ST. CHARLES COUNTY
DESIGN CRITERIA
FOR THE PREPARATION
OF
IMPROVEMENT PLANS

COMMUNITY DEVELOPMENT &
HIGHWAY DEPARTMENTS

FEBRUARY 2002
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10.00 Definitions

The definitions of terms used in these guidelines are as follows:

1. AASHTO - American Association of State Highway and Transportation Officials.

2. Alley - A secondary means of ingress and egress serving more than one tract of land and used primarily for vehicular service, and which may be used for public utility purposes. Alleys are not maintained by the Department and are normally located adjacent to the rear property lines.

3. Applicant - The government agency, utility company, contractor, developer or individual seeking permission to work within the right-of-way of any roadway under the jurisdiction of St. Charles County.


5. Arterial Road System - The system of roads classified by the Department that provides the principal routes for arterial type traffic in both the municipalities and unincorporated St. Charles County. Arterial roads within the municipalities of Cottleville, Dardenne Prairie, Flint Hill, Foristell, Josephville, New Melle, Portage Des Sioux (Commons Lane, Payne Road & part of Lawrence Street only), St. Paul and Weldon Spring are maintained by St. Charles County in lieu of returning their half of the road and bridge tax collected.

6. Backfill - The material used to fill an excavation.

7. Base Flood - The 100-year flood, hereafter referred to as the base flood, is a measure of flooding of a specific magnitude used as a standard in the National Flood Insurance Program. The base flood has a one-percent chance of occurrence in any given year. The depicted one-percent chance flood has one chance in 100 of being equaled or exceeded in any future one-year period.

8. Basement - The lowest level or story of a structure that has its floor below grade on all sides.

9. Bedding - The material on which the pipe or conduit is supported and protected.

10. Bench Mark - A definite point of known elevation and location and of more or less permanent character. The identity and elevation shall be based on United States Geological Survey (U.S.G.S.) Datum.

11. Block - A piece or parcel of land entirely surrounded by public or private highways or streets, other than alleys. In cases where the platting is incomplete or disconnected, the Director of Planning shall determine the outline of the block.

12. Bridge - A structure having a clear span greater than 20 feet measured on a horizontal plane along the centerline of the roadway; also a multiple span structure where the total length of span is in excess of 20 feet. For both a single and multiple span bridge, the clear span shall be construed to mean the total distance from stream face to stream face of end bents or outer
walls of structure. For multiple pipe, the span shall be construed to mean the total distance measured between the two exterior pipes, provided the clear distance between each pipe is less than one-half the diameter of the pipe.

13. Building Line (Setback) - A line or lines on a plat designating the area outside of which buildings may not be erected, except landings, open balconies and roof overhangs, as permitted in the Zoning Ordinance.

14. Channel - A natural or artificial water course.

15. Classified Road - A road that has been designated for future improvement to a specific minimum right-of-way and pavement width. All classified roads are on either the Arterial Road System or the County Road System.


17. Common Land/Ground - The land set aside for open space including stormwater, retention lakes, ponding or recreational use for the owners of residential lots in a subdivision. This land is conveyed by the developer in fee simple absolute title by a warranty deed to the Trustees. The trust indenture for common land shall provide that it be used for the sole benefit, use and enjoyment of the lot owners present and future and shall be the maintenance responsibility of the trustees of the subdivision. No lot owner shall have the right to convey his interest in common land except as an incident of his ownership of a regularly platted lot.

18. County - That part of St. Charles County, Missouri outside of incorporated cities, towns, and villages.

19. County Road System - All county maintained roads located in unincorporated St. Charles County and all roads within the municipalities of Cottleville, Dardenne Prairie, Flint Hill, Foristell, Josephville, New Melle, Portage Des Sioux (Commons Lane, Payne Road & part of Lawrence Street only), St. Paul and Weldon Spring maintained by St. Charles County in lieu of returning their half of the road & bridge tax collected, exclusive of roads on the Arterial Road System.

20. Cross Access - A commonly shared or used private pedestrian way or vehicular driveway that internally connects or serves two or more adjacent properties.

21. Crossroad Culvert - A pipe or box culvert passing surface drainage carried in side ditches or channels beneath roads to adjacent property.

22. Department - For the purpose of this publication, the St. Charles County Highway Department.

23. Design Speed - On existing roadways design speed shall be the 85th percentile speed of motorists on the roadway as established by radar studies, or 5 m.p.h. greater than the posted speed limit, whichever is greater. On new roadways, design speed shall be 5 m.p.h. greater than the anticipated posted speed limit. For non-residential and residential streets with a pavement width of 26' or less, the design speed shall be the anticipated posted speed limit.
24. Detention - The temporary storage of the differential runoff of stormwater by providing permanent facilities, such as dry reservoirs, ponds or other acceptable alternatives.

25. Developer - The person, firm or corporation who develops and improves a tract pursuant to the requirements of this book and the *Unified Development Ordinance*.

26. Development - The act of changing and the state of a tract of land after its function has been purposefully changed by man including, but not limited to, structures on the land and alterations to the land.

27. Differential Runoff - The difference in rate and volume of stormwater runoff from a parcel or project between its undeveloped natural condition and its developed condition.

28. Director - For the purpose of this publication, the County Engineer.

29. Drainage Facility - Any system of artificially constructed drains, including open channels and separate stormwater sewers, used to convey stormwater, surface or ground water, either continuously or intermittently to natural water courses.

30. Drive, Multi-Family Access - A private way or driveway that affords a means of vehicular access to parking areas and bays and to abutting buildings in a multiple dwelling unit subdivision.

31. Driveway - A privately maintained travelway used for vehicular access to a site and distribution within a site, not including sidewalks.

32. Driveway, Common (Party) - A single driveway providing vehicular access to two adjoining properties.

33. Easement - A grant by a property owner to the public, a corporation, or a person, for the use of land for a specific purpose.

34. Easement, Common Ground - A grant by the Developer to the Trustees of a subdivision, for the use of land areas surrounded by public rights-of-way.

35. Easement, Cross Access - A designated private access way for the servicing of aisles or driveways that internally connect two or more properties.

36. Easement, Multiple Family Access - A designated private access way for the servicing of parking areas and bays and to abutting buildings developed as multi-family dwellings.

37. Easement, Permanent Drainage - A grant by a property owner to the County for the purpose of improving, constructing, repairing and maintaining drainage structures.

38. Easement, Permanent Footing - A grant by a property owner to the County for the purpose of improving, constructing, repairing and maintaining a retaining wall footing.
39. Easement, Permanent Roadway Improvement, Maintenance, Utility, Sewer and Sidewalk - A grant by a property owner to the County for the purpose of improving, constructing, repairing and maintaining roadway improvements, public or private utilities, storm and/or sanitary sewers and sidewalks.

40. Easement, Permanent Sidewalk, Sewer and Utility - A grant by a property owner to the County for the purpose of improving, constructing, repairing and maintaining sidewalks, sewers and utilities.

41. Easement, Permanent Sight Distance - A grant by a property owner to the County for the purpose of controlling and directing grading and the installation and maintenance of plant material, trees and/or structures by the property owner in a manner that will provide and insure sight distance for motorists as required by the County.

42. Easement, Permanent Stormwater Control - A grant by a property owner to the County for the purpose of improving, constructing, repairing and maintaining stormwater drainage facilities.

43. Easement, Permanent Stormwater Control Access - A grant by a property owner to the County to provide for access and upkeep of the area within designated stormwater control easements.

44. Easement, Permanent Traffic Signal - A grant by a property owner to the County for the purpose of improving, constructing, repairing and maintaining traffic signals and appurtenant structures.

45. Easement, Permanent Utility - A grant by a property owner to a public or private utility company for the purpose of improving, constructing, repairing and maintaining utilities.

46. Easement, Private Roadway - A designated private access way for the servicing of individual lots within a subdivision.

47. Engineer - A professional engineer registered in the State of Missouri.

48. Entrance, Commercial - A driveway providing ingress and egress for a commercial site.

49. Entrance, Residential - A driveway providing ingress and egress for a residential site.

50. Escrow - An agreement between the developer and St. Charles County whereby the developer establishes funds to cover the cost of completion of required on-site improvements as depicted upon approved construction improvement plans.

51. Escrow Agent - A title company, bank, savings and loan association, trust company, attorney or any other person or agency approved by the County Counselor to act as escrow agent under the provisions of the *Unified Development Ordinance*.

53. Finish Elevation - The proposed elevation of the land surface of a site after completion of all site preparation work.

54. Finished Grade - The final elevation of the ground surface after development.

55. Flood Plain - A geographic area susceptible to periodic inundation from the overflow of natural waterways during the base (100-year) flood. It is determined as to extent in St. Charles County, by the current Federal Emergency Management Agency Flood Insurance Study for St. Charles County, Missouri-Unincorporated Areas, with accompanying Flood Insurance Rate Maps and Flood Boundary and Floodway Maps, and any future revisions thereof to be made by the Commission or as amended in accordance with the provisions of the Zoning Ordinance.

56. Floodway - The area designated as Floodway on the Federal Emergency Management Agency Flood Boundary and Floodway Maps. It is derived by determining that portion of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.

57. Floodway Fringe - That area of the 100-year Flood Plain excluding the floodway is known as the floodway fringe. It is also that portion of the 100-year Flood Plain that can be developed without cumulatively raising the base flood elevation more than one foot.

58. Frontage - All property on one (1) side of a street or highway, measured along the right-of-way line of the street.

59. Geotechnical Report - A report, signed and sealed by a registered geotechnical engineer, used to determine extent of development and grading, slope stability in the form of maximum slopes, sink hole conditions, need for interceptor ditches and any items that may affect the extent of development and/or location of structures on the site.

60. Grade - The rate of deviation of the ground surface from the horizontal surface, expressed in percentages (i.e., 2%, 3%, etc.).

61. Highway - Same as street.

62. Highway System Plan - A plan depicting the general alignment and nature of road improvements for existing and future classified roads on the Arterial and County Road Systems and listing of classification, minimum future pavement width and minimum right-of-way requirements for all classified roads.

63. Hydraulic Grade Line - A line coinciding with the level of flowing water at any given point along an open channel; or the level to which water would rise in a vertical tube connected to any point along a pipe or closed conduit flowing under pressure.

64. Improvements - Street pavement, turning lanes, traffic signals, bridges and culverts, sidewalk pavement, pedestrian way pavement, utilities, fire hydrants, storm sewers and roadside drainage ditches, erosion and siltation control, sanitary sewers, signs, monuments,
landscaping, street lights, and other similar items.

65. Land Surveyor - A professional land surveyor registered in the State of Missouri.

66. License, Temporary Slope Construction - A grant by a property owner to the County for the purpose of making cuts, fills and sloping embankments, constructing driveways, providing working room and implementing any and all other related construction items in connection with the improvement.

67. Loading Space - A durably dustproofed, properly graded for drainage, off-street space used for the loading and unloading of vehicles, except passenger vehicles, in connection with the use of the property on which such space is located. Each such designated space shall comply with the dimensional requirements set forth in Section 405.440 of the Unified Development Ordinance. Off Street Parking and Loading Requirements shall be located to avoid any maneuvering on public roadways.

68. Lot - An area of land which is part of a subdivision, the plat of which has been legally approved and recorded in the Office of the Recorder of Deeds of St. Charles County and is intended to be separately owned, developed or otherwise used as a unit or an area of land which was legally approved and the deed recorded in the Office of the Recorder of Deeds.

69. Lot Area - The total horizontal area within the boundaries of a lot exclusive of any area designated for street purposes.

70. Lot, Corner - A platted area of land abutting two road rights-of-way at their intersection. A corner lot shall be deemed to have a front yard setback for each street.

71. Lot, Double Frontage - A lot having frontage on two (2) non-intersecting streets, as distinguished from a corner lot. Such lot shall be deemed to have a front yard on each street.

72. Lot (Parcel) of Record - A lot which is part of a subdivision, the plat of which has been legally approved and recorded in the Office of the Recorder of Deeds of St. Charles County, or a parcel of land which was legally approved and the deed recorded in the Office of the Recorder of Deeds of St. Charles County.

73. MoDOT - Missouri Department of Transportation.

74. Monument - A marker to be made of materials and placed by a land surveyor at locations specified in Section 410.400 of the Unified Development Ordinance and/or as directed by the Department.

75. Monuments and Signs, Ornamental Entrance - A structure or device designed or intended to convey information to the public in written or pictorial form, and which identifies residential or non-residential subdivision and/or commercial developments.

76. Municipality - A city, town, or village which has been duly incorporated in accordance with the laws of the State of Missouri, as a unit of local government.

78. On-Street Parking Space - A temporary storage area for a motor vehicle that is located on a dedicated street right-of-way.

79. Parcel (Tract) of Land - A separately designated area of land delineated by identifiable legally recorded boundary lines.

80. Parking Bay - A paved vehicle storage area directly adjacent to the access street or privately controlled pavement.

81. Parking Space - A surfaced, properly graded for drainage, usable space, enclosed in a main building or in an accessory building, or unenclosed, reserved for the temporary storage of one vehicle, and connected to a street, alley, or other designated roadway by a surfaced aisle or driveway. Each such designated space shall comply with the dimensional requirements set forth in Sections 405.440 and 405.460 of the Unified Development Ordinance.

82. Parkway - A road or roadway intended to be used primarily for passenger vehicles and developed with a park-like or scenic character, with recreational uses.

83. Pave (Pavement) - The act or result of applying a hard, water-tight material to any ground surface in such manner as to present a uniform surface over large areas.

84. Pedestrian Way - An easement or right-of-way designated to facilitate pedestrian access to adjacent streets and properties.

85. Permit - The Special Use Permit issued by the Department.

86. Person - Any individual, co-partnership, firm, association, company, or combination of individuals, of whatever form or character.

87. Plan, Concept - Drawing showing the site, internal circulation, adjacent public roads and commercial and residential entrances. Such plans must also show the dimensions and lane use of the existing public roadways.

88. Plan, General - A plan or any portion thereof for the coordinated development of St. Charles County, adopted in accordance with the St. Charles County Charter.

89. Plan, Site - A drawing showing plan and section views of the existing conditions and proposed improvements.

90. Plans, Construction - Same as Plans, Improvement.

91. Plans, Improvement - The engineering drawings showing the construction details and the types of materials for the physical structures and facilities, excluding dwelling units, to be installed in conjunction with the development of the project.

92. Plat - A subdivision of land legally approved and recorded.
93. Plat, Preliminary – Preliminary engineering maps, drawings or charts, and supportive material indicating the proposed layout of the subdivision.

94. Property Line - The legally recorded boundary of a lot, tract, or other parcel of land.

95. Public Utility Facility, Local - A public utility facility serving a local area only, such as an electric substation or a water or gas pumping or regulating station or a telephone switching center.

96. Record Subdivision Plat - That plat recorded in the Office of the Recorder of Deeds of St. Charles County containing the necessary affidavits, dedications and acceptances. Said plat shall contain complete bearings and dimensions of all lines defining lots and blocks, streets and alleys, public areas, and other dimensions of land.

97. Right-of-way - A dedication of land to be used generally for streets, alleys, or other public uses, wherein the owner gives up owner's rights to the property as long as it is being used for the dedicated purpose. Right-of-way is also a land measurement term meaning the distance between lot property lines which generally contains not only the street pavement, but also the sidewalks, grass area, underground utilities, and sometimes aboveground utilities.

98. Road - Same as Street.

99. Roadway - The entire area within public or private vehicular easement or right-of-way lines, whether improved or unimproved.

100. Roadway Right-of-Way Line - The boundary that divides a lot from a public or private roadway.

101. Setback (Building Line) - The required minimum distance from a road right-of-way or lot line that establishes the area within which a structure can be erected or placed, except as may be permitted in the Zoning Ordinance.

102. Sight Distance Triangle - A triangular-shaped portion of land established at street intersections in which nothing is erected, placed, or allowed to grow in such a manner as to limit or obstruct the sight distance of motorists entering or leaving the intersection.

103. Sign, Guide - A sign identifying entrances, exits, aisles, ramps, and similar traffic-related information.

104. Siltation Control - The installation of such devices as sediment ponds, bales of straw, siltation fencing, sodding or seeding and mulching, or other devices to prevent silting of abutting properties and roadway during the period of construction and up to and including such time as permanent ground cover is attained.

105. Single Lot Development - A development consisting of one or more buildings to be erected on a platted parcel of land or a single lot which is part of a subdivision, intended to be separately owned, developed, and otherwise used as a unit.
106. Slope - The rate of deviation of the ground surface from the horizontal surface, expressed in percentages or proportions (i.e., 3 horizontal: 1 vertical, 4 horizontal: 1 vertical, etc.).


109. Steep Grade - Roadway grades in excess of 8%.

110. Street - A public or private thoroughfare that affords the principal means of access to abutting property, including all facilities that normally occur within the right-of-way. The term shall also include such other designations as highway, thoroughfare, parkway, throughway, road, pike, avenue, boulevard, lane, place, court, but shall not include an alley or a pedestrian way. The pavement requirements for private streets shall be the same as public streets except that special roadway sections may be used for drainage and perpendicular parking.

111. Street, Access - A private thoroughfare or driveway that affords a means of access to parking areas and bays and to abutting buildings.

112. Street, Arterial - A major street so designated on the Highway System Plan or otherwise designated by the County Engineer, and utilized primarily for heavy volumes of traffic on a continuous route or for high vehicular speeds with intersections at grade.

113. Street, Collector - Collector streets interconnect the major arterial system with local streets; provide internal circulation within residential, commercial and industrial areas; provide access to abutting properties; and have a moderate volume and design capacity and travel speeds.

114. Street, Cul-de-Sac - A short, independent, minor street terminating in a circular turnaround.

115. Street, Dead End (No Outlet) - Local streets similar to cul-de-sacs, except that they provide no turnaround circle at their closed end, and are not permitted in any proposed subdivision. Stub streets, planned for future continuation, are not considered to be dead end streets, and must provide temporary turnaround areas that shall meet the requirements of the County Engineer for design, maintenance, and removal.

116. Street, Frontage or Service - A secondary street, generally parallel and adjacent to arterial streets and highways, which provides access to abutting properties and protection from through traffic by way of controlled access points along arterial streets or highways.

117. Street, Local Access - Same as Street, Minor.

118. Street, Loop - A short, independent, minor street that usually terminates along the same collector street of its origin.

119. Street, Minor - A land service facility for access to abutting properties. Minor streets serve
the local neighborhood and are in the form of a cul-de-sac or loop street. Any combination of loop and cul-de-sac streets may be utilized without the streets being designated as collector streets provided such an arrangement serves the same function and the average daily traffic does not exceed the total allowed within the provisions of Exhibit “A1” in Chapter 410 of the Unified Development Ordinance.

120. Street, Multi-Family Access - A private way or driveway which affords a means of vehicular access to parking areas and bays and to abutting buildings in a multiple dwelling unit subdivision.

121. Street, Private - A privately maintained thoroughfare which affords the principal means of public access to abutting property and which is constructed within easements provided by adjacent property owners.

122. Street, Public - A street maintained by the Department.

123. Structure - Anything erected, reconstructed, altered, repaired, relocated, or portable, the use of which requires a location on a parcel of land. It includes a movable structure that is located on land that can be used for housing, business, commercial, industrial, agricultural, or office purposes, either temporarily or permanently.

124. Subdivision - Shall, for the purpose of these regulations, be the division of a tract of land:

   a) Into three (3) or more lots, tracts, sites, or parcels, where each of which are less than three (3) acres in area, providing that no illegal zoning lot is created; or

   b) the division of a tract of land into any number of lots, tracts, sites, or parcels of any size in which a public street is to be dedicated, reserved, platted, opened, or constructed, or the dedication or platting, or recording of any streets; or

   c) the division of a tract of land into three (3) or more lots, tracts, sites, or parcels which front on and utilize an easement of access.

125. Subdivision, Multi-Family Residential - A tract of land, whether divided into separate lots or not, which is intended entirely for the construction of duplexes, multiple family dwellings, row houses and other arrangements of attached or connected building units.

126. Subdivision, Non-Residential - Either (a) a division or redivision of a tract of land into more than one (1) lot, plat, or site for commercial or industrial purposes; or (b) the dedication or establishment of a street, alley, pedestrian way in conjunction with or use in any such tract.

127. Subdivision, Single Family, Large Lot - A division or redivision of a tract or tracts of land wherein all lots are three (3) acres or more in area and each boundary meets the requirements set forth in Section 405.080 of the Unified Development Ordinance.

128. Subdivision, Single Family Residential - A division or redivision of a tract or tracts of land into lots, plats, or site for immediate or future sale or building development wherein any such lot, plat, or site meets the definition and requirements set forth in Section 405.090 of the
Unified Development Ordinance.

129. Subdivision Ordinance - Chapter 410 of the Unified Development Ordinance, as amended, which controls and regulates the division and redivision of land for St. Charles County.

130. Substantial Construction, Development or Work -

   a) In a project involving structures, the completion of excavation for footings and foundations.

   b) In a project involving no structures or insignificant structures, the completion of grading.

131. Title Company - A corporation qualified and acting under the Missouri Title Insurance Law or a corporation that is an issuing agency for an insurance company insuring land titles.

132. Title Page - Refer to Section 410.160 of the Unified Development Ordinance.

133. Tract - An area or parcel of land which the developer intends to subdivide and improve, or to cause to be subdivided and improved, pursuant to the requirements of this criteria and applicable St. Charles County Ordinances.

134. Traffic Generation Assessment - An assessment required of developers in the unincorporated areas of St. Charles County where ordinance conditions are imposed on new development, redevelopment or additions to existing development for improvements to area roadways to handle the additional traffic generated by this development.

135. Unclassified Road - All roads in unincorporated St. Charles County that are not classified, typically a minor or local access street.

136. Zoning Ordinance – Chapter 405 of the Unified Development Ordinance as from time to time amended, which controls and regulates zoning for St. Charles County.
20.10 Arterial & Major Street Design Criteria

20.10.1 Right-of-Way and Pavement Width Requirements

Right-of-way and pavement width requirements shall be determined by the County Engineer but shall not be less than the requirements for major residential collector or industrial streets. Any arterial or arterial collector pavement removal shall be replaced with equivalent pavement materials and thicknesses unless more stringent requirements are imposed by the County Engineer.

20.10.2 Side Road Connections

20.10.2.1 Side Road Connections being constructed or replaced as part of an arterial road improvement project shall be constructed of the same cross section specified for the arterial pavement. Type “G” transverse joints utilizing dowel supporting units will be required.

20.10.2.2 Side road connections to an existing arterial road must be constructed of a minimum seven (7) inches non-reinforced Portland cement concrete or two (2) inches of type “C” (BP-1) asphaltic concrete over seven and one-half (7 1/2) inches of type “X” bituminous asphaltic concrete base. A minimum of four (4) inches of type 1 or 5 rolled aggregate base shall be required under both types of pavements.

20.10.2.3 Pavement materials and thicknesses required in 20.10.2.1 and 20.10.2.2 shall, at a minimum, extend to the limits of the side street roundings. If the right-of-way limits of the arterial road extend beyond the side street roundings, then the entrance pavement must extend to the arterial right-of-way limits.

20.20 Reserved

20.30 Residential Street Design Criteria

20.30.1 Right-of-Way and Pavement Width Requirements:

<table>
<thead>
<tr>
<th>Street Classification</th>
<th>Lanes</th>
<th>R/W Width</th>
<th>Pav’t Width</th>
<th>Standard Dwg. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor (M)</td>
<td>2</td>
<td>42</td>
<td>26</td>
<td>C203.82</td>
</tr>
<tr>
<td>Minor Collector (MC)</td>
<td>2</td>
<td>48</td>
<td>32</td>
<td>C203.83</td>
</tr>
<tr>
<td>Major Collector (MJC)</td>
<td>3</td>
<td>54</td>
<td>38</td>
<td>C203.84</td>
</tr>
</tbody>
</table>

1. All of the above designated pavement widths shall be constructed with rolled curb with the exception of the following conditions:
   a. Where subdivisions are approved with commercial lot frontages that require vertical curb.
   b. Where subdivision collector streets are designed with vertical curb and restricted
access and adjacent lots are served from the internal cul-de-sac and loop streets.

c. Where Minor classified streets are approved for improvement with open drainage facilities as shown on Standard Drawings C203.81A and C203.81B.

2. The 38' pavement width shown for major collector classified streets shall be designed in accordance with the following lane configurations:

   a. 3 driving lanes where adjacent residential lots are served from internal cul-de-sac and loop streets.

   b. 2 driving lanes with 2 emergency parking lanes where adjacent residential lots are served from the collector roadway. However, at major intersections 3 driving lanes with tapers, appropriate pavement joint transitions and posted parking restrictions will be required.

20.30.2 Pavement Requirements:

<table>
<thead>
<tr>
<th>Minor (M) Streets (All Subdivision Streets less than 32' wide)</th>
<th>Flexible Pavement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-1/2&quot; Type “C” (BP-1) Asphallic Concrete Wearing Surface</td>
</tr>
<tr>
<td></td>
<td>6&quot; Type “X” Bituminous Asphallic Concrete Base</td>
</tr>
<tr>
<td></td>
<td>Rigid Pavement</td>
</tr>
<tr>
<td></td>
<td>6&quot; Portland Cement Concrete</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minor Collector (MC)</th>
<th>Flexible Pavement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2&quot; Type “C” (BP-1) Asphallic Concrete Wearing Surface</td>
</tr>
<tr>
<td></td>
<td>7-1/2&quot; Type “X” Bituminous Asphallic Concrete Base</td>
</tr>
<tr>
<td></td>
<td>4&quot; Type 1 or 5 Aggregate Sub Base</td>
</tr>
<tr>
<td></td>
<td>Rigid Pavement</td>
</tr>
<tr>
<td></td>
<td>7&quot; Portland Cement Concrete</td>
</tr>
<tr>
<td></td>
<td>4&quot; Type 1 or 5 Aggregate Base</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Major Collector (MJC)</th>
<th>Flexible Pavement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2&quot; Type “C” (BP-1) Asphallic Concrete Wearing Surface</td>
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<tr>
<td></td>
<td>7-1/2&quot; Type “X” Bituminous Asphallic Concrete Base</td>
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<td></td>
<td>4&quot; Type 1 or 5 Aggregate Sub Base</td>
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<td>Rigid Pavement</td>
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<tr>
<td></td>
<td>7&quot; Portland Cement Concrete</td>
</tr>
<tr>
<td></td>
<td>4&quot; Type 1 or 5 Aggregate Base</td>
</tr>
</tbody>
</table>
### 20.30.3 Horizontal and Vertical Alignment Requirements

<table>
<thead>
<tr>
<th>Street Classification</th>
<th>Lanes</th>
<th>Grades (1)</th>
<th>Centerline Alignment</th>
<th>Anticipated Posted Speed Limit (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor (M)</td>
<td>2</td>
<td>2% Min. 8% Max. 8% to 10% by special approval of Department. Special design may be required.</td>
<td>150’ R Min. 150’ to 75’ R by special approval of Department.</td>
<td>25 MPH Min. Under 20/25 MPH by special approval of Department.</td>
</tr>
<tr>
<td>Minor Collector (MC)</td>
<td>2</td>
<td>2% Min. 6% Max. 6% to 8% by special approval of Department. Special design may be required.</td>
<td>15 Degree Max. (375’ R)</td>
<td>25 MPH Min.</td>
</tr>
<tr>
<td>Major Collector (MJC)</td>
<td>3</td>
<td>2% Min. 6% Max. 6% to 8% by special approval of Department. Special design may be required.</td>
<td>15 Degree Max. (375’ R)</td>
<td>25 MPH Min. 30 MPH where adjacent residential lots are served from internal residential streets.</td>
</tr>
</tbody>
</table>

1. Roadway grades less than 2% or in excess of 8% must be approved by the Department prior to the preparation of improvement plans. Refer to Exhibit 20.50-1 for Design Control for Vertical Curves.

2. Design Speed - On existing roadways design speed shall be the 85th percentile speed of motorists on the roadway as established by radar studies, or 5 m.p.h. greater than the posted speed limit, whichever is greater. On new roadways design speed shall be 5 m.p.h. greater than the anticipated posted speed limit. On residential minor streets with a pavement width of 26 ft. or less, the design speed shall be the anticipated posted speed limit.
20.40 Non-Residential Street Design Criteria

20.40.1 Right-of-Way and Pavement Width Requirements:

<table>
<thead>
<tr>
<th>Street Classification</th>
<th>Lanes</th>
<th>R/W Width</th>
<th>Pav’t Width</th>
<th>Standard No. Dwg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor (M)</td>
<td>2</td>
<td>42</td>
<td>26(^{(1)})</td>
<td>C203.91</td>
</tr>
<tr>
<td>Minor Collector (MC)</td>
<td>2</td>
<td>48</td>
<td>32(^{(1)})</td>
<td>C203.92</td>
</tr>
<tr>
<td>Major Collector (MJC)</td>
<td>3</td>
<td>54</td>
<td>38(^{(1)})</td>
<td>C203.93</td>
</tr>
</tbody>
</table>

\(^{(1)}\) Pavement widths shown for all classifications require 6" vertical curb on both sides of the roadway.

20.40.2 Pavement Requirements:

All classifications and pavement widths

**Flexible Pavement**
- 2" Type “C” (BP-1) Asphalitic Concrete Wearing Surface
- 7-1/2" Type “X” Bituminous Asphalctic Concrete Base Course
- 4" Type 1 or 5 Aggregate Sub Base

**Rigid Pavement**
- 7" Portland Cement Concrete*
- 4" Type 1 or 5 Aggregate Base

* Denotes Type “G” Transverse Joints required (Refer to Standard Drawing C502.03).
### 20.40.3 Horizontal and Vertical Alignment Requirements

<table>
<thead>
<tr>
<th>Street Classification</th>
<th>Lanes</th>
<th>Grades (1)</th>
<th>Centerline Alignment</th>
<th>Anticipated Posted Speed Limit (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor (M)</td>
<td>2</td>
<td>2% Min. 8% Max. 8% to 12% by special approval of Department. Special design may be required.</td>
<td>150’ R Min.</td>
<td>25 MPH Min. Under 25 MPH by special approval of Department</td>
</tr>
<tr>
<td>Minor Collector (C)</td>
<td>2</td>
<td>2% Min. 6% Max. 6% to 8% by special approval of Department. Special design may be required.</td>
<td>15 Degree Max. (375’ R)</td>
<td>25 MPH</td>
</tr>
<tr>
<td>Major Collector (MJC)</td>
<td>3</td>
<td>2% Min. 6% Max. 6% to 8% by special approval of Department. Special design may be required.</td>
<td>15 Degree Max. (375’ R)</td>
<td>30 MPH</td>
</tr>
</tbody>
</table>

(1) Roadway grades less than 2% or in excess of 8% must be approved by the Department prior to the preparation of improvement plans. Refer to Exhibit 20.50-1 for Design Control for Vertical Curves.

(2) Design Speed – On existing roadways design speed shall be the 85th percentile speed of motorists on the roadway as established by radar studies, or 5 m.p.h. greater than the posted speed limit, whichever is greater. On new roadways design speed shall be 5 m.p.h. greater than the anticipated posted speed limit. For non-residential minor streets with a pavement width of 26 feet or less, the design speed shall be the anticipated posted speed limit.
### Design Speed "K" Values for Crest and Sag Vertical Curves

<table>
<thead>
<tr>
<th>M.P.H.</th>
<th>2 Lane Pavement Crest</th>
<th>2 Lane Pavement Sag</th>
<th>3 Lane Pavement Crest</th>
<th>3 Lane Pavement Sag</th>
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**Minimum Value of "L"**

- 50’
- 60’
- 75’
- 90’
- 105’
- 120’
- 135’
- 150’
- 165’
- 180’
- 195’
- 210’

**Formulas:**

- \( K = \frac{L}{2} \) or \( L = KA \)

---

**General Notes:**

1. On existing roadways, the design speed shall be the 85th percentile speed of motorists on the roadway as established by radar studies, or 5m.p.h. greater than the posted speed limit, whichever is greater. For residential and non-residential streets with a pavement width of 26 ft. or less, the design speed shall be the anticipated posted speed limit.

2. On new roadways, the design speed shall be 5m.p.h. greater than the anticipated posted speed limit. For residential and non-residential streets with a pavement width of 26 ft. or less, the design speed shall be the anticipated posted speed limit.

3. Ultimate pavement width shall be used to determine the "K" Values.

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**Saint Charles County Highway Department**

**ST. CHARLES, MISSOURI**

**Recommended Design Control for Vertical Curves**

**Date:** December, 2000

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**CAUTION:** Special attention to drainage must be exercised where a "K" Value greater than 160 is used.
30.00 Improvement Plan Requirements

The preliminary plat or concept plan must be approved before the Department will approve the roadway improvement plans.

Each approved preliminary plat or concept plan must contain all information required in Section 410.110 of the Unified Development Ordinance, where applicable, and in addition shall show existing and proposed right-of-way, easements, edge of pavement, islands, medians, lane usage, intersecting streets and driveways, sidewalks, traffic signal facilities and drainage structures on both sides of the roadway along the proposed site frontage and for a distance beyond the site limits to include required tapers, turning lanes, etc., as directed by the Department. Existing utility facilities such as poles, underground vaults, mains, pedestals, fire hydrants, etc., shall be shown and identified. Where possible these facilities should be avoided due to the relocation costs connected with them. For developments within 200 feet of an intersection, the above referenced existing and proposed roadway features must include all approaches to the intersection for a distance of 200 feet. The preliminary plat or concept plan must also include planned future roadway construction improvements by others in the vicinity of the proposed site development.

Preliminary plat or concept plans should also show the sight distance in each direction for all existing and proposed intersecting streets and driveways that will be affected by the proposed roadway improvements. Sight distance, including Permanent Sight Distance Easements, shall be determined and provided in accordance with the criteria specified in Section 40.25, “Sight Distance at Intersections.”

The preliminary plat or concept plan shall not be considered a construction plan. Intersection geometrics, median locations, size of channelization islands, radii, taper lengths, traffic signal improvements, easements, etc., are to be considered approximate and may need to be adjusted on the improvement plan. Construction details of any and all required geometric improvements are not considered finally approved until the improvement plan has been reviewed and approved by the Department.

The preliminary plat or concept plan shall be any scale from one inch equals ten feet (1” = 10’) through one inch equals two hundred feet (1” = 200’), so long as the scale is an increment of ten (10) feet and is sufficiently clear in reflecting the proposed improvements.

Following preliminary plat or concept plan approval, improvement plans for all aspects of the subdivision or site development must be submitted to the Department, as applicable, for review.

The improvement plans shall be any scale from one inch equals ten feet (1” = 10’) through one inch equals fifty feet (1” = 50’), so long as the scale is an increment of ten (10) feet and is sufficiently clear in reflecting the details of the proposed construction. However, all entrance plans shall be drawn to scale at one inch equals twenty feet (1” = 20’). Improvement plans shall be prepared on exhibits having a maximum sheet size of twenty-four (24) inches by thirty-six (36) inches. They shall generally consist of the Site Plan (single lot developments) or Title Page with plan view (subdivision developments) with an index of the drawings included with the plans, the Roadway Construction Detail Sheets, including applicable St. Charles County Standard Drawings, the Sanitary/Storm Sewer Plan and Profile Sheets, the Grading, Cross
Section and/or Contour Sheets, Interim Grading/Sediment & Erosion Control Plan sheets, Hydraulic Computation Forms, Right-of-Way and Easement Dedication Plat and other plans/drawings necessary to illustrate the improvements.

30.00.1 Sealing of Plans by Registered Engineers, Land Surveyors and Architects

The Missouri Board of Registration for Engineers, Land Surveyors and Architects is rigidly enforcing Missouri law in regard to the requirements for the practice of these professions. In this regard, professional seals and signatures are required on all plans, specifications, estimates, plats, reports, surveys or other like documents and must be affixed to every sheet in a set of documents. Following is a general list of documents for which professional seals are required:

**Sketch Plan** - No Seals Required by the Department

**Engineer’s Seal Required For Submittal of:**
- Circulation Plan (if engineering is involved)
- Preliminary Plat or Concept Plan
- Construction Plans
- Improvement Plans
- Flood Plain Study (for proposed change in the flood limits)
- Grading Plan
- Interim Grading/Sediment & Erosion Control Plan
- Storm or Sanitary Plans
- Hydraulics
- Soil Study
- Structures
- Engineering Reports
- Utility Companies-For Major Facilities, Structures, etc.
- Traffic Reports
- Record Plans
- Department Consultant Plans
- Department In-House Plans
- Department Major Maintenance Projects

**Surveyor’s Seal Required For Submittal of:**
- Record Plans
- Record Plat
- Right-of-Way Plans
- Land Surveys
- Topographic Surveys
- Subdivisions
- Bench Marks and Level Notes
- Monuments
- Floodplain (identify existing line only)
- Department In-House Plans
- Department In-House Surveys
- Department Consultant Plans
- Department Major Maintenance Projects
30.00.2 Site Plan/Title Page

The Site Plan or Title Page shall be used as the cover sheet for all improvement plans submitted for approval under this section.

Specific details shall include, but not be limited to, the following:

1. All information required in Chapter 410 of the Unified Development Ordinance.

2. Key map showing the relationship of the area to be subdivided to the tract and which shall reflect areas of the tract previously subdivided plus adjacent streets.

3. North arrow and graphic scale.

4. Title block showing name and address of developer and engineering firm.

5. One or more bench marks with level notes, in or near the site or subdivision, to which the development is referenced. Refer to Subsection 30.00.7 for additional requirements.


7. Grading and paving details conforming to St. Charles County standard specifications and requirements.

8. Existing and proposed survey monuments on site plans for single lot developments or on proposed record plat for subdivisions.

30.00.3 Roadway Construction Detail Sheets

All construction details pertaining to the roadway improvements (e.g., pavement widening, curbing, sidewalk, unpaved areas, entrances, etc.) shall be shown as a typical section and in plan and profile. The improvement plans should show existing and proposed right-of-way, easements, edge of pavement, islands, medians, lane usage, intersecting streets and driveways, sidewalks, traffic signal facilities and drainage structures on both sides of the roadway along the proposed site frontage and for a distance beyond the site limits to include required tapers, turning lanes, etc., as directed by the Department. Existing utility facilities such as poles, underground vaults, mains, pedestals, fire hydrants, etc., shall be shown and identified. Where possible these facilities should be avoided due to the relocation costs connected with them. For developments within 200 feet of an intersection, the above referenced existing and proposed roadway features must include all approaches to the intersection. The improvement plan must also include planned future roadway construction improvements by others in the vicinity of the proposed site development.

Specific details shall include, but not be limited to, the following:

1. All information required in Chapter 410, Article IV of the Unified Development Ordinance, where applicable.
2. Pavement widening or resurfacing improvements shall be dimensioned and developed in accordance with the “Standard Typical Section” applicable to the project or roadway (refer to Standard Drawings C203.81 through C203.93).

3. Pavement widening and resurfacing improvements shall be established about the original right-of-way centerline, unless otherwise directed by the Department.

4. Road improvements, involving new horizontal or vertical alignments within the site’s road frontage, shall be constructed symmetrically about the construction centerline, unless otherwise directed by the Department.

5. Mathematical profile grade elevations shall be shown at twenty-five (25) foot intervals on vertical curves and fifty (50) foot intervals on tangent sections for all roadway construction. Elevations shall be provided along the pavement edge at street intersection corner roundings at the point of curvature, the point of tangency and at 1/4 delta angle intervals for 32’ radius corners. For all radii larger than 32’, elevations at ten (10) foot intervals are required.

6. Resurfacing or widening profile grade elevations shall be shown at all breaks in grade and at twenty-five (25) foot intervals on the existing centerline and edges of pavement. Also the new centerline and edge of pavement profile elevations shall be shown with required superelevation provided on all horizontal curves.

7. Existing manholes to be affected by proposed resurfacing shall be adjusted to grade with expansion type adjusters (Nupco Adjust-to-Grade Manhole Castings or approved equal) and/or where the manhole has been previously adjusted to grade shall require adjustment of the manhole masonry necessary to establish the manhole frame and cover at the finished grade elevation.

8. The location and type of joint shall be indicated when it differs from the Pavement Construction Details on Standard Drawings C502.01 through C502.04. All longitudinal joints shall be constructed along proposed lane lines as directed by the Department. The locations of all sawed Type “A” expansion joints, as directed in Standard Drawing C502.04, shall be shown on the site plan views.

9. The type and location of entrance construction shall be indicated (Refer to Standard Drawings C608.00 through C608.02 and C608.30 through C608.35).

10. All intersection platforms shall be developed in accordance with Standard Drawing C203.54.

11. Compatibility with existing facilities shall be shown for streets, entrances and structures adjacent to and across from the subject site.

12. Drawings showing calculations of and provisions for adequate sight distance in each direction shall be provided for all existing and proposed intersecting streets and driveways which will be affected by the proposed roadway improvements.
30.00.4 Sanitary/Storm Sewer Plan and Profile Sheets

All construction details pertaining to the sewer improvements shall be prepared in accordance with the drainage requirements of this booklet (refer to Sections 50.10, 50.20 and 50.30) and shown in plan and profile.

Specific details shall include, but not be limited to, the following:

1. Existing ground, rock lines where necessitated by involvement with proposed improvements and finished grade elevations shall be shown and identified.

2. Open trenching of concrete pavements where permitted, shall require the replacement of the entire slab from joint to joint over thoroughly compacted granular backfill.

3. Open trenching of asphalt pavements where permitted, shall require a saw cut along each edge of the trench and replacement with full depth asphalt over thoroughly compacted granular backfill as directed on Standard Drawing C613.00. The Contractor or Permittee, where a Special Use Permit has been issued authorizing the work, shall be responsible for the repair of settlement and related deficiencies for a period of one (1) year.

4. Limits of granular backfill and pavement replacement, at all crossings of existing roadway surfaces not bored, shall be shown.

5. The location of all utilities to be encountered in construction shall be shown. Plans must be submitted to all utilities for verification of conflicts. The Department shall be contacted regarding all major utility conflicts within the road right-of-way.

6. Improvement Plan Approval shall be subject to plan approval by other political subdivisions having jurisdiction over the development.

30.00.5 Grading/Cross Section Sheets

All grading details pertaining to the site development shall be shown in plan view by contours or on cross section sheets.

Specific details shall include, but not be limited to, the following:

1. Existing and proposed contours shall be plotted at two (2) foot intervals. Contour intervals for Grading Plans other than the above shall require special approval.

2. Site grading shall be compatible with the ultimate roadway elevations.

3. Existing ground and finished grade elevations for the cross section sheets shall be plotted at any scale between one inch equals fifty feet (1" = 50') horizontal and one inch equals ten feet (1" = 10') vertical, and one inch equals five feet (1" = 5') horizontal and vertical.

4. Sinkholes (Refer to Section 40.60).
30.00.6 Interim Grading/Sediment & Erosion Control Plan Sheets

All interim grading and all sediment and erosion control measures shall be shown in plan view and contain all information required in Chapter 410, Article VI of the Unified Development Ordinance.

30.00.7 Bench Marks

The bench mark datum source for development in St. Charles County shall be U.S.G.S. or F.I.R.M. or Missouri Department of Transportation benchmarks based on U.S.G.S. datum. Level notes which tie the bench mark reference to the temporary bench mark on the site shall be provided with the plans.

30.00.8 Subdivision Improvement Plan Review

The procedure for reviewing the improvement plans shall be as follows:

1. There shall be submitted the required number of paving and street grade plans together with drainage maps and run-off sheets for stormwater. The plans shall be reviewed by the Department. The sanitary sewage facilities of the subdivision shall be reviewed by the appropriate sewer district. Corrections or additions shall be made, if needed, and when the plans are satisfactory to the reviewing agencies, approval shall be given by the Department. Complete approval of the plans by all reviewing agencies and payment of plan review fees constitutes authority to start construction or to post bond or escrow to cover the cost of improvements.

2. After the improvement plans have been approved, but before recording the record subdivision plat, the County shall review and approve a performance guarantee in accordance with Section 410 of the Unified Development Ordinance. Said guarantee shall be valid for a period of two (2) years. In the event that the improvements are not satisfactorily installed within that time, the Governing Body has the right to remove said monies to complete the guaranteed improvements, unless an extension in time is granted by the Governing Body.

3. Each sheet of the improvement plans shall be dated for initial submittal and subsequent revisions.

4. When revised improvement plans are submitted for review or approval, the revised portion of the plans shall be circled. The circled portion will be for current submittal only.

30.00.9 Highway/Subdivision Inspection Fee

A plan review fee shall be collected by the St. Charles County Highway Department in accordance with Section 425.020, I of the Ordinances of St. Charles County, Missouri.

Inspection fees shall be collected by the St. Charles County Highway Department in accordance with Section 425.020, J and K of the Ordinances of St. Charles County, Missouri,
based upon the Department’s estimate of time required to inspect storm sewers and other drainage structures, and the streets, public or private, including paving and sidewalks. The Department shall be entitled to full compensation for the time expended in making such inspections. If the estimated fee is inadequate, the necessary additional fees shall be collected by the Department and if the estimated fee is in excess of the amount actually expended, the balance shall be refunded by the Department. Claims for such refunds shall be made to the Department and shall be paid when audited and approved by the County Engineer.

30.00.10 Electronic Files

In addition to the printed improvement plans required for final approval, an electronic copy of the plans in AutoCAD format, if available, is requested to be submitted to the Department.

30.00.11 Utility Relocations

When utility relocations are required to accomplish the construction proposed within the public right-of-way, the consulting engineer shall make all necessary provisions for the coordination of the construction activities with the utility owner required to relocate same and provide verification of coordination to the Department.

Copies of all correspondence, plans and other information relating to the relocations shall be submitted directly to:

St. Charles County Highway Department
201 N. Second Street, Room 429
St. Charles, Missouri 63301

Attention: Highway Projects Engineer
Phone No. : 636-949-7305

1. Responsibility for costs connected with the relocation of utilities shall be determined by the following:

a. Utilities within right-of-way (without prior rights of utility companies):

   (1) At utility company’s expense when relocation is required to accommodate road improvements contracted for/completed by St. Charles County.

   (2) At developer’s expense when relocation is due to road improvements contracted for/completed by a private development.

b. Utilities within right-of-way (with prior rights of utility companies) or utilities on utility company owned easement:

   (1) At St. Charles County's expense when relocation is required to accommodate road improvements contracted for/completed by St. Charles County.
(2) At developer’s expense when relocation is due to road improvements contracted for/completed by a private development.

2. The developer should also be aware of extensive delays in utility company relocations and adjustments. Such delays will not constitute a cause to allow occupancy prior to completion of road improvements.

30.00.12 Utility Improvement Plans

When a new underground utility is proposed in the right-of-way of a County roadway, and the County roadway is proposed for future improvement, the Department will furnish typical sections to indicate where the utility line should be placed in order to minimize the possibility of future relocation due to improvement of the roadway to its ultimate configuration.

However, in view of changing Federal requirements, St. Charles County can accept no responsibility for relocations of utilities made necessary by future changes in grade or typical section.

Utility locations requested by the utility owner that are not in compliance with the Department’s recommendations must be accompanied by letter acknowledging the utility company’s responsibility for future relocation.
40.10 Street Improvements

All streets shall be graded and the roadway improved by surfacing. Roadway surfacing shall be in accordance with St. Charles County standards and specifications. All grading and surfacing shall be done under observation and inspection of the Department and shall be subject to its approval. The treatment of the intersection of any new street with a State highway shall be subject to approval by the District Engineer of the Missouri Department of Transportation.

At such times as a subdivision is proposed adjacent to a street that is accepted and maintained by St. Charles County, that street and other streets required shall be improved to handle the increased traffic due to said subdivision as directed by St. Charles County’s Highway System Plan, and the additional right-of-way and the cost of improvement of the right-of-way adjacent to the proposed subdivision shall be included in the overall subdivision improvements. The improvements shall be made to current County specifications and standards.

However, a large lot subdivision shall not be required to make the above improvements. The construction of a standard street intersection approach and right-of-way dedication only may be required as necessary for the relocation and/or widening of an adjoining County road.

In certain cases involving the subdivision of tracts of property, the reservation of right-of-way access may be required for future road improvements as authorized by the tract’s preliminary plat.

40.10.1 Street Design

All street construction, modification or widening shall be designed in accordance with the requirements of the Highway System Plan and the classification, design criteria and standards of the Department as follows:

<table>
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<th>Classification</th>
<th>Section</th>
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<td>Arterial &amp; Arterial Collector</td>
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<tr>
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<td>20.30</td>
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<tr>
<td>Non-Residential</td>
<td>20.40</td>
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All construction, details and specifications pertaining to roadway improvements within St. Charles County right-of-way shall be accomplished under the observation and inspection of the Department and shall be subject to its approval.

40.10.2 Street Name Signing

ReflectORIZED street signs bearing the name of the street, as designated on the record plat, shall be placed at all street intersections. Each and every intersection formed by the developer shall have at least one street name sign for each intersecting street mounted in a bracket on top of one post. Two sets of street name signs on separate posts shall be required at intersections where one street is thirty-eight (38) feet wide or greater, or when one street is an arterial roadway. Refer to Standard Drawing C903.10.
The Department shall approve the location and inspect the installation of street name signs in all subdivisions. The size, height, and type of sign shall be in accordance with the MUTCD or specifications of the Department. Street signs shall be required for large lot subdivisions; however, MUTCD specifications will not be required unless the intersection occurs with an existing or proposed publicly maintained street.

The required sign post location shall depend upon the traffic volume on the roadway and the width of pavement. Each post shall be placed a minimum of 3.5 feet from the back of the curb. Street name sign posts shall be located where they may be used for future “Stop” or “Yield” signs. This means that one set of street name signs shall be installed on the near right corner for the lesser volume roadway. Also, when one of the intersection streets is 38 feet or greater in width, or when one street is an arterial roadway, two sets of street name signs shall be required. Refer to Standard Drawing C903.10.

40.10.3 Speed Limit Signing

A speed limit sign meeting the requirements of the MUTCD shall be erected by the developer at all entrances to the subdivision. The speed limit signs shall display a posted speed limit of 25 miles per hour, unless directed otherwise by the County Engineer, and they shall be installed along the inbound lane of the subdivision within 150 feet of the subdivision entrance. The Department shall approve the location and inspect the installation of speed limit signs in all subdivisions.

40.10.4 Guard Rail

Guard rail shall be required to protect traffic from hazardous features, or to restrict or prohibit traffic movements. Guard rail will be required for roadway fill heights of 10 feet or more adjacent to the roadway or fill heights of 7 feet or more at pavement terminations. Terminal sections will be required for both directions of traffic flow on two-way pavement. Where the distance between terminal sections of two sections of guard rail will be 100 feet or less, one continuous length of guard rail shall be installed.

Guard rail shall be provided for protection of traffic adjacent to creeks and lakes, at bridge ends, piers, signs and headwalls, and as street barricades, as directed by the Department. Refer to Standard Drawings C606.00 through C606.12.

40.10.5 Roadway Berms

The grading and placement of berms within the road right-of-way as an alternate to guard rail may be permitted with special approval by the Department where such installations are considered compatible with the roadway typical section. Berms shall be constructed to a height of 3 feet above the adjacent edge of pavement or curb with 3:1 side slopes.

40.10.6 Escape Area

The grading of an escape area as an alternate to guard rail or roadway berms will have a slope no steeper than 6:1 and will be permitted by the Department in accordance with the following:
Minimum Escape Area Distance

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<th>Design Speed</th>
<th>From Edge of Pavement to Breakpoint</th>
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<td>30 - 35 MPH</td>
<td>25 Feet</td>
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<td>40 MPH</td>
<td>30 Feet</td>
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40.10.7 Medians

Raised median strips may be required by the Department to restrict through and/or left turning movements at or near driveways, commercial entrances and/or street intersections. Refer to Standard Drawings C608.03 through C608.48. Raised medians may also be utilized for ornamental entrance monuments and signs in accordance with Section 405.475 of the Unified Development Ordinance. Where medians are located at four-way street intersections, their widths shall conform to the requirements of Standard Drawing C608.09. For ultimate tee type street intersections, where the median is proposed on the minor side street, wider medians may be permitted by the Department to accommodate larger entrance monument designs. Refer to Section 40.50.2.

40.20 Street Standards

The arrangement, character, extent, width, grade and location of all streets and required improvements shall be considered in their relation to existing and proposed streets, to topographical conditions, to public convenience and safety, and in their appropriate relation to the proposed uses of the land to be served by such streets. The following standards shall apply:

1. Arrangement of subdivision streets shall conform as nearly as possible to St. Charles County’s Highway System Plan and the developer shall make provision for the extension and/or relocation of major, collector and minor streets, which impact the property. Except for dead-end streets, streets normally shall connect with streets already established, or provide for future connections to adjoining unsubdivided tracts, or shall be a reasonable projection of streets in the nearest subdivision tracts.

2. Stub streets shall be constructed to the property lines when required to provide for future connections to adjoining undeveloped tracts. Reasonable projections of streets in nearby subdivisions will establish the location of certain stub streets.

3. Where a subdivision abuts or contains an existing or proposed major street, the Department of Planning may require frontage streets or service streets, double frontage lots with screen planting, and non-access strips at the rear of such lots.

4. Minor street intersection jogs or discontinuities with centerline offsets of less than one hundred (100) feet shall be avoided.

5. Reserved strips of land which control or limit access at the terminus of streets or prevent access to streets located adjacent to undeveloped land are prohibited.
6. A subdivision entrance street shall intersect the major or collector street with an interior angle of seventy (70) to ninety (90) degrees unless otherwise approved by the Department. Each entrance street shall be positioned to provide required sight distance along each intersecting roadway as determined by the Department. Refer to Exhibit 40.25-1 for Sight Distance at Intersections criteria.

7. A minimum radius of twenty-four (24) feet at street right-of-way intersection and a minimum radius of thirty-two (32) feet at the back of the curb shall be required. Greater radii and channelization may be required at an intersection with a major or collector street or to provide access for vehicles having large turning radius requirements. The Department may permit a series of comparable cut-off or chords approximating the edge of pavement radius. Subdivision entrances shall, at a minimum, have roundings designed to accommodate the turning movements of a single unit truck (SU-30) and a school bus, if applicable, (S-BUS-36 or S-BUS-40) without causing the design vehicle to cross the centerlines of either intersecting street. Subdivision entrances shall also have roundings designed to accommodate the turning movements of a semitrailer (WB-40) without causing the design vehicle’s wheels to pass over any raised medians or rounding curbs.

8. All interior residential streets intersecting on collector streets shall be directly opposite existing or other proposed streets or shall be a minimum of one hundred and fifty (150) feet distant, as measured between street center lines. All other streets intersecting on arterial, county or nonresidential streets shall be directly opposite existing or other proposed streets or shall be a minimum of three hundred (300) feet distant, as measured between street center lines.

9. Where a collector street enters or connects with a major street, the Department must approve the entrance plan.

10. Streets shall be constructed to St. Charles County standard specifications.

11. All stub streets in excess of two hundred and fifty (250) feet in length measured from the centerline of the street intersection to the property line or plat boundary shall be provided with a temporary turnaround. Permits will not be issued for building construction on lots abutting a temporary turnaround as shown on any recorded subdivision plat unless and until the temporary facility is actually constructed and has been approved by the Department. Refer to Standard Drawing C502.06.

The removal of the temporary turnaround surface and the restoration of the disturbed ground shall be the responsibility of the party (ies) that will be extending the street in accordance with Section 410.320 of the Unified Development Ordinance.

12. All streets shall be designed to meet the minimum requirements set forth in Section 410 of the Unified Development Ordinance. These standards are designed to provide the maximum allowable flexibility in street construction standards, while at the same time, insuring the protection of the public interest. The widths of right-of-way and pavement are allowed to vary as functions of the type of street and the corresponding intensity of use.
13. Any subdivision platted along an existing street shall provide additional right-of-way as required in Section 410.270 of the Unified Development Ordinance. Additional right-of-way, in excess of the standard requirement, may be required when the subdivision is located on the inside of a curved roadway or conditions exist on the opposite side of the right-of-way which dictate right-of-way offset from the right-of-way centerline. When the subdivision is located on only one side of an existing street or County road, one-half of the required right-of-way shall be provided, measured from the centerline of the right-of-way, unless otherwise directed by the Department. The centerline must meet the requirements of the Department with regard to radius when located on a curved roadway.

14. Roadway easements for the servicing of large lot subdivisions shall have a minimum width of fifty (50) feet.

15. A subdivision plat involving new or existing streets crossing railroad tracks shall provide adequate rights-of-way, including approach rights-of-way and slope easements for construction of an underpass or overpass, unless otherwise specified by the Commission. Approval of the State of Missouri Public Service Commission and the Department must be received relative to all railroad crossings. The developer may be required to install crossing signals.

16. A street on which residential lots front and which parallels, but is not adjacent to a railroad right-of-way, shall be at a distance from the railroad right-of-way sufficient to provide lots with a minimum depth of one hundred sixty (160) feet.

17. Commercial and industrial subdivision streets shall be constructed with vertical curbs on both sides.

18. Where in the best interest of the traveling public, to provide circulation, health and safety measures, the Department may require a street to be dedicated to public use.

19. The pavement width set forth in the street specifications for multiple family access streets does not allow for, nor will parking be permitted on the streets. For each parallel parking space adjacent to these streets, an additional width of 10 feet shall be provided. Additional parking requirements shall be provided herein and/or to the standards established by the Commission.

20. If roadways are designated to be private roadways, maintenance of private roadway will be the responsibility of the property owner(s) or trustees.

21. Additional lanes and/or widening, pavement thickness, drainage facilities, granular base and/or traffic control devices may be required to accommodate heavy traffic volumes, unsuitable soil conditions, steep grades or other conditions not apparent at the time of the Preliminary Plat approval.

22. The developer shall provide adequate temporary off-street parking for construction employees. Parking on non-surfaced areas shall be prohibited in order to eliminate the condition whereby mud from construction and employees vehicles is tracked onto the pavement causing hazardous road and driving conditions.
23. If any public roads are proposed within a development, they must be built above the 100-year flood elevation with proper freeboard, or protected from flood damage by an approved levee. Any roads and/or drives proposed below this elevation, not protected by an approved levee, are to be private and remain private forever.

24. A tangent of less than one hundred (100) feet in length shall be avoided between reverse curves on major and collector streets.

25. Temporary or permanent turnarounds may be requested to accommodate school buses. The turnarounds shall have a pavement radius of fifty-five (55) feet. Refer to Standard Drawings C502.09 through C502.10. If school bus turnarounds are required, the school district will submit verification that they will permit buses to enter the subdivision utilizing the turnarounds.

26. Pavement lugs may be required on all street grades exceeding six percent (6%) that have been approved by the Department. Spacing of pavement lugs will be as follows:
   a) 200 feet intervals on tangent sections.
   b) 100 feet intervals on horizontal curve sections.
   c) Pavement lugs shall be located at or near the point at which the street grade first reaches six percent (6%) and proceed uphill at the required spacing with the last pavement lug located at or near the point at which the street grade becomes less than six percent (6%).
   d) Pavement lugs shall be constructed:
      4 feet in depth for street grades between 6% and 11.9%.
      5 feet in depth for street grades 12% and above.
   e) Type A Expansion Joints are required with each pavement lug and shall be located 10 feet downgrade of each pavement lug installation.
   f) Pavement lugs shall not be constructed within 30 feet of Grated Troughs (Refer to Standard Drawing C604.35).
      For construction details of the pavement lug and joint requirements, refer to Standard Drawings C502.03 and C502.12.

27. Roadway grades in excess of eight percent (8%) must be approved by the Department prior to the preparation of improvement plans. If proposed streets with grades in excess of eight percent (8%) are to be accepted by St. Charles County for maintenance, it will be necessary for the developer to provide a public disclosure that the development will have steep grades and that St. Charles County will not provide priority snow removal services to this development. This disclosure shall be noted on all approved plans for the site and on the sales contracts for the affected lots and posted in the display area. Refer to Section
40.70 for steep grade approval.

28. Prior to any action by the Department on a private roadway or public road right-of-way presently not maintained by St. Charles County, the residents, trustees, and/or property owners along the private or non-County maintained roadway shall be required to sign an affidavit stating the type of materials which have been used to maintain the roadway, the hauler of those materials, and the supplier or source of those materials. Also, in areas that may contain contaminated substances as identified by the U.S. Environmental Protection Agency, provide verification of review by the Department of Community Health and Medical Care.

29. Normally churches will not be required to construct pavement widenings along County roadways. However, right-of-way dedication, roadside grading and sidewalk construction will be required in accordance with the classification of the particular roadway involved.

30. In subdivision developments it is recommended that two (2) access points be established whenever possible for the benefit of emergency vehicles.

31. Sight distance criteria shall be based upon the ultimate number of lanes required for the roadway. Refer to Exhibit 40.25-1 for Sight Distance at Intersections criteria. If required sight distance cannot be provided at the access location, acquisition of right-of-way, removal of plant material, reconstruction of pavement, and other off-site improvements may be required to provide the required sight distance as directed by the Department.

32. When portions of roadway improvements required for the safety of the public require the acquisition of additional right-of-way and easements from private property, the normal sequence of design, right-of-way acquisition and construction shall commence immediately upon approval of the requested rezoning. If the developer is unable to acquire the necessary right-of-way and easements through negotiation with the particular property owners involved, St. Charles County may acquire same through eminent domain proceedings. The cost of appraisals, negotiations, administration, court proceedings and all associated costs incurred by County proceedings shall be paid by the developer.

33. Installation of Landscaping and Ornamental Entrance Monument construction, shall be reviewed by the Department for sight distance considerations and approved prior to installation or construction. Refer to Section 40.50.

34. Proposed development utilizing roadways with structurally deficient pavement within the site, or providing access to the development from such roadways, may be required to overlay the existing road surfacing or make other remedial improvements, as required by the Department, to bring the structural stability of the pavement up to minimum requirements.

35. All longitudinal joints in concrete pavement shall be constructed along proposed lane lines as directed by the Department. Where proposed lane striping and existing longitudinal joints do not coincide, a two (2) inch overlay of Type “C” (BP-1) Asphaltic Concrete Wearing Surface over engineering fabric shall be required.
SIGHT DISTANCE FOR VEHICLE ENTERING ROADSIDE FROM STOPPED POSITION ASSOCIATED WITH NEW DEVELOPMENT

<table>
<thead>
<tr>
<th>Design Speed (MPH)</th>
<th>Sight Distance to the Left (&quot;Y&quot;)</th>
<th>Sight Distance to the Right (&quot;Y&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W = 1 Lane</td>
<td>150'</td>
<td>150'</td>
</tr>
<tr>
<td>W = 2 Lane</td>
<td>200'</td>
<td>200'</td>
</tr>
<tr>
<td>W = 3 Lane</td>
<td>250'</td>
<td>250'</td>
</tr>
<tr>
<td>W = 4 Lane</td>
<td>300'</td>
<td>300'</td>
</tr>
<tr>
<td>W = 5 Lane</td>
<td>350'</td>
<td>350'</td>
</tr>
<tr>
<td>W = 6 Lane</td>
<td>400'</td>
<td>400'</td>
</tr>
<tr>
<td>W = 7 Lane</td>
<td>450'</td>
<td>450'</td>
</tr>
<tr>
<td>W = 8 Lane</td>
<td>500'</td>
<td>500'</td>
</tr>
<tr>
<td>W = 9 Lane</td>
<td>550'</td>
<td>550'</td>
</tr>
<tr>
<td>W = 10 Lane</td>
<td>600'</td>
<td>600'</td>
</tr>
<tr>
<td>W = 11 Lane</td>
<td>650'</td>
<td>650'</td>
</tr>
<tr>
<td>W = 12 Lane</td>
<td>700'</td>
<td>700'</td>
</tr>
</tbody>
</table>

Typical Profile Along Line of Sight to the Left

General Notes:
1. Do not scale drawings. Follow dimensions.
2. Sight distance design criteria shall be based upon the number of lanes of the alternative roadway.
3. On existing roadways, the design speed shall be the 85th percentile speed of motorists on the roadway, as established by motor studies, or 5 mph greater than the posted speed limit, whichever is greater.
4. On new roadways, the design speed shall be 5 mph greater than the anticipated posted speed limit.
5. For residential and non-residential roadways, other existing or new, with a pavement width of 23 ft. or less, the design speed shall be the anticipated posted speed limit.
6. If "Y" is greater than 3 lanes or "Y" is greater than 5 lanes, sight distance data shall be increased by extrapolating from values shown on the chart.
7. If "Y" or "Y" include a median, sight distance data shall be increased by interpolating between values shown on the chart.
8. Height of motorist eye in stopped vehicle = 5 ft. Height of approaching vehicle = 4.25 ft.
9. Sight distance requirements shall be satisfied by left and right for a median in each lane of a single or divided highway.
10. Sight distance requirements for left turning motorists on the through roadway attempting to enter a side street or driveway shall be the same as that required for "Y" in the nearest exit lane plus an additional 22 feet of sight distance.

Saint Charles County
Highway Department
St. Charles, Missouri

Sight-Distance At Intersections

Date: June, 2008
40.30 Entrance Standards

All entrance construction within St. Charles County roadway right-of-way shall be constructed in accordance with the St. Charles County Standard Specifications and the Entrance Standards, shown on Standard Drawings C608.00, C608.01 and C608.30. Refer to Exhibit 40.25-1 for Sight Distance at Intersections criteria.

40.30.1 Residential Entrances

Residential entrances on existing County roads shall not be less than ten (10) feet wide nor more than twenty (20) feet wide at the right-of-way line. When the distance between the sidewalk and pavement edge is less than four (4) feet, the minimum entrance width shall be twelve (12) feet.

Residential entrances on existing County roads shall be located so the edges of the curb opening shall be a minimum of five (5) feet from the nearest edge of street inlets and ten (10) feet from the street corner radius point. The edges of the curb opening shall not project beyond the side property line extended normal to the pavement. Clearances and dimensions are shown on Exhibits 40.35-1 and 40.35-2.

In the case of corner lots, no driveways shall be constructed within the sight triangle area bounded by the property lines of a corner lot and a line connecting two (2) points on the property lines each measured thirty (30) feet from the intersection of the two property lines at the intersection. Where applicable, easement lines shall be substituted for property lines.

The distance between adjacent residential entrances shall be a minimum of twenty (20) feet measured along the road right-of-way line. When residential development conditions necessitate reduction of the distance between adjacent residential entrances to ten (10) feet or less, the Department may require a Common Entrance Approach.

40.30.2 Commercial Entrances

Commercial entrances shall not be less than twenty-four (24) feet wide or more than forty (40) feet wide at the right-of-way line. The radius used to increase the opening at the curb or pavement edge shall not be less than ten (10) feet nor more than forty (40) feet. Exception to the width and/or radius may be required, or allowed with special approval by the Department, to insure adequate provisions for large vehicles and/or high traffic volumes.

Commercial entrances shall be located in accordance with the site plan requirements and shall be designed so the edges of the curb opening shall be a minimum of five (5) feet from the nearest edge of street inlets and as far as possible from the street corner radius point. The edges of the curb opening shall not project beyond the side property line extended normal to the pavement. Clearances and dimensions are shown on Exhibits 40.35-3 through 40.35-5.

In the case of corner lots, no entrances, parking spaces or other obstacles shall be constructed or placed within the sight triangle area bounded by the property lines of a corner lot and a line connecting two (2) points on the property lines each measured thirty (30) feet from the intersection of the two property lines at the intersection. Sign poles may be allowed if they are fifteen (15) inches or less in diameter and if the sign they support is not visually...
obstructing traffic at the intersection.

The number of commercial entrances for each property or site shall be limited on the basis of traffic requirements as determined by the Department. The maximum number of commercial entrances allowed, if all traffic requirements are satisfied, shall be as indicated in the following guidelines:

**Left Turn Restrictions**
*(When required by the Department)*

<table>
<thead>
<tr>
<th>Frontage (feet)</th>
<th>Max. Number Commercial Entrances</th>
<th>Method of Restriction</th>
<th>Standard Drawing Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 200</td>
<td>One (1)</td>
<td>Median</td>
<td>C608.13</td>
</tr>
</tbody>
</table>
| 200 - 500       | Two (2)                          | Median or Rt. In-Rt. Out Channelized Entrance | C608.13  
|                 |                                  |                       | C608.14                 |
| 500 - 1000      | Three (3)                        | Rt. In-Rt. Out Channelized Entrance | C608.03  
|                 |                                  |                       | C608.14                 |
| More than 1000  | As directed by Dept.             | Rt. In-Rt. Out Channelized Entrance | C608.03 |

Properties, which have frontage on two or more streets, shall have the number of commercial entrances on each street limited in accordance with traffic requirements and the above guideline. The distance between adjacent commercial entrances shall be a minimum of one hundred (100) feet measured along the road right-of-way line, unless otherwise approved by the Department.

For a service and/or gas station or a convenience store with gas sales development on a corner lot, the following guidelines are established. For a new development on a lot for which previous use was not associated with service and/or gas station or a convenience store with gas sales: One (1) entrance intersection from each street shall be permitted and located as far as possible from the street intersection corner. For redevelopment (complete rebuilding) of a lot for which present use is associated with service and/or gas station or a convenience store with gas sales which is presently served by less than three (3) entrances: One (1) entrance intersection from each street shall be permitted at a location approved by the Department.

For redevelopment of a present use that is presently served by three (3) or more entrances: The two (2) entrances located farthest from the corner may remain. The entrance located nearest to the corner on the inbound approach of the intersection shall be removed and the right-of-way restored to surrounding conditions or improved as required. The entrance located nearest to the corner on the outbound approach of the intersection may remain provided that this entrance is restricted, where required by the Department, to right turns in and right turns out by an existing or required median. For remodeling or renovation of an existing use (i.e. canopy addition, island
replacement or addition, dispenser replacement or addition, sales area renovation or addition, car wash addition) all existing entrances shall be permitted to remain except when changes to circulation patterns to the driveways result in an increased emphasis on the entrance located nearest the inbound approach of the intersection. Such entrance shall then be subjected to further review and possible elimination by the Department.

40.30.3 Left Turn Restrictions

The restriction of entrance turning movements will require the construction of right in - right out channelized entrances or raised median, as directed by the Department, based upon proximity to the nearest intersecting street or driveway, left turn storage requirements within the public right-of-way, development land use and traffic generation, sight distance limitations and cross access provisions as indicated in the above guidelines.

Where left turns are restricted by the construction of right in-right out channelization islands, the Department will require such turning restrictions to be legislated by the applicable city and/or county authority prior to opening the entrance to traffic.

40.30.4 Entrance Clearance

Residential and commercial driveway entrance locations that do not meet the side property line clearance requirements shall not be approved for construction without a consent letter from the abutting property owner.

40.30.5 Temporary Emergency Access

In certain instances, the Department may grant temporary access to roadways for emergency vehicles only. The access shall be a 12-foot wide, 12-inch thick rock drive with a standard paved approach within the right-of-way constructed of Type “X” Bituminous Asphalitic Concrete Base - 6" thick and Type “C” (BP-1) Asphalitic Concrete Wearing Surface - 2” thick. A gate must be provided across the drive at the right-of-way line with the sign, “Emergency Vehicles Only” on each side of the gate. The gate shall have a lock with the only keys thereto in possession of the St. Charles County Highway Department, the St. Charles County Sheriff Department and the appropriate Fire Protection District.

40.30.6 Parking Area

The requirements for off-street parking of the St. Charles County Unified Development Ordinance shall be implemented with regard to the minimum dimensions as stated in Section 405, Article II, Parking and Loading Requirements.

All required parking spaces shall be located out of the flood plain.

On-site parallel parking stalls shall be 9.0' x 24.0' adjacent to a 22' two-way lane or 15' one-way lane.

Curbed islands are required at ends of aisles where necessary for traffic control or drainage.

In the event that the desired parking angle is not specified in Section 405 of the Unified
Development Ordinance, the St. Charles County Department of Planning may specify other equivalent dimensions associated with the desired parking angle by interpolating the dimensions listed in the table.

In all zoning districts, all parking and loading areas, including driveways, shall be paved, except in the Agricultural and Non-Residential Districts where the Department and the Department of Planning may approve an alternate dustproofing method.

Off-street parking areas in all zoning districts shall provide ingress and egress to any public right-of-way only at such location as approved by the Department.

In a commercial or industrial district, parking space provided in an unenclosed area shall not be closer to the street right-of-way than fifteen feet, but may be located on any other part of the lot in conformance with zoning regulations. The area between the street right-of-way and front yard line, except for required driveways, shall be landscaped and such landscaping shall be adequately maintained.

For additional requirements refer to the St. Charles County Uniform Development Ordinance, Section 405, Article II, Parking and Loading Requirements.

40.30.7 Loading Docks

Loading docks shall be designed so that trucks shall not be forced to maneuver on public or private streets.

For additional requirements refer to the St. Charles County Uniform Development Ordinance, Section 405, Article II, Parking and Loading Requirements.

40.30.8 Cross Access

Cross access is defined as a commonly shared or used pedestrian way or vehicular driveway that connects or serves two or more properties.

The purpose of cross access may be to reduce the number of entrance intersections to an arterial or county street, to provide access via a signalized intersection, to provide direct access between adjacent developments, to provide access to lots not having road frontage, etc.

Cross access may be required as part of the Site Plan or Subdivision Review Procedure, zoning request, and/or special procedure request and shall be provided in accordance with the following conditions:

a) At the time the site plan is submitted for review, the Department will identify adjacent existing land use and its potential for change, existing traffic volumes and design features of the surrounding roadways, etc. in order to ascertain requirements for cross access. If cross access is required, the plan shall show the area to be included for cross access to include the driveway approach, internal driving and parking lot aisles and their extension to the property line(s) at the area(s) designated for connection to adjacent property to that area of cross access. In the event that cross access has not previously been established on adjacent property, no pavement connection to adjacent property is required other than
that necessary for the functioning of the site.

b) The area designated for cross access shall be kept free of all landscaping, fences, trash enclosures, parking/loading spaces, and/or other improvements except as required by the *Unified Development Ordinance*. Any approved improvements located in the areas designated for cross access shall be removed by the developer who is required to construct the pavement connection.

c) A Temporary Slope Construction License shall be provided to facilitate construction of the future cross access by the adjacent development or property owner. Maintenance of cross access areas shall be accomplished by each property owner or as may be agreed to by the owners. The owners shall provide copies of all such agreements to the Department for approval prior to execution and recording.

d) The Cross Access Easement Agreement shown on pages 40.35-7 and 40.35-8 may be duplicated for execution and submittal to the Department as part of the improvement plan approval.

e) Any modification of the Cross Access Easement Agreement shall be reviewed by the County Counselor and Departments of Highways and Planning and approved prior to execution and recording.
See Standard Drawings C608.00 and C608.30 for Entrance Construction Details not shown.

TYPE 1 RESIDENTIAL ENTRANCES

* May be varied to conform to type of entrance construction in approved subdivisions.
TYPE 2 RESIDENTIAL ENTRANCES

* May be varied to conform to type of entrance construction in approved subdivisions.
See Standard Drawings C608.02 for Entrance Construction Details not shown.

See Standard Drawings C608.51 through C608.54 for Curb Ramp Details.

TYPE 1 SPECIAL COMMERCIAL ENTRANCES

* Entrance radii may be increased as determined by the County Highway Department to provide for high traffic volumes or movement of large trucks.
See Standard Drawings C608.02 for Entrance Construction Details not shown.

See Standard Drawings C608.51 through C608.54 for Curb Ramp Details.

TYPE 2 SPECIAL COMMERCIAL ENTRANCES

* Entrance radii may be increased as determined by the County Highway Department to provide for high traffic volumes or movement of large trucks.
See Standard Drawings C608.02 for Entrance Construction Details not shown.

See Standard Drawings C608.51 through C608.54 for Curb Ramp Details.

TYPE 2 COMMERCIAL ENTRANCE WITH TAPERED APPROACH

* Entrance radii may be increased as determined by the County Highway Department to provide for high traffic volumes or movement of large trucks.
On-site parallel parking stalls shall be 9.0’x 24.0’ adjacent to a 22’ two way lane or 15’ one way lane.

Curbed islands are required at ends of aisles where necessary for traffic control and/or drainage.

A  Parking Angle
B  Stall Width
C  19’ Min. Stall to Curb
D* Aisle Width
E  Curb to Curb

* Additional width may be required where the aisle serves as the principal means of access to on-site buildings or structures.
CROSS ACCESS EASEMENT AGREEMENT

THIS AGREEMENT, made and entered into this ____ day of _________, 20__, by and between ____________________, owner of a tract of land described in Deed Book ______, Page ______ of the St. Charles County Records, party of the first part and _________________, owner of a tract of land described in Deed Book ______, Page _________ of said County Records and ____________________, owner of Lot ____ of ________________, a subdivision according to the plat thereof, recorded in Plat Book _____, Page _____ of said County Records, parties of the second part.

NOW, THEREFORE, it is the desire of the party of the first part to grant to the parties of the second part and to their respective successors and assigns, their tenants, subtenants, licensees, and the respective officers, employees, agents, representative, customers and invitees, the nonexclusive right, privilege and easement to use drives and roads as may now or from time to time hereafter be situated on the property of the party of the first part for ingress and egress to the property of the parties of the second part, and to the public road by automobile or other passenger vehicle. Said easement being fully described on Exhibit “A” attached hereto and incorporated herein by reference. Said easement shall be perpetual, and further, shall run with the real estate of the party of the first part forever. The party of the first part agrees not to obstruct the aforesaid roadway by means of a fence or other barrier, and further, to keep a road open and usable on their property leading from the aforesaid roadway to the public road so that there will be continuing access to the public road through the real estate of the party of the first part. No such accessway shall be relocated, narrowed or otherwise altered without the approval of the St. Charles County Highway Department on a revised circulation plan and the easement hereby established shall apply fully to such altered accessway.

IN WITNESS WHEREOF, the said party___ of the first part has executed these presents the day and year first above written.

(Corporation)

Attest: ____________________

Secretary

(SEAL)
STATE OF MISSOURI)
COUNTY OF ST. CHARLES) SS. On this ___ day of ___________, 20__, before me personally appeared _______________ to me known to be the person(s) described in and who executed the foregoing instrument, and acknowledged that executed the same as free act and deed.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year first above written.
My term expires: ________________________________

Notary Public

STATE OF MISSOURI )
COUNTY OF ST. CHARLES) ) SS. On this___ day of______________20__, before me appeared __________________________ to me personally known, who, being by me duly sworn, did say that he is the __________________ of _____________
_____________________
a Corporation of the State of _____________, and that the seal affixed to the foregoing instrument is the corporate seal of said corporation, and that said instrument was signed and sealed in behalf of said corporation, by authority of its Board of Directors; and said __________________ acknowledged said instrument to be the free act and deed of said corporation.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year first above written.
My term expires: ________________________________

Notary Public

Cut along this line

Preparation Notes:

The second paragraph on page 48 makes reference to an “attached Exhibit”.

The Cross Access Easement Agreement shown on pages 48 and 49 may be copied, pasted or taped together to measure 8-1/2” x 11” and duplicated for execution and recording in the office of the Recorder of Deeds. Consult the St. Charles County Recorder of Deeds office regarding their requirements for the format of the deed before executing and recording.

Any modification of the Cross Access Easement Agreement shall be reviewed by the County Counselor and Departments of Highways and Planning and approved prior to execution and recording.
40.40 Sidewalks and Handicap Ramps

All sidewalks and handicap ramps within St. Charles County road right-of-way or easement shall be constructed in accordance with St. Charles County Standard Specifications. All sidewalks located adjacent to State Highway right-of-way shall be constructed in accordance with St. Charles County Standards within a Permanent Sidewalk, Sewer and Utility Easement dedicated to St. Charles County. Maintenance of sidewalk along State highways shall be the responsibility of the abutting property owners or trustees of the subdivision and shall be so noted on the plans. Sidewalk construction along State highways requires authorization by the Department.

40.40.1 Sidewalk Construction

Sidewalks shall be four (4) feet wide (minimum) and constructed of four (4) inch thick concrete, except across driveways and temporary turn-arounds where the thickness shall be increased to match the driveway approach or adjacent pavement thickness. Under special circumstances five (5) inch thick asphaltic concrete sidewalk may be approved for use by the Department. Also, for commercial entrances, the thickness of the first section of sidewalk or handicap ramp on each side of the entrance shall be increased to match the driveway approach pavement thickness as shown on Standard Drawing C608.50. Additional width shall be required when sidewalks are adjacent to curbs and/or in commercial areas. Where sidewalks are located adjacent to or intersect with a curb within the County road right-of-way or easement, concrete handicap ramps will be required. Sidewalks constructed within municipalities adjacent to arterial streets may be subject to municipal ordinances or regulations specifying construction which exceeds this Department’s requirements.

40.40.2 Sidewalk Variances

Sidewalks shall be provided along road rights-of-way in accordance with the requirements in Section 410.330 of the Unified Development Ordinance. A determination as to the need for sidewalks is made by reviewing existing conditions, future development and projected pedestrian needs.

Sidewalks may be required from industrial subdivisions along the frontage of an arterial roadway as directed by the Director of Planning and Governing Body.

The existing conditions along the roadway frontage and adjoining properties will be examined closely to determine if new church developments will be required to construct sidewalk along their site frontage. In the case of churches being constructed in relatively undeveloped areas, sidewalk construction may not be required as part of the initial site development, provided arrangements can be made to ensure future construction in conjunction with development of abutting properties. However, in the event that the church is located in a more fully developed area where a sidewalk construction pattern has been established, construction of sidewalk will be required.

40.40.3 Sidewalk Escrow

The subdivision developer or site owner is responsible for the construction of sidewalk adjacent to common ground or privately owned property. Escrow funds for the construction
of sidewalk by the subdivision developer or site owner will be required to be included in the overall Subdivision Improvements Escrow. Sidewalk construction adjacent to platted subdivision lots is regulated by the St. Charles County Building Department as part of the Occupancy Permit process.

40.40.4 Sidewalk District

In areas where there are no sidewalks along County maintained roadways and residents are desiring the construction of sidewalks, a Neighborhood Improvement District (NID) could be formed involving those properties which would benefit from the construction of a sidewalk. This may require dedication and/or acquisition of right-of-way and related easements and assessment to property owners in the Neighborhood Improvement District to pay for the cost of construction. Contact the St. Charles County Highway Department Office for information regarding the requirements for formation of such Neighborhood Improvement District.

40.50 Landscaping

All landscaping where permitted within St. Charles County road right-of-way shall be planted and installed in accordance with St. Charles County Standard Specifications. The recommended location for street trees varies between five (5) and ten (10) feet from the road right-of-way line on private property, depending upon the type of tree being planted. Permits shall be required for the planting of hedges, shrubs, landscaping, ornamental entrances and monuments, berm slopes, trees, etc. within the right-of-way and shall not be issued without the approval of the subdivision trustees.

40.50.1 Location

Trees shall not be located within a street right-of-way unless approved by the County Engineer. Location of new street trees shall not be allowed within the following areas: three (3) feet of any curbs, twenty-five (25) feet of street lights, ten (10) feet of street inlets or manholes, or, at street intersections within the triangular area bounded by the pavement lines and a line connecting the two (2) points of the edge of the street pavement sixty (60) feet from the point of intersection of the projected lines of the street pavement. No structure or plant material exceeding thirty-six (36) inches in height above the elevation of the adjacent street pavement may be planted or maintained within the sight triangle area bounded by the property lines of a corner lot and a line connecting two (2) points on the property lines each measured thirty (30) feet from the intersection of the two (2) property lines at the street intersection. Likewise, no trees may be planted or maintained within the triangular area that have bottom branches lower than seven (7) feet above the elevation of the adjacent street pavement.

No plant material exceeding a height of thirty (30) inches above the adjacent ground surface or thirty-six (36) inches above the elevation of the adjacent street pavement may be planted or maintained within fifteen (15) feet of the pavement edge of public roadways. Trees within this area shall have bottom branches no lower than seven (7) feet above the elevation of the adjacent street pavement. This requirement shall cover both County right-of-way and private property within the fifteen (15) feet from the pavement edge of a public roadway.
40.50.2 Ornamental Entrance Monuments and Signs

Structures and/or signs proposed at subdivision and commercial development entrances shall conform to the requirements of the Zoning Ordinance.

The width, height, grade and location of all entrance monuments and signs shall be reviewed with relation to the existing and proposed streets and/or major commercial driveway intersections for possible sight distance restrictions affecting nearby vehicular and pedestrian traffic and other requirements as follows:

1. Ornamental entrance monuments and signs when located in medians approaching street intersections shall be located a minimum of twenty (20) feet from the prolongation of the intersecting road right-of-way or easement line and constructed symmetrically about the median centerline.

2. Monuments and signs located in proximity to the street intersection corners shall not be located within the road right-of-way.

3. Monuments and signs located within the Sight Distance Triangle area of the street intersection corners shall be subject to the height limitations governing trees and plant materials described in previous Item 1 on page 40.50-1.

4. Ornamental entrance monuments and signs shall not be placed or constructed within the public road right-of-way or easement without authorization by the Department through the issuance of a permit.

5. Plans shall be provided showing elevation and section views of the proposed construction. Plans shall indicate the location of the adjacent right-of-way, easements, curbing, sidewalk, street pavement, utilities and/or landscaping.

6. Plans for monuments and sign structures shall be approved by the Planning Department prior to issuance of the Highway Department’s special use permit. (Where special permits, i.e., building, electrical and/or plumbing are required, they shall accompany the plans.)

7. Sight distance triangles shall be shown.

8. Permit for construction will be issued initially to the developer or later to Trustees or other individuals designated in the trust indentures.

9. Where the entrance monument and sign have not been specifically provided for in the recorded indentures, amendments shall be recorded prior to plan approval and permit issuance.

10. Indentures must provide for maintenance and repair of structure and sign authorized by permit.

11. Indentures must hold County harmless from all claims, demands and suits of any kind arising out of or in conjunction with any permits issued.
12. Entrance monuments and signs located within the public road right-of-way under permit authorization shall be removed if requested in writing by the Department.

40.50.3 Types of Trees for Planting

Tree species presently used for locations along road sides are the Tulip Tree (Liriodendron Tulipfera), Bradford Pear (Pyrus Calleryanna), Honeylocust (Gleditsia Triacanthos var. inermis), Littleleaf Linden (Tilia Cordata), Zelkova (Zelkova Serrata), Sweet Gum (Liquidamberg Stryaciflua) and True Pin Oak (Quercus Palustris) and are planted at an interval of forty-five (45) to fifty (50) feet. The above tree species are recommended due to their deeper growing root systems and thus reduce damage to nearby curbs and sidewalks.

40.50.4 Maintenance

Maintenance of trees planted is the responsibility of the property owners individually or the subdivision trustees as a group, and if located as recommended above would not normally be subject to future removal.

In the event that the adjacent property owner or trustees do not complete this work and a safety hazard to the general public would result, the Department will trim the trees and shrubs.

Trustees may legally work on St. Charles County public road right-of-way and will be issued a no charge special use permit to do certain work.

The following plant material requirements should be satisfied:

a) Within St. Charles County right-of-way, trees must be trimmed so that the bottom branches are a minimum of seven (7) feet above the elevation of the adjacent pavement and/or sidewalk, and must be cut to back of curb.

b) In the case of corner lots, where plant growth causes a sight obstruction, plant material exceeding a height of thirty-six (36) inches above the elevation of the adjacent street pavement may not be planted or maintained within the triangular area bounded by the property lines and a line connecting the two points on the property lines thirty (30) feet from the intersection of the property lines. Also, within this area, trees shall be trimmed so that the bottom branches are a minimum of seven (7) feet above the elevation of the street pavement.

c) Shrubbery shall be trimmed so that it does not extend over the roadway pavement or sidewalk. Also, the lower branches on trees shall be trimmed so that they do not become an obstacle for pedestrians on the sidewalk.

40.50.5 Permits

When it is determined that certain barriers (other than trees and shrubbery) do not constitute a hazard or nuisance, the property owner may be notified to obtain a Special Use Permit from the Department. If the property owner fails to submit a request for a permit within thirty (30)
days, the barriers shall be removed from the right-of-way.

40.50.6 Hazardous Situations

The following guidelines have been established to properly identify possible plant material and barrier hazards.

a) A fence located within County right-of-way may not necessarily constitute a hazard. Fences that obscure the sight distance for motorists entering an intersection could be a hazard. Also, fences that are located directly behind the edge of pavement could be a hazard to pedestrians depending upon the width of pavement and the volume of traffic.

b) Rocks, railroad ties, or other posts located within the County right-of-way may not necessarily be a hazard. These barriers could be hazards if they are located in the path of normal pedestrian traffic and/or are located so close to the edge of pavement that motorists could strike them.

c) Plant material located on the corners of intersections could be a hazard if motorists are unable to see cross traffic approaching.

d) Trees with low branches across a sidewalk or walkway could be a hazard to pedestrians.

40.50.7 Inspection and Removal

Within the St. Charles County right-of-way adjacent to the public roadway, certain cases may dictate the need to remove any plant material including trees within the right-of-way. The discretion and authority to remove such plant material is the function of the Department.

In order to ensure that plant material and barrier hazards have been removed from County streets and parkways where necessary, the following policy shall be effective:

a) The Department shall investigate all possible hazards created by plant material and barriers that are known through citizen complaints and/or by report from Departmental personnel.

b) When it is determined that certain plant material and/or barriers installed by the abutting property owner are hazardous (that is, obstruct or endanger traffic) or constitute a nuisance, the Department shall notify the property owner of the hazard or nuisance and request removal of same as soon as possible.

c) After a reasonable length of time, the Department will conduct a follow-up investigation to determine if the property owner has corrected or removed the hazard or nuisance.

d) If the notified property owner has not corrected the hazard or nuisance, the Department will make arrangements to remove said hazard or nuisance as soon as possible without further notification to the property owner.
40.50.8 Other Landscaping Concerns:

a) Ground Cover - The Department may require sodding or other means of ground cover to ensure erosion control.

b) Common Land - The Department may require the clearing of underbrush, sodding, seeding, and other landscaping improvements in that portion of the common land that has been altered or graded.

40.60 Geotechnical Reports

A Geotechnical Report shall be required where grading and proposed improvements on the site are located in an area where soil conditions are susceptible to rapid erosion, landslide, settlement and/or creep. The report shall verify the adaptability of grading and improvements with soil and geologic conditions. A statement of compliance with this study, signed by the Geotechnical Engineer preparing the report, shall be included on all Site Development Plans. The development plan and improvement plans shall be designed to conform to the requirements and conditions of the Geotechnical Report. A Geotechnical Engineer shall be required to inspect construction in accordance with the grading and soils requirements and conditions contained in the report.

In general, all slopes shall be graded to meet St. Charles County’s standard 3:1 or flatter slope for both cut and fill. 2:1 slopes may be approved by the Department where their use is supported by detailed soils information. If the preliminary grading plans or site plans propose high terraces, the soils report should indicate measures to intercept and divert surface water from flowing over terraces and walls.

In all areas of questionable soil stability such as sinkholes, ponds, marshy areas, etc., the Department shall be notified prior to commencement of grading so that these locations can be inspected.

Sinkhole Report – Where improvements are proposed in an area identified as sinkhole areas, a sinkhole report will be required. This report is to be prepared by a Professional Engineer, registered in the State of Missouri, with demonstrated expertise in geotechnical engineering, and shall bear his or her seal.

The sinkhole report shall verify the adaptability of grading and improvements with the soil and geologic conditions available in the sinkhole areas. Sinkhole(s) shall be inspected to determine its functional capabilities with regard to handling drainage.

The report shall contain provisions for the sinkholes to be utilized as follows:

1. All sinkhole crevices shall be located on the plan. If the sinkhole is either in the public road right-of-way or within 10’ of the public road right-of-way, it shall be excavated to the crevice, treated and brought to grade by the construction of a manhole or inlet.

2. Functioning sinkholes shall be utilized as a point of drainage discharge by a standard drainage structure with a properly sized outfall pipe provided to an adequate natural discharge point, such as a ditch, creek, river, etc.
3. Non-functioning sinkholes and sinkholes under a proposed building may be capped.

4. Sinkholes may be left in their natural state; however, they will still require a properly sized outfall pipe to an adequate natural discharge point.

5. An overland flow path shall be required for all sinkholes assuming the outfall pipe and sinkhole become blocked.

Where the topography will not allow for an overland flow path, the following will be required if deemed necessary by the Department.

1. The storm sewer shall be designed for the 100-year, 20 minute storm; and

2. If this storm pipe is smaller than thirty-six (36) inches in diameter, a designated ponding area shall be identified, assuming the pipe is blocked; and

3. The ponding area shall be based on the 100-year, 24-hour storm; and

4. The low sill of all structures adjacent to the ponding area shall be above the 100-year high-water elevation.

5. All sinkholes must be inspected by the Department prior to treatment. Special siltation measures shall be installed during the excavation of sinkholes and during the grading operations to prevent siltation of the sinkhole crevice.

In general, the following procedure shall be followed in treating sinkholes:

1. Excavation - Prior to filling operations in the vicinity of a sinkhole, the earth in the bottom of the depression will be excavated to expose the fissure(s) in the bedrock. The length of fissure exposed will vary, but must include all unfilled voids or fissure widths greater than 1/2 inch maximum dimensions which are not filled with plastic clay.

2. Closing Fissures - The fissure or void will be exposed until bedrock in its natural attitude is encountered. The rock will be cleaned of loose material and the fissures will be hand-packed with quarry-run rock of sufficient size to prevent entry of this rock into the fissures, and all the voids between this hand-packed quarry-run rock filled with smaller rock so as to prevent the overlying material’s entry into the fissures. For a large opening, a structural (concrete) dome will be constructed with vents to permit the flow of groundwater.

3. Placing Filter Material - Material of various gradations as approved will be placed on top of the hand-packed rock with careful attention paid to the minimum thicknesses. The filter material must permit either upward or downward flow without loss of the overlying material.

    The fill placed over the granular filter may include granular material consisting of clean (no screenings) crushed limestone with ten (10) inch maximum size and one (1) inch minimum size or an earth fill compacted to a minimum density of ninety (90) percent


modified Proctor as determined by ASTM D-1557.

4. Supervision - Periodic supervision of the cleaning of the rock fissures must be furnished by the Soils Engineer who prepared the Soils Report. Closing of the rock fissures will not begin until the cleaning has been inspected and approved by that Soils Engineer. During the placement and compaction of earth fill over the filter, supervision by the Soils Engineer shall be continuous. Earth fill densities will be determined during the placement and compaction of the fill in sufficient number to ensure compliance with the specification. The Soils Engineer is responsible for the quality of the work and to verify that the specifications are met.

For reports concerning proposed developments located on property containing steep slopes or erosive soils, the consultant should prepare conditions within the report covering the following, at a minimum.

1. Erosion of silt-rich loessial soil: What should be done to minimize surface erosion during and after construction? Also, what measures should be taken to address erosive velocities at discharge points?

2. Developments on slopes greater than 20%: Soil creep is a potential problem on slopes this steep, and developments in these areas will require engineering analysis and solutions.

3. Cut and fill: Construction of cut and fill slopes in these areas should be detailed to assure slope stability.

For reports done on proposed developments located on property containing plastic soils or rock shelves, the consultant should prepare a report covering the following, at a minimum.

1. Natural slope stability: Are the natural slopes on shale stable enough for the density of development proposed?

2. Swelling soils: The potential for swelling soils and their affect on home and road foundations should be discussed.

Additional considerations that can be covered in these reports include affect of stream erosion on private property, foundation design, foundation drainage, road design, excavations, etc.

The reports for the erosion-prone area do not necessarily require subsurface investigation. The shale areas, however, would almost certainly require shallow exploration. The reports shall be prepared under the supervision of and sealed by an engineer.

Developments that require more detailed soils information are those with very dense housing (greater than 3–4 houses per acre), extensive grading and site preparation (including cut and fill), steep slopes, etc. Some developments can be less critically reviewed due to minimal site disturbance and low density housing (2 or less houses per acre).
**40.70 General Miscellaneous Requirements**

**40.70.1 Noise Pollution**

It is possible that substantial sound levels may be present for a development site located adjacent to a Federal Aid highway, and acceptable noise levels established by the Federal Highway Administration for the Federal-Aid System may be exceeded. A noise study evaluating the impact of existing and proposed traffic on the development should be provided. Certain noise abatement criteria established by the Federal Highway Administration must be followed in developing the site. This Department has no plans to provide sound attenuation devices for development. The Federal Highway Administration has indicated that Federal money cannot be spent on noise control projects if the local government has not taken steps to exercise land use control over remaining developed lands adjacent to the highway to prevent further development of incompatible activities. However, after local authorities have taken measures to exercise land use control over undeveloped lands adjacent to highways, noise abatement measures may be employed to protect activities and land uses to prevent further development of incompatible activities.

**40.70.2 School Speed Zone Policy**

The Department will consider reduced speed limits along county maintained roads adjacent to elementary schools in accordance with the following policy guidelines:

a) Applies to all County maintained roadways located in unincorporated St. Charles County and in municipalities whose roads are maintained by the County.

b) Applies to any existing school speed zone that may require modification of said speed zone.

c) Applies only to Elementary Schools and not to Middle/Junior High Schools or High Schools.

d) A school speed study will normally be initiated only after a request from the Principal or Administrator of the Elementary School/School District.

e) The school speed zone shall be 10 miles less than the posted speed limit or a minimum of 25 MPH.

f) The school zone speed limit will only be in effect during school hours.

g) Signs reading “School”, the reduced speed limit, the hours during which the school zone is in effect will be posted on a single post at the beginning of the zone and as needed throughout the zone. Signs reading “End School Zone” and the normal posted speed limit will be posted on a single post at the end of the zone.

h) The length of the school speed zone along a County roadway would be determined by the traffic study for the particular elementary school.
40.70.3 Fire Station Signals

When fire station signals are required by the Department, installation and material costs shall be the responsibility of the developer or fire district.

40.70.4 Steep Grade Justification

Street grades exceeding 8% are considered not desirable. If street grades exceeding 8% are proposed, a separate plan submittal is required requesting steep grade approval. This plan submittal shall include as a minimum:

a) Plan and profile sheets showing the proposed grade, an 8% grade and giving the street names and stationing.

b) Existing ground line and rock line based on actual field borings and survey.

c) Cross sections, including rock elevations, at critical locations to determine the grading of adjacent lots.

d) Cost estimates of rock excavation required to obtain an 8% grade versus the proposed grade.

e) Earthwork quantities and cost estimates required to obtain an 8% grade versus the proposed grade.

f) Cost estimate of hauling operation if earthwork balance cannot be obtained by using 8% grades.

The following will not be considered as justification for steep grade approval:

aa) Inability to obtain the total number of lots permitted by zoning.

bb) Adhering to previously approved flood plain study.

cc) Removal of tree cover.

dd) Variance from standard typical sections.

Approval of steep grades exceeding 8% will be given by the County Engineer based on the data submitted.

When steep grades are approved, steep grade drainage shall include grated troughs and pavement lugs where required.

Standard platforms ranging from 2% to 4% for sixty (60) feet will be required at all side street intersections regardless of steep grade approval. (Refer to Standard Drawing C203.54).
40.70.5 Street Lighting

Street lighting on County roads is not provided and paid for by St. Charles County Government. Street lights are maintained by the subdivision residents as a trustee function in accordance with Section 410.330 of the *Unified Development Ordinance*.

40.70.6 Retaining Walls

Railroad tie and wood retaining walls will not be permitted under any circumstances.

Reinforced concrete retaining walls are required for all roadway fills. Modular or interlocking concrete retaining wall with or without a geogrid soil reinforcement system may be approved for use within or outside of the public right-of-way by the County Engineer. Final design of any retaining wall system shall be based on adequate site investigations by a qualified Soils Engineer.

It will be necessary to obtain building permits from the St. Charles County Building Department for retaining walls constructed in areas where they cannot be considered to be attendant to the building structure involved.
50.00 Storm Drainage Facilities

50.10 General Design Requirements for Storm Drainage Facilities

Stormwater sewers or channels provide the facility for removing and transporting surface runoff produced from rainfall. Storm drainage improvements consisting of storm sewers, open channels, or a combination thereof, shall be designed to adequately drain the areas being developed. The design of drainage improvements shall be coordinated to the extent possible with present and probable future development so as to form part of an integrated system. Adequate provisions shall be made for the disposal of storm water, in accordance with the standards and specifications of the St. Charles County Highway Department.

This section gives the minimum technical design requirements for storm drainage facilities in unincorporated St. Charles County. In general, the formulae presented herein for hydraulic design represent "acceptable" procedures not necessarily to the exclusion of other sound and technically supportive formulae. Any departure from these design requirements should be discussed before submission of plans for approval and should be justified. All construction details pertaining to storm sewer improvements shall be prepared in accordance with the Metropolitan St. Louis Sewer District (MSD) Standard Construction Specifications unless otherwise noted. For "Sewer Construction Details," refer to St. Charles County Standard Details of Sewer Construction sheets C604.34 through C604.94 or current MSD sewer detail drawing Sheets 1-62, excepting Sheet 47, "Precast Concrete Inlet Cover,” Sheet 59, “Gutter Sumps For Vertical Curb,” Sheet 60, “Gutter Sump For Lip Curb,” and Sheet 61, “Flared End Section” which are not approved for use in St. Charles County.

A signed and dated professional engineer's seal shall be required on all engineering plan sheets and calculations submitted for approval.

50.20 General Requirements of Storm Sewer Construction

All storm sewers shall meet the following general requirements:

50.20.1 Size and Shape

The minimum diameter of pipes for stormwater sewers shall be twelve (12) inches. Sewers shall not decrease in size in the direction of the flow unless approved by the Department. Circular pipe sewers are preferred for stormwater sewers, although rectangular or elliptical conduits may be used with special permission.

50.20.2 Materials

All materials shall conform to MSD Standard Construction Specifications. Reinforced concrete pipe joints shall be Type "A" or better, as required.
50.20.3 Bedding

The Project Plans and Specifications shall indicate the specific type or types of bedding, cradling, or encasement required in the various parts of the storm sewer construction if different than current MSD Standard Construction Specifications. Special provisions shall be made for pipes laid within fills or embankments and/or in shallow or partial trenches, either by specifying extra-strength pipe for the additional loads due to differential settlement, or by special construction methods, including ninety (90) percent modified proctor compaction of fill to prevent or to minimize such additional loads.

Compacted granular backfill shall be required in all trench excavation within public or private street rights-of-way or areas where street rights-of-way are anticipated to be dedicated for public use. Under areas to be paved, the compacted granular backfill shall be placed to the subgrade of the pavement. Under unpaved areas, the compacted granular backfill shall be placed within two (2) feet of the finished surface.

A minimum of three (3) feet of cover is desired over all storm pipes. Pipes having a cover of less than one and a half (1.5) feet shall be required to have a special bedding design that must be approved by the Department. Storm sewer pipes which cross over existing or proposed sanitary sewer trenches shall be cradled in concrete through the full width of the sanitary sewer trench. The trench shall be backfilled and compacted with granular fill to the bottom of the concrete cradle. Concrete cradle will not be required if crossing an existing sanitary sewer pipe that has been in the ground for a period exceeding two (2) years.

If the storm and sanitary sewers are parallel and in the same trench, the upper pipe shall be placed on a shelf and the lower pipe shall be bedded in compacted granular fill to the flow line of the upper pipe.

50.20.4 Concrete Pipe or Conduit Strengths

All storm sewer pipes shall be reinforced concrete pipe, Class II minimum.

Any concrete pipe, conduit or culvert beneath a street right-of-way or with reasonable probability of being so located, shall be a minimum of Class III, but also shall account for all vertical loads, including the live load required by the highway authority having jurisdiction. In no case shall the design provide for less than HS-20 loading per AASHTO. For other locations, the minimum design live load shall be the HS-10 loading.

50.20.5 Corrugated Metal Pipe

The use of corrugated metal pipe for permanent storm water drainage shall be limited to private, residential driveways, within or off of the public right-of-way, or to minimum three (3) acre lot subdivisions with private streets. Corrugated metal pipe must be a minimum of 14 gauge. A greater wall thickness may be required for excessive fills or unusual live loads. Wall thickness shall be designed and specified by a professional engineer based on an analysis of all anticipated loads.
Corrugated metal pipe may be required for storm sewer lines discharging into stormwater channels as directed by the Department. Refer to St. Charles County Standard Details of Sewer Construction sheet C604.92 or the current MSD detail Sheet 62.

50.20.6  Monolithic Structures

Monolithic reinforced concrete structures shall be designed structurally as continuous rigid units.

50.20.7  Alignment

Sewer alignments are normally limited by the available easements, which, in turn, should reflect proper alignment requirements. Since changes in alignment affect certain hydraulic losses, care in selecting possible alignments can minimize such losses and use available head to the best advantage.

Sewers shall be aligned:

1. To be in a straight line between structures, such as manholes, inlets, inlet manholes and junction chambers, for all pipe sewers thirty (30) inches in diameter and smaller.

2. To be parallel with or perpendicular to the centerlines of straight streets unless otherwise unavoidable. Deviations may be made only with approval of the Department.

3. To avoid meandering, off-setting and unnecessary angular changes.

4. To make angular changes in alignment for sewers thirty (30) inches in diameter or smaller in a manhole located at the angle point, and for sewers thirty-three (33) inches in diameter or larger, by a uniform curve between two tangents or, with the approval of the Department, in a manhole located at the angle point. Curves shall have a minimum radius of ten (10) times the pipe diameter.

5. To avoid angular changes in direction greater than necessary and any exceeding ninety (90) degrees.

50.20.8  Location

Storm sewer locations are determined primarily by the requirements of service and purpose. It is also necessary to consider accessibility for construction and maintenance, site availability and competing uses, and effects of easements on private property.

Storm sewers shall be located:

1. To serve all property conveniently and to best advantage.

2. In public or private streets, roads, alleys, rights-of-way, or in sewer easements dedicated to St. Charles County.
3. On private property along property lines or immediately adjacent to public streets, avoiding diagonal crossings through the central areas of the property.

4. At a sufficient distance from existing and proposed buildings (including footings) and underground utilities or other sewers to avoid encroachments and reduce construction hazards.

5. To avoid interference between other stormwater sewers and house connections to foulwater or sanitary sewers.

6. In unpaved or unimproved areas whenever possible.

7. To avoid, whenever possible, any locations known to be or probably to be beneath curbs, paving or other improvements particularly when laid parallel to centerlines.

8. To avoid sinkhole areas if possible. However, if sinkhole areas cannot be avoided, see section 40.60 for requirements.

9. Crossing perpendicular to street, unless otherwise unavoidable.

50.20.9 Flowline

The flowline of storm sewers shall meet the following requirements:

1. The flowline shall be straight or without gradient change between the inner walls of connected structures; that is, from manhole to manhole, manhole to junction chamber, inlet to manhole, or inlet to inlet.

2. Gradient changes in successive reaches normally shall be consistent and regular. Gradient designations less than the nearest 0.001 foot per foot, except under special circumstances and for larger sewers, shall be avoided.

3. Sewer depths shall be determined primarily by the requirements of pipe or conduit size, utility obstructions, required connections, future extensions and adequate cover.

4. Stormwater pipes discharging into lakes shall have the discharge flowline at or near the lake's normal water line. Designs that cause water from normal lake levels to pond into any significant length and depth of the discharging storm sewer pipe will not be approved.

5. A concrete cradle is required when the grade of a sewer is twenty (20) percent or greater. A special design and specification is required for grades exceeding fifty (50) percent.

6. For all storm sewer pipes, a minimum 1% grade or a self-cleaning velocity of three (3) feet per second will be required. For sewers with a design grade less than one (1) percent, field verification of the sewer grade will be required for each installed reach of sewer, prior to any surface restoration or installation of any surface improvements.
7. The Department may require the submittal of revised hydraulic calculations for any sewer reach having an as-built grade flatter than the design grade by more than 0.1 percent. Based on a review of this hydraulic information, the Department may require the removal and replacement of any portion of the sewer required to ensure sufficient hydraulic capacity of the system.

50.20.10 Manholes

Manholes provide access to sewers for purposes of inspection, maintenance and repair. They also serve as junction structures for lines and as entry points for flow. Requirements of sewer maintenance determine the main characteristics of manholes.

1. For sewers thirty (30) inches in diameter or smaller, manholes shall be located at changes in direction; changes in size of pipe; changes in flowline gradient of pipes, and at junction points with sewers and inlet lines.

For sewers thirty-three (33) inches in diameter and larger, manholes shall be located on special structures at junction points with other sewers and at changes of size, alignment change and gradient. A manhole shall be located at one end of a short curve and at each end of a long curve.

2. Spacing of manholes shall not exceed four hundred (400) feet for pipe sewers thirty-six (36) inches in diameter and smaller; five hundred (500) feet for pipe sewers forty-two (42) inches in diameter and larger, except under special approved conditions. Spacing shall be approximately equal, whenever possible.

3. When large volumes of stormwater are permitted to drop into a manhole from lines twenty-one (21) inches or larger, the manhole bottom and walls below the top of such lines shall be of reinforced concrete.

4. Manholes shall be avoided in driveways or sidewalks.

5. Connections to existing structures may require rehabilitation or reconstruction of the structures being utilized. This work will be considered part of the project being proposed.

6. When a project requires a manhole to be adjusted to grade a maximum of twelve (12) inches of rise is allowed if not previously adjusted. When adjustments to raise or lower a manhole are required, the method of adjustment must be stated on the project plans and approved by the Department.

50.20.11 Overflow/Design System

The "design" components of the drainage system include the inlets, pipe, storm sewers, and improved and unimproved channels that function during typical rainfall events. The "overflow" system comprises the major overflow routes such as swales, streets, floodplains, detention basins, and natural overflow and ponding areas.
The purpose of the overflow system is to provide a drainage path to safely pass flows that cannot be accommodated by the design system without causing flooding of adjacent structures.

The criteria for the design of the overflow and design systems shall be as follows:

1. The "design" system shall be designed in accordance with Section 50.30.

2. The "overflow" system shall be designed for the 15-year, 20-minute event, assuming the "design" system is blocked. The capacity of the "overflow" system shall be verified with hydraulic calculations at critical cross-sections. The "overflow" system shall be directed to the detention facility, or as approved by the Department.

3. The low sill of all structures adjacent to the "overflow" system swales shall be above the 15-year high water elevation.

4. Where the topography will not allow for an overland flow path, the following will be required if deemed necessary by the Department:
   a. The storm sewer shall be designed for the 100-year, 20-minute storm; and
   b. If this storm pipe is smaller than thirty-six (36) inches in diameter, a designated ponding area shall be identified, assuming the pipe is blocked; and
   c. The ponding area shall be based on the 100-year, 24-hour storm; and
   d. The low sill of all structures adjacent to the ponding area shall be above the 100-year high water elevation.

5. The "overflow" system shall be designated on the drainage area map and on the grading plan.

6. All overflow systems will be considered on a site-specific basis.

50.30 Stormwater Design Criteria

50.30.1 Flow Quantities

Flow quantities are to be calculated by the "Rational Method" in which:

\[ Q = API \]

where:
- \( Q \) = runoff in cubic feet per second
- \( A \) = tributary area in acres
- \( P \) = runoff factor based on runoff from pervious and impervious surfaces
- \( I \) = Average intensity of rainfall (inches per hour) for a given period in a given frequency

\( P \) (Runoff Factors) for various impervious conditions are shown in Table 50-2.
P.I. values for various impervious conditions are shown in Tables 50-3 to 50-5.

There may exist extreme cases, such as large off site watersheds, when the use of other methods of analysis, such as "Techniques for Estimating Flood-Peak Discharges from Urban Basins in Missouri" (U.S.G.S. Water Resources Investigations Report 86-4322), "Technique for Estimating the 2 to 500 Year Flood Discharges on Unregulated Streams in Rural Missouri" (U.S.G.S. Water Resources Investigations Report 95-4231), or the Unit Hydrograph, shall be considered for storm water design. However, prior approval must be obtained from the Department at the preliminary design stage when the use of alternate methods of analysis is requested. Alternate methods of storm water run off analysis may also be required by the Department. This requirement should be made during the preliminary plat process or during the preliminary design stage.

In locations where a current, detailed FEMA study has determined the run off in the creek or tributary, the run off from that study should be used.

1. Rainfall Frequency and Duration

   In the design of local storm sewer systems, a fifteen (15) year rainfall frequency and a twenty (20) minute storm duration shall be used. Figure 50-1 gives rainfall curves for 2-5-10-15-20 and 100-year frequencies.

2. Impervious Percentages and Land Use

   Minimum impervious percentages must be based on the Zoning District and shall use Table 50-1.

   The design engineer shall provide adequate detailed computations for any proposed, expected or contingent increases in imperviousness and shall make adequate allowances for changes in zoning use. If consideration is to be given to any other value than the above for such development, the request must be made at the beginning of the project, must be reasonable, fully supported, and adequately presented, and must be approved in writing before its use is permitted.

   Although areas generally will be developed in accordance with current zoning requirements, recognition must be given to the fact that zoning ordinances can be amended to change the currently proposed types of development, and any existing use. Under these circumstances the possibility and the probability of residential areas having lot sizes changed or rezoned to business, commercial, or light manufacturing uses should be given careful consideration.

3. Reduction in P.I. with Time and Area

   Reduction in P.I. values for the total time of concentration exceeding twenty (20) minutes, and for tributary areas exceeding three hundred (300) acres will be allowed only in trunk sewers and main channels. The reduced average P.I. value for the tributary area shall not be less than the value determined as follows on the basis of:
a. Time. As the time of concentration increases beyond twenty (20) minutes, select the appropriate P.I. value from Table 50-2. These reduced values shall be used unless a further reduction is allowed for the area.

b. Area. As the total tributary area at any given location in a channel increases in excess of three hundred (300) acres, the P.I. value may be further reduced by multiplying it by an area coefficient "Ka". (The area coefficient is obtained from data in a special study of a major storm in the St. Louis area by the U. S. Corps of Engineers.) The average rainfall rate, for a given storm, for a given period for the tributary area, is less than the corresponding point value as determined from recording rainfall gauges. The curve data is as follows:

<table>
<thead>
<tr>
<th>Area (Abscissas)</th>
<th>&quot;Ka&quot; (Ordinates)</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 to 449 Acres</td>
<td>1.00</td>
</tr>
<tr>
<td>450 to 549 Acres</td>
<td>0.99</td>
</tr>
<tr>
<td>550 to 749 Acres</td>
<td>0.98</td>
</tr>
<tr>
<td>750 to 999 Acres</td>
<td>0.97</td>
</tr>
<tr>
<td>1000 to 1280 Acres</td>
<td>0.96</td>
</tr>
<tr>
<td>1281 to 1600 Acres</td>
<td>0.95</td>
</tr>
<tr>
<td>1601 to 1920 Acres</td>
<td>0.92</td>
</tr>
<tr>
<td>1921 to 2240</td>
<td>0.91</td>
</tr>
</tbody>
</table>
### TABLE 50-1 RUN OFF - P.I. FACTORS

<table>
<thead>
<tr>
<th>Zoning District</th>
<th>Minimum Lot Area</th>
<th>Minimum % Impervious</th>
<th>15 Yr.</th>
<th>50 Yr.</th>
<th>100 Yr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural</td>
<td>5 ac.</td>
<td>5</td>
<td>1.7</td>
<td>2.2</td>
<td>2.3</td>
</tr>
<tr>
<td>RR Single-Family Residential</td>
<td>3 ac.</td>
<td>10</td>
<td>1.8</td>
<td>2.3</td>
<td>2.4</td>
</tr>
<tr>
<td>R1A Single-Family Residential</td>
<td>1 ac.</td>
<td>15</td>
<td>1.9</td>
<td>2.4</td>
<td>2.6</td>
</tr>
<tr>
<td>R1B Single-Family Residential</td>
<td>20,000 s.f.</td>
<td>32</td>
<td>2.2</td>
<td>2.8</td>
<td>3.0</td>
</tr>
<tr>
<td>R1C Single-Family Residential</td>
<td>15,000 s.f.</td>
<td>35</td>
<td>2.3</td>
<td>2.9</td>
<td>3.1</td>
</tr>
<tr>
<td>R1D Single-Family Residential</td>
<td>10,000 s.f.</td>
<td>45</td>
<td>2.5</td>
<td>3.2</td>
<td>3.4</td>
</tr>
<tr>
<td>R1E Single-Family Residential</td>
<td>7,000 s.f.</td>
<td>48</td>
<td>2.55</td>
<td>3.3</td>
<td>3.5</td>
</tr>
<tr>
<td>PR Park Recreational</td>
<td>1 ac.</td>
<td>15</td>
<td>1.9</td>
<td>2.4</td>
<td>2.6</td>
</tr>
<tr>
<td>RM Man./Mobile Home Residential</td>
<td>6,000 s.f.</td>
<td>50</td>
<td>2.6</td>
<td>3.3</td>
<td>3.5</td>
</tr>
<tr>
<td>R2 Two-Family Residential</td>
<td>7,000 s.f.</td>
<td>50</td>
<td>2.6</td>
<td>3.3</td>
<td>3.5</td>
</tr>
<tr>
<td>R3A Medium Density Residential</td>
<td>10 units/ac.</td>
<td>65 *</td>
<td>2.9</td>
<td>3.7</td>
<td>3.9</td>
</tr>
<tr>
<td>R3B Multi-Family Residential</td>
<td>20 units/ac.</td>
<td>75 *</td>
<td>3.1</td>
<td>3.9</td>
<td>4.1</td>
</tr>
<tr>
<td>RF Riverfront District</td>
<td>25 ac.</td>
<td>100 *</td>
<td>3.5</td>
<td>4.5</td>
<td>4.8</td>
</tr>
<tr>
<td>HTCD High Tech Corridor District</td>
<td></td>
<td>70 (max)*</td>
<td>3.0</td>
<td>3.8</td>
<td>4.0</td>
</tr>
<tr>
<td>CO Office Commercial</td>
<td></td>
<td>100 *</td>
<td>3.5</td>
<td>4.5</td>
<td>4.8</td>
</tr>
<tr>
<td>C1 Neighborhood Commercial</td>
<td></td>
<td>100 *</td>
<td>3.5</td>
<td>4.5</td>
<td>4.8</td>
</tr>
<tr>
<td>C2 General Commercial</td>
<td></td>
<td>100 *</td>
<td>3.5</td>
<td>4.5</td>
<td>4.8</td>
</tr>
<tr>
<td>C3 Highway/Major Commercial</td>
<td></td>
<td>100 *</td>
<td>3.5</td>
<td>4.5</td>
<td>4.8</td>
</tr>
<tr>
<td>I1 Light Industrial</td>
<td></td>
<td>100 *</td>
<td>3.5</td>
<td>4.5</td>
<td>4.8</td>
</tr>
<tr>
<td>I2 Heavy Industrial</td>
<td></td>
<td>100 *</td>
<td>3.5</td>
<td>4.5</td>
<td>4.8</td>
</tr>
<tr>
<td>Paved Parking, Streets, Roofs</td>
<td></td>
<td>100</td>
<td>3.5</td>
<td>4.5</td>
<td>4.8</td>
</tr>
</tbody>
</table>

* Note: Drainage Areas may be broken into component areas with the appropriate run off factor applied to each component; i.e., a proposed development may show 100% impervious for paved areas and 5% impervious for grassed areas.

** Average P.I. Factor in C.F.S. per acre based on 20 minute rainfall duration.
50.30.2 Hydraulic Grade Line for Closed Conduits

1. Computation Methods

The hydraulic grade line is a line coinciding with (a) the level of flowing water at any given point along an open channel, or (b) the level to which water would rise in a vertical tube connected to any point along a pipe or closed conduit flowing under pressure.

The hydraulic grade line shall be computed to show its elevation at all structures and junction points of flow in pipes, conduits and open channels, and shall provide for the losses and the differences in elevations as required below. Since it is based on design flow in a given size of pipe or conduit or channel, it is of importance in determining minimum sizes of pipes within narrow limits. Sizes larger than the required minimum generally provide extra capacity, however consideration still must be given to the respective pipe system losses.

There are several methods of calculating "losses" in storm sewer design. The following procedures are presented for the Engineer's information and consideration.

It is expected that the design will recognize the reality of such "losses" occurring and make such allowances as good engineering judgment requires.

a. Friction Loss

The hydraulic grade line is affected by friction loss and by velocity head transformations and losses. Friction loss is the head required to maintain the necessary flow in a straight alignment against frictional resistance because of pipe or channel roughness. It is determined by the equation:

\[ hf = L \times S_h \]

Where:

- \( hf \) = difference in water surface elevation, or head in feet in length \( L \)
- \( L \) = length in feet of pipe or channel
- \( S_h \) = hydraulic slope required for a pipe of given diameter or channel of given cross-section and for a given roughness "\( n \)" expressed as feet of slope per foot of length

From Manning's formula: \( S_h = \left[ V n / (1.486 R^{0.667}) \right]^2 \)

Where:

- \( R \) = hydraulic radius of pipe, conduit or channel (feet) (ratio of flow area/wetted perimeter)
- \( V \) = velocity of flow in feet per second (fps)
- \( n \) = Manning's value for coefficient of roughness

Use:
n = .013 for pipes of concrete, vitrified clay, and PVC pipe
n = .024 for pipes of corrugated metal
n = .012 for formed monolithic concrete, i.e., vertical wall channels, box culverts and for R.C.P. over 48" in diameter
n = .015 for concrete lining in ditch or channel inverts and trapezoidal channels
n = .028 for placed rip-rap lining on ditch or channel side slopes
n = .033 for gabion walled channels

Note:

"n" will have a weighted value for composite lined channels.

"n" values for unlined channels to be determined on an individual basis.

b. Curve Loss

Curve loss in pipe flow is the additional head required to maintain the required flow because of curved alignment, and is in addition to the friction loss of an equal length of straight alignment. It should be determined from Figure 50-2, which includes an example.

c. Entrance Loss at Terminal Inlets

Entrance loss is the additional head required to maintain the required flow because of resistance at the entrance. The entrance loss at a terminal inlet is calculated by the formula:

\[ H_{ei} = \frac{V^2}{2g} \]

Where:

V = Velocity in flow of outgoing pipe
g = Acceleration of gravity (32.2 Ft/Sec/Sec)

d. Turn Loss

Head losses in structures due to change in direction of flow (turns) in a structure, will be determined in accordance with the following:
<table>
<thead>
<tr>
<th>Change in Direction of Flow (A)</th>
<th>Multiplier of Velocity Head of Water Being Turned (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 Deg.</td>
<td>0.7</td>
</tr>
<tr>
<td>60 Deg.</td>
<td>0.55</td>
</tr>
<tr>
<td>45 Deg.</td>
<td>0.47</td>
</tr>
<tr>
<td>30 Deg.</td>
<td>0.35</td>
</tr>
<tr>
<td>15 Deg.</td>
<td>0.18</td>
</tr>
<tr>
<td>0 Deg.</td>
<td>0.0</td>
</tr>
<tr>
<td>Other Angles</td>
<td>By Interpolation</td>
</tr>
</tbody>
</table>

**DIAGRAM:**

![Diagram showing manhole or inlet, lateral or main, and a change in direction angle A.](image)

Formula: \( H_L = K(V_L)^2 / 2g \)

Where:

- \( H_L \) = Feet of head lost in manhole due to change in direction of lateral flow
- \( V_L \) = Velocity of flow in lateral in Ft/Sec
- \( g \) = Acceleration of gravity (32.2 Ft/Sec/Sec)
- \( K \) = Multiplier of velocity head of water being turned

e. **Junction Chamber Loss**

A sewer junction occurs for large pipes or conduits too large to be brought together in the usual forty-two (42) inch diameter manhole or inlet where one or more branch sewers enter a main sewer. Allowances should be made for head loss due to curvature of the paths and due to impact at the converging streams.

Losses in a junction chamber for combining large flows shall be minimized by setting flowline elevations so that pipe centerlines (springlines), will be approximately in the same planes.

At junction points for combining large storm flows, a manhole with a slotted cover shall be provided.
A computation method for determining junction chamber losses is presented below:

\[ H_j = y + V_{h1} - V_{h2} \]

Where:

- **\( H_j \)** = junction chamber loss (ft.)
- **\( V_{h1} \)** = upstream velocity head
- **\( V_{h2} \)** = downstream velocity head
- **\( y \)** = change in hydraulic grade line through the junction in feet

Where:

\[ y = \left\{ \left[ Q_2 V_2 \right] + \left[ \left[ Q_3 V_3 \cos \theta_3 \right] + \left[ Q_n V_n \cos \theta_n \right] \right] \right\} \frac{0.5(A_1 + A_2)}{g} \]

Where:

- **\( Q_2 \)** = Discharge in cubic feet per second (cfs) at the exiting conduit
- **\( V_2 \)** = Velocity in feet per second (fps) at the exiting conduit
- **\( A_2 \)** = Cross-sectional area of flow in sq. ft. for the existing conduit
- **\( Q_1 \)** = Discharge in cfs for the incoming pipe (main flow)
- **\( V_1 \)** = Velocity in fps for the incoming pipe (main flow)
- **\( A_1 \)** = Cross-sectional area of flow in Sq. Ft. for the incoming pipe (main flow)
- **\( Q_3, Q_n \)** = Discharge(s) in cfs for the branch lateral(s)
- **\( V_3, V_n \)** = Velocity(ies) in fps for the branch lateral(s)
- **\( \theta_3, \theta_n \)** = The angle between the axes of the exiting pipe and the branch lateral(s)
- **\( g \)** = Acceleration of gravity (32.2 ft/sec/sec)

Where:

- **\( \theta \)** = the angle between axes of the outfall and the incoming laterals

f. **Losses at Junctions of Several Flows in Manholes and/or Inlets**

The computation of losses in a manhole, inlet or inlet manhole with several flows entering the structure should utilize the principle of the conservation of energy. This involves both the elevation of water surface and momentum (mass times the velocity head). Thus, at a structure (manhole, inlet or inlet manhole) with laterals, the sum of the energy content for inflows is equal to the sum of the energy content of the outflows plus the additional energy required by the turbulence of the flows passing through the structure.
The upstream hydraulic grade line may be calculated as follows:

\[ H_u = \frac{V_U^2}{2g} - \left( \left( \frac{Q_U}{Q_D} \right) \left( 1 - K \right) \left( \frac{V_U^2}{2g} \right) \right) + \left( \left( \frac{Q_{L1}}{Q_D} \right) \left( 1 - K \right) \left( \frac{V_{L1}^2}{2g} \right) \right) + \left( \left( \frac{Q_{LN}}{Q_D} \right) \left( 1 - K \right) \left( \frac{V_{LN}^2}{2g} \right) \right) + H_D \]

Where:

- \( H_u \) = Upstream hydraulic grade line in feet
- \( Q_U \) = Upstream main line discharge in cubic feet per second
- \( Q_D \) = Downstream main line discharge in cubic feet per second
- \( Q_{L1} - Q_{LN} \) = Lateral discharges in cubic feet per second
- \( V_U \) = Upstream main line velocity in feet per second
- \( V_D \) = Downstream main line velocity in feet per second
- \( V_{L1} - V_{LN} \) = Lateral velocities in feet per second
- \( H_D \) = Downstream hydraulic grade line in feet
- \( K \) = Multiplier of velocity of water being turned
- \( g \) = Acceleration of gravity, 32.2 ft/sec/sec

The above equation does not apply when two (2) almost equal and opposing flows, each perpendicular to the downstream pipe, meet and no other flows exist in the structure. In this case the head loss is considered as the total velocity head of the downstream discharge.

g. **Transition Loss**

The relative importance of the transition loss is dependent on the velocity head of the flow. If the velocity and velocity head of the flow are quite low, the transition losses cannot be very great. However, even small losses may be significant in flat terrain. The sewer design shall provide for the consideration of the necessary transitions and resulting energy losses. The possibility of objectionable deposits is to be considered in the design of transitions.
For design purposes it shall be assumed that the energy loss and changes in depth, velocity and invert elevation, if any, occur at the center of the transition. These changes shall be distributed throughout the length of the transition in actual detailing. The designer shall carry the energy head, piezometric head (depth in an open channel), and invert as elevations, and work from the energy grade line. Because of inherent differences in the flow, transitions for closed conduits will be considered separately from those for open channels.

(1) Closed Conduits

Transitions in small sewers may be confined within a manhole. Special structures may be required for larger sewers. If a sewer is flowing surcharged, the form and friction losses are independent of the invert slope; therefore, the transition may vary at the slopes of the adjacent conduits. The energy loss in a transition shall be expressed as a coefficient multiplied by the change in velocity head \( \frac{V^2}{2g} \) in which \( V \) is the change in velocity before and after the transition. The coefficient may vary from zero to one, depending on the design of the transition.

If the areas before and after a transition are known, it is often convenient to express the transition loss in terms of the area ratios and either the velocity upstream or downstream.

For an expansion:

\[
H_L = K(V_1 - V_2)^2/2g \approx [K(V_1)^2/2g] \left[1 - \left(A_1/A_2\right)\right] \]

In which \( H_L \) is the energy loss; \( K \) is a coefficient equal to 1.0 for a sudden expansion and approximately 0.2 for a well-designed transition and the subscripts 1 and 2 denote the upstream and downstream sections, respectively, i.e., \( A_1 = \text{Area Before Transition} \) and \( A_2 = \text{Area After Transition} \).

For a contraction:

\[
H_L = \left[ K(V_2)^2/2g \right] \left[ (1/C_C) - 1 \right] \approx \left[ K(V_2)^2/2g \right] \left[1 - \left(A_2/A_1\right)\right] \]

in which \( K \) is a coefficient equal to 0.5 for a well-designed transition, \( C_C \) is a coefficient of contraction, and the other terms and subscripts are similar to the previous equation. Losses in closed conduits of constant area are expressed in terms of \( \frac{V^2}{2g} \).

The above equations may be applied to approximate the energy loss through a manhole for a circular pipe flowing full. If the invert is fully developed, that is, semi-circular on the bottom and vertical on the sides from one-half depth up to the top of the pipe, for the expansion \( A_1/A_2 = 0.88 \), and for the contraction \( A_2/A_1 = 0.88 \). The expansion is sudden; therefore, \( K = 1 \). The contraction may be rounded if the downstream pipe has a bell or socket. In this case, \( K \) may be assumed to be 0.2.
The expansion energy loss is 0.014 $[ (V_1)^2/2g ]$ and the contraction energy loss is 0.010 $[ (V_2)^2/2g ]$. If the invert is fully developed, the manhole loss is small, but if the invert is only developed for one-half of the depth, or not at all, the losses will be of considerable magnitude.

(2) Open Channel Transitions

The hydraulics of open channel transitions are further complicated by possible changes in depth. As a first approximation to the energy loss, unless a jump occurs, the equations given above may be used with a trial-and-error solution for the unknown area and velocity. The K value for a well-designed expansion should probably be increased to 0.3 to 0.4. Whether the properties of the upstream or downstream section will be known will depend on the characteristics of the flow and the channel, but can be determined by a profile analysis. In transitions for supercritical flow, additional factors shall be considered. Standing waves of considerable magnitude will be produced in transitions. The height of these waves must be estimated to provide a proper channel depth. In addition, in long transitions, air entrainment will cause bulking of the flow with resultant greater depths of air-water mixture.

50.30.3 Hydraulic Grade Line Limits

The hydraulic grade line shall not rise above the following limits as determined by flow quantities calculated per Section 50.30.1.

1. The hydraulic grade line at any inlet or storm manhole shall not be higher than one (1) foot below the inlet sill or top of manhole.

2. The beginning point for the hydraulic grade line computations shall be the higher elevation as determined below:

   a. For connection to an existing pipe system:

      (1) Top of pipe intrados of one reach downstream of the connection point of the existing system; or

      (2) The hydraulic grade line computed for the existing system one reach downstream of the connection point.

   b. For connection to channels or ditches:

      (1) Top of pipe intrados of the proposed pipe; or

      (2) The hydraulic grade line computed for the channel or ditch as approved by the Department.
50.30.4 Inlets

Inlets function entirely as entry points for stormwater flow. They also may be constructed to serve as a manhole on separate stormwater sewers, and are then termed inlet manholes. Steep gradients may give such low inlet capacities that additional inlets should be located at more favorable grade locations or special inlets designed for steep gradients must be used. Provision must be made to control by-pass flow and to provide additional capacity in the inlet and line affected by such increased flow. Six (6) inch, open-throat inlets should be used at all times.

Grated inlets, without an open throat or other provision for overflow shall be avoided except under exceptional conditions, and are prohibited in grade pockets. Any exceptions shall be used only with Department approval.

Curb inlets shall be placed at street intersections or driveways such that no part of the inlet structure or sump is within the curb rounding.

1. Inlets are shown in the St. Charles County Standard Details of Sewer Construction. The minimum depth of a terminal inlet is four (4) feet from the top of the inlet to the flowline of the outlet pipe. Greater depth shall be used for intermediate inlets if necessary for the required depth of the hydraulic grade line.

2. Inlet capacity should not be less than the quantity flow tributary to the inlet and by-pass flow shall be avoided whenever possible. Inlets at low points or grade pockets should have extra capacity to compensate for possible flow by-pass of upstream inlets.

Figure 50-3 and Table 50-6 show inlet capacity/maximum gutter capacity with a given gutter line grade and flow. Inlets shall be appropriately sized and spaced taking into consideration by-pass, depth of flow, and gutter capacity. Additional inlet capacity analysis, using the “HEC 22 – Urban Drainage Design Manual” or other approved method, may be required by the County Engineer for street inlets proposed to be located on steep street grades and/or where a large amount of storm water runoff is proposed to drain onto a public street.

3. Connections to existing structures may require rehabilitation or reconstruction of the structure being utilized. This work will be considered part of the project being proposed.

4. For inlets in vertical sag curves (low points), the center of the main chamber shall be placed within one (1) foot of the exact mathematical low point of the pavement.

5. Curb inlets shall be located so the inlet face is a minimum of two (2) feet or a maximum of two and one-half (2.5) feet behind the back of the three (3) inch rolled roadway curb. Curb inlets shall be located so the inlet face is two (2) feet behind the back of the six (6) inch vertical roadway curb. The sump shall begin two (2) feet in front of the back of curb. The top elevation of the stone shall remain three (3) inches above the top of rolled curb and level with the top of vertical curb. When required,
the nearest two (2) sections of sidewalk on each side of the inlet shall be warped down to the top of the inlet stone elevation.

6. By-pass shall be minimized at inlet structures and shall be shown on the hydraulic computations and site drainage map. By-pass shall be used in determining gutter flow downstream. By-pass shall not be considered in sizing of the storm sewer pipe system (i.e., pipe shall be designed for total tributary “Q” regardless of by-pass).

7. Inlets in roadway ditches shall be compatible with the ultimate pavement improvements. Rear yard area inlets shall be required when more than one (1) c.f.s. is concentrated between buildings and crossing sidewalks or curbs.

8. Street inlets shall be required to intercept runoff when more than one (1) c.f.s. crosses a street intersection.

50.30.5 Open Channels

*NOTE: This section contains some excerpts relating to design and is attributed to Open Channel Hydraulics by Ven Te Chow, a McGraw-Hill work published in 1959.

All open channels shall meet the following requirements:

1. Size and Shape
   Open channels shall not decrease in size in the direction of flow. Open channels shall be vertical walled except in special cases where other approved materials are being considered.

2. Materials
   Channels may be constructed with reinforced concrete or other approved material. However, the Department shall have the right to approve or disapprove any channel material and shall select the appropriate channel material if proposed material is rejected. Swales shall be sodded or protected with commercial erosion control blanket unless velocities are excessive, greater than five (5) fps, in which case concrete swales, rip-rap, or a special type of erosion control blanket designed for the calculated channel velocities and shear stresses must be used. Where velocities are less than two (2) fps, seed and mulch may be used to line channels.

3. Bedding
   Special provisions shall be made for channels or paved swales laid over fill on non-supportive soils to support the channel on paved swales. Pipes extended to the channel in a fill area shall have compacted crushed limestone bedding for support.

4. Structural Considerations
   Provisions must be made for all loads on the channel.
5. Alignment

Open channel alignments may be limited by available easements, physical topography, existing utilities, buildings, residential development, maintenance access and roadways.

6. Locations

Storm channel locations are determined primarily by natural drainage conditions. It is also necessary to consider accessibility for construction and maintenance, site availability and competing uses, and evaluating effects of easements on private property.

Storm channels shall be located:

a. To serve all adjacent property conveniently and to best advantage.

b. In easements or rights-of-way dedicated to the Department.

c. In easements on common ground when feasible.

d. On private property along property lines or immediately adjacent to public streets, avoiding crossings through the property.

e. At a sufficient distance from existing and proposed buildings (including footings) and underground utilities or sewers to avoid future problems of flooding or erosion.

f. To avoid interference between stormwater sewers and house connections to foulwater or sanitary sewers.

g. In unpaved or unimproved areas whenever possible.

h. Crossing perpendicular to streets, unless unavoidable.

7. Flowline

The flowline of open channels shall meet the following requirements:

a. Gradient changes shall be kept to a minimum and be consistent and regular.

b. Gradient designations less than the nearest 0.001 foot per foot shall be avoided.

c. Channel and swale depths shall be determined primarily by the requirements of the channel size, utility obstructions and any required connections.

8. Other Open Channel Considerations and Requirements

a. All erosive natural channels and ditches shall be improved if deemed necessary by the Department.
b. Drainage within private property should be controlled to prevent damage to the property crossed. Swales, or broad shallow grass-lined ditches with non-erosive slopes, are generally located at or near rear lot and along common property lines. If a paved gutter is utilized, then appropriate erosion protection shall be used at both ends.

c. When it is undesirable or impractical to enclose a channel with a pipe across a road or street, a suitable bridge or culvert shall be required.

d. For flows greater than four (4) cfs, area inlets or inlet manholes are required to intercept the gutter or swale flow.

e. Channels and water courses draining large areas shall be located in rights-of-way, common ground, or easements previously approved by the Department as a part of an adequate overall plan for drainage.

9. Design Limitations

a. The flow quantity shall be calculated by the method presented in Section 50.30.1 of this manual.

b. If the channel is within an area designated in a community's flood insurance study, then the channel shall also meet all the Department's and the community's floodplain requirements.

c. Other agencies of jurisdiction may have requirements that must be met. A U.S. Army Corps of Engineers permit may be required for any construction affecting a watercourse.

10. Hydraulic Grade Line

a. Computation Methods

In open channels, the water surface is identical with the hydraulic grade line. The hydraulic grade line shall be computed throughout the channel reach to show its elevation at junctions with incoming pipes or channels and at the ends of the channel reach under consideration. It shall also provide for the losses and differences in elevations as required below. Since it is based on design flow in a given channel, it is of importance in determining minimum sizes within narrow limits. The depth at which the actual flows will occur is controlled by the two end conditions of the reach considered, and by the relationship between the energy available and by the energy required to overcome the losses that are encountered along the channel.

There are several methods of calculating "losses" in channel design. The following procedures are presented for the engineer’s information and consideration.

It is required that the design recognizes the reality of such "losses" occurring and makes such allowances as good engineering judgment indicates.
(1) **Control Sections**

The Engineer should locate all possible control sections for the reach in question. A control section refers to any section at which the depth of flow is known or can be controlled to a required stage. At the control section, flow must pass through a control depth that may be the critical depth, the normal depth or any other known depth. Three types of control sections include (a) Upstream Control Section; (b) Downstream Control Section; (c) Artificial Control Section, which occurs at a control structure, such as a weir, dam, sluice gate, roadway embankment, culvert, bridge, or at the confluence with a major river or stream.

(2) **Friction Loss**

The friction loss may be calculated by the same procedure as is presented in Section 50.30.2 of this chapter.

(3) **Flow in Curved Channels**

The centrifugal force caused by flow around a curve produces a rise in the water surface on the outside wall and lowering of the inner wall. This phenomenon is called superelevation. The flows tend to behave differently according to the state of flow.

In subcritical flow, friction effects are of importance, whereby in supercritical flow, the formation of cross-waves is of major concern.

(a) **Curve Losses**

Curve losses may be estimated from Figure 50-2 by replacing D, diameter, with b, width of channel.

(b) **Superelevations**

In addition to curve losses, an evaluation of superelevations should be considered and, if required, an allowance made in the top elevation of the outside wall. Equations are presented below which may be used to determine the superelevation at channel bends.
1) Trapezoidal Channels

Subcritical Flow:
\[ H_w = 1.15\left(\frac{V^2}{2gr_c}\right)[b+D(ZL+ZR)] \]

Supercritical Flow:
\[ H_w = 2.6\left(\frac{V^2}{2gr_c}\right)[b+D(ZL+ZR)] \]

2) Rectangular Channels

Subcritical Flow:
\[ H_w = \left(\frac{V^2b}{2gr_c}\right) \]

Supercritical Flow:
\[ H_w = \left(\frac{V^2b}{gr_c}\right) \]

Where:

\[ H_w = \] Change in water height above the centerline water surface elevation.
\[ V = \] Average velocity of design flow in Fps
\[ g = \] Acceleration of gravity (32.2 Ft/Sec/Sec)
\[ r_c = \] radius of curve on horizontal alignment in feet
\[ b = \] Base width of channel in feet
\[ D = \] Depth of flow in straight channel
\[ ZL = \] Left side slope (ft/ft)
\[ ZR = \] Right side slope (ft/ft)

(4) Transitions

Transitions should be designed to accomplish the required change in cross-section with as little flow disturbance as possible.

The following features are to be considered in design of transition structures.

(a) Proportioning

For a well-designed transition, the following rules should be used:

1) The optimum maximum angle between the channel axis and a line connecting the channel sides between the entrance and exit sections is 12.5 degrees.

2) Sharp angles in the structure should be avoided.

(b) Losses

The energy loss in a transition consists of the friction loss and the conversion loss. The friction loss may be estimated by the Manning Formula. The conversion loss is generally expressed in terms of the
change in velocity head between the entrance and exit section of the structure.

\[ H_t = K_t V_H \]

Where:

- \( H_t \) = Conversion loss
- \( K_t \) = Coefficient of head loss in transition
- \( V_H \) = Absolute change in velocity head

Average design values for \( K_t \) are presented in the table below:

<table>
<thead>
<tr>
<th>Type of Transition</th>
<th>Contracting Section</th>
<th>Expanding Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warped</td>
<td>0.10</td>
<td>0.20</td>
</tr>
<tr>
<td>Wedge</td>
<td>0.20</td>
<td>0.50</td>
</tr>
<tr>
<td>Cylinder-quadrant</td>
<td>0.15</td>
<td>0.25</td>
</tr>
<tr>
<td>Straight Line</td>
<td>0.30</td>
<td>0.50</td>
</tr>
<tr>
<td>Square End</td>
<td>0.40</td>
<td>0.75</td>
</tr>
</tbody>
</table>

See Figure 50-4 for sketches of each type of transition.

(c) Freeboard

A transition shall have a minimum of one (1) foot of freeboard above the hydraulic grade line.

(d) Hydraulic Jump

The existence of a hydraulic jump in a transition may become objectionable, and the design of the transition should be checked for such.

(e) Sudden Enlargement and Contraction

A sudden enlargement results when an intense shearing action occurs between incoming high-velocity jet and the surrounding water. As a result, much of the kinetic energy of the jet is dissipated by eddy action. The head loss at a sudden enlargement, \( H_{Le} \), is:

\[ H_{Le} = K_e (V^2/2g) \]

Where:

- \( K_e \) = Coefficient of head loss for enlargements = 1
- \( V \) = Change in velocities between incoming and outgoing sections
- \( g \) = Acceleration of gravity (32.2 Ft/Sec/Sec)
The flow in a sudden contraction is first contracted and then expanded resulting in high losses as compared to a sudden enlargement. Thus the head loss at a sudden contraction, $H_{lc}$, is:

$$H_{lc} = K_c \left( \frac{V^2}{2g} \right)$$

Where:

- $K_c =$ Coefficient of head loss for contractions = 0.5
- $V =$ Change in velocities between incoming and outgoing sections
- $g =$ Acceleration of gravity (32.2 Ft/Sec/Sec)

(5) Constrictions

A constriction results in a sudden reduction in channel cross-section. The effect of the constriction on the flow depends mainly on the boundary geometry, the discharge and the state of flow. When the flow is subcritical, the constriction will induce a backwater effect that extends a long distance upstream. If the flow is supercritical, the disturbance is usually local and will only affect the water adjacent to the upstream side of the constriction. A control section may or may not exist at a constriction. The control section, when it exists, may be at either side of the constriction (upstream or downstream), depending on whether the slope of the constricted channel is steep or mild. The entrance and outlet of the constriction then acts as a contraction and an expansion, respectively.

(6) Obstructions

An obstruction in open-channel flow creates at least two paths of flow in the channel. Typical obstructions include bridge piers, pile trestles, and trash racks. The flow through an obstruction may be subcritical or supercritical.

b. Hydraulic Grade Line Limits

(1) The hydraulic grade line at any point along a channel shall not be higher than one (1) foot below the top of the channel wall.

(2) The hydraulic grade line at any point along a channel shall not cause the hydraulic grade limits of the storm sewer system to be exceeded as stated in Section 50.30.3 of this manual.

11. Hydraulic Jump

When flow changes from the supercritical to subcritical state, a hydraulic jump may occur. A study should be made on the height and location of the jump, and for discharges less than the design discharge, to ensure adequate wall heights extend over the full ranges of discharge.
12. Open Channel Junctions
   a. General

   (1) Consideration shall be given in the design of open-channel junctions to the geometry of the confluence of flows in order to minimize undesirable hydraulic effects due to supercritical velocities.

   b. Confluence Design Criteria

   (1) The momentum equation can be applied to the confluence design if the below stated criteria is used.

   (2) The design water-surface elevations in the two joining channels should be approximately equal at the upstream end of the confluence.

   (3) The angle of the junction intersection can vary from 0-12 degrees.

   (4) The width of the main channel shall be expanded below the junction to maintain approximate flow depths throughout the junction.

   (5) Flow depths should not exceed ninety (90) percent of the critical depth.

13. Erosion Protection

   Placed rock blankets underlain with a woven geotextile fabric, minimum one (1) foot thick, shall be required at each end of the improved channel. The minimum length of the placed rock blanket shall be twenty five (25) feet. A grouted rock toe wall, minimum three (3) feet deep, shall be constructed at the free end of each blanket.

14. Sanitary Sewer Crossings

   The characteristics of any sanitary sewer crossing shall be given consideration in the design of the channel floor.

50.30.6 Culverts

The design of culverts shall include consideration of many factors relating to requirements of hydrology, hydraulics, physical environment, and imposed exterior loads, construction and maintenance.

With the design discharge and general layout requirements determined, the design requires detailed consideration of such hydraulic factors as shape and slope of approach and exit channels, allowable head at entrance (and ponding capacity, if appreciable), tailwater levels, hydraulic and energy gradelines, and erosion potential.

1. Hydraulic Design

   The hydraulic design of a culvert for a specified design discharge involves (1) selection of a type and size, (2) determination of the position of hydraulic control, and (3) hydraulic computations to determine whether acceptable headwater depths
and outfall conditions will result. Hydraulic computations will be carried out by standard methods based on pressure, energy, momentum and loss considerations.

Crossroad culverts, not at low points, shall be designed on a storm frequency of fifteen (15) years and a minimum of two (2) feet of freeboard at the shoulder line. Culverts at or near low points not in flood plains, shall be designed on a storm frequency of fifty (50) years and a minimum of two (2) feet of freeboard at the shoulder line. Culverts at or near low points in flood plains, shall be designed on a storm frequency of one hundred (100) years and a minimum of two (2) feet of freeboard at the shoulder line. Refer to the U.S. Department of Transportation Hydraulic Engineering Circular No. 5, "Hydraulic Charts for the Selection of Highway Culverts." All crossroad culverts shall be R.C.P., pre-cast or poured-in-place reinforced concrete with the exception of culverts in minimum three acre lot subdivisions with private streets.

2. Entrances and Headwalls - Outlets and Endwalls

Where an existing culvert is to be extended, the possibility for maintaining or improving existing capacity should be investigated. Marked improvement may be obtained by proper entrance design. All culverts shall be designed for possible extension unless there are extenuating circumstances.

50.40 Bridges

Bridges shall be designated to meet the current criteria of the governing agencies.

50.40.1 Waterway Capacity and Backwater Effects

Sufficient capacity will be provided to pass the runoff from the design storm determined in accordance with principles given elsewhere in this manual.

50.40.2 Clearance

The lowest point of the bridge superstructure shall have a (freeboard) clearance of two (2) feet above design water surface elevation for the 15-year frequency and one (1) foot for the 100-year frequency.

50.40.3 Waterway Alignment

The bridged waterway will be aligned to result in the least obstruction to stream-flow, except that for natural streams, consideration will be given for future realignment and improvements of the channel.

50.40.4 Erosion Protection

To preclude failure by scouring, abutment and pier footings usually will be placed either to a depth of not less than five (5) feet below the anticipated depth of scour, or on firm rock if such is encountered at a higher elevation. Large multispans structures crossing alluvial streams may require extensive pile foundations. To protect the channel, revetment on
channel sides and/or bottom, consisting of concrete or placed rock blanket should be placed as required. The governing authority should be contacted regarding their design requirements.

50.50 Outlet Erosion Protection

Outfall termination shall occur at a natural drainway/channel so that the flow does not exceed the natural capacity of the drainway/channel. Discharge velocities in an outfall pipe or lined channel shall not exceed eight (8) feet per second where practical. Special approved methods of energy dissipation will be required when discharge velocities exceed five (5) feet per second. Concrete outfall pipes shall have a reinforced concrete headwall or a flared end section with a cut-off wall. The outfall pipes shall discharge onto properly sized, placed revetment (rip-rap) underlain with a woven geotextile fabric or a paved ditch. Revetment for pipes not discharging into lakes or ponds shall be a minimum length of ten (10) feet or ten (10) times the diameter of the discharging pipe (in feet) whichever is greater. Revetment in lakes or ponds shall be placed between the outlet of the pipe to a point a minimum of three feet below the normal water elevation. Cut-off walls shall be a minimum of three (3) feet deep at the end of the pipe.

For paved channels, a cutoff wall will be required at the termini with appropriate protection. The cutoff wall shall extend a minimum depth of three (3) feet into the existing ground line.

Erosion protection in the form of asphalt curb, gutters, additional structures, paving, and/or revetment may be required at the temporary termination of pavements.

50.60 Surface Drainage

Sheet flow shall not be allowed over terraces. Berms and/or swales shall be provided to collect the flow at the top and/or bottom of the terrace and carry it to a drainage structure. Total accumulation inside berms and/or swales shall be a maximum of four (4) cfs. Critical cross sections, profile, and hydraulic computations for ditches and swales with flows in excess of one (1) cfs shall be provided.

Area inlets shall be required to intercept overland flows greater than one (1) cfs to prevent that flow from crossing sidewalks and curbs.

50.70 Plans and Calculations

Plans shall be any scale from one inch equals ten feet (1"\=10') through one inch equals fifty feet (1"\=50'), so long as the scale is an increment of ten (10) feet. Plans shall be prepared on exhibits having a maximum sheet size of twenty (24) inches by thirty-six (36) inches. All calculations submitted shall be prepared in a legible manner. Plans and calculations shall be prepared in accordance with this section and shall include the following information:
50.70.1 Site Drainage Map

A drainage map shall be developed from a base reproduction of the site plan or grading plan. The existing and proposed contours shall be shown, normally at two foot intervals, for the subject property, extending off-site 100' or less as determined by the Department for proper design of the proposed improvements. Contour intervals, other than the above, shall be used as determined by the site topography or other ordinance. Only U.S.G.S. Datum shall be used.

The location of existing and proposed property lines, streets, sinkholes, railroads, areas within the tract subject to inundation by storm water and other significant natural features, such as wooded areas and rock formations, etc., shall be included on the map. All existing and proposed storm water facilities, such as inlets, manholes, pipes, culverts, bridges, channels, etc., and all existing and proposed improvements required for proper design review, such as pavement, buildings, etc., shall be included on the map.

The runoff details shall be required, showing individual flows for each existing and proposed inlet structure and cumulative flows in pipes and gutters, including "Q" and drainage area. The map shall show all bodies of water, such as ponds or lakes (including surface area and elevation), and all waterways (including their names or the names of creeks or rivers they flow into).

50.70.2 Supplemental Drainage Map

A supplemental drainage map may be required. It shall be developed from a portion of the U.S.G.S. Quadrangle Map, County Orthophoto Map, aerial map, or similar source. It shall include the site boundary and the watershed tributary to the project area.

50.70.3 Drainage Structures

The lateral location of all street drainage structures shall be shown on the plans by the street center line stationing and the perpendicular offset distance.

1. Subsurface precast storm water structures may be used provided detailed drawings are submitted and approved prior to construction plan approval.

2. The type of structure (single, double, grated, etc.), the flow line and top elevations and the "Q" in the upstream gutter line shall be required on the plans and/or profiles. The hydraulic grade line elevation at the structure shall be shown on the computation sheets.

50.70.4 Drainage Pipes

The location, length, alignment and grade of all pipes shall be shown on the plans and/or profiles. Also, the curve data for radius pipes shall be shown (deflection angle, radius, and curve length).

1. At intake structures such as flared end sections or headwalls, entrance control shall be applied. Two (2) feet minimum freeboard shall be required. Upstream inundation shall be checked. Where inundation extends beyond the site property
line and exceeds the Design Water Surface Elevation of the natural drainway/channel, a backwater ponding easement from the affected off-site property owner(s) shall be required prior to Improvement Plan approval. Concrete outfall pipes shall have a reinforced concrete headwall or flared end section with a cut-off wall and properly sized, placed revetment (rip-rap) underlain with a woven geotextile fabric or paved ditch. Cut-off walls shall be a minimum of two (2) feet deep on upstream headwalls/end sections.

2. Storm Sewer "Y" connections will be approved only if the trunk diameter is a minimum of 48 inches, the maximum length of the lateral run from the "Y" connection to the inlet is 30 feet, the "Y" connection point is not more than 75 feet from a point of entry into the trunk sewer, and the minimum ratio of diameters of the incoming pipe to the trunk line is 1:3.

50.70.5 Bridges

Two (2) additional sets of plans for bridges shall be submitted. Structure widths shall be designed for the ultimate roadway width as obtained from the Department. Guard rail and fencing shall be required at appropriate locations. Reinforced Concrete Approach Slabs shall be required for all bridges.

50.70.6 Culverts

Two (2) additional sets of plans for poured-in-place or pre-cast culverts shall be submitted. Size, type, grade, alignment, minimum cover for the loading, wing-walls, and/or erosion protection in the form of paving or revetment or flood walls shall be shown, including cut-off footings, etc., if required. Any connections to culverts shall be shown with a detail. No utilities shall run through any culvert. Alignment and changes in grade shall be shown the same as for pipes. Slopes from culverts to roadways shall be no steeper than 3:1, and shall be sodded or protected with placed revetment or paved ditch as required. A soils report will be required in areas of excessive fill beneath the roadway involved with creeks, lakes and/or swampy areas. Inspection of fill material placement to be made by the Department.

50.80 Stormwater Detention

50.80.1 When Required

1. The requirement of stormwater detention shall be evaluated for all projects submitted to the Department for review and approval and may be required, if deemed necessary. Detention facilities shall be provided and designated in accordance with the requirements of this section.

2. Developments that have a differential runoff of less than two (2) cfs for the 15-year, 20-minute event and developments with three acre or larger lot sizes shall be exempt from detention requirements unless there are known storm water problems or special conditions downstream from a project.

3. If there are known storm water problems or special conditions downstream from a project, detention will be required.
4. Detention requirements will be at the discretion of the County Engineer for projects that have a differential runoff of two (2) cfs to five (5) cfs for the 15-year, 20-minute event. Projects that have a differential runoff of greater than five (5) cfs for the 15-year, 20-minute event or projects where detention will be required by the County Engineer shall have the following detention requirements:

a. The post-developed peak flow from the site may not exceed the existing peak flow for the 2 year, 24 hour event and the 10 year, 24 hour event for sites larger than ten (10) acres. For sites less than 10 acres, the post-developed peak flow from the site may not exceed the existing peak flow for the 2 year, 20 minute event and the 15-year, 20-minute event.

The Department, at its discretion, can create stricter detention standards for watersheds that are known to have storm water management problems. The Engineer shall be made known of any stricter standards during the preliminary plat process.

b. The existing and post developed peak flows shall be determined using Technical Release 55 (TR-55) for sites ten (10) acres or greater. All assumptions that are required for the TR-55 method shall be approved, in writing, by the Department prior to commencing clearing or grading activities or approval of an interim grading plan. For sites less than 10 acres, flow rates shall be determined using the method set forth in section 50.30.1 "Flow Quantities."

5. When existing detention facilities are going to be used to accommodate additional runoff from building or parking lot expansions or subdivision additions, the facilities shall be retrofitted to meet the current detention requirements for the drainage area that is a tributary to the facility. Projects that cannot meet this requirement due to physical constraints will be evaluated on a case-by-case basis.

50.80.2 Design Considerations

1. The 2-year, 10-year, and 100-year, 24-hour inflow hydrographs shall be determined by using Technical Release 55 (TR-55), "Urban Hydrology for Small Watersheds" from the Natural Resources Conservation Service, formerly Soil Conservation Service (SCS). The inflow hydrograph shall be developed based on the actual flow and timing characteristics upstream of the detention facility. The rainfall distribution shall be Type II.

2. The rates of runoff (pre-developed and post developed) for sites less than ten acres shall be determined by the Rational Method for the 20 minute rainfall intensity. The 2-year, 15-year, and 100-year, 20-minute inflow hydrographs shall be determined as directed in Figure 50-5.

3. For sites larger than ten acres, stormwater shall be detained on-site or off-site, as approved, and released at a rate not to exceed the release rate from the site under existing (pre-developed) conditions for the 2-year and 10-year, 24-hour events. Note that stormwater pipes, downstream from the control structure, shall be sized
to carry the runoff from the 15-year, 20-minute design storm for the total tributary upstream watershed. No reduction in outfall pipe size shall be permitted because of detention.

4. For sites less than 10 acres, stormwater shall be detained on-site or off-site, as approved, and released at a rate not to exceed the release rate from the site under existing (pre-developed) conditions for the 2-year and 15-year, 20 minute events. Note that stormwater pipes, downstream from the control structure, shall be sized to carry the runoff from the 15-year, 20-minute design storm for the total tributary upstream watershed. No reduction in outfall pipe size shall be permitted because of detention.

5. The volume of detention may be provided through permanent detention facilities such as dry basins or ponds, permanent ponds or lakes, underground storage facilities or in parking lots. The Engineer shall make every effort to locate the detention facility at or near the lowest point of the project such that all of the on-site runoff will be directed into the detention facility.

Flows from off-site upstream areas should be by-passed around the detention facility to ensure that the proposed detention facility will function as designed and will provide effective control of downstream flows with development in place. If off-site flows are approved by the Department to be directed into a detention facility, the Engineer must provide an analysis showing that the detention basin will adequately release storm water under both existing and future developed off-site conditions. Modifying the release rate to accommodate off-site flows may reduce or eliminate the effectiveness of the detention facility, because it will no longer control the increased volume of runoff during the critical time period of the watershed.

6. Detention basin volume will be based on routing the post-developed 2-year, 10-year, and 100-year, 24-hour inflow hydrographs or the 2-year, 15-year, and 100-year, 20-minute inflow hydrographs through the detention facility while satisfying the appropriate allowable release rate. The routing computations shall be based on an application of the continuity principle, (i.e., level pool routing).

7. Design of Underground Basins
   a. Adequate access for basin maintenance and inspection shall be provided. A means of visual inspection from the ground surface of the low flow device, overflow weir and outlet structure is necessary. Access also shall be provided to allow for cleaning of the low-flow device from the ground surface.

   b. The basin should have sufficient volume and spillway capacity to pass/contain the 100-year, 24-hour event.

8. The Engineer must submit the following for review of a detention facility:
   a. Elevation vs. Discharge tables or curves for all frequencies.
b. Elevation vs. Storage tables or curves for all frequencies.

c. Inflow calculations and data for all frequencies.

d. Hydraulic gradeline computations for pipes entering and leaving the basin for all frequencies.

e. If the embankment contains fill material a geotechnical report may be required.

f. Site plan showing appropriate design information.

g. Structural calculations for the outlet control structures (if required).

h. Cross sections defining size, shape and depth of the detention basin shall be required. At a minimum, three sections, one at each end and one in the middle of the basin will be required. These sections will be used to compute the as-built volume of the basin and thus must be tied to a known physical structure or baseline.

9. All ends of pipes discharging into a dry basin or pond shall be connected with the low-flow pipe or control structure by means of a paved swale. The paved swale shall be non-reinforced concrete, six (6) inches thick, with a minimum two (2) percent slope to the center and a minimum 0.2 percent longitudinal slope. Paved swales shall be a minimum of six (6) inches deep and four (4) feet wide or 1.3 times the diameter of the pipe entering the basin, whichever is greater, and be keyed to a structure or channel. The bottom of the basin shall be sloped a minimum of two (2) percent towards the concrete swale.

10. Railroad tie walls cannot be used where water will be in contact with the railroad tie wall.

11. Permanent detention ponds or lakes are to be designed to minimize fluctuating lake levels. Maximum fluctuation from the permanent pool elevation to the maximum ponding elevation shall be three (3) feet.

12. The maximum side slopes for dry basins or ponds, and the fluctuating area of permanent ponds or lakes shall be 3:1 (three feet horizontal, one foot vertical) without fencing.

13. Dry basins or ponds and the fluctuating areas of permanent ponds or lakes are to be lined with placed revetment, sod, or commercial erosion control blanket and kept mowed.

14. Control structures and overflow structures are to be reinforced concrete.

15. The outflow pipe shall be sized for the developed flow rate.
16. In basins with concrete walls or rock blanket covered slopes, the bottoms should be paved or provisions should be made for moving equipment to reach the bottom (ramps, etc.). Retaining walls and any required safety features must be designed and constructed as regulated by the St. Charles County Building Department.

50.80.3 Maximum Depths

1. The maximum depth of water in a dry detention basin or pond shall not exceed six (6) feet. Projects that need a deeper basin to attain the required detention volume due to physical constraints may be evaluated on a case-by-case basis. The design and construction of dams greater than eight (8) feet or as directed by the Department must be sealed and certified by a Professional Engineer registered in the State of Missouri with demonstrated expertise in geotechnical engineering.

2. Parking lots used for automobiles shall have a maximum depth of eight (8) inches of water.

3. Parking lots used for trucks or truck trailers shall have a maximum depth of water of twelve (12) inches.

50.80.4 Limits of Maximum Ponding

1. The maximum ponding elevation shall be calculated based on a routing of the 100-year, 24-hour design storm for sites greater than ten (10) acres and the 100-year, 20 minute design storm for sites less than 10 acres.

2. The limits of maximum ponding in dry basins or ponds and permanent lakes or ponds shall not be closer than thirty (30) feet horizontally to any building, and not less than two (2) feet vertically below the lowest sill elevation of any building.

3. The limits of maximum ponding in parking lots shall not be closer than ten (10) feet horizontally from any building and not less than one (1) foot vertically below the lowest sill elevation of any building.

4. A minimum of two (2) feet of freeboard shall be provided from the top of the basin to the maximum ponding elevation.

50.80.5 Common Ground Required

In subdivisions, the detention basin, access roads or paths, control structures and outfall pipes are to be located in common ground dedicated to the subdivision trustees.

50.80.6 Maintenance Agreement

The subdivision trust indentures shall provide for maintenance responsibility and funding for the basin(s). Maintenance on privately owned sites shall be the responsibility of the owner. The Department will not be responsible for maintenance of the detention basins.
50.80.7  Detention Basin Elevation

The low elevation of the detention basin shall be above the 15-year, 20-minute hydraulic elevation of the receiving channel or pipe system.

50.80.8  Dam Permit Requirements

Dams with a height of thirty-five (35) feet or greater will require approval from the Missouri Department of Natural Resources.

50.90.  Miscellaneous Requirements

50.90.1  Storm Sewer Discharge

All pipes shall be designed to discharge in common ground or at the property line at a natural drainway or channel. If discharge is at a property line, an attempt shall be made to acquire a discharge easement on the adjacent property prior to plan approval. Where a discharge easement can not be obtained, the outfall pipe shall be set back from the property line at a distance determined to allow discharge at the property line to occur without a negative impact to the adjacent property; in which case, a large enough on-site easement must be dedicated to allow for future extension of the outfall pipe to the property line. Discharge elevation shall be at the flow line of an existing ditch or creek.

50.90.2  Open Channel Setback Requirement

Development along natural watercourses shall have residential lot lines, commercial or industrial improvements, parking areas, or driveways set back from the top of the existing stream bank or from the 100 year water surface elevation where no established top of bank can be determined, as provided by Part 3, Article VI of Chapter 405 of the Unified Development Ordinance. In the case of subdivision plats, the watercourse and the setback area shall be preserved and made the responsibility of the subdivision trustees. In the case of a site plan, commercial, industrial, or private site, the watercourse and the setback area shall be preserved and made the responsibility of the property owner(s). Permanent vegetation and existing ground elevation and grades within the setback area shall be left intact and undisturbed, except as permitted by Part 3, Article VI of Chapter 405 of the Unified Development Ordinance. FEMA and U.S. Army Corps of Engineers guidelines shall be followed, where applicable, regarding site development areas designated as flood plains and wetlands.

50.90.3  Natural Drainageway Enclosure

If development plans call for the enclosure of an existing, natural drainageway that carries greater than 100 c.f.s. during a 15-year, 20-minute storm event, the enclosure shall be sized for a 50-year, 20-minute storm event. Two (2) feet minimum freeboard shall be required. Upstream inundation shall be checked. Where inundation extends beyond the site property line and exceeds the Design Water Surface Elevation of the natural drainway/channel, a backwater ponding easement from the affected off-site property owner(s) shall be required prior to Improvement Plan approval. A reduction in the design storm requirements may be granted by the County Engineer when existing off-site, downstream storm sewers would be
smaller than the required on-site, upstream sewers and the downstream storm sewers are not designed to intercept/pass the 50-year, 20-minute storm event.
P FACTOR FOR RUNOFF

<table>
<thead>
<tr>
<th>PERCENT IMPERVIOUS</th>
<th>DURATION OF RAIN IN MINUTES</th>
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Values of P for 0% and 100% are those used for St. Louis Modified 9-1939

Rainfall intensity of 1 inch per hour on 1 acre

\[= 1.008 \text{ cu. ft. per second on 1 acre}\]

\[= 1 \text{ cu. ft. per second on 1 acre (approximately)}\]

P x I = Q = Runoff in cu. ft. per second per acre for given % imperviousness of contributing areas during a rainfall of given intensity corresponding to the given duration and a selected frequency.

I = Intensity of rainfall in inches per hour for given duration and given frequency.

Runoff = P = Ratio of runoff contributed by an area of given % imperviousness for a given duration period to the rainfall of a given intensity corresponding to the same duration period and a selected frequency.

TABLE 50 – 2

| P (RUNOFF FACTORS) FOR VARIOUS IMPERVIOUS CONDITIONS |
## P.I. VALUES FOR VARIOUS IMPERVIOUS CONDITIONS

(15-YEAR AND 20-YEAR RAINFALL FREQUENCIES)

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<th>Duration of Rain in Minutes</th>
<th>15-Year Rainfall Frequency</th>
<th>20-Year Rainfall Frequency</th>
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</thead>
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### P.I. Factor in Cubic Feet per Second per Acre

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### P.I. Values for Various Impervious Conditions

(2-Year and 5-Year Rainfall Frequencies)

---

**TABLE 50-4**
### P.I. FACTOR IN CUBIC FEET PER SECOND PER ACRE

<table>
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<tr>
<th>DURATION OF RAIN IN MINUTES</th>
<th>IMPERVIOUS</th>
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<th>100-YEAR RAINFALL FREQUENCY</th>
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<td>3.46</td>
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</table>

### TABLE 50-5

**P.I. VALUES FOR VARIOUS IMPERVIOUS CONDITIONS**

(10-YEAR AND 100-YEAR RAINFALL FREQUENCIES)
RAINFALL INTENSITY – DURATION CURVES
(2, 5, 10, 15, 20, & 100 YEAR RAINFALL FREQUENCY)
SYMBOLS
D = DIAMETER OF PIPE
r = RADIUS OF CURVE
V = VELOCITY IN FT. PER SEC.
Kc = CURVE LOSS COEFFICIENT
hc = HEAD LOSS DUE TO CURVED ALIGNMENT
α = DEFLECTION ANGLE IN RADIANS
C = FACTOR OF CONSERVATISM TO ACCOUNT FOR THE VARIATION IN THE EXPERIMENTAL DATA.
FOR THESE CURVES C = 1.5 FOR THE DESIGN OF HYDRAULIC CAPACITY.
Ln = NATURAL LOG

\[ Kc = C \frac{2\alpha}{\pi^2 (\ln \phi + \alpha)} \]

\[ hc = Kc \frac{V^2}{2g} \]

\[ \alpha = \text{DEFLECTION ANGLE (IN DEGREES)} \]

EXAMPLE
Q = 260cfs \hspace{1cm} V = 13.2fps
D = 60^\circ \hspace{1cm} \alpha = 90^\circ
r = 50' \hspace{1cm} V^2/2g = 2.71'
r/D = 10

FROM \alpha = 90^\circ \text{ ON THE ABSISSA FOLLOW A VERTICAL LINE UP TO THE INTERSECTION WITH THE } D = 10 \text{ CURVE. THEN TRANSFER ON A HORIZONTAL LINE TO THE ORDIINATE AND READ THE CORRESPONDING CURVE LOSS COEFFICIENT.}

Kc = 0.123

THE HEAD LOSS DUE TO CURVED ALIGNMENT =

\[ hc = Kc \frac{V^2}{2g} = (0.123)(2.71) = 0.33 \]

FIGURE 50 - 2

HEAD LOSS FOR CURVED ALIGNMENT OF CONCRETE PIPES
GENERAL NOTES:
1. DO NOT SCALE DRAWING. FOLLOW DIMENSIONS.

2. LOW POINT INLETS ARE CONTROLLED BY CAPACITY IN GUTTER BASED ON PERCENT OF GRADE OF THE GUTTER AT THE BEGINNING POINT OF THE STANDARD SUMP, EG., 0.5% GRADE, 2% CROSS SLOPE, 3" DEEP, .016n = 3.1 C.F.S. UNDER NO CIRCUMSTANCE WILL GREATER THAN THREE (3) C.F.S. BE ALLOWED TO BE DIRECTED TO A SINGLE CURB INLET AND NO GREATER THAN FIVE (5) C.F.S. WILL BE ALLOWED TO BE DIRECTED TO A DOUBLE CURB INLET AT STREET LOW POINTS.

3. ASSUME INLET INTERCEPTS 100% OF FLOW.

FIGURE 50 - 3
INLET AND GUTTER INTERCEPT AND CAPACITY CHART
<table>
<thead>
<tr>
<th>STREET GRADE (%)</th>
<th>SINGLE INLET (cfs)</th>
<th>DOUBLE INLET (cfs)</th>
<th>STREET GRADE (%)</th>
<th>SINGLE INLET (cfs)</th>
<th>DOUBLE INLET (cfs)</th>
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Indicates Gutter Capacity

Area/Yard Inlet Capacities:

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<th>Per Side</th>
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<th>Double</th>
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**TABLE 50 - 6**

**INLET AND GUTTER INTERCEPT AND CAPACITY TABLE (FROM FIGURE 50 - 3)**
TRANSITION TYPES FOR RECTANGULAR CHANNELS
Tc - Time of Concentration (minutes)

Qp - Peak Inflow (c.f.m.)

Qp1 = Qp * (20/Tc)

---

**FIGURE 50 - 5**

INFLOW HYDROGRAPHS
20 MINUTE STORM DURATION
60.00 Design Criteria & Guidelines For Erosion & Sediment Controls

60.10 Design Criteria

The erosion and sediment controls and temporary facilities during land disturbance activities shall be designed according to the criteria defined in this section.

60.10.1 Design Storm

Designs for erosion and sediment controls (ESC) and temporary facilities constructed during land disturbance activities shall be based on the design storms shown in the following table.

### Table 60-1 Design Storm

<table>
<thead>
<tr>
<th>Erosion &amp; Sediment Control &amp; Temporary Facilities</th>
<th>Design Storm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm Water Conveyance Systems:</td>
<td></td>
</tr>
<tr>
<td>On-site drainage ditches &amp; diversions</td>
<td>6-mo</td>
</tr>
<tr>
<td>By-pass storm sewers &amp; channels</td>
<td>2-yr</td>
</tr>
<tr>
<td>Entrance road culvert</td>
<td>2-yr</td>
</tr>
<tr>
<td>Storm Inlet Sediment Protection</td>
<td>6-mo</td>
</tr>
<tr>
<td>Stream Crossing Structures:</td>
<td></td>
</tr>
<tr>
<td>Duration of use: 4 months or less</td>
<td>2-yr</td>
</tr>
<tr>
<td>Duration of use: longer than 4 months</td>
<td>10-yr</td>
</tr>
<tr>
<td>Sediment Basin:</td>
<td></td>
</tr>
<tr>
<td>Basin area and volume</td>
<td>6-mo</td>
</tr>
<tr>
<td>Basin outflow</td>
<td>10-yr</td>
</tr>
</tbody>
</table>

60.10.2 Runoff Coefficient

The runoff coefficient (C) corresponds to the effective storm water runoff for all storm events based on ground cover, ground slope, and that portion of rainfall that is lost to surface runoff due to processes such as depression storage, infiltration, interception, and evapotranspiration. The following runoff coefficients listed in Table 60-2 shall be used in calculating peak runoff rates and storm water volumes:

### Table 60-2 Runoff Coefficient Table (C)

<table>
<thead>
<tr>
<th>Ground Cover</th>
<th>Runoff Coefficient (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasture and unimproved areas</td>
<td>15%</td>
</tr>
<tr>
<td>Woods</td>
<td>10%</td>
</tr>
<tr>
<td>Lawns ≤ 6% slope</td>
<td>15%</td>
</tr>
<tr>
<td>Lawns &gt; 6% slope</td>
<td>30%</td>
</tr>
<tr>
<td>Graded/no vegetation ≤ 6% slope</td>
<td>50%</td>
</tr>
<tr>
<td>Graded/no vegetation &gt; 6% slope</td>
<td>60%</td>
</tr>
<tr>
<td>Gravel Parking Lot</td>
<td>75%</td>
</tr>
<tr>
<td>Gravel Road</td>
<td>80%</td>
</tr>
<tr>
<td>Pavement, walks, buildings</td>
<td>95%</td>
</tr>
</tbody>
</table>
The runoff coefficients shall be determined for each drainage area to proposed erosion and sediment control and temporary facilities based on the following criteria:

1. Land disturbance areas shall be considered stripped of all vegetation in determining runoff for erosion and sediment controls placed prior to land disturbance activities.

2. After cut and fill operations are completed, land disturbance areas shall be considered stripped of all vegetation, and pavement installed in determining sediment controls, runoff conveyance systems, and erosion prevention devices.

60.10.3 Peak Runoff Rate Calculation Method

The Rational Method, as developed by Mulvaney in 1851, shall be used to determine the peak (maximum) runoff rate. The Rational Method (also known as the Rational Formula) is:

\[ Q = C \times i \times A \]  
Equation 60-1

Where

\( Q \) = peak runoff rate in cubic feet per second (cfs)
\( C \) = runoff coefficient (dimensionless)
\( i \) = rainfall intensity rate in inches per hour
\( A \) = drainage area in acres

1. The runoff coefficients (C) to be used are defined in Table 60-2.

2. The rainfall intensity rate (i) was derived for St. Charles County from the Rainfall Frequency Atlas for the Midwest, Bulletin 71 by Huff and Angel, 1992 for a ten (10) minute rain event. The rainfall intensity rates shall be used as found in Table 60-3.

<table>
<thead>
<tr>
<th>Design Storm</th>
<th>Rainfall Intensity Rate (inches/hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-month</td>
<td>2.86</td>
</tr>
<tr>
<td>1-year</td>
<td>3.54</td>
</tr>
<tr>
<td>2-year</td>
<td>4.38</td>
</tr>
<tr>
<td>5-year</td>
<td>5.53</td>
</tr>
<tr>
<td>10-year</td>
<td>6.62</td>
</tr>
</tbody>
</table>

60.10.4 Total Runoff Volume Calculation Method

The total volume of runoff for calculating sediment basin size shall be based on the runoff coefficient times the total rainfall in a 24 hour period, which is:

\[ V = 3630 \times P \times C \times A \]  
Equation 60-2

Where

\( V \) = total runoff volume in cubic feet
\( P \) = inches of rainfall in a 24 hour period
\( C \) = runoff coefficient (dimensionless)
\( A \) = drainage area in acres
1. The runoff coefficient (C) to be used is defined in Table 60-2.

2. The total inches of rainfall in a 24 hour period was derived for St. Charles County from the Rainfall Frequency Atlas for the Midwest, Bulletin 71 by Huff and Angel, 1992. See Table 60-4.

<table>
<thead>
<tr>
<th>Design Storm</th>
<th>Total Rainfall (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-month</td>
<td>2.03</td>
</tr>
<tr>
<td>1-year</td>
<td>2.50</td>
</tr>
<tr>
<td>2-year</td>
<td>3.25</td>
</tr>
<tr>
<td>5-year</td>
<td>4.10</td>
</tr>
<tr>
<td>10-year</td>
<td>5.00</td>
</tr>
</tbody>
</table>

**Table 60-4 Total Inches of Rainfall in a 24-Hour Period**

**60.20 Design Guidelines for Erosion and Sediment Controls**

This section furnishes design guidelines to provide the engineer a flexible tool to select and design appropriate structural and non-structural methods to mitigate erosion and sediment impacts caused by land disturbance for use in St. Charles County. Drawing ESC 1 and Appendix E can be used as quick references in determining ESC spacing, design requirements, and limitations for various devices.

This section is not intended to be the sole source regarding acceptable ESC methods. Engineering professionals are encouraged to design innovative ways to address site specific conditions, including the use of available on-site, recyclable materials and manufactured technology. Alternative ESC methods should be reviewed with the Development Review Division staff and design criteria shall be approved for use by the Director during the preliminary design stage of a project.

**60.20.1 Earthwork**

1. The soil textures determined throughout the site after grading is completed will be the basis for determining the erosion value “K.” Soil classification will be determined by an approved geotechnical engineer or geologist. See ESC 2 USDA Soil Texture Chart.

2. Grading proposed with deep cuts, high embankments, or steep slopes will require the submittal of a geotechnical engineering report identifying the global and local slope stability.

3. No cut or fill slope shall be made steeper in slope than three (3) horizontal to one vertical (33%) without a geotechnical report and approval by the Director of Development Review. Slopes steeper than 3:1 shall require special design and stabilization considerations that shall be adequately shown on the plans. These considerations must address methods of permanent slope surface stabilization that will not require the need for routine maintenance and methods to permanently divert surface storm water runoff from draining onto the slope.
4. Individual and isolated slopes, rock dikes, undisturbed natural slopes and slopes blending with the natural terrain may be steeper than the requirements as approved by the Director.

5. Provisions shall be made to safely conduct surface water to storm drains or to suitable natural watercourses and to prevent surface runoff from damaging cut faces and fill slopes.

6. Surface water shall be diverted from the face of all cut and fill slopes exceeding eight (8) feet in vertical elevation by the use of diversions, ditches, and waterways or conveyed down-slope by the use of a designed structure except where:

   a. The face of the slope is or shall be stabilized and the faces of all graded slopes shall be protected from surface runoff until they are stabilized.

   b. The face of the slope shall not be subject to excessive amounts of sheet flow runoff that would cause erosion of the slope nor any concentrated flows of surface water such as from natural drainageways, graded waterways, downspouts, etc.

   c. The face of the slope will be protected by special erosion control materials, sod, mulch, tackifiers, soil binders, bonded fiber matrix, gravel, riprap, or other stabilization methods.

7. Diversions (slope breaks) shall be provided whenever the vertical interval of any slope exceeds 20 feet. Diversions shall be located to divide the slope face as equally as possible and shall convey the water to a stable outlet. Soils, seeps, rock outcrops, etc. shall also be taken into consideration when designing diversions.

   a. Diversions shall have a minimum bottom width of six feet to provide for maintenance.

   b. Diversions shall be designed with a cut slope of 6:1 or flatter to the toe of the upper slope and with a minimum of one foot in depth. The gradient to the outlet shall be between 2% and 3% unless accompanied by an appropriate design and design computations.

   c. The flow length within a diversion shall not exceed 800 feet unless accompanied by an appropriate design and computations.

8. Cut slopes occurring in rip-able rock shall be serrated. These serrations shall be made with conventional equipment as the excavation is made. Each step or serration shall be constructed on the contour and will have steps cut at nominal two-foot intervals with nominal three-foot horizontal shelves. These steps will vary depending on the slope ratio or the cut slope. These steps will weather and act to hold moisture, lime, fertilizer, and seed, thus producing a much quicker and longer lived vegetative cover and better slope stabilization. Overland flow shall be diverted from the top of all serrated cut slopes and carried to a suitable outlet.
9. No excavation shall be made so close to property lines as to endanger any adjoining public or private street or property without supporting and protecting such public or private street or property from erosion, sliding, settling, cracking, or other damage.

10. No fill shall be made so as to cause or to allow the same to be deposited upon or to flow onto another property without written consent of the owner.

11. No fill shall be made so as to cause or to allow the same to be deposited upon or to flow onto any public street, walk, place or way, nor so close to the top of a bank of a channel as to create the possibility of bank failure or decrease the natural carrying capacity of the stream.

12. A 25 to 50 foot setback will be required as a buffer to sensitive areas, as determined by Development Review Division.

13. Materials for fills shall consist of material obtained from cut areas, excavation of banks, borrow pits, or other approved sources. Material shall be free of vegetative matter, rubbish, building debris, and other deleterious material and shall not contain large rocks or lumps except as certified by a geotechnical engineer to be acceptable fill material. Fill should be free of stones over two inches in diameter where compacted by hand or mechanical tampers or over eight inches in diameter where compacted by rollers or other equipment. Frozen material shall not be placed in the fill nor shall the fill material be placed on a frozen foundation.

14. All fills and trench backfills shall be compacted to the minimums as defined in the Design Manual. Compaction of fills and backfills must be certified by a geotechnical engineer.

15. Stockpiles, borrow areas, and spoil areas shall be shown on the plans and shall be subject to the provisions of this manual. Stockpiles shall be located in areas that will not erode, block drainage, or interfere with work on the site.

16. Solid rock, shale, tree stumps, masonry, and other obstructions shall be removed to a depth of two (2) feet below finished grade or pavement subgrade.

17. Subsurface drainage shall be provided in areas having a high water table to intercept seepage that would affect building foundations, slope stability, or create undesirable wetness.

60.20.2 Surface Stabilization

It is critical that temporary and permanent surface stabilization be provided as soon as possible to reduce erosion at the source. There are several acceptable methods to stabilize bare ground: revegetation by seeding or sodding, mulching, erosion control blankets, soil binders, rock topping, structural topping such as concreting, etc. Temporary seed and surface stabilization methods can be used if the area will be disturbed later in the development. The area should be permanently revegetated or surfaced when no further land disturbance will occur.
Bare ground must be stabilized by revegetation, mulching, erosion control blankets and netting, soil binders, rock surfacing, structural topping, or other approved techniques. See ESC 3 for use of appropriate surface stabilization methods for sheet flow.

The following provisions shall apply to surface stabilization:

1. Surface stabilization must effectively stabilize at least 70% of the total disturbed site area.

2. Surface stabilization may be suspended from portions of the project area which have an active building permit. Upon completion of the building activity, the site must be permanently stabilized.

3. Non-degradable mats shall be used only as a permanent installation, and in areas that will not be mowed.

4. Surface stabilization shall be scheduled as provide in Table 60-5 below:

<table>
<thead>
<tr>
<th>Soil Disturbance Activity or Condition</th>
<th>Required Stabilization Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil disturbance has ceased in areas greater than 2,000 square feet.</td>
<td>14 days</td>
</tr>
<tr>
<td>After construction of dikes, swales, diversions, and other concentrated flow areas</td>
<td>5 days</td>
</tr>
<tr>
<td>When slopes are steeper than 3 horizontal to 1 vertical</td>
<td>7 days</td>
</tr>
<tr>
<td>When slopes are greater than 3% and longer than 150 feet.</td>
<td>14 days</td>
</tr>
<tr>
<td>Perimeter controls around soil stockpiles.</td>
<td>End of workday</td>
</tr>
<tr>
<td>Stabilization or covering of inactive stockpiles.</td>
<td>30 days</td>
</tr>
<tr>
<td>When land disturbance is completed, permanent soil stabilization must be installed.</td>
<td>30 days</td>
</tr>
</tbody>
</table>

60.20.2.1 Temporary Seeding

Temporary seeding and mulching shall be applied to all cleared, unvegetated, or sparsely vegetated soil surfaces where vegetative cover is required for less than 1 year. Temporary seeding shall germinate to a density of at least 70% of the total disturbed site area. Temporary seeding may be used for diversions, dams, temporary sediment basins, temporary road banks, topsoil stockpiles, and any other exposed areas of a construction site, which meet velocity and other requirements for its use.

Temporary seeding may be suspended from individual lots located in the project area, which have an active building permit. Upon completion of the building activity, the site shall be permanently vegetated.
60.20.2.1.1   Seed

Seed must be clean, relatively free of weed seed and other contaminants, and comply with the Federal Seed Act and the Missouri State Seed Law. Seed that has become wet, moldy, or otherwise damaged in transit or storage is not acceptable. Turf mixes can be used with no more than 10% Kentucky bluegrass and at least 20% perennial rye.

60.20.2.1.2   Seedbed Preparation

Seedbed preparation is essential for the seed to germinate and grow. For broadcast seeding and drilling, loosen the top 3 to 6 inches of soil. Lime and fertilizer should be incorporated by diskng. If recent tillage or grading operations have resulted in a loose surface, additional tillage may not be required. If rainfall caused the soil surface to become sealed or crusted, surface tilling will be required prior to seeding.

The seedbed area shall be tested by an approved nursery for proper application rates of lime and fertilizer. Results of the test are to be sent to the County inspector with the recommended application rates. Mulching or the addition of stockpiled topsoil is required on all seedbeds prior to the placement of seed wherever there are inadequate amounts of topsoil. Mulch shall be applied after seeding for protection and to aid in seed germination. Mulch shall be placed in accordance with the mulching section of this document.

In lieu of soil testing for land disturbance sites less than two (2) acres, the following fertilizer and lime rates shall be applied:

<table>
<thead>
<tr>
<th>Soil Amendment Material</th>
<th>Application Rate (Lb per Acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizer</td>
<td></td>
</tr>
<tr>
<td>Nitrogen (N)</td>
<td>30¹</td>
</tr>
<tr>
<td>Phosphate (P₂O₅)</td>
<td>90¹</td>
</tr>
<tr>
<td>Potash (K₂O)</td>
<td>90¹</td>
</tr>
<tr>
<td>Lime</td>
<td>1,000²</td>
</tr>
</tbody>
</table>

¹Increase the rate by 25% for slopes steeper than 5:1.
²Rate is in effective neutralizing material (ENM) units.

60.20.2.1.3   Temporary Seeding Rates and Times

In areas that are on slopes flatter than 4:1 and that are not within watercourses, seeding shall be applied at the rates and times specified in Table 60-7 and Table 60-8. Seed shall be evenly spread with a broadcast seeder, drill, or hydro seeder. The proper depth is 1/4 to 1/2 inches deep for legumes and grasses such as annual ryegrass and up to 1 and 1/2 inches for cereal grains. If the seed is applied by a broadcast method, the area will be rolled or culti-packed immediately after seeding on a prepared seedbed only. Rolling or culti-packing is not required if the broadcast seeding rate is increased by 50 percent. Other seed species and mixtures can be
proposed prior to planting, as recommended by an agronomist, competent nursery company, or refer to NRCS MOFOTG Code 340 (Cover Crop) in Appendix D.

For channels, embankments, and slopes of 4:1 or steeper, seeding shall be a mixture of K31 fescue and rye at a rate of 400 pounds per acre.

**Table 60-7 Temporary Fall Seeding**

<table>
<thead>
<tr>
<th>Plant Species</th>
<th>Rate 1 (lb/acre)</th>
<th>Seeding Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side-Oats</td>
<td>65</td>
<td>8/16 – 9/30</td>
</tr>
<tr>
<td>Winter Rye</td>
<td>50</td>
<td>8/01 – 10/15</td>
</tr>
<tr>
<td>Winter Wheat</td>
<td>60</td>
<td>8/01 – 10/15</td>
</tr>
<tr>
<td>Orchard Grass</td>
<td>120</td>
<td>8/01 – 10/15</td>
</tr>
<tr>
<td>Perennial Ryegrass</td>
<td>80</td>
<td>8/01 – 10/15</td>
</tr>
<tr>
<td>Tall fescue, Smooth Brome</td>
<td>80</td>
<td>8/01 – 10/15</td>
</tr>
<tr>
<td>K-31 Fescue</td>
<td>120</td>
<td>9/01 – 11/15</td>
</tr>
<tr>
<td>Ladino Clover</td>
<td>2 2</td>
<td>8/15 – 9/15</td>
</tr>
<tr>
<td>Crimson Clover</td>
<td>6 2</td>
<td>8/15 – 9/15</td>
</tr>
<tr>
<td>Orchard Grass and Oats or Rye</td>
<td>15 2 40 2</td>
<td>8/15 – 9/15</td>
</tr>
</tbody>
</table>

1If using aerial seeding or other broadcast method to apply seed without rolling or cultipacking, increase seeding rates by 50 percent.

2Pure live seed (PLS)

**Table 60-8 Temporary Spring Seeding**

<table>
<thead>
<tr>
<th>Plant Species</th>
<th>Rate 1 (lb/acre)</th>
<th>Seeding Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter Rye</td>
<td>50</td>
<td>3/15 – 5/31</td>
</tr>
<tr>
<td>Spring Oats</td>
<td>65</td>
<td>3/15 – 5/31</td>
</tr>
<tr>
<td>Annual Ryegrass</td>
<td>4 2</td>
<td>3/15 – 6/15</td>
</tr>
<tr>
<td>Sudangrass</td>
<td>16 2</td>
<td>4/15 – 6/15</td>
</tr>
<tr>
<td>K-31 Fescue</td>
<td>30 2</td>
<td>3/15 – 5/31</td>
</tr>
<tr>
<td>Red Clover &amp; Oats</td>
<td>2 2 30 2</td>
<td>3/15 – 5/31</td>
</tr>
</tbody>
</table>

1If using aerial seeding or other broadcast method to apply seed without rolling or cultipacking, increase seeding rates by 50 percent.

2Pure live seed (PLS)
60.20.2.1.4 Submittals & Follow-up Care

The following submittals are required prior to temporary seeding:

1. Soil test report
2. Seeding date
3. Fertilization mixture and rate
4. Seed mixture(s) and rate(s), supplier, purity percentage
5. Mulching material(s) and application rate(s)
6. Mowing height and schedule

Seeded areas shall be re-fertilized 4 weeks after initial seeding. All areas identified as bare and sparse (less than 30% ground cover) during the inspection shall be re-seeded and mulched. Grass shall not be cut until 4 inches of growth occurs.

60.20.2.2 Permanent Seeding

After land disturbance activities have been completed in an area, permanent seeding shall be applied. Permanent seeding is the establishment of perennial vegetation on disturbed areas for periods longer than 12 months. Permanent seeding is used when vegetation is designed to permanently stabilize the soil. Particular care is required to establish a thick cover of permanent grass.

Refer to sections 60.20.2.1.1, 60.20.2.1.2, and 60.20.2.1.4 and to NRCS MOFOTG Code 342 (Critical Area Planting) in Appendix D for permanent seeding guidelines.

60.20.2.3 Sodding

Sodding is the use of a vegetative cover to provide immediate erosion control in disturbed areas. Sodding is well suited for stabilizing erodible areas such as grass-lined channels, stormwater detention basins, diversions, swales, slopes, and filter strips because it provides an instant vegetative cover with an established root system. Placement of sod on slopes steeper than 10% should be staked.

60.20.2.4 Mulching

Mulching and hydro mulch are the application of plant residues such as straw or other suitable materials to the soil surface. Mulch protects the soil surface from the erosive force of raindrop impact and reduces the velocity of overland flow. It helps seedlings germinate and grow by conserving moisture, protecting against temperature extremes, and controlling weeds. Mulch also maintains the infiltration capacity of the soil.

Mulch shall be applied to seeded areas to help establish plant cover. It can also be used as temporary cover in unseeded areas to protect against erosion over the winter or until final grading and shaping can be accomplished. Application rates are shown in Table 60-9 below.
Table 60-9 Mulching Materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Rate</th>
<th>Requirements</th>
<th>Installation/Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straw</td>
<td>1.5-2.5 tons/ac</td>
<td>Dry, unchopped, unweathered; free of weed seeds &amp; rot.</td>
<td>Spread by machine 1.5-2.5 inches deep; must be tacked or tied down.</td>
</tr>
<tr>
<td></td>
<td>(3-4 tons, if</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>roller punched)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compost Blanket</td>
<td>1” thick</td>
<td>Double the application rate for embankments</td>
<td>Follow manufacturer’s application method.</td>
</tr>
<tr>
<td>Wood fiber, wood cellulose,</td>
<td>1-2 tons/ac</td>
<td>Double the application rate in critical areas</td>
<td>Use with power mulcher or hydroteeder; may be used to tack straw on steep</td>
</tr>
<tr>
<td>paper</td>
<td></td>
<td></td>
<td>slopes. Cannot be used in hot dry weather.</td>
</tr>
</tbody>
</table>

60.20.2.5 Tackifiers & Soil Binders

Tackifiers and soil binders can increase the performance of mulch material. Binders can also be directly applied to the bare soil to provide binding of the soil particles and reduce the erosion potential of the bare soil.

60.20.2.5.1 Tackifiers and Binders

Tackifiers and binders are applied to organic mulch to reduce the potential of mulch movement by water or wind and increase the performance of the material. Substances are used to anchor straw, hay, paper, or wood mulch by causing the organic material to bind together.

60.20.2.5.2 Bonded Fiber Matrix (BFM)

A classification of erosion control products that are designed to stay in place on steep slopes. A bonded fiber matrix is a continuous layer of elongated fiber strands held together by a binding agent that is water-resistant. Once dry, the BFM forms a water absorbent protective cover that is porous and breathable and secures soil and seed while enhancing establishment of vegetation. Due to many different types of products available on the market, it is best to consult with the manufacturer for proper application rates and procedures with a minimum of 2 tons per acre.

60.20.2.5.3 Flexible Growth Medium (FGM)

FGM combines both chemical and mechanical bonding techniques to lock the engineered medium in place to bond directly to the soil. Wood fibers, crimped man-made fibers, and performance-enhancing additives form a lofty, interlocking matrix that creates air space and water absorbing cavities that accelerate germination, reduce the impact of raindrop energy, and minimize soil loss. The chemistry enables this matrix to handle higher rates of surface flow energy. As with the BFM, maximum effectiveness is achieved when the matrix has dried and has thoroughly cured.
60.20.2.6 Rolled Erosion Control Products (RECP)

A rolled erosion control product is a preformed protective blanket of plastic fibers, straw, or other plant residue designed to protect soil from the impact of precipitation and overland flow and to retain moisture to facilitate the establishment of vegetation. RECPs are used where:

1. Protection of newly seeded areas is critical.
2. Slopes are greater than 3:1.
4. The expected velocity of concentrated runoff will cause erosion (drainageways and swales).

There are many products on the market designed for a variety of applications. Several factors such as soil conditions, steepness and length of slope, depth of flow, runoff velocities, and time required to establish desired vegetation influence the choice of product.

Products are available for a variety of uses:

1. Netting: synthetic or natural fiber mesh installed over disturbed area to hold organic mulch and/or seed in place.
2. Biodegradable RECP: natural fiber blanket held together by netting to provide temporary erosion protection on slopes and channels.
3. Permanent RECP - synthetic blanket material which provides permanent erosion control on slopes and channels with increased water flow velocities.
4. Turf Reinforcement Mat (TRM): 3-dimensional permanent synthetic mat that provides a matrix to greatly reinforce the root system of the desired vegetation for permanent erosion protection in high flow channels and on critical slopes. Since TRMs are non-degradable, they should be used as a permanent installation. TRMs require the design by a geotechnical engineer based on the shear stress of the soil.

RECPs shall be installed per the manufacture's specifications or as called out below, whichever standard is greater. RECPs shall be installed after all topsoiling, fertilizing, liming, and seeding are complete. The blanket must be in firm contact with the soil and it shall be anchored per the manufacturer's recommendation with the proper number and spacing of wire staples. The staples shall be the proper width and length to meet the manufacturer's recommendations.

On slopes and in small drains the blanket shall be unrolled upstream to downstream parallel to the direction of flow. The upstream end of each blanket shall be anchored in a minimum 6-inch deep anchor trench. These blankets, when laid side by side, shall overlap a minimum of 3 inches. When more than one blanket length is needed, the material shall be overlapped 6 inches over the downstream piece. All edges shall be stapled as per manufacturer's recommendation.
60.20.3 Sediment Controls

60.20.3.1 Vehicle Wash-Off Pad & Construction Entrance

A vehicle wash-off pad is designed to provide a buffer area where mud and soil can be cleaned from construction vehicles and deposited to avoid tracking it onto public roads. The wash-off pad must be located where traffic leaves a construction site. Only one construction entrance will be permitted for grading/trucking operations. Vehicles leaving the site must travel over the entire length of the stabilized construction entrance. Permits may be required to be obtained from the state, county, or municipal authority that is responsible for maintaining the intersecting street before constructing the entrance.

ESC plans shall show the location, dimensions, culvert as required, and water source of the entrance wash-off pad. Depending upon the slope at the entrance, a mountable diversion berm or soil sock should be shown to divert all surface water flowing toward the connecting public road. See Drawing ESC 4.

60.20.3.2 Silt Fence Barrier

Silt fence is a temporary sediment barrier consisting of a synthetic fabric stretched across and attached to supporting posts and entrenched or sliced in place. A properly installed silt fence will detain small amounts of sediment from disturbed areas of limited extent in order to prevent sediment from leaving the construction site and it will decrease the velocity of sheet flows.

Silt fence can be used for sheet flow with less than ½ acre drainage area per 100 linear feet of barrier. Silt fence should be placed at least 10 feet from the toe of slopes steeper than 15% to provide a broad shallow sediment pool. The fence should be installed on the contour where fence can intercept runoff as sheet flow only. The ends of the fence should be flared uphill to temporarily impound water.

Silt fence cannot be used in channels, waterways, or other concentrated flow paths. Limitations for using silt fence are shown in Drawing ESC 5.

Support Posts
- 4-inch diameter hardwood or 1.33 lb./linear foot steel, buried or driven to a depth of 24 inches.
- 1-1/4” square hardwood to be used when they are prefabricated with backing.
- Posts shall be placed at 10 foot spacing with support backing, or 5 foot spacing for high strength fabric without support backing.

Support Backing
- Wire backing
- Plastic net backing

Sediment Fence Fabric
- Filtering Efficiency 75% ASTM 5141
- Flow Rate 0.2 gal./sq.ft./minute ASTM 5141
- Standard strength 30 lb./ linear inch ASTM 4632
**60.20.3.3 Straw Bale Barrier**

Straw bale barriers can be used for sheet flow with less than ¼ acre drainage area per 100 linear feet of barrier. Straw bale barriers should be located at least 5 feet from the base of disturbed slopes with grades steeper than 10% percent. Straw bale barriers should be installed along the contour. Straw bales can be used as check dams in low concentrated areas, as limited in Drawing ESC 12. Straw bales will not be permitted as inlet protection devices. Straw bales are to be set 4 inches into the ground and staked. Bales shall be replaced when bales prevent water seepage due to silt buildup or regrowth or when they have deteriorated to a point of being ineffective to control the migration of sediment. See Drawing ESC 6.

**60.20.3.4 Compost Tubes & Berms**

Compost tubes and berms consist of organic mulch or composted material blown in place and used as erosion and sediment control devices. Tubes and berms can be designed as perimeter controls for surface runoff from areas less than 0.5 acre per 100 feet of berm length. They can also be designed as diversions above the disturbed area to bypass stormwater around the site. Tubes and berms should be placed on the contour prior to the start of construction. Compost tubes can be used to protect storm sewer inlets. Compost tubes cannot be used in channels or other concentrated flow locations. Tubes and berms require vegetation, and are very effective if used in combination with vegetation buffers or filter strips.

Filter tubes and berms filled with mulch or other permeable material can be used when no seeding or planting is planned. Filter mulch material particle size gradation must conform to the following specification:

- 99 percent passing 1-inch sieve;
- 90 percent passing ¾-inch sieve;
- not more than 30 percent passing the 3/8-inch sieve; and,
- 98 percent of the material shall not exceed 3-inches in length.

**60.20.3.5 Wood Chip Barriers**

Wood chip barriers are perimeter sediment control structures used to prevent soil in runoff from leaving a construction site. Wood chip barriers are constructed of chip material produced from the tree removal on the site. The wood chips are windrowed along the perimeter of the site. In some cases, wood chip barriers are covered with a filter cloth to stabilize the structure and improve barrier efficiency.

Wood chip barriers can be used in place of silt fencing in sheet flow conditions. The drainage area for wood chip barrier should be no greater than 0.5 – 1.0 acre per 100 feet of barrier length depending on whether the barrier is wrapped with filter fabric and its height. Wood chip barriers cannot be used on embankments steeper than 10%. Wood chip barriers cannot be used in channels or other concentrated flow locations.

The barrier mound should be at least 3 feet high, 3 feet wide at the top, and 15 feet wide at the base. The maximum height is 6 feet. If a filter fabric is used, the edge should be
buried in a trench 4 inches deep and 6 inches wide on the drainage side of the barrier. This is done to secure the fabric and create a barrier to sediment while allowing storm water to pass through the water-permeable filter fabric. The filter fabric should be extended just over the peak of the brush mound and secured on the down-slope edge of the fabric by fastening it to twine or small-diameter rope that is staked securely. See Drawing ESC 7.

60.20.3.6 Vegetated Buffers (Filter Strips)

Filter strips can be used to intercept sediment and reduce velocity before leaving disturbed areas that are less than 5 acres. The vegetated buffer strip should be installed on ground slopes less than 15%. The area should be fenced off and protected from traffic.

The minimum length of strip between the grading area and the receiving watercourse must be at least as long as the contributing drainage area, but no less than 50 feet, plus 4 feet for each one percent increase in slope. The minimum width should conform to Table 60-10 below. See Drawing ESC 8.

**Table 60-10 Minimum Width of Buffer Strips**

<table>
<thead>
<tr>
<th>Slope of Filter Strip</th>
<th>Width of Filter Strip</th>
<th>Length of Filter Strip</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grassed (ft)</td>
<td>Wooded (ft)</td>
</tr>
<tr>
<td>0</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>8</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>15</td>
<td>50</td>
<td>75</td>
</tr>
</tbody>
</table>

where: DL = Drainage area length upstream of filter strip

60.20.3.6.1 Grassed Buffer Strip

Grass buffer strips should be constructed along the perimeter of a site immediately after the area for the filter strip is graded. The area for the grass filter strip shall be clear of trees, stumps, brush, rocks or other material that can interfere with the installation of a dense grass. The grass shall be seeded, fertilized and mulched. Silt fence may be required in front of the filter strip until there is a dense enough stand of grass to prevent erosion. The seed should be for native vegetation for the area. No shrubs, trees, or plants should be placed in the filter strip so a continuous dense mass of vegetation can adequately filter sediment. Grass should be cut to no less than 6 inches.
60.20.3.6.2  **Wooded Buffer Strip**

Natural wooded buffer strips shall be fenced off prior to construction. No construction activity will be allowed in the buffer area, including storing debris from clearing and grubbing and other construction waste material. Constructed vegetative buffer strips should be planted with trees, shrubs, or grasses with a more fibrous or seed-forming root system. Avoid using trees or shrubs with top roots or clump forming grasses.

60.20.3.7  **Log and Wattle Products**

Log or wattle products are tubes of open weave containment material filled with straw, rice or wheat straw, excelsior, coir, or coconut. These products are used for disturbed areas of ¼ acre or less and where the runoff does not exceed 1 cfs. They come in a variety of diameters and lengths. The engineer must specify the product, size and method of installation. Logs or wattles can be used as perimeter control where sediment fence is not practical. Logs and wattles can be used along contours as slope breaks, for inlet protection, as ditch checks, and for stream bank protection. Ground slopes should not be steeper than 1.5:1 at natural channel banks and rivulets. Ground slopes should not be steeper than 2:1 as slope breaks for sheet flow.

60.20.3.8  **Slope Breaks**

Slope breaks, such as diversions, compost berms, log or wattle products, or other devices as appropriate, will reduce the slope length of cut and-fill slopes, limit sheet and rill erosion, and help prevent the formation of gullies.

Slope breaks are a function of ground slope as shown in Table 60-11. Refer to Drawing ESC 1 for a graphical representation of the spacing of slope breaks.

**Table 60-11 Terrace & Diversion Berm Spacing**

<table>
<thead>
<tr>
<th>Ground Slope</th>
<th>Spacing between Berms</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:1 to 4:1</td>
<td>30’</td>
</tr>
<tr>
<td>At 15%</td>
<td>60’</td>
</tr>
<tr>
<td>At 10%</td>
<td>80’</td>
</tr>
<tr>
<td>At 5%</td>
<td>100’</td>
</tr>
<tr>
<td>At 2%</td>
<td>125’</td>
</tr>
</tbody>
</table>

60.20.3.8.1  **Terraces**

Terraces are slope breaks that can be installed during grading operations on long hillsides to minimize soil erosion and control sediment. Terracing can be used for temporary or permanent purposes. The terrace is installed at a 1% to 3% slope along the contour of the hillside. See Drawing ESC 9.
**60.20.3.8.2 Logs & Wattles**

Logs & Wattles can be used on embankments as slope breaks where silt fence is not practical. See Section 60.20.3.7 above for specific design information.

**60.20.3.8.3 Diversions**

Diversions are slope breaks that form a channel to divert runoff to stabilized outlets and sediment to sediment traps. Drainage areas to diversions cannot exceed 3 acres. Swale sediment traps should be installed every 100 feet along the channel in highly erodible areas.

**60.20.3.8.4 Ridge Diversions**

Ridge Diversions comprise of earth or rock berms, dikes, or other raised obstructions at least 18 inches above the original grade to direct sheet flow into a swale or channel. The waterway can be an excavated channel or swale that runs along the base of the diversion berm to a stable outlet. The channel cannot exceed 3% slope. See Drawing ESC 10.

**60.20.3.9 Check Dams**

Check dams are small temporary dams constructed across a swale or drainage ditch having a drainage area no more than 3 acres. Check dams reduce the runoff velocity, which, in turn reduces the erosion of the swale or ditch, and they will trap sediment behind the dam. In highly erodible drainage areas and steep channels, swale sediment traps are used in conjunction with check dams. In highly erodible ditches, erosion control blankets shall be installed on the downstream side of the check dam.

Check dams can be constructed of 6”-8” diameter rock, sand bags, staked straw bales, or several ESC products, such as Triangular Silt Dike™. The following design guidelines should be used:

1. Maximum drainage area is 3 acres (1 acre for straw bale checks).

2. In all cases the dam spacing must be established where the downstream top of the check dam is equal to or higher than the ground elevation at the upstream check dam. Table 60-12 below provides general spacing guidelines.

3. The dam shall span the ditch bottom and banks until the bottom edge of the check dam is at least 6 inches higher than the top of the check dam at its lowest point. See Drawings ESC 11 and ESC 12.

4. Once vegetation has been permanently established, the check dams should be removed and vegetated.

5. Swale Sediment Traps are used in conjunction with check dams. Traps are excavated upstream of check dams. Check dams can be any of the permitted types listed in this manual. The use of this trap is limited to swales having
drainage areas less than 2 acres. This type of trap cannot be used in live streams. See Drawing ESC 13.

### Table 60-12 Check Dam Spacing

<table>
<thead>
<tr>
<th>Ditch Slope (^{%})</th>
<th>Check Dam Maximum Spacing (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Check Dam Only</td>
</tr>
<tr>
<td>9</td>
<td>---</td>
</tr>
<tr>
<td>8</td>
<td>---</td>
</tr>
<tr>
<td>6</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>75</td>
</tr>
</tbody>
</table>

60.20.3.10 **Storm Inlet Sediment Protection**

Storm sewer inlets that are to be used for drainage on a disturbed site need to be protected to prevent sediment from entering the storm sewers. The drainage area must be less than one acre for use of this method. Each inlet trap type has specific design requirements. See Table 60-13 below. For drainage areas greater than one acre, see sections 60.20.4 and 60.20.4.2.3.

### Table 60-13 Storm Inlet Protection Design Criteria

<table>
<thead>
<tr>
<th>Storm Inlet Protection Type</th>
<th>Design Criteria</th>
</tr>
</thead>
</table>
| Drop Inlets \(^1\)           | • Sheet flow with 1% slope within 8’ of structure.  
                              | • Requires approval of vendor product to be used. |
| Fabric Drop at Inlet        | • Shallow sheet flow with < 5% grade.  
                              | • 1% maximum slope within 3’ of openings.  
                              | • 2 cfs maximum runoff. |
| Curb Inlets \(^2\)          | • Flow to inlet throat cannot be restricted.  
                              | • Curb checks may be required to trap sediment before curb inlets at low points. |
| Area Inlet Silt Dike        | • 1% maximum slope within 3’ of dike.  
                              | • Requires approval of vendor product to be used. |
| Area Inlet Sod Filter       | • Only used within 2 months of project completion.  
                              | • Sheet flow 4:1 slope or flatter.  
                              | • 4 linear feet of sod completely around inlet.  
                              | • Runoff velocity < 5 fps. |

\(^1\) Siltsack® and other approved products can be used. Gravel or sand bags will not be permitted.

\(^2\) Beaver Dam®, True Dam®, Dandy Bag®, FilterSox®, Gutterbuddy® and other approved products can be used.
60.20.4  Sediment Basin Design

Sediment basins will be used to control the rate of discharge from the site and to reduce the Total Suspended Solids (TSS) to meet water quality performance standards. See Drawing ESC 18 for installation details. An Excel computer spreadsheet program for sediment basin design has been prepared and is available for use.

60.20.4.1  Sizing Requirements

- The basin volume below the outlet elevation must be sized to contain the sum of the calculated dry volume and the calculated wet volume.

- The dry volume shall be sized to contain the expected sediment yield for the planned construction period or one year maximum. Sediment volume will be calculated for each construction year of operation by the use of a modified version of the Revised Universal Soil Loss Equation (RUSLE). Appendix C provides the method for manual calculations.

- The wet volume shall be sized to contain the 6-month, 24-hour storm. See Section 60.10.4 for the method of calculation.

- The surface area at the overflow elevation, in acres, shall be a minimum of 0.01 times the peak 6-month inflow runoff rate in cubic feet per second (cfs).

- The travel length from the inflow point to the outlet point at the basin bottom shall be at least two times the width of the basin. Baffles in the basin or multiple cells may be installed to attain the required length. If there are multiple inflow locations, any inflow location to the basin that constitutes 30% or more of the total flow must meet the travel length requirement. The effective width of the basin is found by using equation 60-3:

\[
W_e = \frac{A}{L} \quad \text{and} \quad \frac{L}{W} \geq 2:1 \quad \text{(Equation 60-3)}
\]

Where:

- \(W_e\) = effective width of basin
- \(A\) = pool area (pool level at outlet elevation)
- \(L\) = length of flow path

6. The volume of a sediment basin can be computed as follows:

\[
V = \frac{(A1 + A2)D}{2} \quad \text{(Equation 60-4)}
\]
where: $V =$ storage volume (cu ft)
$A_1 =$ area of basin at the bottom (sq ft)
$A_2 =$ area of basin at the outlet elevation (sq ft)
$D =$ depth of basin measured from bottom to the outlet (ft)

7. The maximum height of the embankment shall not exceed 5 feet as measured from the natural ground at the discharge embankment to the top of the trap.

8. The top width of the embankment shall be 4.0 feet minimum.

60.20.4.2 Outlet Structures

The outlet structures for sedimentation basins shall be designed to convey the peak 10-yr runoff rate. The outlet structures may be different types depending upon the tributary drainage area. See Table 60-14 below.

<table>
<thead>
<tr>
<th>Outlet Structure</th>
<th>Drainage Area MAX (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riser Pipe</td>
<td>any</td>
</tr>
<tr>
<td>Rock Spillway Weir</td>
<td>5</td>
</tr>
<tr>
<td>Excavated Grass Weir</td>
<td>5</td>
</tr>
<tr>
<td>Area Inlet</td>
<td>3</td>
</tr>
<tr>
<td>Culvert Inlet</td>
<td>3</td>
</tr>
</tbody>
</table>

60.20.4.2.1 Riser Pipe Outlet

The riser pipe shall be designed to maintain a minimum of one (1) foot of freeboard between the calculated 10-yr peak water surface elevation and the top of the basin embankment. Any proposed use of a secondary spillway to achieve the freeboard requirements must be approved by the director prior to plan submittal. The riser pipe material may be concrete, corrugated metal, or an approved plastic type (PVC/HDPE). The riser inflow pipe size shall be determined from the lesser of the two following equations:

Weir Flow: $Q_W = 9.739 Dr h^{3/2}$
Orifice Flow: $Q_O = 3.782 Dr^2 h^{1/2}$

where: $Q_W =$ weir flow discharge (cfs)
$Q_O =$ orifice flow discharge (cfs)
$Dr =$ riser pipe diameter (feet)
$h =$ water elevation above top of riser pipe (ft)

The riser pipe shall be connected to an outlet pipe that discharges through the sediment basin. The outlet pipe will be designed to convey the peak 10-yr runoff through the riser with a controlled discharge velocity less than 10 feet per second.
Discharge through the outlet pipe shall be determined through the use of the following equation:

\[ Q_p = 0.044 \text{Dp}^2 \text{h}_p^{0.5} / [1.5 + (N \text{Lp}) / \text{Dp}^{4/3}]^{0.5} \]  
(Equation 60-7)

where:
- \( Q_p \) = outlet pipe discharge (cfs)
- \( \text{Dp} \) = outlet pipe diameter (in)
- \( \text{h}_p \) = water elevation above center of pipe outlet (ft)
- \( N \) = 5088 \( n^2 \) where: \( n \) = Manning’s roughness coefficient
- \( \text{Lp} \) = outlet pipe length (ft)

60.20.4.2.2 Rock Spillway & Excavated Grass Weir Outlets

Spillway outlet traps with drainage areas of less than 3 acres may have their volumes sized to be 67 yd\(^3\)/drainage area in acres, rather than using section 60.20.4.1.

The spillway thru the sediment basin berm must pass the peak 10-yr runoff with a discharge velocity less than 2.5 fps. A minimum of one foot of freeboard shall be provided between the calculated 10-yr water surface elevation and the top of the basin embankment. Weir flow over the spillway will be calculated as follows:

\[ Q_W = C \text{L} \text{h}^{3/2} \]  
(Equation 60-8)

where:
- \( Q_W \) = weir flow discharge (cfs)
- \( C \) = weir coefficient (dimensionless)
- \( L \) = weir length (feet)
- \( h \) = water elevation above top of weir (ft)

For a drainage area having no more than a composite runoff coefficient of 65%, the minimum spillway length \( (L) \) in feet shall be calculated using equation 60-9. If an area has a higher composite runoff coefficient than 65%, the engineer must provide design calculations.

\[ L = \text{DA} \times 3.5 \]  
(Equation 60-9)

where:
- \( L \) = weir length (feet)
- \( \text{DA} \) = drainage area (acre)

The grass spillway trap must discharge onto an undisturbed, well-vegetated, level surface. An excavated grass trap is either not dewatered or it may be dewatered manually by siphoning through a maximum 1” diameter hose. The siphon hose within the basin shall remain within the upper half of the wet pool to minimize the resuspension and discharge of settled solids during dewatering. The dewatered runoff should be appropriately filtered before allowing it to be discharged from the site.

The rock spillway weir must discharge to a stable outlet or a stable, natural drainageway. The rock trap is dewatered through the weir section or through an underdrain piping system. See Drawing ESC 19.
60.20.4.2.3 Area Inlet Overflow

An area inlet can be used as a sediment basin discharge. Rather than using section 60.20.4.1, the basin volume can be sized to be 67 yd³/drainage area in acres. No other calculations are required for drainage areas 3 acres or less. The following design criteria shall also be adhered to:

- Storage basin volume to be a minimum of 67 yd³/drainage area in acres.
- If placed in a concentrated swale, provide a 2:1 length to width ratio basin shape.
- Minimum 1’ freeboard from inlet opening and top of berm.
- Depth of trap to be 1’ minimum to 2’ maximum below the inlet opening.

See Drawing ESC 20.

60.20.4.2.4 Culvert Inlet Overflow

During the phase of a project where elevation and drainage patterns change, causing original control measures to be ineffective, there is a need to provide sediment control at points where runoff will leave the area through existing or newly installed piping. A sediment trap is placed in front of the pipe allowing proper settlement to occur before discharging over a weir into the pipe. The trap volume shall be a minimum of 67 yd³/drainage area in acres. No other calculations are required for drainage areas 3 acres or less. See Drawing ESC 21.

60.20.4.3 Dewatering Requirements

Sediment basins that have riser pipes shall be dewatered within 24 hours based on the total volume of wet storage of the basin. Two acceptable dewatering methods are single orifice and perforated riser.

60.20.4.3.1 Single Orifice

The area of the orifice for a 24 hour dewatering time is as follows:

\[
A = \frac{q}{4.81\sqrt{h}} \quad \text{and} \quad q = \frac{V_w}{86400}
\]

Equation 60-10

where:
- \(A\) = area of orifice (sq ft)
- \(q\) = flow rate (cfs)
- \(h\) = head above center of orifice (ft)
- \(V_w\) = total wet storage volume (cu ft)

The orifice opening shall be covered with ½” mesh wire screen, and 2” diameter clean rock.
60.20.4.3.2 Perforated Riser

The total area of multiple openings for a 24 hour dewatering time is calculated per equation 60-9, above, however “h” is calculated as follows:

\[ h = \frac{r - b}{2} \]

Equation 60-11

where:  
\( r \) = top of the riser pipe elevation (ft)  
\( b \) = bottom elevation of lowest hole (ft)

Dewatering holes in the riser pipe should be placed in the upper two-thirds of the riser. The holes shall be covered with ½” mesh wire screen, and 2” diameter clean rock.

The perforations in the riser pipe shall have the following limitations:

<table>
<thead>
<tr>
<th>Minimum Hole Size</th>
<th>3/4” diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Holes Size</td>
<td>2” diameter</td>
</tr>
<tr>
<td>Column Spacing</td>
<td>3 x hole diameter</td>
</tr>
<tr>
<td>Row Spacing</td>
<td>2.5 x hole diameter</td>
</tr>
</tbody>
</table>

An anti-vortex cap must be placed on the riser pipe. If the riser pipe is only used as a dewatering pipe, the top should be capped with an air vent. See ESC 22 for the typical riser pipe section.

60.20.5 Runoff Conveyance

All tributary runoff shall be used in the design of the ESC devices, regardless of where the runoff was generated. Runoff from off-site properties upland of the development should be diverted around the construction site, wherever possible. Off-site stormwater runoff can be diverted as a temporary or permanent measure. Ponding or the redirection of stormwater on adjacent property is not permitted without proper approval from the property owner.

Temporary facilities for conveyance of stormwater should be operational as soon as possible after the start of construction and, if possible, before the disturbance of the surrounding areas.

The designs of temporary facilities conveying stormwater during grading operations are dependent upon the peak runoff of the design storm and a suitable method to prevent erosion after its construction. Generally, the following methods are used for temporary conveyance of stormwater:

- By-Pass Storm Sewers and Culverts -- are to be designed according to Section 50.00 and as modified in this section for the appropriate storm event.

- Diversion Channels and Ditches -- are to be designed per Section 50.00 and as modified in this section and for consideration of the soil type and type of channel lining.
Pipe Slope Drains -- are used in conjunction with terracing, diversions, and sediment basins. The pipe sizes have been established based on the drainage area.

60.20.5.1 Roughness Coefficient

Table 60-15 shows typical roughness coefficients that are to be used in Manning’s Formula for temporary channels, ditches, and swales. These values can vary considerably depending on the conditions of the channel lining, vegetation type and height, cross-section shape and channel meander, and depth of channel flow and velocity. Alternate “n” factors shall be approved or required on a site specific basis for channel conditions that are outside of the range of the values in Table 60-15.

Table 60-15 Roughness Coefficient “n” for Channel Conveyance

<table>
<thead>
<tr>
<th>Surface Material</th>
<th>Roughness Coefficient “n”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bare Soil (weathered)</td>
<td>0.020</td>
</tr>
<tr>
<td>Maintained Grass (&lt;4”)¹</td>
<td>0.045</td>
</tr>
<tr>
<td>Sod ¹</td>
<td>0.050</td>
</tr>
<tr>
<td>Tall Grass (&gt; 12”)²</td>
<td>0.080</td>
</tr>
<tr>
<td>Gravel (1-2”)</td>
<td>0.030</td>
</tr>
<tr>
<td>Riprap (3-6”)</td>
<td>0.035</td>
</tr>
<tr>
<td>Riprap (&gt;6”)</td>
<td>0.045</td>
</tr>
<tr>
<td>Concrete</td>
<td>0.015</td>
</tr>
<tr>
<td>Woven Paper Net</td>
<td>0.015</td>
</tr>
<tr>
<td>Jute Netting, Nylon Mat</td>
<td>0.030</td>
</tr>
<tr>
<td>Straw Netting, Curled Wood Mat</td>
<td>0.035</td>
</tr>
<tr>
<td>RECPs, TRMs</td>
<td>Per manufacturer specifications</td>
</tr>
</tbody>
</table>

¹Add 0.01 for flow depths less than 0.7 feet.
²Add 0.02 for flow depths less than 0.7 feet.

60.20.5.2 Permissible Open Channel Velocities

Acceptable channel velocities are a function of channel slope and channel lining. Table 60-16 identifies permissible velocities for open channel conveyance systems.
### Table 60-16 Permissible Velocities in Open Channels

<table>
<thead>
<tr>
<th>Channel Slope</th>
<th>Vegetative Lining</th>
<th>Permissible Velocity (fps) based on soil erosion factor “K”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>( K \leq 0.35 )</td>
</tr>
<tr>
<td>&lt; 5%</td>
<td>Temporary seeding</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Sod</td>
<td>5.5</td>
</tr>
<tr>
<td>5-10%</td>
<td>Temporary seeding</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Sod</td>
<td>5</td>
</tr>
<tr>
<td>&gt; 10%</td>
<td>RECPs &amp; TRMs</td>
<td>Based on manufacturers recommendation for permissible shear stress of the bare soil.</td>
</tr>
<tr>
<td></td>
<td>Sod</td>
<td>4</td>
</tr>
</tbody>
</table>

Refer to Section 50.30.5 for structurally improved channels.

### 60.20.5.3 Natural Channel Degradation Protection

Natural channels are to be protected from the effects of increased runoff caused by land disturbance activities throughout the length of the project.

- Encroachment into or crossings of active water courses, riparian areas, and wetlands shall be avoided to the maximum extent practicable. All County, State and Federal permits and approvals shall be obtained.

- Stabilization adequate to prevent erosion shall be provided at the outlets of all temporary pipes and channels based on the discharge velocity for the designed conveyance system. See other subsections below.

- Temporary discharges into receiving streams for sites > 3 acres shall not increase the pre-developed runoff rate for the entire site for the 6-month design storm event.

- Temporary discharges into receiving streams with drainage areas exceeding 3 acres shall not increase the pre-developed runoff rate at the point of discharge for the 6-month design storm event.

- Existing erosion problems, increased flowrate, and increased velocity may cause the need to provide channel protection. Channel bank protection will be determined from hydraulic analysis of the existing channel flow versus the proposed design flow for the 10-yr storm. Channel protection improvements will be based on a soil analysis/report by a licensed geotechnical engineer.

### 60.20.5.4 Temporary Slope Drain

A temporary slope drain is a flexible tube or conduit extending from the top to the bottom of a cut or fill slope. It temporarily conducts concentrated stormwater runoff safely down the face of a cut or fill slope without causing erosion on or below the slope. There is
often a significant lag between the time a cut or fill slope is completed and the time a permanent drainage system is installed. During this period, the slope is usually not stabilized and is particularly vulnerable to erosion. This situation also occurs during slope construction before final grade is reached. Temporary slope drains should be used to protect exposed slopes until permanent drainage structures can be installed or vegetation can be established.

 Temporary slope drains can be used in conjunction with diversion channels, terracing, and sediment basins to convey runoff from a drainage area above a slope to the base of the slope without erosion. It is very important that these temporary structures be installed properly since their failure will often result in severe gully erosion on the site and sedimentation below the slope. The entrance section must be securely entrenched, all connections must be watertight, and the conduit must be staked securely.

 The slope drain shall consist of heavy-duty, flexible material designed for this purpose. The diameter of the slope drain shall be equal over its entire length. Reinforced hold-down grommets shall be spaced at or less than 10-foot intervals. See Drawing ESC 23. Slope drains shall be sized as listed in Table 60-17 below for a drainage area having no more than a composite runoff coefficient of 65%. If an area has a higher composite runoff coefficient than 65%, the engineer must provide design calculations for an inlet culvert design where the headwater to diameter ratio is \( \leq 1.0 \). Due to the weight of water in the pipe drain, it is recommended that the upstream drainage area be broken up and diverted to multiple smaller pipes when it reaches 3 acres.

<table>
<thead>
<tr>
<th>Drainage Area (ac)</th>
<th>Pipe Diameter (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1</td>
<td>12</td>
</tr>
<tr>
<td>1 &lt; 2</td>
<td>15</td>
</tr>
<tr>
<td>2 &lt; 3</td>
<td>18</td>
</tr>
<tr>
<td>3 &lt; 4</td>
<td>21</td>
</tr>
<tr>
<td>4 &lt; 5</td>
<td>24</td>
</tr>
<tr>
<td>5 &lt; 6.5</td>
<td>27</td>
</tr>
<tr>
<td>6.5 ( \leq ) 10</td>
<td>30</td>
</tr>
</tbody>
</table>

An earthen dike shall be used to direct stormwater runoff to the temporary slope drain. The height of the dike at the centerline of the inlet shall be equal to the diameter of the pipe plus 6 inches. Where the dike height is greater than 18 inches at the inlet, it shall be sloped at the rate of 3H:1V or flatter to connect with the remainder of the dike. Outlet pipe protection will be required. See Drawing ESC 26.

### 60.20.5.5  Level Spreader

A level spreader receives concentrated flow from channels, outlet structures, or other conveyance structures, and converts them to sheet flow. Level spreaders are used in wide, level areas where concentrated runoff occurs. The location of the level spreader should be in undisturbed soil stabilized by vegetation. The spreader must be constructed absolutely level.
The design of the spreader is a function of flow rate, entrance velocity, exit velocity, weir height, and weir length to control the discharge velocity to be non-erosive. Table 60-18 has simplified the calculation.

### Table 60-18 Level Spreader Dimensions

<table>
<thead>
<tr>
<th>Flow Rate (cfs)</th>
<th>Lip Type</th>
<th>Width (ft)</th>
<th>Length of Lip (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 8</td>
<td>Vegetative</td>
<td>6</td>
<td>L = Q+1</td>
</tr>
<tr>
<td>≤ 13</td>
<td>Rigid</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>≤ 16</td>
<td>Rigid</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>≤ 20</td>
<td>Rigid</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

Flows to the spreader should be relatively free of sediment or the spreader will be quickly overwhelmed by sediment and lose its effectiveness. Swale sediment traps or other ESC devices should be used to reduce the sediment entering the level spreader. See Drawings ESC 24 and ESC 25.

### 60.20.5.6 Outlet Stabilization

A rock outlet is required at all pipe and concrete channel discharges to open watercourses to prevent scour by expanding flow, dissipating energy, and reducing the velocity of concentrated stormwater flows. The maximum flow velocity is 10 fps. If the discharge velocity exceeds 10 fps, an engineered energy dissipater will be required. The velocity is based on partial flows at the appropriate design storm. It is imperative that the open channel is improved to allow for the expansion of flow and be adequately protected downstream of the point discharge. See Drawing ESC 26.

**Elevation** - There should be a smooth transition between the rock apron and the receiving channel. The elevation of the rock apron at the downstream end should be at the same elevation as the bottom of the receiving channel.

**Alignment** - The alignment of the rock outlet should be straight throughout its length. If a curve is required, it should be located in the upstream section of the outlet.

**Riprap** - Riprap should consist of a well-graded mixture of rock. Larger rock should predominate, with sufficient smaller sizes to fill the remaining. The rock should be hard, angular, and highly chemical and weather resistant. The specific gravity of the individual stones should be at least 2.5. The riprap size, thickness, and length are a function of flow depth and velocity. See Table 60-19 below for minimum criteria.
Table 60-19 Riprap Outlet Dimensions

<table>
<thead>
<tr>
<th>Pipe Dia. (in)</th>
<th>Rock Size (in)</th>
<th>Velocity ≤ 5 fps</th>
<th>Blanket</th>
<th>Rock Size (in)</th>
<th>Velocity ≤ 10 fps</th>
<th>Blanket</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>d50</td>
<td>d100</td>
<td>T (in)</td>
<td>L (ft)</td>
<td>d50</td>
<td>d100</td>
</tr>
<tr>
<td>12</td>
<td>5</td>
<td>9</td>
<td>15</td>
<td>12</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>15</td>
<td>5</td>
<td>9</td>
<td>15</td>
<td>14</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>18-24</td>
<td>5</td>
<td>9</td>
<td>15</td>
<td>16</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>27-30</td>
<td>5</td>
<td>9</td>
<td>15</td>
<td>18</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>36-42</td>
<td>9</td>
<td>14</td>
<td>24</td>
<td>22</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>48-54</td>
<td>9</td>
<td>14</td>
<td>24</td>
<td>26</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>60-66</td>
<td>12</td>
<td>18</td>
<td>27</td>
<td>34</td>
<td>15</td>
<td>24</td>
</tr>
<tr>
<td>72-84</td>
<td>15</td>
<td>24</td>
<td>30</td>
<td>42</td>
<td>15</td>
<td>24</td>
</tr>
<tr>
<td>96</td>
<td>18</td>
<td>27</td>
<td>30</td>
<td>50</td>
<td>18</td>
<td>27</td>
</tr>
</tbody>
</table>

For improved channel discharges, the velocity and flow depth will be used. For non-circular discharges, the engineer will calculate a circular pipe equivalent.

Where:  
\[ d_{50} = \text{median stone size (50\% stones equal or smaller size)} \]  
\[ d_{100} = \text{largest stone size (100\% stones equal or smaller size)} \]  
T = blanket thickness  
L = length of blanket

60.20.6 Temporary Stream Crossing

A temporary waterway crossing is a small waterway crossing required when in-stream utility construction is involved or when construction vehicles need to cross. Generally this is applicable to flowing streams with drainage areas less than one square mile. Structures or methodology for crossing streams with larger drainage areas should be designed by methods that more accurately define the actual hydrologic and hydraulic parameters that will affect the functioning of the structure. Crossings serve to help protect sediment from entering the stream from construction within approach areas, minimize the amount of disturbance within the stream itself, and allow vehicle access across the waterway.

60.20.6.1 Utility Crossings

Utility construction frequently crosses live streams. There is a potential for excessive sediment loss into a stream by both the disturbance of the approach areas and by the work within the streambed and banks. It is often a difficult task to decide what type of control to use for an open cut utility stream crossing. Consideration must be given to providing adequate mitigation of sediment loss while minimizing the amount of encroachment and time spent working in the channel. Consideration should be given to substantial in-stream controls or stream diversion in order to prevent excessive erosive damage. As with most ESC measures, site-specific design and innovative variations are encouraged. The following guidelines shall be addressed in the design:

1. The drainage area should be no greater than one square mile.
2. Water-diverting structures should be used at all trenching and construction road approaches 50 feet on either side of the crossing.

3. Site restoration must be made as soon as possible after the utility crossing has been constructed.

4. Channel diversions, discharge rates, channel hydraulics, and other items may be required.

5. Generally, a USACE section 404 permit and a MDNR 401 permit will be required.

6. Generally, a flood plain development permit and no-rise certification will be required from the county for crossings of streams within a regulated floodplain and floodway.

60.20.6.2 Construction Equipment Crossings

Temporary stream crossings are necessary to prevent construction vehicles from damaging stream banks and continually tracking sediment and other pollutants into the flow regime. They should be planned to be in service for the shortest practical period of time and to be removed as soon as their function is completed. Refer to Drawing ESC 27.

1. A temporary bridge crossing is a structure made of wood, metal, or other material that provides access across a stream or waterway. These structures can be quickly removed and reused. This is the preferred method for temporary waterway crossings.

2. A temporary culvert crossing is a structure consisting of stone and sections of circular pipe, pipe arches, or oval pipes of reinforced concrete, corrugated metal, or structural plate which are used to convey flowing water through the crossings. Temporary culverts are used where the channel is too wide for normal bridge construction or the anticipated loading of construction vehicles may prove unsafe for single span bridges. The stone, along with the temporary culverts, can be salvaged and reused. See Table 60-20 for design criteria.
### Table 60-20 Temporary Stream Crossing Design Criteria

<table>
<thead>
<tr>
<th>Loading</th>
<th>To withstand the anticipated live load of the construction traffic.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>One lane traffic (12’ min to 20’ max)</td>
</tr>
<tr>
<td>Skew</td>
<td>90º preferable - 15º maximum</td>
</tr>
<tr>
<td>Hydraulics</td>
<td>≤ 4 months of expected use - the structure shall be large enough to convey the flow from a 2-year storm without appreciably altering the stream flow characteristics.</td>
</tr>
<tr>
<td></td>
<td>Over 4 months of expected use, the structure must be designed to convey the 10-year storm.</td>
</tr>
<tr>
<td>Approach Road</td>
<td>Approaches to the crossing shall consist of pads constructed of 3 to 6-inch stone that are a minimum of 6 inches thick and at least as wide as the structure.</td>
</tr>
<tr>
<td></td>
<td>A water diverting structure such as a dike or swale shall be constructed across the roadway on both roadway approaches at a maximum distance of 50 feet from the top of either bank of the waterway.</td>
</tr>
<tr>
<td></td>
<td>All fill materials associated with the roadway approach shall be limited to a maximum height of 2 feet above the existing floodplain elevation (BFE).</td>
</tr>
<tr>
<td>Bank Protection</td>
<td>Appropriate perimeter controls such as sediment fence or turbidity curtains must be employed when necessary along banks of stream.</td>
</tr>
</tbody>
</table>

**Specific to Culverts:**

<table>
<thead>
<tr>
<th>Culvert Opening</th>
<th>Multiple culverts may be used in place of one large culvert if they have equivalent capacity. The minimum culvert diameter shall be 18 inches.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culvert Length</td>
<td>The length to extend the full width of the crossing plus 2:1 side slopes (minimum).</td>
</tr>
<tr>
<td>Culvert Slope</td>
<td>At least 0.25 inch per foot.</td>
</tr>
<tr>
<td>Base Rock</td>
<td>3 to 6-inch coarse aggregate or larger will be used to form the crossing. The depth of stone cover over the culvert shall be equal to one-half the diameter of the culvert or 12 inches, whichever is greater.</td>
</tr>
</tbody>
</table>

### 60.20.7 Biotechnical Stream Bank & Channel Stabilization

Generally, a biotechnical slope protection system is used to stabilize streams and it consists of structural or mechanical elements and vegetative elements working together to stabilize the channel and its slopes. The structural elements provide stability while the vegetation is being established. Biotechnical stabilization measures designed for vegetative stream bank protection will depend on soil type, size of the stream, drainage area, bed load, and availability of plant materials. Reports are required by a geotechnical and civil engineer for the structural/mechanical/hydraulic elements and by a botanist experienced with riparian vegetation for the vegetative elements when using biotechnical methods. Native vegetation
shall be used whenever possible within vegetated riparian buffers protected under county ordinances. The use of willow or similar riparian trees/seeds in the following methods is recommended. The dormant plant material often begins re-growth and helps to anchor the structural elements with its developing root system.

Stream bank and channel protection should begin and end at stable locations along the stream. The channel bottom should be stable or stabilized prior to installing protective measures. Protection measures should carry up the bank slope to the average high water elevation or the 10 year storm elevation, if the high water elevation is indeterminate. It is extremely important that impacts to the watercourse are examined a significant distance upstream and downstream of the proposed stabilization. There are several biotechnical methods identified below.

60.20.7.1 Wattling

This technique uses bundles of branches which are staked into shallow trenches, then covered with soil. They are oriented along the contour and are placed in multiple rows to help stabilize a slope.

60.20.7.2 Brush Layering

This technique is generally used to stabilize slope areas above the flowline of stream banks as well as cut and fill slopes. It involves the use of long branches that are placed with cut ends into the slope on bulldozed terraces. The tops protrude outside the finished slope. A layer usually includes three layers of brush separated with a thin (3”) layer of soil. On this layer, a “lift” of 3-5 feet of soil is placed to form the next terrace and so forth.

60.20.7.3 Live Cribwall

A combination of vegetation and structural elements generally used along streams where flowing water is a hazard. Layers of logs are alternated with long branches protruding out between them. The logs are spiked together and anchored into the bank with earth fill behind them to create a wall. The live stems help tie the logs together and screen the wall.

60.20.7.4 Live Staking

This method consists of large stakes or poles sharpened at the bottom ends of properly prepared live branches or trunks and forced vertically into the soft earth along the waterline and banks usually about 1 foot apart. Depending on the size of the stakings and the composition of the stream bank, machinery may be required to force them into the ground or to prepare holes for planting. The stakings will grow forming a very thick barrier to flow. Willow is a recommended material for this use.
60.20.7.5 Wattle Flow Deflectors

Wattles are used along the stream or river banks to deflect the flow or current away from the stream bank. The wattles are placed in a trench, they are live staked or planted, and they are backfilled at the appropriate downstream orientation. As the live stakes/plants grow, the vertical stems extend the deflector upward improving the flow control during high water. Caution should be exercised when employing this method since deflecting flow can result in an increase in the local water surface elevation and the creation of erosion problems at another location in the stream.

60.20.7.6 Rock Chevrons/Grade Control

Rock or riprap weirs, formed into the shape of chevrons, can be constructed into the stream channel in such a manner as to direct the energy and flow away from the banks and toward the center of the channel. Chevrons must be positioned so that they are pointing in the upstream direction. The redirected flow helps keep the channel clear from sedimentation and it allows for upstream settlement and the re-establishment and stabilization of the channel bottom grade. It is critical that the chevrons be “keyed” into both the channel bottom and the stream banks. Spacing of the chevrons is also critical. An engineered design and channel analysis is required for use of this method.

60.20.7.7 Brush Matting

This method uses hardwood brush layered along a stream bank as a mattress and anchored in place with a grid of stakes and wire. The toe below the waterline is anchored by rock. This living blanket acts as mulch for seedlings and plantings established in the bank. It also prevents erosion of sloped surfaces.

60.20.7.8 Manufactured Products

There are numerous products available that can be used on their own or in combination with vegetation to stabilize both the channel and the channel banks.

60.20.7.9 Maintenance

Due to the susceptibility of plant materials to the physical constraints of the site, climate conditions, and animal populations, it is necessary to inspect installations frequently. This is especially important during the first year or two of establishment. Plant materials missing or damaged should be replaced as soon as possible. Sloughs or breaks in drainage pattern should be re-established for the site as quickly as possible to maintain stability.
## Listing of Standard Drawings

<table>
<thead>
<tr>
<th>Drawing Number</th>
<th>Drawing Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
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<td>C203.54</td>
<td>Street Intersection Platform</td>
<td>139</td>
</tr>
<tr>
<td>C203.81A</td>
<td>Standard Typical Section</td>
<td>140</td>
</tr>
<tr>
<td>C203.81B</td>
<td>Residential 42' R/W 24' Pav't.</td>
<td>141</td>
</tr>
<tr>
<td>C203.82A</td>
<td>Standard Typical Section</td>
<td>142</td>
</tr>
<tr>
<td>C203.82B</td>
<td>Residential 42' R/W 26' Pav't. (w/o Sidewalk)</td>
<td>143</td>
</tr>
<tr>
<td>C203.83A</td>
<td>Standard Typical Section</td>
<td>144</td>
</tr>
<tr>
<td>C203.83B</td>
<td>Residential 48' R/W 32' Pav't. (w/o Sidewalk)</td>
<td>145</td>
</tr>
<tr>
<td>C203.84A</td>
<td>Standard Typical Section</td>
<td>146</td>
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<td>C203.84B</td>
<td>Residential 54' R/W 38' Pav't. (w/o Sidewalk)</td>
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<td>C203.91</td>
<td>Standard Typical Section</td>
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<tr>
<td>C203.92</td>
<td>Non-Residential 42' R/W 26' Pav't.</td>
<td>149</td>
</tr>
<tr>
<td>C203.93</td>
<td>Non-Residential 48' R/W 32' Pav't.</td>
<td>150</td>
</tr>
<tr>
<td>C404.13</td>
<td>Butt Joint Detail</td>
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<td>Integral Vertical Curb and Concrete Pavement Typical Sections and Details</td>
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<td>Integral Rolled Curb and Concrete Pavement</td>
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<td>C502.03</td>
<td>Joints and Curbs</td>
<td>154</td>
</tr>
<tr>
<td>C502.04</td>
<td>Type &quot;A&quot; Expansion Joint</td>
<td>155</td>
</tr>
<tr>
<td>C502.05</td>
<td>Integral Curb Detail &quot;B&quot; at Driveways</td>
<td>156</td>
</tr>
<tr>
<td>C502.06</td>
<td>Residential Temporary Turnaround</td>
<td>157</td>
</tr>
<tr>
<td>C502.07</td>
<td>Cul-de-Sac and Turn Around Configuration</td>
<td>158</td>
</tr>
<tr>
<td>C502.08</td>
<td>Cul-de-Sac and Turn Around Configuration</td>
<td>159</td>
</tr>
<tr>
<td>C502.09</td>
<td>55' Radius Turnaround Configuration (With Island)</td>
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</tr>
<tr>
<td></td>
<td>63' Radius Right-of-Way</td>
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<tr>
<td>C502.10</td>
<td>55' Radius Turnaround Configuration (Without Island)</td>
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<td>63' Radius Right-of-Way</td>
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<td>Dowel Supporting Units</td>
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<td>Pavement Lugs</td>
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</tr>
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<td>C503.00</td>
<td>Concrete Approach Slab and Appurtenances to Bridges</td>
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<td>Drawing Description</td>
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<td>C604.01</td>
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<td>Canted Inlets</td>
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<td>C604.35</td>
<td>Grated Trough</td>
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<td>Street Inlet Sumps</td>
<td>170</td>
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<td>C604.40</td>
<td>Flared End Section (Concrete)</td>
<td>171</td>
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<td>C604.41</td>
<td>Flared End Section (Metal)</td>
<td>172</td>
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<td>C604.42</td>
<td>Flared End Section (Inlet/Outlet Protection)</td>
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<td>C604.43</td>
<td>Pipe Collars</td>
<td>174</td>
</tr>
<tr>
<td>C604.44</td>
<td>Payline Widths of Trench and Pay – Quantities of Concrete</td>
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<td>C604.45</td>
<td>Payline Limits for Excavation</td>
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<td>C604.46</td>
<td>Pipe Bedding Class “C” (for all pipe except reinforced concrete)</td>
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<tr>
<td>C604.47</td>
<td>Pipe Bedding Class “C” (modified for reinforced concrete pipe)</td>
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<tr>
<td>C604.48</td>
<td>Special Pipe Bedding Detail For Subgrade Replacement 12” Depth or More</td>
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<td>Concrete Encasement</td>
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<td>Concrete Cradle</td>
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<td>C604.51</td>
<td>Line Manhole Pipe Sewers 8” – 24” Dia</td>
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*Use Current Edition of M.S.D. Standard Details of Sewer Construction*

1. M.S.D. grate inlets are not approved for use within St. Charles County maintained right-of-way. Neenah Type “L” or Type “V” grates, or equivalent, may be used within St. Charles County maintained right-of-way by special approval of the County Engineer.

2. Precast Concrete Inlet Covers are not approved for use within St. Charles County.
GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. 6% or 8% dependant upon street classification. May be varied with Steep Grade Approval only by County Highway Department. Special design may be required.
3. See graph "Design Control for Vertical Curves" for lengths of vertical curves. Refer to page 20.50-1 of the "Design Criteria for the Preparation of Improvement Plans."
GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. Sections shown are symmetrical about construction centerline.
3. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions refer to the Pavement Construction Details for "Joints and Curbs", Std. Dep. C502.03.
4. All necessary pavement markings shall be as required by Saint Charles County.
5. Sections shown may not apply at intersections.
6. Sidewalk thickness increases to 6" at Residential Driveways. See "Entrance Construction Details."
7. Easements when required shall be established as a "Permanent Roadway Improvement, Maintenance, Utility, Sewer and Sidewalk Easement" and dedicated to St. Charles County.
8. All Portland Cement concrete for streets, sidewalks, entrances, and approaches on proposed public right-of-way shall be constructed in compliance with the most current mix design, inspection and testing requirements as approved and adopted by the Eastern Missouri Pavement Consortium. Details can be obtained at www.empcppavement.org.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

STANDARD TYPICAL SECTION
RESIDENTIAL
42' R/W 26' PVMT.

DATE: May, 2018
DRAWING C203.81A
GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. Sections shown are symmetrical about construction centerline.
3. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions refer to the Pavement Construction Details for "Joints and Curbs", Std. Dwg. C502.03.
4. All necessary pavement markings shall be as required by Saint Charles County.
5. Sections shown may not apply at intersections.
6. Sidewalk thickness increases to 6" at Residential Driveways. See "Entrance Construction Details."
7. Easements when required shall be established as a "Permanent Roadway Improvement, Maintenance, Utility, Sewer and Sidewalk Easement" and dedicated to St. Charles County.
8. All Portland Cement concrete for streets, sidewalks, entrances, and approaches on proposed public right-of-way shall be constructed in compliance with the most current mix design, inspection and testing requirements as approved and adopted by the Eastern Missouri Pavement Consortium. Details can be obtained at www.emcppavement.org.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

STANDARD TYPICAL SECTION
RESIDENTIAL
42' R/W 26' PVMT.

DATE: May, 2018
DRAWING C203.81B
GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. Sections shown are symmetrical about construction centerline.
3. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions refer to the Pavement Construction Details for "Joins and Curbs", Std. Doc. C502.03.
4. All necessary pavement markings shall be as required by Saint Charles County.
5. Sections shown may not apply at intersections.
6. Sidewalk thickness increases to 6" at residential driveways. See "Entrance Construction Details."
7. Easements when required shall be established as a "Permanent Roadway Improvement, Maintenance, Utility, Sewer and Sidewalk Easement" and dedicated to St. Charles County.
8. All Portland Cement concrete for streets, sidewalks, entrances, and approaches on proposed public right-of-way shall be constructed in compliance with the most current mix design, inspection and testing requirements as approved and adopted by the Eastern Missouri Pavement Consortium. Details can be obtained at www.empcpavement.org.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI
STANDARD TYPICAL SECTION
RESIDENTIAL
42' R/W  26' PVMT.

DATE: May, 2018    DRAWING C203.82A
GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. Sections shown are symmetrical about construction centerline.
3. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions refer to the Pavement Construction Details for "Joints and Curbs", Std. Dwg. C502.03.
4. All necessary pavement markings shall be as required by Saint Charles County.
5. Sections shown may not apply at intersections.
6. Sidewalk thickness increases to 6" at Residential Driveways. See "Entrance Construction Details."
7. Easements when required shall be established as a "Permanent Right-of-Way Improvement, Maintenance, Utility, Sewer and Sidewalk Easement" and dedicated to St. Charles County.
8. All Portland Cement concrete for streets, sidewalks, entrances, and approaches on proposed public right-of-way shall be constructed in compliance with the most current mix design, inspection and testing requirements as approved and adopted by the Eastern Missouri Pavement Consortium. Details can be obtained at www.empccomment.org.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

STANDARD TYPICAL SECTION
RESIDENTIAL
42' R/W 26' PVMT.

DATE: May, 2018
DRAWING C203.82B
**GENERAL NOTES**

1. Do not scale drawing. Follow dimensions.
2. Sections are symmetrical about construction centerline.
3. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions refer to the Pavement Construction Details for Joints and Curbs, Std. Dwg. C902.03.
4. All necessary pavement markings shall be as required by Saint Charles County.
5. Sections shown may not apply at intersections.
6. Sidewalk thickness increases to 6" at Residential Driveways. See "Entrance Construction Details."

**SAINT CHARLES COUNTY**
**HIGHWAY DEPARTMENT**
**ST. CHARLES, MISSOURI**

**STANDARD TYPICAL SECTION**

**RESIDENTIAL**

48' R/W 32' PAVT.

DATE: September, 2002

DRAWING C203.83A
**GENERAL NOTES**

1. Do not scale drawing. Follow dimensions.
2. Sections are symmetrical about construction centerline.
3. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions refer to the Pavement Construction Details for "Joints and Curbs," Std. Dwg. C502.03.
4. All necessary pavement markings shall be as required by Saint Charles County.
5. Sections shown may not apply at intersections.

**SAINT CHARLES COUNTY**  
**HIGHWAY DEPARTMENT**  
**ST. CHARLES, MISSOURI**

**STANDARD TYPICAL SECTION**  
**RESIDENTIAL**  
48' R/W   32' PAVT.

**DATE:** September, 2002  
**DRAWING** C203.83B
**GENERAL NOTES**

1. Do not scale drawing. Follow dimensions.
2. Sections are symmetrical about construction centerline.
3. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions refer to the Paverment Construction Details for "Joints and Curbs," Std. Dwg. C502.03.
4. All necessary pavement markings shall be as required by Saint Charles County.
5. Sections shown may not apply at intersections.
6. Sidewalk thickness increases to 6" at Residential Driveways. See Entrance Construction Details.
7. The applicable lane configuration for a 38ft. collector pavement width shall be as follows: 
   a) 3 driving lanes where adjacent residential lots are served from internal cul-de-sac and loop streets.
   b) 2 driving lanes with 2 emergency parking lanes where adjacent residential lots are served from the collector roadway. At major intersections 3 driving lanes with tapers and posted parking restrictions will be required.

**SAINT CHARLES COUNTY**

**HIGHWAY DEPARTMENT**

**ST. CHARLES, MISSOURI**

**STANDARD TYPICAL SECTION**

**RESIDENTIAL**

**54’ R/W 38’ PAVT.**

**DATE:** September, 2002  

**DRAWING:** C203.84A
**GENERAL NOTES**

1. Do not scale drawing. Follow dimensions.
2. Sections are symmetrical about construction centerline.
3. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions refer to the Paverment Construction Details for "Joints and Curbs,” Std. Dwg. C502.03.
4. All necessary pavement markings shall be as required by Saint Charles County.
5. Sections shown may not apply at intersections.
6. The applicable lane configuration for a 38ft. collector pavement width shall be as follows:
   a) 3 driving lanes where adjacent residential lots are served from internal cul-de-sac and loop streets.
   b) 2 driving lanes with 2 emergency parking lanes where adjacent residential lots are served from the collector roadway. At major intersections 3 driving lanes with tapers and posted parking restrictions will be required.

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**SAINT CHARLES COUNTY**
**HIGHWAY DEPARTMENT**
**ST. CHARLES, MISSOURI**

**STANDARD TYPICAL SECTION**

**RESIDENTIAL**

54' R/W  38' PAVT.

DATE: ___ September, 2002 ____________

DRAWING

C203.84B
GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. Sections are symmetrical about construction centerline.
3. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions refer to the Integral Curb Pavement Typical Sections and Details.
4. All necessary pavement markings shall be as required by Saint Charles County.
5. Sections shown may not apply at intersections.
6. Sidewalk thickness increases to 7" at commercial driveways. See Entrance Construction Details.
7. Additional pavement thickness, reinforcement and/or base is required for heavy vehicular usage or high traffic volume.
8. Easement required shall be established as a Permanent Roadway Improvement, maintenance, Utility, Sewer and Sidewalk Easement and dedicated to Saint Charles County.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

STANDARD TYPICAL SECTION
NON-RESIDENTIAL
42' R/W 26' PAVT.

DATE: September, 2002
DRAWING C203.91
GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. Sections are symmetrical about construction centerline.
3. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions refer to the Pavement Construction Details for "Joints and Curbs," Std. Dwg. CS02.03.
4. All necessary pavement markings shall be as required by Saint Charles County.
5. Sections shown may not apply at intersections.
6. Sidewalk Thickness increases to 7" at Commercial Driveways. See "Entrance Construction Details.
7. Additional pavement thickness, reinforcement and/or base is required for heavy vehicular usage or high traffic volume.
8. Easements when required shall be established as a Permanent Roadway Improvement, Maintenance, Utility, Sewer and Sidewalk Easement and dedicated to Saint Charles County.

SECTION SHOWING SIDEWALK
LOCATION WHERE REQUIRED
Remainder of Section Same as Type 1 or 2

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

STANDARD TYPICAL SECTION
NON-RESIDENTIAL
48' R/W 32' PAVT.

DATE: September, 2002

DRAWING C203.92
GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. Sections are symmetrical about construction centerline.
3. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions refer to the Pavement Construction Details for Joints and Curbs, Std. Dwg. CS02.03.
4. All necessary pavement markings shall be as required by Saint Charles County.
5. Sections shown may not apply at intersections.
6. Sidewalk Thickness increases to 7" at Commercial Driveways. See "Entrance Construction Details.
7. Additional pavement thickness, reinforcement and/or base is required for heavy vehicular usage or high traffic volume.
8. Easements when required shall be established as a Permanent Roadway Improvement, Maintenance, Utility, Sewer and Sidewalk Easement and dedicated to Saint Charles County.

SECTION SHOWING SIDEWALK
LOCATION WHERE REQUIRED
Remainder of Section Same as Type 1 or 2

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

STANDARD TYPICAL SECTION
NON-RESIDENTIAL
54' R/W 38' PAVT.

DATE: May, 2002
DRAWING C203.93
Detail of Butt Joint

- Depth of Resurfacing
  - Finish Surface of BP-1 Bituminous Concrete
- Existing Pavement to be Removed
  - 2’ Minimum to 20’ Maximum (Typ.)
- Exact length to be determined in field by Engineer. Longer lengths may be required due to field conditions.
INTEGRAL VERTICAL CURB AND CONCRETE PAVEMENT TYPICAL SECTIONS AND DETAILS

SECTION—28’ WIDTH

SECTION—32’ WIDTH

SECTION—38’ WIDTH

SECTION—38’ WIDTH

SECTION—51’ WIDTH

PLAN OF JOINT LOCATION

GENERAL NOTES
1. Do not scale drawings. Follow dimensions.
2. All steel items shall be separated from the pavement and curb by expansion joint material extending completely through curb and slab. Welded collars within the pavement limits shall be located as shown.
3. Where a joint falls within a wall, parapet, or other structure, nothing shall be required in the slab or pavement at the confluence of different grades or between courses of rectangular structures.
4. Concrete foundations are shown in the "Concrete Construction" drawings.
5. Construction joints must be formed when a joint is placed immediately with pavement.
6. Minimum thickness for pavement is 8".

NOTE
Joint filler material shall meet ASTM designations as follows:
- Type A: ASTM C68
- Type B: ASTM C68

Table: Joint Requirements for Concrete Paving

<table>
<thead>
<tr>
<th>Joint Type</th>
<th>Joint and Gap Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>1/4&quot; smooth sheet's 16&quot; x 12&quot;</td>
</tr>
<tr>
<td>Type B</td>
<td>1/4&quot; smooth sheet's 16&quot; x 12&quot;</td>
</tr>
</tbody>
</table>

SAINT CHARLES COUNTY HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

Pavement Construction Details
INTEGRAL VERTICAL CURB
AND CONCRETE PAVEMENT
TYPICAL SECTIONS AND DETAILS

DATE: October, 2002
DRAWING C502.01
NOTES:

1. THE NUMBER OF BACKER RODS REQUIRED WILL VARY WITH THE PAVEMENT THICKNESS. BACKER RODS AND FLEXIBLE FOAM FILLER MUST EXTEND THROUGH THE FULL DEPTH OF THE PAVEMENT.

2. JOINT FILLER SHALL BE A FLEXIBLE, NON-ABSORBENT, NON-GASSING, NON-STAINING, NON-SHRINKING MATERIAL, EXTRUDED FROM A CLOSED-CELL POLYMER, ASTM D-5249.

3. JOINT FILLER COMPOSED OF CELLULAR FIBERS, ASTM D-1751, MAY BE USED AT DRIVEWAY, SIDEWALK, AND SEWER INLET AND MANHOLE LOCATIONS.

4. SEE "INTEGRAL CURB DETAIL "B" AT DRIVEWAYS" FOR EXPANSION JOINT REQUIREMENTS AT DRIVEWAY CONNECTIONS TO THE STREET AND THE GARAGE.
NOTES:
1. A 1" JOINT IS REQUIRED AT THE CURB AND GARAGE FOR ALL DRIVEWAYS LOCATED ON THE OUTER EDGE OF CURVED PAVEMENT, UNLESS GROOVED JOINTS ARE USED AT SIDEWALK. THEN A 2" JOINT IS REQUIRED AT CURB.
2. A 1/2" JOINT IS REQUIRED AT THE CURB AND GARAGE FOR ALL DRIVEWAYS LOCATED ON TANGENT SECTIONS OF PAVEMENT OR ON THE INNER EDGE OF CURVED PAVEMENT.
3. EXPANSION JOINT MATERIAL MUST EXTEND THROUGH THE FULL DEPTH OF THE PAVEMENT.
4. SIDEWALK THICKNESS SHALL BE A MINIMUM OF 7" THROUGH COMMERCIAL DRIVEWAYS.
GENERAL NOTES

1. Do not scale drawing. Follow dimensions.
2. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions not shown, refer to the Pavement Construction Details for "Joints and Curves", Std. Dwg. C502.03.
3. All necessary pavement markings shall be as required by Saint Charles County.
4. For roadway cross slopes, pavement types and thickness refer to "Standard Typical Sections."
5. Permits will not be issued for building construction on lots abutting a temporary turnaround unless and until the turnaround is actually constructed and has been approved by the Department.
6. The removal of the temporary turnaround surface, the restoration of the disturbed ground, and the extension of any sidewalk shall be the responsibility of the party(ies) that will be extending the street.
7. All Portland Cement concrete for streets, sidewalks, entrances, and approaches on proposed public right-of-way shall be constructed in compliance with the most current mix design, inspection and testing requirements as approved and adopted by the Eastern Missouri Pavement Consortium. Details can be obtained at www.empcpavement.org.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

PAVEMENT CONSTRUCTION DETAILS
RESIDENTIAL TEMPORARY TURNAROUND

DATE: May, 2018
DRAWING C502.06
GENERAL NOTES

1. Do not scale drawing. Follow dimensions.
2. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions not shown refer to the "Pavement Construction Details." See Std. Dwgs. C502.01, C502.02 and C503.03.
3. All necessary pavement markings shall be as required by Saint Charles County.
4. Sidewalk thickness increases to 6" at Residential Driveways. See Entrance Construction Details.
5. For roadway cross slopes, pavement types and thickness refer to "Standard Typical Sections."


SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

PAVEMENT CONSTRUCTION DETAILS
RESIDENTIAL
40’ RADIUS TURNAROUNDS
48’ RADIUS RIGHT-OF-WAY

DATE: June, 2002

DRAWING
C502.07
GENERAL NOTES

1. Do not scale drawing. Follow dimensions.

2. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions not shown refer to the "Pavement Construction Details." See Std. Dwgs. C502.01, C502.02 and C502.03.

3. All necessary pavement markings shall be as required by Saint Charles County.

4. Sidewalk thickness increases to 6" at residential driveways. See "Entrance Construction Details."

5. For roadway cross slopes, pavement types and thickness refer to "Standard Typical Sections."

GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions not shown refer to the "Pavement Construction Details." See Std. Dws. C502.01, C502.02 and C502.03.
3. All necessary pavement markings shall be as required by Saint Charles County.
4. Sidewalk thickness increases to 6" at Residential Driveways. See "Entrance Construction Details."
5. For roadway cross slopes, pavement types and thickness refer to "Standard Typical Sections."
7. All Portland Cement concrete for streets, sidewalks, entrances, and approaches on proposed public right-of-way shall be constructed in compliance with the most current mix design, inspection and testing requirements as approved and adopted by the Eastern Missouri Pavement Consortium. Details can be obtained at www.empcpavement.org.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

PAVEMENT CONSTRUCTION DETAILS
RESIDENTIAL
55' RADIUS TURNAROUNDS
63' RADIUS RIGHT-OF-WAY

DATE: May, 2018
DRAWING C502.09
1. Do not scale drawing. Follow dimensions.
2. The dowel supporting units shall be factory assembled and capable of holding the dowels in their required positions. In the completed joint installation, no dowels shall vary from its required position more than 1 in 36.
3. The dowel bar spacing shall be 12 inches on centers, beginning 6 inches from outer edge of the pavement.
4. Tie wires, bars, or clips used to strengthen dowel basket assemblies for shipment and installation shall be removed or cut prior to placing concrete.
5. Staking pins shall be fabricated from 0.065 (0.3055) wire minimum with suitable hook. Staking pins shall have a length of 18 inches Type A and Type B Assemblies unless otherwise directed by the engineer.
6. Wires, bars, or clips shall be used as necessary to strengthen the assemblies.
7. Minor variations in the configuration of the support units will be allowed.
8. The wire end of each epoxy coated dowel shall be marked with a spot at point at least one inch in diameter and contrasting in color with the epoxy coating.
9. The free end of the dowel bar for a length of at least 11 inches shall be coated with an approved graphite grease.
10. The details shown are adapted from the Missouri Department of Transportation Standard Drawings.
GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions refer to the Paverpment Construction Details for Joints and Curbs, Std. Dwg. C502.03.
3. Pavement Lugs shown are for a 26’ wide pavement. When required on pavement narrower or wider than 26’, details are similar.
4. Specify that chairs are to be used to ensure the proper placement of the steel.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

PAVEMENT CONSTRUCTION DETAILS

PAVEMENT LUGS

DATE: June, 2002
DRAWING
C502.12
GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. For sump details refer to the Sewer Construction Details for Street Inlet Sumps, Standard Drawing C604.36.
3. When required the nearest two (2) sections of sidewalk on each side of the inlet shall be warped to meet the top of the inlet stone elevation.
4. Canted Inlet to be used only when there is a 7ft. grass area or when sidewalk is not required.
5. Canted Inlets allowed only when opposite the direction of traffic.
6. Transition curb to meet face of inlet wall.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

SEWER CONSTRUCTION DETAILS

CANTED INLETS

DATE: June, 2002

DRAWING C604.34
PLAN VIEW

Placed Rock Blanket 12" Min. Depth

Rock Line

Not less than the bottom width of channel

SECTION A-A

Flared End Section
24" min. intake end
36" min. discharge end
or to rock

12" min.

10' - 0" min. at outlet end

Top of Bank

24" min. depth

Rock Blanket
12" min. depth
underlain with woven geotextile fabric

END VIEW

3

2/3 0" min.

1

1/2

1

NOTE:

1. To be used at intake and discharge end of pipe.
Grade of Rock Blanket to be adjusted accordingly.

2. Woven Geotextile Fabric required under Rock Blanket.
### Type A Collar

<table>
<thead>
<tr>
<th>Size of Pipe</th>
<th>Dimensions</th>
<th>Length of Bars</th>
<th>Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>Length</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>25</td>
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<tr>
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<tr>
<td>25</td>
<td>40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

One layer commercially available 35-pound coating.

### General Notes

1. Do not scale drawings. Follow dimensions.
2. Concrete used for collars shall be Class B.
3. Metal pipe for pipe collars shall be of the same gauge and have the same corrosion properties as the corrugated metal pipe to be connected.
4. If the pipe collar design is not applicable to the type of pipe being selected, the pipe collar shall be modified to insure a joint connection that will fit the pipe.
5. The details shown are adopted from the Missouri Department of Transportation Standard Drawings.

### Type C Collar

(Bending Diagram for B-Bars)

### Section A-A

**Elevation:**

(Fore Concrete Pipe to Concrete Pipe)

**Type C Collar**

###パイプコラール

（Type A and C Collar）

### Type C Collar

(For Concrete Pipe to Corrugated Metal Pipe)

**Elevation:**

(Fore the Concrete Pipe)

**Type C Collar**

### Saint Charles County

Highway Department

St. Charles, Missouri

Sewer Construction Details

Date: June 2022

Drawing C604.43
SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

GUARDRAIL
MEDIAN LESS THAN 60°

DATE: December, 2000
DRAWING: CSD8.02

GENERAL NOTES:

1. GUARDRAIL END TERMINAL SHALL BE LACED VERTICALLY AND HORIZONTALLY, AS INDICATED, TO THE MEDIAN END TERMINAL.
2. GUARDRAIL END TERMINAL SHALL BE LACED VERTICALLY AND HORIZONTALLY, AS INDICATED, TO THE MEDIAN END TERMINAL.

(T) TYPE E GUARDRAIL, LE-48" IN LENGTH AND FACTORY FORMED TO THE REQUIRED MODEL.
(T) PRODUCT FOR THE END TERMINAL WILL BE CONFORMED FULL COMPLIMENT OF GUARDRAIL END TERMINAL AS SPECIFIED BY THE MANUFACTURER.

TYPICAL EXAMPLE OF GUARDRAIL END TERMINAL TO USE A FULL LE-48" GUARDRAIL ENSURING, SUCH ATTACHING TO THE GUARDRAIL END TERMINAL.
COMMERCIAL ENTRANCE WITH ROLLED CURB

General Notes:
1. Do not scale drawings. Follow dimensions.
2. All permitted expansion joints shall extend from the subgrade to 1/2" below top of finished surface of concrete. Joint shall be designed to conform to Section 1571.3.2 of the Standard Specifications for Highway Construction.
3. Curb and joint dimensions shown in pavement construction details for "curbs and gutters," St. Louis County, page 11-5.
4. The thickness of the first section of swale or each side of the entrance shall be increased to match the driveway approach pavement thickness (7/). 3/8" is permitted on 18" in length of 12" centers placed in drill holes filled with neat thick grout.
5. Portland cement concrete for streets, sidewalks, entrances, and approaches on proposed public right-of-way shall be constructed in compliance with the most current mix design, inspection and testing requirements as approved and adopted by the East Missouri Pavement Consortium. Details can be obtained at www.emppavement.org.
6. A minimum of four (4) inches of Type S aggregate base is required under concrete and asphalt pavement.

SECTION A-A
See Note 6

SECTION B-B
See Note 6

SECTION C-C
See Note 6

SECTION D-D
See Note 6

Saint Charles County
Highway Department
St. Charles, Missouri
Entrance Construction Details
Commercial Concrete Entrances

Drawing: C03A0S-51
Date: May, 2018
1. AREA OF PAVEMENT (ACCEL/DECEL AND NORMAL SIDE ROAD) WITHIN RIGHT-OF-WAY
   CHOICE OF
   A. 7" NON-REINFORCED P.C.C. PAVEMENT
   B. 2" BP-1 (TYPE "C") ASPHALTIC CONCRETE LAYER ON 7 1/2" BIT.BASE (TYPE "X")
   ASPHALTIC CONCRETE
2. 4" OF TYPE 1 OR 5 ROLLED AGGREGATE BASE REQUIRED UNDER PAVEMENT
3. ALL DRAINAGE STRUCTURES MUST BE REINFORCED CONCRETE PIPE (RCP)
4. CULVERT SECTIONS AND HYDRAULIC DATA CALCULATIONS MUST BE INCLUDED
5. EXISTING AND PROPOSED RIGHT-OF-WAY MUST BE ILLUSTRATED
6. PERMISSION MUST BE OBTAINED FROM THE COUNTY ENGINEER TO OPEN CUT THE PAVEMENT
   ON EXISTING COUNTY ROADS
7. DECELERATION LANE SHALL BE SLOPED AT 2 1/2 % TO BACK OF PAVEMENT/CURB
8. SAWCUT SMOOTH EDGE ALONG EXISTING PAVEMENT
9. FOR ENTRANCES LOCATED ON COUNTY ROADS WITH POSTED SPEED LIMITS OF LESS THAN 35 MPH,
   A 15:1 TAPER MAY BE USED
GENERAL NOTES

1. Do not scale drawing. Follow dimensions.
2. Sections are symmetrical about construction centerline.
3. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions refer to the "Pavement Construction Details." Note that width and location of each poured portion of the pavement may change the type and location of joint required.
4. All necessary pavement markings shall be as required by Saint Charles County.
5. Sidewalk thickness increases to 6" at Residential Driveways and 7" at Commercial Driveways. See Entrance Construction Details.
6. All catch basins shall be separated from the pavement and curb by expansion material extending completely through the curb and slab. Manhole castings within the pavement limits shall be boxed as shown in the "Pavement Construction Details."
7. When a joint falls within 5ft. of, or contacts basins, manholes, or other structures, shorten one or more panels either side of opening to permit joint to fall on round structures and at or between corners of rectangular structures.
8. Driveway configurations are shown in the "Entrance Construction Details."
9. For roadway cross slopes, pavement types and thickness refer to "Standard Typical Sections."
10. Transverse or longitudinal construction joints in slip formed pavements may be made with a groover or tool, if such devise has been approved in advance by the Department.
11. The location of the Type B and Type C longitudinal construction joints in the sections may be interchanged for the different widths of construction if approved by the Department.
12. Curb ramps are required with sidewalk and curb.

13. Additional pavement thickness and/or base is required for heavy vehicular usage and volume.
   Minimum Thickness for Pavement is:
   - All Residential 2 Lane Local Streets... CONCRETE (T)
   6"  
   - Residential 2 Lane, All County and Non-Residential Streets and All Commercial Entrances.... 7"
   - All Arterial Streets By County Engineer

14. For detail of channelization islands and curb ramps in channelization islands refer to the Intersection Channelization Details for 4' Raised Concrete Channelization Island With Curb Ramps, Std. Dwg. C608.13.
11. The location of the Type C longitudinal construction joints in the sections may be interchanged for the different widths of construction if approved by the Department.

12. Each corner radius shall be as required by the geometric layout shown and increased to the nearest 5 foot dimension. The minimum acceptable corner radius shall not be less than 50 feet.

13. For detail of channelization islands and curb ramps in channelization islands refer to the Intersection Channelization Details for 4" Raised Concrete Channelization Island With Curb Ramps, Std. Dwg. C608.13.

14. The intersection angle shall be designed at 90° unless otherwise approved by the Highway Department.

15. Greater channelization lane widths may be required if an intersection angle less than 90° is approved by this Department.

16. This detail to be used in conjunction with Std. Dwg. C203.64.

17. Taper to 2 driving lanes and 2 emergency parking lanes where adjacent residential lots are served from the collector roadway.

GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. Sections are symmetrical about construction centerline.
3. For roadway cross slopes, pavement types and thickness refer to "Standard Typical Sections."
4. Driveway configurations are shown in the "Entrance Construction Details."
5. All necessary pavement markings shall be as required by Saint Charles County.
6. Sidewalk thickness increases to 6" at Residential Driveways and 7" at Commercial Driveways. See "Construction Entrance Details."
7. All catch basins shall be separated from the pavement and curb by expansion joint material extending completely through the curb and slab. Manhole casings within the pavement limits shall be boxed as shown in the "Pavement Construction Details."
8. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions refer to the "Pavement Construction Details."
   Note that width and location of each poured portion of the pavement may change the type and location of joint requirement.
9. When a joint falls within 5ft. of, or contacts basins, manholes, or other structures shorten one or more panels either side of opening to permit joint to fall on round structures and at or between corners of rectangular structures.
10. Transverse or longitudinal construction joints in slip formed pavements may be made with a groover or tool, if such device has been approved in advance by the Department.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

INTERSECTION CHANNELIZATION DETAILS
RESIDENTIAL - 38' WIDE
EXCLUSIVE RIGHT TURN LANE
(CONCRETE PAVEMENT)

DATE: September, 2002
DRAWING C608.05
11. The location of the Type C longitudinal construction joints in the sections may be interchanged for the different widths of construction if approved by the Department.

12. Each corner radius shall be as required by the geometric layout shown and increased to the nearest 5 foot dimension. The minimum acceptable corner radius shall not be less than 50 feet.


14. The intersection angle shall be designed at 90° unless otherwise approved by the Highway Department.

15. Greater channelization lane widths may be required if an intersection angle less than 90° is approved by this Department.

16. When the lane usage on an approach to an intersection is subject to change, a temporary portion of channelization island may be required. Each temporary portion of a channelization island shall consist of 4 P.C. Concrete (non-reinforced) installed without dowel bars on concrete pavement.

17. This detail is to be used in conjunction with Std. Dwg. C203.84.

18. Taper to 2 driving lanes and 2 emergency parking lanes where adjacent residential lots are served from the collector roadway.

SAINT CHARLES COUNTY HIGHWAY DEPARTMENT ST. CHARLES, MISSOURI

INTERSECTION CHANNELIZATION DETAILS RESIDENTIAL – 38' WIDE EXCLUSIVE LEFT TURN LANE (CONCRETE PAVEMENT)

DATE: September, 2002 DRAWING C608.06
10. The location of the type B and C longitudinal construction joints in the sections may be interchanged for the different widths of construction if approved by the Department.

11. Curb ramps are required with sidewalk and curb.

12. Transverse or longitudinal construction joints in slip formed pavements may be made with a groover or tool, if such device has been approved in advance by the Department.

13. All catch basins shall be separated from the pavement and curb by expansion joint material extending completely through curb and slab. Manhole castings within the pavement limits shall be boxed in as shown in the "Pavement Construction Details."

14. When a joint falls within 5ft., or contacts basins, manholes, or other structures, shorten one or more panels either side of opening to permit joint to fall on round structures and at or between corners of rectangular structures.

15. Sidewalk thickness increases to 6" at Residential Driveways and 7" at Commercial Driveways. See Entrance Construction Details.

16. Driveway configurations are shown in the "Entrance Construction Details."

17. Additional pavement thickness and/or base is required for heavy vehicular usage and volume. Minimum Thickness for Pavement is: CONCRETE (T)

   All Residential Minor and Local Streets 6"

   Residential Collector, All County and Non-Residential Streets and All Commercial Entrances 7"

   All Arterial Streets By County Engineer

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

INTERSECTION CHANNELIZATION DETAILS
RIGHT IN - RIGHT OUT
CHANNELIZED STREET OR
COMMERCIAL ENTRANCE
(CONCRETE PAVEMENT)

DATE: September, 2002
DRAWING C608.07
11. Curb ramps are required with sidewalk and curb.

12. Transverse or longitudinal construction joints in slip formed pavements may be made with a groover or tie, if such device has been approved in advance by the Department.

13. All catch basins shall be separated from the pavement and curb by expansion joint material extending completely through curb and slab. Manhole castings within the pavement limits shall be boxed in as shown in the "Pavement Construction Details."

14. When a joint falls within 5 ft., or contacts basins, manholes, or other structures, shorten one or more panels either side of opening to permit joint to fall on round structures and at or between corners of rectangular structures.

15. Sidewalk thickness increases to 6" at Residential Driveways and 7" at Commercial Driveways. See "Entrance Construction Details."

16. Driveway configurations are shown in the "Entrance Construction Details."

17. Additional pavement thickness and/or base is required for heavy vehicular usage and volume. Minimum Thickness for Pavement is CONCRETE (T) 6".

All Residential Minor and Local Streets

Residential Collector, All County and Non-Residential Streets and All Commercial Entrances.

All Arterial Streets By County Engineer

18. When the mainline pavement width at an approach to an intersection will be widened at a future date, a temporary portion of a channelization island will be required. The temporary portion of the channelization island shall consist of 4" P.C. concrete (non-reinforced) installed without dowel bars on concrete pavement.

19. Interim curb shall intersect ultimate curb at a point of Compound Curvature located opposite an corner of the pavement channelization island.

GENERAL NOTES

1. Do not scale drawing. Follow dimensions.

2. Sections are symmetrical about construction centerline.

3. For roadway cross slopes, pavement types and thickness refer to "Standard Typical Sections."

4. All necessary pavement markings shall be as required by Saint Charles County.

5. Each corner radius shall be as required by the geometric layout shown and increased to the nearest 5 foot dimension. The minimum acceptable corner radius shall not be less than 50 feet.


7. The intersection angle shall be designed at 90° unless otherwise approved by the Highway Department.

8. Greater channelization lane widths may be required if an intersection angle less than 90° is approved by this Department.

9. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions refer to the "Pavement Construction Details." Note that width and location of each poured portion of the pavement may change the type and location of joint required.

10. The location of the type B and C longitudinal construction joints in the sections may be interchanged for the different widths of construction if approved by the Department.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

INTERSECTION CHANNELIZATION DETAILS
INTERIM RIGHT IN - RIGHT OUT
CHANNELIZED STREET OR COMMERCIAL ENTRANCE (CONCRETE PAVEMENT)

DATE: September, 2002

DRAWING C608.08
**GENERAL NOTES**

1. Do not scale drawing. Follow dimensions.
2. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions not shown refer to the "Pavement Construction Details for Integral Curb and Concrete Pavement."
3. All necessary markings shall be as required by Saint Charles County.
4. Sidewalk thickness increases to 6" at Residential Driveways and 7" at Commercial Driveways. See "Entrance Construction Details."
5. For roadway cross slopes, pavement types and thickness refer to "Standard Typical Sections."
6. This type intersection shall not be permitted if signalization is required or anticipated.
7. The intersection angle shall be designed at 90° unless otherwise approved by the Highway Department.
8. The distance to the nose of the median is dependent upon the 50° turning radius used for the inbound left turn movement.
9. No private driveways shall be permitted within the area of the median.
10. Curb ramps are required with sidewalk and curb.
11. See drawing C608.03 for deceleration lane configuration.

**SAINT CHARLES COUNTY**
**HIGHWAY DEPARTMENT**
**ST. CHARLES, MISSOURI**

**PAVEMENT CONSTRUCTION DETAILS**
**MEDIAN AND INTERSECTION CONFIGURATION**

**DATE:** September, 2002  
**DRAWING**  
**C608.09**
GENERAL NOTES

1. Do not slope drawing. Follow dimensions.
2. Sidewalks and sidewalk curb ramps shall be constructed in accordance with County Standards and the Americans with Disabilities Act Accessibility Guidelines (ADAAG).
3. Provide a landing at the top of each ramp. The landing area (not less than 36" x 36") is required for Type 2 ramp only. A curb ramp shall be provided, including an accessible lander, on grade, including all negative (-) values, not landing is required.
4. Minimum sidewalk width along 5° vertical curb shall be 3 feet. Minimum sidewalk with curb 3° rolled curb shall be 4 feet.
5. Minimum sidewalk cross slope 0.027%.7.
6. All sidewalk sections shall be 6" thick, except where indicated on 4" thick by dotted pattern shown on details. All sidewalk sections and curb ramps, regardless of thickness, shall be paved for 6 Concrete Sidewalk.
7. Where curb ramps meet pavement, bullnose will not be permitted.
8. Construct a depressed ramp when the maximum center radius allowed for a straight ramp is exceeded.
9. If precast concrete curb is constructed, slice of dummy (4") field at bottom of ramp at curb line. If precast curb is installed, blank out pavement to provide full depth curb across ramp from water point of curb lip.
10. For sidewalk locations on 4"-or-Sidewalk, refer to "Pavement Construction Details".
11. For pavement longitudinal and transverse joints and its base requirements and dimensions, refer to the Pavement Construction Details for "Concrete and Sidewalk, St. Charles, MO".
12. For roadway cross slopes, pavement types and thicknesses, refer to "Standard Typical Section".
13. All curb ramps shall have detectable warning complying with "Recommendations with Disabilities Act Accessibility Guidelines (ADAAG).

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

PAVEMENT CONSTRUCTION DETAILS

CONCRETE SIDEWALK
AND CURB RAMPS

DATE: June, 2002
DRAWING C608.10
GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. Sidewalk and island curb ramps shall be constructed in accordance with those shown and the spirit of the 1990 Americans with Disabilities Act Accessibility Guidelines (ADAAG).
3. Where curb ramp meets pavement, bulbouts shall be provided.
4. "T" refers to the thickness of pavement.
5. Where the above usage on an approach to an intersection is subject to change, a temporary portion of a channelization island may be required.
6. Permanent channelization islands constructed in bituminous concrete pavement shall be installed prior to placement of Bituminous Concrete Surface. Temporary portions of channelization islands (if required) shall be concrete and placed within pavement lines adjacent to permanent portions of island on top of Bituminous Concrete Wearing Surface.
7. Permanent channelization islands constructed in concrete pavement shall be installed after placement of concrete pavement which has been previously backcut. Temporary portions of channelization island (if required) shall be concrete and placed within pavement lines adjacent to permanent islands on or top of concrete pavement.
8. All curb ramps shall have a detectable warning complying with "Specifications with Disabilities Act Accessibility Guidelines (ADAAG)."

TYPE 11 Curb Ramp in 4" Channelization Island

PLAN
(TYPE 11 CURB RAMP)

SECTION A - A
(TYPE 11 CURB RAMP)

SECTION B - B
P.C. Concrete Pavement

SECTION B - B
Bituminous Concrete Channelization Island with Curb Ramps
GENERAL NOTES

1. Do not scale drawing. Follow dimensions.

2. Sidewalk cross slope 0.02'/ft.

3. Sidewalk thickness increases to 6" on each side of Private Driveways and 7" on each side of Commercial Driveways for one section of sidewalk equal in length to the width of the sidewalk. See "Entrance Construction Details".

4. Sidewalk thru private and commercial driveways will be paid for as 6" and 7" approaches, see "Integral Curb Detail 'B' At Driveways".

5. For sidewalk locations on Cul-De-Sacs see "Pavement Construction Details".

6. For longitudinal and transverse joints, dowel, and tie bar requirements and dimensions refer to the "Integral Curb Pavement Typical Sections and Details".

7. All necessary pavement markings by St. Charles County.

8. For roadway cross slopes, pavement types, and thickness, refer to "Standard Typical Section".

9. See "Integral Curb Detail 'B' at Driveways" for premolded expansion joint requirements.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

CONCRETE SIDEWALK

DATE: October, 2002
GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. Length of the tie bars shall equal the thickness of pavement plus the height of curb less 3".
3. All necessary pavement markings shall be as required by Saint Charles County.
4. Transverse joint spacing for the concrete median shall be the same as the adjacent concrete pavement or on 16 ft. intervals with bituminous pavement.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

PAVEMENT CONSTRUCTION DETAILS
6" RAISED DOWELED-ON CONCRETE MEDIAN

DATE: September, 2002

DRAWING C608.19
COMMERCIAL ENTRANCE WITH ROLLED CURB

12' Radius (Type 1) 20' Radius (Type 2)
(For Actual Radius - SEE PLANS)

For length of adjustment and pavement materials

A B

ELEVATION

GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. Curb and Joint dimensions shown in pavement construction.
3. Plan is perpendicular to construction centerline.
4. The thickness of the first sectional at sidewalk and/or
curb ramps on each side of the entrance shall be increased
3. See Plans

SECTION A-A
See Note 6

SECTION B-B
See Note 6

SECTION C-C
See Note 6

SECTION D-D
See Note 6

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI
ENTRANCE CONSTRUCTION DETAILS
TYPE 1 & 2 SPECIAL
COMMERCIAL BITUMINOUS
CONCRETE ENTRANCES

DATE: May, 2018
DRAWING C608.32
GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. Sections are symmetrical about construction centerline.
3. For longitudinal and transverse joints, dowel and tie bar requirements and curb dimensions refer to the Pavement Construction Details for "Joint and Curbs", Std. Dwg. C502.03.
4. All necessary pavement markings shall be as required by St. Charles County.
5. For roadway cross slope, pavement types and thickness refer to "Standard Typical Sections."
6. All Portland Cement concrete for streets, sidewalks, entrances, and approaches on proposed public right-of-way shall be constructed in compliance with the most current mix design, inspection and testing requirements as approved and adopted by the Eastern Missouri Pavement Consortium. Details can be obtained at www.empcpavement.org.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

PAVEMENT CONSTRUCTION DETAILS
STANDARD RESIDENTIAL STREET ENTRANCE

DATE: May, 2018
DRAWING C608.35
GENERAL NOTES

1. Do not scale drawing. Follow dimensions.
2. Sections are symmetrical about construction centerline.
3. For roadway cross slopes, pavement types and thickness refer to "Standard Typical Sections."
4. Driveway configurations are shown in the "Entrance Construction Details."
5. All necessary pavement markings shall be as required by Saint Charles County.
6. Sidewalk thickness increases to 7" at Commercial Driveways. See "Entrance Construction Details."
7. All catch basins shall be separated from the pavement and curb by expansion joint material extending completely through the curb.

SANCT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

PAVEMENT CONSTRUCTION DETAILS
RIGHT IN - RIGHT OUT
CHANNELIZED STREET OR
COMMERCIAL ENTRANCE
(Bituminous Concrete Pavement)

DATE: September, 2002
DRAWING C608.36

9. Additional pavement thickness and/or base is required for heavy vehicular usage and volume.
   Minimum Thickness for Pavement is:
   BITUMINOUS CONCRETE
   - All Residential Minor
   - All Commercial Entrances
   - All Arterial Streets
   7 1/2" (T)
   9"
   By County Engineer

10. Curb ramps are required with sidewalk and curb.
GENERAL NOTES

1. Do not scale drawing. Follow dimensions.
2. Sections are symmetrical about construction centerline.
3. For roadway cross slopes, pavement types and thickness refer to "Standard Typical Sections."
4. Driveway configurations are shown in the "Entrance Construction Details."
5. All necessary pavement markings shall be as required by Saint Charles County.
6. Sidewalk thickness increases to 6" at Residential Driveways and 7" at Commercial Driveways. See "Construction Entrance Details."
7. All catch basins shall be separated from the pavement and curb by expansion joint material extending completely through the curb.
8. Each corner radius shall be as required by the geometric layout shown and increased to the nearest 5 foot dimension. The minimum acceptable corner radius shall not be less than 50 feet.
9. For detail of channelization islands and curb ramps in channelization islands refer to "Intersection Channelization Details for "Raised Concrete Channelization Island With Curb Ramps."
10. The intersection angle shall be designed at 90° unless otherwise approved by the Highway Department.
11. Greater channelization lane widths may be required if an intersection angle less than 90° is approved by this Department.

12. This detail to be used in conjunction with Std. Dwg. C203.93.

13. Concrete gutter shall be overlaid with 2" BP-1 Bituminous Concrete Wearing Surface if lane width to face of gutter is less than 11 feet.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

INTERSECTION CHANNELIZATION DETAILS
COLLECTOR – 38' WIDE
EXCLUSIVE RIGHT TURN LANE
(BITUMINOUS CONCRETE PAVEMENT)

DATE: September, 2002
DRAWING C608.39
1. Do not scale drawing. Follow dimensions.
2. Sections are symmetrical about construction centerline.
3. For roadway cross slopes, pavement types and thickness refer to Standard Typical Sections.
4. Driveway configurations are shown in the "Entrance Construction Details".
5. All necessary pavement markings shall be as required by Saint Charles County.
6. Sidewalk thickness increases to 6" at residential Driveways and 7" at Commercial Driveways. See "Construction Details.".
7. All catch basins shall be separated from the pavement and curb by expansion joint material extending completely through the curb.
8. Each corner radius shall be as required by the geometric layout shown and increased to the nearest 5 foot dimension. The minimum acceptable corner radius shall not be less than 50 feet.
10. The intersection angle shall be designed at 90° unless otherwise approved by the Highway Department.
11. Greater channelization lane widths may be required if an intersection angle less than 90° is approved by this Department.
12. This detail to be used in conjunction with Std. Dwg. C203.53.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

INTERSECTION CHANNELIZATION DETAILS
COLLECTOR - 38' WIDE
EXCLUSIVE LEFT TURN LANE
(BITUMINOUS CONCRETE PAVEMENT)

DATE: September, 2002
DRAWING C608.40
13. Additional pavement thickness and/or base is required for heavy vehicular usage and volume.
  Minimum Thickness for Pavement is:
  **BITUMINOUS CONCRETE**
  All Residential Minor
  and Local Streets
  7 1/2"
  Residential Collector, All County
  and Non-Residential Streets and
  All Commercial Entrances
  9"
  All Arterial Streets
  By County Engineer

14. Concrete gutter shall be overlayed with 2" BP-1
  Bituminous Concrete Wearing Surface if lane width is
  less than 11 feet.

GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. Sections are symmetrical about construction centerline.
3. For roadway cross slopes, pavement types and
   thickness refer to "Standard Typical Sections."
4. All necessary pavement markings shall be as
   required by Saint Charles County.
5. Each corner radius shall be as required by the
   geometric layout shown and increased to the
   nearest 5 foot dimension. The minimum accepta-
   ble corner radius shall not be less than 50
   feet.
6. For detail of channelization island and curb
   ramps in channelization island refer to the
   Intersection Channelization Details for "4'
   Raised Concrete Channelization Island With
7. The intersection angle shall be designed at 90°
   unless otherwise approved by the Highway
   Department.
8. Greater channelization lane widths may be
   required if an intersection angle less than 90°
   is approved by this Department.
9. Sidewalk thickness increases to 6" at Residenti-
   al Driveways and 7" at Commercial Driveways.
   See "Entrance Construction Details."
10. Driveway configurations are shown in the
    Entrance Construction Details.
11. Curb ramps are required with sidewalk and curb.
12. All catch basins shall be separated from the
    pavement and curb by expansion joint material
    extending completely through the curb.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

INTERSECTION CHANNELIZATION DETAILS
RIGHT IN – RIGHT OUT
CHANNELIZED STREET OR
COMMERCIAL ENTRANCE
(BITUMINOUS CONCRETE PAVEMENT)

DATE: September, 2002

DRAWING C608.47
11. Curb ramps are required with sidewalk and curb.

12. Sidewalk thickness increases to 6" at Residential Driveways and 7" at Commercial Driveways. See "Entrance Construction Details."

13. Driveway configurations are shown in the "Entrance Construction Details."

14. All catch basins shall be separated from the pavement and curb by expansion joint material extending completely through the curb.

15. Additional pavement thickness and/or base is required for heavy vehicular usage and volume. Minimum Thickness for Pavement is:

- BITUMINOUS CONCRETE
- All Residential Minor and Local Streets: 7 1/2"
- Residential Collector, All County and Non-Residential Streets and All Commercial Entrances: 9"
- All Arterial Streets: By County Engineer

16. Concrete gutter shall be overlayed with 2" BP-1 Bituminous Concrete Wearing Surface if lane width to face of gutter is less than 11 feet.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

INTERSECTION CHANNELIZATION DETAILS
INTERIM RIGHT IN – RIGHT OUT
CHANNELIZED STREET OR COMMERCIAL ENTRANCE
(BITUMINOUS CONCRETE PAVEMENT)

DATE: September, 2002
DRAWING C608.48
6 INCH HIGH CURB

Surface of Road

3/4"

4"

2 1/4"

6"

7"

6" min.

9 1/4"

3/4"

2"

1/2 "R.

1/2 "R.

Surface of Road

12°12'

3"

2"

10"

6" min.

3 INCH HIGH CURB
(Continuous Through Driveway Entrances)
GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. For construction details on asphaltic concrete curbs refer to Std. Dwg. C609.30.
3. For application of tack coat refer to Section 407 of the Saint Charles County Standard Specifications for Highway Construction.
GENERAL NOTES
1. Do not scale drawing. Follow dimensions.
2. Heavy Stone Revetment shall be of at least 12 inches of thickness and weigh not less than 1000 lbs.
3. Stones shall be placed perpendicular to the slope and shall be firmly bedded against the slope.
4. No space shall be filled with spoils or small stones in such manner that all revetment stones are tightly wedged.
5. Slopes on which Heavy Stone Revetment are to be placed shall conform to the sections shown on the approved construction plans.
6. Toe Walls shall be constructed or both sides of upstream and downstream end of ditch bottom.
7. Geotextile fabric shall be placed under stone revetment.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

HEAVY STONE REVETMENT
DITCH LINER

DATE: December, 2000
DRAWING CS11.5D
GENERAL NOTES

1. Temporary barricades may be required at any location as directed by the County Engineer.

2. End of roadway barriers are required at the termination of all approaches unless otherwise directed by the County Engineer.

3. Temporary barriers are to be used with all temporary signs when storm water inlets are present.

4. All interior signs shall conform to City/County Specifications for Reflective Paint.

5. This contractor shall be responsible for verification of underground utilities and infrastructure shown and will provide a plan for the placement of all temporary signs and guardrails.

6. Street names signs shall be 30 in. high with a red background and white reflective letters to be entered as part of future development.
**GENERAL NOTES**

1. If a permit is issued to replace the existing asphaltic concrete pavement with full depth bituminous concrete pavement and concrete pavement is found under the existing asphaltic concrete pavement, the applicant will be required to follow the detail for Bituminous Concrete over Concrete Pavement Cut. The applicant will use Duracrete or equivalent to replace the existing concrete and use 4" Type 1 or Type 5 Aggregate Base Course or Granular Backfill or Pugmill as a subbase. Duracrete sets up in approximately 4 hours at which time the BP-1 Bituminous Concrete Overlay can be applied to the base course.

2. If Bituminous Concrete over Concrete Pavement or Concrete Pavement is broken before sawcutting the pavement full concrete slab replacement will be required.

3. Minimum Thickness for Pavement Replacement to:

   - **CONCRETE (T)**
     - All Residential Minor
     - Local Streets
     - Residential Collector
     - All County and Non-Residential Streets
     - All Arterial Streets
   - **BITUMINOUS (T)**
     - 6" 7 1/2"
     - 9 1/2"
     - 12"

   Pavement replacement will require 4" Type 1 or Type 5 Aggregate Base Course. Granular Backfill and Base will be compacted by mechanical tampering methods in lift no greater than 6 inches.

**SAINT CHARLES COUNTY**
**HIGHWAY DEPARTMENT**
**ST. CHARLES, MISSOURI**

**DETAILS OF TEMPORARY OPENINGS IN ROADWAY PAVEMENT**

**DATE:** October, 2002

**DRAWING** C613.00
PATCH CONSTRUCTION DETAILS

DETAIL "A"
To be used where patch is adjacent to transverse joints—
See Patch Types ① ② and ③ on Std. Dwg. C613.02.

5/8" Dia. Reinf. Steel Bars
(Deformed) 18" long @ 12" ctrs.

Granular Backfill
(where required)

Seal with Joint filler
Non-extruding expansion joint filler
Non-Shrink Grout, in place

Patch
Existing Pavement

Undisturbed earth or base material

DETAIL "B"
To be used where patch is adjacent to transverse joints—
See Patch Types ① ② and ③ on Std. Dwg. C613.02.

5/8" Dia. Reinf. Steel Bars
(Deformed) 18" long @ 12" ctrs.

Granular Backfill
(where required)

Seal with Joint filler
Non-extruding expansion joint filler
Non-Shrink Grout, in place

Patch
Existing Pavement

Undisturbed earth or base material

DETAIL "C"
To be used where patch is adjacent to longitudinal keyed joint—See Patch Type ③ on Std. Dwg. C613.02.

5/8" Dia. Reinf. Steel Bars
(Deformed) 18" long @ 12" ctrs.

Granular Backfill
(where required)

Seal with Joint filler
Non-Shrink Grout, in place

Existing Pavement

Not edged or sealed

Saw cut edge
Non-Shrink Grout, in place

Patch
Existing Pavement

Undisturbed earth or base material

DETAIL "D"
To be used where patch is adjacent to existing concrete where no joint is located—See Patch Types ① ② and ③ on Std. Dwg. C613.02.

5/8" Dia. Reinf. Steel Bars
(Deformed) 18" long @ 12" ctrs.

Granular Backfill
(where required)

Seal with Joint filler
Non-Shrink Grout, in place

Existing Pavement

Vertical edges painted with slow curing Epoxy Polysulfide Resin (Colina Bonding Compound or equal) in accordance with manufacturers directions.

Granular Backfill
(where required)

Normal irregular face formed by breaking concrete with concrete breaker

Undisturbed earth or base material

GENERAL NOTES
1. For additional details refer to Std. Dwgs. C613.02 and C613.03, also refer to the Saint Charles County Standard Specifications for Highway Construction Section 813.

2. Minimum Thickness for Pavement Replacement is: CONCRETE (1)
   All Residential Minor and Local Streets 6"
   Residential Collector, All County and Non-Residential Streets 7"
   All Arterial Streets 8"

3. Where base material exists under pavements, replacement will be made with 4" Type 1 or Type 5 Aggregate Base Course. Granular Backfill and Base will be compacted by mechanical tamping methods in lifts no greater than 6 inches.

4. Wherever tiebars, tiebolts, dowels or other load transfer devices are found in a joint the exposed ends will be cleaned and left in place. All smooth slip dowels should be straightened if necessary and greased prior to placing the patch.

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

CONSTRUCTION DETAILS
FOR CONCRETE PATCHES

DATE: November, 2002
DRAWING C613.01
**TYPES OF PATCHES**
CLASSIFIED ACCORDING TO THEIR POSITION IN THE PAVEMENT

**LEGEND**
1. Exterior edge patch across joint
2. Exterior edge patch
3. Interior edge patch

**GENERAL NOTES**
1. For additional details refer to Std. Dwg. C613.01.
2. All transverse expansion joints must be reproduced in their original position through patches of Types 2 and 3.

**SAINT CHARLES COUNTY**
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

**CONSTRUCTION DETAILS**
FOR CONCRETE PATCHES

DATE: September, 2002
DRAWING C613.02
GENERAL NOTES
1. For additional details refer to Std. Dwg. C613.01.
2. If the repair area can not be confined to the dimension shown then the entire slab shall be replaced.
3. Full depth sawcutting is required around the repair area.
4. Repair depth shall match surrounding pavement.
5. No longitudinal sawcutting of slabs will be permitted.
GENERAL NOTES

1. Do not scale drawing. Follow dimensions.
2. Bolts to be used for the flanged pipes are 3/8" x 1 1/2" bolt, 5/8" nut and two 3/8" washers per set. The bolt sets should be attached with
   corrosion resistant or zinc coated. The sets required per specified diameters are:
   8" HDPE: 10 sets
   10" HDPE: 10 sets
   12" HDPE: 10 sets
   14" HDPE: 10 sets
   The pipe to be used for the 1/2" HDPE flanged pipe is 3/8". The bolt sets should be resistance or zinc coated. The sets required per
   specified diameters are:
   1/2" HDPE: 10 sets
   3/4" HDPE: 9 sets
   1" HDPE: 9 sets

3. Aluminum diecasts are to be fabricated on an upper and lower flanges, welded to a half flange. The diecasts are designed to form the
   corrugated aluminum pipe (CAP) to a minimum of 1.5 times nominal pipe diameter. The diecasts should be fabricated
   with the connections using the correct aluminum alloy as cast in the fabrication of the diecasts.

4. The diecasts shall be 3/4" closed cell neoprene. Two neoprene gaskets are required when the alternate diecasts for flanged pipe is
   used.

5. The diecasts shall be fabricated in two single
   40° flanges 72° x 12° flange pipe and 12°
   72° x 12° flange pipe. The alternate
   diecasts for flanged pipe may be fabricated
   as a single unit or be fabricated in two
   bolts and assembled in the field.

6. The alternate diecasts for flanged pipe shall be made using
   aluminum alloy. The neoprene gasket between the pipe and
   connecting bolt is required.

Note: The diecasts may be fabricated from 10 gauge
aluminum stock or 10 gauge corrugated aluminum stock.

Note: The diecasts may be fabricated from 10 gauge
aluminum stock or 10 gauge corrugated aluminum stock.

Note: The diecasts may be fabricated from 10 gauge
aluminum stock or 10 gauge corrugated aluminum stock.

Note: The diecasts may be fabricated from 10 gauge
aluminum stock or 10 gauge corrugated aluminum stock.

Note: The diecasts may be fabricated from 10 gauge
aluminum stock or 10 gauge corrugated aluminum stock.

Note: The diecasts may be fabricated from 10 gauge
aluminum stock or 10 gauge corrugated aluminum stock.

Note: The diecasts may be fabricated from 10 gauge
aluminum stock or 10 gauge corrugated aluminum stock.

ALTERNATE TWO PIECE DIAPHRAGM
WITH FLANGED PIPE CONNECTION

ALUMINUM DIAPHRAGMS

DATE: September 2002
DRAWING: C725.32

SAINT CHARLES COUNTY
HIGHWAY DEPARTMENT
ST. CHARLES, MISSOURI

SEWER CONSTRUCTION DETAILS
**General Notes**

1. Do not scale drawing. Follow dimensions.
2. Installation of the Casing and Carrier pipe shall meet the requirements of Part 4, Section M of the “Wallingford ST. Louis Sewer District Standard Construction Specifications for Sewers And Drainage Facilities.”
3. All joints in the Casing Pipe shall be welded.
4. The pipe to be placed in the bore hole shall be cast iron pipe except as required on the plans.
5. If necessary or required, a field or shop shall be provided for the pipe to permit flow of grout through the pipe, and to prevent spilling along the pipe surface.
6. Grout shall consist of an approved mix and it shall be placed in inserting the pipe pipe to be exposed above on the bore hole to not be lower than the water surface of the bore hole, and a minimum of 3 feet of flow shall be provided following the pipe as filling proceeds.
7. Boring without casing will be permitted for small sewer and gas when substantive conditions are met and the excellent written approval of the County Engineer.
8. Steel casing pipe used in the installation of sewer and gas shall have a minimum yield strength of 35,000 psi.
9. Reinforced clay carrier pipe shall be Class III.
10. PVC.Pipe carrier pipe shall be standard strengths.
11. Polyvinyl chloride (PVC) pipe shall meet ASTM D-3035 specifications.
12. Sewers bored without the use of casing shall be pre-tied and meet the requirements of ASTM A133-84.
13. Grout shall meet the requirements of Part 4, Section M of the “Wallingford ST. Louis Sewer District Standard Construction Specifications for Sewers And Drainage Facilities.”
14. Carrier pipe used in the installation shall have minimum thickness corresponding to the following requirements:

**Saint Charles County Highway Department**

**St. Charles, Missouri**

**Sewer Construction Details**

**Pipe Boring**

**Drawing**

**C726.31**

**Date:** July 2002
GENERAL NOTES

1. All signs shall be fabricated with High Intensity Prismatic (HIP) reflective sheeting meeting both ASTM D4956–09 Type III, Type IV, and ASTM D4956–07 Type X specifications.
2. Sign shall be screen printed unless otherwise approved.
3. All street identification signs shall be 0.080" minimum thick aluminum covered in HIP green, reflective sheeting with HIP white letters.
4. The characters on the street identification sign shall be 6” minimum upper-case and 4.5” lower-case letters or shall be compliant with the latest revision of the current MUTCD.
5. Sign posts shall be mounted a minimum of 3.5 feet from the back of curb with a minimum clearance from the sidewalk of 1.5 feet.
6. Sign posts shall be mounted 18–24 inches in the ground and set in a concrete base.
7. The contractor shall be responsible for verification of underground utilities and structures shown of not shown prior to the placement of sign posts.
DESIGN CRITERIA

1. SILT FENCE SHALL HAVE A MAXIMUM DRAINAGE AREA OF 1/2 ACRE PER 100 LF.

2. STRAW BALE BARRIERS FOR SHEET FLOW SHALL HAVE A MAXIMUM DRAINAGE AREA OF 1/4 ACRE PER 100 LF.

3. REFER TO INDIVIDUAL ESC FIGURE FOR INSTALLATION.

4. TERRACING INCLUDES LOGS, WATTLE & FILTER SOCKS.
NOTES

1. REFER TO DESIGN MANUAL FOR APPLICATION RATES.

2. DUE TO THE DIFFERENT PRODUCTS ON THE MARKET, CONTRACTOR MUST SUBMIT MANUFACTURER SPECIFICATIONS ON APPLICATION RATE AND PROCEDURES.

St. Charles County Erosion & Sediment Controls Standard Drawings
SURFACE STABILIZATION CHART FOR SHEET FLOW

DATE: MAY 2005
DRAWING ESC-3
NOTE:
A SPECIAL USE PERMIT IS REQ'D FOR THE ENTRANCE.

DESIGN NOTES
1. DIVERT ALL RUNOFF TO A SEDIMENTATION CONTROL DEVICE.
2. PROVIDE WATER SUPPLY FOR WASHDOWN.

St. Charles County
Erosion & Sediment Controls
Standard Drawings
CONSTRUCTION
TRAFFIC WASH-OFF PAD

DATE: APRIL 2008
DRAWING ESC-4
**ELEVATION**

1. **Woven Fabric** (Mirafi 100x or equal) over wire mesh (12½ ga, 6x6 mesh)
2. **2x2 Construction Grade Lumber**, 4' long
3. **Install along contour** no slope
4. **Fasten with 3-50 lb. diagonal cable ties within top 8” of fabric or 4-1” long staples**

**SECTION**

- **<1% Slope in Front of Barrier, 5’ Min**
- **Wire Mesh**
- **Fabric**
- **Trench to be backfilled and compacted**
- **Flow**
- **Wrap geotextile around stakes before driving**
- **24” Min**
- **6’ Min Depth**
- **Bury 1’ of fabric along bottom and edge of trench**

**Criteria**

1. **Silt fence shall be 30 inches high.**
2. **Silt fence shall not be used for concentrated flows.**
3. **Geosynthetic reinforced silt fence backing may be used in lieu of wire mesh.**

**Note:** If fabric is installed by equipment designed to slice into the ground, the trench is not req’d.

**Joining Sections of Silt Fence**
ANCHOR BALES WITH TWO 36" LONG 2x2 HARDWOOD STAKES

4" BURIAL DEPTH

FLOW

BALE WIDTH

CROSS-SECTION

4" COMPACTED SOIL TO PREVENT PIPING

WEDE LOOSE STRAW INTO GAPS BETWEEN BALES

FLOW

FLOW

FLOW

PERSPECTIVE VIEW

CRITERIA

1. EXCAVATE TRENCH THE WIDTH OF THE BALE AT LEAST 4 INCHES DEEP AND LONG ENOUGH THAT THE END BALES ARE SOMewhat UPSLOPE.

2. REFER TO ESC 1 AND ESC 12 FOR SPACING AND STRAW BALE USES AS DITCH CHECKS.

3. UPSLOPE FACE OF BALE MUST BE AT LEAST 5' FROM A DISTURBED EMBANKMENT.
WOOD CHIP BARRIER DESIGN

<table>
<thead>
<tr>
<th>D.A. PER 100' BERM</th>
<th>FILTER FABRIC</th>
<th>BERM HEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 AC</td>
<td>NO</td>
<td>3'</td>
</tr>
<tr>
<td>0.75 AC</td>
<td>YES</td>
<td>3'</td>
</tr>
<tr>
<td>1 AC MAX</td>
<td>YES</td>
<td>6</td>
</tr>
</tbody>
</table>

CRITERIA

1. WOOD CHIPS GENERATED FROM ON-SITE CLEARING OPERATIONS CAN BE USED.
2. THIS DEVICE MAY BE USED AS AN ALTERNATIVE FOR SILT FENCE.
3. BARRIER MUST BE AT LEAST 5' FROM A DISTURBED EMBANKMENT (EITHER SIDE).
4. REFER TO TABLE FOR DESIGN DETAILS.
1. DRAINAGE AREA TO BE LESS THAN 5 ACRES.
2. NO SHRUBS, PLANTS OR TREES TO BE PLANTED IN GRASSED FILTER STRIP.
3. VEGETATION SHOULD BE NATIVE GRASSES.
4. VEGETATION SHOULD BE MAINTAINED BETWEEN 6”–12” TALL.

FILTER STRIP DIMENSIONS

<table>
<thead>
<tr>
<th>SLOPE (%)</th>
<th>WIDTH &quot;W&quot;</th>
<th>LENGTH &quot;L&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GRASS</td>
<td>WOODED</td>
</tr>
<tr>
<td>0</td>
<td>20'</td>
<td>50'</td>
</tr>
<tr>
<td>2</td>
<td>20'</td>
<td>50'</td>
</tr>
<tr>
<td>4</td>
<td>20'</td>
<td>50'</td>
</tr>
<tr>
<td>6</td>
<td>20'</td>
<td>50'</td>
</tr>
<tr>
<td>8</td>
<td>25'</td>
<td>60'</td>
</tr>
<tr>
<td>10</td>
<td>30'</td>
<td>60'</td>
</tr>
<tr>
<td>15</td>
<td>50'</td>
<td>75'</td>
</tr>
</tbody>
</table>
STRAW ROLL INSTALLATION REQUIRES THE PLACEMENT AND SECURE STAKING OF THE ROLL IN A TRENCH, 3”–5” DEEP. RUNOFF MUST NOT BE ALLOWED TO RUN UNDER OR AROUND ROLL.

STRAW OR LIVE WATTLES (8”–10” DIA)

WATTLES (AS SLOPE BREAKS)

SPACING DISTANCE SEE ESC 1

1” X 1” STAKE

SPACING DISTANCE SEE ESC 1

9”–12”

1, 2

ADJACENT ROLLS SHALL TIGHTLY ABUT

WATTLES IN PERSPECTIVE VIEW

NOTES:
1. TERRACES SHALL SLOPE AT 1%–3% AND DRAIN TO AN ADEQUATE OUTLET.
2. TERRACES MUST BE FORMED BY CONSTRUCTION OF A BERM, OR APPROVED DIVERSION PRODUCT.
3. WATTLES MAY REMAIN AS A PERMANENT INSTALLATION.
4. WATTLES SHALL BE PLACED ALONG THE CONTOUR.

St. Charles County
Erosion & Sediment Controls
Standard Drawings

TEMPORARY SLOPE BREAKS

DATE: APRIL 2008
DRAWING ESC-9
DIVERSION BERM

**Design Criteria**

1. Diversions shall be used for drainage areas ≤ 3 acres.
2. Diversion channels shall be designed to convey the 6-MO storm at non-erosive velocities.
3. Critical locations shall be designed for the 10-YR storm.
4. Maximum channel slope of 3% without check dams.
5. Swale sediment traps are to be used in highly erosive areas.
6. Channels shall be protected using appropriate channel liners.
7. Channel outlets must be stabilized.
8. Storm sewers may be used in lieu of open channels.
SAND BAG OR GRAVEL BAG
CHECK DAM

FLOW

12” MINIMUM

LEVEL CENTER SECTION, WITH 12” RISE ON BOTH SIDES TO CAUSE FLOW OVER, NOT AROUND, CHECK DAM

CROSS SECTION

18”-20”

3’0” WOVEN FABRIC

PROFILE

2:1 SLOPE (TYP)

4’6” WOVEN FABRIC

FLOW

6”-8” COARSE AGGREGATE

PROFILE

ROCK CHECK DAM

NOTE:
1. CHECK DAMS MAY BE CONSTRUCTED OF SEVERAL ESC CHECK DAM PRODUCTS, SUCH AS TRIANGULAR SILT DIKE®.
2. SEE TABLE 60-12 AND ESC 1 FOR CHECK DAM SPACING.

7 OZ. BURLAP OR POLYPROPYLENE BAG WITH TIES

1”-2” AGGREGATE

FILL BAGS 2/3 FULL, 60 LBS. MAX. WEIGHT

GRAVEL BAG

St. Charles County
Erosion & Sediment Controls
Standard Drawings

CHECK DAMS

DATE: APRIL 2008
DRAWING ESC-11
CRITERIA FOR LOW CONCENTRATED FLOWS

1. DRAINAGE AREAS SHALL BE LESS THAN 1 ACRE.
2. INSTALL TWO STAKES PER BALE.
3. BALES WILL BE TRENCHED 4" DEEP INTO EARTH.
4. MAXIMUM CHANNEL SLOPE OF 3%.
5. SEDIMENTATION TRAPS TO BE USED IN HIGHLY EROSIIVE AREAS.

CHECK DAM SPACING

<table>
<thead>
<tr>
<th>Slope</th>
<th>Maximum Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3%</td>
<td>50'</td>
</tr>
<tr>
<td>2%</td>
<td>75'</td>
</tr>
</tbody>
</table>

TRAPEZOIDAL DITCH  V-DITCH

DOWNSTREAM BALE TOP SHALL BE LEVEL WITH THE LOWEST GROUND ELEVATION OF THE UPSTREAM BALE.

DITCH PROFILE
DESIGN CRITERIA

1. SEDIMENTATION TRAPS TO BE USED IN HIGHLY EROSIWE OR STEEP AREAS.

2. SEDIMENT TRAPS ARE TO BE USED IN CONJUNCTION WITH ANY APPROVED CHECK DAM OR DIVERSION CHANNEL SYSTEM, EXCEPT STRAW BALES.

3. STRAW BALE CHECK DAMS SHALL NOT BE USED IN THIS APPLICATION.

4. SEE ESC 1 FOR CHECK DAM SPACING WITH TRAP. MAXIMUM CHANNEL SLOPE 9°.
1. Maximum drainage area — 1 acre.
2. Peak runoff shall not exceed 2 CFS based on a 6-month storm event.
3. Other sediment protection products may be used, such as filter fence.

St. Charles County
Erosion & Sediment Controls
Standard Drawings

**AREA INLET PROTECTION FABRIC DROP**

**DATE:**
MARCH 2008

**DRAWING:**
ESC-14
DIKE APRON (STAPLED PER MANUF.)
"TRENCH-IN" DIKE APRON

DESIGN CRITERIA
1. MAXIMUM DRAINAGE AREA – 1 ACRE.
2. SEVERAL PRODUCTS ON THE MARKET CAN BE APPROVED FOR THIS USE, SUCH AS FILTR FENCE™.

PLAN VIEW

SILT DIKE (TYP)

1% MAX SLOPE WITHIN 3' OF DIKE (ALL SIDES)

2:1 MAX

1’ MIN

TEMPORARY BERM 1’ HIGHER THAN SILT FENCE TO PREVENT BY-PASS, WHERE REQ’D.

AREA INLET

ELEVATION

STAPLED APRON

3”–6” TRENCH

FLOW

St. Charles County
Erosion & Sediment Controls
Standard Drawings

AREA INLET
PROTECTION
SILT DIKE

DATE: MARCH 2008
DRAWING ESC-15
DESIGN CRITERIA

1. MAXIMUM DRAINAGE AREA – 1 ACRE.

2. MAXIMUM RUNOFF VELOCITY SHALL NOT EXCEED 5 FPS BASED ON 6-MONTH STORM EVENT.

3. THIS METHOD CAN ONLY BE USED IN THE LAST 2 MONTHS OF CONSTRUCTION DURING THE FINAL LANDSCAPING OF THE SITE.
**TRAP PLACEMENT AT LOW POINT**

- Curb Inlet
- Place outside of sump
- Single row of gravel bags
- Single gravel bag for drainage
- Flow
- 6’ MIN

**SILT SOCK (ALTERNATIVE)**

- Curb Inlet
- Place outside of sump
- Silt sock or equal
- Flow
- 5’ MIN

**TRAP PLACEMENT AT INTERMEDIATE INLET**

**DESIGN CRITERIA**

1. Maximum drainage area - 1 acre.
2. Peak runoff shall be ≤2 CFS based on the 6-month storm.
3. Stack gravel bags double high, provide gap for drainage.

**SPACING OF TRAPS**

<table>
<thead>
<tr>
<th>Gutter Slope</th>
<th>SPACING S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low PT</td>
<td>15’</td>
</tr>
<tr>
<td>1%</td>
<td>20’</td>
</tr>
<tr>
<td>2%</td>
<td>15’</td>
</tr>
<tr>
<td>3% Max.</td>
<td>10’</td>
</tr>
</tbody>
</table>

**St. Charles County**

Erosion & Sediment Controls

Standard Drawings

**CURB INLET PROTECTION**

**DATE:**

MARCH 2008

**DRAWING:**

ESC-17
**Plan View**

1. **Monitoring Post (3 Each)**
2. **Porous Baffles, As Req'd**
3. **Stabilized Emergency Spillway In Unfilled Area (Typ)**
4. **Stabilized Discharge**

**Flow**

**Design Criteria**

1. **The Riser/Outlet Pipe Shall Be Sized For The 10-Yr Storm With A 1' Freeboard.**

2. **Baffle Height Shall Be Greater Than Top Of Riser Pipe And Less Than Top Of Embankment.**

3. **Porous Baffles Shall Be Jute Matting, Rock, Silt Fence, Or Similar Approved Material.**

4. **Silt Monitoring Post(s) Shall Be Installed Near The Outlet, The Middle Third, And Upper Third Of Basin, And Be Marked With Maximum Permissible Level Of Sediment.**

**Profile**

- **Wet Storage**
- **Anti-Vortex Cover**
- **Perforated Riser Pipe**
- **Sediment Storage (RUSLE Method)**
- **Outfall Pipe Backfilled With Min. 6” Moist Clayey Soil**

**St. Charles County**

**Erosion & Sediment Controls**

**Temporary Sediment Basin**

**Date:**

**March 2008**

**Drawing:**

**ESC-18**
ROCK OUTLET WEIR

OUTLET WEIR WITH DEWATERING PIPE

DEWATERING PIPE DETAIL

PERSPECTIVE VIEW

SECTION THRU GRASS TRAP

EXCAVATED GRASS WEIR

St. Charles County
Erosion & Sediment Controls
Standard Drawings

SEDIMENT BASIN
OUTLET WEIRS

DATE:  MARCH 2008
DRAWING  ESC-19
DESIGN CRITERIA

1. Maximum drainage area – 3 acres.

2. Depth of storage area shall be a minimum of 1 ft and a maximum of 2 ft.

3. Basin volume shall be as measured below the inlet sill. Volume to be 67 cu yd/drainage area in acres.

4. Use basin dimensions found on plans.

5. Clean out when half full.

St. Charles County
Erosion & Sediment Controls
Standard Drawings

AREA INLET
SEDIMENT TRAP

DATE:
MARCH 2008

DRAWING
ESC-20
DESIGN CRITERIA

1. MAXIMUM DRAINAGE AREA – 3 ACRES.

2. DEPTH OF SEDIMENT STORAGE AREA SHALL BE A MINIMUM OF 2 FT.

3. ALL CONSTRUCTION USED FOR TEMPORARY SEDIMENT TRAPS SHALL APPLY TO THIS DEVICE.

4. VOLUME OF STORAGE SHALL BE 67 CU YD/ACRE OF DRAINAGE AREA.

PLAN VIEW

ELEVATION

St. Charles County
Erosion & Sediment Controls
Standard Drawings

CULVERT INLET
SEDIMENT TRAP

DATE: MARCH 2008
DRAWING ESC-21
DESIGN CRITERIA:

1. The top of riser pipe shall be a min. of 18" below the top of the embankment.
2. The riser pipe shall be sized for the 10-yr storm with a 1 ft freeboard.
3. Holes shall be spaced as shown. Holes are to be placed within 150° facing away from the embankment.
4. 2" clean rock shall cover the holes. Holes shall be covered with 1/2" wire mesh.
DIVERSION RIDGE TO BE 4’ WIDE AT THE TOP, AT LEAST 6” HIGHER THAN THE TOP OF THE PIPE, AND AT LEAST 6” HIGHER THAN THE ADJOINING RIDGE ON THE OTHER SIDE.

HOLD-DOWN STAKES AT 10’ SPACING

4’ MIN. LEVEL SECTION

DISCHARGE PIPE PROTECTION ESC

TOP OF DIVERSION

FLOW

DIVERSION CHANNEL

1’ MIN.

.5’ MIN.

3:1 MAX SIDESLOPES

FLOW

1.5’ MIN.

OPTIONAL T-SECTION ELEVATION

ISLAND OVER T-SECTION INLET

INLET (OPTIONAL T-SECTION)

LENGTH AS NECESSARY TO GO THRU DIKE AT SLOPE 3% OR STEEPER

SURFACE OF COMPACTED FILL

PROFILE

TYPICAL INSTALLATION

NOTE:

1. PIPE CAN BE CMP, PVC, FLEXIBLE TUBING, OR SIMILAR.

2. THIS METHOD MUST BE USED IN CONJUNCTION WITH OTHER ESC DEVICES. THIS IS NOT A STAND ALONE CONTROL DEVICE.

SLOPE DRAIN

Size

Drainage Area (ac) Diag.

< 1.0 12”

< 2.0 15”

< 3.0 18”

< 4.0 21”

< 5.0 24”

< 6.5 27”

6.5–10 30”

St. Charles County
Erosion & Sediment Controls
Standard Drawings
TEMPORARY SLOPE DRAIN

DATE:
APRIL 2008

DRAWING
ESC-23
**DIVERSION CHANNEL**

**TRANSITION SECTION**
20' MIN, 1% GRADE

**GRADE = 0%**

**FLOW**

**SPREADER LIP**

**UPLAND AREA**
UNIFORM SLOPE <10%, AND WELL-VEGETATED.

**6" HIGH BERM AROUND SIDE AND END, 2"-3" WASHED STONE, SAND BAGS, OR GRAVEL BAGS**

**WIDTH** (SEE ESC-25)

**LENGTH**

**SHEET FLOW**

**DISSOLUTION AREA**
STABILIZED SLOPE THAT WILL NOT RE-CONCENTRATE.

**POST MARKED at 5" DEPTH LOCATED AT 1/3 POINTS.**

**DESIGN CRITERIA**

1. **CAPACITY OF SPREADER TO MATCH DIVERSION CHANNEL.**
2. **THE LEVEL LIP MUST BE CONSTRUCTED IN CUT.**
3. **THERE CAN BE NO VEHICULAR TRAFFIC OVER THE SPREADER.**
4. **LENGTH = FLOW RATE+1 (IN FT).**

---

**St. Charles County**
**Erosion & Sediment Controls**
**Standard Drawings**

**LEVEL SPREADER LAYOUT**

**DATE:** MARCH 2008  
**DRAWING:** ESC-24
TIMBER LIP

VEGETATED LIP

St. Charles County
Erosion & Sediment Controls
Standard Drawings

LEVEL SPREADER
TYPICAL SECTIONS

DATE: MARCH 2008
DRAWING ESC-25

FLOW RATE (CFS) | LIP TYPE | W (FT)
--- | --- | ---
≤ 8 | VEG. | 6
≤ 13 | TIMBER | 8
≤ 16 | TIMBER | 10
≤ 20 | TIMBER | 12
PLAN VIEW
W/FLARED END SECTION

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>VELOCITY &lt; 5 FPS</th>
<th>VELOCITY &lt; 10 FPS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ROCK SIZE APRON DIM</td>
<td>ROCK SIZE APRON DIM</td>
</tr>
<tr>
<td></td>
<td>ds0</td>
<td>dmax</td>
</tr>
<tr>
<td>(in)</td>
<td>(in)</td>
<td>(in)</td>
</tr>
<tr>
<td>12</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>15</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>18-24</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>27-30</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>36-42</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>48-54</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>60-66</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>72-84</td>
<td>15</td>
<td>24</td>
</tr>
<tr>
<td>96</td>
<td>18</td>
<td>27</td>
</tr>
</tbody>
</table>

d_s0  - NOMINAL DIAMETER
d_max - MAXIMUM DIAMETER
T    - THICKNESS
L    - LENGTH

DESIGN CRITERIA
1. FROUDE NUMBER MUST BE \( \leq 2.50 \).
2. USE 3 TIMES PIPE DIAMETER FOR DOWNSTREAM CHANNEL WIDTH IF THERE IS NO DEFINED CHANNEL.
3. BANK PROTECTION HEIGHT TO BE 2/3 TIMES PIPE DIAMETER.
4. ROCK SLOPES SHALL BE NO STEEPER THAN 2:1.

St. Charles County
Erosion & Sediment Controls
Standard Drawings
TEMPORARY OUTLET
PIPE DISCHARGE
PROTECTION

DATE: MARCH 2008
DRAWING ESC-26
DIVERT SURFACE FLOW WITH SWALE (BOTH SIDES)

ELEVATION

LOW WATER CROSSING
(BANKS ≤ 4 FT)

ORIGINAL GRADE
12" THICH RIP-RAP
3"-6" MINUS STONE

HIGH FLOW AREA
(TYPICAL)

2" MINUS STONE
WOVEN FABRIC TO SPRINGLINE

MULTIPLE CULVERTS

2" MINUS STONE
WOVEN FABRIC TO SPRINGLINE

SINGLE CULVERT

SHALLOW BANKS

STEEP BANKS

LOW WATER CULVERT(S)

DESIGN CRITERIA

1. PIPE SIZE SHALL BE DESIGNED TO CONVEY STREAM FLOWS FOR THE FOLLOWING PEAK RUNOFF RATES:
   - ≤ 4 MONTH – 2 YR
   - > 4 MONTH – 10 YR

2. MINIMUM CULVERT DIAMETER SHALL BE 18".

3. MAXIMUM SKEW SHALL BE 15°.

4. CULVERT SLOPE SHALL BE A MINIMUM OF 2%.

5. WIDTH OF CROSSING SHALL BE ABLE TO ACCOMMODATE ONE LANE TRAFFIC WITH 2:1 SIDESLOPES.

6. PIPE MATERIAL MAY BE RCP, CMP, STEEL, OR APPROVED EQUIVALENT TO SUPPORT THE EXPECTED LOADING.
APPENDIX A

CHECKLISTS AND FORMS

This appendix contains various checklists and forms that are to be used in obtaining and maintaining a land disturbance permit and site and subdivision plan and plat approval including:

* Erosion & Sediment Control & Land Disturbance Permit Checklist
* Subdivision Improvement Plans Checklist
* Contractor Submittal Checklist - Land Disturbance Permit
* Procedures for Filing Escrow/Lender Agreements
Three (3) sets of plans (construction drawings) plotted on 24” by 36” paper or smaller at an appropriate horizontal scale between 1”=50’ and 1”=10’.

ESC Plan Review Fee (See fee schedule – UDO 425.020, N, 1)

**General Information**

- Name, address and telephone number of property owner or Permittee.
- Property address and location map of land disturbance property.
- Property boundaries and adjacent property owners.
- A site map showing the outlines of the total project area and land disturbance areas.
- Total acreage of site or property.
- Total acreage of land disturbance.
- Name, address and phone number of engineering firm or engineer.
- Existing land use and zoning.
- Signature, seal, and date of a licensed professional engineer.

**Existing Topography & Site Conditions**

- Permanent USGS benchmark source and site benchmark on USGS datum.
- Signature, seal, and date of a registered land surveyor and his (her) statement identifying sources of topographical information.
- Topographic survey of physical features to at least 25 feet beyond the land disturbance activity area.
- Existing surface contours at interval no greater than two (2) feet to at least 25 feet beyond the land disturbance activity area (5 foot contour intervals for > 3 acre lots with private streets).
- FEMA flood panel number, and delineation of 100-year flood plain and floodway.
- Location of soil types, wooded areas, watercourses, wetlands, surface water bodies, and soil borings.
## EROSION & SEDIMENT CONTROL PLAN & LAND DISTURBANCE PERMIT SUBMITTAL CHECKLIST

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
</tr>
</thead>
</table>
|     |    |     | Location of all underground and above ground utilities, including pipelines operated at a service pressure in excess of 200 psig.
|     |    |     | Delineation of the Tree Preservation Plan and required standard notes (*Design Criteria* Appendix B) per Section 410.145 of the *Unified Development Ordinance* (Residential Subdivisions Only).
|     |    |     | Delineation of the Vegetative Buffer Plan per Sections 405.5024 & 405.5026, H of the *Unified Development Ordinance* including field surveyed natural watercourses showing top of banks and buffer limits.
|     |    |     | Locations of any downstream impoundments which could be affected by the proposed land disturbance activities.
|     |    |     | Drawing depicting the runoff travel paths for each drainage area to determine the time of concentration (Sites requiring 24 hour detention only).
|     |    |     | Calculations for time of concentration, composite curve number (CN), and runoff for pre-developed watersheds (Sites requiring 24 hour detention only).

### Proposed Land Disturbance, Construction, & ESC Measures

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
</tr>
</thead>
</table>
|     |    |     | Proposed surface contours at intervals no greater than two (2) feet to at least 25 feet beyond the land disturbance activity area (5 foot contour intervals for > 3 acre lots with private streets).
|     |    |     | Applicable standard construction notes (*Design Criteria* Appendix B).
|     |    |     | Proposed construction traffic access to the site from public R/W or easement and design for wash-off pad.
|     |    |     | All proposed permanent improvements to be constructed as part of the land disturbance activity and design calculations for such.
|     |    |     | A geotechnical report identifying the United States Department of Agriculture soil textures throughout the site; slope stabilization analysis for cut and fill slopes, and, other pertinent data related to erosion or sediment concerns during land disturbance activities.
|     |    |     | Sequence of all land disturbance & construction activities or SWPPP showing or describing the ESC measures needed for each phase of construction to include at a minimum:
  - Stripping and clearing
  - Interim grading
  - Temporary vegetation & surface stabilization
- After changes in drainage courses
- Construction of underground infrastructure
- Construction of structures (pavement, buildings, retaining walls, etc.)
- Final grading and permanent vegetation/landscaping

☐ ☐ ☐ ☐ Separate ESC plan sheets for separate phases of project, if required.

☐ ☐ ☐ ☐ Details of any temporary drainage system proposed to be installed in connection with any and all phases of land disturbance activity.

☐ ☐ ☐ ☐ Description of erosion and sediment controls that will be installed prior to and during land disturbance activity to control pollutants in storm water discharges.

☐ ☐ ☐ ☐ Details of proposed water impoundment structures, embankments, sediment or debris basins, grass or lined waterways and diversions, slope drains, stream crossings.

☐ ☐ ☐ ☐ Locations and details of proposed stable outlets.

☐ ☐ ☐ ☐ Drainage area maps with appropriate pre-development, interim, and post-development runoff calculations for each proposed sediment basin/trap, storm water conveyance system, and ESC measure.

☐ ☐ ☐ ☐ Stabilization of any stream bank erosion problems existing in natural watercourses that are to be left undisturbed that may jeopardize private lots, public utilities, or detention facilities.

☐ ☐ ☐ ☐ Description and location of permanent erosion and sediment controls after land disturbance activities have ended.

☐ ☐ ☐ ☐ Design calculations for each proposed sediment basin/trap, storm water conveyance system, and ESC measure (*UDO Section 412.170 & Design Criteria Section 60*).

☐ ☐ ☐ ☐ Applicable standard construction drawings (*Design Criteria Section 99.00*).

☐ ☐ ☐ ☐ Application to Building Division for any required building permits needed as part of the grading operation (demolition, retaining walls, etc.).

**Other Required Permits, Fees, Guarantees, & Submittals**

☐ ☐ ☐ ☐ Completed county Land Disturbance Permit application.

☐ ☐ ☐ ☐ Payment of base inspection fee (*UDO Section 425.020, N, 2*).
<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
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<tr>
<td>Cost estimate using schedule in Section 412.080, B of the <em>Unified Development Ordinance</em> and/or a line item estimate for installation, maintenance, and replacement of all erosion and sediment controls and all other proposed permanent improvements to be constructed as part of the ESC plan.</td>
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<tr>
<td>Executed performance guaranty for erosion and sediment control (<em>UDO Section 412.080</em>).</td>
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<tr>
<td>Acknowledgement from easement owners/utility agencies for all improvements proposed within or adjacent to existing easements/utilities.</td>
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<td>Executed easements or signed, written permission needed for land disturbance activities or access to the site.</td>
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<tr>
<td>County Flood Plain Development Permit (Planning &amp; Zoning).</td>
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<td>United States Army Corps of Engineers Section 404 permit and Missouri Department of Natural Resources Section 401 permit.</td>
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<td>Missouri Department of Natural Resources Land Disturbance Permit</td>
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<td>County Building Permits needed as part of the grading operation (demolition, retaining walls, etc.).</td>
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<td>County Highway Department Special-Use Permit or MoDOT permit for construction within county or state maintained R/W.</td>
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<td>Alternative material &amp; vendor specifications for manufactured ESC devices.</td>
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CHAPTER 1

SUBDIVISION IMPROVEMENT PLAN CHECKLIST

1. PLAN REVIEW FEE
   __ (Section 425.020, J – UDO)

2. PRELIMINARY PLAT REQUIREMENTS
   __ Preliminary Plat Approval (Section 410.110 UDO)
   __ Adherence To Approved Preliminary Plat

3. SITE INFORMATION (Section 30.00.2 Design Criteria)
   __ Location Map & North Arrow (clearly located on cover sheet)
   __ Subdivision Developer(s) (include address & telephone number)
   __ Consulting Engineer (include address & telephone number)
   __ List of Utility Agencies Serving Site

4. BENCHMARK INFORMATION
   __ Site Benchmark (must be tied to Permanent Benchmark - include level notes)
   __ Permanent Benchmark (U.S.G.S., F.I.R.M., or MoDOT on U.S.G.S. datum)

5. CONSTRUCTION NOTES
   __ Required Construction Notes For St. Charles County
   __ Any Other Special Construction Notes Specific To Site

6. SUBDIVISION ENTRANCES
   __ Sight Distance (Section 40.25 Design Criteria)
   __ Permanent Sight Distance Easements (Section 40.25 Design Criteria)
   __ Arterial Road Improvements Design (curb/pavement removal/replacement - if warranted)
   __ Street Intersection Alignment and Spacing (Section 40.20 Design Criteria)
   __ Entrance Configuration & Turning Movements (1” = 20’ scale detail - Section 40.20, # 7 Design Criteria)
   __ Deceleration Lane (where required – C608.03 Design Criteria)
   __ Street Intersection Platform (C203.54 Design Criteria)
   __ Edge of Pavement Warping Elevations (existing & proposed) & Surface Storm Water Drainage
   __ Pavement Composition (Section 20.10.2 Design Criteria)
   __ Standard Entrance Details (C608.00 – C608.09 & C608.30 – C608.48 Design Criteria)

7. HORIZONTAL STREET ALIGNMENT/SURVEY DATA
   __ Centerline Curve Radii Dimensions & Stationing (Sections 20.30 – 20.40 Design Criteria)
   __ Street Intersection Alignment and Spacing (Section 40.20 Design Criteria)
   __ Cul-de-sac Pavement, Cul-de-sac Rounding, & Intersection Rounding Radii Dimensions
   __ Sawed Type “A” Expansion Joint Locations (concrete pavement - C502.04 Design Criteria)
   __ Tapered Pavement Dimensions (taper ratio, offset & stationing)
8. VERTICAL STREET ALIGNMENT/PROFILES
   __ Street Intersection Platform (C203.54 Design Criteria)
   __ Street Grades (Sections 20.30 – 20.40 Design Criteria)
   __ Curve Information – Stationing, Length, & “K” Factor (Section 20.50 Design Criteria)
   __ Profile Grade Elevations at Specified Intervals (existing & proposed – Section 30.00.3 Design Criteria)
   __ Steep Grade Approval & Disclosure (if applicable – Sections 40.20 & 40.70.4 Design Criteria)
   __ Pavement Lug Design & Details (if required – Section 40.20 & C502.12 Design Criteria)

9. CUL-DE-SAC AND INTERSECTION Rounding WARPINGS (Section 30.00.3 – Design Criteria)
   __ Warping Profiles or Details Showing Edge-of-Pavement Elevations for Intersection Roundings
   __ Warping Profiles or Details Showing Edge-of-Pavement Elevations for Cul-de-sacs & Cul-de-sac Roundings

10. IMPROVEMENTS IN STATE, COUNTY, OR MUNICIPAL MAINTAINED RIGHT-OF-WAY
    __ Highway Department Approval & Special-Use Permit
    __ Coordination with Arterial Road Improvements Design (if applicable – consult Highway Dept. for design criteria)

11. STREET PAVEMENT CONSTRUCTION DETAILS
    __ Typical Street Sections (C203.81 – C203.93 Design Criteria)
    __ Integral Curb & Pavement Sections & Details (concrete pavement – C502.01 & C502.02 Design Criteria)
    __ Joints & Curb Details (C502.03 – C502.05, C609.30 & C609.31 Design Criteria)
    __ Cul-de-sac Configuration Details (if applicable - C502.06 – C502.10 Design Criteria)

12. TRAFFIC CONTROL & SIGNAGE (Coordinate with Highway Dept.)
    __ Street Sign Locations (Section 40.10.2 Design Criteria)
    __ Speed Limit Signs (Section 40.10.3 Design Criteria)
    __ Stop Signs/Other Traffic Control Signs (if required – see preliminary plat & Hwy. Dept. - Section 410.360, B UDO)
    __ Private Street Maintenance Signs (at entrances to subdivisions with private streets only – Section 410.390 UDO)
    __ Striping Plans & Details (if required)
    __ Details for Signage and Striping (C903.10 Design Criteria & M.U.T.C.D.)
SUBDIVISION IMPROVEMENT PLAN CHECKLIST

13. END-OF-PAVEMENT BARRIERS AND TEMPORARY TURNArounds (Stub Streets)
   __ Barrier Locations & Specifications at End of Stub Streets
   __ Barrier Details (C612.11 Design Criteria)
   __ Temporary Turnarounds (stub streets in excess of 250 ft. – Section 40.20 Design Criteria)
   __ Temporary Turnaround Detail (C502.06 Design Criteria)
   __ Temporary Turnaround Removal (extension of street – Section 40.20 Design Criteria)

14. SIDEWALK & HANDICAP RAMPs
   __ Sidewalk Location & Design (see preliminary plat & Section 40.40 Design Criteria)
   __ Handicap Ramp Locations (identify all ramp types - Section 40.40 Design Criteria)
   __ Sidewalk & Handicap Ramp Details (C608.10 – C608.14 Design Criteria)

15. INTERIM GRADING - SEDIMENT & EROSION CONTROL PLAN (See Separate Checklist)
   __ Approved Sediment & Erosion Control Plan & Performance Guaranty

16. GRADING PLAN (Section 30.00.5 Design Criteria)
   __ Final Grading Plan (existing & proposed contours showing final grades)
   __ Clearing/Grading Limits
   __ Final Temporary Sediment Control & Permanent Erosion Control (after completed grading)
   __ Limits of 100 Year Flood Plain & Floodway (if applicable)
   __ Emergency Overflow System Path (See # 28 - Section 50.20.11 Design Criteria)
   __ Geotechnical Report (when required – Section 40.60 Design Criteria)
   __ Retaining Wall Design & Analysis (Building Permit – Section 40.70.6 Design Criteria)
   __ Sinkholes (Section 40.60 Design Criteria)

17. NATURAL WATERCOURSE VEGETATED BUFFER PLAN (Chapter 405, Article VI UDO)
   __ Establishment of Field Surveyed Natural Watercourses and Buffer Limits (clearly marked on site and inspected and approved by a county representative)
   __ Field Surveyed Natural Watercourse Locations (tops of banks)
   __ Field Surveyed Vegetated Buffer Limits (25-50 ft. setback)
   __ Clearing/Grading Limits
   __ Limits of 100 Year Flood Plain & Floodway (if applicable)
   __ Note(s) to Reference Any Vegetated Buffer (“There shall be no clearing, grading, construction or disturbance of vegetation except as permitted by Section 405.5026 of the Unified Development Ordinance of St. Charles County, Missouri.”)
SUBDIVISION IMPROVEMENT PLAN CHECKLIST

18. TREE PRESERVATION PLAN (Section 410.145 UDO)
   - Adherence to Concept Plan per Subdivision Improvements (see preliminary plat)
     - Revisions require recalculation and approval of required tree preservation areas
   - Adherence to Section 410.145, C, # 2 UDO (including statement of intent by property owner)
   - Tree Preservation Calculations (required and preserved - Section 410.145, D UDO)
   - Tree Preservation Required Notes
   - Establishment of Field Surveyed Tree Preservation Areas (clearly marked with posted signs on site and inspected and approved by a county representative)
   - Landscaping Plan (when required)

19. DRAINAGE AREA MAPS & FLOW QUANTITIES
   - On-Site Drainage Area Map (showing drainage areas to all storm water inlets with calculated areas, P.I. factors, and design runoff – Sections 50.30.1 & 50.70.1, Tables 50-1 – 50-5, Figure 50-1 Design Criteria)
   - Off-Site Drainage Area Map (may be part of plans or submitted separately - 50.70.2 Design Criteria)
   - Regression equations, TR-55, other hydrologic methods for large drainage areas
   - Emergency Overflow System Path (Section 50.20.11 Design Criteria)

20. SURFACE DRAINAGE, PERMANENT DRAINAGE SWALES, OPEN CHANNELS
   - Sheet Flow – Terraces, Berms, & Swales (Section 50.60 Design Criteria)
   - Typical Cross-Sections
   - Methods of Permanent Erosion Control (permanent swale linings)
   - Hydraulic Calculations for Depth of Flow & Velocity (under both newly graded and permanently lined conditions – Section 60.20.5.1 Design Criteria)
   - Open Channel Design (paved channels - Section 50.30.5 Design Criteria)

21. STORM WATER COLLECTION SYSTEM (Sections 30.00.4 & 50.00 Design Criteria)
   - Plan View of Storm Sewer Layout & Inlet/Manhole Identification
   - Location, Alignment, Turn Angles, & Curved Pipe (Section 50.20.7, 50.20.8, & 50.70.4 Design Criteria)
   - Street Inlet Stationing & Offsets (Section 50.70.3 Design Criteria)
   - Inlet/Manhole Spacing & Design (Section 50.20.10 Design Criteria)
   - “Y” Connections (Section 50.70.4 Design Criteria)
   - Drainage to Sinkholes (Section 40.60 Design Criteria)

22. STORM SEWER PROFILES (Sections 30.00.4 & 50.00 Design Criteria)
   - Flow Line Elevations, Pipe Lengths, & Slope (Section 50.20.9 Design Criteria)
   - Pipe Sizes & Pipe Material Specifications (Sections 50.20.1 – 50.20.6 Design Criteria)
   - Curved Pipe Radii, Length, & Deflection Angles (Section 50.70.4 Design Criteria)
   - Hydraulic Grade Line Profile (see # 24)
22. STORM SEWER PROFILES (continued)
   __ Existing & Proposed Ground Profile/Rock Lines/Cover Over Pipes (Section 50.20.3 Design Criteria)
   __ Concrete Encasement/Special Bedding/Compacted Fill (if required - Section 50.20.3 Design Criteria)
   __ Granular Backfill (within right-of-way and including sidewalks – Section 50.20.3 Design Criteria)
   __ Concrete Cradle (storm sewer pipes crossing over sanitary & steep slopes – Sections 50.20.3 & 50.20.9 Design Criteria)
   __ Locations of Other Existing and Proposed Utilities, Sanitary Sewers, and Storm Sewers

23. STORM WATER INLETS (Section 50.30.4 Design Criteria)
   __ Inlet Locations (roundings, sag curves/low points, curb inlet height & offsets, sump)
   __ Inlet/Gutter Capacity & Bypass (Figure 50-3, Table 50-6 Design Criteria)
   __ HEC 22 Analysis (when required – Section 50.30.4, # 2 Design Criteria)
   __ Grated Inlets (where required or allowed)
   __ Runoff Crossing Intersections (< 1 cfs - Section 50.30.4, # 8 Design Criteria)
   __ Runoff Between Buildings & Crossing Sidewalks & Curbs (< 1 cfs - Section 50.30.4, # 7 Design Criteria)
   __ Rear Yard Swales (< 4 cfs – Section 50.60 Design Criteria)
   __ Terminal Inlets (min 4 ft. depth)

24. STORM SEWER HYDRAULIC COMPUTATIONS
   __ Hydraulic Grade Line computations (Section 50.30.2 – 50.30.3 Design Criteria)
   __ Hydraulic Depth (freeboard at inlets/manholes & depth above sewer - Section 50.30.3 Design Criteria)
   __ Manning’s Pipe Capacity
   __ Discharge Velocities (Sections 50.50, 60.20.5.2, & 60.20.5.6 Design Criteria)

25. STORM WATER CULVERTS
   __ Culvert design, drawing details, & specifications (Section 50.70.6 Design Criteria)
   __ Design Storm & Freeboard (Section 50.30.6 Design Criteria)
   __ Inlet & Outlet Control Calculations (including calculations for tailwater)
   __ Headwalls or Flared End Sections (Sections 50.30.6, 50.70.4, & 50.70.6 Design Criteria)
   __ Upstream Inundation & Ponding Easements (Section 50.70.4 Design Criteria)
   __ Off System Bridge Inventory (Span Greater Than 20 ft. – S, I, & A Required)

26. BRIDGES
   __ Plans (Section 50.70.5 Design Criteria)
   __ Water Surface Profile, Alignment, & Clearance (Section 50.40 Design Criteria)
   __ Erosion Protection (Section 50.40.4 Design Criteria)
   __ Off System Bridge Inventory (Span Greater Than 20 ft. – S, I, & A Required)
SUBDIVISION IMPROVEMENT PLAN CHECKLIST

27. STORM WATER DISCHARGE
   __ Location (at natural drainageway/designed channel - outlet at bank, not in channel
     - discharge flowline at channel flowline or normal pond surface - Section 50.90.1
       Design Criteria)
   __ On-site & Off-site Easements (Section 50.90.1 Design Criteria)
   __ Downstream Channel Capacity
   __ Discharge Pipe Slope (partial flow velocities & supercritical flow)
   __ Erosion Protection (Sections 50.50, 60.20.5.2, & 60.20.5.6 Design Criteria)
   __ Headwalls, FES, & Cut-off Walls (Sections 50.50 & 50.70.4 Design Criteria)
   __ Special Energy Dissipation Methods (V > 10 fps)

28. EMERGENCY OVERFLOW SYSTEM/RELIEF SWALES (Section 50.20.11 Design
     Criteria)
   __ Emergency Overflow Path (on Grading Plan & Drainage Area Map)
   __ Low Sill Elevations of all Structures Adjacent to Overflow System
   __ Spot Elevations at Critical Points of the Overflow System (elevations where storm
     water would pond)
   __ Typical Cross-Sections for Overflow Swales
   __ Hydraulic Calculations at Critical Points of the Overflow System
   __ Storm Design Where Topography Won’t Permit Overland Flow Path (Section
     50.20.11, # 4 Design Criteria)

29. STORM WATER DETENTION
   __ Differential Runoff Calculations (Section 50.80.1 Design Criteria)
   __ Retrofit Existing Basin(s) (Section 50.80.1, #5 Design Criteria)
   __ Bypass Off-Site Flows (Section 50.80.2, #5 Design Criteria)
   __ Free Outfall Condition (lowest basin elevation > 15-yr, 20 min. hydraulic
     elevation of receiving channel/pipe system – Section 50.80.7 Design Criteria)
   __ Pre and Post Development Storm Water Runoff Analysis for Watersheds ≥ 10
     acres (2-yr, 10-yr, & 100-yr, 24 hour, TR-55, Type II storm events) to include:
     __ Schematic view of hydrologic models
     __ Time of Concentration Calculations (including exhibits showing runoff
       travel paths & watershed boundaries)
     __ Curve Number Calculations
     __ Pond Volume Calculations (Elevation vs. Storage)
     __ Outlet Connectivity & Hydraulic Setup (to include routing through outfall
       culvert & any tailwater conditions)
     __ Summary of routing results for all modeled hydrographs
     __ Electronic copy of computer models (PondPack users only – for submittals
       using other software or when an electronic copy of the model is
       unavailable, printed copies of all calculated hydrographs, elevation vs.
       discharge tables, and elevation vs. storage tables must be submitted in
       addition to the items listed above)
   __ Pre and Post Development Storm Water Runoff Analysis for Watersheds < 10
     acres (2-yr, 15-yr, & 100-yr, 20 minute storm events) to include:
     __ Inflow & Outflow Hydrographs (Figure 50-5 Design Criteria)
     __ Time of Concentration Calculation

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29. **STORM WATER DETENTION (continued)**

Pre and Post Development Storm Water Runoff Analysis for Watersheds < 10 acres (2-yr, 15-yr, & 100-yr, 20 minute storm events) to include:

- Pond Volume Calculations (Elevation vs. Storage)
- Outlet Connectivity & Hydraulic Setup (to include routing through outfall culvert & any tailwater conditions)
- Calculation/Summation of Peak Flows

Freeboard:
- Above Ground (2 ft. to top of basin ~ 100-yr event, Section 50.80.4, #4 Design Criteria)
- Below Ground (volume & spillway capacity to contain/pass 100-yr event, Section 50.80.2, #7a Design Criteria)
- Parking Lots (see Maximum Depths & Limits of Maximum Ponding)

Maximum Depths:
- Dry Ponds (6 ft. ~ 100-yr event, Section 50.80.3, #1 Design Criteria)
- Wet Ponds (3 ft. ~ 100-yr event, Section 50.80.2, #11 Design Criteria)
- Parking Lots (for automobiles – 8”, for trucks/trailers – 12”, 100-yr event, Section 50.80.3, #2 & 3 Design Criteria)

Limits of Maximum Ponding (Section 50.80.4 Design Criteria):
- Dry or Wet Basins (≤ 30 ft. horizontal to any building, ≤ 2 ft. vertical to lowest sill, 100-yr. event)
- Parking Lots (≤ 10 ft. horizontal to any building, ≤ 1 ft. vertical to lowest sill, 100-yr. event)

- Paved Swale – Dry Basins (Section 50.80.2, #9 Design Criteria)
- Details & Structural Calculations for Outlet Control Structures (Section 50.80.2, #8g & 14 Design Criteria)
- Geotechnical Report/Design (generally dam height > 8 ft. – Section 50.80.2, #8e & Section 50.80.3, #1 Design Criteria)
- Emergency Spillway (required where runoff from overtopped dam would jeopardized buildings before it could be directed to a channel or pipe system with adequate capacity)
- MDNR Dam Permit Requirements (generally dam height ≥ 35 ft.)
- Permanent Erosion Control (revetment, sod, commercial erosion control blanket, plantings – Section 50.80.2, #13 Design Criteria)
- Common Ground & Maintenance Access (Section 50.80.2, #7a, 13, 16, Section 50.80.5, Section 50.80.6 Design Criteria, Sections 410.210, E & 410.410, B UDO)

30. **SANITARY SEWER PROFILE**

- Granular Backfill (within right-of-way and including sidewalks – Section 50.20.3 Design Criteria)
- Concrete Cradle (storm sewer pipes crossing over sanitary – Section 50.20.3 Design Criteria)
- Locations of Other Existing and Proposed Utilities & Storm Sewers
31. MISCELLANEOUS IMPROVEMENTS/REQUIREMENTS
   __ Guard Rail/Roadway Berms/Escape Areas & Details (Sections 40.10.4 – 40.10.6 & C606.00 – C606.12 Design Criteria)
   __ Off-Site Grading/Construction – Easements/Letters of Permission – Notification of Property Owners & Restoration of Off-Site Properties
   __ Pipeline/Utility Setbacks & Easements (acknowledgement & conditions)
   __ 404/401 Permits (Corps of Engineers & MDNR)
   __ Flood Plain Development (P&Z)
   __ Building Permits

32. CONSTRUCTION SPECIFICATIONS AND DETAILS
   __ Standard Drawings (Section 99.00 Design Criteria)
   __ Non-Standard Drawings, Calculations, & Engineering Seal

33. ENGINEER’S COST ESTIMATE
   __ Itemized Estimate for each Plat
   __ Performance Guaranty (for recording final plat)

34. ENGINEER’S SEAL
   __ Signed, Dated P.E. Seal from State of Missouri (original drawings & calculations)

35. ELECTRONIC COPY OF APPROVED CONSTRUCTION PLANS
   __ AutoCAD file of plan view showing locations of all utilities and streets
CONTRACTOR SUBMITTAL CHECKLIST

It is the responsibility of the Permittee to ensure that the following items are performed prior to construction startup, unless deemed non-applicable to the project by the Director of Development Review.

1. Schedule a preconstruction conference with the Director of Development Review prior to the start of each construction phase of land disturbance activity including installation of the temporary construction entrance. The Permittee will be responsible for notifying all contractors and other entities including utility crews that will perform work at the site to be in attendance.

2. Supply in writing, to the Director of Development Review, the name and telephone number of all contractors and subcontractors and a 24 hour telephone number of the Permittee’s designated agent supervising and directing all land disturbance activities on site.

3. Stake and post signs of tree preservation areas per Section 410.145 of the Unified Development Ordinance and vegetated buffer areas per Section 405.5021 of the Unified Development Ordinance.

4. Identify in writing each erosion and sediment control product that is not a specification authorized by Article IV of Section 412 in the Unified Development Ordinance, and submit manufacturer specifications and installation techniques for approval by the Director of Development Review for performance equivalency with county specifications.

5. Identify proposed good housekeeping practices to control general site pollutants such as construction wastes, site litter, construction debris, dust, and sanitary wastes.

6. Identify toxic or hazardous substances, petroleum products, pesticides, herbicides, and other pollutants that will be used on site. Identify pollution control method for each substance, and submit an emergency management plan for responding to any loss of toxic materials due to a containment failure. This plan must include documentation of actions and mandatory reporting to the Saint Charles County Division of Environmental Services, Solid Waste Enforcement.

7. Provide a location map depicting any proposed borrow or fill sites in the county and the proposed truck haul routes through the county.

8. Provide an erosion and sediment control installation sequencing schedule for approval by the Director of Development Review. The schedule should be a graph or tabulation of each erosion and sediment control installation.

9. The following submittals are required prior to temporary & permanent seeding:
   a. Soil test report
   b. Seeding date
   c. Fertilization mixture & rate
   d. Seed mixture(s) and rate(s), supplier, purity percentage
   e. Mulching material(s) and application rate(s)
   f. Mowing height and schedule
Seeded areas shall be re-fertilized 4 weeks after initial seeding. All areas identified as bare and sparse (less than 30% ground cover) during the inspection shall be re-seeded and mulched. Grass shall not be cut until 4 inches of growth occurs.

10. Provide a copy of the storm water pollution prevention plan (SWPPP) for the project (if required)
LAND DISTURBANCE PRE-CONSTRUCTION MEETING
St. Charles County Government
Community Development Department
Development Review

Permit No.: ________________________________ Date: __________________
Project Name: ____________________________________________________
Project Address: __________________________________________________

Attendance List:

Name: ____________________________________________________________
Job Title/Area of Responsibility: _____________________________________
Phone (day): ________________________________ (night): _________________

Name: ____________________________________________________________
Job Title/Area of Responsibility: _____________________________________
Phone (day): ________________________________ (night): _________________

Name: ____________________________________________________________
Job Title/Area of Responsibility: _____________________________________
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Name: ____________________________________________________________
Job Title/Area of Responsibility: _____________________________________
Phone (day): ________________________________ (night): _________________
Meeting Checklist:

_____ Attendance list filled out and proper contact information recorded

_____ Notification of all construction activities, i.e. start date, approximate date of land disturbance, project phasing, special project considerations.

_____ Explanation of Weekly Inspection Log and Inspection requirements. Distribution of weekly inspection forms.

_____ Review of proposed Erosion and Sediment Control measures and installation schedule.

_____ Maintenance Schedule for all Erosion and Sediment Control measures.

_____ Procedure review for change of all Erosion and Sediment Control measures.

_____ Transfer of responsibility.

_____ Receipt and understanding of Section 412.090 of the Unified Development Ordinance for St. Charles County which outlines Surface Stabilization Requirements.

_____ Receipt and understanding of Section 412.200 of the Unified Development Ordinance for St. Charles County which outlines Earthwork Requirements.

_____ Receipt and understanding of Section 412.210 of the Unified Development Ordinance for St. Charles County which outlines Stormwater Conveyance Requirements.

_____ Receipt and understanding of Section 412.220 of the Unified Development Ordinance for St. Charles County which outlines Sediment Control Requirements.

_____ Receipt of Permit for Land Disturbance.

ATTENDEE SIGNATURE:______________________________ DATE:________________

NOTES:_________________________________________________________________
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PROCEDURES FOR SUBMISSION OF ESCROW & LENDER’S AGREEMENTS AS A PERFORMANCE GUARANTEE

The following are the procedures for submission of Escrow or Lender’s Agreements, hereafter referred to as "Agreement." Both forms consist of a three party agreement between the developer/owner, the lender or escrow holder (usually a bank or title company), and the county. The guarantee must be secured with lawful money of the United States using the Escrow Agreement or with a Deed of Trust using the Lender’s Agreement.

Separate Agreements are required for Sediment & Erosion Control and for Subdivision Improvements. Three (3) original executed Agreement forms (photocopies are not acceptable) must be submitted to the Division of Development Review. Executed agreements for sediment & erosion control must be submitted prior to plan approval. Executed agreements for subdivision improvements are required prior to final subdivision plat approval and recording.

A copy of the approved engineer's cost estimate should accompany the Agreement. The engineer's cost estimate should comply with reasonable standards and prices for the costs of construction and must be approved by the Development Review Director. Agreements for sediment & erosion control will be established and released in accordance with Section 412.080: Performance Guarantee in the Unified Development Ordinance. Agreements for subdivision improvements will be established and released in accordance with Section 410.180: Performance Guarantee in the Unified Development Ordinance.

The Sediment & Erosion Control Agreement may be established using the formulas in section 412.080, B in the Unified Development Ordinance and/or it must cover costs for any measures (structural or otherwise) used to control sediment run off or prevent erosion due to land disturbance from the improvement of the site. If itemizing the costs is desired or required, the Agreement must include, but is not limited to, the following costs:

- Sediment Controls (straw bales, siltation fences, diversion swales/berms, etc.)
- Sediment Traps/Basins
- Construction Entrance
- Stream Bank Protection
- Temporary Drainage Systems
- Revegetation (seed, mulch, fertilizer, sod, etc. for entire land disturbance area)
- Non-vegetative Soil Stabilization (commercial erosion control blankets, rip-rap, retaining walls, etc.)
- Permanent infrastructure needed during interim grading

The Subdivision Improvements Agreement must cover the costs for all public improvements maintained by the County and detention facilities. The Agreement must include, but is not limited to, the following costs:

- Earthwork (grading, clearing, demolition, etc.)
- Street and miscellaneous pavement
- Sidewalks (adjacent to common ground & handicap ramps)
- Retaining walls, if approved as part of the site grading
- Storm sewer systems, bridges, and culverts
- Channel improvements
- Storm water detention/retention facilities
- Street signs, guard rail, and other ancillary items
PROCEDURES FOR SUBMISSION OF ESCROW & LENDER’S AGREEMENTS AS A PERFORMANCE GUARANTEE

All blank spaces on the form must be properly filled-in with indelible ink or typewritten. Provide the name(s) of the developer/owner or their development organization, the escrow holder or lender, the name of the development as it will appear on the recorded plat or approved site plan, the **plat number** (if more than one exists or will exist), the land disturbance permit number, and the performance guarantee sum where requested on the first and second sheets. The performance guarantee sum should be obtained from the engineer's cost estimate as approved by the Development Review Director.

The dates of execution must be provided along with the developer's/owner’s signature and the signature of the escrow holder or lender. Those signing for a business entity must be officials empowered to sign for that business organization. The names of the officers signing the Agreement, their office title, and their business addresses must also be printed on the spaces provided.

**All signatures must be legally notarized using the proper notary forms.** Notary forms for individuals, partnerships, limited liability companies, corporations, and political subdivisions are included in the back of the Agreement or under separate document entitled **notary.doc**. If either party is signing for a corporation, then that party's signature must be signed by an officer empowered to use the corporate seal and the corporate seal should be imprinted below the signatures in the space provided. If either party is signing for a corporation and no corporate seal exists for that corporation, then all verbiage concerning the corporate seal should be removed from the notary form by placing a line through the verbiage. The "crossed-out" verbiage should be initialed by the notary public.

Upon submittal to the Division of Development Review, all information requested in the Agreement will be reviewed and the remaining signatures required for execution will be provided by the County Engineer or the Development Review Director and the County Registrar. One original executed Agreement will be sent to the developer/owner and one will be sent to the escrow holder or lender. Release of performance guarantee funds to the developer shall be directed by the recommendation of the County Engineer or the Development Review Director.

Performance Guaranty Forms and Notary Forms for Escrow and Lenders Agreements for Erosion Sediment Control and Subdivision Improvements are located on the Community Development Department website at [http://cd.sccmo.org/commdev/](http://cd.sccmo.org/commdev/).
APPENDIX B

REQUIRED STANDARD CONSTRUCTION NOTES

This appendix contains standard construction notes that are to be placed on interim grading/erosion & sediment control plans and on applicable site and subdivision improvement plans.
GRADING/SEDIMENT & EROSION CONTROL NOTES

Sediment and erosion control shall not be limited to the measures shown on the plans. The contractor, with the approval of the County inspector, shall utilize best management practices to prevent sediment from entering adjacent properties, roadways, storm sewers, and drainageways.

All filled places under proposed storm and sanitary sewer lines and/or paved areas including trench backfills within and off the road right-of-way shall be compacted to 90 percent of maximum density as determined by the "Modified AASHTO T-180 Compaction Test" (ASTM D-1557). All tests shall be verified by a Soils Engineer concurrent with grading and backfilling operations.

All filled places in proposed and existing St. Charles County roads (highways) shall be compacted from the bottom of the fill up to 90 percent maximum density as determined by the "Modified AASHTO T-180 Compaction Test" (ASTM D-1557). Paved areas in cuts shall meet the same compaction requirements. All tests shall be verified by a Soils Engineer concurrent with grading operations.

All trucking operations shall follow the approved trucking haul route. Concrete trucks shall have proper washouts, as approved by the County inspector. County and state roads shall be cleaned and kept clear of mud, sediment, and any other debris at all times throughout construction.

All on-site trash, litter, discarded building materials, other construction site wastes, and debris, either existing or from construction, must be removed and properly disposed of off-site.

Debris and foundation material from any existing on-site building or structure which is scheduled to be razed for this development must be properly disposed of off-site.

Contractor shall provide sufficient temporary toilet facilities to serve the number of workers on the site.

Contractor shall provide the County Inspector information concerning storage and handling of all hazardous and toxic substances brought onto the site. The Contractor will adhere to applicable federal and state regulations concerning storage and dispensers, spill prevention control, and countermeasure plans for clean-up.

Any wells and/or springs which may exist on this property should be located and sealed in a manner acceptable to the St. Charles County Highway Department and the Building Division of the Community Development Department.

Soft soils in the bottom and banks of any existing or former pond sites or tributaries or any sediment basins, traps, or other ESC measures should be removed, spread out and permitted to dry sufficiently to be used as fill. None of this material should be placed in proposed public right-of-way locations or on any storm sewer location. Any other wet soils that are outside the optimum moisture range to obtain the proper compaction shall be air dried sufficiently before use as fill.

A Pre-Construction Conference must be scheduled with the Director of Development Review prior to the start of each construction phase of land disturbance activity. The Permitee will be
responsible for notifying all contractors, utility crews, and other entities that will perform work at the site to be in attendance.

The Erosion Control Inspector of the Community Development Department shall be notified a minimum of 48 hours prior to the commencement of clearing, grading, and/or prior to the commencement of construction to arrange for an inspection of the site.

All excavations, grading, or filling shall have a finished grade not to exceed a 3:1 slope (33%).

Temporary siltation control measures (structural) shall be maintained until vegetative cover is established at a density sufficient to provide erosion control on the site.

Contractor shall provide dust control, as determined by the County inspector.

Upon completion of storm sewers, siltation control shall be provided around all open sewer inlets and shall remain until the disturbed drainage areas have been properly stabilized.

Where natural vegetation is removed during grading, vegetation shall be re-established in such a density as to prevent erosion.

Temporary vegetation or other approved surface stabilization methods shall be established within 14 days when the soil disturbance has ceased on areas greater than 2,000 sq. ft.

Permanent grass must be established at a density sufficient to provide erosion control on the site within 30 days of the completion or suspension of grading operations. Between permanent grass seeding periods, temporary cover shall be provided according to the recommendation of the Director of the Division of Development Review.

**TREE PROTECTION NOTES**
*(RESIDENTIAL SUBDIVISIONS ONLY)*

The protection area around trees shall include all land within the canopy drip line. This area shall remain free of all grading and filling activities.

Construction site activities such as parking, material storage, soil stock piling, and concrete wash-out shall not be permitted within tree protection areas.

Tree protection areas shall be clearly identified prior to any land disturbance. Methods that may be used include snow fence, polyethylene, chain link fence, or construction stakes placed every fifteen (15) feet. Designated areas shall remain clearly marked throughout construction and until the protected area has been inspected.

Signs shall be used to designate tree protection areas. Signs are to be posted visibly on all sides of the preservation area and must be visible throughout the development process. Minimum size for the signs is 24” x 36” and should state the following: “TREE PROTECTION AREA – Machinery Access and Dumping or Storage of Materials and Equipment Prohibited.”
CONSTRUCTION/IMPROVEMENT PLAN NOTES
(FOR ALL CONSTRUCTION REQUIRED TO BE BUILT TO PUBLIC STANDARDS)

LOCATED ON THE STORM SEWER PROFILES:

Concrete pipe joints shall be MSD Type "A" approved compression-type joints and shall conform to the requirements of the Specifications for joints for Circular Concrete Sewer and Culvert Pipe, using Flexible, Watertight, Rubber-type Gaskets ASTM C443. Band-type gaskets depending entirely on cement for adhesion and resistance to displacement during jointing shall not be used.

All storm sewer pipes shall be reinforced concrete pipe, Class II minimum. Any concrete pipe, conduit, or culvert beneath a street right-of-way or with reasonable probability of being so located shall be a minimum of Class III, but also shall account for all vertical loads. In no case shall the design provide for less than HS-20 loading per AASHTO. For other locations, the minimum design live load shall be the HS-10 loading.

LOCATED ON THE SANITARY SEWER PROFILES:

All sanitary lateral street crossings, if trenched, shall be backfilled with granular material (aggregate).

LOCATED ON BOTH THE SANITARY AND STORM SEWER PROFILES:

Storm sewer pipes that cross over existing or proposed sanitary sewer trenches shall be cradled in concrete through the full width of the sanitary sewer trench. The trench shall be backfilled and compacted with granular fill to the bottom of the concrete cradle.

If the storm and sanitary sewers are parallel and in the same trench or overdig, the upper pipe shall be placed on a shelf and the lower pipe shall be bedded in compacted granular fill to the flow line of the upper pipe.

LOCATED WITH THE CUL-DE-SAC WARPINGS OR PLAN VIEW:

All cul-de-sacs must be hand-formed beginning at the PC's of the roundings. A continuous slope must be maintained from the center of the cul-de-sac to the curb.

LOCATED ON THE COVER SHEET:

All filled places under proposed storm and sanitary sewer lines and/or paved areas including trench backfills within and off the road right-of-way shall be compacted to 90 percent of maximum density as determined by the "Modified AASHTO T-180 Compaction Test" (ASTM D-1557). All tests shall be verified by a Soils Engineer concurrent with grading and backfilling operations.

All filled places in proposed and existing St. Charles County roads (highways) shall be compacted from the bottom of the fill up to 90 percent maximum density as determined by the "Modified AASHTO T-180 Compaction Test" (ASTM D-1557). Paved areas in cuts shall meet...
the same compaction requirements. All tests shall be verified by a Soils Engineer concurrent with grading operations.

The Chief Inspector of the St. Charles County Highway Department shall be notified a minimum of 24 hours prior to the commencement of street, sewer, and/or utility construction.
APPENDIX C

CALCULATING SEDIMENT VOLUME

The size of a sediment basin has two components: sediment volume and stormwater storage volume. This appendix contains the step-by-step method to calculate the sediment volume.

A spreadsheet has been developed to size sediment basins and riser pipes meeting County Design Manual criteria. The spreadsheet includes the calculation of sediment volume based on County modified RUSLE, stormwater volume for the design storm, and the design of the riser pipe.
CALCULATING SEDIMENT VOLUME

County Modified RUSLE
Revised Universal Soil Loss Equation (RUSLE) as modified in this appendix shall be used to determine the sediment volume for construction sites.

\[ Y = DA \times R \times K \times LS \times C \]

where:
- \( Y \) - Sediment Yield (tons)
- \( DA \) - Tributary drainage area (acre)
- \( R \) - Erosivity factor
- \( K \) - Soil erodibility factor
- \( LS \) - Topographic factor
- \( C \) - Cover-management factor

Sediment Volume (Vs)
The sediment volume is converted from tonnage to cubic feet based on the USDA soil texture classification density of the eroded soil found in Table C1 below:

<table>
<thead>
<tr>
<th>USDA Soil Texture</th>
<th>Density (( \gamma ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - Clay</td>
<td>70</td>
</tr>
<tr>
<td>2 - Silt</td>
<td>85</td>
</tr>
<tr>
<td>3 - Sand</td>
<td>105</td>
</tr>
<tr>
<td>4 - Loam</td>
<td>85</td>
</tr>
<tr>
<td>5 - Clay Loam</td>
<td>70</td>
</tr>
<tr>
<td>6 - Silt Loam</td>
<td>85</td>
</tr>
<tr>
<td>7 - Sandy Loam</td>
<td>85</td>
</tr>
<tr>
<td>8 - Silty Clay</td>
<td>85</td>
</tr>
<tr>
<td>9 - Sandy Clay</td>
<td>85</td>
</tr>
<tr>
<td>10 - Loamy Sand</td>
<td>105</td>
</tr>
<tr>
<td>11 - Sandy Clay Loam</td>
<td>85</td>
</tr>
<tr>
<td>12 - Silty Clay Loam</td>
<td>85</td>
</tr>
</tbody>
</table>

Sediment Volume Equation:
\[ Vs = \frac{2000Y}{\gamma} \]

where:
- \( Y \) - Average sediment yield (tons)
- \( \gamma \) - Soil density (pcf)

Erosivity Factor (R)
The annual value of 'R' for St. Charles County is 200. The distribution of the erosivity factor is according to the following Table C2. To determine the R Factor in the equation, sum the values of 'R' for the months the sediment basin will be operating. For example, if a basin will be operating from August thru April of the following year, the R Factor would be 123.
<table>
<thead>
<tr>
<th>Month</th>
<th>Value of R</th>
</tr>
</thead>
<tbody>
<tr>
<td>August</td>
<td>- 37</td>
</tr>
<tr>
<td>September</td>
<td>33</td>
</tr>
<tr>
<td>October</td>
<td>- 16</td>
</tr>
<tr>
<td>November</td>
<td>- 9</td>
</tr>
<tr>
<td>December</td>
<td>- 5</td>
</tr>
<tr>
<td>January</td>
<td>- 4</td>
</tr>
<tr>
<td>February</td>
<td>- 4</td>
</tr>
<tr>
<td>March</td>
<td>- 5</td>
</tr>
<tr>
<td>April</td>
<td>- 10</td>
</tr>
<tr>
<td>R Factor</td>
<td>= 123</td>
</tr>
</tbody>
</table>

Table C2 - 'R' Erosivity Factor Monthly Distribution

<table>
<thead>
<tr>
<th>Month</th>
<th>R DISTRIBUTION</th>
<th>R MONTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>2.0%</td>
<td>4</td>
</tr>
<tr>
<td>February</td>
<td>2.0%</td>
<td>4</td>
</tr>
<tr>
<td>March</td>
<td>2.5%</td>
<td>5</td>
</tr>
<tr>
<td>April</td>
<td>5.0%</td>
<td>10</td>
</tr>
<tr>
<td>May</td>
<td>8.0%</td>
<td>16</td>
</tr>
<tr>
<td>June</td>
<td>13.0%</td>
<td>26</td>
</tr>
<tr>
<td>July</td>
<td>17.5%</td>
<td>35</td>
</tr>
<tr>
<td>August</td>
<td>18.5%</td>
<td>37</td>
</tr>
<tr>
<td>September</td>
<td>16.5%</td>
<td>33</td>
</tr>
<tr>
<td>October</td>
<td>8.0%</td>
<td>16</td>
</tr>
<tr>
<td>November</td>
<td>4.5%</td>
<td>9</td>
</tr>
<tr>
<td>December</td>
<td>2.5%</td>
<td>5</td>
</tr>
</tbody>
</table>
Soil Erodibility Factor (K)
The value of the soil erodibility factor 'K' must be determined by a soil test in conjunction with Drawing ESC 2, or drawing below.

```
PERCENT SAND
PERCENT CLAY
PERCENT SILT
07
03
10
04
06
02
12
05
08
01
09
11
K=0.20
0.30
0.40
0.50
0.60
0.10
'K' VALUE DETERMINATION
Bienz Soil Chart published by United States Department of Agriculture.
```

Topographic Factor (LS)
Determine the topographic factor 'LS' using Table C3 by dividing the drainage basin into representative areas having similar ground slope and slope length. Each value of 'LS' for the specific area can be appropriately averaged.

<table>
<thead>
<tr>
<th>Example:</th>
<th>Area (ac)</th>
<th>Slope (%)</th>
<th>Length (ft)</th>
<th>LS</th>
<th>Area x LS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>8</td>
<td>100</td>
<td>1.10</td>
<td>2.20</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>5</td>
<td>75</td>
<td>0.58</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
<td>3.07</td>
</tr>
</tbody>
</table>

**LS average: 3.07 / 3.5 = 0.88**
Table C3 - LS Factor

<table>
<thead>
<tr>
<th>Ground Slope</th>
<th>Slope Length (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>25</td>
</tr>
<tr>
<td>1</td>
<td>0.10</td>
</tr>
<tr>
<td>2</td>
<td>0.16</td>
</tr>
<tr>
<td>3</td>
<td>0.21</td>
</tr>
<tr>
<td>4</td>
<td>0.26</td>
</tr>
<tr>
<td>5</td>
<td>0.31</td>
</tr>
<tr>
<td>6</td>
<td>0.36</td>
</tr>
<tr>
<td>8</td>
<td>0.45</td>
</tr>
<tr>
<td>10</td>
<td>0.57</td>
</tr>
<tr>
<td>12</td>
<td>0.71</td>
</tr>
<tr>
<td>14</td>
<td>0.85</td>
</tr>
<tr>
<td>16</td>
<td>0.98</td>
</tr>
<tr>
<td>20</td>
<td>1.24</td>
</tr>
<tr>
<td>30</td>
<td>1.86</td>
</tr>
<tr>
<td>40</td>
<td>2.41</td>
</tr>
<tr>
<td>50</td>
<td>2.91</td>
</tr>
</tbody>
</table>
Cover Management Factor (C)
The cover management factor is the most sensitive factor related to sediment volume. The higher the number, the more sediment volume. As graded sites (C=1.00) are covered, the value of 'C' reduces considerably. See Table C4 below.

<table>
<thead>
<tr>
<th>Ground Cover</th>
<th>C factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unimproved</td>
<td>0.02</td>
</tr>
<tr>
<td>Pasture</td>
<td>0.03</td>
</tr>
<tr>
<td>Woods</td>
<td>0.01</td>
</tr>
<tr>
<td>Lawns &gt; 6% slope</td>
<td>0.01</td>
</tr>
<tr>
<td>Lawns ≤ 6% slope</td>
<td>0.03</td>
</tr>
<tr>
<td>Graded &gt; 6% slope</td>
<td>1.00</td>
</tr>
<tr>
<td>Graded ≤ 6% slope</td>
<td>1.00</td>
</tr>
<tr>
<td>Temp Seeding Only</td>
<td>0.40</td>
</tr>
<tr>
<td>Seed and Mulch</td>
<td>0.10</td>
</tr>
<tr>
<td>Sod</td>
<td>0.01</td>
</tr>
<tr>
<td>Gravel Parking Lot</td>
<td>0.10</td>
</tr>
<tr>
<td>Gravel Road</td>
<td>0.20</td>
</tr>
<tr>
<td>Buildings</td>
<td>0.00</td>
</tr>
<tr>
<td>Pavement &amp; Walks</td>
<td>0.00</td>
</tr>
</tbody>
</table>
SEDIMENT BASIN DESIGN

A five acre development which has 1/2 acre off-site drainage is to have a proposed sediment basin. See Figure C-1. This example takes the designer through the steps needed to design the sediment basin.

Anticipated Project Schedule
Basin Use: March of first construction year to September of second construction year.
Site Clearing: March
Site Grading: April through June.
Underground installations and pavement: July through October.
Temporary seeding over winter.
Home building over 12 months.

Soil Testing Results
Initial soil testing provided the following soil data:

B-1: Silt Loam: 65% silt, 15% sand, 20% clay
B-2: Silty Clay Loam: 50% silt, 15% sand, 35% clay
Figure C-2  Proposed Grading
Calculation of each factor in RUSLE

1. R Factor
   a. Determine R for first construction season: by adding the values of R for the months between March and December. Total R = 192.
   b. Determine R for second construction season in a similar fashion by adding the values of R for the months between January and August. Total R = 137.
   c. The value of R to be used will be for the first construction year, R=192.

2. K Factor
   B-1: Silt Loam: 65% silt, 15% sand, 20% clay
   B-2: Silty Clay Loam: 50% silt, 15% sand, 35% clay

   ![K Value Determination Diagram]

   Figure C-3  K Factor Chart

   a. Plot soils data for each boring on Figure C-3.
   b. Interpolate K Factor for each boring.
   c. Estimate the areas associated with each boring. In this example B-1 represents the upper portion of the drainage basin. B-2 represents the lower portion of the drainage basin on both sides of the drainage channel. Refer to the site map shown above.
d. The K Factor to be used for the upper area (1.8 acres) is 0.43. The K Factor for the lower areas (2.0 acres and 1.2 acres) is 0.30.

3. LS Factor
   a. Determine the general slope and slope length of each drainage area associated with the borings. The areas can be divided in a practical manner, as long as it generally represents an average condition.

   b. The LS factors for soil determined from borings B-1 and B-2 are 1.47 and 1.88, respectively. See Table C 5 for LS averaging.

### Table C 5 - Average LS Determination

<table>
<thead>
<tr>
<th>Boring</th>
<th>Acreage</th>
<th>Length (ft)</th>
<th>Slope (%)</th>
<th>LS Factor&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Ac x LS</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>1.2</td>
<td>200</td>
<td>7</td>
<td>1.72&lt;sup&gt;2&lt;/sup&gt;</td>
<td>2.06</td>
</tr>
<tr>
<td>B-1</td>
<td>0.6</td>
<td>150</td>
<td>8</td>
<td>1.43</td>
<td>0.86</td>
</tr>
<tr>
<td>Totals</td>
<td>1.8</td>
<td>----</td>
<td>LS Factor</td>
<td>1.62</td>
<td>2.92</td>
</tr>
</tbody>
</table>

| B-2    | 1.2     | 250         | 4         | 0.98<sup>3</sup>      | 1.18   |
| B-2    | 2.0     | 350         | 8         | 2.70<sup>4</sup>      | 5.40   |
| Totals | 3.2     | ----        | LS Factor | 2.06                  | 6.58   |

<sup>1</sup> See portion of Table C3 below.
<sup>2</sup> Round up to 8%.
<sup>3</sup> Round up to next even hundred feet.

### From Table C3 - LS Factor

<table>
<thead>
<tr>
<th><strong>Ground Slope</strong></th>
<th><strong>Slope Length (ft)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>75</td>
</tr>
<tr>
<td>3</td>
<td>0.36</td>
</tr>
<tr>
<td>4</td>
<td>0.47</td>
</tr>
<tr>
<td>5</td>
<td>0.58</td>
</tr>
<tr>
<td>6</td>
<td>0.69</td>
</tr>
<tr>
<td>8</td>
<td>0.91</td>
</tr>
<tr>
<td>10</td>
<td>1.20</td>
</tr>
</tbody>
</table>
APPENDIX D

NRCS CONSERVATION PRACTICE STANDARD & SPECIFICATIONS FOR SEEDING

CODE 340 “COVER CROP”
CODE 342 “CRITICAL AREA PLANTING”
CODE 484 “MULCHING”
CODE 590 “NUTRIENT MANAGEMENT”
CODE 723 “VEGETATION ESTABLISHMENT, HERBACIOUS SEEDING”

Use the following website to obtain the most current specifications for St. Charles County, Missouri: www.mo.nrcs.usda.gov. Once at the site, select the “Technical Resources” tab and then select “eFOTG” from the menu. Click on the map of the USA for Missouri and then on the map of Missouri for St. Charles County and select the desired sections from Section IV, “Practice Standards & Specifications.” Code 342 (Critical Area Planting) requires the uses of Codes 484, 590, and 723 in its specifications.
APPENDIX E

SUMMARY OF EROSION & SEDIMENT CONTROL METHODS AND TECHNIQUES

In the appendix each ESC method or technique is listed with specific design limitations and other requirements.
Table E-1 - Summary of Erosion & Sediment Control Methods

<table>
<thead>
<tr>
<th>Method or Technique</th>
<th>Maximum D.A. (Acre)</th>
<th>Design Storm</th>
<th>Other Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surface Stabilization</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporary Seeding &amp; Fertilizing</td>
<td></td>
<td></td>
<td>Table 60-5/soil test/Appendix D</td>
</tr>
<tr>
<td>Permanent Seeding</td>
<td></td>
<td></td>
<td>soil test/Appendix D</td>
</tr>
<tr>
<td>Sodding</td>
<td></td>
<td></td>
<td>stake &gt; 10% slope</td>
</tr>
<tr>
<td>Mulching</td>
<td></td>
<td></td>
<td>see ESC 3</td>
</tr>
<tr>
<td>Tackifiers, BFMs, FGM</td>
<td></td>
<td></td>
<td>see ESC 3</td>
</tr>
<tr>
<td>RECP, TRMs</td>
<td></td>
<td></td>
<td>see ESC 3</td>
</tr>
<tr>
<td><strong>Sediment Controls</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction Traffic Wash-Off Pad</td>
<td></td>
<td></td>
<td>water source &amp;/or rumble strip - ESC 4</td>
</tr>
<tr>
<td>Temporary Entrance Culvert</td>
<td>2 yr</td>
<td></td>
<td>S.U. Permit</td>
</tr>
<tr>
<td>Silt Fence Barrier</td>
<td>0.5/100 ft</td>
<td></td>
<td>sheet flow - see ESC 1</td>
</tr>
<tr>
<td>Straw Bale Barrier</td>
<td>0.25/100 ft</td>
<td></td>
<td>sheet flow - see ESC 1</td>
</tr>
<tr>
<td>Compost Tubes/Berm</td>
<td>0.5/100 ft</td>
<td></td>
<td>sheet flow - see ESC 1</td>
</tr>
<tr>
<td>Wood Chip Barrier</td>
<td>.5-1/100 ft</td>
<td></td>
<td>sheet flow - see ESC 1</td>
</tr>
<tr>
<td>Filter Strip</td>
<td>5</td>
<td></td>
<td>&lt;15% ground slope</td>
</tr>
<tr>
<td>Logs &amp; Wattles</td>
<td>LD ≤ .25</td>
<td></td>
<td>Q ≤ 1 cfs</td>
</tr>
<tr>
<td>Terracing/Wattles</td>
<td>3</td>
<td></td>
<td>see ESC 1</td>
</tr>
<tr>
<td>Ridge/Channel Diversion</td>
<td>3</td>
<td>6 mo</td>
<td>10 yr storm (critical areas)</td>
</tr>
<tr>
<td>Diversion Dike/Berm</td>
<td>3</td>
<td>6 mo</td>
<td>10 yr storm (critical areas)</td>
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<tr>
<td>Rock Check Dam</td>
<td>3</td>
<td></td>
<td>see ESC 1</td>
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<tr>
<td>Gravel Bag Check Dam</td>
<td>3</td>
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<td>see ESC 1</td>
</tr>
<tr>
<td>Straw Bale Check Dam</td>
<td>1</td>
<td></td>
<td>see ESC 1</td>
</tr>
<tr>
<td><strong>Runoff Conveyance/Erosion Prevention</strong></td>
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<td></td>
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<tr>
<td>By-Pass Storm Sewer &amp; Channels</td>
<td>2 yr</td>
<td></td>
<td>cannot pond off-site</td>
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<tr>
<td>Grass Lined Channel</td>
<td>6 mo</td>
<td></td>
<td>see Table 60-16</td>
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<tr>
<td>Temporary Slope Drain</td>
<td>10&lt;sup&gt;1&lt;/sup&gt;</td>
<td>6 mo</td>
<td>see Table 60-17</td>
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<tr>
<td>Level Spreader</td>
<td>20 cfs</td>
<td></td>
<td>see Table 60-18</td>
</tr>
<tr>
<td>Outlet Stabilization</td>
<td>10 fps</td>
<td></td>
<td>see Table 60-19</td>
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<tr>
<td>Bio-Engineering</td>
<td></td>
<td></td>
<td>requires geotech engr</td>
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<tr>
<td><strong>Sediment Basin</strong></td>
<td></td>
<td></td>
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<tr>
<td>Sediment Basin – Riser Outlet</td>
<td>none</td>
<td>10 yr</td>
<td>volume=6 mo+RUSLE</td>
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<tr>
<td>Sediment Trap - Rock Outlet</td>
<td>≤ 5</td>
<td>10 yr</td>
<td>volume=6 mo+RUSLE&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sediment Trap - Excavated Grass</td>
<td>≤ 5</td>
<td>10 yr</td>
<td>volume=6 mo+RUSLE&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Method or Technique</td>
<td>Maximum D.A. (Acre)</td>
<td>Design Storm</td>
<td>Other Requirements</td>
</tr>
<tr>
<td>-------------------------------------</td>
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<tr>
<td>Sediment Trap - Area Inlet</td>
<td>3</td>
<td>10 yr</td>
<td>67 yd$^3$/acre volume</td>
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<tr>
<td>Sediment Trap - Culvert Inlet</td>
<td>3</td>
<td>10 yr</td>
<td>67 yd$^3$/acre volume</td>
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<tr>
<td>Sediment Trap - Swale</td>
<td>2</td>
<td>6mo-2yr</td>
<td>see ESC 13</td>
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<tr>
<td>Sump Pit</td>
<td>isolated</td>
<td>6 mo</td>
<td>Filtered Release</td>
</tr>
<tr>
<td>Portable Sediment Tank</td>
<td>isolated</td>
<td>6 mo</td>
<td>Filtered Release</td>
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<tr>
<td><strong>Inlet Sediment Protection</strong></td>
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<tr>
<td>Inlet Protection - Fabric Drop</td>
<td>1</td>
<td>6 mo</td>
<td>$\leq 2$ cfs, $&lt; 5%$ slope</td>
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<tr>
<td>Inlet Protection - Silt Dike</td>
<td>1</td>
<td>6 mo</td>
<td>$\leq 1%$ slope</td>
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<tr>
<td>Inlet Protection - Sod Filter</td>
<td>1</td>
<td>6 mo</td>
<td>V $&lt; 5$ fps, 2-mo use</td>
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<tr>
<td>Curb Inlet Protection</td>
<td>1</td>
<td>6 mo</td>
<td>$\leq 2$ cfs - spacing ESC 17</td>
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<tr>
<td><strong>Biotechnical Stream Stabilization</strong></td>
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<tr>
<td>Wattling</td>
<td></td>
<td></td>
<td>Requires engineered design by approved professional</td>
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<tr>
<td>Brush Layering</td>
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<tr>
<td>Live Cribwall</td>
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<td>Live Staking</td>
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<td>Wattle Flow Deflectors</td>
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<td>Rock Chevrons/Grade Control</td>
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<td>Brush Matting</td>
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<tr>
<td><strong>Temporary Stream Crossing</strong></td>
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<tr>
<td>Utility Crossing</td>
<td></td>
<td></td>
<td>see 60.20.6.1</td>
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<tr>
<td>Construction Equipment Crossing</td>
<td>$\leq 4$ mo</td>
<td>2 yr</td>
<td>see Table 60-20</td>
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<tr>
<td>Turbidity Curtain</td>
<td>as needed</td>
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<td>engineering plans req'd</td>
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<td><strong>Pollution Prevention</strong></td>
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<tr>
<td>Topsoiling &amp; Stockpiling</td>
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<td>perimeter controls</td>
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<td>Haul Route (Borrow or Fill Site)</td>
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<td>SWPPP</td>
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<tr>
<td>Dust Control</td>
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<td>SWPPP</td>
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<tr>
<td>Solid/Sanitary Waste Disposal</td>
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<td></td>
<td>SWPPP</td>
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<tr>
<td>Spill Prevention &amp; Countermeasures</td>
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<td>emergency plan - SWPPP</td>
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</tbody>
</table>

1 Recommend maximum DA of 3 acres or use of multiple pipes for DA $> 3$ acres
2 If DA $< 3$ acres, minimum volume = 67 yd$^3$/acre