construction plans).
    11) Record of review of test results
    12) Record of review of ADA inspections
    13) Record of pavement grade and depth measurement by street stationing
    14) General remarks including citizen contact or complaints received
    15) Record of review of inspection requirements of the permit
c) Notify the County inspector two business days before the start of construction or resumption of work after shutdowns.
d) Temporarily suspend the work for lack of compliance with these Standards, land use requirements, permit conditions, plans, specifications and/or safety deficiencies.
e) Communicate critical issues to the County inspector including proposed changes, significant construction problems, property owner disputes or complaints, need for County inspections, etc.
f) Ensure County approval prior to the commencement of work affected by any revisions.

A PI is not authorized to:
a) Revise, alter, or relax the requirements of the permit.
b) Direct how the work is to be performed.

180.4 Testing

a) All testing required by the County shall be at the applicant's expense.
b) Testing shall be in accordance with the most recent edition of the *ODOT Manual of Field Test Procedures*.
c) Special testing shall be at the expense of the applicant and performed by a qualified testing firm. The applicant shall give County inspector not less than two business days' notice prior to special testing.

180.5 Required Inspections of ADA Accessibility Features

a) All ADA accessibility features within the County right of way, including but not limited to sidewalks, paths, crosswalks, curb ramps, medians, traffic islands, signs, on-street parking, and pedestrian traffic signal accessibility features including clear spaces shall be inspected for compliance with ADA requirements. No project shall be accepted as complete without documentation prepared by the County inspector showing that all ADA accessibility features meet requirements or have a previously approved exception per Section 170.2.

b) **Forms Inspection** - The forms inspection shall determine if the forms and survey marks for an accessibility feature are placed in such a manner to meet requirements. The contractor shall provide a signed written record of the dimensions and relative elevations of the forms for an ADA accessibility feature prior to placement of pavement using an inspection report form supplied by the County. A diagram of the ADA accessibility feature shall be provided and at least one photo of the forms prior to fabrication. Dimensions of all sides of the accessibility feature shall be measured with a steel tape and compared with the approved design. The height of the curbs and any corners shall be determined in relation to the lowest point on the accessibility feature using a level. The completed forms inspection report provided by the contractor including diagram and photos shall be included in the project file.

c) **Post fabrication inspection** - The post fabrication inspection shall determine compliance of the accessibility feature with all ADA requirements. The inspection shall be conducted using the standard county inspection checklists and required measurement tools and techniques. Dimensions and curb heights shall be determined using standard methods. Slopes shall be determined using the ODOT specified 6 inch and 2 foot smart levels with multiple slope measurements taken for each feature used to determine compliance. Any element that fails to meet required *PROWAG* standards shall be replaced by the applicant and re-inspected for compliance. If it is determined that an ADA feature does not comply with *PROWAG* standards, the applicant shall have the option of appealing that determination. For the appeal the builder shall retain a Land Surveyor to conduct a survey of the ADA accessibility feature and prepare a plan showing actual elevations and slopes for the accessibility feature. If the survey plan demonstrates that the accessibility feature meets *PROWAG* standards the applicant will not be required to replace that accessibility feature. If the survey plan demonstrates that the accessibility feature fails to meet *PROWAG* standards, then the accessibility feature shall be replaced at the applicant's expense and re-inspected for compliance.

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180.6 Inspection Requests

A minimum of two business days' notice shall be provided for inspection requests via the method described on the permit, which also lists the required inspections.

180.7 Failure to Obtain Inspection

If the County inspector is not able to inspect the work after proper notice, the applicant should take measures to reschedule the work. Work that is completed without the required inspections, as dictated by the permit or as required by Section 180 is subject to rejection and/or code enforcement procedures of the *County Code*.

The County inspector may pre-approve work to continue without County inspection with proper documentation provided by a primary inspector or other documentation.

SECTION 190 - PERFORMANCE SURETY, WARRANTY AND ACCEPTANCE OF WORK

190.1 General

To ensure the acceptable completion of permitted private or public improvements, a Performance Surety and/or Warranty Surety may be required and integrated into Engineering related permits.

a) A Performance Surety shall be required prior to:

1) Issuance of a Utility Permit for mainline utilities or other utility work that significantly impacts the existing roadway except when performed by a "public utility company or municipal authority" per *County Code* 7.03.130.E. Per County Code, if an existing roadway is left in disrepair and is a hazard to the traveling public, the County may repair the road and call the surety to cover the cost of repairing the road. If the Performance Surety is redeemed to repair a road during the course of a project, an additional surety may be required by the County to complete the project;
2) Issuance of a Development Permit impacting an existing roadway under the jurisdiction of the County. If at any time, an existing roadway is left in disrepair and is a hazard to the traveling public, the County reserves the right to repair the road or call the surety to cover the cost of repairing the road. If the Performance Surety is redeemed to repair a road during the course of a project, an additional surety may be required by the County to complete the project;
3) Issuance of a Certificate of Occupancy when all improvements required by the Development Permit and the land use requirements are not completed and accepted; or
4) Recordation of a plat when all improvements required by the Development Permit and the land use conditions are not completed and/or accepted.
5) A Performance Surety may be required prior to issuance of a Right of Way Permit for events that have a strong potential of damage occurring to the right-of-way.

b) Substantial Completion of residential partitions and subdivisions shall be achieved prior to acceptance of any surety for guarantee of work to record a plat. Requests for acceptances of a surety for guarantee of work without achieving Substantial Completion will be evaluated by Engineering using the criteria in Section 190.2 if minimum fire, life and safety issues are met.
c) A Warranty Surety shall be required for improvements located in the right-of-way under County jurisdiction after the acceptance of improvements.

Typically, Performance Surety or Warranty Surety will not be required for Entrance Permits or Right-of-Way Permits, but may be required by the Road Official.

190.2 Substantial Completion for Development Permits

Substantial completion is achieved when:
a) All required right-of-way dedications and easements have been accepted or are shown on the final plat.
b) The sanitary sewer mainline and service laterals under subject roadways are constructed and accepted.
c) The roadway drainage system is constructed and accepted, including LIDA when required.
d) The water main line and service laterals are constructed and accepted and water is available for fire suppression.
e) Conduits for franchise utilities within the roadway are installed and accepted.
f) The pavement wear course is installed. If pavement is not required, the full gravel structural section has been placed and properly compacted.
g) Shared private roadways and emergency access turnouts and turnarounds are constructed.
h) All other land use or Development Permit conditions required to be met prior to plat or occupancy approval are completed.
i) The EOR shall complete a Certificate of Compliance and Completion.

190.3 Performance Surety

Acceptable Performance Sureties include a Performance Bond, a Security Agreement (commitment of funds), or a Cash Acknowledgement.
a) Performance Bonds shall be provided only through State regulated surety companies
b) A Security Agreement, or commitment of savings or loan proceeds, shall be through State regulated financial institutions.
c) A Cash Acknowledgment is a cash surety held directly by the County.
d) A Development Agreement shall accompany all types of sureties and be recorded.

190.3.1 Forms

All sureties and Development Agreements shall be submitted on forms provided by the County and are subject to review and approval by County Counsel.

190.3.2 Timeframe

Sureties shall be in effect at the time of plat approval or issuance of a Certificate of Occupancy and until County acceptance of the improvements resulting in release of the surety.

190.3.3 Amount

a) The financial amount established for the Performance Surety shall be equal to 125% of the estimated value of the improvement.
b) An Engineer's estimate is required and shall be approved by Engineering. A contractor's bid or estimate is not acceptable. The surety shall cover the County's cost for completing the work with public contracting procedures and include project management and inspection services.
c) The minimum amount for Performance Sureties shall be $10,000. The minimum amount for all other sureties including the Cash Acknowledgment shall be $2,500.
d) Engineering will not approve more than one surety reduction throughout the life of the project, not including the reduction of Performance Surety to the Warranty Surety.

190.4 Maintenance and Warranty Period for Development Permits

a) Typically, the Warranty Period will begin when all improvements, with the exception of street trees, are accepted by the County. If there are remaining improvements to be constructed, the Warranty Surety will also include a Performance Surety. All outstanding performance items shall be guaranteed at 125%. This combined surety may require the minimum warranty period to be extended to two years from the date all performance improvements have been completed.
b) The applicant shall provide a Warranty Surety as part of a Development Permit for work located in a public right-of-way under County jurisdiction. The Warranty Surety/maintenance requirements shall be held for a minimum of two years.
c) The required Warranty Surety shall be valued at 25% of the Engineer's estimate and approved by Engineering.
d) The County may require an extension of the Warranty Surety/maintenance period for more than the minimum required if the required improvements show signs of failure during a final inspection and work is completed to correct these deficiencies.
e) The Warranty Surety does not expire and may only be released after a final inspection has been completed and the minimum warranty period has elapsed. At the time of final warranty inspection, any items not completed or maintained to County standards will be included in a punch list provided to the applicant and/or guarantor. These items shall be addressed prior to the release of the Warranty Surety.

190.5 Maintenance and Warranty Period for Utility Permits

a) Utilities installed as part of Utility Permits do not have a Warranty Period.
b) When related to a Development Permit, the Warranty Surety/maintenance requirements for utility work will follow those listed under 190.4 for work located in a public right-of-way under the jurisdiction of the County.

190.6 Acceptance of Work

Prior to County acceptance of the improvements and release of the Performance Surety and/or Warranty Surety/maintenance period, the following shall occur:
a) The applicant shall repair any damage caused by the construction of the work to any public roads, private roads and/or property that is not part of the project as well as any identified haul routes per Section 225.6.
b) The applicant shall perform a thorough cleaning of the roadway surface and storm drain system.

c) If a private PI is required, the PI shall conduct an inspection of the improvements.
d) If the private PI indicates that the work is complete, the EOR shall complete a Certificate of Compliance and Completion.
e) The County shall conduct an inspection of the improvements.
f) The County shall make a determination of completion in conformance with the permit.
g) Any deficiencies resulting in non-acceptance of the work permitted in the Development Permit shall be identified in writing on a punch list and presented to the applicant with a date named for correction and completion.
h) Upon correction of the noted deficiencies and the determination that all work is in conformance with the requirements, repeat steps a) through f).
i) When the improvements are found complete and the work is accepted, the Performance Surety will be released and the Warranty Period will begin.
j) Once the Warranty Period has passed, and there are no defects in workmanship found by County inspection, the Warranty Surety will be released.

190.7 Acceptance of Roads

When the permit requirements are met and the Warranty Period is over and all sureties have been released, the County will then accept the road right-of-way as dictated by the road's classification.

190.8 Nonperformance of Permit

Failure to complete the project prior to expiration of the Development Permit and Utility Permit shall be construed as nonperformance and may be considered a violation of the permit. The surety may be demanded in order to bring the project to completion. If compliance is not achieved, the permit is subject to code enforcement. Development Agreements should not be extended unless there is adequate surety to guarantee the improvements through the extended period.

CHAPTER 2 - ROADWAY DESIGN & CONSTRUCTION

SECTION 210 – GENERAL

Chapter 2 establishes the technical requirements associated with roadway design and construction.

Roadways in Clackamas County should be designed as follows:

a) For the safe and efficient travel of all users of the transportation system.
b) To meet or exceed the minimum design guidelines referenced herein. Considerations will be made to best accommodate interrelationships of existing and proposed roadways, topographic conditions and the land use to be served by the roadway.
c) To flexibly consider roadway context with regard to the mix of users, adjacent land use, type of traffic, traffic volume, and speed of traffic to be carried.
d) To comply with the cross section elements illustrated in the *ZDO*, *Comprehensive Plan* and the *CIP*.

SECTION 215 - FUNCTIONAL CLASSIFICATION & REGIONAL STREET DESIGN GUIDELINES

a) The functional classification of existing and planned roadways has been established by the *Comprehensive Plan*, Chapter 5 - Transportation. Design standards for new roadway construction and existing roadway improvements are based on these functional classifications. The functional classification of a roadway determines how the roadway will be designed.
b) Functional classifications of individual roadways can be found on Maps 5-4a and 5-4b of the *Comprehensive Plan*. Descriptions of each functional classification can be found Chapter 5of the *Comprehensive Plan*.
c) Roadway design shall consider the Regional Street Design Type Guidelines as described per *Comprehensive Plan* policy 5.O.5 as illustrated in Map 5-5.
d) Community Planning Areas, as referenced in the *Comprehensive Plan*, have exceptions to these *Standards*. Otherwise, Standard Drawings C110 through C140 shall be used for design of roads under the jurisdiction of Clackamas County.
e) Use of Urban Alternate 1 and 2 sections per Standard Drawing C110 may be considered on very low volume roads or roads that cannot be extended, and where the alternate street section would better accommodate:
    1) Sustainable surface water management solutions such as low infiltration planters and basins, swales, ponds, rain gardens, trees, and minimal disruption to natural drainage systems;
    2) Preservation of existing significant trees and native vegetation;
    3) Preservation of natural terrain and other natural landscape features; and
    4) Existing development.
f) All other roadway design shall comply with these *Standards*.

SECTION 220 - ACCESS MANAGEMENT

220.1 General

a) Access management for private accesses or public intersections is required to improve safety and efficiency of traffic flow for users of the transportation network and to balance those needs with livability, economy and community values.
b) The location and number of roadway intersections and other access points shall be planned, coordinated and controlled by Engineering.
c) By the nature of the roadway functional classification system, higher speed arterial streets require the highest level of access management restriction tending toward less access. Lower speed collector streets and connector streets require less restrictive access management. Local streets require very few access management restrictions and tend towards more frequent access.

d) Chapter 10 of the *Comprehensive Plan* provides various standards for access within certain Community Planning Areas. Within those plan areas, access shall be determined according to the *Comprehensive Plan.*

220.2 General Requirements

Accesses are subject to the sight distance standards of Section 240, the design requirements of Sections 230 and 330, and this section. Accesses that are not compliant with these requirements may not be approved. Existing accesses may be required to be removed or modified in order to comply with these requirements.

220.3 Access Spacing Standards

Accesses subject to a land use approval and those subject to spacing standards per the Entrance Permit Matrix shall adhere to the minimum spacing requirements of Tables 2-1 or Table 2-2 and requirements of Section 220.4. Considering access along both sides of the roadway (i.e. spacing from existing accesses on the south side of a road when an access on the north side of a road is proposed), access spacing shall be measured from the proposed centerline to the centerline of an existing access or roadway or planned roadway. Planned roadways are those illustrated in the *Comprehensive Plan*, other local transportation system plans, or those approved as part of an approved development not yet constructed.

Table 2-1. Minimum Access Spacing Inside the UGB

Functional Classification	Full access spacing	Restricted access spacing*
Major Arterial	500	250
Minor Arterial	250	150
Collector	150	100
Connector	25**	N/A
Local	25**	N/A

Table 2-2. Minimum Access Spacing Outside the UGB

Functional Classification	Full access spacing
Major Arterial	500
Minor Arterial	400
Collector	300
Connector	200
Local (Non-Residence District)	100
Local (Residence District)	25**

*If approved, restricted access spacing implemented typically by raised median only

N/A = Restricted access not considered on these roadways

**Access shall be placed a minimum of 100 feet from any intersection with an arterial roadway. If less than 100 feet of frontage, spacing from the intersection shall be maximized.

Access modifications may be approved per Section 220.6 and Section 170.

220.4 Additional Access Requirements

The following conditions apply in addition to the requirements of Tables 2-1 and 2-2:

a) Existing or proposed accesses subject to land use approval shall first take access to the lower functional classified roadway unless evidence or an engineering study establishes that access(es) to the higher functional classified roadway are needed for safety, circulation, to address topography or environmental constraints, or are otherwise a benefit to the public. Existing accesses where ADT is increased by ten or fewer trips are not subject to this standard if the sight distance standards of Section 240 are met.

b) Parcels or contiguous parcels under the same ownership shall be limited to one access except on local or connector roads where the number of accesses is not limited if sight distance and access spacing standards are met.
c) Accesses subject to the Entrance Permit Matrix that provide the only access to a parcel or contiguous parcels under the same ownership shall comply requirements of Table 2-1 or 2-2 to the extent feasible. First priority will be given to achieving adequate sight distance per Section 240, second to access by functional classification per 220.4(a) and (b) and third to access spacing requirements. Based on the judgment of the Road Official, the access will be placed in the safest location.
d) Commercial, multifamily and industrial developments that can comply with spacing standards to collectors and arterials may request additional access but shall establish that the proposed access is/are needed for safety, circulation, to address topography or environmental constraints, or are otherwise a benefit to the public.
e) Reciprocal access easements may be required even if these standards are met in order to promote connectivity and to reduce conflicts on the public street system.
f) On roadways with an ADT greater than 1000 and outside the UGB, additional access(es) may be permitted on collectors, minor arterials and major arterials for logging, agricultural, and accessory structure use when sight distance, functional classification, and spacing standards are met, and for all uses when needed to address safety, circulation, to address topography or environmental constraints, or are otherwise a benefit to the public.
g) On roadways with an ADT less than or equal to 1000 and outside the UGB, additional access(es) may be permitted on collectors, minor arterials and major arterials for all land uses when sight distance, functional classification and spacing standards are met.
h) Conflicting access movements within the 95th percentile queue of any traffic movement of an intersection may be reason to deny, relocate or restrict access. A traffic study complying with Section 295 will be required if this is a likely issue.
i) Accesses that serve only emergency vehicles are exempt from these requirements. However, these accesses shall be gated.
j) Accesses, other than those to a local or connector roadway, that require any vehicle to back onto a public roadway are prohibited.

220.5 Roadway Intersection Management

New developments that will require construction of new streets shall provide full street connections at intervals of no more than 530 feet, where feasible. If full street connections are not feasible at such intervals, accessways for pedestrians, bicyclists or emergency vehicles at intervals of no more than 330 feet shall be provided. Exceptions may be made where there are barriers, including topography, railroads, freeways, pre-existing development, existing easements, or environmental constraints such as streams and wetlands."

No public roadway/public roadway intersection may be offset by less than 100 feet unless approved per Section 250.8.3.

Comply with requirements of Section 225.1.

220.6 Modification Considerations

a) All access requests not meeting these standards for access shall include a scaled site plan and a traffic report if required by Engineering. The scope of the development will determine the information required and shall comply with Sections 170 and 295. The evaluation of the access request will consider the impacts that traffic generated by the proposed development will have on through traffic, traffic patterns, traffic queuing, and safety.
b) If approved, access may be restricted to right-in/right-out movements or other movement restrictions.

SECTION 225 - ROADWAY DEVELOPMENT

225.1 Future Extension of Roadways Related to Development

a) When required by land use approval, a proposed development shall construct a public roadway, or private roadway acceptable to the County, to the boundaries of the development to permit future development or division of adjoining land, in order to promote connectivity.
b) A roadway master plan may be required prior to approval of the location of a roadway stubbed to the current development boundary to ensure connectivity of the future roadway system and to retain the development potential of adjacent land. This master plan shall consider topographical and geographical information and assume maximum development consistent with existing zoned densities.
c) New public roadways that are stubbed to adjacent property with future potential extension may require the construction of a temporary turnaround, depending on the length of the dead end street and/or the dedication of right-of-way for the temporary turnaround or future turnaround.
d) Public streets that cannot be extended shall end in a County approved cul-de-sac or turnaround.

225.2 Termination of Roadways/Dead End Streets (Cul-De-Sacs, Turnarounds & Hammerheads)

Dead end streets may be allowed when deemed appropriate by Engineering and shall meet the following minimum criteria:
a) Dead end roads are allowed on local and private roads only.
b) Dead end public roads should terminate in a cul-de-sac. Alternate designs may be considered on a case by case basis depending on topography, length, ADT, or other design constraints.
c) Dead end streets are allowed only where topography or pre-existing development precludes roadway connections.
d) A roadway ending in a dead end shall be as short as possible, having a maximum length of 400 feet, serving not more than 18 dwelling units.
e) The length of the roadway ending in dead end shall be measured along the centerline of the roadway from the near side right-of-way of the nearest cross street to the farthest point of the dead end right-of-way.
f) Dead end streets longer than 400 feet may be approved if no other means are available for development of the property and special provisions are made for: public facilities, pedestrian and bicycle circulation and emergency service access and vehicle turnaround.
g) For dead end streets less than one hundred fifty (150) feet in length, sidewalk is required on one side only, but shall include the entire turnaround area.
h) Cul-de-sac bulbs and other approved turnarounds shall have a maximum grade of 5%
i) Cul-de-sacs shall conform to Standard Drawing C300.
j) For alternate termination designs see Standard Drawing C350.

225.3 Opening or Upgrade of Unimproved or Substandard Public Right-Of-Way to Benefit Private Access

An existing unimproved or substandard public right-of-way may be opened, upgraded, or improved for vehicular access subject to a permit. Requirements include:
a) Applicants for the improvement shall bear all costs inclusive of survey, engineering, construction and maintenance.
b) Subsequent to this investment, no proprietary rights or exclusive use to the funded improvement will or could be granted within the public right-of-way.
c) Case-by-case interpretation of construction standards based on the proposed use is necessary to define the extent of construction, location and width of available existing right-of-way consistent with the proposed use or impact.
d) The applicant may be required to dedicate additional right-of-way or easements along the property frontage and at the terminus as deemed necessary by engineering to comply with County standards.
e) If satisfactory access cannot be constructed within the available public right-of-way, the applicant has the option of acquiring additional right-of-way as required or may seek an alternative private access.

225.4 Off-Site Access Standards

On a case by case basis, the County may require construction of improvements within existing off-site (beyond a development site's frontage) public rights-of-way in order to provide adequate safe access to newly created lots or parcels or for other development. If Engineering determines that off-site roadway improvements are necessary to achieve minimally adequate and safe traffic flow, such improvements may be required before Engineering can recommend approval of a proposed development.

225.5 Structural and Surface Road Improvements Related to Development

a) The County cross section standards of Standard Drawings C110 to C140, community plans in the *Comprehensive Plan* or design equivalents, shall be applied to the roadway design and constructed in the course of the development or redevelopment along the site frontage and extended to an off-site roadway as established in site specific land use requirements.
b) Road right-of-way or easement width dedications for roadway or public utility purposes along the site frontage (see Section 160.5) is required to meet the adopted cross section width and any additional width identified in a traffic impact analysis.
c) Frontage improvements shall typically be designed and constructed to the standard cross section.
d) Staff may rely upon Table 2-3 as a guideline or other alternatives when the full standards cannot be required.
e) The extent of frontage improvements typically are based on providing a half street improvement. Occasionally, a situation may call for more than a half street improvement and will be determined based on:
    1) Location of the existing pavement in relation to the right-of-way;
    2) Pavement width;
    3) Pavement condition;
    4) Centered crown, offset crown, shed or other;
    5) Cross slope;
    6) Road grade;
    7) Elevation of existing curbs within 300' of the property lines, including opposite the development.
f) The extent of offsite tapers will be determined per Section 250.6.4 and by the need to:
    1) Match an offset crown;
    2) Match to existing grades and cross slopes
g) When a fee in lieu of improvements ("FILO") is paid, a development's site frontage should meet minimum widths listed in Table 2-3. When FILO is paid and the minimum frontage improvements are existing, the applicant shall still provide roadway improvements compliant with utility restoration standards of Chapter 7 and Standard Drawings U275 to U290.

Table 2-3. Frontage Improvement Guidelines

	Required Frontage Improvements	
Type of Development	Inside UGB	Outside UGB
Cell Towers, Solar Facilities	None	None
Partitions, Marijuana subject to land use, Duplexes, Triplexes	Std or When FILO is paid: Std R/W with Min 16' paved & Min 20' clear roadway	R/W, Min 20' clear roadway
Short Subdivisions (4-10 lots)	Std	Adjacent to local/connector: Std R/W, Min. 20' clear roadway
	Std	Adjacent to collector/arterial: Std
Long Subdivisions (11+)	Std	Std
Commercial/Industrial/Institutional/ Multi-Family	Std	Std

Std = Dedicate half street right-of-way and construct standard half street cross sections per Section 225.5.a and 225.5.b
Std R/W = Dedicate half street right-of-way per Section 225.5.a and 225.5.b

h) The applicant may be required to provide an analysis of the pavement and base structural sections to determine the structural section and the current condition of the road. When required, the analysis shall include:
   1) Surface Defects
      i. Raveling & Loss of Surface Aggregate
      ii. Flushing
   2) Surface Deformations (due to a weak sub-base or instability in the pavement)
      i. Rippling and Shoving
      ii. Wheel Track Rutting
      iii. Distortion
   3) Cracking (caused by either thermal stresses or weak base)
      i. Longitudinal Wheel Track Single and Multiple, Alligator
      ii. Centerline Single and Multiple, Alligator
      iii. Pavement Edge Single and Multiple, Alligator
      iv. Transverse Single and Multiple, Alligator
      v. Longitudinal - Meander or Mid-lane

i) The County will review the analysis to determine if an overlay, grind and inlay or full depth reconstruction is warranted based on the existing conditions of the road, the proposed construction impacts and the ADT with the added development. Different causes of the pavement condition will warrant different remedies.

j) If an existing County or public road terminates along a development's frontage without the benefit of a cul-de-sac or turnaround and the roadway cannot be extended, the development shall construct a full County cul-de-sac per Standard Drawing C300 or approved turnaround per Standard Drawing C350.

225.6 Construction Haul Routes

Construction activities for some developments should not deteriorate roadways classified as local roads, which are more susceptible to damage due to reduced maintenance and/or structural section. Clackamas County Transportation Maintenance performs annual pavement condition reviews on county maintained roads and may be able to provide a Pavement Condition Index (PCI) rating for the road but not necessarily at the project site frontage. Temporary construction access via an Entrance Permit may be granted to avoid impacts to local roads.

Residential subdivisions, commercial, industrial and multifamily developments that utilize a local road as a haul route for construction or will otherwise impact a local road may be required to improve those roads. If during the work or at the conclusion of work, there is any visible deterioration or drop in PCI of 8 or more the applicant may be required to provide an overlay, grind and inlay or other sufficient improvement to restore the roadway to as good as or better than before the work was initiated.

Should this be required, the applicant shall provide the following:

a) An exhibit depicting haul routes and the location of the construction entrance(s) for all construction equipment and materials if an existing local road will be utilized prior to intersection with a collector or arterial;
b) Such routes may be subject to possible restrictions or conditions to protect existing infrastructure and address traffic impacts;
c) An existing conditions PCI from County Transportation Maintenance, if available;
d) Photographic/video evidence of the conditions before and after construction;
e) Core samples, as requested, of the pavement and base section, before and after construction;
f) A financial surety of not less than $10,000 or 125% of the cost estimate for addressing anticipated infrastructure improvements along the haul route, whichever is greater, prior to Development Permit issuance;
g) Temporary measures to limit further deterioration of the roadways that are currently in poor or very poor condition prior to Development Permit issuance; and/or
h) The applicant shall maintain affected roads at an acceptable and safe level throughout the work.

225.7 Creation of a Private Roadway

In certain circumstances, creation of a private roadway may be the only reasonable method and alternative to provide access to the proposed lots or parcels. If connectivity and access to adjacent properties is not an issue, private roadways, as addressed in the *ZDO*, may be permitted. The following shall apply:

a) Design and construction of a private roadway shall be consistent with the design standards for public roads, except as noted in these *Standards* regarding widths, cross section and design speed, and in no case shall improvements be less than minimums set out in Standard Drawing R100.
b) Provisions should be made through a formal maintenance agreement or equivalent to ensure private responsibility for future maintenance.
c) Private roadways and their respective easements shall be distinguished from public roadways and any reservations, restrictions, and maintenance agreements related to the created private roadways shall be described in the land division plat or deed records.
d) The need for utilities and roadway drainage shall be considered.

SECTION 230 – RESIDENTIAL, AGRICULTURAL & LOGGING DRIVEWAY DESIGN

230.1 General

The following standards shall apply to the design of residential, agricultural and logging driveways approaching public or private roadways. County Code Section 7.030.240 provides some exceptions to the requirements below. The Entrance Permit Matrix provides additional requirements.

230.2 Standard Drawings

Driveways that intersect with a proposed or existing sidewalk or other pedestrian facility shall meet ADA accessibility requirements and should be constructed in conformance with the applicable standards depicted in the most recent versions of *Oregon Standard Drawings* RD725, RD730, RD735, RD740, RD745, or RD750. Residential, agricultural and logging driveways shall be constructed in conformance with the applicable standards depicted in Standard Drawings D250 through D700. The County shall determine the specific driveway detail, based upon the existing and planned improvements.

230.3 Provisions for ADA Accessibility of Driveways

a) All new or altered driveways required to meet ADA accessibility standards shall meet the *PROWAG* standards for a Pedestrian Access Route whether or not the driveway is connected to sidewalk or path.
b) The driveway shall provide a connection on both sides to existing or planned sidewalk or path, at a location identified by DTD.
c) The pedestrian access route across the driveway shall be at least 5 feet wide perpendicular to the direction of pedestrian travel with a cross slope of no more than 2% and a grade in the direction of pedestrian travel that does not exceed the grade of the adjacent street.
d) The edge of the pedestrian access route on the driveway shall be flush with the adjacent sidewalk or path with a vertical surface discontinuity of no more than ¼ inch.
e) If it is necessary to provide ramp(s) connecting the driveway pedestrian access route to the adjacent sidewalk or path, the ramp shall have a running slope in the direction of pedestrian travel no more than 8.33%, ramp length not to exceed 15 feet, and cross slope no more than 2%.
f) If the driveway serves commercial uses and is 50 feet or more wide, or stop controlled, or both, truncated dome texture contrast shall be provided perpendicular to the direction of pedestrian travel on the sidewalk on the transition from the adjacent sidewalk or path to the driveway on both sides. The truncated dome texture contrast shall extend 2 feet in the direction of pedestrian travel and completely across the sidewalk.

230.4 Driveway Vertical Geometry

a) For residential driveways, the average driveway grade shall not exceed 12%, and no grade shall exceed 15% for gravel driveways or 20% for paved driveways.
b) All grades in excess of 12% shall be approved by the fire district.
c) The grade break for all driveways shall be a maximum of 9%. Grade breaks in excess of 9% shall require vertical curves with a minimum K value of one (1).
d) Vertical transitions shall be designed for the design vehicle to not "bottom out" at minimum. The functionality of the intersecting roadways shall be considered to ensure that vehicles on major roadways are not excessively slowed or endangered by driveway operations.
e) For residential driveways, vertical clearance shall not be less than 13.5 feet.
f) Steep, uphill driveways having greater than a ten percent grade shall be constructed with diagonal water bars (berms) to assure that water from uphill properties is directed into the ditch line. In drainage situations which will not be remedied by valley gutters or water bars, it is the responsibility of the owner to construct ditches, etc., to prevent damage to the roadway or danger to the traveling public.

230.5 Driveway Horizontal Geometry

a) Standard driveway throat widths for agricultural and logging driveways and residential driveways vary from a minimum of 12 feet to a maximum of 35 feet at their intersections with public roadways. Driveway widths should be minimized. A truck turning analysis should accompany any design modification requests.
b) Horizontal clearance shall not be less than 20 feet for driveways subject to fire access requirements.
c) Minimum centerline curve radius shall be 50 feet for driveways subject to fire access requirements.
d) Turnaround geometrics shall conform to Standard Drawing C350 or C300, as applicable.

230.6 Driveway Structural Capacity

For driveways subject to fire access requirements, roadway base, bridges, and culverts shall be capable of supporting a 75,000 pound fire truck. See Chapter 5 regarding requirements associated with structures such as walls, bridges and other structures.

230.7 Emergency Services

a) All residential and agricultural driveways longer than 150 feet in length shall be designed to provide for fire access and shall be provided with an emergency vehicle turnaround area at or near the driveway termination.
b) Residential and agricultural driveways with a travel surface less than 20 feet wide and in excess of 400 feet in length shall have a turnout every 400 feet per Standard Drawing C350 at locations approved by the fire district.
c) Gates shall be placed a minimum of 30 feet from back of sidewalk or edge of pavement. If queues are likely to extend into the travel lane of the nearest roadway, then a queuing analysis shall be provided per Section 295. Gates may require the approval of the fire district.
d) Exceptions to these standards are illustrated in the Entrance Permit Matrix.

230.8 Driveway Surface Water

a) Surface water runoff shall not be allowed to flow along or across an access or entrance from private property onto the travel surface of the roadway.
b) Driveways and buildings that increase impervious surface by the thresholds described in Chapter 4 are subject to stormwater management requirements.
c) Requirements for erosion control shall be addressed per Chapter 4.

230.9 Driveway Culverts

a) All driveways on non-curbed roadways shall have culverts for proper road drainage unless Engineering determines that they are not required.
b) Culvert installations are typically not required on paved and curbed roads. The installation of driveway culverts to control surface runoff shall be required as deemed necessary by Engineering.
c) Driveway culverts shall provide a minimum 12 inch inside diameter. Larger culverts are required based upon the design calculations and under the following conditions:
    1) Culverts shall be designed to convey storm water from the contributing basin for the 25 year storm at full build-out of the basin.
    2) When the existing storm sewer culverts above and below the proposed driveway entry are a larger diameter than l2-inches;
    3) When there is evidence that erosion has occurred in the roadside ditch;
    4) When there is other evidence to show that a larger diameter would be appropriate.
    5) Bedding requirements for concrete and metal culvert pipe shall never be below the Class C bedding specification contained in the *Oregon Standard Specifications for Construction*.
    6) Storm sewer culvert shall have enough aggregate and/or pavement cover to support HS-20 loading per Standard Drawing D250.
    7) Notwithstanding the requirements of this subsection, ORS 368.251 to 368.281 shall govern storm sewer culverts and the accompanying entry structure.
    8) Culverts shall be maintained in good condition so the flow of storm water is not impeded.

230.10 Intersection Angle

Comply with requirements of Section 250.8.2.

230.11 Permit Requirements

An Entrance Permit or Development Permit, whichever is applicable, shall be obtained from Engineering.

230.12 Inspection Requirements

Comply with requirements of Section 180.

230.13 Intersection Sight Distance Requirements

Comply with requirements of Section 240.

230.14 Maintenance Requirements

The maintenance of existing driveway entries within the right-of-way, including culverts, aggregate, and driving surface, shall be the responsibility of the owner of the property being served by the driveway. Maintenance must be performed so that the entry does not become a hazard including the responsibility of ongoing management of private property and the right-of-way to maintain sight distance per Section 240. Additional requirements are provided in *County Code* Section 7.03.

SECTION 240 - SIGHT DISTANCE

240.1 General

Sight distance shall be determined and approved in accordance with the procedures as stated in the current AASHTO "*A Policy on Geometric Design of Highways and Streets*" or AASHTO's "*Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400)*".

240.2 Sight Distance – Standard

a) Comply with the requirements of *County Code* Section 7.03 which requires that no person shall place objects in the right-of-way or private property in such a way that they limit ISD or SSD per Table 2-6 to 2-10.
b) Adequate intersection sight distance ("ISD") and adequate stopping sight distance ("SSD"), per Tables 2-6, 2-7, and 2-8, should be provided at all existing intersections and shall be provided at all new intersections.
c) Adequate intersection sight distance ("ISD") and adequate stopping sight distance ("SSD"), per Tables 2-6, 2-7, and 2-8, should be provided at all proposed accesses and existing accesses that are subject to land use approval that increase in ADT by 21 or more.
d) Sight distance at intersections and accesses to very low volume local, connector and collector roadways with a 20 year entering volume of less than or equal to 400 ADT and meeting the eligibility requirements of Table 2-9 may be based upon Table 2-9.
e) Existing access subject to land use approval where ADT is increased by 20 or fewer trips shall provide adequate SSD per Table 2-10.
f) Existing access not subject to land use approval but subject to a permit shall maximize ISD and SSD by removing visual obstructions located on the applicant's property or located in the road right-of-way.
g) Proposed access to parcels or contiguous parcels with no other access and not subject to land use approval but subject to a permit shall maximize ISD and SSD by removing visual obstructions located on the applicant's property or located in the road right-of-way.
h) Adequate SSD should be provided along all roadways per Table 2-10 except very low volume local roads, which may be based upon Table 2-9.
i) Adjustments to the sight distance tables of these *Standards* for street grade, design vehicle, or other factors, with regard to ISD and SSD requirements, shall be made per AASHTO guidelines.
j) If required ISD or SSD cannot feasibly be achieved, lesser sight distance may be acceptable per Section 170.

An applicant may be required to provide evidence that proposed improvements will not create situations where sight distance is made inadequate for other driveways, intersections, or other sections of roadway. If sight distance for existing driveways, intersections or sections of roadway is already inadequate, the applicant shall provide evidence that sight distance is not worsened by the applicant's improvements.

Access that doesn't comply with the above criteria are subject to denial, removal or modification.

240.3 Existing Offsite Public Roadway Intersections

Proposed developments subject to adequate safety requirements of the *ZDO* that impact off-site public roadway intersections (public road intersecting another public road) may be subject to ISD and SSD adequacy requirements at those off-site intersections if safety issues may result from the proposed development in the judgment of the Road Official. A development may be found to impact off-site intersection(s) if the development's only access or all directions of access to the nearest collector or arterial road is/are via intersection(s) turning movement(s) with inadequate ISD or SSD per Section 240.2. The applicant may be responsible for submitting data that substantiates trip movements. The following criteria apply:

a) Developments that add a minimum of 15 daily trips to the inadequate movement(s) at the off-site intersection(s) may be required to mitigate that/those intersection(s) along at least one route from the site access to the nearest collector or arterial roadway per the standards of Section 240.2 or be denied access; or
b) Developments that add between five and 14 daily trips to the inadequate movement(s) at the off-site intersection(s) may be required to mitigate that/those intersection(s) along at least one route from the site access to the nearest collector or arterial roadway per the standards of Table 2-10 and measured per Section 240.4 or be denied access; or
c) Developments that add less than five daily trips to the inadequate movement(s) at the off-site intersection(s) will only be required to mitigate that/those intersection(s) along at least one route from the site access to the nearest collector or arterial roadway per the standards of Table 2-10 and measured per Section 240.4 if any of the off-site intersections are experiencing a crash history related to the inadequate ISD, inadequate SSD or if the development is anticipated to create a significant safety issue.

240.4 Intersection Sight Distance Measurement

ISD shall be measured from a driver's eye height of 3.5 feet and 14.5 feet from the edge of the nearest travel lane (edge line, bike lane line or if neither exits, edge of pavement) to an object height of 3.5 feet above the roadway surface and measured along the center of a travel lane. Sight distance measurements shall be modified under the following conditions:

a) Where a significant percentage of trucks will intersect a roadway, sight distance measurements may also dictate compliance with the truck sight distance measurements of AASHTO.
b) At the intersection of a local roadway and a private driveway serving up to two single family residential homes, sight distance may be measured 10 feet from the edge of the nearest travel lane except where backing maneuvers are likely to occur.

240.5 Stopping Sight Distance Measurement

SSD shall be measured from a driver's eye height of 3.5 feet to an object height of 2.0 feet above the roadway surface and measured along the center of a travel lane.

240.6 Sight Distance Design Speed

Design speed, for the purpose of determining sight distance, shall be based upon the guidance of Section 250.1.2. If desired or required, a speed study shall be completed by the applicant in conjunction with County staff direction.

Table 2-6 Intersection Sight Distance (ISD) - Left Turn from Stop

Design Speed (MPH) of Major Roadway	Intersection Sight Distance (feet)
15	170
20	225
25	280
30	335
35	390
40	445
45	500
50	555
55	610
60	665
65	720
70	775
75	830
80	885

Note: ISD shown is for a stopped passenger car to turn left onto a two-lane roadway with no median and minor street/driveway approach grades of 3 percent or less. For other conditions, the time gap must be adjusted and required sight distance recalculated per AASHTO.

Table 2-7 Intersection Sight Distance (ISD) - Right Turn from Stop and Crossing Manuever

Design Speed (MPH) of Major Roadway	Intersection Sight Distance (feet)
15	145
20	195
25	240
30	290
35	335
40	385
45	430
50	480
55	530
60	575
65	625
70	670
75	720
80	765

Note: ISD shown is for a stopped passenger car to turn right onto or cross a two-lane roadway with no median and minor street/driveway approach grades of 3 percent or less. For other conditions, the time gap must be adjusted and required sight distance recalculated per AASHTO.

Table 2-8 Intersection Sight Distance (ISD) - Left Turn from Major Road

Design Speed (MPH) of Major Roadway	Intersection Sight Distance (feet)
15	125
20	165
25	205
30	245
35	285
40	325
45	365
50	405
55	445
60	490
65	530
70	570
75	610
80	650

Note: ISD shown is for a passenger car making a left turn from an undivided highway.
For other conditions, the time gap must be adjusted and required sight distance recalculated per AASHTO.

Table 2-9 Intersection Sight Distance for Very Low-Volume Local and Connector Roads

Design Speed (MPH) of Major Roadway	Intersection Sight Distance (feet)		
	0-100 ADT	100-250 ADT	250-400 ADT
15	65	65	65
20	90	95	95
25	115	125	125
30	135	165	165
35	170	205	205
40	215	250	250
45	260	300	300
50	310	350	350
55	365	405	405
60	435	470	470

Note: ADT is based upon 20 year projected entering volume.
Applies to local/local, connector/connector, connector/local, collector/connector, collector/local road intersections only with a 20 year projected ADT of 400 or less.
Intersections with a collector must be found to be functioning as local roadways by Engineering.

Table 2-10 Stopping Sight Distance

Design Speed (MPH)	Stopping Sight Distance (feet)
15	80
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645
70	730
75	820
80	910

SECTION 245 - ROADSIDE & CLEAR ZONE

245.1 General

Roadside and clear zone standards strive to ensure that the roadside remains free of fixed objects and is sufficiently flat in the event that a vehicle runs off the roadway, enabling the vehicle to recover under ideal conditions. For additional information, refer to the AASHTO *Roadside Design Guide.*

245.2 Clear Zone Measurement

The clear zone width is measured from the edge of the travel lane of the roadway, the fog line or bike lane line.

245.3 Clear Zone Standards

Minimum clear zone widths are defined by Table 2-11 and are enforced by Section 7.03.090(C) of the *County Code*.

Table 2-11. Roadway Clear Zone

Functional Classification	INSIDE THE UGB					OUTSIDE THE UGB				
	Posted Speed or Design Speed (MPH)					Posted Speed or Design Speed (MPH)				
	55	45-50	35-40	30	25 and under	55 or Basic Rule	45-50	35-40	30	25 and under
Major Arterial	15'	15'	10'	10'	10'	15'	15'	10'	10'	10'
Minor Arterial	N/A	15'	10'	10'	7'	15'	15'	10'	10'	10'
Collector	N/A	N/A	10'	7'	7'	15'	10'	10'	7'	7'
Connector	N/A	N/A	10'	7'	7'	10'	10'	10'	7'	7'
Local	N/A	N/A	N/A	7'	18"	10'	10'	7'	7'	18"

Notes:
N/A = Not applicable

245.4 Clear Zone Requirements

a) Fixed objects located along the edge of the traveled portion of the roadway should be located outside the clear zone.
b) Fixed objects are defined by AASHTO's *Roadside Design Guide* and the *County Code*.

245.4.1 Fixed Objects Allowed in Clear Zone

The following permanent objects are permitted within the clear zone under the following conditions:
a) Approved street trees.
b) Mailboxes erected per the Standards for Installing Mailboxes on County Roads.
c) Fences and walls approved by Engineering or meeting the requirements of Section 130.2.
d) Illumination poles.
e) Approved street furniture.
f) Objects permitted by the *County Code*.
g) Other objects approved or installed by the County.

245.4.2 Embankments and Ditches

New construction of foreslopes and backslopes should be based upon Standard Drawings C110 to C140. Proposed slopes within the clear zone should be "recoverable." Slopes that are "critical" per the AASHTO *Roadside Design Guide* should be avoided with new construction.

245.4.3 Vegetation

Vegetation should not be allowed over a height of 30 inches in locations where it would limit sight distance per Section 240. Overhanging tree limbs should have a minimum vertical clearance of 10 feet within the clear zone. Overhanging tree limbs should have at least 14 feet of vertical clearance above the pavement surface over the traveled portion of the roadway. Measurement shall be taken from pavement surface.

245.4.4 Above Ground Appurtenances

Above ground appurtenances constructed as component parts of any underground utility line should be located outside the clear zone as practicable.

245.5 Clear Zone Exceptions

If fixed objects cannot be moved from the clear zone and cannot meet the standards of the *County Code*, Sections 245.1 through 245.4.3 and Table 2-11, the County may allow the obstructions to remain with consideration given to delineating or protecting the objects.

SECTION 250 - GEOMETRIC DESIGN

The design of public and private roadways shall be largely based upon these *Standards*, the manuals and standards of Section 115 and the Standard Drawings.

The County reserves the right to restrict specific combinations of horizontal and\or vertical alignments which contain steep grades, minimum K values, minimum centerline radii, and broken back curves.

250.1 General

250.1.1 Roadway Cross Section

a) Standard Drawings C110 to C140 are to be used for the design of roadways under the jurisdiction of the County. These figures illustrate the required right-of-way width, paved widths, shoulder widths, lane configurations, easement widths, pedestrian facility widths, planter strips widths, curbs, bike facility widths, and design speeds for each functional classification.
b) Roadway cross sections shall consider the Regional Street Design Type Guidelines as described per *Comprehensive Plan* Chapter 5 as illustrated Map V-5.
c) Community and Design Plans are provided in the *Comprehensive Plan* that have exceptions to these *Standards*.
d) The *Active Transportation Plan*, projects adopted in the *Comprehensive Plan* and *CIP* should be referenced in determining the appropriate bicycle facility.
e) An urban street section shall be used on all roadways within the Urban Growth Boundary (UGB) and within unincorporated communities except as allowed by Engineering.
f) A rural road section shall be used on all roadways outside the UGB, unless located within an unincorporated community.

250.1.2 Design Speed

a) The design speed for all roads shall be determined by Engineering.
b) The minimum design speed for all public roads shall be 25 MPH.
c) Design speed shall be determined or assumed as one of the following:
    1) Intended posted regulatory speed.
    2) Existing posted regulatory speed.
    3) 85th percentile speed.
    4) In the vicinity of a horizontal curve, the advisory speed posting plus 10 MPH.

250.1.3 Design & Control Vehicle

a) Engineering shall determine the appropriate design and control vehicle for a facility.
b) A "design vehicle" frequently uses a facility and must be accommodated without encroaching into opposing traffic lanes.
c) A "control vehicle" infrequently uses a facility but encroachment into opposing traffic lanes, multiple-point turns or minor encroachment into the roadside is acceptable.
d) The Engineer may be required to provide evidence that the design vehicle and control vehicle are accommodated in their designs.
e) Functional classification, safety and roadway use all play a role in determining the acceptability of lane encroachment by control vehicles. For example, on a local road, full lane encroachment by a control vehicle may be acceptable if sight distance was adequate while on a major arterial, such encroachment may not be permitted.

250.2 Curbs

a) When needed, curbs shall conform to Standard Drawings S100 to S180, as specified by Engineering.
b) Curbs may be omitted when it is demonstrated that surface water quality and storm water discharge considerations can be better achieved by collection in shallow, grass-lined swales paralleling the roadway and provisions for maintenance can be arranged. Additional pavement width along shoulders or on separated facilities shall be shown to demonstrate sufficient accommodations for pedestrian and bicycle traffic.

250.3 Pedestrian Improvements - General

a) All pedestrian improvements shall comply with the *PROWAG* standards for a pedestrian access route. The specific provisions of the *PROWAG* standards for pedestrian access routes can be found in the Sidewalk/Multiuse Path – ADA Design Review Checklist.
b) Pedestrian facilities are required within the UGB and unincorporated communities. Pedestrian facilities are not required outside the UGB except within unincorporated communities.
c) If right-of-way or public easement is adequate and a development is required to construct a pedestrian facility, the development is required to connect to an existing pedestrian facility that is terminated mid-block and within 15 feet of the proposed pedestrian facility, the development shall connect to that pedestrian facility. The development shall be required to construct the connecting pedestrian facility and associated improvements including curb, drainage and landscaping and comply with Section 250.3.9.
d) On roadways with an anticipated ADT of less than 400 where pedestrian facilities would otherwise be required, pedestrian facilities may be provided on only one side.
e) Minimum pedestrian facility widths are found in *ZDO* Section 1007. However, compliance with Section 250.1.1 is required.
f) Pedestrian facilities within the public right-of-way may have a running slope in the direction of pedestrian travel equal to the grade of the adjacent roadway. Pedestrian facilities outside the public right-of-way may not have a running slope in the direction of pedestrian travel in excess of 5%.

250.3.1 Sidewalks

Sidewalks should be designed to comply with Standard Drawing S960.

250.3.2 Shared-Use (Multi-Use) Paths

a) As an alternative or in addition to sidewalk and separated bike facilities, shared use paths may be allowed according to the criteria of the *ZDO* and as part of conditions of approval of development or allowed as part of a County initiated project.
b) The location of planned shared use paths is provided by Map 5-3 of the *Comprehensive Plan*.
c) The required shared use path width varies from an unobstructed minimum width of ten feet depending upon anticipated use. These circumstances will consider relative anticipated use of the facility, topography, preservation of significant trees, safety, and right-of-way.
d) Shared use paths under County jurisdiction shall be constructed of concrete.

250.3.3 Cycle Tracks

Separated pedestrian facilities constructed at the same grade as a cycle track shall be physically or visually separated from the cycle track. The design of these facilities should be based upon Standard Drawing S960.

250.3.4 Landscape Strips

a) All pedestrian facilities should be located adjacent to a landscape strip or other physical buffer from vehicular traffic unless otherwise approved.
b) Landscape strip width shall be determined per Standard Drawings C110-140 or by the *Comprehensive Plan*.
c) Landscape strips shall include landscaping elements of Section 255.

250.3.5 Right-of-way and Easements

All roadway improvements including sidewalks, cycle tracks, and shared use paths should be constructed within the public right-of-way. These improvements may be located within a public easement if approved.

250.3.6 Horizontal and Vertical Clearance

A minimum horizontal clearance around any obstacles shall be compliant with PROWAG and be provided on all pedestrian facilities.

The minimum vertical clearance above a sidewalk or shared use path is eight feet.

250.3.7 Pedestrian Facilities Cross Slope

The cross slopes of pedestrian facilities perpendicular to the direction of travel shall be designed to a maximum 1.5%, and shall not exceed 2% per ADA requirements as identified in the Sidewalk/Multiuse Path – ADA Design Review Checklist.

250.3.8 Curb Ramps

At any location where the route of pedestrian travel requires crossing a curb, a curb ramp shall be provided. Two curb ramps are typically required at each intersection corner, with one curb ramp to serve each direction of pedestrian travel. Curb ramp considerations include:

a) Curb ramps are to be placed as near as possible to continue the natural path of pedestrians using the adjacent sidewalk.
b) Design of curb ramps shall comply with ADA requirements as identified in the Curb Ramp – ADA Design Review Checklist. Typical curb ramp designs are shown on *Oregon Standard Drawings* RD755, RD756 and RD757. Typical designs for a ramp to allow pedestrians to transition from the end of a sidewalk, separated path or shared use path to the road surface are shown on *Oregon Standard Drawing* RD754.
c) For pedestrian facilities proposed to end mid-block that do not connect to an existing pedestrian facility, curb ramps shall be provided as such:
    1) At both ends of the new pedestrian facility when the proposed construction length exceeds 100 feet.
    2) At one end of the new pedestrian facility when the proposed construction length is between 50 feet and 100 feet.
    3) No curb ramps if not required by 1) or 2).
d) For pedestrian facilities proposed to end mid-block that connect to an existing pedestrian facility, curb ramps shall be provided as such:
    1) At the end of the new pedestrian facility when a curb ramp already exists. The existing curb ramp, even if located off-site from a development, shall be removed and replaced with appropriate curb and landscaping.
    2) At the end of a new pedestrian facility when the proposed construction length exceeds 50 feet.
    3) No curb ramps if not required by 1) or 2).
e) Exceptions to the ADA requirements for curb ramps may be requested using the process identified in Section 170 in cases of physical barriers that make full compliance infeasible.

250.3.9 Curb Ramp Closures

a) A crosswalk may be considered for closure and a curb ramp not required under any of the following criteria:
    1) There is no sidewalk or shoulder at least five feet wide on the opposite side of the street on the natural path of pedestrian travel and the construction of the curb ramp would result in a safety issue;
    2) Per the provisions of ORS 801.220 there is a marked crosswalk at the intersection serving the same direction of pedestrian travel and the construction of the curb ramp may result in a safety issue.
    3) There are closely spaced crossings of offset T-intersections;
    4) The crosswalk is within a maneuvering area or storage length of an intersection and crossing at that location would result in a safety issue;
    5) An ADA compliant curb ramp cannot be designed, and a non-compliant curb ramp approved through an exception would be a safety hazard for users due to excessive slope, cross slope or other existing physical constraints;

6) The crosswalk would not have adequate stopping sight distance based on the design speed, or
7) A physical barrier exists that prevents roadway crossing.

b) In the event that a crosswalk is closed, appropriate signs/barriers should be provided.
c) A curb ramp should be constructed but signed as "crosswalk closed" if an accessible pedestrian path is not available on the opposite side of the street in the natural path of pedestrian travel but is reasonably expected to be built within five years.

250.3.10 Bulb Outs (Curb Extensions)

Bulb outs are typically used to span parking areas on arterials and collectors to make pedestrians more visible, reduce pedestrian crossing length and should be provided in the following instances:

a) At midblock crossing locations and intersections within the UGB with adjacent established on-street parking along arterial and collector roadways.
b) As required by the Sunnyside Village Community Plan or similar community or design plan area standards in the *Comprehensive Plan*.
c) At other locations determined by Engineering.

250.3.11 Midblock Crosswalks

a) Marked midblock crosswalks may be considered in the UGB in the following cases and may be provided if warranted per the *MUTCD*:
   1) On arterial or collector roadways with a posted speed of 35 MPH or less where existing intersections, proposed intersections, or existing crossing opportunities are more than 330 feet apart.
   2) In locations of existing or anticipated moderate to high pedestrian volumes.
b) Midblock crosswalks should be designed and constructed with the following features:
   1) Generally pursuant to the recommendations of Table 9.5 of ITE's *Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities: An ITE Proposed Recommended Practice*.
   2) With a raised concrete median per Section 250.10 when crossing three or more lanes of traffic.
   3) Curb ramps meeting ADA requirements as identified in the ADA Assessment Checklist – Curb Ramps should be provided on both sides of the street per these *Standards*.

250.3.12 Pedestrian Facility Condition & Repair

a) For pedestrian facilities under the jurisdiction of Clackamas County, comply with the requirements of the *County Code* Section 7.03 with regard to vertical displacements, cracks and disrepair.
b) Concrete pedestrian facilities may be ground up to ½" in depth from the original pedestrian facility depth. When more than ½" depth is proposed or required for removal, the full panel of the pedestrian facility shall be replaced.

250.4 Bicycle Improvements

a) Bicycle facilities should be designed and constructed per the *Oregon Bicycle and Pedestrian Design Guide*, the AASHTO *Guide for the Development of Bicycle Facilities* and with consideration given to NACTO's *Urban Bikeway Design Guide*.
b) Separated bicycle facilities shall be provided on all collector and arterial roadways.
c) The location of planned bicycle facilities is established by *Comprehensive Plan* Map V-7a in the urban area and V-7b in the rural area.
d) The *Comprehensive Plan* and *Active Transportation Plan* provide guidance on bicycle facility selection.
e) Bicycle facilities shall be provide travel in both directions along a roadway, where planned.

250.4.1 Shared Use Paths

See Section 250.3.3.

250.4.2 Other Bicycle Facilities

See the Oregon *Bicycle and Pedestrian Design Guide*, the AASHTO *Guide for the Development of Bicycle Facilities*, and NACTO *Urban Bikeway Design Guide* for design guidance.

250.5 Transit Improvements

The applicant shall evaluate existing transit amenities and work with transit providers to determine if transit feature improvements are necessary based upon established transit agency guidelines. Each project shall provide reasonable accommodations for the incorporation of public transit per transit design guidelines.

250.6 Horizontal Alignment

250.6.1 Horizontal Curves

a) The horizontal alignment of County, public and private roadways shall conform to the following requirements:
   1) The centerline alignment of roadway improvements shall be common to the centerline of the right-of-way or access easement unless otherwise approved by Engineering.
   2) The centerline of a proposed roadway extension shall be aligned with the existing centerline.
   3) Horizontal curves shall meet the minimum radii requirements shown in Table 2-13. The minimum horizontal curve radii are determined by the following formula:

$$R = \frac{V^2}{15\,(e+f)}$$

where
- R = minimum centerline radius (ft)
- V = design speed (MPH)
- e = rate of roadway superelevation (ft/ft)
- f = side friction factor

Table 2-13. Minimum Centerline Horizontal Curve
Low Speed Urban Roadways

Design Speed (MPH)	Minimum Horizontal Curve (feet) *
15	50
20	107
25	198
30	333
35	510
40	762
45	1039

Notes:
*Assumes standard crown section of -0.025. For other sections, consult AASH
Urban conditions emax = 0.04, see AASHTO Exhibit 3.15

b) Very low volume local roads with ADT less than or equal to 400 may use a centerline radius of 178 ft per AASHTO's *Guidelines for Geometric Design of Very Low-Volume Local Roads*. Exceptions for very low-volume local roads can be found in Section 250.6.3.
c) Residential driveways that serve no more than three lots, and are less than 400 feet in length or have topographic constraints may use a 50 foot centerline radius for a 12 foot width or 40 foot centerline radius for a 20 foot width. Engineering and emergency service provider approval is required.

250.6.2 Design Intent for Horizontal Curves

Minimum radii may be used only as approved by Engineering. The following excerpts from AASHTO's *A Policy on Geometric Design of Highways and Streets* and ITE's *Urban Street Geometric Design Handbook* clarify the use of minimum radii and are adopted by Engineering as general design controls:

Per AASHTO Chapter 3 - Elements of Design, "General Controls for Horizontal Alignment":

a) "Winding alignment composed of short curves should be avoided because it usually leads to erratic operation."
b) "In an alignment developed for a given design speed, the minimum radius of curvature for that speed should be avoided wherever practical."
c) "Abrupt reversals in alignment should be avoided. Such changes in alignment make it difficult for drivers to keep within their own lane."
d) "The broken-back or flat-back arrangement of curves (with a short tangent between two curves in the same direction) should be avoided… "

Per AASHTO Chapter 3 - Elements of Design, "General Design Controls":

a) "Sharp horizontal curvature should not be introduced at or near the top of a pronounced crest vertical curve. This condition is undesirable because the driver may not perceive the horizontal change in alignment, especially at night."
b) "…sharp horizontal curvature should not be introduced near the bottom of a steep grade approaching or near the low point of a pronounced sag vertical curve."
c) AASHTO Chapter 5 - Local Roads and Streets, "Local Urban Streets", Page 5-12:
d) "[Local urban] street curves should be designed with as large a radius curve as practical, with a minimum radius of 100 feet."

Per ITE, Chapter One 1.6.3:
"Although local streets may be planned, constructed and operated with the primary purpose of providing access to adjacent property, some local streets also may serve a limited amount of through traffic due to street network deficiencies. In these situations, the designer should utilize geometric design and traffic control features more typical of collector streets to encourage the safe and efficient movement of all street users."

250.6.3 Exceptions for Very Low Volume (≤400 ADT) Local Streets with a Speed of 25 MPH or less

The following are allowed under the listed circumstances on a limited basis:

a) Horizontal curves on local roadways within residential areas may have a minimum centerline radius of one hundred (100) feet as limited in this section.
b) A single 15 MPH maneuver is allowed on a local road on a limited basis when physical constraints or property boundary limitations exist.
c) A 100 foot tangent length shall be provided between low speed maneuvers. The tangent length provides the driver adequate time to recognize the maneuver and slow down to accomplish the turn.

250.6.4 Roadway and Marking Transitions

Shifts in roadway alignment, widening, or narrowing within motor vehicle travel lanes shall be accomplished through roadway transitions as described below.

a) Roadway transitions within through lanes or left turn lanes:

$$L = S \times W \qquad (S \geq 45 \text{ MPH})$$

$$L = \frac{WS^2}{60} \qquad (S < 45 \text{ MPH})$$

where L = minimum taper length (ft)

S = design speed (MPH)
W = offset (shift) width (ft)

b) Exclusive right turn lanes shall have a minimum 8 (length) to 1 (offset) widening taper for design speeds 35 MPH and below and 15:1 for design speed of 40 and above.
c) On all bike facilities and all paved shoulders, roadway width transitions shall have a minimum 8 (length) to 1 (offset) pavement taper for design speeds 35 MPH and below and 10:1 for design speed of 40 and above.
d) Along local and connector roads within the UGB, roadway width transitions are not required if traffic is not expected to utilize the shifting roadway.

250.6.5 Lane Widths

The *Comprehensive Plan* and these *Standards* present a range of lane widths. Engineering will utilize will consider the following when making decisions about lane widths:

a) Lane widths should be kept as narrow as possible.
b) Wider lane widths should be considered when the mix of heavy vehicles is greater.
c) When no bicycle facility or shoulder is present, a shy distance from a vertical curb should be considered.
d) If the purpose of the design is a lower speed environment, narrower travel lanes should be selected.
e) The *Active Transportation Plan* for guidance on the type and width of bicycle facilities.

250.7 Vertical Alignment

The vertical alignment of the County's public and private roadways shall conform to the following requirements:

250.7.1 Minimum Roadway Gradient

a) The minimum tangent roadway gradient shall be 1% along the crown and vertical curb line.
b) A minimum of 0.5% may be designed with concrete curb and gutter with Engineering approval.
c) Through curb ramps, the minimum gradient shall be designed to 1.0% to 1.5%

250.7.2 Maximum Roadway Gradient

The maximum roadway gradient shall be based on Standard Drawings C110-C140. Grades in excess of these maximums may be approved by Engineering on a case-by-case basis per Section 170.

250.7.3 Intersection Landing

a) At intersections, a landing shall be provided on the secondary or subordinate approach or on a stop-controlled approach.
b) Landings should be 20 feet in length for private driveways, 50 feet in length for local roadways and one hundred 100 feet in length for all other roadways.
c) Landings should be measured from the edge of pavement of the intersected roadway at full development and shall have an average grade of not greater than 5%.

250.7.4 Vertical Curves

a) Vertical curves shall be used when design grade breaks of more than 1% are necessary.
b) Vertical curves shall conform to the values in Table 2-14 and calculated as below.

$$K = \frac{L}{A}$$

where A = algebraic difference in grades (percent)
L = length of vertical curve (feet)

Table 2-14. Design Controls for Stopping Sight Distance for Crest and Sag Vertical Curves

Design Speed (MPH)	K-Crest	K-Sag
15	3	10
20	7	17
25	12	26
30	19	37
35	29	49
40	44	64
45	61	79
50	84	96
55	114	115
60	151	136
65	193	157

c) The minimum vertical curve length shall be fifty (50) feet.
d) K-Sag values may be reduced to K-Crest values if adequate street lighting is present along the entire sag vertical curve.

250.7.5 Roadway Widening

a) Required road widening for land use approvals generally require a half street improvement; however, when one or more of the following apply up to a full street widening may apply:
   1) Setting new curbs;
   2) Centering up road improvements in the right-of-way;
   3) Existing cross slopes are below the minimum or above the maximum standards;
   4) Cross slopes vary from one side to the other; or
   5) Offset crowns exist.
b) Road widening shall not reduce existing road structural sections beyond the minimum standard structural section unless the road structural section is reconstructed to standards.
c) Road widening designs require designed cross sections at 25' on center that illustrate the elevations at:
   1) Centerline of right-of-way,
   2) Crown of road,
   3) Saw cut line, and
   4) Gutter line
      i) Show the existing and new cross slopes between elevation points;
      ii) Provide the station for each cross slope;
      iii) These cross slopes are usually for plan review to insure that the cross slopes and crown are designed within the acceptable standards and can be provided as a separate exhibit to the plans unless they are also needed to provide information to the contractor.
   5) The maximum grade break between existing and proposed cross slopes shall be 2%.
   6) Cross sections through existing driveways and intersections shall be provided.

250.7.6 Superelevation

a) Design elements for superelevation should be based on AASHTO guidelines.
b) Superelevation is not allowed on roadways with a design speed of 35 MPH or less.
c) The maximum rate of roadway superelevation for urban conditions should be 4% ($e_{max} = 0.04$).
d) The use of superelevation in the urban area is discouraged and shall be approved by Engineering before used.

250.8 Intersections

250.8.1 Minimum Curb Radii

a) Minimum curb radii at intersections within the UGB are shown in Table 2-15.
b) Minimum curb radii at intersections outside the UGB are determined by Engineering.
c) The minimum right-of-way radii shall be sufficient to maintain at least the same distance from right-of-way to edge of pavement or curb as the lower classified roadway.
d) Curb radii shall be designed to accommodate the design and control vehicle per Section 250.1.3.
e) Curb radii shall be approved by Engineering based upon an assessment of design and control vehicle considerations as well as pedestrian and design speed considerations.

Table 2-15. Minimum Urban Area Turning Radii - Edge of Pavement or Curb Radius

Functional Classification	Major Arterial	Minor Arterial	Collector	Connector	Local
Major Arterial	35	35	30	25	25
Minor Arterial		35	30	25	25
Collector			25	20	20
Connector				20	20
Local					20

Notes:

If a bike lane or on-street parking exist on both roadways, then the above radii may be reduced by five (5) feet

Larger radii may be needed to accommodate the design and control vehicle, designers shall identify each for the roadway and ensure that movements can be made with the associated minimum turning radii.

250.8.2 Intersection Angle

The intersection angle at intersecting roadways shall be kept as near to 90 degrees as possible. Intersection angles from 80 to 85 degrees and 95 to 100 may be considered per Section 170.

250.8.3 Roadway/Lane Offset

New lanes, roadways or driveways intersecting an existing intersection should not be significantly offset from the existing alignment. Minor offsets may be approved where low speed maneuvers are predominant or where otherwise acceptably safe operations would occur.

250.8.4 Tangent Section

In order to improve the safety at intersections, new intersections should conform to the following tangent requirements unless otherwise approved by Engineering. The following tangent sections should be provided per Table 2-16.

Table 2-16. Minimum Tangent of Intersecting Roadway
(Measured in feet from nearest intersecting curbline or edge of pavement)

Major Roadway	Intersecting Roadway					
	Major Arterial	Minor Arterial	Collector	Connector	Local	Private Access
Major Arterial	100	100	75	50	50	20*
Minor Arterial		100	75	50	50	20*
Collector			50	20	20	20*
Connector				20	20	20*
Local					20	20*

Notes:
*Private Access tangents shall be based upon relative ADT of the planned driveway and will be determined on a case by case basis as part of the land use review process.

250.8.5 Residential Intersection Design

Four-legged intersections should be considered for neighborhood traffic circles per Section 265.

250.8.6 Roundabouts

a) Roundabout intersections shall be designed in accordance with FHWA's *Roundabouts: An Informational Guide*.
b) Roundabouts shall be considered per Section 260.1.1 prior to the approval of a traffic signal.
c) Roundabouts with pedestrian facilities shall be designed to comply with ADA requirements as identified in *PROWAG* Section R306.3.

250.8.7 Intersection Sight Distance

Comply with intersection sight distance requirements of Section 240.

250.8.8 Turn Lane Design

a) The need for left or right turn lanes shall be based upon a traffic study per Section 295.18.1 and/or as dictated by the *Comprehensive Plan* or *CIP*.
b) Queue storage estimates shall be based upon a traffic study per Section 295.16.
c) Left turn lanes, when provided, shall have a storage queue of at least 50 feet.
d) Design of left or right turn lanes should be based upon ODOT's *Highway Design Manual*.

250.9 Roadway Grading

a) Roadway grading should conform to clear zone requirements of Section 245 and cross section requirements of Standard Drawings C110 to C140.
b) Slopes along and adjacent to the roadway should be as specified in Standard Drawings C110 to C140. The maximum slopes outside the clear zone as detailed in Section 245 are as follows:
   1) Cut Slope - 2 to 1
   2) Fill Slope - 2 to 1
c) Roadway embankment should be constructed with crushed aggregate no larger than 6"-0 and no larger than 1½"-0 to 3"-0 can be used within one-foot of the structural section of the roadway.
d) Flatter slopes are preferred and may be required by the County if soils are unstable as determined by a geotechnical analysis.
e) Side slopes exceeding four feet in height shall be constructed in conformance with design and specifications prepared by an Engineering Geologist or Geotechnical Engineer. All side slopes shall be stabilized by grass

sod, seeding, riprap, or other acceptable ground stabilizing materials as recommended by a geotechnical engineer.

f) Side slopes necessary for roadway stability extending outside the public right-of-way will require slope easements.

250.10 Non-traversable Medians and Accessible Route Islands

a) Non-traversable medians should be required in the following cases:
   1) On arterial roadways within the UGB with five or more travel lanes.
   2) When described as an element of a project listed an adopted plan.
   3) On roadways where right-in/right-out driveway access maneuvers are required.

b) Non-traversable medians should be considered in the following cases:
   1) On arterial or collector roadways within the UGB with three or more travel lanes.
   2) On roadways where improved access management is desirable.

c) Medians should be designed and constructed with the following features:
   1) Landscaping per Section 255.
   2) Landscaping with a mature height of 2.5 feet should not be planted within 50 feet of an intersection.
   3) With a minimum width of eight feet when designed to serve as a pedestrian refuge.
   4) With a minimum width of one foot when not designed to serve as a pedestrian refuge.
   5) To contain a "shy" distance from adjacent traffic of varying width depending upon the design speed of the roadway.
   6) Medians that are crossed by a pedestrian access route and accessible route islands shall comply with ADA requirements as identified in ADA Design Review Checklist – Medians/Traffic Islands and depicted in Oregon Standard Drawing RD710.

SECTION 252 - STRUCTURAL SECTION

Roadways shall be constructed, reconstructed and repaired with asphaltic concrete over a crushed rock base or Portland Cement Concrete over a crushed rock base. All construction work and material shall be in accordance with Chapter 1 of these *Standards*.

In weak soil conditions, where the strength of the standard base rock section is inadequate, Cement Treated Base (CTB) may be used as an alternative as approved by Engineering.

In conditions where the road surface is not structurally sound or is damaged by construction activities or traffic, Full Depth Reclamation (FDR) may be used as an alternative as approved by Engineering.

252.1 Subgrade Evaluation

a) Soil testing may be required by Engineering to determine soil strength and design of the roadway structural section.
b) Soil tests are needed on undisturbed samples of the subgrade materials that are expected to be within three (3) feet of the planned subgrade elevation.
c) Samples are needed for each 500 feet of roadway and for each visually observed soil type.
d) Soil tests are required from a minimum of two locations.
e) The results of the soil testing shall be included in a soils report prepared by an Engineering Geologist or Geotechnical Engineer.
f) This soils report shall also address subgrade drainage and ground water considerations for year-round conditions, percolation data in areas of proposed drywells or french drains, and recommendations for both summer and winter construction.

252.2 Asphaltic Concrete

a) The standard asphaltic concrete structural section shall be in accordance with Standard Drawing C100.

b) Asphalt concrete is to be ½ inch or ¾ inch dense HMAC. Material and installation shall conform to *Oregon Standard Specifications for Construction*.
c) No single lift shall be less than 2 inches or greater than 3 inches in thickness.
d) Smoothness of ride characteristics shall meet the *Oregon Standard Specifications for Construction* Section 00744.70.
e) When unusually weak soil conditions exist, or in higher elevations with frequent freeze/thaw cycles, or high volumes of truck traffic exist, the pavement and aggregate thickness may be determined by the Asphalt Institute Method. If it is determined that the street section identified in Standard Drawing C100 is inadequate, the EOR shall provide a pavement design.
f) Design values used in the asphaltic concrete design shall be supplied by an Engineer. Traffic data shall be obtained and include the following: Design period, traffic volumes, rate of growth, and percent of trucks.
g) Design of asphalt concrete pavement structures shall conform to the guidelines determined by Engineering of the Asphalt Institute publication, *Thickness Design - Highways and Streets*.
h) The Equivalent Axle Load (EAL) for design of roadways shall be determined by a traffic analysis considering traffic growth, truck distribution determined on the basis of local traffic data and load equivalency factors as set forth in the above-referenced manual. For collectors and local roadways, the EAL may be determined using simplified procedures which relate the EAL to the average daily number of 18,000 lb. single axle loads estimated for the design lane during the design period.
i) Testing and evaluation of the subgrade soil strength shall be required for all pavement designs. Testing methods shall include but not be limited to:
    1) The Asphalt Institute Publication, Method of Test for Resilient Modulus of Soil, Manual Series No. 10 or
    2) AASHTO T-193 (CBR Method), or
    3) AASHTO T-190 (R-Value Method)
j) If the CBR value of the subgrade exceeds twenty (20) or the R value of the subgrade exceeds sixty (60), then CBR and R-Value methods shall not be used.
k) Test methods and results shall be incorporated in a soils report in accordance with the requirements of Section 250.10 of these *Standards*.

252.3 Portland Cement Concrete ("PCC")

The PCC structural section shall be determined using the guidelines and requirements of the Portland Cement Association ("PCA"). The following design parameters shall be used:

a) Design shall be determined by projected estimated axle loading (EAL) of the road.
b) Minimum thickness of PCC shall be seven inches.
c) Jointing plans will be required one week prior to start of construction, delineating intersection and utility structure jointing for final review and approval by Engineering.
d) Design values used in the PCC design shall be prepared by an Engineer. Traffic data shall be obtained and shall relate to a 20 year projection.

252.4 Cement Stabilized Roadway (CSR) by Full Depth Reclamation (FDR) or Cement Treated Base (CTB)
252.4.1 General

This work consists of in-place construction of cement stabilized roadway utilizing pulverized existing pavement and base materials mixed with Portland cement as per design specifications, and shaping the roadway to design/plan grades and cross slopes, including cure sealing or paving and the relocation of excess sub-grade material where required. The first till pulverizes for shaping to compacted design base grades (minus cement volume) and the second till incorporates (mixes) the cement into the prepared compacted roadway to final design base grades and seals the CSR for curing via fog seal, chip seal or an asphalt base lift per design/plan specifications.

This section details the requirements for full depth reclamation (FDR). Cement treated base (CTB) will follow the same standards with the exception that there is no existing road surface to pulverize. The CTB

requirements cover the remediation of both base rock and sub-grade. If the CTB shall be overlain with a full depth of base rock as per these standards, a chip seal or vapor barrier is not required.

252.4.2 Materials, Preparation & Equipment

a) The aggregate shall conform to the requirements of the *Oregon Standard Specifications for Construction* Section 02630.10.
b) The Portland cement shall conform to the requirements of the *Oregon Standard Specifications for Construction* Section 02010.
c) The water shall conform to the requirements of *Oregon Standard Specifications for Construction* Section 00340.
d) Portland cement shall be applied at the rate determined by an engineered design in percent of the dry weight of the material within a depth to be treated to achieve a seven day strength between 300 psi and 400 psi. The design shall indicate the optimum moisture content.
e) The Engineer shall obtain samples of the material to be pulverized to determine the design. Cores will be taken at 7 days and tested as per ASTM C39/C39M-12a and ASTM C42/C42M-12 to confirm that the strength of the CTB is within the correct range.
f) The asphalt used in the curing seal shall be either CRS-1 or CRS-2 emulsified asphalt as designated. The emulsified asphalt shall conform to the requirements of the *Oregon Standard Specifications for Construction* Section 00710. Cover aggregate for the cure seal shall conform to the requirements of Section 00710 and shall be ¼ - #10 size.
g) A traveling single or multiple transverse shaft mixer shall be capable of mixing to a depth of 12-inches in one pass. The cutting and mixing rotor shall be capable of adjustment to conform to the slope of the pavement. The mixer must have a working water system to bring the CSR to optimum moisture content.
h) Cement shall be spread using a mechanical spreader capable of uniformly distributing the cement across the width of the spread. The cement spreading equipment shall be in good working condition and shall be equipped with a metering device and travel speed indicator capable of accurately metering and uniformly spreading the required amount of Portland cement on the grade.
i) Equipment used to compact CSR shall be self-propelled 12 ton minimum, vibratory steel wheel, tamping foot, and/or pneumatic tire rollers. Rollers shall be capable of compacting the material to a firm, even surface. The tamping foot roller shall be placed immediately behind the tilling operation and before the initial grader operation.

252.4.3 Construction

a) The CSR shall be constructed so that the work will result in a finished sealed or continuously watered, curing CSR section conforming to specifications regardless of the daily or seasonal variations in weather, temperature and humidity under which the work is permitted to proceed. CSR shall not be constructed during periods of rain. CSR shall not be constructed out of frozen bases. Construction shall not occur when descending air temperatures fall below 40° F. Cement shall not be applied during windy conditions.
b) On the first till the existing road base and pavement materials shall be pulverized to a depth, as specified in the engineered design/plans to a condition such that all material will pass a 2-inch sieve.
c) Roads Without Curbs: The surface of the pulverized material shall then be brought to the uniform grades and cross sections, as shown in the plans for the final CSR grades (minus the cement volume) and compacted to specifications.
d) Roads With Curbs: The plans will show the first till depth noted above, as the depth of the existing asphalt and rock sections combined or 12" maximum. This material is to be stock piled and the subgrade (not tilled) is dug out and removed (to accommodate the depth of the new asphalt section, the cement and redistributed stockpiled material; so that the final finished asphalt grade matches the designed/plan curb exposure). The stockpiled material is then evenly redistributed, and brought to uniform grades and cross sections, as shown in the plans for the final CSR grades and compacted to specifications. Any material to be hauled off must go to an approved dump site.
e) The County makes no representation as to the type and size of the material that may be encountered in the existing roadway. The contractor shall notify the County immediately if the type and size of material (solid objects 3" > dia.) exceeds that which can be cement treated without excessive damage to the tiller.

f) In those areas which show excessive deflection or exhibit pumping under the wheel loads of the construction equipment, the pulverized material shall be removed and the sub-grade shall be over excavated to a firm depth as directed by the Engineer. Backfill the over excavation to the top of the existing sub-grade with 2"-0 size aggregate compacted in 9-inch maximum, loose depth, thickness lifts. Each lift shall be compacted to at least 95 percent of the maximum dry density determined by inspection. After backfilling of the over excavation, the remainder of the depth shall be backfilled with stockpiled pulverized material and brought to a uniform grade and cross section.

g) Cement shall be uniformly applied at the designated rate. The equipment and method used shall ensure the uniformity of cement distribution throughout the material to be treated. Water shall be added at the tiller during mixing operations to bring the mix to within – 0 to +1 ½ percent of the optimum moisture/density point. This moisture content shall be maintained until the mixing is completed.

h) The second tilling/mixing of the cement, water, and aggregate materials shall be started immediately but no later than two hours after the application of the cement. Mixing shall continue until a homogeneous mixture is obtained.

i) The CSR mixture shall integrate the pulverized material to a depth of 12 inches or design/plan depth.. This CSR mixture shall then be brought to a uniform profile and cross section as noted in the plans. Shaping and compaction of the CSR mixture shall be completed within two hours after mixing has been completed.

j) Special attention shall be taken around utility structures, survey monument boxes and next to curbs to ensure that the material is thoroughly pulverized, mixed with cement, moistened and compacted to the specified depth. Material that is inaccessible to the mixer shall be bladed or shoveled into the pulverizing and mixing process after which it shall be returned to its original position. Vibratory plate compactors shall be used to achieve compaction of the mixture in areas which are inaccessible to the rollers.

k) Special attention shall be given to ensure that the material next to all joints is thoroughly pulverized, mixed with cement, moistened and compacted to the specified depth.

l) Longitudinal and transverse joints adjacent to partially hardened CSR shall be constructed by cutting back with the mixer into the previously constructed work. The amount of the overlap shall be sufficient to cut back into solid materials.

m) Longitudinal and transverse joints adjacent to existing asphalt, concrete or hardened CSR shall be formed by saw cutting back into the work to form a straight vertical face. When completed, the face of the joint must be free of loose and shattered material.

252.4.4 Curing

Immediately after the grading, compaction and finishing of the cement treated base has been completed and during the same day while it is still moist, the surface shall be sealed with a fog or chip seal. The fog or chip seal shall be applied in accordance with applicable portions of Section 00710 of the *Oregon Standard Specifications for Construction* at the rates of 0.26 gallons per square yards of emulsified asphalt and 0.006 cubic yards (truck measure) per square yard for the cover aggregate. An asphalt surface course may be chosen as a sealing course on high volume roads that must remain in constant service when the County determines that the chip seal does not have sufficient strength to carry the anticipated traffic. If an asphalt surface course is chosen to seal the CSR, it may be installed no sooner than Day 2. If the fog/chip seal or asphalt concrete surface sealing course is not placed within forty eight hours (Day 2) following start of the mixing operation, then the CSR shall be allowed to cure, while maintaining moisture, for a period of 7 days (Day 7) before placing any asphalt concrete surface course.

252.4.5 Micro-Cracking

a) If specified by the Engineer and approved by Engineering, micro-cracking may be used as part of the design. Micro-cracking shall occur between Day 2 and Day 3.
b) Micro-cracking consists of 3 full passes, up and back, of a 12 ton vibratory roller with maximum vibrations for the full extent of the CSR.

252.4.6 Performance

a) The cement treated mixture shall be compacted to 98 percent of the maximum dry density as established by AASHTO T 134. Final finishing shall be accomplished by rolling accompanied by light watering and reshaping to provide a finished surface free of hairline cracking and free of ridges exceeding 0.04 foot in height.
b) If the specified compaction is not obtained, the contractor shall notify the County and Engineer. The contractor may be required to use a modified compaction procedure or apply additional compactive effort.
c) If approved materials meeting the specifications cannot be compacted to the required density regardless of compactive effort or method, the Engineer may reduce the required density or direct that alternate materials be used. In no case shall CSR construction proceed until the contractor is able to compact the material to the satisfaction of the Engineer.
d) When directed by the Engineer, the surface of the CSR shall be tested with a 12-foot straight edge provided by the contractor. No point shall vary by more than 0.04 foot from the testing edge when applied in any direction to the pavement surface. The completed surface of the CSR shall be within plus or minus .04 foot of the grade required to allow for placement of the specified thickness of asphalt concrete to the designated finished grade height.

252.4.7 Traffic Control Considerations

The CSR construction shall be scheduled so that at the completion of the day the work may be opened to local traffic. The surface of the CSR shall be protected by placement of the asphalt concrete surface course or by placement of the cure seal. If a cure seal is placed, it shall be placed a minimum of two hours in advance of opening the road to traffic. The asphalt surface shall be below 140 degrees before opening the road to traffic. When approved by Engineering, the road should be closed to through traffic, especially to through truck traffic, for 7 day cure period per Section 290.

SECTION 255 - LANDSCAPING

Within the public right-of-way, landscaping and irrigation shall be maintained by adjacent the property owner unless an agreement exists that requires maintenance by others. Street trees located within landscape strips are required by the *ZDO* as part of development. The number of street trees along a property frontage shall be maintained by the property owner unless otherwise approved by the County. Approved ground cover including shrubs, plants, or grasses should be installed at the time of development within landscape strips and landscaped medians.

If installed as part of development, landscaping and irrigation are subject to a Development Permit. Otherwise, landscaping installation compliant with Section 130.2 is not subject to a permit. Street trees that are removed are required to be replaced if required as part of land use approval.

The County presents guidelines for street tree installation and landscaping not subject to a Development Permit. It should be noted that regardless of compliance with County standards and guidelines for street tree planting, the adjacent property owner is responsible for the landscaping, and per ORS 368.910 and *County Code* Section 7.03, is responsible for the maintenance of adjacent sidewalk and curb and any damage that may be caused by landscaping or other activities.

255.1 Topsoil

The top 6" of topsoil in the planter strips shall be a well-draining soil blend suitable for growing.

255.2 Shrubs, Plants and Grasses

a) Shrubs, plants and grasses species should comply with the County's Shrub, Groundcover, Riparian Plant List.
b) Landscaping should be designed to minimize water consumption and utilize Oregon native plants.
c) In addition to street trees, landscape strips should be planted with a sufficient quantity and density of shrubs, plants and grasses to minimize weed growth.
d) Irrigation should be provided unless the applicant presents a planting plan that is likely to succeed as recommended by a Landscape Architect and/or Arborist.

255.3 Street Trees

These standards are intended to ensure that new trees planted within the right-of-way are of the highest quality, require low maintenance, and will not compromise public safety. Comply with the requirements of Standard Drawings L100 and L200.

255.3.1 Street Tree Selection

Street trees shall comply with the Clackamas County Street Tree List.

255.3.2 Street Tree Quality at Time of Planting

a) The trees shall have a straight trunk perpendicular to the ground with a minimum branching height of four feet above the ground for trees 1 ½" caliper to a minimum of six feet above the ground for trees with 2" caliper. No trees may be planted with a caliper less than 1 ½" except as noted below.
b) Plant material shall be grown to the current standards and specifications of the American Association of Nurserymen and American Standard for Nursery Stock. Plant material shall be of standard quality or better, true to name and type of their species or cultivar.
c) Trees shall be provided reasonably free, as defined by nursery industry standards for street trees, from insects, decay, major structural defects and damage to the trunk, branches, and root system.

255.3.3 Street Tree Condition at Time of Planting

a) If balled and burlapped in wire baskets:
    1) Trees shall have a sound root ball with a firm attachment of the trunk with the root ball. The trunk shall not be loose, but firmly held within the root ball.
    2) The size and condition of root balls shall conform to the current standards and specifications of American Association of Nurserymen and the American Standard for Nursery Stock.
    3) Root balls of trees shall not be allowed to dry out at any time from the nursery to the final planting.
    4) Trees shall have a well-developed root system and not be root bound or have circling/girdling roots.
b) If in a container:
    1) Trees shall be free of circling/girdling roots.
    2) The trees shall have been grown in the container for a maximum period of one year.
c) If bare root:
    1) Shall not exceed 1 ½" caliper, measured six feet above mean ground level.
    2) The roots shall not be allowed to dry out and shall be kept moist at all times from the nursery to final planting.
    3) The roots shall be well established and full of live and vigorous fibrous roots along with the larger structural roots.

255.3.4 Preparation of Tree Planting Holes

a) If balled and burlapped and in wire baskets:
   1) A shallow, broad tree planting hole at least 1 ½ times the diameter of the root ball shall be excavated to a depth that will position the trunk flare level with finish grade.
   2) The inner surfaces of the excavation shall be scored or roughened to the extent necessary to encourage rooting in the native soil.
b) If bare root:
   1) Tree planting holes shall be one inch wider than the spread of the roots.
   2) Holes shall have sufficient depth to position the trunk flare level with finish grade.
c) A mound of native soil shall be left in the center of the hole to support the roots. The roots shall be draped and spread in their natural position over the mound.

255.3.5 Seating of Trees

a) Trees shall be set plumb, upright, and faced for best appearance. Broken branches should be pruned after planting.
b) The hole shall be backfilled one-half with original soil and the hole flooded with water to remove any air pockets. After backfilling is complete, the entire planting area shall be thoroughly saturated with water to remove any remaining air pockets.
c) Mulch shall be applied to a depth of two to four inches around the tree. Mulch shall be kept free of an area within two inches of the trunk.
d) A continuous three inches high raised berm shall be constructed around the planting hole to direct water to the roots. The berm should be removed after one year.

255.3.6 Staking

If an anchor system is not provided per Standard Drawing L200, staking is required:
a) Hardwood stakes shall be driven firmly into the ground outside of the hole. Care shall be taken to avoid driving the stakes through the root structure.
b) Trees shall be attached to the stakes at a height of two feet using non-binding tree ties or tree ties that are at least one inch wide to prevent damage to the tree trunk. Ties shall be attached in a manner that will allow the tree to move but still be held firmly in place.

255.3.7 Establishment Period

If installed as part of development, the establishment period for an original tree or replacement tree shall be determined by Section 190.4.

255.3.8 Root Barrier

Any tree planted ten feet or closer to a structure, such as curb or sidewalk, shall have an engineered impenetrable root barrier installed near the structure. The root barrier shall run the length of the planting area or the structure and reach a depth of at least 18 inches.

255.4 Sight Distance

Proposed landscaping shall comply with the sight distance standards of Section 240. If in question due to marginally adequate vertical or horizontal curvature, landscaping designers shall be required to provide evidence that proposed landscaping will not grow to become sight hazards.

SECTION 260 - TRAFFIC SIGNALS, FLASHERS & COMMUNICATION

260.1 Traffic Signal Approval

A traffic signal may be approved if the criteria of this section are met.

260.1.1 Traffic Analysis

A traffic analysis is required prior to the approval of a traffic signal. Analysis requirements shall be based upon Section 295 and should include the following:

a) An analysis of other alternatives is required prior to the approval of a traffic signal. Possible alternatives to traffic signal installation include right and left turn lane additions, other lane additions, alternative routes via planned or existing roadways, roundabout installation as well as modifications to traffic control.
b) An analysis of capacity, queuing and safety both with and without the proposed traffic signal. Additional roadway improvements may be required based upon this analysis to ensure safety is maintained with the installation of a traffic signal, notably left turn lanes.
c) Unless the *Comprehensive Plan* specifically calls for a traffic signal, an analysis of alternatives shall establish that a roundabout is impractical or unreasonable before a traffic signal will be approved. The analysis shall include preliminary geometry, a comparative estimate of right-of-way impacts of a traffic signal versus a roundabout, benefit/cost ratio, and a capacity analysis.
d) Evidence that the criteria of Section 260.1.2 can be met.
e) In locations with other traffic signals nearby, the proposed traffic signal shall not unacceptably decrease the corridor bandwidth.
f) A consideration of bicycle and pedestrian safety and mobility.
g) An analysis of traffic signal phasing including:
    1) Phasing analysis for different peak periods.
    2) Evaluation of warrants for left turn protected, protected/permissive, and permissive/protected signal phasing, and protected right turn signal phasing based upon ODOT's *Traffic Signal Policy and Guidelines*.

260.1.2 Traffic Signal Warrants

a) New traffic signals at intersections on County roadways shall meet at least one, preferably several, of the traffic signal warrants of the current version of the *MUTCD* prior to the approval of a traffic signal.
b) Traffic signals meeting only peak hour volume warrants should only be approved if the intersection serves a special trip generator with unique peak traffic characteristics and evidence is provided that the traffic signal is a benefit to the public.

260.1.3 Traffic Signal Spacing

Traffic signals should be separated from existing or planned traffic signals a minimum of ¼ mile apart unless evidence supports adequate long term operations at a lesser spacing. If an existing comprehensive plan illustrates spacing closer than this spacing, additional long term analysis is not required.

260.2 Traffic Signal Design

a) Traffic signal design should be based upon the ODOT *Traffic Signal Design Manual*, *Oregon Standard Drawings* TM 400 and TM 600 Series, Clackamas County traffic signal drawings and details and the *MUTCD*.
b) Plans shall be consistent with the results of the traffic analysis performed under Section 260.1.1.
c) Signalized intersections should be accompanied by channelized left turn lanes on the major street, on minor street arterials and collectors, and designed per Section 250.8.8.

d) Signalized intersections may be accompanied by channelized right turn lanes on the major street and minor street arterials and collectors as warranted by Section 295.19.1 and designed per Section 250.8.8.
e) Signalized intersections with pedestrian access routes shall comply with ADA requirements as described in the most recent version of ODOT's *Traffic Signal Policy and Guidelines* including accessible pedestrian signals and push buttons complying with the *MUTCD*, and meeting the provisions of *PROWAG*.
f) All plans shall be prepared under the direction of and stamped by an Engineer with expertise in traffic engineering.

260.3 Traffic Signal Materials

Materials used in the construction of traffic signals shall be approved by Engineering and comply with the *Oregon Standard Specifications for Construction* and the Clackamas County traffic signal drawings and details.

260.4 Material Submittals

Prior to signal construction, the materials to be used on the project shall be submitted to Engineering for review and approval in the form of standard Oregon traffic signal blue sheets, green sheets, red sheets and applicable cut sheets.

260.5 Traffic Signal Funding and Agreements

If approved in conjunction with a development, the following shall apply:
a) The applicant shall be required to enter into necessary agreements to fulfill the obligations of this section.
b) The applicant shall provide funds for necessary signal timing synchronization with existing traffic signals systems.
c) If approved at the intersection of a private driveway with a public roadway, the applicant shall be required to provide funds equal to 20 years of the maintenance and power of the traffic signal.
d) The applicant shall provide the necessary right-of-way and/or easements for County maintenance of the traffic signal appurtenances constructed at a development's private driveway or along a development's frontage.
e) The applicant shall maintain on-site pavement markings and signage in such a way that is consistent with the approved design. Markings and signage shall be maintained in a way that is compliant with the *MUTCD*.

260.6 Underground Communication Conduit

As required by Engineering, developments within the UGB shall be required to install fiber optic ready conduit under any of the following conditions:
a) When the development is required to install landscape strip and/or sidewalk along a collector or arterial roadway, the length of the work exceeds 200 feet, and is along a planned fiber optic network.
b) When the development abuts existing fiber optic conduit and extending the fiber optic conduit would extend a planned fiber optic network.
c) When the conditions of Section 260.7 apply.

260.7 Fiber Optic Communication

As required by Engineering, the installation of new traffic signals shall be accompanied by the installation of fiber optic conduit and fiber optic cable, unless existing, between the proposed traffic signal and adjacent traffic signals.

260.8 Flashers in School Zones

New schools or existing schools with an expansion of 20% floor area or greater shall be required to install school zone flashers on roadways that are classified as arterial or collector roadways if the proposed or existing school speed zone signing supports a school speed 20 MPH zone and the County supports a school speed zone installation. In addition to school zone flashers, radar speed signs may be required along arterial roadways.

The applicant shall be required to provide funds equal to 20 years of the maintenance and power of the school zone flasher and/or radar speed sign.

SECTION 265 - TRAFFIC CALMING

a) The County has adopted a *Clackamas County Local Streets Traffic Calming and Skinny Streets Program*.
b) The use of traffic calming measures shall be considered in cases where a development will have a detrimental effect upon existing residential local streets. See Section 295 for additional information.
c) Traffic calming devices will only be considered if meeting the criteria of the *Clackamas County Local Streets Traffic Calming and Skinny Streets Program* or as recommended by Engineering to mitigate the impacts of a proposed development or project.

SECTION 270 - TRAFFIC SIGNING

270.1 Design and Construction Requirements

a) All proposed signing and pavement markings shall comply with the requirements of the *MUTCD*, Oregon MUTCD supplement, the ODOT *Sign Policy and Guidelines*, *Standard Highway Signs*, the ODOT *Qualified Products List*, *Oregon Standard Drawings*, *Oregon Standard Details*, the ODOT *Traffic Line Manual*, ODOT *Pavement Marking Design Guidelines*, and *Oregon Standard Specifications for Construction*.
b) All plans shall be prepared under the direction of and stamped by an Engineer with expertise in traffic engineering.

270.2 Street Name Signs

The design and construction of permanent street name signs shall conform to Standard Drawing T100.

270.3 End of Street

The end of streets shall be signed with:
a) Type OM4-2 object markers with a maximum spacing of six feet; or
b) Type III barricades per Standard Drawing T350.

270.4 End of Sidewalk

The end of sidewalks shall be signed with at least one OM4-2 object marker. For sidewalks wider than 8 feet, two OM4-2 object markers are required. Signs shall be mounted at approximate eye level (60").

270.5 Sign Mounting

The design and construction of permanent sign mounting shall conform to Standard Drawings T150 to T250.

SECTION 280 - PAVEMENT MARKINGS

280.1 Crosswalk Markings

a) Crosswalk markings shall be "continental" style (CW-SC per *Oregon Standard Drawings* TM 500 series) with two-foot wide bars and approximately three-foot wide gaps and be oriented in travel lanes to avoid vehicle wheel tracks.
b) Crosswalks markings shall extend ten feet longitudinally. Curb ramps, when required, shall always be located within the longitudinal borders of the marked crosswalk.
c) Marked crosswalks shall be used at all signalized intersections. Marked crosswalks should be provided across all legs of a signalized intersection unless an engineering study establishes that a crosswalk would create a safety issue or significant operational issue at the intersection.
d) Marked crosswalks may be used in other locations as required by Engineering.
e) Marked crosswalks shall not be provided if there is not a curb ramp provided at ends of the marked crosswalk where it is necessary for pedestrians to cross a curb.

280.2 Left Turn and Right Turn Lanes Markings

a) Turn arrows shall be elongated per *Oregon Standard Drawings* TM500 series.
b) A minimum of two turn arrows shall be provided within each turn lane at both signalized and unsignalized turn lanes.
c) At signalized intersections, the first set of arrows should be placed a minimum of 40 feet from the crosswalk.
d) Dual turn lanes shall include dotted lane extension lines (WD per *Oregon Standard Drawings* TM500 series) through the intersection.

280.3 Stop Bars

a) Stop bars, if required, shall be placed behind the location of pedestrian crossings.
b) Stop bars should be used at all intersections with arterial, collector and connector roadways.
c) Stop bars are not required if crosswalk markings are present except to address unique geometry or as directed by Engineering.

280.4 Transverse Marking Materials

Durable markings (Type B-HS) shall be used for all crosswalks, bike lane symbols, turn lane arrows, stop bars and other pavement legends unless installed for construction activities.

280.5 Longitudinal Markings

a) Durable markings should be used for all major and minor arterials within the urban area.
b) Durable markings should be used for all lane extension lines and transition areas.
c) Durable markings should be used on all approaches within the queuing and transition areas approaching a signalized intersection or other areas where traffic would be expected to transition or frequently traverse over markings.
d) High performance markings should be used for all other longitudinal markings.
e) Arterials and collectors should be marked with centerlines unless the requirements of the *MUTCD* don't call for centerlines.
f) Arterials and collectors should be marked with edge lines except where the overall road width is less than 20 feet.
g) Paint, as defined by the *Oregon Standard Specifications for Construction*, may not be used on non-maintained local access roads unless temporary or as part of maintenance activities.

280.6 Reflective Pavement Markers (RPMs)

Centerline recessed reflective pavement markers (RPMs) should be used on the following roadways:
a) Arterial roadways.
b) Collector roadways outside the UGB.
c) Roadways where reflective pavement centerline markers already exist.

280.7 Temporary Markings

a) Foil-back tape of similar width to the permanent line may be used for temporary marking for a period not to exceed one month. For periods exceeding one month, paint should be utilized.
b) Temporary reflective pavement markers (also known as "stick and stomps") may be used for a period not to exceed two weeks and should be checked frequently to ensure adequate delineation is present.

280.8 Marking Materials

The materials to be used on the project shall be submitted to Engineering for review and approval prior to marking layout.

280.9 Marking Layout

The applicant should contact the County at least two business days in advance of striping for inspection of an applicant or contractor supplied striping field layout.

SECTION 290 - TEMPORARY TRAFFIC CONTROL

290.1 General

a) Traffic control in the public right-of-way is subject to a permit.
b) All traffic control shall comply with the requirements of the *MUTCD*, Oregon MUTCD supplement, the ODOT *Sign Policy and Guidelines*, FHWA's *Standard Highway Signs*, *Oregon Standard Specifications for Construction, Oregon Temporary Traffic Control Handbook for Operations of Three Days or Less*, and *Oregon Traffic Control Plans Design Manual. Oregon Standard Drawings* TM800 series should be used with particular reference to TM844 for temporary pedestrian access routes.
c) Traffic control plans need not generally bear the stamp of an Engineer, except as required by Engineering. If required due to complexity, plans shall be prepared under the direction of and stamped by an Engineer with expertise in traffic engineering.

290.2 Control of Site

a) At no time shall flagging operations delay traffic for a period greater than twenty (20) minutes.
b) Work and activity zones (construction, restoration, erosion control) shall extend no more than 2500 lineal feet at any one time unless otherwise approved.
c) Open trenches shall extend no more than 250 lineal feet at any one time, unless otherwise approved.
d) No trenches are to be left unprotected between dusk and dawn.
e) Trenches shall conform to the technical requirements of Section 00405 of the *Oregon Standard Specifications for Construction*.
f) Trench plating shall be positively secured from movement and shall be ramped with anti-skid coated plate ramps.

290.3 Temporary Pedestrian Accessible Route

If existing pedestrian access will be obstructed by construction, alteration, maintenance or other temporary conditions, a continuous temporary pedestrian accessible route (TPAR) shall be provided consistent with the requirements of this section. Temporary pedestrian accessible routes shall conform to the requirements of Part 6 of the *MUTCD*, and the most recent update of the *Oregon Standard Specifications for Construction*, Section 00220.02(b). The temporary pedestrian accessible route plan shall be included in the traffic control plans.

County inspectors will inspect the TPAR. If deficiencies are identified the inspector will stop work until such deficiencies are corrected. TPAR requirements include:

a) In work zones pedestrian access shall not be blocked by parking of vehicles or equipment, materials storage or for any other reason except for construction.
b) The TPAR shall parallel the disrupted pedestrian access route, on the same side of the street where possible.
c) Bicyclists should not routed into the TPAR. If it is necessary to divert bicyclists around the work, provision should be made for a separate route for bicyclists.
d) If the work impacts the accessibility of pedestrian routes through or around the work zone, limit impacts to one corner of an intersection at a time.
e) Close sidewalk at a point where there is an alternate way to proceed and provide signing and other traffic control devices directing pedestrians to an alternate pedestrian route.
f) The TPAR shall be inspected by the applicant on a regular basis to ensure that it is safe and does not have gaps or surface displacements creating a hazard.
g) The TPAR shall meet the standards of a pedestrian access route as defined in *PROWAG*:
    1) Minimum width shall be 48 inches. Provide a 60 by-60 inch passing space every 200 feet along the route.
    2) Surface shall be smooth and nonslip.
    3) Vertical clearance shall be at least 8 feet.
    4) Cross slope shall be no more than 2.0% perpendicular to the direction of pedestrian travel.
    5) Grade shall be less than or equal to the grade of the adjacent road.
    6) Minimum turning space of 4 feet by 4 feet shall be provided wherever it is necessary for pedestrians to turn.
    7) If it is necessary to cross a curb, the TPAR shall include a temporary ramp meeting standards for a curb ramp.
    8) If it is necessary for the TPAR to cross a driveway or construction access truncated dome warning shall be provided. If it is not possible to provide truncated dome warning construction staff shall be provided at all times when construction vehicles are crossing the pedestrian access route.
    9) Night time lighting shall be provided.
g) Provide and maintain Pedestrian Channelizing Devices (PCD) through the period in which the permanent pedestrian access route is disrupted. Pedestrian channelizing devices are intended to prevent those with disabilities from straying into the vehicular way or an active construction area. Caution tape is not sufficient to guide those who are blind or low vision. Use only PCDs that are on the approved ODOT Qualified Products List, that are designed to be ADA compliant. Provide pedestrian channelizing devices:
    1) Between the TPAR and any adjacent construction site.
    2) Between the TPAR and the vehicular way, if the temporary pedestrian access route is diverted into the street.
    3) Between the TPAR and any protruding objects, drop-offs, or other hazards to pedestrians.
    4) At a curb ramp if the opposite curb ramp is temporarily and completely blocked, and no adjacent alternate circulation path is provided.
h) When work briefly or intermittently blocks or restricts the use of a pedestrian route, and a temporary detour route is not practicable due to the short duration of the restriction, provide a temporary means of allowing pedestrian access through or around the work area. Means of providing temporary pedestrian accessibility may include, but are not limited to temporarily suspending the work and making the pathway passable, or use of construction staff to guide pedestrians through or around the area. When a TPAR is created in the public right-of-way, both visual and audible warning shall be provided at both ends of the temporary pedestrian access.
i) When direction signage or warnings are provided they should be located to minimize backtracking. Audible warnings shall be provided for those who are blind or low vision and should include specific directions allowing them to find the desired path.

290.4 Impacts to Traffic Signals

a) In no case may flagging operations take place in conflict with the indications of an operating traffic signal.
b) No flagging operations may take place within 200 feet of an operating traffic signal without a custom traffic control plan subject to a permit.
c) Should traffic control requirements dictate the "turn-off" and/or "turn-on" of a traffic signal, the applicant shall coordinate with the County Traffic Signal Shop at least two business days prior to turn-off and/or turn-on.

290.5 Temporary Road Closures

Temporary road closures are not for the purpose of convenience or cost reduction for an applicant. Proposed closures shall establish that a clear public safety and convenience benefit would result from a closure.

a) The detour route shall be capable of safely and legally accommodating the detoured traffic.
b) With increasing ADT, functional classification and closure duration, the applicant's burden becomes greater in establishing the benefit of a proposed closure.
c) If a road closure is proposed, the following may be required:
    1) Evidence that other methods of traffic control and/or that temporary improvements are not feasible in order to keep the road open.
    2) Time of day restrictions or extension of normal working hours and days.
    3) Contract requirements of incentives/disincentives for completing/not completing closure on time.
    4) A public engagement plan.
    5) Off-site improvements to meet minimum safety of the detour route and/or to return the detour route to its original condition prior to the detour per Section 225.6.

SECTION 295 - TRANSPORTATION IMPACT STUDY (TIS) REQUIREMENTS

295.1 General

The objective of a transportation impact study (TIS) is to assess the impacts of a proposed project or land use action on the transportation system and identify mitigation for any capacity or safety deficiencies. These requirements are intended to provide standards for generation of a TIS for land development applications that are consistent with land use regulations and guidelines for traffic analysis that is prepared for County capital projects.

295.2 Requirement for a Traffic Impact Study

a) A TIS shall be required based upon an assessment of Engineering regarding the anticipated relative impact of a proposed development on the existing or planned transportation system.
b) A TIS to address traffic capacity is not required where the proposed development will generate less than twenty vehicles trips in any peak hour unless to address specific safety issues identified by the County. The need for a TIS is at the discretion of the Road Official.

295.3 Traffic Study Scope and Coordination

a) Engineering and the applicant should coordinate to develop a written TIS scope that will guide the work of the TIS and define the study requirements based upon the anticipated influence area of the proposed development.
b) The influence area of a proposed development establishes the requirements of analysis for the TIS and is defined on a case by case basis, but is typically based upon the trip generation of the proposed development in relation to the proximity of congested roadways and intersections or the proposed development's potential impact on safety issues.

295.4 Traffic Engineering Expertise

All traffic impact studies shall be conducted under the direction of and stamped by an Engineer with expertise in traffic engineering.

295.5 Coordination with Other Agencies

As applicable, the applicant is expected to coordinate with ODOT and affected local jurisdictions in the scoping, development, and review of a TIS regarding intersections or roadways that are not under the County's jurisdiction. In some cases, the County has adopted adjacent agency standards as part of the *ZDO*.

295.6 Zone Changes and Comprehensive Plan Amendments

Zone changes and *Comprehensive Plan* amendments require analysis compliant with OAR 660-012-0060, the Transportation Planning Rule.

295.7 Clackamas Regional Center (CRC) Area Analysis Period

a) The *ZDO* and *Comprehensive Plan* Chapter 10 require special analysis periods within the Clackamas Regional Center Area.
b) Within the CRC area, a weekday PM peak two hour analysis is required. The first hour of analysis shall be based upon the peak hour of the subject intersections. If the mobility standard is met for the first hour, no further analysis is required. If the mobility standard is not met in the first hour, a second hour of analysis is required. The second hour of analysis shall be based upon the "shoulder" ½ hours before and after the peak hour, which may require additional traffic counts.
c) Within the CRC area, a weekday midday hour analysis is required.

295.8 Analysis Methodology

a) All analyses shall be conducted in compliance with the most recent versions of the following:
    1) *Highway Capacity Manual* (*HCM*) with the exception of signalized intersections, which shall be based upon the HCM 2000
    2) ITE *Trip Generation Manual*
    3) ITE *Trip Generation Handbook*
    4) MUTCD
    5) AASHTO - *A Policy on the Geometric Design of Highways and Streets*
    6) AASHTO - *Guidelines for Geometric Design of Very Low-Volume Local Roads*
    7) AASHTO - *Highway Safety Manual*
b) It is recognized that in many instances, the HCM's methodology is limited especially in highly congested conditions. In instances where the HCM is incapable of providing accurate analysis, the County and applicant shall coordinate on an appropriate analysis method.
c) The following establish the County's LOS and v/c determination method and other analysis parameters required to evaluate the requirements of the *Comprehensive Plan* and *ZDO*.

295.8.1 Two-Way Stop Controlled (TWSC) Intersections

At two-way stop controlled intersections, including driveways, the weighted average methodology of the critical approach of the *HCM* shall determine the LOS and v/c of the intersection.

295.8.2 All-Way Stop Controlled (AWSC) Intersections

At all-way stop controlled intersections, the intersection average methodology of the *HCM* shall determine the LOS and v/c of the intersection.

295.8.3 Signalized Intersections

At signalized intersections, the intersection average methodology of the *HCM* shall determine the LOS and v/c of the intersection.

295.8.4 Roundabout Intersections

At roundabouts, the critical approach shall determine the LOS and v/c of the intersection.

295.9 Signalized Intersection Analysis Parameters

a) The TIS shall analyze traffic signals in the following manner with regard to traffic signal timing:
   1) The existing, background and total traffic analysis shall be consistent with the existing signal timing.
   2) Analysis of isolated intersections shall optimize the existing splits within the maximum cycle length.
   3) Signals that operate in a coordinated timing plan shall be analyzed without adjustments.
   4) If modifications to the signal timing are proposed or shown in the analysis, the total traffic analysis shall contain two scenarios: total traffic with existing signal timing and total traffic with proposed signal timing. However, signal timing modifications are typically not acceptable as mitigation to a project's impacts.
b) Additional analysis requirements may apply in the case of coordinated signal systems as changes at one intersection may affect other intersections not included in the study area of the project.
c) The Engineer shall request County, ODOT and local jurisdiction signal timing for use in their analysis. The Engineer is responsible for ensuring that the appropriate signal timing is used in the analysis.
d) If signal timing changes are recommended by the applicant and approved by Engineering as acceptable mitigation to a project's impacts, funds will be required to design and implement new signal timing plans suggested as mitigation by the applicant.
e) Where adaptive signal timing exists, the applicant and County will work together to determine the appropriate signal timing parameters.

295.10 Peak Hour Factor ("PHF")

a) The peak 15 minutes of the peak hour shall be the basis for determining intersection operations except as noted in the *ZDO* and *Comprehensive Plan*, which allows a one hour peak period in some situations. In those instances, the peak hour factor shall be set to 1.0 and the entire peak hour traffic volume shall be evaluated.
b) The PHF shall be derived from the existing raw manual turning movement counts and be applied uniformly over each scenario except as provided below in 3).
c) In the case of zone change or comprehensive plan amendment analysis, the peak hour factors presented in ODOT's Development Review Guidelines or existing PHF shall be used in analysis.

295.11 Microsimulation Models

a) Congested conditions will require the use of microsimulation models.
b) The use of microsimulation shall require compliance with the ODOT *Analysis Procedures Manual* (*APM*)

295.12 Growth Rates and In Process Traffic

a) For short term analysis of five years or less, linear growth rates shall not be less than 2% per year unless verifiable evidence is submitted or known which indicates that the local growth rate is less than 2% per year.

b) For long term analysis of six years or more, linear growth rates should not be used if regional travel demand volumes are available. In that case, the analysis should rely upon regional travel demand volumes and post process those volumes per the *APM*. If no regional travel demand volumes are available, the historical trends methodology of the *APM* or other approved methodology may be acceptable.
c) In process traffic, or developments that have been approved and have current land use approval yet are not occupied or fully built-out, shall be included in addition to growth projections. That information may be omitted for zone changes and comprehensive plan amendments.

295.13 Turning Movement Counts

Turning movement counts shall be conducted as follows:

295.13.1 Count Hours

The count hours stated in Table 2-19 shall be collected in analysis unless the TIS scope specifies otherwise.

Table 2-19. Traffic Count Hours by Area

Outside UGB	
Weekday AM Peak Hour	6:30 AM to 8:30 AM
Weekday PM Peak Hour	4 PM to 6 PM
Inside UGB	
Weekday Midday Peak Hour	11 AM to 1 PM
Weekday PM Peak Hour	3:30 PM to 6:30 PM

295.13.2 Day of Week

Turning movement counts shall be conducted on Tuesdays, Wednesdays and Thursdays unless otherwise directed.

295.13.3 Holidays

Turning movement counts shall not be conducted within one week of a federal holiday.

295.13.4 Current Counts

Traffic counts should be based upon counts collected within 24 months of the completed land use application. Counts older than 24 months may not be accepted or may require adjustment to current traffic conditions with Engineering approval.

295.13.5 Vehicle Classification, Bicycles and Pedestrian Data

Turning movement counts shall separately include vehicular (truck vs. non-truck), bicycle and pedestrian traffic volumes.

295.14 Trip Generation

a) Trip generation shall be based upon the latest edition of ITE's *Trip Generation Manual* and *Trip Generation Handbook*.
b) The traffic impact study shall include an estimate of site generated trips, pass-by trips, diverted linked trips, and internal capture trips during each study period.
c) If a trip generation rate similar to the proposed use is not available within *Trip Generation Manual*, then the procedures of the *Trip Generation Handbook* regarding obtaining local trip rates should be used unless

otherwise approved by Engineering. Engineering may require evidence that the use's trip generation is similar to the use described in the *Trip Generation Manual*.

d) Trip generation shall be based upon an average weekday unless otherwise specified by Engineering.

295.15 Trip Distribution

Trip distribution shall be approved by Engineering.

295.16 Queuing Analysis

a) All development may be required to provide a queuing analysis that evaluates the impact of queues onto public roadways. Developments that are anticipated to back traffic onto public roadways are considered to be a safety issue.
b) Development that proposes a drive-thru service shall provide a queuing analysis that evaluates the impact of drive-thru queues onto public roadways.
c) As required by Engineering, the TIS shall provide 95th percentile queue estimates for each movement at each study intersection. The TIS shall identify the existing available queue storage, anticipated 95th percentile queue and indicate if that storage is or will be exceeded.
d) In cases where the anticipated 95th percentile queue exceeds the available storage and the queuing is considered to be a safety issue, the development will be required to mitigate a queue back to the background traffic condition.
e) Microsimulation utilized to substantiate queuing shall comply with Section 295.11.

295.17 Traffic Safety

If required, the TIS shall analyze the safety of the transportation network by addressing the following. If any of these conditions cannot be met and mitigation does not sufficiently address the deficiencies, Engineering may recommend that a proposed development does not meet safety standards:

a) Sight distance is adequate subject to the standards of Section 240.
b) Crash history is adequate per Section 295.17.1.
c) Queuing is adequate per Section 295.16.
d) Access requirements are adequate per Section 220.
e) A turn lane, if warranted and recommended by Engineering per Section 295.18.1, is provided.
f) Truck circulation is adequate per Section 295.17.2.
g) Off-site access is adequate per Sections 225.4 and 225.5.

295.17.1 Crash History

a) Crash history shall be analyzed for all study intersections and sections of roadway to which access is proposed. Crash rates, frequency and severity shall be evaluated.
b) The applicant shall evaluate the existing crash history to determine crash patterns, severity and frequency and make recommendations for safety improvements.
c) Intersection crash rates in excess of typical crash rates require further safety analysis based upon the *Highway Safety Manual* the *APM* to determine the development's impact on safety and may require proportional mitigation.
d) As required, segment crash rates in excess of typical crash rates require further safety analysis based upon the *Highway Safety Manual* and the *APM* to determine the development's impact on safety and may require proportional mitigation.

295.17.2 Truck Circulation

a) For developments that will generate greater than 50 daily vehicles of a size greater than or equal to WB-50, an analysis of truck turning movements at the intersection of the following will be required:
    1) The nearest collector or arterial roadway (whichever is closer) if within the UGB.

2) With the nearest arterial roadway if outside the UGB.

b) Mitigation will be required if a safety issue would result.

295.18 Mitigation

a) The traffic study shall include suggested mitigation to comply with *ZDO* and *Comprehensive Plan* mobility requirements, to provide a minimum level of safety to support the proposed development and to address other requirements of these *Standards* as required.
b) Proposed mitigation may require a safety analysis based upon the *Highway Safety Manual* and *APM*.
c) Mitigation that shall be considered in the analysis is described below, as applicable:

295.18.1 Turn Lane Warrants

a) The applicant shall analyze the need for right and left turn lane warrants as required by Engineering.
b) The County utilizes the current ODOT left turn and right turn siting criteria of the *Highway Design Manual* when establishing the possible need for left and right turn lanes.
c) The affirmation of a warrant being met for a turn lane does not dictate its installation. County staff will make a determination regarding the need for turn lanes.
d) Signalized intersections shall be accompanied by channelized left turn lanes on the major street and minor street and designed per Section 250.8.8 except as approved per Section 170.
e) Signalized intersections may require channelized right turn lanes as warranted above and designed per Section 250.8.8.

295.18.2 Traffic Signal Approval

A traffic signal proposed to address safety or capacity issues shall meet the requirements of Section 260 including evidence to indicate that other alternatives have been considered.

295.18.3 Analysis of Impacts on Local, Residential Streets

a) Some developments may have a detrimental effect upon existing residential uses. As applicable, the TIS shall evaluate impacts such as traffic volume increases, potential speed increases, safety impacts and other livability issues on local, residential streets.
b) Based upon the relative impact of the development upon local, residential streets, improvements to mitigate a development's impact may be required.
c) Elements to be considered as potential mitigation include the traffic calming measures of Section 265.

295.18.4 Other Mitigation

Other mitigation, such as the installation of stop signs, warning signs, signal timing modifications, additional lanes, roundabouts, traffic circles, pedestrian and bicycle improvements and other potential improvements, will be evaluated on a case by case basis. Suggested mitigation shall be accompanied by appropriate engineering analysis to allow for the review of such proposals including a review of the mobility and safety impacts of the proposed mitigation.

295.19 Traffic Study Components

The following elements typically make up a TIS.

295.19.1 Executive Summary

An executive summary that discusses the proposal and the results of the study and any necessary traffic related mitigation to meet the requirements of the land use application.

295.19.2 Project and Study Area Description

A description of the existing and proposed land uses, site characteristics, surrounding land uses, roadway system characteristics, transit service, pedestrian and bicycle facilities, and any pending transportation system improvements as identified in the *Clackamas County Capital Improvement Program*, *Comprehensive Plan*, and ODOT or local jurisdiction plans.

295.19.3 Analysis Periods and Scope

a) Analysis of intersection capacity and/or roadway segment capacity, as required by the Scope, meeting the requirements of these *Standards*, *ZDO* and *Comprehensive Plan*.
b) The analysis shall include the following study scenarios at a minimum or as directed by staff:
    1) Existing Traffic (Analysis based upon "current" traffic counts)
    2) Background Traffic at a reasonable full build-out year (Existing Traffic + Growth + In Process Traffic)
    3) Total Traffic at a reasonable full build-out year (Background Traffic + Site Generated Traffic)

295.20 Submittal Requirements

a) Completed traffic studies and revisions shall be submitted as a pdf document.
b) All electronic files used in support of a traffic analysis shall be submitted upon request.

CHAPTER 3 - ON SITE DESIGN OF COMMERCIAL, INDUSTRIAL AND MULTIFAMILY DEVELOPMENTS

SECTION 310 - GENERAL

Chapter 3 establishes the technical requirements associated with on site design of commercial, industrial and multifamily developments

Site improvements for commercial, industrial, and multifamily developments are reviewed through the land use approval process, described and administered pursuant to the *ZDO*.

This chapter supplements the requirements of the *ZDO*, which contain greater detail in relation to onsite design of commercial, industrial and multifamily developments.

SECTION 320 – PARKING AREAS

320.1 Maximum Slopes and Grades

a) The plan review, permit and inspections for ADA improvements will be covered under a Development Permit when they are not related to a building permit under review.
b) The ADA facilities should be designed with a 0.5% tolerance from maximum slopes and grades.
c) General parking areas and adjacent drive aisle slopes should not exceed +/-5%.
d) Drive aisles not adjacent to parking spaces should not exceed a longitudinal slope of 10%. Cross slopes shall not exceed 5%.

320.2 Pedestrian Walkways

a) Walkway connections to the public sidewalk shall meet ADA landing area requirements per *PROWAG* and be reviewed and permitted by Engineering.
b) Onsite accessible routes, when permitted through a Development Permit, shall meet the requirements of the latest version of the Oregon Structural Specialty Code (OSSC) Chapter 11 and the International Code Council (ICC) A117.1.

320.3 Vehicular Circulation and Maneuvering

All vehicle maneuvering shall be provided on site and should limit backing maneuvers in locations where pedestrians are expected.

a) For dimensions of parking spaces and drive aisles refer to Standard Drawings P100 and P200.
b) To be considered a parking space, adequate maneuvering area shall be provided for each vehicle to enter and exit said parking space.
c) All garbage and recycling facilities shall have adequate access, with onsite maneuvering and circulation for the service provider's vehicle.
d) All movements for non-passenger design vehicles should be shown on an exhibit, showing paths traced by the extremities of the vehicles, including off-tracking. Adequate turning radii shall be provided for all loading spaces and the largest anticipated vehicles maneuvering on site and at driveway approaches. At a minimum, the circulation of a fire truck and garbage truck shall be illustrated.

320.4 Parking and Maneuvering Area Surface & Structural Section

a) The parking and maneuvering surface (gravel or paving) shall comply with *ZDO* Section 1015 or with Standard Drawing R100 if not related to development.
b) The structural section of parking and drive aisle areas shall meet or exceed Standard Drawing R100.

320.5 Parking Stalls

a) All automobile off-street parking quantity and dimensions shall meet the *ZDO* and Roadway Standard Drawing P100 or P200
b) Dimensions for on-street parking spaces shall meet or exceed the requirements of Roadway Standard Drawing P100 or P200. The on-street parking shall utilize the street for the drive aisle. The parking spaces shall not diminish or obstruct the required travel lanes or bike lanes.
c) All compact, carpool, disabled, and loading berth spaces shall be labeled on the plans.
d) Accessible parking spaces shall meet the requirements of the *Oregon Transportation Commission's Standards for Accessible Parking Places*, latest edition.

320.6 Curbs and Wheel Stops

a) If parking lot curbs carry, direct or channel surface water, the curb should be structural curb.
b) Alternative curbs will be considered when it is determined by Engineering that structural curb is not the most appropriate.
c) Extruded curbs shall not be used for carrying, directing or channeling surface water, or as a vehicle wheel stop.

320.7 Signage and Pavement Markings

a) All traffic control devices on private property shall be installed and maintained by the property owner. Traffic control devices that are located where private driveways intersect a road right-of-way shall be kept in good condition.
b) The applicant shall provide a signing and pavement marking plan to Engineering for onsite parking and circulation. This plan shall be reviewed and approved by Engineering and the local fire service provider prior to the applicant being issued a Development Permit.
c) All compact, carpool, disabled parking spaces shall be clearly marked on the site.

320.8 Reciprocal Access Easements

Comply with Section 220.

SECTION 330 - COMMERCIAL, INDUSTRIAL AND MULTIFAMILY DRIVEWAYS

a) All driveways shall meet ADA accessibility requirements if the driveway intersects with a planned or existing sidewalk or other pedestrian facility.
b) Driveways should be designed with a minimum 28-foot wide approach except where the *Comprehensive Plan* requires narrower driveways.
c) If the design vehicle for the site requires it per Section 250.1.3 or if traffic operations necessitate additional travel lanes, driveways wider than 28 feet may be required to reduce the pedestrian crossing length or implement additional measures to reduce conflicts with pedestrians.
d) Driveways on streets with curb tight sidewalk should be constructed per Standard Drawing D600.
e) Driveways on streets with curb and sidewalk with a landscape strip should be constructed per Standard Drawing D650.
f) In rare cases where a development's trip generation is such that higher speed egress maneuvers from the adjacent roadway are desired or is used for a large number of truck deliveries, the County may allow or require driveways to be constructed per Standard Drawing D675.
g) Driveways constructed without curbs should be constructed per Standard Drawing D500.
h) Driveway throats (measured from the back of the public sidewalk in the UGB and from the edge of pavement outside the UGB to the nearest perpendicular drive aisle) shall have a minimum length of 20 feet but should be designed to accommodate the 95th percentile queue. Driveway throat depths may be required to be based upon a traffic study per Section 295.
i) Driveways accessed by trucks with trailers, should require a minimum throat length of 50 feet.

j) Parking, intersecting drive aisles and designated pedestrian crossings are prohibited within the minimum throat depth.
k) If a gate is proposed on a driveway serving the public, the gate shall be placed a minimum of 20 feet from back of sidewalk or edge of pavement, whichever is greater. If queues are likely to extend into the travel lane of the nearest roadway, then a queuing analysis shall be provided per Section 295. Gates may require the approval of the fire district.
l) Gates are required to have a minimum of a 20' wide unobstructed opening. The opening width will be required to increase when the length of the anticipated vehicle increases unless the gate is set back far enough for the vehicle to be perpendicular to the gate.

SECTION 340 - REFUSE AND RECYCLING ENCLOSURE STANDARDS FOR COMMERCIAL, INDUSTRIAL AND MULTIFAMILY DEVELOPMENTS

Grades may not exceed +/- 3% in the service area.

CHAPTER 4 - STORM WATER MANAGEMENT

SECTION 410 - GENERAL

Chapter 4 establishes the technical requirements associated with storm water management.

410.1 Regulatory Authority

The Engineering Division of DTD is responsible for ensuring the adequate drainage of public roadways and developed properties in unincorporated areas outside of established stormwater districts within the County. Engineering regulates the construction of public and private roads and other site improvements to ensure adequate drainage of storm/surface water to an appropriate discharge point.

Clackamas County has multiple surface water districts: Water Environment Services (WES) encompasses the Clackamas County Service District #1 (CCSD#1) and the Surface Water Management Agency of Clackamas County (SWMACC) and Hoodland Service District. The other districts are Clean Water Services (CWS) and the Oak Lodge Sanitary District (OLSD).

Engineering manages storm water drainage and surface water regulations for all development outside of the County's established storm water districts or outside city limits located within the County's boundary. For the regulations in these other areas, please refer to the respective jurisdiction.

410.2 Engineering Regulations

Engineering has adopted WES stormwater standards, with the exceptions noted within this chapter.

410.3 Erosion Control Contractor Certification Not Required

WES Erosion Control Certification shall not apply to Engineering regulations.

410.4 Fees

Fees listed in the WES rules and regulations, or their Stormwater *Standards*, only apply to areas within their surface water management districts. For information on Engineering stormwater and erosion control fees outside of existing surface water management districts, see *County Code*, Appendix A: Fees. For surface water management fees, within another district or municipality, contact the district or municipality directly.

SECTION 420 - EXCEPTIONS TO WES STANDARDS

The following standards are exceptions to WES stormwater standards. These standards are directed towards the design and construction of public storm drainage facilities and for the coordination of stormwater runoff from private drainage systems into public systems. The intent is to ensure a comprehensive engineering review and sufficient design to identify and mitigate existing deficiencies, protect the environmental health of our watersheds, as well as to identify the capacity requirement of new system improvements resulting in an overall benefit of reduced flooding.

If any conflicts arise between these standards and WES standards, the following shall govern.

420.1 Best Management Practices (BMP) & Low Impact Development Approaches (LIDA)

Engineering acknowledges the need for Best Management Practices (BMP) or Low Impact Development Approaches (LIDA) with development. In addition to any LIDA standards adopted by WES, Engineering encourages designers to submit LIDA designs for review to meet the water quality and infiltration requirements outlined in WES stormwater standards. Calculations will be required to illustrate to Engineering how a given LIDA provides water quality benefit. Private improvements in rural areas may work

with DTD to provide a simplified approach to stormwater management that utilizes vegetation and infiltration if the site conditions warrant it. City of Portland's Simplified Approach for infiltration testing and typical details for stormwater management may be used in the rural area.

420.2 Acreage as a BMP

Development outside WES service districts is predominated by larger lot sizes. A reasonable BMP outside the UGB may be the utilization of undeveloped acreage. The applicant shall demonstrate to Engineering that water quality, detention, and/or infiltration requirements are met using the acreage BMP.

420.3 Surface Water Management Applicability

Surface water management plans in conformance with this chapter will be required for any of following:

a) When 5,000 square feet or more of new or reconstructed impervious surface is proposed within the UGB.
b) When 10,000 square feet or more of new or reconstructed impervious surface is proposed outside the UGB.
c) When grading or any new or reconstructed impervious surface is proposed or replaced within 50 feet of a perennial stream, creek, wetland, or lake, or within 10 feet of a property line.

420.4 Underground Injection Control (UIC) Devices

UICs are only permitted in Clackamas County right-of-way when registered with DEQ and maintained by an established stormwater district, unless otherwise approved by DTD Transportation Maintenance. When UIC are proposed in County right-of-way, an approved IGA and maintenance agreement with an established stormwater district shall be in place prior to Development Permit issuance.

SECTION 430 - HYDROLOGY

430.1 Acceptable Hydrology Methods (Detention Hydraulics)

Engineering accepts the Rational Method, and TR-55, in addition to WES approved methodology. Other methods will require prior approval from Engineering.

Detention pond routing shall be by the Storage Indication (Modified Pulse) method:

$\{2S_2/\Delta t + O_2 = I_2 + I_1 + 2S_1/\Delta t + O_1\}$ or approved equal.

430.2 Rational Method

The Rational Method (Q=ciA) may be used to estimate peak discharge from drainage basins of less than 300 acres.

The Soil Conservation Service ("SCS") TR55 method may be used for drainage areas less than 25 square miles.

Refer to the ODOT *Hydraulics Manual* for additional information. Some of the figures contained herein have been reproduced from the above manual.

430.2.1 Rational Method Basic Methodology

The Rational Method is a simplified model for estimating the discharge of a drainage basin based on the area of the basin, type of ground cover, and intensity of rainfall.

$Q = ciA$

Q = peak discharge (cfs)
c = runoff coefficient
i = rainfall intensity (in/hr)
A = drainage area (acres)

The Rational Method can result in a wide range of discharge values based on assumptions made by the Engineer. The following sections establish parameters for the variables in the Rational Method and should be used in the design of drainage systems within Clackamas County.

430.2.2 Runoff Coefficient

The runoff coefficient (C) is a dimensionless parameter based on the type of ground cover and slope of the terrain. Table 4-1 lists runoff coefficients for various conditions of ground cover and slope.

Where ground conditions vary throughout a drainage basin, a composite runoff coefficient can be calculated as follows:

$$C_{avg} = \frac{(C_1A_1 + C_2A_2 + C_3A_3 + \ldots C_nA_n)}{(A_1 + A_2 + A_3 + \ldots A_n)}$$

Table 4-1 Runoff Coefficients (C) for Storm Drainage

Ground Cover	Terrain		
	Flat	Rolling 2-10%	Hilly Over 10%
Pavement and Roofs	0.9	0.9	0.9
Earth Shoulders	0.5	0.5	0.5
Drives and Walks	0.75	0.8	0.85
Gravel Pavement	0.5	0.55	0.6
City Business Areas	0.8	0.85	0.85
Apartment Dwelling Areas	0.5	0.6	0.7
Suburban, Normal Residential	0.45	0.5	0.55
Dense Residential Sections	0.6	0.65	0.7
Lawns, Sandy Soil	0.1	0.15	0.2
Lawns, Heavy Soil	0.17	0.22	0.35
Grass Shoulders	0.25	0.25	0.25
Side Slopes, Earth	0.6	0.6	0.6
Side Slopes, Turf	0.3	0.3	0.3
Median Areas, Turf	0.25	0.3	0.3
Cultivated Land, Clay and Loam	0.5	0.55	0.6
Cultivated Land, Sand and Gravel	0.25	0.3	0.35
Industrial Areas, Light	0.5	0.7	0.8
Industrial Areas, Heavy	0.6	0.8	0.9
Parks and Cemeteries	0.1	0.15	0.25
Playgrounds	0.2	0.25	0.3
Woodland and Forests	0.1	0.15	0.2
Meadows and Pasture Land	0.25	0.3	0.35
Unimproved Areas	0.1	0.2	0.3

430.2.3 Rainfall Intensity

The rainfall intensity indicates the "quantity" of rainfall and is related to the rainfall duration and the design storm. Rainfall intensity is usually represented by an Intensity-Duration-Frequency (I-D-F) curve. The IDF curves for drainage design in Clackamas County are taken from the *Hydraulics Manual* (see Figures 4-1 to 4-5).

430.2.4 Time of Concentration

a) The duration of rainfall is equal to the time of concentration (T_c), in minutes, where the time of concentration is defined as "that amount of time from beginning of a storm event, that it takes water from the most remote time location in the basin to reach the point being considered."

b) Determination of the time of concentration, T_c, shall be in accordance with the *Hydraulics Manual* as follows: Most drainage basins will consist of overland flow segments as well as channel flow segments. Overland flow can be further divided into a sheet flow component and a shallow concentrated flow component. Urban drainage basins may be further complicated by having significant pipe flow segments. The travel time is computed for each flow segment and the time of concentration is equal to the sum of the segment travel times.

c) The best method of determining overland sheet flow time is the kinematic wave equation. The equation is only applicable for travel distances less than 300 feet.

$$T_c = KL^{0.6}n^{0.6} / I^{0.4}S^{0.3}$$

Where: T_c = overland flow time in minutes
L = overland flow length in feet
n = Manning's roughness coefficient (see Table 4-2)
I = rainfall intensity, in/hr
S = the average slope of the overland area
K = 0.93

d) Figure 4-6 is a nomograph for the solution of the kinematic wave equation for overland sheet flow. In using the nomograph, the time of concentration and rainfall intensity are unknown. The solution is one of iteration or trial and error.

Table 4-2 Mannings Surface Roughness Coefficients (n) for Overland Sheet Flow

Surface Type	n Value
Pavement and Roofs	0.014
City Business Areas	0.014
Graveled Surfaces	0.02
Apartment Dwelling Areas	0.05
Industrial Areas	0.05
Urban Residential Areas (> than 6 units/acre)	0.08
Meadows, Pastures and Range Land	0.15
Rural Residential Areas (< than 6 units/acre)	0.24
Playgrounds, Light Turf	0.24
Parks and Cemeteries, Heavy Turf	0.4
Woodland and Forests	0.4

e) After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from Figure 4-7 in which average velocity is a function of watercourse slope and type of channel. This figure was reprinted from the 1972 SCS Handbook.

f) For open channels, Manning's equation can be used to estimate average flow velocity, which is usually determined for bank-full flow.

430.2.5 Design Storm

a) A design storm defines the statistical recurrence interval of a storm event. The probability of a 25-year storm occurring in a given year is 4%. Conversely, a 25-year storm will statistically occur once every 25 years. The selection of a design storm is dependent on the balance between the cost of the drainage facility and the flood risks associated with the storm event. The design storm required for public drainage facilities within the County, but outside an existing stormwater district, shall be based on a 25-year storm event. Design storms within existing surface water management districts, shall be based on the districts requirements, but in no case shall public drainage facilities within the County's right-of-way be designed for less than the 25-year storm at basin buildout with 85% impervious.
b) The effects of the 100 year storm event on storm drainage structures and bridges shall be evaluated as required.
c) The effects of the 100 year storm event on developments within a flood plain shall be evaluated as required.
d) The effect of the 100 year storm shall be evaluated when the path of the drainage could place persons or property in jeopardy.

430.2.6 Drainage Area

The discharge of a storm system is dependent on the size of the basin contributing to the flow. The design of a drainage facility should account for the entire drainage basin surrounding the affected area. The Engineer shall submit a topographic map of the entire drainage basin with the drainage calculations. This map should identify the existing and proposed drainage facilities and sub-basins considered in the design. This overall design shall anticipate and accommodate the acceptance and conveyance of surface water on or crossing the roadway or roadway system considered in the design area.

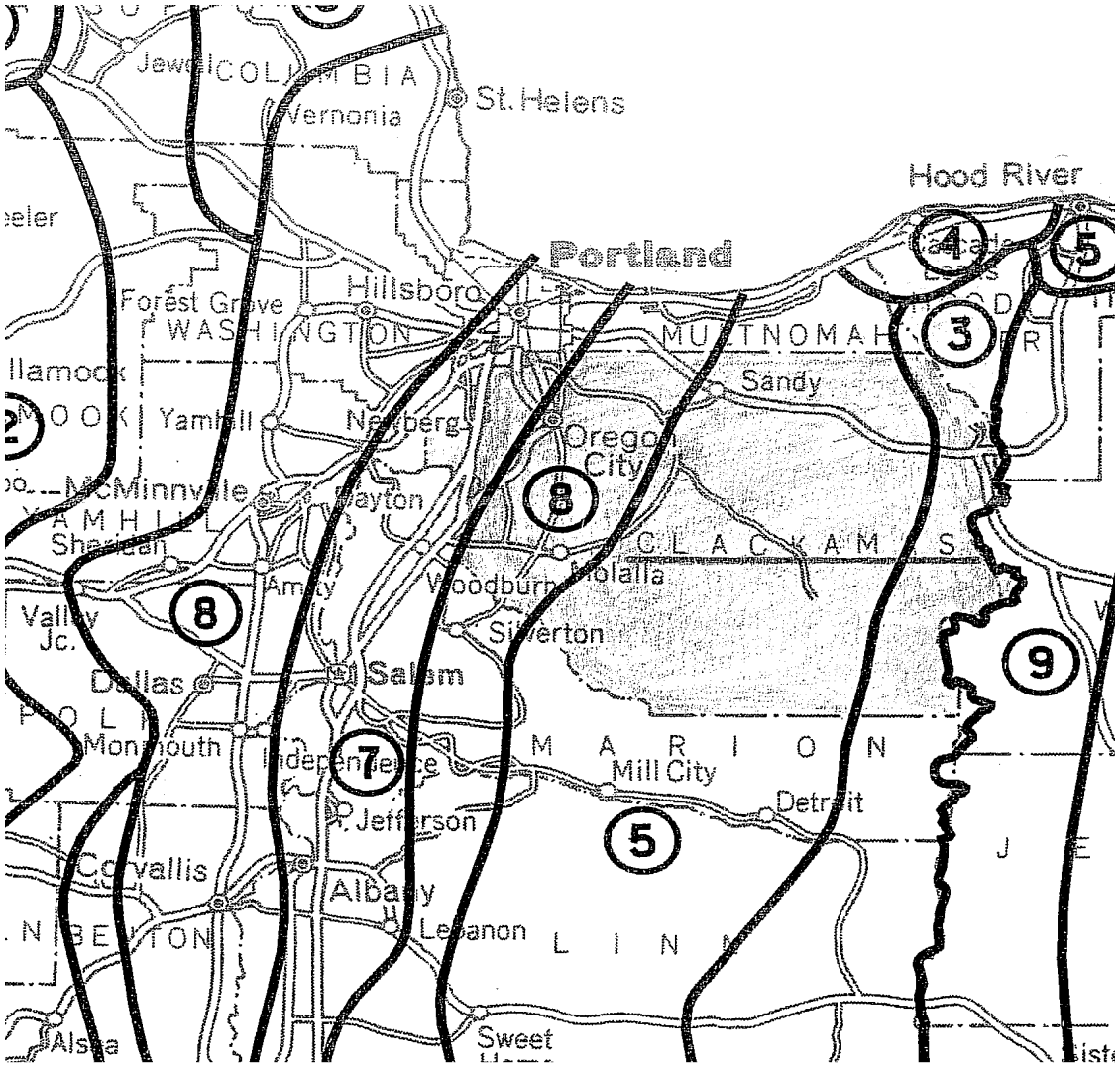

Figure 4-1. Clackamas County Rainfall Zones
Reference: ODOT Hydraulics Manual

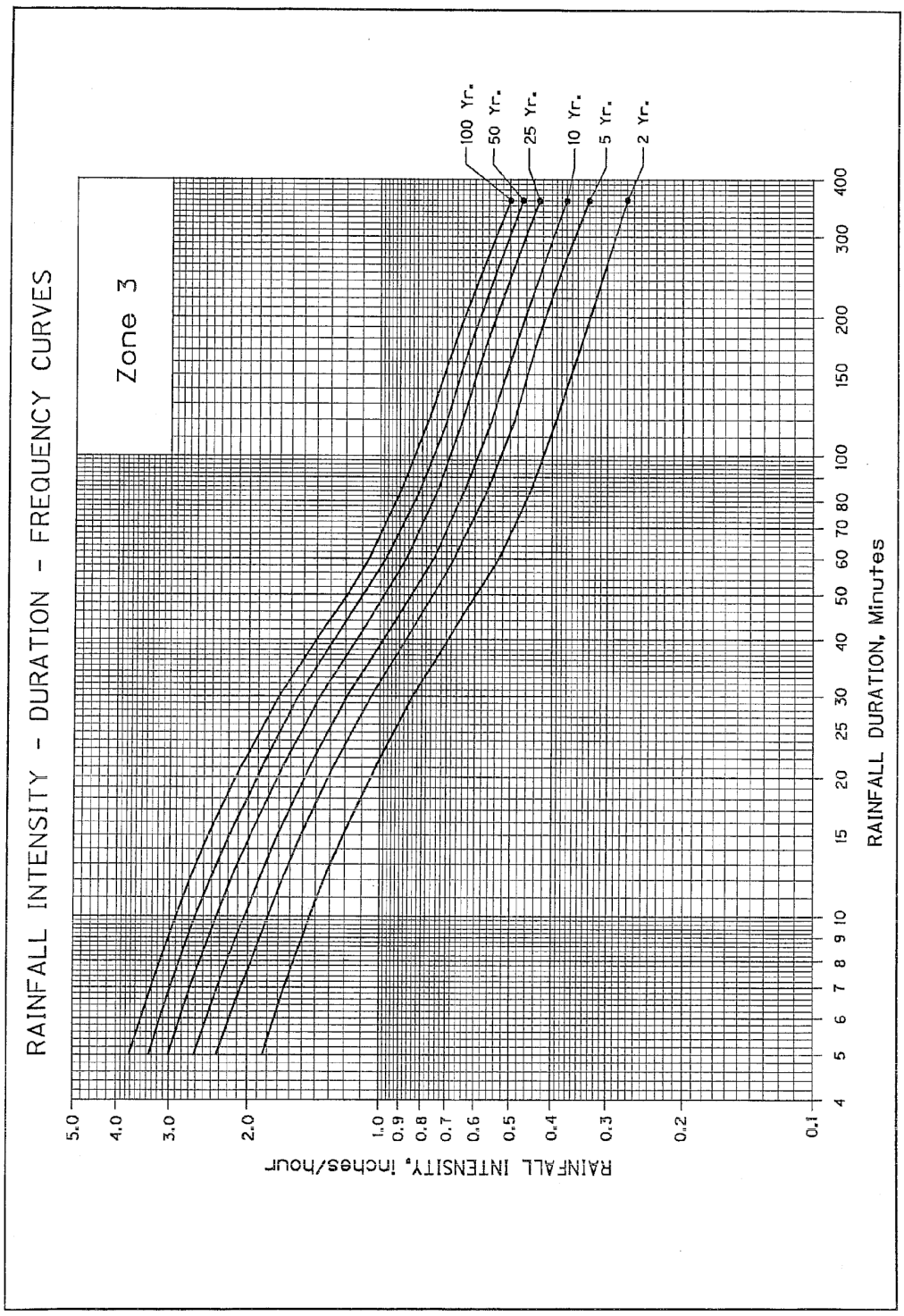

Figure 4-2. ZONE 3 Rainfall Intensity, Duration, Frequency Curves
Reference: ODOT Hydraulics Manual

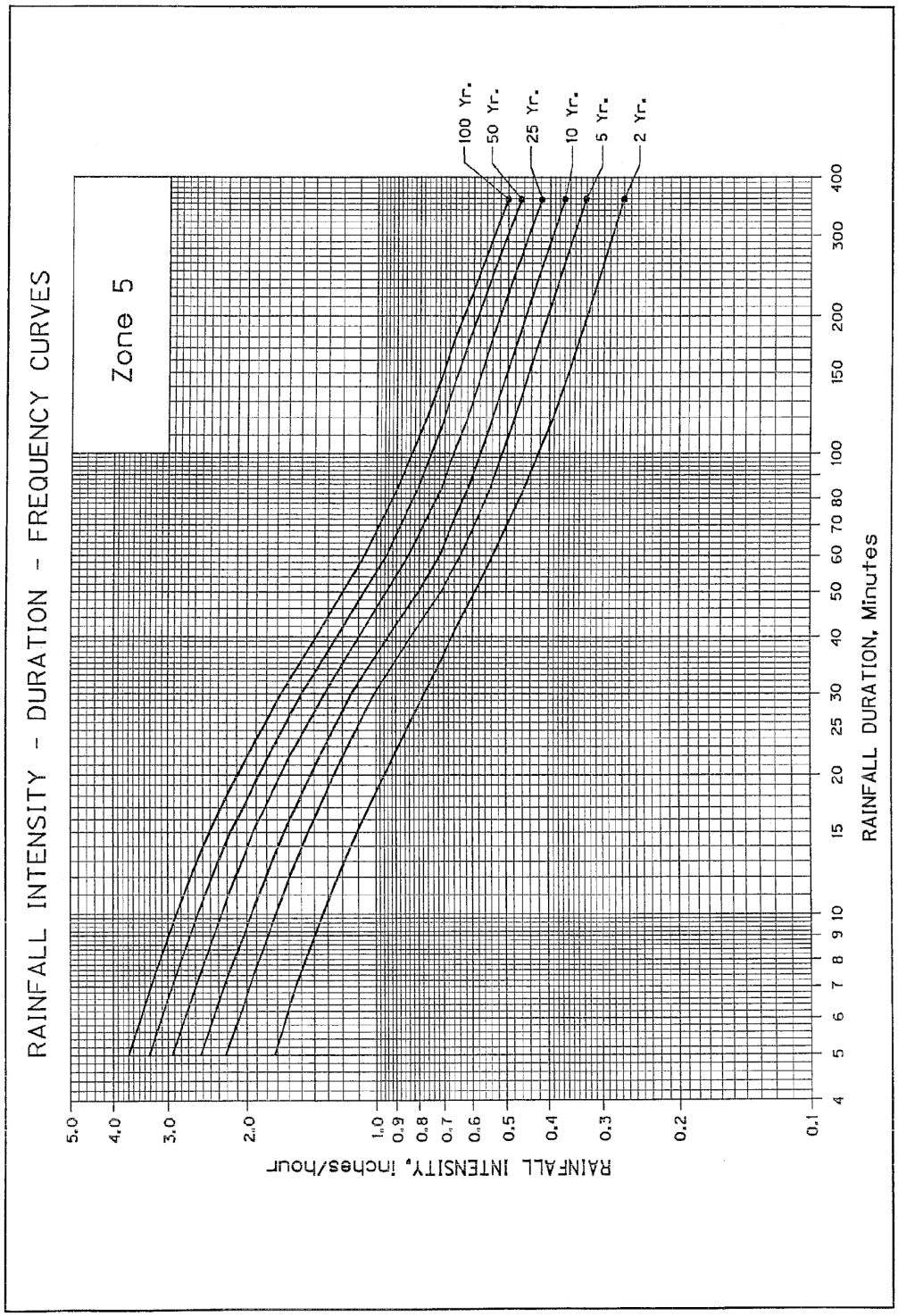

Figure 4-3. ZONE 5 Rainfall Intensity, Duration, Frequency Curves
Reference: ODOT Hydraulics Manual

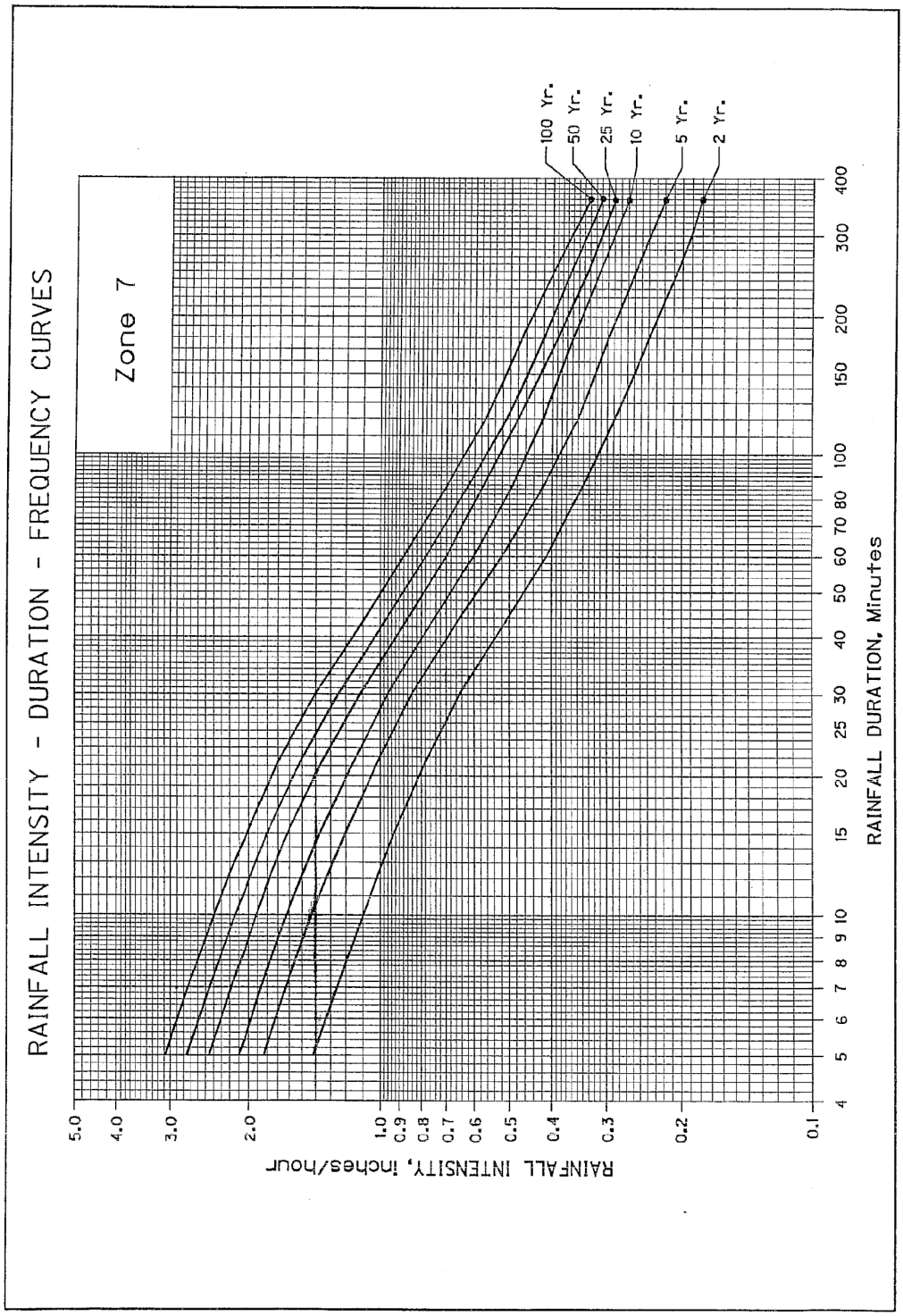

Figure 4-4. ZONE 7 Rainfall Intensity, Duration, Frequency Curves
Reference: ODOT Hydraulics Manual

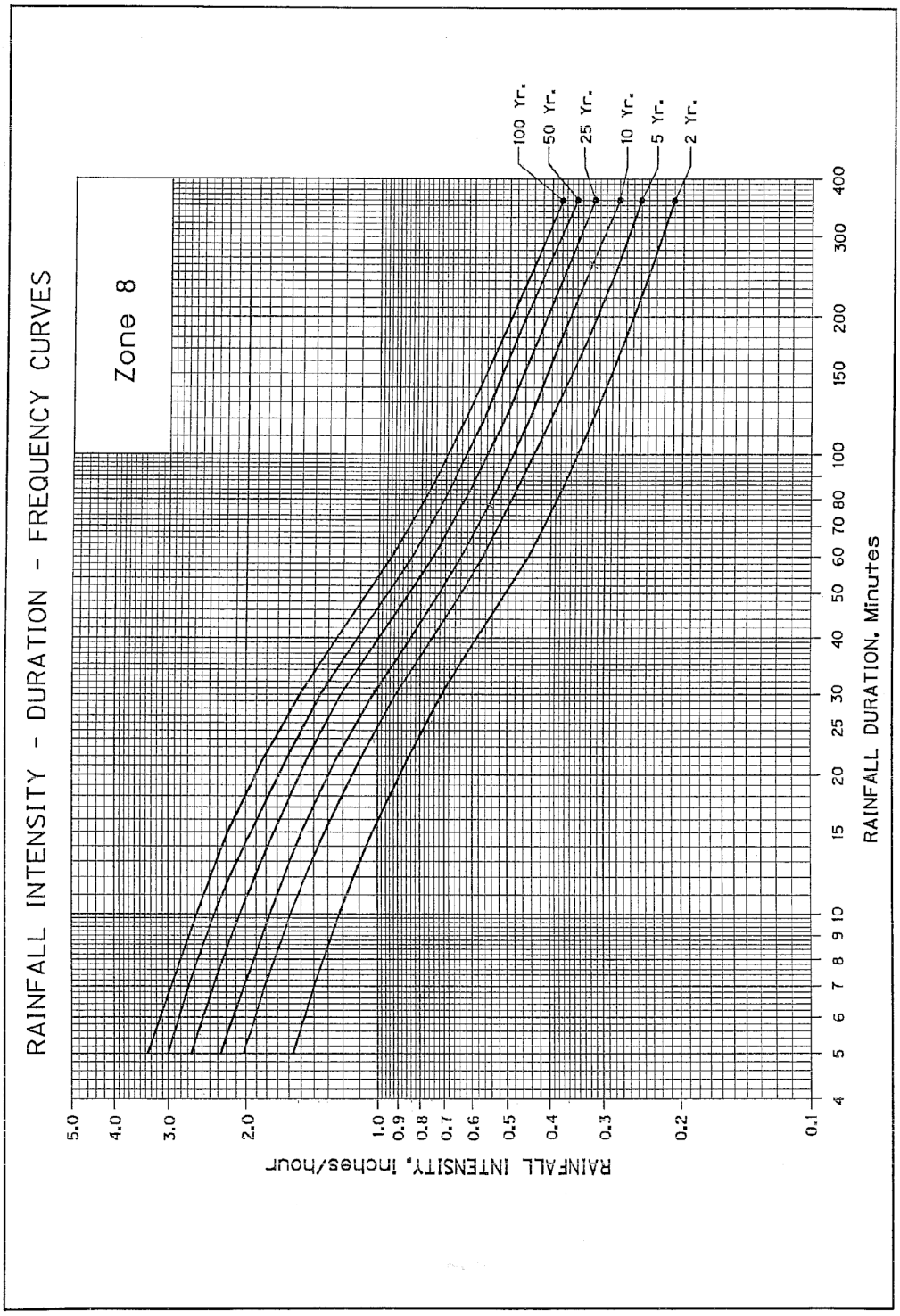

Figure 4-5. ZONE 8 Rainfall Intensity, Duration, Frequency Curves
Reference: ODOT Hydraulics Manual

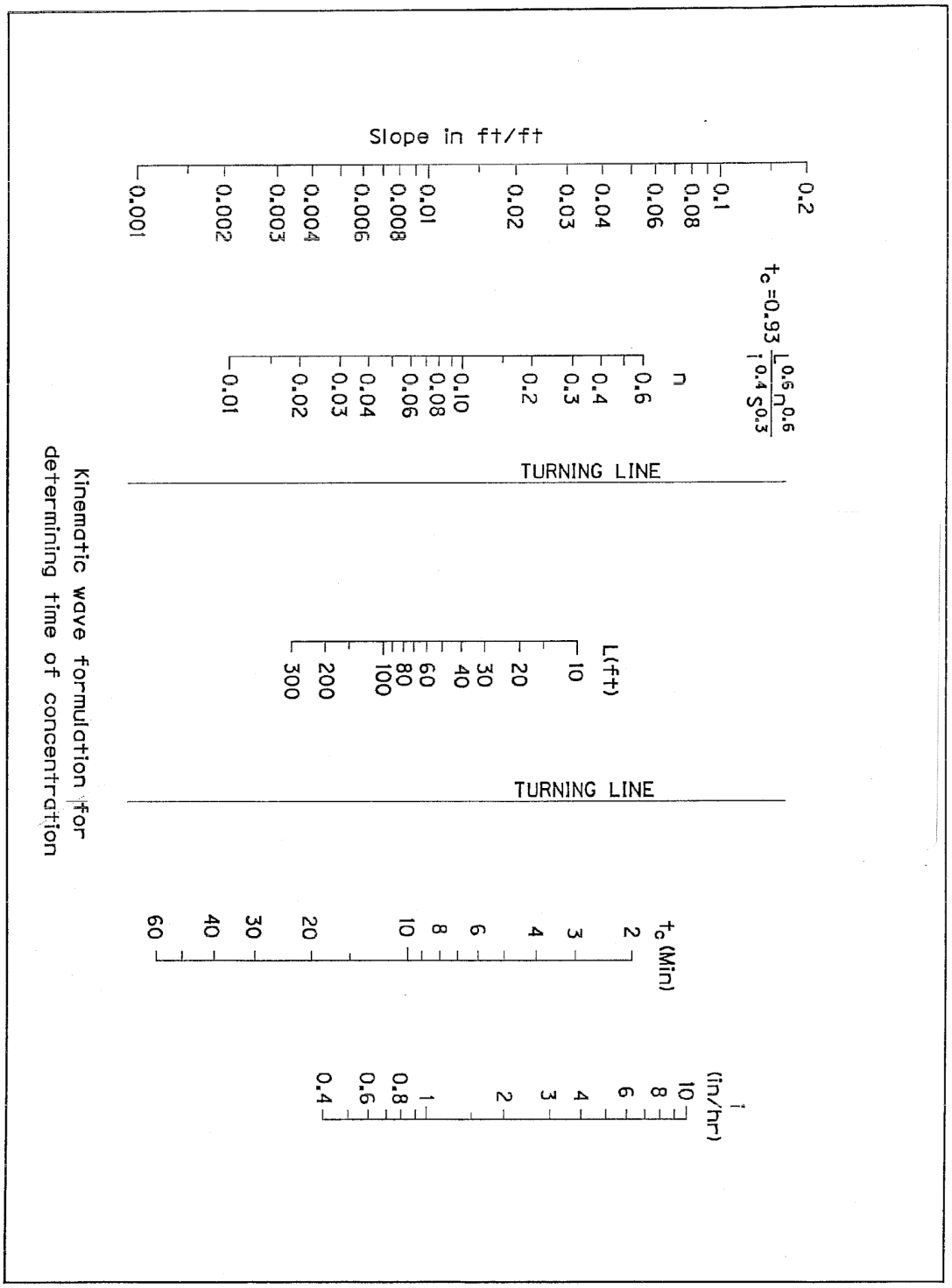

Figure 4-6. Time of Concentration
Reference: ODOT Hydraulics Manual

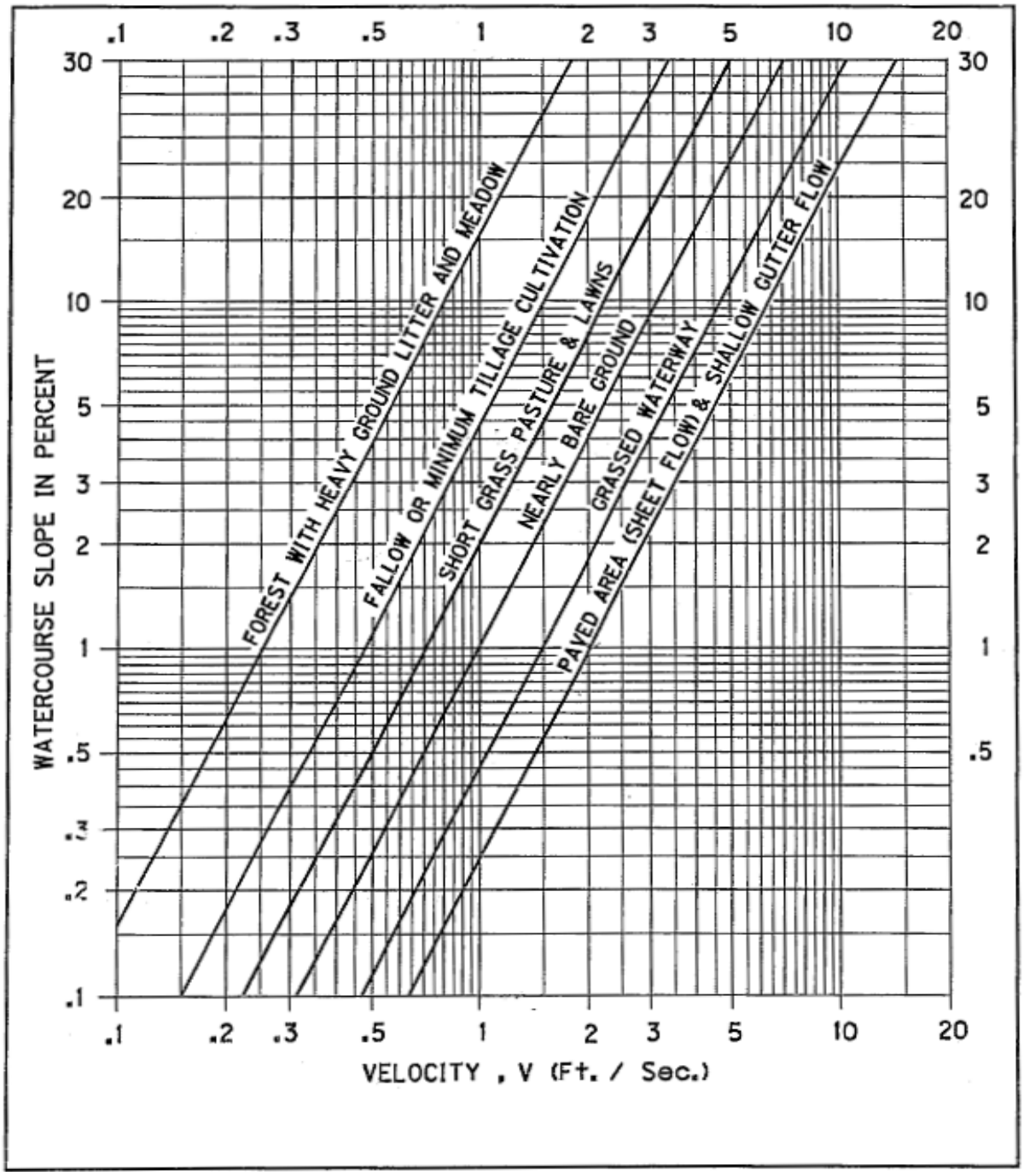

Figure 4-7 – Shallow Concentrated Flow Velocity
Reference: ODOT Hydraulics Manual

SECTION 440 - STORM DRAINAGE COMPONENTS

440.1 Pipes and Culverts

440.1.1 Pipe Material

a) The pipe material permitted for use within the public right-of-way is as follows:
   1) Concrete, non-reinforced, ASTM C-14, Class 3 (maximum size: 18" inside diameter).
   2) Concrete, reinforced, ASTM C-76, Class III (minimum).
   3) Ductile Iron, cement lined, class 50 wall thickness for pipes sizes up to 12-inch; class 51 wall thickness for 14-inch pipe sizes and larger.
   4) High Density Polyethylene Pipe (HDPE) smooth interior, corrugated exterior HDPE sewer pipe and associated HDPE fittings shall conform to AASHTO M294, AASHTO 252, ASTM 405 or ASTM 667.
   5) High Performance Polypropylene (HP3) smooth interior, corrugated exterior HP3 sewer pipe (12" to 30") as per ASTM F2736 and smooth interior and smooth exterior HP3 sewer pipe encasing a corrugated layer (30" to 60") as per ASTM 2764. Associated HP3 fittings shall conform to ASTM D3212.
   6) PVC C900 or PVC 3034 with a minimum 3' of cover can be used for storm runs between manholes or between catch basins. No PVC pipe is allowed as culvert pipe.
b) The minimum life span of pipe used within the right-of-way shall be 70 years.
c) The Engineer shall provide to the County certification with respect to alternative pipe materials, if allowed by the County. Certification shall state that upon inspection the installation, cover, and backfill compaction are in conformance with the manufacturer's recommendations for installation and the product and installation procedures are sufficient for HS 20 loading.
d) The specific strength and depth of cover for pipe shall be based on the manufacturer's recommendations for the loading requirements. Private storm drainage materials shall conform to the Oregon State Plumbing Specialty Code and requirements of the local plumbing official. If private storm drainage materials and applications are not listed in the plumbing code, Engineering will determine the requirements.

440.1.2 Pipe Size

a) Publicly maintained storm drains shall be a minimum of 12-inch inside diameter.
b) Pipes shall be sized to convey the 25 year design storm flow within the County right-of-way to accommodate the existing and subject development at a minimum velocity of 3 ft/sec when flowing full.
c) The method of analysis shall be based on Manning's equation as follows:

$$Q = \frac{1.49}{n} \times A \times R^{0.67} \times S^{0.5}$$

Where: Q = discharge (cfs)
n = Manning's roughness coefficient (see Table 4-2)
A = pipe area (ft^2)
R = hydraulic radius (ft)
S = slope of the energy grade line (ft/ft)

Table 4-2 Mannings Surface Roughness Coefficients (n) for Pipes

Pipe Material	n Value
Concrete	0.013
Concrete Lined Ductile Iron	0.013
High-Density Polyethylene	0.012
Polyvinyl Chloride	0.011

440.1.3 Pipe Slope

All pipes and culverts shall be designed to operate under gravity flow and be sloped to provide a minimum velocity of 3 ft/sec when flowing full. This may be reduced to 2.5 ft/sec with approval of Engineering.

440.1.4 Pipe Cover

a) Pipe trenching, bedding, and backfill shall conform to Standard Drawings U200 through U270B.
b) The required minimum cover for pipe for all public storm drains shall be 36 inches or shall be as specified by the manufacturer, whichever is greater, as measured from the top of pipe to the finished roadway or ground grade.
c) Reduced depth of cover may be considered by the County due to topographical constraints. Appropriate pipe material shall be used to ensure the pipe's capacity to withstand HS 20 loading.
d) Fill heights over pipes shall meet manufacturer's recommendations and are subject to the approval of Engineering.

440.1.5 Pipe Alignment and Connections

a) Pipes shall be laid to a straight line and grade with no curves, bends, or deflections in any direction.
b) All changes in pipe slope, material or alignment shall require a manhole or catch basin.
c) Catch basin locations shall have a maximum spacing of 500 feet from the high point in the road provided that the catch basins drain in opposite directions and there is not a pipe connected for that distance. Typical in line spacing shall be 250 feet.
d) Extensions of pipes and culverts shall be in the same line, grade, and inside diameter as the existing pipe. Extensions shall be of like material and with a connection approved by Engineering.

440.1.6 Pipe Inspection Including Televiewing

a) All pipes shall be lamped, mandreled and video recorded.
b) Upon completion of all storm drain construction, the storm line shall be inspected by televiewing. The applicant shall coordinate the video recording inspection with Engineering.
c) If deficiencies are revealed by the inspection, the corrections shall be made and the televiewing shall be repeated until all work is accepted. The cost of the televiewing shall be borne by the Applicant.

440.2 Catch Basins and Inlets

440.2.1 Catch Basin Type

Standard GB-2 catch basins shall be used in locations where vertical curb is used. Standard catch basins shall conform to WES Standard Drawings. Substandard catch basins shall be upgraded when connections are proposed.

440.2.2 Catch Basin and Inlet Spacing and Location

a) The spacing of catch basins or curb inlets shall be as required to limit gutter flow to less than 4 inches depth and limit water depth in a travel lane to less than 1 inch during the 10 year storm event. The maximum length of pipe between catch basins and inlets shall be 250 feet.
b) Catch basins or inlets shall be provided just prior to curb returns where the centerline gradient is greater than 5% or where the next upstream inlet is 100 feet away or farther. Catch basins also are required within 500 feet of the high point of the roadway profile.

440.2.3 Catch Basin and Inlet Connections

All catch basin laterals shall be a minimum 12 inches inside diameter. Catch basin laterals shall connect to the receiving main with a manhole or another catch basin or curb inlet. Blind tee connections are not allowed.

440.2.4 Lateral Connections

Lateral Connections to newly installed mainlines shall be factory fittings. "Inserta-Tee" fittings are only allowed on existing pipe when the lateral diameter is at least two nominal sizes smaller than the mainline pipe or the mainline is at least 12". The lateral shall be installed above the spring line of the mainline. The lateral shall have a clean out at the property line. Connections will not be allowed if the lateral is connected to an inlet or area drain.

440.3 Manhole Sizing and Alignment

a) The diameter of manhole required shall ensure a minimum dimension, of solid concrete manhole wall, between pipe openings of 12 inches. The standard and minimum manhole size shall be 48 inches in diameter. Maximum spacing of manholes shall be 250 feet.
b) Access locations shall be required at a change in vertical or horizontal alignment or a change in pipe size or material.
c) Manhole rims shall be flush with top of asphalt. If only one lift is placed, or a portion of the overall depth of asphalt, the rim shall still be flush with the top of the asphalt constructed. As additional asphalt thickness is added later, the rim shall be adjusted to be level with the new top of asphalt.

440.4 Open Channels and Ditches

440.4.1 Natural Channels

a) Natural channels are those which occur naturally due to the flow of water or, following construction, those manmade channels that have become vegetated and stable.
b) Natural channels shall remain in their existing, or natural, condition wherever feasible. The preservation of natural drainage-ways shall conform to the requirements of the *ZDO*. Alteration of natural drainage-ways shall not occur without approval of all agencies having jurisdiction.

440.4.2 Constructed Channels & Ditches

a) Constructed channels include those constructed and maintained by human activity and include bank stabilization at existing channels.
b) Roadside ditches shall conform to the requirements and sections for County rural roadways. Roadside ditches shall not be constructed within the urban growth boundary.
c) The County may consider a constructed channel along the roadside when pedestrian and vehicle safety are not compromised and sufficient road right-of-way is available.

440.4.3 Design Criteria

a) Roadway grading shall conform to clear zone requirements of Section 245 and cross section requirements of Standard Drawings C110 to C140.
b) Constructed channels and ditches shall be trapezoidal or parabolic in cross section with side slopes no steeper than 3H:1V, or 4H:1V within the clear zone, for vegetation-lined channels and 2H:1V for rock-lined channels. Constructed channels and ditches shall be designed for a 25 year storm event. Constructed channels and ditches within the required recoverable slopes shall meet recoverable slope requirements: 4H:1V on the fore slope (down slope) and 3H:1V on the back slope (up slope).
c) Vegetation-lined channels shall maintain a maximum velocity of 5.0 ft/sec at the 25 year event. Rock-lined channels or bank stabilization shall be required when design velocities exceed 5.0 ft/sec.

d) Access and utility easements shall be provided for all publicly maintained open channels and ditches as required by the County.

SECTION 450 - DETENTION AND DOWNSTREAM IMPACTS

a) Bridges and other major conveyances identified as deficient in a downstream analysis shall be designed to accommodate the 100 year storm.
b) The outfall of detention facilities may be required to accommodate the 100 year storm depending on the downstream impacts.
c) Detention structures shall not be constructed in the public right-of-way without prior approval from Engineering.
d) Conveyance facilities shall be designed to carry a 25 year storm event with the basin built with 85% impervious.
e) Infiltration testing is required for all detention ponds and other surface water management facilities proposed that utilize infiltration. In rural areas, the simplified method for infiltration testing may be used if coordinated with County staff.

SECTION 460 - WATER QUALITY

a) The installation of water quality facilities shall conform to WES standards.
b) Water quality structures shall not be constructed in the public right-of-way without prior approval from Engineering.

SECTION 470 - EROSION AND SEDIMENTATION CONTROL

Erosion and sedimentation control measures are required for construction areas where the ground surface will be disturbed by clearing, grading, fills, excavations, and other construction activities. Erosion and sediment controls shall conform to WES standards and their *Erosion* Prevention and Sediment *Control Plan*ning and Design Manual. Engineering will require an erosion and sediment control plan for projects that disturb between 800 square feet and one acre when located in the unincorporated area and outside a stormwater district. A permit is required for this work.

For areas outside a surface water management district, NPDES 1200-C permits are required for projects that disturb an acre or more and are issued by the Department of Environmental Quality (DEQ). An applicant will be required to provide evidence of an approved 1200-C permit upon request.

CHAPTER 5 - STRUCTURES

Chapter 5 establishes the technical requirements associated with structures.

Structures not under the review of Clackamas County Building Codes will be reviewed by Engineering. All structures proposed in the public right-of-way including walls, bridges, box culverts and stairs are subject to a Development Permit.

Structures under the review of Engineering shall meet the following requirements:

a) All structures described herein shall be designed by an Engineer.
b) Walls installed by the County are allowed within the public right-of-way.
c) As feasible, retaining walls should be located on private property. Easements shall be provided as necessary.
d) Stairs located in the public right-of-way shall meet IBC requirements.
e) Other structures in the public right-of-way will be reviewed per AASHTO requirements or as otherwise determined by Engineering.

CHAPTER 6 - STREET ILLUMINATION

SECTION 610 - GENERAL

Chapter 6 addresses the technical requirements associated with street illumination.

Street illumination is typically installed as part of a Development Permit.

610.1 Street Illumination Required Within UGB

Street illumination installation is required of all partitions, subdivisions, commercial, industrial, and multifamily residential development within the UGB in Clackamas County by the *ZDO* if adequate street lighting does not already exist.

610.2 Street Illumination Design by PGE

Street illumination design and installation is subject to the approval of Clackamas County Service District No. 5 ("Service District"), working through Engineering, and the utility serving the development, Portland General Electric ("PGE").

610.3 Street Illumination are Option A

Street illumination is owned, operated, and maintained by PGE, as Option A and the applicant is responsible for the design. PGE and the District are responsible for the design approval.

610.4 Illuminating Engineering Society (IES)

Street illumination is generally designed to IES guidelines for the road classification utilizing existing infrastructure (poles, transformers, and circuitry) where available.

610.5 Fixture Approval

The Service District has final approval for all street illumination fixtures for each development.

SECTION 615 - PROCESS FOR OBTAINING APPROVAL FOR STREET ILLUMINATION

The following process is required in order to obtain Service District approval for street illumination for all development as required above:

615.1 Approval Process

a) The applicant shall contact the Service District and have the property owner sign a "Request for Street Lighting."
b) The applicant shall also contact PGE and provide PGE with a street illumination design.
c) The Service District, in turn, places an annual assessment determined by the district rate schedule on the property tax statement of the affected properties for the operation of the street illumination.
d) The tax lots in the development will be required to form an assessment area within Clackamas County Service District No. 5 for the purpose of paying for the operation and maintenance of street illumination.
e) After a formal hearing process, a special assessment is placed on the tax roll at the District rate determined by the classification of the property and the type of illumination installed.
f) Contact Engineering at 503-742-4400 with any questions or to initiate the street illumination process for a development.

615.2 Construction & Installation

a) In areas where new underground or overhead electricity supply circuitry is required, PGE will coordinate the street illumination circuitry design with the primary power supply. However, the applicant cannot assume that this will happen automatically, a separate request for street illumination shall still be made.
b) Depending on the circumstances of the installation, the applicant may be required to provide and install at their expense and according to the design approved by the District and PGE:
    1) Pad-vaults for transformers or overhead transformers for street illumination,
    2) Splice boxes, and/or
    3) Circuitry conduit with pull line.
c) PGE will provide the transformers and circuitry for street illumination but will bill the applicant directly for any costs that may be incurred to install these; these charges may be offset to some extent by PGE line extension allowances.
d) PGE will provide and install the street illumination poles and luminaries at no charge to the applicant.

615.3 Rates

Rates are subject to change annually. The first assessment is usually in November following the date of installation and the assessment is pro-rated to the date of installation.

CHAPTER 7 - UTILITIES

SECTION 710 – GENERAL

Clackamas County regulates the placement and ongoing requirements of utilities that are located in the public right-of-way and easements under the jurisdiction of the County. This chapter addresses the technical requirements associated with utility installation.

County Code Title 7.03.099 should be referenced for additional important information. Additionally, some utilities have separate agreements with Clackamas County that may modify the requirements included herein.

Applicants shall conform to the requirements of Chapter 4 regarding soil loss and erosion control measures.

710.1 Potholing Requirements

On arterial and collector roadway, work subject to a Development Permit shall pothole for existing utility locations to verify that the design has no conflicts with existing utilities. The County may require potholing in other situations and on other roadways depending on the type of facility and scope of the work. Any conflicts with existing utilities including storm or sanitary will be resolved prior to excavation for installation of the utility.

Potholing requires a Utility Permit.

710.2 Location Requirements

a) New and relocated utility installations shall follow Standard Drawing U100 for placement.
b) The utility shall be placed as far as possible from the edge of the roadway including within public utility easements as feasible.
c) Any placement shall not impede, obstruct, or hinder operation of any emergency service, maintenance operations, pedestrian or vehicular access or travel including to or from private properties and of legally parked vehicles or permitted items within a public right-of-way.
d) Above ground utility facilities shall follow the clear zone standards of Section 245 and pedestrian facility requirements of Section 710.3.
e) Utilities shall be installed underground per the *ZDO* or as required by land use requirements.
f) Any manhole lids, junction boxes, vault lids, water meters, etc. that are located in vehicular travel lanes are to be out of any wheel tracks.

710.3 Pedestrian Considerations

When considering pedestrian facilities, utilities:
a) Shall not obstruct the pedestrian facility width.
b) Any surface access to utilities (including manhole lids, junction boxes, vault lids, water meters, etc.) shall not be installed in a pedestrian facility unless no reasonable alternative exists. If no reasonable alternative exists, the surface access shall be flush with the pedestrian facility grade. The surface access located in a pedestrian facility shall be slip resistant and not have holes or depressions that can cause a tripping hazard per *County Code* Section 7.03.
c) Surface access for new utilities shall not be constructed within any ADA ramps or landing.
d) If existing utilities are located where an ADA facility needs to be constructed and the utility cannot be relocated, the surface access shall be made flush with the ADA ramp or landing and an ADA exception shall be formally requested and approved.

710.4 Structures

When attachment to a structure (i.e. a bridge or a box culvert) located in a public right-of-way is involved:

a) The applicant shall provide an engineering assessment of the existing structure to add the facility including a structural analysis that illustrates the ability of the structure to carry the weight of the facility and also considering:
    1) Dead load of the facility
    2) Supports to attach to the structure
    3) Attachment method
    4) Spacing of the supports
b) No utility shall be attached to a bridge or other structure crossing a body of water prior to County Planning and Zoning review for a possible Floodplain Development Permit and shall obtain the concurrence of County Transportation Maintenance.

710.5 Pressurized Pipes

When the proposed utility involves pressure pipe line, the applicant shall provide the:
a) Design pressure of pipe;
b) Normal operating pressure;
c) Maximum operating pressure.

710.6 Vertical Clearance

Any aerial utilities shall meet the requirements of the National Electric Safety Code for vertical clearance.

710.7 Burial Requirements

710.7.1 Depth

All underground installations shall be buried a minimum of thirty (30) inches below the nearest vertical roadway surface, (i.e., from the bottom of ditch line). Minimum depth of bury may be decreased with Engineering approval based on topographical constraints or when matching existing utilities. If placed less than 30 inches deep, utilities shall be placed below any cross culverts and should not be placed above cross culverts. Additional requirements may be imposed on installations not meeting the minimum depth requirements including identifying tape. Plans must show the distance from the nearest vertical roadway surface to the top of the proposed buried cable, pipe line, or facility.

710.7.2 Warning Signage & Ability to Locate

Warning signs for buried power or communications cable, and for pipe lines carrying gas or flammable liquids, shall be placed at each crossing under the roadway, and at intervals along longitudinal installations as required by the current Public Utility Commissioner's Order and as specified by the Road Official as follows:
a) Signs shall be placed as near the right-of-way line as is practical.
b) Notwithstanding 1) above, signs for an installation within the roadway shall be placed behind any existing guardrail.

Tracer wire or other locating device is required immediately above the facility enabling the ability to locate the facility within two feet of the facility per Oregon dig laws.

710.7.3 Pedestal Placement

Pedestals installed as part of a buried cable installation are to be located as far from the traveled portion of the roadway as is practical, and preferably one foot from the right-of-way line. The locations shall not impact driveways or ADA ramps.

710.8 Requirements and Specifications for Trench Backfill

a) Backfill materials meeting the *Oregon Standard Specifications for Construction* (aka "standard trench backfill") shall be required for use when trenches exceed one of the following dimensions:
   1) 100 feet in length or longer; or
   2) Greater than 10 feet in depth.

b) Standard trench backfill may be used per Standard Drawing U200 except when the following conditions exist and then CDF shall be utilized per U250 through U275B:
   1) Utility trenches are within the roadway of arterial and collector classified roadways;
   2) The affected roadway surface is newer than 5 years from the time of the last overlay, without regard to roadway classification; or
   3) Engineering deems it necessary.

c) CDF shall conform to the following specifications:
   1) Be able to excavate and produce unconfined, compressive, 28-day strengths from 100 psi to a maximum of 200 psi.
   2) Contain aggregate no larger than 3/4 inch, and for trenches less than 12 inches in width, the aggregate shall be no larger than 3/8 inch.
   3) Slump shall be 6 to 8 inches to insure flowability and will fill all voids without requiring compaction efforts.
   4) The surface of fill shall reach a strength to withstand the process of paving without displacement or disruption within 48 hours, regardless of weather conditions, temperature or moisture content of the soil where placed. Additives such as calcium (1% or 2%), hot water and/or a pozzilith (water reducer) are acceptable means to achieve this set.
   5) Copies of the CDF batch weights must be submitted to Engineering.
   6) Alternative backfill may utilized per Standard Drawings U270A and U270B.

d) Exemption from CDF may be considered if all of the following construction requirements are otherwise met:
   1) Backfill materials meeting Class "B" backfill specifications from the *Oregon Standard Specifications for Construction* or its approved equal are used;
   2) Not less than 95% relative maximum density (using AASHTO T-99) is achieved;
   3) Compaction results are provided by a certified testing lab;
   4) Perimeter excavation for manholes is 10'X10' or greater to allow for sufficient mechanical compaction of the backfill;
   5) The surety repair time duration is extended an additional two years beyond the three years as specified in Section 710.9.

e) Trenches shall be protected in the following manner:
   1) Sufficient weight and size steel plating or approved equal materials, capable of carrying a minimum of H-20
      loading, shall be present at the work site prior to excavation and placed over the trench to protect the public.
   2) Plating shall be positively secured from movement and shall be ramped with anti-skid coated plate ramps.
   3) Plates must extend beyond the trench wall a minimum of one foot on all sides.
   4) Lighted barricades with appropriate signage shall be placed sufficiently ahead of, and adjacent to, plating to warn all traffic.
   5) All plating and signs are to remain in place until permanent surface repair paving operations are underway.
   6) Additionally as required by Section 290.

710.9 Open Cuts of Paved Roadway Surfaces

a) Unless there are extenuating circumstances that require open cutting the road to install utilities or special permission is granted by the Road Official to open cut the road, a cable, pipeline, or conduit, which crosses under the roadway, other roadway connections e.g. road approaches or driveways, shall be placed in a casing bored under the surface for that purpose in accordance with the following provisions:
    1) All utility companies serving the work site vicinity shall be contacted to request line locate services.
    2) Any utility conflicts shall be resolved before initiation of construction.
    3) The applicant will be required to comply with ORS 757.
b) Installations by plowing of cable or conduits within the UGB shall not be allowed.
c) Burial of cable outside the UGB placed by the plowing method shall be limited to areas behind the ditch line or as close the right-of-way line as practical when no ditch exists. Approval of alternate means of installation is subject to time and schedule restraints to allow for preferable soil moisture conditions, pavement surface temperatures, and other roadway characteristics.
    1) In all cases mechanical compaction efforts shall be applied to the entire disturbed portion of the right-of-way.
    2) Restoration of gravel shoulders and drainage ditches and the verification of the function of all drainage structures must be achieved prior to completion.
d) Open cut utility installations in paved streets shall restore those streets per Standard Drawings U275 through U290.
e) Open cut service laterals, when allowed, shall be grouped together per Standard Drawing U290.
f) In addition to the requirements of Standard Drawings U275 to U295, utility cut requirements may include, but not be limited to the following conditions:
    1) Repaving may include surface grinding, base and sub-base repairs, or other related work as needed to restore the road to the minimum standards and to reduce the number of seams or eliminate pavement seams in a wheel path.
    2) Pavement restoration beyond trench patching along roadways with sidewalk may require the installation or replacement of ADA curb ramps.
    3) Disturbance to existing ADA facilities may require replacement of those facilities to current PROWAG standards.
    4) Additional asphalt area removal and replacement may be required to ensure the smoothness of ride characteristics to meet the *Oregon Standard Specifications for Construction* Section 00744.70.
    5) As required by these Roadway *Standards* and/or as determined by the Road Official the requirements may include up to full-width surface paving of the roadway depending on the limits of disturbance and the condition of the existing pavement;
    6) Limitations on the operation to protect the roadway from temperature related damage, i.e. delamination of pavement surfaces and subgrade;
    7) If the County determines that the final repaving of the street is not appropriate at that particular time for reasons relating to weather or other short term concerns, the County may grant a delay until proper conditions allow for repaving.
    8) Apply restrictions as to the size and type of equipment during freeze/thaw conditions or for saturated subgrade with a poor or very poor PCI rating; it could also be due to the existing width of the road and traffic flow or other conditions that warrant limitations on equipment;
    9) Designation of routes upon which materials may be transported;
    10) Mitigation of potential subsurface hydrologic flow along the utility or appurtenant trench; e.g. bentonite check dams;

710.10 Concrete Street Surface Repairs

Concrete roadway surface repairs shall conform to the following specifications:

a) The entire Portland Cement Concrete (PCC) panel must be removed between the nearest expansion joint. If the trench excavation is within two feet of the nearest joint the abutting panel must be removed.
b) Placement of the bedding material and approved granular backfill must be placed and compacted to 95% compaction.

c) Replacement of the Portland Cement Concrete panel must equal the thickness and design strength of the concrete material removed, or be of a minimum 4,000 pound, 28 day strength design mix, whichever is stronger. The concrete must be placed in conformance with industry standards and protected against freezing. The texture of the concrete surface must be like the adjoining surfaces.
d) Perpendicular PCC joints - 18" long, 1 ¼" smooth dowels with epoxy coating, embedded 9" into both the new PCC panel and the existing, abutting panel, spaced at 12" on center
e) Longitudinal PCC joints - 16" long, #4 rebar smooth dowels with epoxy coating, embedded 8" into abutting panels (new and existing), spaced at 18" on center
f) Longitudinal joint with curb and gutter - 8" long, #4 rebar smooth dowels with epoxy coating, embedded 4" into both the PCC gutter and panel, spaced at 18' on center.
g) Concrete roadway restoration beyond along roadways with sidewalk may require the installation or replacement of ADA curb ramps.
h) Disturbance to existing ADA facilities may require replacement of those facilities to current PROWAG standards
i) The work area must be signed and protected to detour traffic away from the repair for seven (7) days following the placement of the concrete repair unless the use of a high early additive is requested and approved in the permit.

715 SMALL WIRELESS FACILITIES

The following governs the installation of small wireless facilities within right-of-way or easements under Clackamas County jurisdiction. The installation of small wireless facilities requires a Utility Permit. In some cases, the installation of small wireless facilities is further governed by the *ZDO*. In those cases, land use approval is required before the application for a Utility Permit. *County Code* Section 7.03 provides additional requirements.

715.1 Application

An application for a small wireless facilities shall not be complete until the following elements have been provided to the County:

a) Land use approval, if required.
b) Utility Permit application which requires:
    1) Evidence of land use approval, if required.
    2) For location on existing traffic signal appurtenances or illumination poles, written authorization or agreement from the owner of those structures.
    3) Plans illustrating the proposed installation that is compliant with the standards of Section 715. Plans for new structures shall include the right-of-way, public utility easements, location of edge of pavement, curbs, sidewalks, landscape strips, curb ramps, driveways, and other structures within the vicinity of the proposed installation.
    4) Provide dimensions of all above ground structures.
    5) Structural engineering calculations for any modifications to County owned infrastructure.
    6) Photographs illustrating the existing site conditions that will be impacted.
    7) An RF certification report per Section 715.9.

715.2 Review and Approval Period

Small wireless facility installations shall comply with regulations and documentations/permissions as set forth by federal, state, and these Standards. The review period for applications will be a maximum of 60 days on existing structures and will be a maximum of 90 days on new structures following receipt of an application per Section 715.1 with one restart after the initial completeness review.

715.3 Location Requirement

Small wireless facilities shall not be located on County owned street illumination poles or on County owned signal infrastructure unless it can be established that the small facilities cannot be placed on other existing, replacement or new support structures.

715.4 Other Siting Requirements

a) New small wireless support structures shall not be sited within 50 feet longitudinally of an existing or approved utility pole, illumination pole or small wireless support structure.
b) Locations for new support structures shall be as near as possible to property lines to avoid interference with building faces, views and business signage.
c) NOC (Network Operation Center) and RF Signage should be placed on same side of cabinet and/or pole as disconnect switch. If NOC contact information cannot be read from ground level without visual aid, it is required to mount an additional NOC sign eight feet above ground level.
d) Any placement shall not impede, obstruct, or hinder operation of any emergency service, maintenance operations, pedestrian or vehicular access or travel including to or from private properties and of legally parked vehicles or permitted items within a public right-of-way.
e) If proposed within the clear zone and a new small cell wireless facility is deemed a fixed object per Section 245, the new small wireless facilities shall be placed as far as possible from the edge of the roadway including within public utility easements unless there is an existing alignment of support structures and such placement would be technically infeasible. In such cases, the small wireless facilities shall be placed within substantially the same alignment as the existing support structure(s).
f) Small wireless facility installations shall comply with the sight distance standards of Section 240, the National Electric Safety Code ("*NESC*"), and *PROWAG*.
g) All electrical, fiber optic or other related infrastructure shall be located within conduits not owned by the County.
h) Any placement shall not impact any existing or planned bridges, retaining walls or guardrail.
i) The small wireless facility placement shall cause no physical, electrical, or radio interference with the operation of traffic signal appurtenances or emergency control devices.
j) When a small wireless facility is installed on a County-owned traffic signal pole, the the facility may only be installed on a traffic signal pole without a luminaire.

715.5 Access Requirements

a) All small wireless facilities shall be installed and operated in compliance with Federal Communications Commission (FCC) regulations and guidelines, including placement of appropriate signage.
b) County and/or other qualified workers and contractors shall have the ability to easily shut off radio signals and power while working on the pole where a small wireless facility is installed or in the vicinity of a radio frequency (RF) emitting device. Each installer shall provide a small wireless facility shut-off switch and shut-off/turn-on instructions.

715.6 Aesthetics

a) To the extent technically feasible, a small wireless telecommunication facility, including all related equipment and appurtenances, shall be a color that is similar to the support structure and use non-reflective materials.
b) The highest point of an antenna shall not exceed FCC standards and the height needed to meet safety requirements.
c) The size of above ground infrastructure shall be as small as technically feasible.
d) If technically feasible, equipment shall be placed on or within the support structure or underground.
e) Lighting should be shrouded to the extent possible from nearby properties.

715.7 Abandonment and Removal

A small wireless facility that is not operated for a continuous period of 12 months, shall be considered abandoned and the owner of the facility shall be responsible for the removal of the facility, including its antenna(s) and equipment, within 60 days of receipt of written notice from the County notifying the owner of such facility abandonment.

715.8 Clackamas Regional Center Design Plan Area Requirements

Within the Clackamas Regional Center Design Plan Area, new support structures shall be black in color and galvanized to match other street lighting poles of the area.

715.9 Inspection

Comply with the requirements of Section 180.

715.10 Expiration

Comply with the Utility Permit requirements of Section 130.3.7.

715.11 Radio Frequency (RF) Certification Report

All new small wireless facilities proposed in County rights-of-way shall be accompanied by a Radio Frequency Certification Report, prepared by a qualified professional, which certifies that the small wireless facility will be installed and operated in compliance with FCC regulations and guidelines. The report shall provide protocols for small wireless facility shut-off and turn-on.