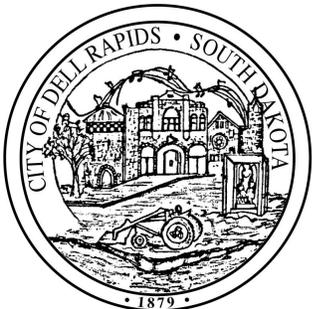


**City of Dell Rapids**  
**Engineering**  
**Design Standards**  
**for**  
**Public Improvements**

**DELL RAPIDS**  
SOUTH DAKOTA

**City of Dell Rapids**  
**302 East Fourth Street**  
**PO Box 10**  
**Dell Rapids, SD 57022**



**Effective: August 7, 2012**

## *Memo*

**TO:** Developers, Engineers, Contractors, Etc.  
**FROM:** City of Dell Rapids  
**DATE:** August 7, 2012  
**RE:** Engineering Design Standards for Public Improvements  
Dell Rapids, South Dakota

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Here, for your easy reference, is a manual setting forth the engineering design standards for public improvements within the City of Dell Rapids. Attention and compliance to these standards will result in less confusion and uncertainty in planning, design, and constructing these improvements within the city. These standards are also developed to reduce the maintenance costs and minimize operational problems associated with public improvements for the City, its citizens, and taxpayers. These standards are by no means all-inclusive. However, they do provide the basic design principles and standards to be used in developing public improvements.

The Table of Contents page will reflect the date of the most recent revision to these standards. The most current approved version will be posted on the City's website at [www.cityofdellrapids.org](http://www.cityofdellrapids.org). The standards will be updated on an annual basis. Typically in the latter part of the year, and will be posted on the website upon approval. If you have any questions regarding any of these design standards or the update process, please contact the City of Dell Rapids, 302 East Fourth Street, P.O. Box 10, Dell Rapids, SD 57022. Please check with the City's website to ensure your manual is current with the most recent version.

# Table of Contents

<b>Chapter</b>	<b>Section</b>	<b>Revision Date</b>
1	General Provisions	08/07/2012
2	Submittal Procedures	08/07/2012
3	Permit Procedures and Requirements	08/07/2012
4	Utility Locations and City Utility Easements	08/07/2012
5	Street Access and Parking Lot Criteria	08/07/2012
6	Geotechnical Exploration and Repot	08/07/2012
7	Grading	08/07/2012
8	Street Design and Pavement Thickness	08/07/2012
9	Sanitary Sewers	08/07/2012
10	Water Mains	08/07/2012
11	Drainage Improvements	08/07/2012
12	Erosion and Sediment Control	08/07/2012
13	Construction Plans	08/07/2012
14	Acceptance Procedures and Requirements for Private Construction of Public Improvements	08/07/2012
15	Street Lighting	08/07/2012
16	Inspection and Testing	08/07/2012

**Chapter 1**  
**General Provisions**

<b>Section</b>	<b>Topic</b>	<b>Page</b>
1.1	Short Title	1.1
1.2	Jurisdiction	1.1
1.3	Amendments and Revisions	1.1
1.4	Enforcement Responsibility	1.1
1.5	Review Process	1.1
1.6	Prior Approval	1.1
1.7	Relationship to Other Standards	1.1
1.8	Variances	1.2
1.9	Private Facilities	1.2

## Chapter 1

### General Provisions

#### 1.1 Short Title

These regulations, together with all future amendments, shall be known as the *City of Dell Rapids Engineering Design Standards for Public Improvements* (hereinafter called Design Standards).

#### 1.2 Jurisdiction

These Design Standards, along with the City of Dell Rapids Standard Specifications for Public Improvements (hereinafter referred to as Standard Specifications), shall apply to all public improvements within the incorporated area of the City of Dell Rapids except where superseded by Federal or State requirements.

#### 1.3 Amendments and Revisions

These standards and criteria may be amended as new technology is developed or experience gained in the use of these Design Standards. The City of Dell Rapids shall consider revisions and/or amendments to these Design Standards.

#### 1.4 Enforcement Responsibility

It shall be the responsibility of the City of Dell Rapids to enforce the provisions of these Design Standards.

#### 1.5 Review Process

The City will review all submittals for compliance with the specific Design Standards. Acceptance by the City does not relieve the Owner, Design Professional, or Contractor from responsibility for insuring that the calculations, plans, specifications, construction, and record drawings are in compliance with the Design Standards.

#### 1.6 Prior Approval

These Design Standards shall not abrogate or annul: (a) any permits issued before the effective date of these Design Standards; (b) any construction plans approved before the effective date of these Design Standards; (c) any final plat documents that have been recommended for approval by the City of Dell Rapids Planning Commission prior to the effective date of these standards; or (d) any easements or covenants already in effect.

#### 1.7 Relationship to Other Standards

If special districts impose more stringent standards, this difference is not considered a conflict and the more stringent standard shall apply. If State or Federal Government imposes more stringent standards, criteria, or requirements, these shall be incorporated into these Design Standards in accordance with Section 1.3 of this Manual.

## **1.8 Variances**

Variances from these Design Standards will be considered on a case-by-case basis by the City of Dell Rapids.

## **1.9 Private Facilities**

If an owner of private street or utility facilities wishes to dedicate these facilities for public use and maintenance, the facilities must meet the standards set forth herein prior to being accepted by the City of Dell Rapids.

## Chapter 2

### Submittal Procedures

<b>Section</b>	<b>Topic</b>	<b>Page</b>
2.1	General	2.1
2.2	Submittal of Reports and Plans for Review	2.1
2.3	Acceptance of Reports and Plans	2.1
2.4	Revisions to Accepted Plans	2.1

## Chapter 2

### Submittal Procedures

#### 2.1 General

2.1.1 All capital improvement plans, private subdivision plans, reports, and related documents shall conform to the following submittal requirements, unless waived by the city.

#### 2.2 Submittal of Reports and Plans for Review

2.2.1 **Submittal Format.** Design Professionals or Owners seeking approval and/or acceptance of reports, plans, and related documents shall submit a copy to the City of Dell Rapids. Submittal shall be in the form of one hard copy and one electronic copy in PDF format. Where the report and/or plans are returned for revisions, all revisions shall be made prior to resubmittal.

2.2.2 **Conformance.** Plans submitted shall be in conformance with Chapter 13. The plans shall include any special provisions. Reports submitted shall be in a typed, bound form in conformance with the requirements of the applicable chapters of these standards. If a report is required which is not provided for in these standards, the report shall include all data, references, and calculations as applicable.

#### 2.3 Acceptance of Reports and Plans

2.3.1 **Review Process.** The City will attempt to complete the review of submitted plans in approximately ten (10) working days. This time will vary due to the complexity of the project and/or workload of the review staff. After review is completed, comments will be compiled and forwarded to the Design Professional/owner. If necessary a review conference will be scheduled. The report and/or plans will be accepted or returned for revisions as noted.

2.3.2 **Acceptance.** Upon acceptance of reports, plans and related documents, three (3) paper copies and an electronic copy (one DWG format and one DWF or PDF format) shall be submitted to the City of Dell Rapids. All final drawings, plans, specifications, reports, plats, or other architectural, engineering, or land surveying documents, papers, or diagrams involved in the practice of architecture, professional engineering, or land surveying shall be dated and bear the signature and stamp or seal of the architect, professional engineer, or land surveyor who was responsible for the preparation thereof.

#### 2.4 Revisions to Accepted Plans

2.4.1 **Initial Acceptance.** Construction plans, specifications, and reports are accepted initially for eighteen (18) months. If not constructed during this time period, such reports automatically become void and must be updated to current criteria before any further permits can be issued. Upon written request, the City Council or a designee may grant a one-year extension to the construction plans, specifications, and/or drainage report, provided a) the development plans, construction plans, and specifications substantially conform to current standards

and b) that other conditions affecting the development site have not substantially changed or do not require a modification to accepted plans or specifications.

#### **2.4.2 Updates to Prior Submittals.**

**2.4.2.1** Whenever updates or revisions to previously accepted construction plans, specifications, or reports are necessary, the design professional will submit updates or revisions through the normal document submittal process. This submittal shall meet the requirements of Section 2.2 of these Design Standards.

**2.4.2.2** Requests for updates and revisions will be considered only if there are NO revisions to the original development plan(s) or report(s). The City will review the original development plan(s) or report(s) for compliance with current standards under normal review procedures.

## Chapter 3

### Permit Procedures and Requirements

Section	Topic	Page
3.1	Application Requirements and Procedures	3.1
3.2	Permit Standards and Conditions	3.3
3.3	Refunds	3.3
3.4	Bonds and Insurance	3.3
3.5	Construction Specifications	3.4
3.6	Traffic Control	3.4
3.7	Restoring Pavements	3.5
3.8	Utility Installations	3.5
3.9	Fees	3.5

## Chapter 3

### Permit Procedures and Requirements

#### 3.1 Application Requirements and Procedures

**3.1.1 Permit Application.** A permit shall be required for any construction or installation within the public right-of-way or public easement for any substantial modification of existing construction or use. Application for such permits shall be made at the City Hall.

**3.1.1.1** No permit will be required for contracts let by the City of Dell Rapids except for water and sewer services. Permits for these will be required; however, they will be on a “no fee” basis. In subdivision work it will be the responsibility of the Owner’s Contractor to obtain the necessary permits from the City of Dell Rapids.

**3.1.1.2** Building permits, which are issued by the City, may include the Sidewalk and Driveway Permit and/or the Excavation and Grading Permit.

#### 3.1.2 Types of Permits.

**3.1.2.1** Sidewalk and Driveway Permit, which governs construction of new and repair or replacement of existing sidewalks and driveways within public right-of-way.

**3.1.2.2** Private Utility Permit, which governs the installation, removal, repair, or maintenance of private utilities other than sanitary sewer, water and storm sewer services in public right-of-way or public easements.

**3.1.2.3** Sewer and Water Service Permit, which governs the installation, removal, repair, or maintenance of sanitary sewer services, water services and storm sewer services.

**3.1.2.4** Construction Permit, which governs the installation of public improvements within the public right-of-way and grading outside the street right-of-way in proposed subdivisions. This includes street grading, curb and gutter, roadway subbase, base and wearing surface, drainage and flood control facilities, water main and sanitary sewer installation, and grading outside the street right-of-way.

**3.1.2.5** Excavation and Grading Permit, which governs grading in excess of 300 cubic yards outside the street right-of-way as defined by the Uniform Building Code (Chapter 7–Grading). An Excavation and Grading Permit is not required if a Construction Permit has been issued.

- 3.1.3 Letters of Responsibility.** Those agencies set forth in Section 3.4.4 may obtain a permit under their Letter of Responsibility, Figure 3.1, or at their option, require the Contractor performing the work to obtain a permit in which event the Contractor would be required to furnish a performance bond as set forth in Section 3.4.1 thereby assuming full responsibility for the work performed. Except as set forth herein, the Contractor performing the work shall be the permittee.
- 3.1.4 Emergency Repairs.** Permits shall apply to emergency repairs. However, a delay of 24 hours is granted, excluding weekends and holidays, following the beginning of such repair.
- 3.1.5 Issuance of Permits.**
- 3.1.5.1** Sidewalk and Driveway Permits and Sewer and Water Service Permits will be issued only to those persons or corporations who, in the opinion of the City of Dell Rapids, are qualified to perform the work. Exceptions to this requirement are Driveway and Sidewalk Permits issued for sidewalk installation where the property owner acquires the permit and does the construction.
- 3.1.6 Time Limits.**
- 3.1.6.1** All permits requiring excavation within the paved portion of a city street will become void on November 1. Upon written request, extensions to existing permits may be made on a case-by-case basis by the City of Dell Rapids. Permits requiring excavation within the paved portion of the street will be issued on an emergency basis only between November 1 and April 1 of the following year.
- 3.1.6.2** Unless otherwise provided for in the special provisions, the Sidewalk and driveway Permit shall be valid for an indefinite period from the date issued, unless revoked by mutual consent, for failure of the applicant to abide by the terms and conditions of the permit, or by operation of the law.
- 3.1.7 Cancellation.**
- 3.1.7.1** Failure of the applicant to comply with any of the terms and conditions of the permit shall be sufficient cause for cancellation of the permit and may result in removal of the utilities, approaches or other facility by the City at the applicant's expense.
- 3.1.7.2** The permit, the privileges granted herein, and the obligations of the applicant created thereby shall be binding upon the successors and assigns of the applicant.

## 3.2 Permit Standards and Conditions

This Section describes the requirements for plans and other information necessary for approval of a permit application.

- 3.2.1 **Permit Approval.** Permits are issued subject to the approval of City, County, State or other governmental agencies having either joint supervision over the section of road, or authority to regulate land use by means of zoning and/or building regulations. It shall be the applicant's responsibility to determine the necessity of and to obtain any such easements and approvals which may be required.
- 3.2.2 **Street Restoration.** Granting of a permit is based upon replacement or restoration of the street and right-of-way to its original condition or to a satisfactory condition by the applicant.
- 3.2.3 **Landscaping.** The permit holder shall be responsible for the restoration of landscaped areas between the property line and adjacent public roadways.
- 3.2.4 **Relocating Utilities.** The applicant shall be responsible for relocating or adjusting any utility facilities located on the street right-of-way as required to accommodate the approach or other facility applied for. Construction of the utility, road approach or other facility by the applicant, his agent or Contractor, will be permitted only after the applicant has furnished the City evidence that satisfactory arrangements for said relocation or adjustment has been made with the Owner of the affected utility facility.
- 3.2.5 **Permit Release.** Applicant must pay required fees and provide insurance and bonding, as required, prior to release of the permit.

## 3.3 Refunds

Refunds may be made on any permit fee at the discretion of the City Council.

## 3.4 Bonds and Insurance

- 3.4.1 **Bonds.** Bonds are required for work as listed in the Revised Ordinances of Dell Rapids, South Dakota.
- 3.4.2 **Inadequate Bond.** Any permit determined to be without an adequate bond as required shall be subject to immediate revocation by the City.
- 3.4.3 **Letters of Responsibility.** Governmental agencies, other than the City of Dell Rapids, special districts, cooperative utilities, and investor-owned electric, gas, and communications utilities, may provide a Letter of Responsibility in lieu of posting the required performance bond. Subject Letter of Responsibility shall be in the format of Figure 3.1.

**3.4.4 Other Forms of Security.** It shall be acceptable to the City to receive cash deposits, certified checks, or similar security in lieu of a performance bond. Bonds shall be filed at the City Hall.

**3.4.5 Liability Insurance.** The applicant shall obtain and carry, for the period of time required for the complete installation of facilities authorized by the permit, including the repair and restoration of the road facilities, and also during such future periods of time when operations are performed involving the repair, relocation, or removal of said facilities authorized by the permit, a liability and property damage insurance policy or policies. Coverage shall be provided against any claim, demand, suit, or action for property damage, personal injury, or death resulting from any activities of the applicant, his officers, employees, agents, or contractors in connection with the construction, installation, repair, or removal of the said facilities authorized by the permit. The said policy or policies shall include as named insured: the City of Dell Rapids, its City Council, its officers, agents, employees, and consultants and their officers, employees and agents, except as to claims against the applicant, for personal injury to any members of the City Council or its officers, agents, and employees, or damage to any of its or their property. The said insurance shall provide coverage as set forth by City ordinance. The said insurance policy or policies shall be in any insurance company duly authorized and licensed to do business in the state of South Dakota. The applicant and/or its Contractor's insurer shall give the City ten (10) days' written notice in advance of any cancellation of insurance required in the terms of these general provisions.

**3.4.6 Certificate of Self-Insurance.** Government agencies other than the City of Dell Rapids, and public utilities, may provide a Certificate of Self-Insurance as shown in Figure 3.2 in lieu of any insurance policy or policies required under Section 3.4.6. Such Certificate shall be approved by the City Attorney and filed with the City of Dell Rapids prior to the issuance of any permit.

### **3.5 Construction Specifications**

**3.5.1 Backfilling.** All backfill material, compaction, and resurfacing of any excavation made in the City right-of-way will be done in accordance with the Standard Specifications and Standard Plates on file with or as directed by the City of Dell Rapids.

### **3.6 Traffic Control**

**3.6.1 Street Closure.** Traffic must be provided with a minimum lane width of ten (10) feet in the construction area. Any plan for traffic control during construction that indicates a complete closure of an arterial or collector street must show detour routes and must be approved by the City prior to issuance of a permit. Normally, only one side of the local street may be blocked at any given time. When a local street is closed to traffic, the Public Works Director or a designee must be notified 48 hours in advance.

**3.6.2 Signing.** Construction signing must be used and shall be maintained by the responsible Contractor. All traffic control devices must be in accordance with the *Manual on Uniform Traffic Control Devices*, latest edition.

### **3.7 Restoring Pavements**

All persons, corporations, governmental agencies, special districts, utility companies who having obtained a permit and made a cut in a public right-of-way shall repair such pavements or surfacing to the original condition. If such pavements or surfacing are not restored and maintained as to the original condition, notice thereof in writing by first class mail shall be given the permittee, who shall put the same in good condition within a maximum of three (3) days. If the permittee fails after notice given to restore and maintain such pavements or the surface thereof, the City may make the necessary repairs and such permittee shall pay the costs thereof, and until paid no other permit shall be issued.

### **3.8 Utility Installations**

**3.8.1 Underground.** All utility lines shall be installed at depths as specified in each section of these Design Standards or as directed by the City of Dell Rapids. Exceptions may be granted where justified with prior written request by the Owner/Developer and approval by the City of Dell Rapids.

**3.8.2 Overhead.** Minimum ground clearances shall conform to the National Electric Safety Code Standards, latest edition.

### **3.9 Fees**

Fees shall be assessed for permits and inspection at the time of issuance of the permit in accordance with the fee schedule in force.

## Figure 3.1

### Letter of Responsibility

City of Dell Rapids  
302 East Fourth Street  
PO Box 10  
Dell Rapids SD 57022

THIS IS TO CERTIFY THAT \_\_\_\_\_  
(Name of Agency)

Does agree that, in lieu of posting the required performance bond, the following practices will be adhered to:

1. That no street cuts, in any Dell Rapids street, highway or other right-of-way, for any purposes, will be made without having secured the proper permit.
2. That any street cut made by the above will be backfilled and compacted in accordance with the current requirements of Dell Rapids, and the surface restored to a condition equal to or better than that condition which existed prior to the making of the cut.
3. The responsibility for the maintenance of the restored cuts shall rest with the above for a period of one year after the cut has been filled and resurfaced.
4. That, in the event repairs are not made or maintained to the satisfaction of the City of Dell Rapids or a designated representative, necessary repairs shall be made by the City at the expense of the above-named organization.

Subscribed to this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

\_\_\_\_\_  
By: \_\_\_\_\_  
Signature of Authorized Agent  
\_\_\_\_\_  
Title

**NOTE:** This document is to be filed with the City of Dell Rapids.

**Figure 3.2**  
**Certificate of Self-Insurance**

City of Dell Rapids  
302 East Fourth Street  
PO Box 10  
Dell Rapids SD 57022

THIS IS TO CERTIFY THAT \_\_\_\_\_,  
a \_\_\_\_\_, in lieu of providing the  
insurance policy required under Section 3.4.6 of the Engineering Design Standards for  
Public Improvements of the City of Dell Rapids, South Dakota, is wholly self-insured or is  
self-insured to cover the deductible limit of \_\_\_\_\_ as expressed by  
Policy No. \_\_\_\_\_ issued by  
\_\_\_\_\_ for combined bodily injury and  
property damage liability. It is further certified that reserves in support of the self-  
insurance program are adequate to provide coverage at the levels required of insurance  
policies in Section 3.4.6.

Subscribed to this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

By: \_\_\_\_\_  
Signature of Authorized Agent

\_\_\_\_\_  
Title

**NOTE:** This document is to be filed with the City of Dell Rapids.

## Chapter 4

### Utility Locations and City Utility Easements

<b>Section</b>	<b>Topic</b>	<b>Page</b>
4.1	Purpose of Standard Locations	4.1
4.2	Plans Required	4.1
4.3	Location Requirements	4.1
4.4	Street Categories	4.2
4.5	City Utility Easements	4.2

## Chapter 4

### Utility Locations and City Utility Easements

#### 4.1 Purpose of Standard Locations

**4.1.1 Conflicts.** It is necessary to provide adequate space for utilities in a manner that will minimize conflicts between using the public right-of-way for transportation purposes and utility purposes. When street grades, alignments, or widths are changed, utilities are usually required to relocate. Oftentimes standard locations are inapplicable and unobtainable in street areas where existing utilities are seriously crowded and where it would not be feasible to expect major or dramatic reorientation of the underground. The location criteria must be practical and applicable in new developments, in urban relocation work, and in cases where overhead facilities are being converted into underground structures and plans.

**4.1.2 Relocations.** Utilities are not expected to revise existing facilities as to location or depth solely or primarily for the purpose of creating uniformity. However, when new or relocation work is undertaken, uniformity should be sought. It is acknowledged that the present may be locked in because of the past, but there should be consideration for uniform utility locations for the future.

#### 4.2 Plans Required

**4.2.1 Construction Approval.** Any utility or other facility constructed in City right-of-way shall have construction plans submitted and approved in accordance with requirements in these Design Standards and ordinances for the City of Dell Rapids. No construction permit shall be issued for the construction of new utilities or the extension of existing facilities (except service taps or laterals to individual properties) without prior construction plan approval by the City.

**4.2.2 Conformance.** The applicant's completed facility shall be in conformance with the drawings or sketches referred to above, unless a special variance has been requested and approved by the City.

#### 4.3 Location Requirements

All utilities located within the public right-of-way shall be approved by the City's authorized personnel.

- (1) Utilities already existing may be replaced in the same location when permitted by the City of Dell Rapids.
- (2) Gravity lines shall take preference as to horizontal and vertical alignment over non-gravity systems and pressure systems.
- (3) Consideration will be given to the use of utility easements adjacent to the public right-of-way and to the use of alleys and medians.

- (4) In the event of a conflict, or if a particular utility requires more than one system be installed in the right-of-way, the alternate location may be used when permitted by the City of Dell Rapids.
- (5) Utilities shown are primarily for local distribution and collection. Large diameter lines may make it necessary to modify utility locations.
- (6) Storm sewer shall normally be located on the south or east side of the street. Any storm sewer 48 inches or larger in diameter shall be reviewed and a case-by-case basis.
- (7) Street trees placed between the curb and street side of sidewalk must not interfere with underground or overhead utilities.
- (8) Normally street lights will be placed on the same side of the street as the electric utility.
- (9) Street lights shall not be located closer than five (5) feet horizontally to fire hydrants.

#### **4.4 Street Categories**

The City of Dell Rapids has developed a list of arterial and major collector streets where approval is required prior to any construction. All utility permits where work will be done in the street pavement or in the right-of-way and would require a lane closure, must be approved by the City of Dell Rapids. All proposed permits shall be submitted a minimum of 48 hours prior to construction and be accompanied by a traffic control plan. The street category list shall be maintained and revised as needed by the City of Dell Rapids.

#### **4.5 City Utility Easements**

Easements for sanitary sewer, storm sewer, drainage, water main, and power shall be obtained when the utilities are to be constructed outside of the typical street right-of-way (ROW) on private property. Sanitary sewer, storm sewer, drainage and water main easements shall have a minimum width of twenty (20) feet. Additional width may be required by the City to ensure proper access for City maintenance equipment. When City utilities are to be located adjacent to one another, the minimum separation distance between the utilities shall be ten (10) feet. Power shall have a minimum easement width of ten (10) feet.

Easements shall be labeled specifically for the utility in which it is describing, for example:

- Sanitary Sewer Easement
- Storm Sewer Easement
- Drainage Easement
- Water Main Easement
- Power Easement

## Chapter 5

### Street Access and Parking Lot Criteria

<b>Section</b>	<b>Topic</b>	<b>Page</b>
5.1	Traffic Studies	5.1
5.2	Access Control	5.1
5.3	Access Design	5.7
5.4	Off-Street Parking Area	5.11
5.5	Accessible Parking Spaces and Signs	5.12

## Chapter 5

### Street Access and Parking Lot Criteria

#### 5.1 Traffic Studies

- 5.1.1** If warranted by the City of Dell Rapids, traffic impact reports may be required in order to adequately assess the impact of a proposal on the existing and/or planned street system. A written report will be required for a nonresidential development proposal when trip generation during the peak hour is expected to exceed 100 vehicles, or any multifamily residential development with 150 or more dwelling units.
- 5.1.2** Preparation of the report shall be the responsibility of the developer and must be prepared by a licensed design professional with experience in transportation planning. Information within the report shall contain, at a minimum, the following information: land use, site, and study area boundaries, existing and proposed site and vicinity uses, and existing and proposed roadways and intersections. All reports must be reviewed by the City before acceptance.
- 5.1.3** A traffic report will be required for all projects proposed for the construction of one or more traffic signals.

#### 5.2 Access Control

##### 5.2.1 General Access

- 5.2.1.1** Access in newly developing areas will follow these provisions. In areas being redeveloped, access will be determined as to the best fit based on traffic safety, existing conditions, future street improvements, and property development along with other considerations as appropriate.
- 5.2.1.2** A Sidewalk and Driveway Permit must be obtained from the City for any public or private access constructed to a public street. Access to streets or highways within the city limits under the jurisdiction of the South Dakota Department of Transportation (SDDOT) are also governed by requirements of the SDDOT. In addition to obtaining a permit from the City, a permit from the Area Engineer of the SDDOT must be obtained. Access shall be limited as dictated by the City of Dell Rapids Design Standards. Any discrepancy between the SDDOT and the City of Dell Rapids regarding precedence of access design standards, the City's standards shall prevail.
- 5.2.1.3** Fire department access to all buildings shall be provided and maintained during construction and upon completion of all improvements.

## **5.2.2 Definition of Terms for Access Control**

Several terms are used herein which have a somewhat distinct meaning. For the purpose of clarity, the definitions of some of these terms are listed below.

- 5.2.2.1** Width of Curb Opening (W)—The width of curb opening measured at the throat of the driveway from the edge of pavement to the edge of pavement.
- 5.2.2.2** Property Line (P)—The distance measured along the right-of-way from the nearest edge of the driveway to the property line.
- 5.2.2.3** Corner Clearance (C)—At an intersecting street the distance measured along the curb line from the end of the corner radius to the nearest edge of the curb opening.
- 5.2.2.4** Distance Between Double Drives (D)—The distance measured along the curb line between the radii or top of curb taper.
- 5.2.2.5** Frontage—The distance along the street right-of-way line of a single property or development within the property lines. Corner property at an intersection would have a separate frontage along each street.
- 5.2.2.6** Residential—Property used primarily for residential purposes such as single-family, two-family, and multifamily units.
  - 5.2.2.6.1** Single-Family (SF) Residential—Single, detached family dwelling units or double bungalows or duplexes.
  - 5.2.2.6.2** Multifamily (MF) Residential—Three or more attached dwelling units including townhouses, condominiums, and apartments.

## **5.2.3 Basic Principles for Curb Openings and Driveways**

### **5.2.3.1 Arterial Street Access**

- 5.2.3.1.1** Private residential access directly to arterial streets and any access to a principal arterial street shall be permitted only when the property in question has no other reasonable access to the general street system, or when denial of direct access to the arterial and alternative access to another roadway would cause traffic operation and safety problems as shown in a Traffic Report. Any access to arterials must adhere to City street standards as described in Chapter 8.

## 5.2.3.2 General Access

- 5.2.3.2.1 High Volume Access. In general, when trip generation served by the driveway exceeds 100 vehicles per hour during the peak hour or the driveway accesses an arterial street, returns using a standard street return radius as set forth in Table 5.1 and Figure 5.1 will be required.
- 5.2.3.2.2 Access Points. Access will not be approved for parking or loading areas that require backing maneuvers onto a public street right-of-way except for single-family or duplex residential uses on local and minor collector streets.
- 5.2.3.2.3 Standards. Every property that accesses the street shall have a driveway. Driveways shall be constructed in accordance with the Standard Plates on file with or as directed by the City of Dell Rapids.
- 5.2.3.2.4 Existing and Future Demands. The opening or driveway width shall be adequate to handle properly the anticipated traffic volume and character of traffic, as well as being within the limits specified for the type of property development. The controls established for curb openings and driveways shall apply to existing streets as well as new streets that may be developed in the future.
- 5.2.3.2.5 Utility Conflicts. Any adjustments which must be made to utility poles, street light standards, fire hydrants, catch basins or inlets, traffic signs and signals, or other public improvements or installations which are necessary as the result of the curb openings or driveways shall be accomplished without any cost to the City.
- 5.2.3.2.6 Access Signs. Driveway approaches, whereby the driveway is to serve as an entrance only or as an exit only, shall be appropriately signed by, and at the expense of, the property owner subject to approval from the City of Dell Rapids. Sign location, height, and legend must be in accordance with the *Manual on Uniform Traffic Control Devices* (MUTCD).
- 5.2.3.2.7 Abandoned Driveways. Any curb opening or driveway which has been abandoned shall be removed and the street restored by the property owner.

**Table 5.1**

**Driveway Dimensions  
(All Dimensions in Feet)**

Arterial	Dimension Reference (See Figure 5.1)	Local			Collector			Arterial		
		Residential	Commercial	Industrial	Residential	Commercial	Industrial	Residential	Commercial	Industrial
Width <sup>1</sup>	W									
Minimum		12	15	20	12	15	20	15	15	20
Maximum		32 <sup>2</sup>	36	40	30	36	40	36	36	40
Right-turn Radius	R									
Minimum		5	10	15	10	15	25	25	25	30
Maximum <sup>3</sup>		15	20	30	25	50	50	30	50	50
Minimum Spacing <sup>4</sup>										
From Property Line	P	O	R	R	O	R	R	R	R	R
From Street Corner	C	10	40	40	50	50	50	NA	NA	NA
Between Driveways	D	10 <sup>5</sup>	25	25	35	50	50	NA	NA	NA
Angle <sup>6</sup>	A	45°	70°	70°	45°	70°	70°			

<sup>1</sup>The minimum width of commercial driveways is intended to apply to one-way operation. In high pedestrian activity areas, such as in a central business district or in the same block with an auditorium, school, or library, the maximum basic width should be 30 feet. The width shown applies to rural routes and most City streets including neighborhood business, residential, and industrial streets. The width is intended to be measured along the right-of-way line, in most instances, at the inner limit of a curbed radius or between the line of the radius and the near edge of a curbed island at least 50 square feet in area.

<sup>2</sup>Maximum width on bulb of cul-de-sac shall be 24 feet.

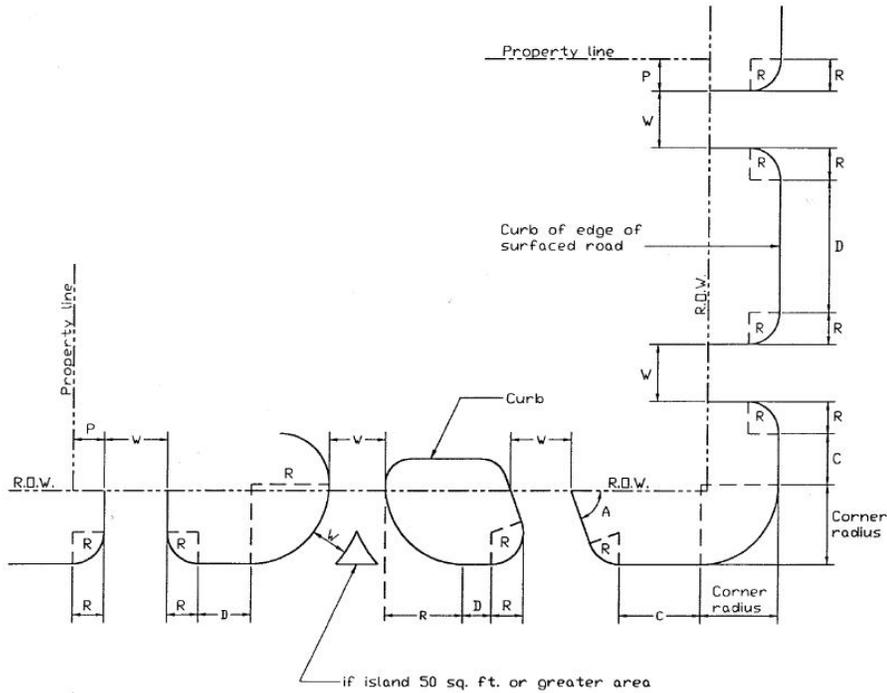
<sup>3</sup>On the side of a driveway exposed to entry or exit by right-turning vehicles. In high pedestrian activity areas, the radii should be half the values shown. The maximum radii for major generator driveways shall be designed in accordance with *A Policy on Geometric Design of Highways and Streets*, published by AASHTO latest edition.

<sup>4</sup>Measured along the curb or edge of pavement from the roadway end of the curb radius. In high pedestrian activity areas, the minimum spacing between driveways should be 5 feet.

<sup>5</sup>Minimum space between driveways may be reduced to 3 feet on one side on local streets only at the discretion of the City of Dell Rapids.

<sup>6</sup>Minimum acute angle measured from edge of pavement, and generally based on one-way operation. For two-way driveways, and in high pedestrian activity areas, the minimum angle should be 80 degrees.

**Figure 5.1: Driveway Dimensions**



**5.2.4 General Requirements**

**5.2.4.1 Number of Openings**

**5.2.4.1.1 Single-Family Residential**—In general, each single-family residential property shall be limited to one access point. However, where houses are located on corner lots or have extra wide frontage, more than one access point may be permitted. Applicable zoning setback requirements must be followed.

**5.2.4.1.2 Multi-Family Residential**—In general, access shall be determined by information provided by the owner/developer in a Traffic Impact Report and/or by comments generated during the City’s review and acceptance of that report.

**5.2.4.1.3 Commercial/Industrial**—In general, access to commercial and industrial property shall be limited to the requirements as set forth in Chapter 8 of the Engineering Design Standards and shall be based on the street classification described by the Dell Rapids Comprehensive Plan. For commercial/industrial property located on a corner of an arterial street, access may be restricted to a side street only. Access may also be restricted if use of such access would be precluded by existing left turn lanes or other traffic control devices.

**5.2.4.2 Access to Roadways with No Curb and Gutter.** Private drive access to local, collector, or arterial streets that have no curb and/or gutter improvements shall be constructed to meet the following requirements:

**5.2.4.2.1** Fdf The private drive shall extend from right-of-way line to the edge of the existing driving surface and shall be constructed of: (a) a eight- (8) inch-thick compacted aggregate base material, or if paved, (b) a minimum two- (2) inch-thick asphalt pavement over six- (6) inch-thick aggregate base material; i.e., minimum acceptable roadway pavement design.

**5.2.4.2.2** Access shall be governed by the driveway criteria.

**5.2.4.2.3** A culvert properly sized for the ditch flow shall be installed at the established roadside ditch flowline beneath the private drive access. Minimum size for the culvert shall be 15 inches. Culverts shall have a sloped end section or cast in place concrete headwall. If a cast in place headwall is built, it shall have a maximum slope of 4:1 on any exposed face. No vertical headwalls will be allowed.

**5.2.4.2.4** A sketch plan of the installation must be submitted with the access permit application. No construction permit will be issued until the access and its construction plan or sketch is approved by the City of Dell Rapids.

**5.2.4.3** Amount of Curb Opening Permitted. Driveway width shall comply with Table 5.1.

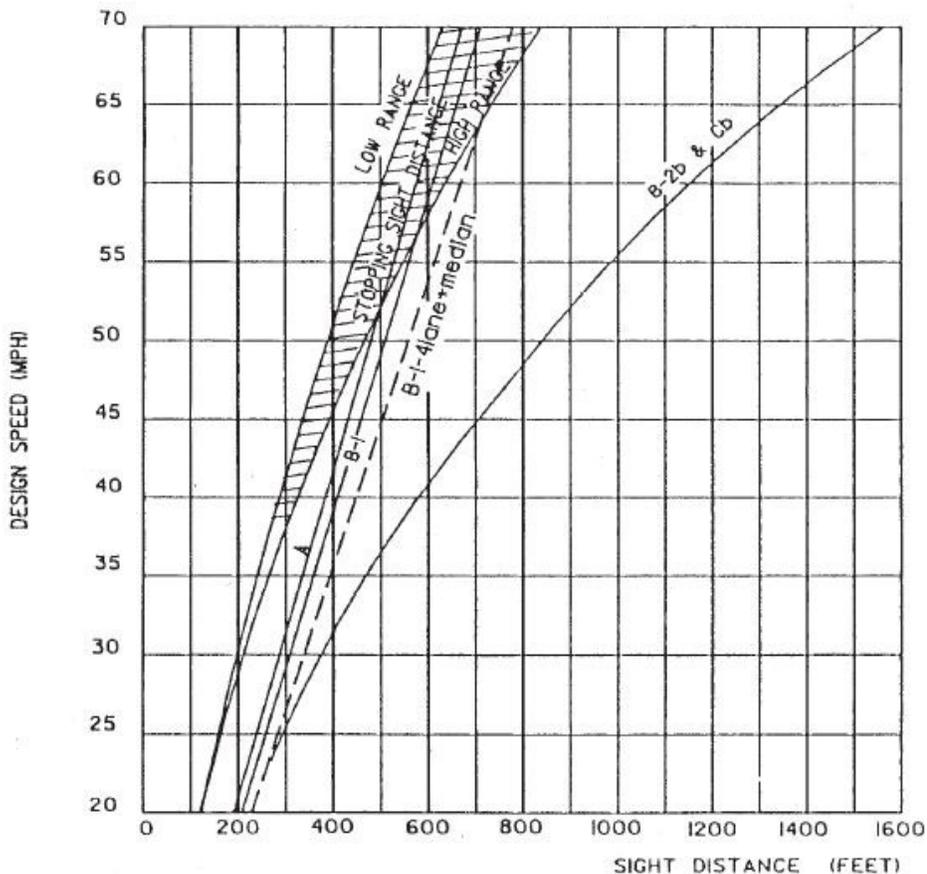
**5.2.4.4** Mutual Access. On commercial, industrial, and multifamily developments, mutual use of access to streets is encouraged and may be necessary to meet driveway spacing requirements. Where used, mutual access will comply with City ordinance and will be shown on plans for approval prior to construction or change of use.

## 5.3 Access Design

### 5.3.1 Driveway Spacing

Where lots are large enough, the center of driveways not in alignment will normally be offset a minimum of 150' for all commercial/multifamily properties. Greater distances may be required if left-turn storage lanes require such on arterial streets. Minimum sight distance shall be provided at all access points as shown in Figure 5.2, which applies to both city street and driveway intersections.

**Figure 5.2: Intersection Distance at At-Grade Intersection**

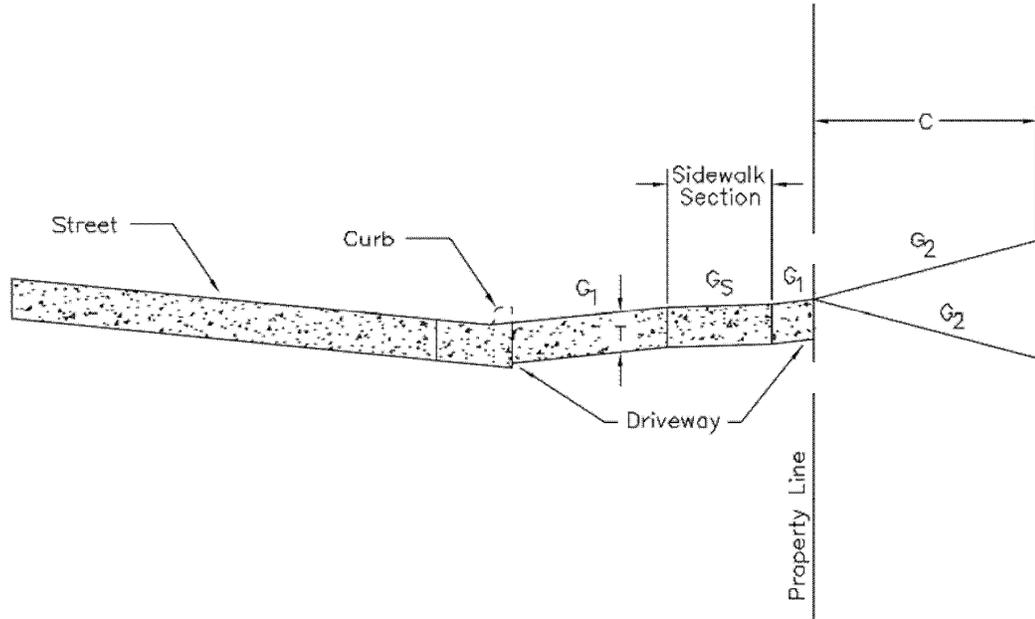


- A - SIGHT DISTANCE FOR P VEHICLE CROSSING TWO-LANE HIGHWAY FROM STOP (SEE DIAGRAM).
- B-1- SIGHT DISTANCE FOR P VEHICLE TURNING LEFT INTO TWO-LANE HIGHWAY ACROSS P VEHICLE APPROACHING FROM LEFT (SEE DIAGRAM).
- B-1-4 Lane+median SIGHT DISTANCE FOR P VEHICLE TURNING LEFT INTO FOUR-LANE HIGHWAY ACROSS P VEHICLE APPROACHING FROM LEFT (SEE DIAGRAM).
- B-2b- SIGHT DISTANCE FOR P VEHICLE TO TURN LEFT INTO TWO-LANE HIGHWAY AND ATTAIN 85% OF DESIGN SPEED WITHOUT BEING OVERTAKEN BY A VEHICLE APPROACHING FROM THE RIGHT REDUCING SPEED FROM DESIGN SPEED TO 85% OF DESIGN SPEED (SEE DIAGRAM).
- Cb- SIGHT DISTANCE FOR P VEHICLE TO TURN RIGHT INTO TWO-LANE HIGHWAY AND ATTAIN 85% OF DESIGN SPEED WITHOUT BEING OVERTAKEN BY A VEHICLE APPROACHING FROM THE LEFT AND REDUCING FROM DESIGN SPEED TO 85% OF DESIGN SPEED.

### 5.3.2 Driveway Design

Driveway sectional details are shown in Figure 5.3 with design requirements listed in Table 5.2.

Figure 5.3: Driveway Grades

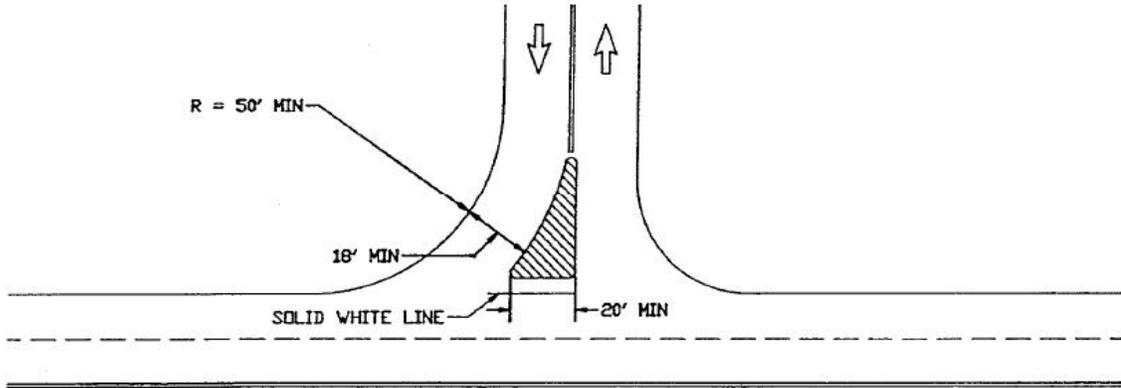


\*All sidewalk grades (Gs) shall be 2.0%.

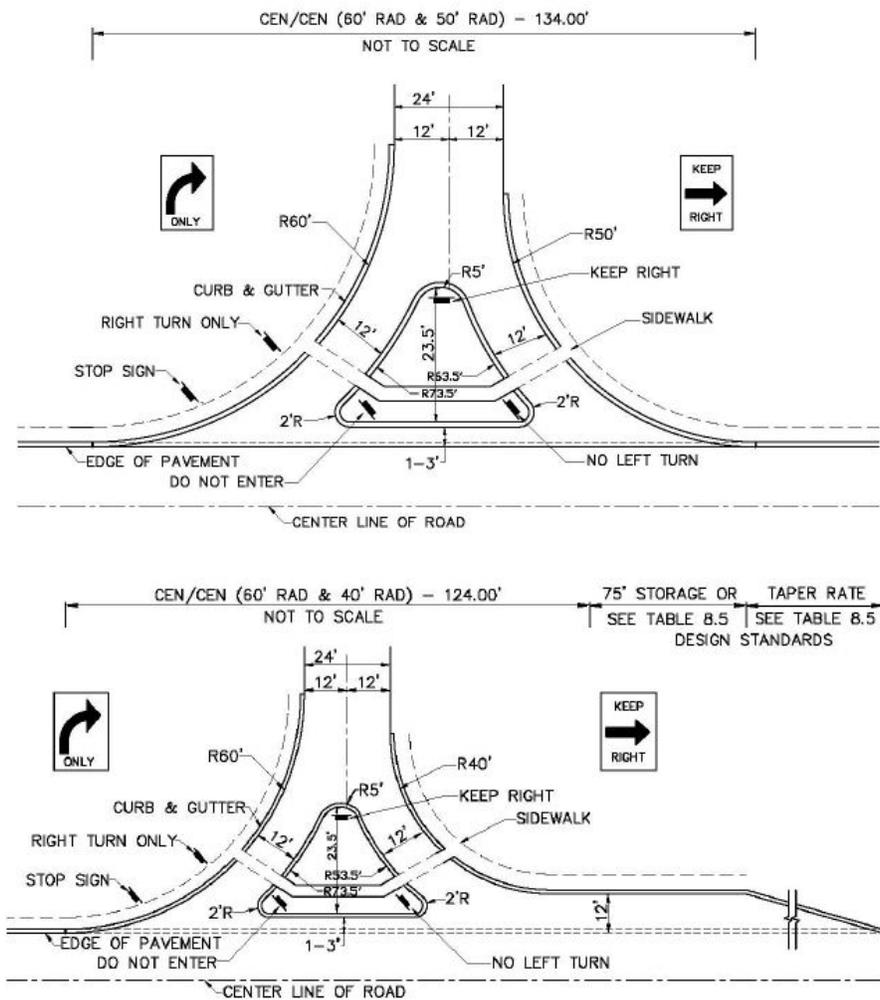
Table 5.2

Type of Driveway	Minimum Thickness	Grade (G1)		Grade (G2)		Control Distance (C)
		Min.	Max.	Min.	Max.	
Low Volume Residential	6"	+5.0%	+8.0%	±0.5%	±13%	20'
Low Volume Commercial/Industrial	7"	±0.5%	±6%	±0.5%	±6%	40'
High Volume	7"	±0.5%	±3%	±0.5%	±3%	40'

The following sketches are the recommended minimum design for limited movement driveways. Acceleration and deceleration lanes may be required to be incorporated into the designs. The islands are raised with vertical curb. The ends of the islands should typically be provided with 2 foot radii.



**Figure 5.4: Right-In, Right-Out, Left-In Driveway Design**



**Figure 5.5: Right-In, Right-Out Driveway Designs**

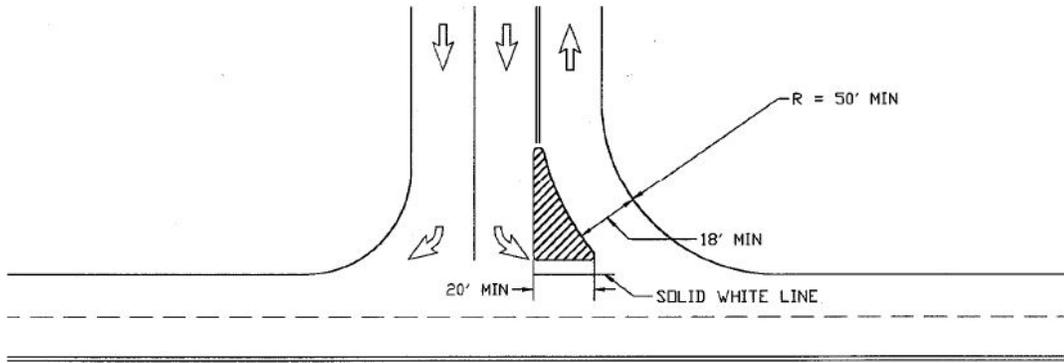


Figure 5.6: Right-In, Right-Out, Left-Out Driveway Design

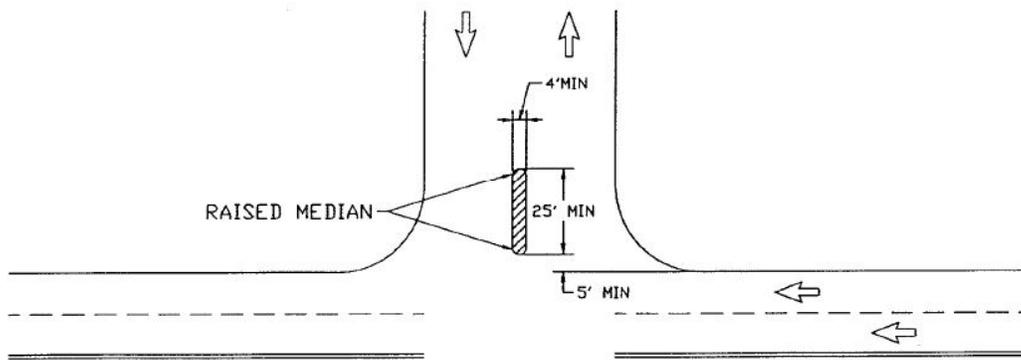


Figure 5.7: Driveway Design with Median Divider

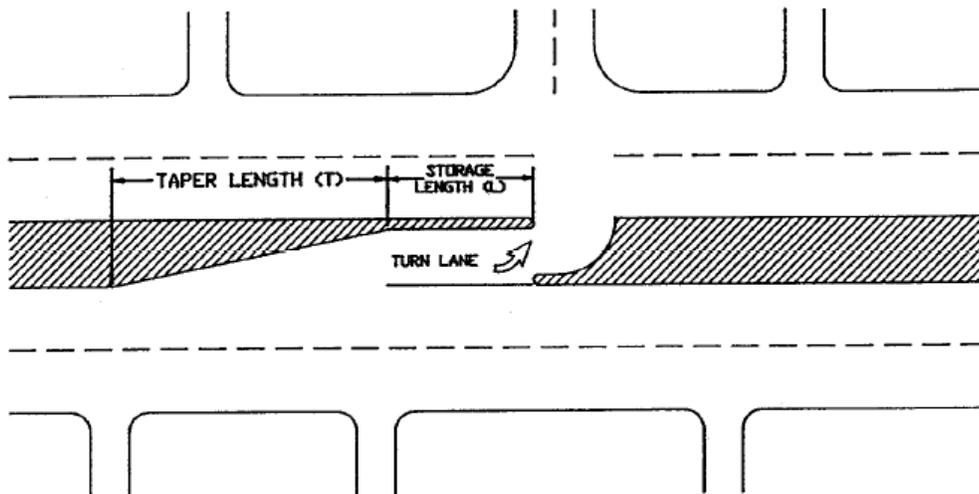


Figure 5.8: Median Design to Restrict Existing Left Turns

## 5.4 Off-Street Parking Area

**5.4.1 General.** The following guidelines regarding the design of off-street parking areas shall be followed.

**5.4.2 Minimum Stall Width.** The minimum stall width shall be eight and one-half feet (8½'), except compact vehicles. Compact vehicle minimum stall width shall be seven and one-half feet (7½').

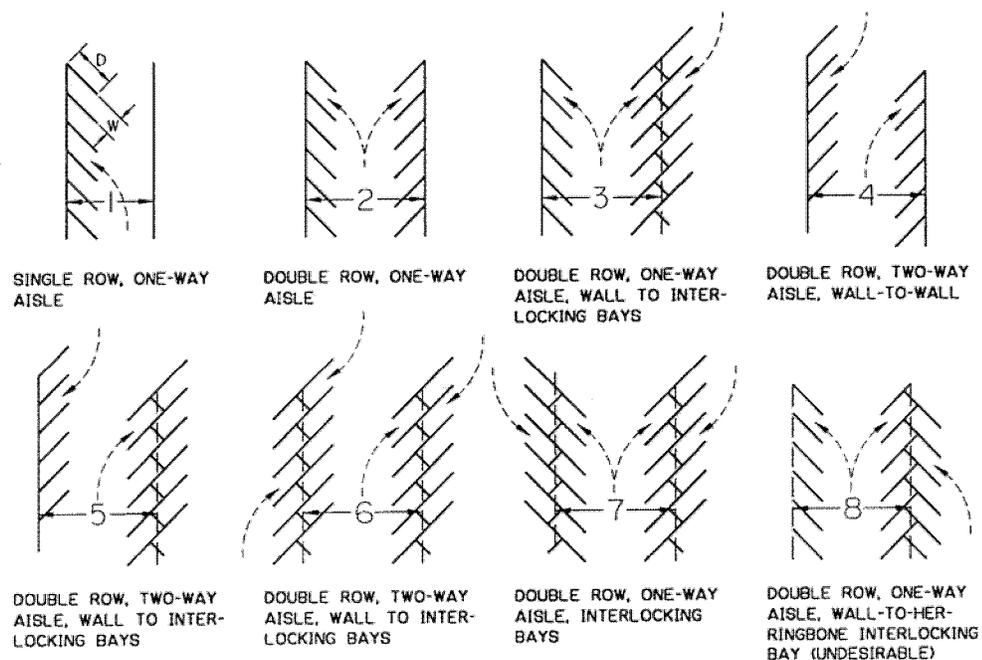
**5.4.3 Compact Vehicles.** A maximum of 33 percent of total required parking stalls may be designated specifically for compact vehicles. When an area is designed for compact vehicles only, the area shall be adequately signed to inform drivers of the exclusion.

**5.4.4 Parking Dimensions.** Minimum module depths shall be as shown on Figure 5.9 and in Table 5.3.

**5.4.5 Backing Into Street Not Allowed.** The spaces shall be so arranged so that no vehicle will be required to be backed into the street in order to exit the lot except for single-family or duplex dwelling units.

**5.4.6 Backing Over Sidewalk Not Allowed.** The spaces shall be so arranged so that no vehicle will be required to be backed over a public sidewalk in order to exit the stall.

**Figure 5.9: Parking Area Layout**



**Table 5.3**  
**Minimum Parking Lot Design Requirements**  
 (All Dimensions in Feet)

PARKING ANGLE (DEGREES)	STALL DEPTH "D" (FEET)	STALL WIDTH "W" (FEET)	MODULE DEPTH (FEET)							
			1	2	3	4	5	6	7	8
45	16*	7.5*	26	41	40	52	50	50	39	39
45	18	8.50	30	48	45	58	54	51	42	42
45	18	9.00	30	48	45	58	54	51	42	42
45	18	9.50	30	48	45	58	54	51	42	42
45	18	10.00	30	48	45	58	54	51	42	42
60	17*	7.5*	29	46	45	57	55	53	43	43
60	20	8.50	37	57	55	60	58	56	53	53
60	20	9.00	36	56	54	60	58	56	52	52
60	20	9.50	34	54	52	60	58	56	50	50
60	20	10.00	33	53	51	60	58	56	50	50
75	17*	7.5*	33	49	49	50	49	49	49	49
75	20	8.50	41	61	60	61	60	59	59	59
75	20	9.00	40	60	59	60	59	58	58	58
75	20	9.50	39	59	58	59	58	57	57	57
75	20	10.00	38	58	57	58	57	57	57	57
90	16*	7.5*	35	50	49	50	50	50	50	50
90	19	8.50	45	64	64	64	64	64	64	64
90	19	9.00	43	62	62	62	62	62	62	62
90	19	9.50	42	61	61	61	61	61	61	61
90	19	10.00	41	60	60	60	60	60	60	60

\* \* COMPACT CARS ONLY

### 5.5 Accessible Parking Spaces and Signs

The following policy regarding the number, location, design, and signing requirements for accessible parking spaces shall be followed in accordance with the most current Americans with Disabilities Act (ADA) guidelines and these Standards.

## Chapter 6

### Geotechnical Exploration and Report

<b>Section</b>	<b>Topic</b>	<b>Page</b>
6.1	General	6.1
6.2	When Required	6.1
6.3	Soil Exploration	6.1
6.4	Report	6.2

## Chapter 6

### Geotechnical Exploration and Report

#### 6.1 General

The geotechnical exploration and report shall determine any special geotechnical conditions and make recommendations regarding the special conditions, grading, foundations and pavement.

#### 6.2 When Required

For public improvement projects, the determination as to when soils reports will be required will be determined on an individual, case-by-case basis by the City of Dell Rapids.

#### 6.3 Soil Exploration

**6.3.1 General.** When geotechnical explorations are required, all sampling and testing of the soil shall be performed in accordance with the appropriate AASHTO (American Association of State Highway and Transportation Officials) and ASTM (American Society for Testing and Materials) designations.

**6.3.2 Sampling.** Representative samples of the soils shall be obtained by drilling shallow penetration soil borings along the route of the existing or proposed public right-of-way.

**6.3.2.1** Borings shall extend to a minimum depth of 5.0 feet below the proposed subgrade foundation, or 2.0 feet below the flow line elevation of any pipe or conduit. Every third boring, or a minimum of one boring, shall be of sufficient depth, or a minimum of ten (10) feet, for monitoring of the ground water elevation.

**6.3.2.2** Borings will be performed at close enough intervals to determine the boundaries of each significant soil type present.

**6.3.2.3** A random technique shall be used to select sampling locations.

**6.3.2.4** Spacing of the borings will vary with the uniformity of the soil profile and the topography. The maximum interval between soil borings may not exceed 400 feet.

**6.3.2.5** Where the original ground line is to be covered with fill material, five (5)-foot depth borings are necessary to determine the character of the support.

**6.3.2.6** Where drainage areas are crossed or boggy areas are encountered, the spacing of the borings shall be at closer intervals in order to determine the boundaries of the "soft" area. At these "weak" areas, the depth of the borings may also have to be increased in order to determine if and to what depth improved subgrade material will be required to provide uniform support for the construction.

**6.3.2.7** Representative samples from the borings shall be collected for submittal to a soils testing laboratory for evaluation.

**6.3.2.8** A boring log shall be maintained for each soil boring performed. The boring log shall contain a complete record of the soil material observed.

### **6.3.3 Testing**

**6.3.3.1** The tests required are those for identification and classification purposes. These tests include a standard sieve and hydrometer analysis (ASTM D422 of AASHTO T-88) and Atterburg Limits (ASTM D423 and 424 or AASHTO T-89 and 90). The test results are used to give a soil a descriptive name and letter symbol (in accordance with the Unified Soils Classification System) indicating its principle characteristics. Based on the test results, similar soil types can be placed into several major groups.

**6.3.3.2** These major groups shall be plotted on a profile sheet to determine their limits. The profile sheet is used with the laboratory data in selecting what soil types further testing should be performed on. Additional testing includes the moisture-density relationship (AASHTO T-99 or T-180) and California Bearing Ratio (MIL STD 621 Method 101 or ASTM D1883). The moisture-density relationship determines the maximum dry density and optimum moisture content for that particular soil. The CBR test is performed at 95 percent of the maximum dry density and at the optimum moisture content. The results of the CBR test determine the relative bearing value of the subgrade and is used in the pavement thickness design. A minimum of a three (3) point curve will be utilized for the CBR testing with a five (5) point curve preferred. If the various soil type areas are not large enough to justify separate pavement designs, a single design shall be made on the worst soil type.

### **6.4 Report**

**6.4.1 General.** The report shall identify any geotechnical special conditions found in the exploration and recommendations to improve the special conditions along with grading, foundations, and subgrade and pavement requirements. The recommendations may be divided into three parts: geotechnical special conditions, grading and foundation, and subgrade and pavement.

**6.4.2 Special Geotechnical Conditions.** The special conditions portion of the report shall consider ground water, frost susceptibility, erosion potential, soils creep, landsliding, expansive soils, soil corrositivity, and any other special geotechnical conditions the Geotechnical Engineer becomes aware of.

**6.4.3 Grading and Foundation.** The grading and foundation portion shall include data regarding the distribution and engineering characteristics of the various soil materials, data about groundwater levels, recommendations about the need for mitigation measures for special geotechnical conditions, grading criteria, foundation design criteria, and any other information the Geotechnical Engineer considers pertinent.

**6.4.4 Subgrade and Pavement.** The subgrade and pavement portion shall include data regarding the distribution of various subgrade materials and design tests (such as CBR, R-value, and/or plate bearing) to be made. Where soils are susceptible to erosion, recommendations shall be made for preventing the undermining of pavements. The pavement design may be included in this report or prepared and submitted separately by the Engineer responsible for preparation of the construction plans and contract documents.

## Chapter 7

### Grading

<b>Section</b>	<b>Topic</b>	<b>Page</b>
7.1	General	7.1
7.2	Grading Requirements for Subdivisions	7.1

## Chapter 7

### Grading

#### 7.1 General

7.1.1 All proposed developments shall be graded such that storm water runoff is conducted away from proposed building sites to swales constructed in drainage easements along lot lines, to public rights-of-way, or to another approved drainage course.

7.1.2 No filling will be allowed in any areas of land within a proposed subdivision or other type of development which lies either wholly or in part within the flood plain of a river, stream, creek, or lake unless under the terms of a permit granted by the U.S. Corps of Engineers and/or the City of Dell Rapids where applicable.

#### 7.2 Grading Requirements for Subdivisions

7.2.1 The longitudinal slope along a rear yard drainage easement shall be not less than 1.0 percent but not so great as to cause erosion.

7.2.2 All grade point elevations shall be shown on the plans for each lot at the property corners and at the low and high points along the property lines.

7.2.3 The general direction of overland drainage in the rear yard shall be indicated in the plans on each lot by an arrow.

7.2.4 High and low street grade points, slope direction (by arrow) and the location of all inlets and drainage ditches shall be shown on the grading plan.

7.2.5 A maximum slope of three (3) feet horizontal to one (1) foot vertical shall not be exceeded for all terracing. The toe of the slope shall be located outside of drainage easements and natural drainage ways unless adequate drainage is provided.

7.2.6 Grading plans shall be drawn to a scale of one inch = 100 feet (1" = 100') or larger.

7.2.7 Grading plans shall include details of typical lot grading and drainage patterns intended to be used.

7.2.8 The grading plans shall show the contours with intervals of one (1) foot for land with a slope of one (1) percent or less, intervals of two (2) feet for a slope between one and one-tenth (1.1) and nine and nine-tenths (9.9) percent and contours of five (5) feet for land with a slope exceeding ten (10) percent.

7.2.9 All elevations shall be on the NAVD 1988 vertical control datum.

7.2.10 Drainage patterns other than those shown in standard details may be used and will be acceptable for review. Details of the typical lot drainage pattern shall be shown on the grading plan with all grade control points identified.

- 7.2.11** In general, for streets with ditches and no curbs, elevation of the front lot line shall be at least six (6) inches above the centerline of the road.
- 7.2.12** All nonconforming lots with drainage patterns other than those in standard details shall be noted on the grading plan.
- 7.2.13** Storm sewers and inlets shall be placed in rear yard swales at low (sump) points where front to rear grading is used.
- 7.2.14** Drainage swales shall be constructed entirely within the easements.
- 7.2.15** The grading plan shall show the minimum ground elevation adjacent to buildings for each lot.

## Chapter 8

### Street Design and Pavement Thickness

Section	Topic	Page
8.1	General	8.1
8.2	Access Management	8.1
8.3	Roadway Design and Technical Criteria	8.3
8.4	Sidewalks	8.6
8.5	Bicycle Paths	8.6
8.6	Drainage	8.7
8.7	Horizontal Alignment	8.8
8.8	Vertical Alignment	8.9
8.9	Off-Site Design	8.11
8.10	Construction Traffic Control	8.11
8.11	Pavement Thickness	8.12
8.12	Rural Urban Street Standards	8.13
8.13	Rural Subdivision Road Standards	8.14

## Chapter 8

### Street Design and Pavement Thickness

#### 8.1 General

- 8.1.1 This chapter sets forth the design and technical criteria to be used in the preparation of all roadway plans. Where design information is not provided herein, *"A Policy on Geometric Design of Highways and Streets"* (AASHTO Standards) as published by AASHTO's most current edition (English units) shall be used.

#### 8.2 Access Management

##### 8.2.1 Access

- 8.2.1.1 **Access Defined.** Access is defined as any connection, driveway, street, turnout, or other means or providing for the movement of vehicles to or from the public roadway system. Access is further defined as any full movement access, right in right out movement, or partial movement access.

Access Management is defined by the Transportation Research Board National Access Management Manual as the systematic control of the location, spacing, design, and operation of driveways, median openings, interchanges, and street connections to a roadway. It also involved the roadway design applications, such as median treatments and auxiliary lanes and the appropriate spacing of traffic signals. The purpose of access management is to provide vehicular access to land development in a manner that preserves the safety and efficiency of the transportation system. The contemporary practice of access management extends to concept of access design and location control to all roadways- not just limited access highways, streets, or interstates.

Access management principals and history can be reviewed in the Access Management Manual published by the Transportation Research Board. The City of Dell Rapids implements access management principals. Using access management techniques can reduce the crash rate on a roadway section roughly in half while keeping the traffic flowing.

The City of Dell Rapids may initiate an access management plan or corridor study that would supercede the design standards for access along an arterial or major collector street. Preparation of the study shall be the responsibility of the City of Dell Rapids, South Dakota Department of Transportation, and/or private individuals, or jointly prepared. However, the study must be prepared by a licensed design professional engineer with experience in transportation planning. The access plan or corridor study shall be approved by the City of Dell Rapids and/or South Dakota Department of Transportation.

Access planning that has not been identified in any type of study in existing development areas will be considered on a case by case basis. Retrofit techniques will adhere to best access management practices as identified in the Transportation Research Board National Access Management Manual.

- 8.2.1.2 Access Permit.** All access to arterial street public right-of-way (ROW) will be required to be approved by the City of Dell Rapids. An Access Permit is defined as a permit issued by a governmental agency for the construction, maintenance, and use of a driveway or public street that connects to a roadway. Access locations shall all be measured from the center line of ROW to centerline of ROW or driveway.

The Development Access Permit is a non-standard access permit that will be completed by the property owner with a supporting map documenting the requested location of each direct or indirect access to arterial functional classification public ROW.

Access permits will be reviewed based on access category criteria, dimensions from centerline of the ROW from adjacent streets, traffic analysis, surrounding access points and any other information relevant to the operation of the access point. The Access Permit shall conform to the requirements listed in ordinance.

## **8.2.2 Spacing of Direct and Indirect Access, Angle of Intersection, and Offsets.**

- 8.2.2.1 Spacing.** For collectors and local streets in a subdivision, four-legged intersections will normally be spaced at least 300 feet apart.
- 8.2.2.2 Angle of Intersection.** Proposed streets and driveways must intersect one another at 90° angles or as close to 90° as topography permits (no less than 80°).
- 8.2.2.3 Offsets.** When “T” intersections are used, the center lines of the streets not in alignment must normally be offset a minimum of 150 feet on local streets, and 300 feet on nonresidential local, and collector streets.

## **8.2.3 Functional Street Classification.**

- 8.2.3.1 Major Street Plan.** The functional street classification of the City’s street network is shown on the Major Street Plan of the Comprehensive Plan kept in the Office of the City Administrator. The right-of-way requirements are noted in Subdivision Ordinances of the City of Dell Rapids. The functional classification is a system used to group public roadways into classes according to their purpose in moving vehicles and providing access to the public.

### **8.3 Roadway Design and Technical Criteria**

The City of Dell Rapids designates streets as local, minor collector, major collector, minor arterial and principal arterial. The highway design speed shall be used to establish features such as superelevation rate, critical length of grade, vertical and horizontal curves, intersections, etc. See Table 8.1 for design standards for each of these street classifications.

#### **8.3.1 Traffic Lane Widths**

**8.3.1.1** The minimum traffic lane width shall be 11 feet. For arterial streets and streets with anticipated truck traffic count in excess of three (3) percent of the total traffic count, the lane width shall be 12 feet.

**8.3.1.2** In the design of local streets, the number of lanes for moving traffic will be a secondary consideration.

#### **8.3.2 Separate Turning Lanes**

**8.3.2.1** Separate turning lanes may be constructed on arterial and collector streets but will, as a rule, not be found on local streets.

**8.3.2.2** Where separate turning lanes are constructed on the basis of a capacity analysis at the intersection, a lane width of 12 feet will be used for arterial streets where truck traffic is involved and 11 feet in width for other streets.

**8.3.2.3** A directional median or  $\frac{3}{4}$  turn or partial opening is allowed in a median section and allows for right in, right out, and left in and/or u turn movements. The left out movement is prohibited. This directional median opening improves safety at intersections and has been proven to reduce crash rates.

#### **8.3.2.4 Left-turn Lane Storage Lengths for New Facilities**

**8.3.2.4.1** Left-turn lane storage design at both signalized and unsignalized intersections for proposed street design plans shall be determined from the use of traffic analysis software or by the use of Figure 8.1. New street will use the desirable lengths. Minimum design lengths will only be permitted under constraints imposed by geometrics of existing streets. Lengths of dual left-turn lanes shall be independently designed.

#### **8.3.3 Parking**

**8.3.3.1** Parking lanes will not be allowed on arterial or major collector streets.

**8.3.3.2** No diagonal or perpendicular parking will be allowed on any City street.

**8.3.3.3** Where on-street parking is provided, the parallel lane width shall be a minimum of eight (8) feet, which would include the gutter pan.

**Table 8.1  
Minimum Street Design Criteria**

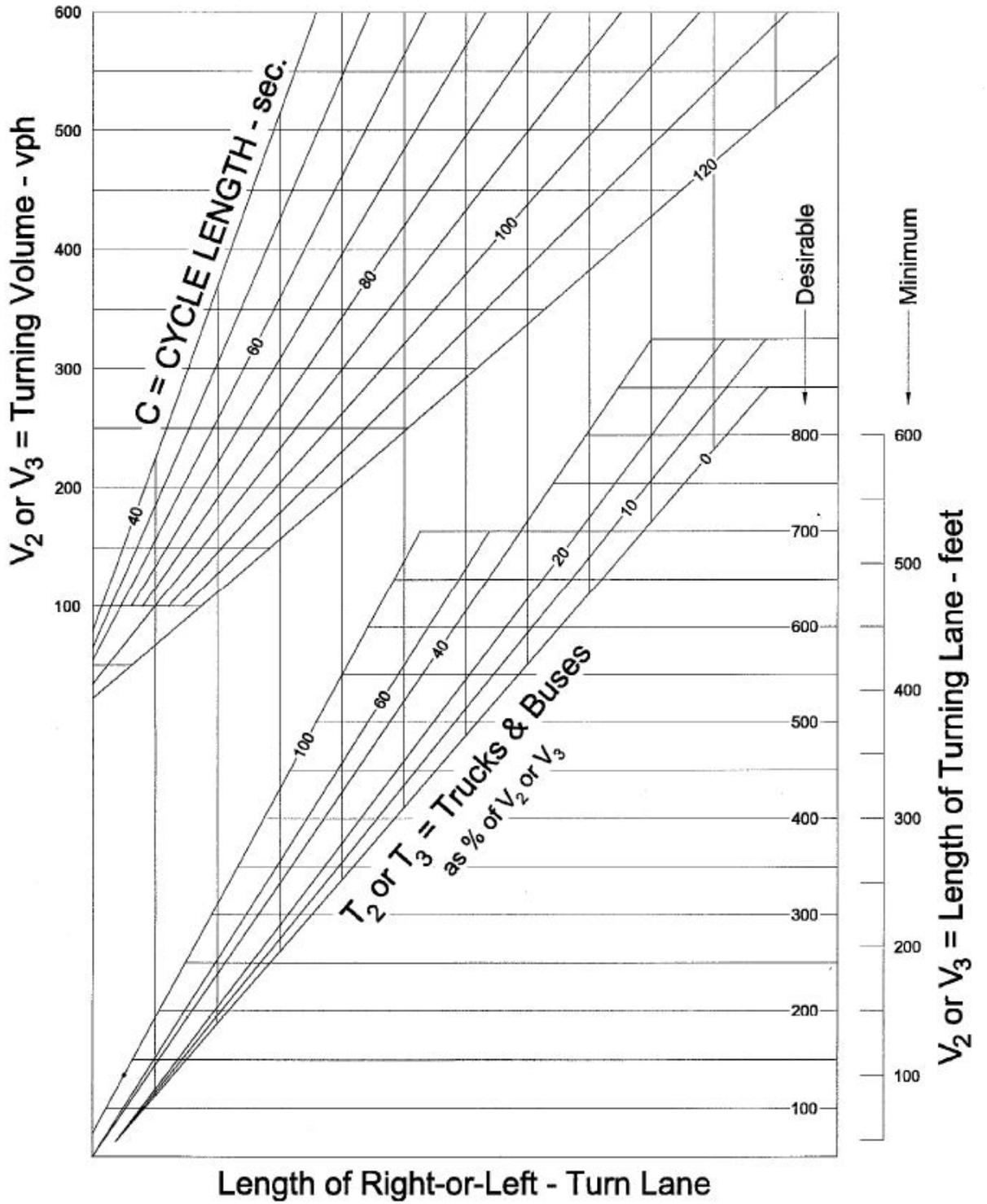
Design Elements	Local		Commercial, Industrial, Multifamily	Collector	Arterial
	Residential Cul-de-sac*	Single Family			
Design Speed (mph)	---	---	---	25 - 40	30 - 50
Driving Lanes	---	---	2	2	4 or more
Right-of-Way (ft.)	55	66	66	66 - 80	100 +
Roadway Width (ft.) (1)	37	37	39	39 - 49	41-53
Lane Width (ft.)	---	---	11	12	12
Sidewalk (2)	4' detached	4' detached	5' detached	5' detached	5' detached
Curb & Gutter	6" vertical	6" vertical	6" vertical	6" vertical	6" vertical
Min.-Max. Grade (%)	0.5-8.0	0.5-8.0	0.5-8.0	0.5-8.0	0.5-6.0
Curb Return Radii (ft.)					
- intersect local	13.5	13.5	13.5	20	---
- intersect collector	20	20	20	25	30
- intersect arterial				30	35
Horizontal Curve Radius (ft.)	150	150	300	---	AASHTO Standards
Vertical Alignment Control	----- AASHTO Standards -----				
Grade at Intersection (%)					
- intersect local	3	3	3	---	---
- intersect collector	2	2	2	2	---
- intersect arterial				2	2

(1) All dimensions are measured to back of curb.

(2) Where sidewalk is attached to curb, sidewalk shall be one foot wider.

(3) \*Non-residential cul-de-sac dimensions will differ

Figure 8.1: Design of Left-Turn Storage Length Volume-Based Nomograph For At-Grade signalized Intersections



## 8.4 Sidewalks

- 8.4.1 General Standards and Location.** Sidewalks may be constructed on both sides of all roadways unless specifically waived by the City of Dell Rapids. Any sidewalk design standard listed in this section that is unable to be met is required to be waived by the City of Dell Rapids. Generally, the sidewalks shall be located adjacent to the property line within the street right-of-way.
- 8.4.2 Sidewalk Curb Ramps.** State law requires that curb ramps be installed at all intersections and at certain mid-block locations for all new construction or reconstruction of curb and sidewalk. Curb ramps shall be constructed in accordance with the ADA and the standard plates of the South Dakota Department of Transportation (SDDOT). Curb ramps may be shown at all curb returns or called out by a general note on the development plans, but must be shown (located) at all "T" intersections. When referencing a curb ramp, specify the SDDOT standard plate to be used to construct that ramp.
- 8.4.3 Sidewalk Curb Ramp Landing.** The minimum dimensions for a landing shall be 48" by 48". A landing shall not have a grade exceeding 2% in any direction. If a landing is at a signalized intersection and has pedestrian push buttons, the horizontal distance between the edge of the landing and the push button location shall not exceed 10".
- 8.4.4 Sidewalk Width.** Minimum sidewalk width shall be as shown in Table 8.1. In areas where high pedestrian traffic is anticipated by the City it may be necessary to install wider sidewalks to allow for an adequate level of service.
- 8.4.5 Sidewalk Cross Slopes.** The maximum cross slope for a sidewalk is 2%. This includes where sidewalks cross driveways. The minimum cross slope is 1%.
- 8.4.6 Sidewalk Grade.** All grades on a sidewalk shall meet the current Americans with Disabilities Act standards.
- 8.4.7 Sidewalk Depth.** Depth of sidewalk shall be 4" thick for detached sidewalk and 6" thick for sidewalk attached to the back of curb and sidewalk within an approach or driveway.
- 8.4.8 Sidewalk Surface.** A sidewalk shall have an accessible vibration free route that is at least 48" wide. The number of surface variations such as junction boxes, grates, decorative pavers, etc. in the accessible vibration free route should be minimized. If grates are present, the openings should run perpendicular to the traveled way with less than a 1/2" opening with the traveled way.
- 8.4.9 Sidewalk Vertical Clearance.** Sidewalks which go under a roadway or structure shall have a minimum clearance of 8' from the top of the sidewalk to the lowest part of the structure.

## 8.5 Bicycle Paths

- 8.5.1 General.** The current AASHTO Guide for the Development of Bicycle Facilities shall be used as a design guide for the design of bicycle paths. A bicycle path, also referred to as a shared use path, is defined as a bikeway physically separated from motorized vehicular traffic by an open space or barrier and either

within the highway right-of-way or within an independent right-of-way. Bike paths may also be used by pedestrians, skaters, wheelchair users, runners, and other non-motorized users.

- 8.5.2 Bicycle Path Width.** A bicycle path should have a preferred minimum of a 12'-wide unobstructed area of travel, which includes 2' wide shoulders. Under special circumstances the City Engineer may allow a narrower path.
- 8.5.3 Bicycle Path Shoulder.** A bicycle path shall have shoulders on both sides, with a minimum of 24" wide.
- 8.5.4 Bicycle Path Cross Slopes.** The maximum cross slope for a bicycle path is 2%. The minimum cross slope is 1%.
- 8.5.5 Bicycle Path Grade.** All grades on a bicycle path shall meet the current Americans with Disabilities Act standards.
- 8.5.6 Bicycle Path Vertical Clearance.** Bicycle paths which go under a roadway or structure shall have a minimum clearance of 8' from the top of the path to the lowest part of the structure.
- 8.5.7 Bicycle Path Horizontal Clearance.** Bicycle paths which pass through tunnels shall have at least a 12' horizontal clearance from wall to wall. The entrances and exits to tunnel sections shall be as visually free of trees, shrubs, and other obstructions to facilitate a wide field of view when exiting tunnels.
- 8.5.8 Bicycle Path Tunnel Lighting.** Tunnel sections shall be lit according to current AASHTO lighting guidelines. It is recommended that the ceilings in the tunnel are painted white.
- 8.5.9 Bicycle Path Surfacing.** As directed by the City Engineer.
- 8.5.10 Paved Bicycle Path Surface.** A paved bicycle path shall have an accessible vibration free route that is at least 48" wide. The number of surface variations such as junction boxes, grates, decorative pavers, etc. in the accessible vibration free route shall be minimized. If grates are present the openings should run perpendicular to the traveled way, with less than a 1/2" opening with the traveled way. In tunnel sections a non-slip surface shall be utilized such as brushed concrete or a rubberized surface.

## **8.6 Drainage**

Drainage systems shall be designed in accordance with Chapter 11—Drainage Improvements. Development plans, including the drainage report, shall be considered as part of the street design and will be required for concurrent review with the street construction plans. Safe conveyance of traffic is the major function of streets; the storm drainage function of the street must therefore be designed to the limits set forth in Chapter 11—Drainage Improvements.

- 8.6.1 Valley Gutters.** Valley gutters shall be constructed in accordance with the Standard Plates on file with or as directed by the City of Dell Rapids. Valley gutters are not permitted across arterial streets and are discouraged across

collector streets. Valley gutters are not allowed on streets with storm sewer systems.

**8.6.2 Inlets.** Inlets shall be located to intercept the curb flow at the point curb flow capacity is exceeded by the storm runoff. Refer to Chapter 11—Drainage Improvements for curb capacity. Inlets shall also be installed to intercept cross pavement flows at points of transition in superelevation. Due to the presence of curb ramps, inlets are not allowed in the curb return, but will be located at the tangent points of the curb returns. In general, inlets shall be placed on the upstream side of the intersection so as to intercept the water before it reaches the pedestrian crosswalk.

**8.6.3 Cross-slope.** Except at intersections or where superelevation is required, streets, in general, shall be level from top of curb to top of curb (or flowline to flowline) and shall have a one and one-half (1.5) percent to three (3) percent crown as measured from centerline to lip of gutter, or lip of median gutter to lip of outside curb on roadways with medians. Where the crownpoint is not centered in the street, the crownpoint can be no further out than the quarter point of the street.

**8.6.4 Temporary Erosion Control.** Temporary erosion control is required at the ends of all roadways that are not completed due to project phasing, subdivision boundaries, etc., in accordance with Chapter 12—Erosion Control and with the Subdivision Regulations of the City of Dell Rapids.

**8.6.5 Sidewalk.** Storm water from concentrated points of discharge shall not be allowed to flow over sidewalks, but shall drain to the roadway by use of storm sewers. Sidewalk chases will not be allowed unless specifically approved by the City of Dell Rapids. If permitted, sidewalk chase sections shall not be located within the driveway.

## **8.7 Horizontal Alignment**

**8.7.1 Horizontal Curves.** Any angular break in horizontal alignment of more than two (2) degrees shall require a horizontal curve. Refer to Table 8.1.

**8.7.2 Curb Return Radius.** Minimum curb return radius shall be as shown in Table 8.1. Where truck traffic is significant, curb return radii shall be provided in accordance with AASHTO standards.

**8.7.3 Construction Signs and Barricades.** Design and construction shall comply with the requirements of the *Manual on Uniform Traffic Control Devices*, latest edition. Details shall be shown on the construction drawings, and installation shall be provided by the contractor and/or owner.

**8.7.4 Superelevation.** The use of superelevation is discouraged for all streets. However, where superelevation is required for curves, horizontal curve radius and superelevation shall be in accordance with the recommendations of the AASHTO standards. Superelevation shall not be used on local roadways. All roadway designs utilizing superelevation are subject to review and acceptance by the City of Dell Rapids.

**8.7.5 Spiral Curves.** Spiral curves shall not be used on streets within the City (State highways excluded) except upon written acceptance by the City of Dell Rapids.

**8.7.6 Cul-de-sacs.** The following criteria shall be used for the horizontal geometry of cul-de-sac turnarounds.

- |   |                 |            |
|---|-----------------|------------|
| (1) Minimum property line radius:   | residential     | 55.0 feet  |
|   | Non-residential | 65.0 feet  |
| (2) Minimum back of curb radius:  | residential     | 42.5 feet  |
|   | Non-residential | 50.5 feet  |
| (3) Maximum length of cul-de-sac measured along centerline, between the radius point of the turnaround and the R.O.W. line of the abutting street |                 | 500.0 feet |

### **8.7.7 Spacing of Direct and Indirect Access, Angle of Intersection, and Offsets**

**8.7.7.1 Spacing.** Four-legged intersections will normally be spaced at least 300 feet apart.

**8.7.7.2 Angle of Intersection.** Proposed streets and driveways must intersect one another at 90° angles or as close to 90° as topography permits (no less than 80°).

**8.7.7.3 Offsets.** When “T” intersections are used, the center lines of the streets not in alignment must normally be offset a minimum of 150 feet on local streets, and 300 feet on nonresidential local, and collector streets.

**8.7.8 Transition Length.** If lanes are added, deleted, or adjusted, it will be necessary to construct a transition section for the safe conveyance of traffic. The following formula shall be applied to the taper or lane change necessary for this transition:

$$L=WS^2/60$$

where:

L = Length of transition in feet

W = Width of offset in feet

S = Speed limit or 85th percentile speed

## **8.8 Vertical Alignment**

**8.8.1 Changing Grades.** The use of grade breaks, in lieu of vertical curves, is not encouraged. However, if a grade break is necessary and the algebraic difference in grade does not exceed one tenth (0.01 ft/ft) of a percent, the grade break will be permitted.

**8.8.2 Vertical Curves.** Design controls for vertical alignment must be in accordance with AASHTO standards. When the algebraic difference in grade (A) is at or exceeds one tenth (0.01 ft/ft) of a percent, a vertical curve is to be used. All vertical curves shall be labeled, in the profile, with length of curve (L) and K (defined as L/A).

**8.8.3 Intersections.** The following criteria shall apply at intersections.

**8.8.3.1** The grade of the “through” street shall take precedence at intersections. At intersections of roadways with the same classification, the more important roadway, as determined by the City of Dell Rapids, shall have this precedence.

**8.8.3.2** The elevation at the end of curb return on the through street is always set by the grade of the through street in conjunction with normal pavement cross-slope.

**8.8.3.3** Carrying the crown of the side street into the through street is not permitted.

**8.8.3.4** Dipping the flowline to the extent that the lip of the gutter is dipped is not permitted, except as specified by Standard Plates concerning curb opening inlets. Tipping an inlet for the benefit of drainage is not permitted.

**8.8.3.5** A more detailed review shall be performed for arterial-arterial intersection to maximize drivability.

**8.8.3.6** Flowline profiles and pavement cross-slopes shall be shown through an intersection until a normal cross-section is obtained. Elevations on a 15-foot grid shall be shown on a plan view drawing. This information shall be submitted using a scale of 1" = 20' horizontally and 1" = 2' vertically.

**8.8.3.7** Parabolic or curved crowns are not allowed. In no case shall the pavement cross-slope at intersections exceed the grade of the through street.

**8.8.3.8** The rate of change in pavement cross-slope, when warping side streets at intersections, shall not exceed one (1) percent every twenty-five (25) feet horizontally on a local roadway, one (1) percent every thirty-seven and one-half (37.5) feet horizontally on a collector roadway, or one (1) percent every fifty six and one-half (56.5) feet horizontally on arterial roadways.

**8.8.4 Curb Returns.** Minimum fall around curb returns shall be one-half of one (0.5) percent.

### **8.8.5 Connection with Existing Roadways**

**8.8.5.1** Existing grade(s) shall be shown for a sufficient distance to assure that horizontal and vertical curve requirements are being or can be met with field verified as-builts showing stations and elevations at twenty-five (25) foot intervals. In the case of connection with an existing intersection, these as-builts are to be shown within a one hundred (100) foot radius of the intersection. This information shall be included in the plan and profile that shows that proposed roadway. Limits and characteristics of the existing improvement are the primary concern in the plan view. Such characteristics include horizontal alignment, offset intersections, limits of the improvements, etc.

- 8.8.5.2 Previously approved designs for the existing improvement are not an acceptable means of establishing existing grades; however, they are to be referenced on the construction plan where they occur.
- 8.8.5.3 The basis of the as-built elevations shall be the same as the design elevations (both flowline or both top of curb, etc.) when possible.

## 8.9 Off-Site Design

The design grade, and existing ground at that design grade, of all roadways that dead end due to project phasing, subdivision boundaries, etc., shall be continued, in the same plan and profile as the proposed design, for at least three hundred (300) feet or to its intersection with another roadway. This limit shall be extended to six hundred (600) feet when arterial roadways are being designed.

## 8.10 Construction Traffic Control

### 8.10.1 Pedestrian Traffic

- 8.10.1.1 Every precaution shall be taken to ensure that construction work does not interfere with the movement of pedestrian traffic, which shall be maintained on the sidewalk at all times and flagmen provided for guidance as necessary.
- 8.10.1.2 Where an excavation interrupts the continuity of the sidewalk, the Contractor shall provide suitable bridge or deck facilities, to be supplemented by the use of such proper devices and measures as prescribed in the *Manual on Uniform Traffic Control Devices*, latest edition, for the safe and uninterrupted movement of pedestrian traffic. The edges or ends of the pedestrian bridge or decking shall be beveled or chamfered to a thin edge to prevent tripping.
- 8.10.1.3 Temporary diversion walkways shall be hard surfaced and electric lighting shall be provided and kept continuously burning during hours of darkness, when required by the City of Dell Rapids.
- 8.10.1.4 Unless otherwise authorized by the City of Dell Rapids, pedestrians shall not be channeled to walk on the traveled portion of a roadway.
- 8.10.1.5 Under certain conditions, it may be necessary to divert pedestrians to the sidewalk on the opposite side of the street. Such crossings shall only be made at intersections or marked pedestrian crossovers.
- 8.10.1.6 Facilities satisfactory to the City of Dell Rapids shall be provided for pedestrians crossing at corners, pedestrian crossovers, and public transportation stops.

### 8.10.2 Vehicular Traffic

- 8.10.2.1 Construction work zone traffic shall be controlled by signs, barricades, detours, etc., which are designed and installed in accordance with the *Manual on Uniform Traffic Control Devices*, latest edition. A traffic control

plan shall be submitted to and approved by the City of Dell Rapids, or designated agent, prior to start of any construction.

- 8.10.2.2** For construction of new facilities, traffic control should strive to keep the motorist from entering the facility. The primary means to accomplish this are by use of temporary barricades, located in advance of the construction area and with appropriate signing. New construction shall not be opened to traffic, and the construction traffic control removed, without the approval of the City of Dell Rapids.
- 8.10.2.3** The details of the traffic control plan must be shown on a map. For minor projects or local roadways, a neat sketch of the roadways and the proposed control devices will suffice. For major projects or major roadways, the traffic control plan shall be superimposed on as-builts, construction plan drawings, or other detailed map.
- 8.10.2.4** The *Manual on Uniform Traffic Control Devices*, latest edition, shall be the basis upon which the traffic control plan is designed, in concert with proper, prudent, and safe engineering practice. All necessary signing, striping, coning, barricading, flagging, etc., shall be shown on the plan.
- 8.10.2.5** Any plan for traffic control during construction that indicates a complete closure of an arterial or collector street must show detour routes and must be approved by the City of Dell Rapids. Requirements as to rerouting of traffic, signing, time of closure, and length of closure will be determined on a case-by-case basis. When a local street is to be closed to traffic, the City of Dell Rapids must be notified, preferably 24 hours in advance.
- 8.10.2.6** Directional access on roadways may be restricted (minimum travel lane width in construction area is ten [10] feet), but proper controls including flagging must be indicated. Removal of on-street parking shall be considered, and noted where applicable.

## **8.11 Pavement Thickness**

Design of pavement thickness for collector and arterial streets and local streets in industrial and commercial zoned areas shall be based on *AASHTO Guide for Design of Pavement Structures*, latest edition. Pavement design shall be based on an inherent reliability of 75 percent. For traffic conditions where the equivalent 18 kip/single axle loading is less than 1,000,000, the low-volume road design method may be used. Recommendations and subgrade properties developed by the Geotechnical Exploration Report shall be used in the design of the pavement structure.

- 8.11.1** Arterial Streets must be designed for pavement thickness on an individual street-by-street basis. Industrial Streets must be designed for pavement thickness on an individual street-by-street basis; however, in no event may the pavement thickness be less than that specified in Table 8.2. Local Residential Streets need not be designed on an individual basis, but must meet the minimum pavement thickness as set forth in Table 8.2.
- 8.11.2** Minimum compressive strength for Portland Cement concrete paving shall be 4000 psi at 28 days.

**8.11.3 Traffic Data.** Where traffic data is available, actual counts shall be used along with projections of traffic growth in determining the pavement design. If traffic data is not available, Table 8.3 may be used to provide data for the traffic design. Traffic data for all arterial streets will be determined by the City of Dell Rapids.

**Table 8.2  
Minimum Pavement Thickness Requirements**

	Local Residential Streets	Commercial, Industrial, & Collector Streets
Portland Cement Concrete (Requires Aggregate Cushion)	6"	8"
Asphaltic Concrete with Aggregate Base	<u>4" AC</u> 6" Aggregate	<u>6" AC</u> 12" Aggregate

**Table 8.3  
Traffic Volumes**

Street Classification	ADT (2 way)	No. of Lots	18-kip ESAL Traffic	AASHTO Traffic Level
Cul-de-sacs and Local Residential	200	20-30	10,000-50,000	Low
Local, Local Multi-Family, Or Commercial	300-700	60-140	50,000-300,000	Low
Local Industrial	200-700		400,000-600,000	Med
Collector	7,000		400,000-1,000,000	High

## 8.12 Rural Urban Street Standards

Rural urban streets, including local, collector, and arterials, shall conform to the current edition of the AASHTO *Policy on Geometric Design of Highway and Streets*. Reference should be made to the current edition of the AASHTO *Roadside Design Guide* where high fills, right-of-way restrictions, watercourses, or other issues render a design where recoverable slopes are not practical. All rural urban street locations will be approved by the City of Dell Rapids.

Where bicycle facilities are included as part of the design, reference should be made to the current edition of the AASHTO *Guide for the Development of Bicycle Facilities*.

### **8.13 Rural Subdivision Road Standards**

- 8.13.1** Subdivisions outside of the City limits and within the extraterritorial platting jurisdiction shall comply with these requirements.
- 8.13.2** Access shall be determined by street classification. Roadway serving the subdivision must be hard surfaced as approved by the City of Dell Rapids.
- 8.13.3** Driveways shall be hard surfaced and comply with Figure 5.3 of the Engineering Design Standards.
- 8.13.4** Minimum width of the driving surface shall be 24 feet of 4/6 asphalt paving/base and two-foot shoulders. Ditches and driveways shall have a maximum side slope of 4:1. Additional lanes may be required for higher traffic roadways as determined by the City of Dell Rapids.
- 8.13.5** If access to the subdivision is not on a paved road, the subdivision roads may have a gravel driving surface. If access to the subdivision is paved surface or planned for paved surfacing, or if the size of development creates a significant traffic impact, the subdivision roads shall be paved.
- 8.13.6** Gravel roads shall have an initial 3-inch lift of gravel covering the road bed, and a second lift of 3 inches of gravel within one year following the completion of construction. Asphalt roads shall be constructed in accordance with Table 8.2.
- 8.13.7** A plan and profile for construction to existing trunk sanitary sewer and its extension upstream is required. Where trunk sewers cross roadways the ultimate roadway grade shall be called out.
- 8.13.8** An access road agreement or other arrangements for maintenance of detention ponds and/or BMP facilities shall be provided by association or other perpetual contract.
- 8.13.9** Culverts in the street right-of-way shall comply with county requirements. Flared end sections or slope concrete headwalls are required on all culverts within the road right-of-way.
- 8.13.10** The size of culverts shall be determined by a drainage study for the entire subdivision.
- 8.13.11** The City of Dell Rapids will be responsible for accepting final street and drainage plans. The owner will be responsible for coordination of road access and approach permits with County, Township, and SDDOT officials.
- 8.13.12** Traffic control signs and street name signs shall be properly posted. Street names shall be approved by the City of Dell Rapids.

**Chapter 9**  
**Sanitary Sewers**

<b>Section</b>	<b>Topic</b>	<b>Page</b>
9.1	General Requirements	9.1
9.2	Determination of Flow	9.1
9.3	Facility Design	9.2
9.4	Sanitary Sewer Easements	9.8

## Chapter 9

### Sanitary Sewers

#### 9.1 General Requirements

**9.1.1 Design.** The design for sanitary facilities shall be in conformance with the following.

1. "Recommended Standards for Wastewater Facilities Great Lakes-Upper Mississippi River Board of State Public Health and Environmental Managers." 1997 Edition (Ten State Standards) or most current version.
2. Requirements and Standards of the South Dakota Department of Environment and Natural Resources.
3. City of Dell Rapids Engineering Design Standards, Standard Specifications, and Standard Plates.
4. South Dakota State Plumbing Code.
5. Uniform Plumbing Code of International Association of Plumbing and Mechanical Officials.
6. Conflict—In case of a conflict between the above design standards, the most restrictive requirement shall apply.

**9.1.2 Construction Standards.** Construction standards shall conform to the most recent version of the Standard Specifications and Standard Plates together with the latest addenda or as directed by the City of Dell Rapids.

#### 9.2 Determination of Flow

##### 9.2.1 Lateral Sewers

1. Discharge ( $Q_A$ ) Average Daily Flow

Equation 1: Area x Area Density x Unit Density x Rate =  
Average Daily Flow

Equation 2: Number of Units x Unit Density x Rate = Average Daily Flow.  
Density for multiple dwelling units shall be not less than 2.5 persons/unit. Density for single family dwelling units shall be not less than 3.5 persons per unit.

2. Discharge ( $Q_P$ ) Peak Lateral Sewer Flow

Average Daily Flow x 400%—Peak Lateral Sewer Flow

3. Design Density and Rate—(See Paragraph 9.3.5)

## 9.2.2 Trunk Sewers

### 1. Discharge ( $Q_A$ ) Average Daily Flow

$$\text{Equation 1: Area} \times \text{Area Density} \times \text{Unit Density} \times \text{Rate} = \text{Average Daily Flow}$$

$$\text{Equation 2: Number of Units} \times \text{Unit Density} \times \text{Rate} = \text{Average Daily Flow}$$

### 2. Discharge ( $Q_P$ ) Peak Trunk Flow

$$\text{Average Daily Flow} \times 250\% = \text{Peak Trunk Sewer Flow}$$

### 3. Design Density and Rate—(See Paragraph 9.3.5)

**9.2.3 Area.** Gross area shall be used in determining design flows and shall include streets and alleys but exclude parks, school grounds, and similar dedicated open space.

**9.2.4 Special Design Densities.** Special design densities shall be subject to approval by the City of Dell Rapids based on methodology provided by the design professional.

## 9.2.5 Density Design Table

Land Use	Area Density	Unit Density	Rate*
Low Density Residential	6 units/acre	3 people/unit	100 gpcd
Med. Density Residential	12 units/acre	2 people/unit	100 gpcd
High Density Residential	25 units/acre	2 people/unit	100 gpcd
Office & Institutional	Special Design Density—dependent on water use		
Commercial	Special Design Density—dependent on water use		
Industrial	Special Design Density—dependent on water use		

\*gpcd—gallons per capita per day

## 9.3 Facility Design

**9.3.1 Capacity of Pipe.** The Manning Equation shall be used to determine pipe capacities. The design Manning's (n) for all Pipe Materials.

$$"n" = 0.013$$

### 9.3.2 Velocity within Pipe

Min. at peak flow = 2 feet per second (fps)

Max. at peak flow = 14 feet per second (fps)

**9.3.3 Approved Pipe Materials.** Refer to Standard Specifications or as directed by the City of Dell Rapids.

### 9.3.4 Force Main Minimum and Maximum Velocity

The minimum force main velocity shall be 2 feet per second.

Suction and discharging piping for lift stations shall be sized so that the maximum velocities do not exceed 5 feet per second and 8 feet per second, respectively.

**9.3.5 Size of Sewer Pipe.** No gravity sanitary sewer to be maintained by the City shall be less than 8-inch diameter. Minimum size of building sanitary sewer stubouts shall be 4-inch diameter. All sanitary sewer services other than single-family residential units (example: commercial, industrial, office, multifamily, etc.) shall be a minimum of 6-inch diameter. No private lateral sewer shall be less than 6 inches in diameter; however, 8-inch diameter sewers are recommended. Six-inch diameter pipe may be used as private laterals where there are relatively low flows, a small number of people to be served, future extensions are not anticipated, and the sewer is capable of handling the design flows. The justification for using the 6-inch pipe shall be provided by the design professional in writing. The possibility of cleaning problems shall be identified by the design professional and accepted by the development.

**9.3.6 Depth of Sewer.** Gravity sewers shall have a minimum depth of 7 feet to top of pipe where practical. They shall be deep enough to serve all basements, designed with a 2 percent grade on building sewers (absolute minimum of 1 percent). They should be well below the frost line at all points and lower than any water lines placed in the same street. Insulation shall be required above the sanitary sewer where the dimension from the finished grade elevation to the top of the pipe is 5 feet or less (see the Standard Plates for pipe insulation details or as directed by the City of Dell Rapids). Risers on service stubouts shall be provided for sewers greater than 12 feet deep as measured at the building line. Maximum depth of sewer shall not exceed the depth recommended by the pipe manufacturer.

**9.3.7 Alignment of Sewers.** Sewers less than 24-inch diameter shall be straight between manholes with the following one exception: In subdivisions where street layouts are such that a straight alignment is not practical, sewers may be curved. The radius of curvature shall not be less than 200 feet for an 8-inch diameter pipe. The pipe manufacturer's recommended maximum deflection may not be exceeded. All sanitary sewers on curved streets shall be located in the center of the street. Where it is possible to maintain the centerline location on a curved street (ex: road centerline radius of curvature less than 200 feet), the sanitary sewer shall be located as close to the centerline as possible and at a distance of at least 10 feet from the back of curb.

### 9.3.8 Physical Requirements

1. **Minimum Manhole Diameter**—48 inches
2. **Maximum Manhole Spacing.** The maximum distance between manholes shall be 400'.

Note: Exceptions will be permitted within a development; however, said exceptions shall not be for more than 5 percent of the manholes in the development. Said exceptions shall not exceed 6 percent of the above distances.

3. **Minimum Grade.** Sewers shall have minimum grade sufficient to maintain 2 fps at peak flow. For low flow lines where feasible, a minimum grade of one percent shall be used. Minimum grade on building sanitary sewer stubouts shall be 1 percent.

4. **Minimum Manhole Drop**

Same pipe size—0.10 feet

Change in pipe size—match 0.8 depth point of all lines as a minimum, and match tops of pipes whenever possible.

5. **Maximum Manhole Drop**

Without drop connection—1.5 feet as measured from invert to invert. When the drop is less than 1.5 feet, the manhole invert shall be constructed to form a uniform slope from the incoming pipes to the outgoing pipe.

6. **Manhole Covers.** For approved types of manhole covers, refer to Standard Specifications or as directed by the City of Dell Rapids. If the possibility of surface runoff cannot be avoided, a solid manhole cover, having an integral self-sealing type gasket that can be bolted closed, must be used.

All manholes located outside dedicated street rights-of-way shall be designed and constructed with a bolt-down type cover, having an integral self-sealing type gasket, and the manhole ring shall be bolted to the manhole cone unless otherwise directed by the City of Dell Rapids. Bolt-down type covers may be required in other locations as directed by the City of Dell Rapids. A note shall be added to the construction plans indicating where the bolt-down covers are required.

Plastic/fiberglass type manhole markers shall be used in areas outside of the dedicated street right-of-way, except for interstate areas, roadway right-of-way areas, and areas designated by the City of Dell Rapids. Steel delineator posts and markers shall be used in interstate areas, roadway right-of-way areas, and areas designated by the City of Dell Rapids (see the supplemental standard specifications and standard plates for types).

7. **Access to Manholes.** Manholes outside the street right-of-way shall be subject to the acceptance of the City of Dell Rapids. Manholes located outside of the

street rights-of-way must be located in areas which allow direct access by maintenance vehicles.

8. **Industrial Sewer Monitoring Facility.** Any new building constructed or proposed to be constructed in an industrially zoned area with a floor space of greater than 5,000 square feet, and with a water meter size of greater than 3/4 inch and projected process wastewater flow greater than 5,000 gallons per day, or if otherwise required by the City of Dell Rapids, shall install a sewer monitoring facility prior to final building inspection approval. The monitoring facility shall normally be situated outside of the building on the user's premises. If the industrial user's service line ties into an existing City manhole and such manhole allows for safe sampling and isolation of the industrial user's discharge, the City of Dell Rapids may allow said manhole to serve as the industrial user's monitoring facility.
9. **Crossings.** Sanitary sewer crossings of storm sewers shall have no less than 6 inches of clearance. Special structural support and insulation will be required if there is less than 18 inches clearance (see the Standard Plates for insulation criteria or as directed by the City of Dell Rapids). The minimum horizontal clearance shall be 2 feet. Clearance refers to the distance from the outside of the sewer pipe to the outside of the storm sewer pipe.

Sanitary sewer crossings of other utilities shall be done in accordance with Ten States Standards, State of South Dakota standards, and Standard Specifications and Standard Plates.

10. **Standard Plates.** See Standard Specifications and Standard Plates for such details as manholes, drop connections, risers, and other appurtenances. If these are not available, details will be as directed by the City of Dell Rapids.
11. "Dead end" manholes on line segments shall be extended to a distance 10' beyond the lot line of the last serviced lot.
12. Sanitary sewer lines ending at development phase boundaries that do not terminate with a manhole shall be ended with a bell end section of pipe and watertight plug. A one foot or less section of pipe with a glued on cap inserted into the bell end of the pipe will be allowable as a watertight plug. Couplings will not be allowed for this type of connection unless there is a change in pipe material.
13. Private sewer service clean-outs will not be allowed in the public right-of-way. All clean-outs shall be protected with approved cover protection.
14. Manholes located at the end of cul-de-sacs shall be located 5 to 10 feet from the back of curb and gutter.

### **9.3.9 Sewer Services**

- 9.3.9.1 **Connections to Manholes.** Individual services may not be connected into manholes.

### 9.3.9.2 Regular Services

1. Each structure shall be served by a separate service line connected to a public or private sanitary lateral sewer. The service should be perpendicular to the lateral sewer line in the public right-of-way. Single-family attached housing (twin homes, duplexes, etc.) will be required to have separate services for each living unit. The service for each living unit shall not be located under the property of the adjacent living unit.
2. Sewer services must meet all the requirements of the Standard Specifications and Standard Plates or as directed by the City of Dell Rapids.
3. All platted lots of a proposed subdivision are to front on and have a separate sewer service to a public sanitary sewer main without crossing any adjacent properties. Additional sewer services will be required for each additional principal structure on a given lot.
4. Sewer services across one lot to provide service to an adjacent lot in a proposed subdivision, may be approved, provided that all of the following conditions are met:
  - a. Proposed subdivision does not exceed two lots.
  - b. A private utility easement 20 feet in width is provided across the burdened lot (to be occupied by sewer service only).
  - c. The City of Dell Rapids determines that a sewer main extension will not be necessary to perpetuate the system and in all likelihood no future development of abutting properties will benefit from a main extension.

**9.3.10 Sewage Lift Stations.** The Standard Specifications and Standard Details for sewage lift stations shall be used for all stations unless a separate design is determined necessary by the City of Dell Rapids. Each pumping station shall be provided with a minimum of two pumps, each having a capacity sufficient to pump the peak design flow. Submersible pumps will not be allowed.

Temporary lift stations with reduced design requirements may be considered by the City of Dell Rapids where future trunk sewers are planned to eliminate the need for the station within five years from the installation date of the lift station.

No sanitary sewage shall be allowed to be discharged into a newly constructed lift station wet well until final completion is made and notification is made by the City assuring operation responsibilities.

**9.3.10.1 Specific Equipment Required.** The sewage lift station shall be supplied with, but not be limited to, the following specific items:

- Flow Meter
- Auto Dialer for Alarm Conditions
- Secondary Power Supply - Engine Generator System
- Automatic Power Switch for the Secondary Power Supply

- Programmable Logic Controller to control and monitor the lift station remotely and locally
- Man Lift for All Dry Well Type Stations Greater Than 20 Feet in Depth (The depth shall be defined as the dimension from the top of the dry well entrance tube to the floor of the dry well.)
- Variable Frequency Drive (VFD) for All Motors Greater Than 30 Horsepower—The requirement for VFDs may be deleted if it is determined unnecessary by the City of Dell Rapids.

**9.3.10.2 Wet Well Design.** The wet well design shall be coordinated with pump sizing in order to avoid frequent on/off cycling of the pumps. To prevent septicity, inflow into the wet well without pumping should not exceed approximately 30 minutes.

Cycle time is the total time between starts of an individual pump and can be determined by comparing the volume between the “on” and “off” levels in the wet well with the pump capacity. Cycle time is computed as follows:

Where:

CT = Cycle Time (minutes),

V = Wet Well Volume between On and Off Levels (gallons),

D = Rated Pump Capacity (gallons per minute), and

Q = Wet Well Inflow (gallons per minute),

$$CT = V/(D-Q) + V/Q$$

With a given wet well volume and pumps of uniform pumping rate, minimum cycle time will occur when the rate of inflow is equal to one-half of the discharge rate of the individual pump under consideration and the formula for cycle time simplifies to  $CT = 2V/Q = 4V/D$ . An effective wet well volume of at least 2.5 times the discharge rate of the pump is required.

The operating volume of the wet well shall be designed to provide the following maximum motor starting times at the design pumping rates.

Motor Size, hp	Maximum Motor Starting Times
0 - 25	6 starts per hour
26 - 35	5 starts per hour
36 - 60	4 starts per hour

**9.3.10.3 Pump Design.** The operating speed of the pumps shall not exceed 1,800 rpm. The test sphere minimum diameter shall be no less than 3 inches in diameter. The minimum suction and discharge diameter shall be no less than 4 inches in diameter.

**9.3.10.4 Engine Generator Design.** The engine generator shall be designed to operate each pump simultaneously but start each pump separately. If more than two pumps are used, the engine generator shall be designed to

start the pumps necessary for the firm pumping capacity of the station simultaneously. It shall be at the City of Dell Rapids discretion to change the generator sizing requirements when the size of the lift station warrants it. The engine generator system shall be a four-cycle water-cooled type. The generator shall be supplied with an automatic transfer switch. An enclosure for the automatic transfer switch shall be supplied and sized large enough to contain the station on/off switches, compatible with the City's SCADA system, and other necessary controls. The generator shall be supplied with all accessories, which make it a complete operating system.

- 9.3.10.5 Power Supply.** The power supply shall be 240 volt, 60 Hz, 3 phase unless 480 volt power supply is required and/or available.
- 9.3.10.6 Lift Station Site Fencing.** A fence may be required and constructed around the lift station/generator sites. The City of Dell Rapids shall determine if a fence is required. The fence shall be as detailed and specified in the Standard Plates.
- 9.3.10.7 Access Road to the Lift Station.** An access into the lift station will be required and shall be shown on the construction drawings. The access road shall meet minimum thickness and materials standards for streets. The surfacing used shall be gravel or asphalt.
- 9.3.10.8 Site Landscaping.** The Contractor shall maintain the grass areas by watering, fertilizing, reseeding, mulching, and mowing until the grass has established a 2-inch catch of grass. The Contractor shall immediately reseed and mulch areas which show bare spots at no additional cost.
- 9.3.10.9 Odor Control.** Odor control shall be provided at the lift station and/or the force main discharge where it is determined to be a detectable problem or shown through a design analysis. The design engineer shall perform an analysis showing the modeled results of the odor control analysis. Odor control will be required at the lift station and force main discharge point if it is found to be a detectable problem in the analysis or in the field as determined by the City of Dell Rapids within the two-year warranty period.

#### **9.4 Sanitary Sewer Easements**

Sanitary sewer easements shall be obtained for all sanitary sewers located on private and public property. Sanitary sewer easements shall have a minimum width of twenty (20) feet. In addition, temporary easements may be required for construction.

Sanitary sewer easements shall be accessible for City maintenance vehicles to drive on to maintain the sanitary sewer. All manholes shall be accessible to City maintenance vehicles. If determined necessary by the City of Dell Rapids, the area over the sanitary sewer shall be benched to provide an access trail along the line and/or to the manholes.

The most current version of the sanitary sewer easement forms shall be used and obtained from the City of Dell Rapids.

The following Table 9.5 lists the minimum easement widths for sanitary sewer with a pipe diameter of 30 inches or less. The minimum easement widths shall be used when

preparing plans. The easement shall be shown on the development engineering plans and construction plans as dimensioned from the centerline of the pipe to the outside edge of the easement and labeled "Sanitary Sewer Easement." The easement widths may be required to be wider depending upon specific site conditions.

**Table 9.5**  
**Minimum Required Easement Width for Sanitary Sewer**  
*(for 30-inch pipe and smaller)*

Pipe Depth (feet)	Minimum Easement Width Required (feet)
8	20
9	20
10	20
11	22
12	24
13	28
14	30
15	34
16	36
17	40
18	42
19	46
20	48
21	52
22	54
23	58
24	60
25	64
26	66
27	70
28	72
29	76
30	78

## Chapter 10

### Water Mains

<b>Section</b>	<b>Topic</b>	<b>Page</b>
10.1	General	10.1
10.2	Fire Hydrants	10.2
10.3	Valves	10.4
10.4	Meters	10.5
10.5	Cross-Connection Control and Backflow Prevention	10.5
10.6	Lawn Irrigation Systems	10.5
10.7	Service Lines	10.5
10.8	Material Specifications	10.6
10.9	Manufactured Home Parks	10.6

## Chapter 10

### Water Mains

#### 10.1 General

**10.1.1.** This chapter sets forth the design and technical criteria to be used in the preparation of all water main plans. Where design information is not provided herein, the most current edition of the following standards shall be used:

1. *Recommended Standards for Water Works*, Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Manages (Ten State Standards).
2. Requirements and Standards of the South Dakota Department of Environmental and Natural Resources.
3. City of Dell Rapids Engineering Design Standards, Standard Specifications, and Standard Plates.
4. American Water Works Association Standards.
5. South Dakota Plumbing Code.
6. Uniform Plumbing Code.
7. International Fire Code and referenced NFPA Standards.

**10.1.2 Construction Standards.** Construction standards shall be the most recent revision of the Standard Specifications and Standard Plates together with the latest addenda or as directed by the City of Dell Rapids. All details, materials, and water appurtenances shall conform to these standards.

**10.1.3** Where a conflict occurs between the above standards, the most restrictive requirement shall apply.

**10.1.4** An Average daily water flow rate of 1,500 gallons per minute with a residual pressure of 20 psi at the at the most remote hydrant shall be maintained for all residential developments. Multifamily, commercial, and industrial developments shall be designed according to acceptable methods to determine their water flow demands. The Insurance Services Office (ISO) fire flow guidelines may be used to determine demand.

**10.1.5** Minimum size water main shall be six inches in diameter.

**10.1.6** Minimum depth of cover, as measured from the top of the pipe to the finished surface elevation, shall be six (6) feet. Where an adjustment is required in order to pass under another utility, the length of the deeper main shall be kept to a minimum, and bends shall be used to achieve the desired offset. The existing main may be lowered in place, if this method is practical and acceptable to be City of Dell Rapids.

**10.1.7** Disinfection, bacteriological, and hydrostatic tests shall be required in accordance with the requirements of the Standard Specifications or as directed by the City of Dell Rapids.

**10.1.8** Water mains shall be located so as to best conform to the layout of the existing facilities. In streets where no pattern has been established, mains shall be generally located 10 feet to the north or east of the centerline of the street. A minimum horizontal separation of 10 feet shall be provided between water mains and sanitary and storm sewers except as allowed in the Ten States Standards and as noted in Chapter 4 of the City of Dell Rapids Engineering Design Standards for Public Improvements - Utility Location and City Utility Easements.

Water mains shall be at least 20 feet away from buildings and under paved areas whenever possible. Water mains under enclosed walkways and tunnels shall be encased. Water mains will not be allowed under buildings.

**10.1.9** Finish grades for all hydrants shall be shown on the plans.

**10.1.10** The minimum size for any private fire main shall be six inches in diameter. A domestic service water line may be connected to the private fire service main six (6) inches, or greater, in diameter. For mains that do not supply fire hydrants, sizes smaller than six inches shall be allowed subject to the following restrictions:

1. The main supplies only automatic sprinkler systems, open sprinkler systems, water spray fixed systems, foam systems, or Class II standpipe systems.
2. Hydraulic calculations show that the main will supply the total demand at the appropriate pressure.

**10.1.11** Private fire service mains and appurtenances shall be installed in accordance with current edition of NFPA 24. Fire flow requirements for buildings or portions of buildings and facilities shall be determined by methods approved by the Dell Rapids Fire Department or the City of Dell Rapids.

Private fire hydrant systems shall be maintained in an operative condition at all times and shall be repaired where defective. Additions, repairs, alterations, and servicing shall comply with approved standards.

Private fire service mains and hydrants shall be periodically inspected, tested, and maintained in accordance with the current edition of NFPA 25 at the following intervals:

1. Private fire hydrants (all types): Inspection annually and after each operation; flow test and maintenance annually.
2. Fire service main piping: Inspection of exposed, annually; flow test every five years.

## **10.2 Fire Hydrants**

**10.2.1** For arterial streets, fire hydrants shall be staggered on both sides of the street such that they are spaced at not more than 500 feet along the centerline of the

street. Fire hydrants on each street side shall be spaced at not more than 1000 feet measured along the centerline of the street.

For collector and local streets, fire hydrants shall be spaced at not more than 500 feet along the centerline of the street.

Private fire hydrants shall be provided to meet the fire code when distance to the nearest hydrant is greater than those prescribed by the fire code.

- 10.2.2** Spacing of hydrants around multiple family, commercial, or manufacturing establishments shall be considered as individual cases and shall be determined by consultation with the City of Dell Rapids Fire Department and City.
- 10.2.2.1** Private fire hydrant systems—Where a portion of the facility or building hereafter constructed or moved into or with the jurisdiction is more than 400 feet from a hydrant on a fire apparatus access road, as measured by an approved route around the exterior of the facility or building, on-site fire hydrants and mains shall be provided where required by the City of Dell Rapids Fire Department and City.
- 10.2.3** Hydrants shall be located on the road right-of-way, two (2) feet behind the back of curb and on a lot line whenever possible.
- 10.2.4** Fire hydrants shall be installed on the end of all dead-end mains. If the main terminates in a cul-de-sac, the fire hydrant shall be installed to meet clear space requirements as outlined in 10.2.7.
- 10.2.5** For commercial construction, fire hydrants shall be located at least 25 feet from the exterior wall of any masonry building and at least 50 feet from any exterior wall of frame or equivalent construction, including brick and stone veneer.
- 10.2.6** Flushing hydrants installed for testing purposes shall be removed once testing has been completed. If the flushing hydrants will remain in place for the duration of a winter season, they shall be installed behind the proposed curb and gutter.
- 10.2.7** A minimum of three (3)-foot clear space shall be maintained around the circumference (outside) of fire hydrants, except as otherwise required or approved by the fire code official. Light poles, posts, fences, vehicles, vegetative growth, trash, storage, mailboxes and other materials or things shall not be placed or kept near fire hydrants in a manner that would prevent such fire hydrants from being immediately discernable and/or usable. The fire department shall not be detoured or hindered from gaining immediate access to a hydrant.
- 10.2.8** When fire hydrants are located outside City ROW and are subject to impact by motor vehicles, guard posts, curb and gutter or other approved means shall be provided for hydrant protection.
- 10.2.9** Fire hydrant(s) shall be installed not more than 100 feet from fire department connection(s) serving any buildings equipped with a standpipe system.
- 10.2.10** Fire hydrant(s) shall open counterclockwise.

## **10.3 Valves**

- 10.3.1** In general, valves on cross connecting mains shall be located so that no single break requires more than 1,000 feet to be out of service. Valves on water main 12 inches in diameter and larger shall be spaced not more than one-fourth (1/4) mile apart. Valves shall be arranged so that any section can be isolated by closing not more than four valves, with a maximum of 30 residential lots out of service.
- 10.3.2** Valves shall be located such that they will not be in the sidewalk line or in driveways.
- 10.3.3** All valves shall be installed with valve boxes.
- 10.3.4** Valves shall be placed on all dead-end mains for future extension, unless no services are planned and re-chlorination can be completed without interruption of water service.
- 10.3.5** Perpendicular service line connections to existing mains shall be by means of a saddle and corporation valve. A smith tap may be used with prior approval by the City of Dell Rapids.
- 10.3.6** Valves and curb stops for domestic services shall be installed at least 20 feet away from the building. If the domestic service comes off of the fire line, both lines must have a shut off valve after they separate.
- 10.3.7** Valves, 12 inches in diameter and greater, shall be installed with two restrainer devices per valve.
- 10.3.8** Valves that are installed in the R.O.W shall be placed at curbing tangent point location.
- 10.3.9** Air Release valves shall be installed at the high points on water mains 12 inches or longer.
- 10.3.10** Valves shall open counterclockwise.
- 10.3.11** Post Indicator Valves—Every connection from the private fire service main to a building shall be provided with a listed post indicator valve located to control all sources of water supply. The City of Dell Rapids Fire Department or City of Dell Rapids shall be permitted to waive the requirement for the post indicator valves required where the following provisions are met.
1. Listed valves in underground pits/vaults with a reliable position indication connected to a remote supervisory station.

Post indicator valves shall be located not less than 40 feet from buildings. Where post indicator valves cannot be located within 40 feet, they shall be permitted to be located closer where approved by the City of Dell Rapids Fire Department or City of Dell Rapids. When domestic water service line is connected to a private fire service main, a post indicator valve shall be installed beyond and downstream from the connection point.

Wall indicator valves may be used where approved by the City of Dell Rapids Fire Department or City of Dell Rapids, provided they are set in locations near blank walls where the possibility of injury by falling walls is unlikely and from which people are not likely to be driven by smoke or heat.

#### **10.4 Meters**

**10.4.1** Water meters will be furnished by the City of Dell Rapids and shall be installed by the user under the supervision of the City of Dell Rapids. The user will be required to pay a service charge on the meter equal to the cost of the meter to the department. Ownership of the meter will remain with the City of Dell Rapids.

**10.4.2** Master meters for main line metering of industrial and commercial complexes shall be subject to the approval of the City of Dell Rapids. Authorization must be obtained from the City of Dell Rapids to allow the use of a master meter in lieu of individual meters. Metering systems shall be reviewed on an individual basis and shall include such auxiliary equipment as deemed necessary by the City of Dell Rapids. The meter shall be installed in an approved vault or an approved heated and ventilated above-grade enclosure. Below-ground vaults and enclosures for meters must be approved by the City of Dell Rapids prior to installation.

#### **10.5 Cross-Connection Control and Backflow Prevention**

**10.5.1** The City of Dell Rapids potable water system shall be protected from all cross connections by a backflow prevention assembly in accordance with the South Dakota Plumbing Code and approved by the City of Dell Rapids.

#### **10.6 Lawn Irrigation Systems**

**10.6.1** Irrigation heads shall be located and maintained so as not to spray over or onto any impervious surface.

**10.6.2** New lawn irrigation systems shall be installed with rain sensors that automatically shut off the system after one-quarter (1/4) inch of rainfall has occurred.

#### **10.7 Service Lines**

**10.7.1** Not more than one (1) consumer shall be supplied from each service line. Each separate account requiring a separate meter shall also require a separate service line.

**10.7.2** Side by side duplexes, triplexes, and town houses shall have a separate account and a separate service line for each unit. The service lines shall be located on the individual consumer's property.

**10.7.3** Apartments and over/under duplexes, triplexes, etc., do not need to be individually metered and do not need separate service lines.

**10.7.4** Residential service lines shall be constructed to the property line as a part of the street construction project.

**10.7.5** Commercial and industrial service lines may be constructed to the property line if the service line size is known.

**10.7.6** All service lines shall be marked by a steel fence post or an approved marker. The steel fence post should be painted blue on the top one-foot portion of the marker. The marker should be placed near the curb stop or at the termination point of the service stub-in. The service line marker shall remain in place and maintained by the property owner until the service line is extended into the property to serve a house, building, or other structure. The property owner will be responsible for replacing damaged markers.

**10.7.7** If newly developing separate platted properties are replatted to a single unit, any additional water services that were previously installed shall be removed to the corporation stop on the City main at the expense of the owner provided the final lift of asphalt or final surfacing has not been installed.

**10.7.8** Polyethylene (PE) pressure pipe and tubing will be acceptable for use as water service piping between the curb stop or valve and meter for new construction. PE tubing will be permitted within the City ROW or dedicated water main utility easement.

## **10.8 Material Specifications**

**10.8.1** Material specifications are as specified in the Standard Specifications or as directed by the City of Dell Rapids. However, ductile iron pipe is required to be used in all sites known to have soil contaminated by volatile organic compounds such as fuel and petroleum products or as directed by the City of Dell Rapids. Piping installed in sites known to have soil contaminated by volatile organic compounds shall be furnished with joint gaskets that are resistant to such contamination. All ductile iron pipe and fittings shall be encased in polyethylene regardless of soil conditions.

## **10.9 Manufactured Home Parks**

**10.9.1** New manufactured home parks will be allowed to have individually metered services if the distribution system within the park is built to meet the City of Dell Rapids Standards. Maintenance and access easements granted to the City of Dell Rapids for the water main and the service lines to the curb stop are also required.

**10.9.2** If individually metered homes are not desired, a metering structure is required for each water main entrance into the park. If a metering structure is used, the distribution system within the park will be considered private and will not be maintained by the City of Dell Rapids.

## Chapter 11

### Drainage Improvements

<b>Section</b>	<b>Topic</b>	<b>Page</b>
11.1	Requirements for Storm Drainage Plans	11.1
11.2	Storm Sewers	11.9
11.3	Storm Sewer Appurtenances	11.12
11.4	Culverts	11.16
11.5	Open Channel Flow	11.17
11.6	Street Flow Capacity	11.18
11.7	Detention Storage	11.21
11.8	Best Management Practices	11.23

## Chapter 11

### Drainage Improvements

#### 11.1 Requirements for Storm Drainage Plans

##### 11.1.1 General

The following criteria shall be utilized in the analysis of the drainage system.

- a. Runoff analysis shall be based upon proposed land use, and shall take into consideration all contributing runoff from areas outside of the study areas.

The analysis of storm runoff from existing developed areas lying outside of the study area shall be based upon present land use and topographic features.

All undeveloped land lying outside of the study area shall be considered as fully developed based upon the Dell Rapids Comprehensive Plan. Whenever the future land use of a specific undeveloped area cannot be accurately predicted, the average runoff coefficient to be used in said area shall not be less than 0.50 for the Rational Method runoff coefficient or an approved equivalent value for any other method, Table 11.1 (Appendix).

- b. The probable future flow pattern in undeveloped areas shall be based on existing natural topographic features (existing slopes, drainageways, etc.).
- c. Average land slopes in both developed and undeveloped areas may be used in computing runoff. However, for areas in which drainage patterns and slopes are established, actual slopes and patterns shall be utilized.
- d. Flows and velocities which may occur at a design point when the upstream area is fully developed shall be considered. Drainage facilities shall be designed to assure flows and velocities will not cause erosion damage.
- e. The primary use of streets shall be for the conveyance of traffic. The computed amount of runoff in streets shall not exceed the requirements set forth in these Design Standards.
- f. The use of on-site detention, detention within the development or detention in a drainage basin of which the development is part may be required. See the Subdivision Ordinances regarding drainageways and detention pond right-of-way dedication.
- g. The changing of natural drainageway locations will not be approved unless such change is shown to protect against unreasonable hazard and liability, substantiated by thorough analysis.
- h. The planning and design of drainage systems shall be such that problems are not transferred from one location to another. Outfall points shall be designed in such a manner that will not create flooding hazards.
- i. Localized flooding information shall include the area inundated by the major storm runoff.

- j. The flow routing for both the minor and major storm runoff shall be as directed by the City of Dell Rapids. Drainage easements will be required and shall be designated on all drainage drawings and subdivision plats.
- k. Approval will not be made for any proposed building or construction of any type of structure including retaining walls, fences, etc., or the placement of any type of fill material, which will encroach on any utility or drainage easement or which will impair surface or subsurface drainage from surrounding areas.

### **11.1.2 Minor and Major Design Storms**

- 1. Urban areas generally have two separate and distinct drainage systems. One is the minor system corresponding to the minor (or ordinary) storm recurring at regular intervals. The other is the major system corresponding to the major (or extraordinary storm) which has a one percent probability of occurring in any one year, called the 100-year storm event. Since the effects and routing of storm waters for the major storm may not be the same for the minor storm, all storm drainage plans submitted for approval shall be submitted in detail identifying the effects of both the minor storm and the major storm.

- a. Minor Storm Provisions.

The minor storm drainage system shall be designed to provide protection against regularly recurring damage, to reduce street maintenance costs, to provide an orderly urban drainage system and to provide convenience to the urban residents. Storm sewer systems consisting of underground piping, natural drainageways, and other required appurtenances shall be considered as part of the minor storm drainage system.

- b. Major Storm Provisions.

The major storm drainage system shall be designed to prevent major property damage or loss of life. The effects of the major storm on the minor drainage system shall be noted. The route of the major storm shall be noted to assure an outlet to a designated major drainageway is available.

### **11.1.3 Design Storm Calculations**

#### **1. Introduction**

Presented in this section are the criteria and methodology for determining the storm runoff design peaks and volumes to be used in the City of Dell Rapids for the preparation of storm drainage studies, plans, and facility design.

#### **2. Design Frequencies**

The residential and commercial design storm return frequency shall not be less than 5 years for the minor storm and 100 years for the major storm. The industrial design return frequency shall not be less than 5 years for the minor storm and 100 years for the major storm.

### 3. Design Rainfall

The design intensity-duration-frequency rainfall data to be used for the Dell Rapids area was obtained from the National Weather Bureau. The intensity-duration-frequency chart in Figure 11.1A (Appendix) for storm durations of less than one hour and the intensity-duration-frequency chart in Figure 11.1B (Appendix) for storm durations of greater than one hour are presented for computations of rainfall intensities.

### 4. Rational Method

The Rational Method may be used in both the minor and major storm runoff computations for basins that are not complex and generally have less than 100 acres.

The Rational Method is based upon the following formula:

$$Q = CIA \quad \text{(Equation 1)}$$

Where:

Q = Peak Discharge (cfs),  
C = Runoff Coefficient (refer to Table 1.1),  
I = Rainfall Intensity (inches/hour), and  
A = Drainage Area (acres).

When using the Rational formula, an assumption is made that the maximum rate of flow is produced by a constant rainfall which is maintained for a time equal to the period of concentration of flow at the point under consideration. Theoretically, this is the time of concentration, which is the time required for the surface runoff from the most remote part of the drainage basin to reach the point being considered.

However in practice, the concentration time,  $T_c$ , is an empirical value that results in acceptable peak flow estimates.

For basins that are larger than 100 acres, and for smaller basins that are complex, it is recommended that the design storm runoff be analyzed by other methods approved by the City.

### 5. Time of Concentration and Travel Time

As discussed in this Section,  $T_c$ , the time of concentration, is the time it requires for runoff to travel from the hydraulically most distant point of the watershed to the point of interest within the watershed.

Travel time is the time it takes water to travel from one location to another in a watershed.

In the application of the Rational Method, the time of concentration must be estimated so that the average rainfall rate of a corresponding duration can be determined from the intensity-duration-frequency chart in Figure 11.1A (Appendix) for storm durations of less than one hour and the intensity-duration-frequency curves shown in Figure 11.1B (Appendix) for storm durations greater than one hour.

Water travels across a watershed as sheet flow, shallow concentrated flow, open channel flow, or some combination of these. The type that occurs is a function of the conveyance system and is best determined by field inspection. The minimum time of concentration shall be 15 minutes.

a. Sheet Flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's  $n$ ) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These  $n$  values are for very shallow flow depths of about 0.1 foot or so. Table 11.2 (Appendix) provides Manning's  $n$  values for sheet flow for various surface conditions.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overton and Meadows 1976) to compute  $T_t$ :

$$\frac{T_t = 0.007 (nL)^{0.8}}{(P_2)^{0.5} s^{0.4}} \quad \text{(Equation 2)}$$

Where:

$T_t$  = travel time (hr),

$n$  = Manning's roughness coefficient, Table 11.2 (Appendix),

$L$  = flow length (ft),

$P_2$  = Two-year, 24-hour rainfall (in) = 2.7 inch for our area, and

$s$  = slope of hydraulic grade line (land slope, ft/ft).

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time.

i. Limitations

- Manning's kinematic solution should not be used for sheet flow longer than 300 feet. Equation 2 was developed for use with the four standard rainfall intensity-duration relationships.
- South Dakota is a Type II intensity-duration relationship, as defined by the Soil Conservation Service (SCS).
- In watersheds with storm sewers, carefully identify the appropriate hydraulic flow path to estimate  $T_c$ . Storm sewers generally handle only a small portion of a large event. The rest of the peak flow travels by streets, lawns, and so on, to the outlet. Consult a standard hydraulics textbook to determine average velocity in pipes for either pressure or nonpressure flow.
- The minimum  $T_t$  used in Technical Release-55 (TR-55) Urban Hydrology for Small Watersheds is 0.1 hr (6 minutes).

b. Shallow Concentrated Flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from Figure 11.2 (Appendix) in which average velocity is a function of watercourse slope and type of channel. Tillage can affect the direction of shallow concentrated flow.

After determining average velocity from Figure 11.2 (Appendix), use the following equation to estimate travel time for the shallow concentrated flow segment:

$$T_t = \frac{L}{3600 V} \quad (\text{Equation 3})$$

Where:

$T_t$  = travel time (hr),

$L$  = flow length (ft),

$V$  = average velocity (ft./sec.), and

3600 = conversion factor from seconds to hours.

c. Open Channel Flow

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation.

Manning's equation is:

$$V = \frac{1.49 r^{2/3} s^{1/2}}{n} \quad (\text{Equation 4})$$

Where:

$V$  = average velocity (ft/s),

$r$  = hydraulic radius (ft) and is equal to  $a/p_w$ ,

$a$  = cross sectional flow area (ft<sup>2</sup>),

$p_w$  = wetted perimeter (ft),

$s$  = slope of the hydraulic grade line (channel slope, ft/ft), and

$n$  = Manning's roughness coefficient for open channel flow.

Manning's  $n$  values for open channel flow can be obtained from standard hydraulic textbooks. After average velocity is computed using Equation 4,  $T_t$  for the channel segment can be estimated using Equation 3, page 11.6.

## **6. Rainfall Intensity (I)**

The intensity (I), is the average rainfall rate in inches per hour for the period of maximum rainfall of a given frequency having a duration equal to the time of concentration. After the design storm frequency has been selected, the rainfall intensity shall be obtained from the intensity-duration-frequency chart in Figure 11.1A (Appendix) for storm durations less than one hour and the intensity-duration-frequency curves in Figure 11.1B (Appendix) for storm durations greater than one hour using the time of concentrations as calculated above.

## **7. Runoff Coefficient (C)**

The runoff coefficient (C) represents the integrated effects of infiltration, evaporation, retention, flow routing, and interception, all of which effect the time distribution and peak rate of runoff. Table 11.1 (Appendix) presents the recommended values of C for the various recurrence frequency storms. The values are presented for different surface characteristics as well as for different aggregate land uses. The coefficient for various surface areas can be used to develop a composite value for a different land use.

### **11.1.4 Concept Drainage Plan**

The Concept Drainage Plan shall be submitted as part of the Development Sketch Plan.

The purpose of the Concept Drainage Plan is to identify any proposed drainage concerns regarding the development. Approximate flow paths and existing conditions will be provided. The Concept Drainage Plan will provide information as directed by the City of Dell Rapids.

### **11.1.5 Developers Preliminary Drainage and Grading Plan**

1. The developer shall submit a drainage plan for the drainage basin(s) of which the development is included. Scales as small as 1 inch equals 500 may be used to show the entire development.
2. The following information shall be included in the submittal:
  - a. A route outlet map will be required. This map shall show how the drainage from the proposed development will be transmitted to the nearest major drainageway. The map shall show any existing structure(s) which may limit the flow en route to the major drainageway. The route outlet map shall show the drainage area upstream of the proposed development and the estimate of flow under current conditions presently draining onto and through the development.
  - b. Data for minor and major storm flows within the proposed development for all drainage basins and sub-basins.
  - c. Identification of drainage problems with proposed solutions to deal with the problems within the development.
  - d. Identification of downstream and upstream facilities as shown on the route outlet map.

- e. Locations and size of proposed detention ponds within the development shall be identified.
- f. General locations and size of potential wetlands shall be identified. Include copies of all correspondence with the U.S. Army Corps of Engineers requesting wetland determinations and any responses. All mitigated wetlands are to be noted.
- g. Any and all existing 100-year floodplains must be identified, as shown by FEMA maps.
- h. Existing contours.
- i. Location and size of existing open channels, bridges, culverts, storm sewers and ponding areas, within the development.
- j. Location of streets.
- k. Identification of all drainage basins tributary to the development.
- l. Drainage patterns within the proposed development.
- m. Provide adequate information as to the effect of the drainage pattern on adjacent property. Provide survey data as required for adequate information. Identify the storm water path to the major drainway.

#### **11.1.6 Development Engineering Final Drainage Plan**

1. The Final Drainage Plan shall be a detailed plan of the proposed development phase, as defined per Subdivision Ordinance. It shall include detailed data for all runoff within the proposed development phase, and detailed data for the design of all drainage structures within the development phase.
2. Drawings and data (actual calculations may be required with submittal) comprising of the Final Drainage Plan shall comply with Chapter 2—Submittal Procedures, and shall include, but not be limited to the following information. Scale will be 1 inch equals 100 feet maximum.
  - a. Proposed contours, and arrows indicating drainage paths.
  - b. Location and elevations of Bench Marks.
  - c. Property lines.
  - d. Streets, names and grades.
  - e. Existing drainage facilities and structures, including existing roadside ditches, drainage ways, gutter flow directions, culverts, etc. All pertinent information such as size, shape, slope, location, etc., shall also be included to facilitate review and approval of drainage plans. Flow areas will be delineated.

- f. Proposed storm sewers and open drainage ways, easement and right-of-way requirements, including proposed inlets, manholes, and culverts. General notes concerning erosion control and energy dissipation shall be provided.
- g. Proposed outfall point for runoff from the development phase.
- h. Routing and accumulative flows at various critical points for the minor and major storm runoff.
- i. 100-year flood level in all streets in which the curb is overtopped during the 100-year storm for sump condition or other critical points.
- j. Identify 100-year flood elevations for major and lateral drainageways.
- k. Inlet flow data.
- l. Pipe flow data.
- m. All flood plains, identified by FEMA maps, within the proposed development phase.
- n. Location and size of potential wetlands.
  - 1. Provide copies of all correspondence with state and federal agencies related to the potential impact to wetlands or other cultural resources. This includes:
    - a. Wetland determination for the US Army Corps of Engineers
    - b. Wetland mitigation plan - if required
    - c. Any restriction covenants that would prevent the City of Dell Rapids from performing maintenance activities such as excavating within the wetlands.
- o. Hydrological data for each drainage area.
  - 1. Areas
  - 2. Watershed lengths, elevations, time of concentration
  - 3. Rainfall intensity
  - 4. Runoff coefficients
  - 5. Projected land uses and existing physical features of areas contributing runoff
  - 6. Storm duration
  - 7. Runoff (Q) (Note: This list of criteria assumes use of Rational Formula. If a different method is used, all relevant factors are to be enumerated.)

- p. Major drainageways
  - 1. Alignment
  - 2. Existing and proposed profiles
  - 3. “n” values (Manning)
  - 4. Velocities
  - 5. Soils analysis with a discussion of the proposed channel erosion potential
  - 6. Shear stress.
- q. Design recommendations
  - 1. Dikes
  - 2. Filling low areas
  - 3. Provision of easements
  - 4. Recommendations against building in certain areas
  - 5. Provisions for onsite retention and detention
  - 6. Other as appropriate for conditions

#### **11.1.7 Existing Floodplain Map—Revisions**

All submittals for floodplain revision must be reviewed and approved by FEMA or their authorized agent. The City of Dell Rapids will not take responsibility for time, scheduling, or cost involved in floodplain map revisions or letters of map amendments.

The developer is responsible for collecting, developing and submitting all information to FEMA. Copies of all information sent to, and correspondence with FEMA must also be sent to the City of Dell Rapids.

#### **11.1.8 Review by Other Agencies**

All open channel construction and existing drainageway modifications will be reviewed by the City and other appropriate county, state, or federal agencies.

### **11.2 Storm Sewers**

#### **11.2.1 Design Flow**

For areas smaller than 100 acres, the Rational formula is acceptable to compute runoff. For areas larger than 100 acres, the Soil Conservation Service method or other acceptable computer applications shall be used. Computations for storm sewer design and storm inlet designs shall be submitted to the city for approval.

### **11.2.2 Material and Installation**

All construction shall be in accordance with the approved Standard Specifications and Standard Plates or as directed by the City of Dell Rapids for drainage improvements.

### **11.2.3 Location of Storm Sewers**

1. All public storm sewers shall be installed in the public easement or right-of-way. If storm sewer pipe is placed on back lot lines or otherwise placed across private property, a drainage easement is required provided the pipe is utilized to drain public storm water. If the storm sewer pipe is to be used for private storm water runoff, no easement is required.

#### **a. Placement**

Storm sewer must be extended to the far edge of the platted subdivision to be serviced, regardless of where the inlets are placed.

#### **b. Easements**

1. All easements must be mutually exclusive for the City of Dell Rapids. Easements shall be identified as public utility and drainage easements. Final Drainage Plans shall identify the type of easement.
2. All drainage easements must be a minimum of 20 feet wide, additional width for access may be required. The pipe shall be placed only along the center of the easement, unless approved by the City of Dell Rapids.
3. No landscaping except grass may be placed in the easement.
4. No permanent structure may be placed in the easement.

### **11.2.4 Size**

No public storm sewer shall be less than 12 inches in diameter. Trunk storm sewers must be not less than 18 inches in diameter.

All changes in pipe size must occur at a manhole, inlet, or junction box.

### **11.2.5 Depth**

The minimum allowable sewer depth of cover shall be 18 inches unless approved by the City of Dell Rapids.

### **11.2.6 Pipe**

Storm Sewer pipes shall be sized to carry a 5-year flow. Hydraulics of the sewer shall be analyzed. The hydraulic gradient shall remain below the gutter or ground surface elevation to prevent overflow.

Storm sewer pipe shall be reinforced concrete unless otherwise approved by the City of Dell Rapids. In certain cases the designer may wish to specify one type of pipe for a certain purpose, in which case no alternate should be given. The “class” of reinforced concrete pipe shall be shown on the plans.

Storm sewer pipe made of other materials such as polyethylene may be approved by the City of Dell Rapids for private development storm sewer or storm sewer to be installed outside the public right-of-way.

Coefficients of roughness, “n,” for use in the Manning formula as listed below shall normally be used:

Type of Pipe	“n”
Concrete	0.013
PVC	0.010
Polyethylene	0.010

#### **11.2.7 Velocity**

The minimum allowable velocity in a storm sewer shall be 3 feet per second (fps). The maximum velocity shall be 15 fps.

#### **11.2.8 Pipe Strength**

Pipe specified shall meet AASHTO HS-20 loadings.

#### **11.2.9 Alignment**

Sewer shall be installed with a straight alignment between structures with the following two exceptions: In locations where layouts are such that a straight alignment is not practical, sewers may be curved. The curvature must be concentric with the curvature of the street. The pipe manufacturer’s recommended maximum deflection angle shall not be exceeded. Storm sewer bends will be shown as required. The City of Dell Rapids may require a structure instead of a bend.

#### **11.2.10 Separation**

1. Storm sewer crossings of the water main will be performed in accordance with the Standard Specifications or as directed by the City of Dell Rapids. Water main will be installed at least ten (10) feet horizontally from any storm sewer.

Crossings of water main and storm sewer will have a minimum of 18 inches clearance between the outside surface of the pipes.

2. Storm sewer crossings of sanitary sewer shall be performed in accordance with the Standard Specifications or as directed by the City of Dell Rapids.

Sanitary sewer shall be installed at least two (2) feet horizontally from any storm sewer.

Crossings of sanitary sewer and storm sewer will have a minimum of six (6) inches clearance between the outside surface of the pipe. Crossings that have less than 18 inches of clearance will be structurally supported.

### **11.2.11 Ground Water Barriers**

When there exists a possibility that ground water may be diverted and follow the path of the new sewer, ground water barriers shall be constructed in adequate numbers to prevent ground water migration along sewer trenches.

## **11.3 Storm Sewer Appurtenances**

### **11.3.1 Junction Boxes**

#### **1. Location**

Trunk storm sewer is defined as any storm sewer 18 inches in diameter or larger that is used to convey storm water from two or more inlets.

Lateral storm sewer is defined as the storm sewer that connects to the trunk sewer system. Minimum lateral storm sewer pipe shall be 12 inches in diameter.

Structures shall be required when trunk line storm sewers intersect.

Pipe Tee-Sections may be used to connect a lateral storm sewer to the trunk storm sewer when the lateral length between the Tee-Section and a structure is 75 feet or less.

Field connections to connect a lateral system to the existing trunk storm sewer system, as described in the previous paragraph, will only be permitted if conditions prohibit the installation of a structure, as determined by the City of Dell Rapids.

Bends may be used along the trunk system between structures when curvature alignment requires the bend and the maximum spacing between structures has not been exceeded. The City of Dell Rapids may require a structure instead of a bend.

For 18-inch-diameter storm sewer, the maximum total bend or curvature allowed is 22.5 degrees. For 24-inch-diameter storm sewer and larger, the maximum single bend allowed is 45 degrees. If more than one bend is required due to alignment curvature, the maximum angle per bend is 7.5 degrees. Maximum total curvature is 90 degrees for 24-inch RCP and larger.

Structures shall be installed at the upper end of each line, at changes in grade, size, curvature or alignment, and at distances not greater than: 400 feet for sewers 15 inches in diameter or less; 450 feet for sewers 18 inches and 21 inches in diameter; and 500 feet for sewers 24 inches or larger.

Structures must be located in areas which allow direct access by maintenance vehicles.

## 2. Flow Channels

When there is an increase in sewer size of a smaller sewer connected with a larger one, the invert of the smaller sewer must be raised to maintain the same energy gradient. An approximate method of doing this is to place the 0.8 depth point of both sewers at the same elevation or to match the crown of the pipe. Structures that have a direction change of flow shall have a minimum 0.1-foot drop between the inverts.

Drop manholes shall be avoided whenever possible.

### 11.3.2 Outlets

1. Where a storm sewer discharges into a natural channel or irrigation ditch, an outlet structure shall be provided that will blend the storm sewer discharge into the natural channel flow in such a way as to prevent erosion of the bed or banks of the channel.
2. When the discharge velocity is low, or subcritical, the outlet structure may be one of the following:
  - a. Flared end section
  - b. Head wall
  - c. Wing walls
3. If the discharge velocity is high, or supercritical, prevention of erosion of the natural channel bed or banks in the vicinity of the outlet may require an energy dissipating structure.
4. All outlets shall have an apron consisting of one of the following:
  - a. Riprap with geotextile fabric base
  - b. Concrete slab
  - c. Other approved methods

### 11.3.3 Inlets

#### 1. Introduction

A storm inlet is an opening into a storm sewer system for the entrance of surface storm runoff. There are three types of inlets: curb opening, grated and combination. In addition, inlets may be further classified as being on a continuous grade or in a sump. The term "continuous grade" refers to an inlet so located that the grade of the street has a continuous slope past the inlet and therefore ponding does not occur at the inlet. The sump condition exists whenever water is restricted to the inlet area because the inlet is located at a low point. A sump condition can occur at a change in grade of the street from positive to negative or due to the crown slope of a cross street when the inlet is located at an intersection.

## **2. Inlet Standards**

Acceptable inlets for public streets shall be Type I curb opening or Type II combination. Curb opening inlets shall be used at true sumps or at sumps formed by crown slope of cross section at the intersection. Either curb opening type or combination inlets may be used on continuous grade. Grated inlets may be used for parking areas and open fields or other applications subject to approval by the City of Dell Rapids.

Reduction factors shall be applied to the theoretical calculated capacity of inlets based upon their type and function. The reduction factors compensate for effects which decrease the capacity of the inlet such as debris plugging, pavement overlaying, and in variations of design assumptions.

The allowable capacity of an inlet shall be determined by applying the applicable reduction factor from Table 11.3 (Appendix) to the theoretical capacity as presented in the following sections.

The size of outlet pipes from storm water inlets shall be based upon the theoretical capacity of the inlet, but shall not be less than 12 inches in diameter.

## **3. Curb Opening Inlet Hydraulics**

A curb opening inlet may operate under two different conditions of flow: (1) free flow conditions under which a free water surface is continuous into the inlet, or (2) submerged conditions, in which the inlet functions as an orifice. The continuous grade design procedures described herein assume that the inlets will be designed to operate under the free flow condition, since the gutter flow depth required to submerge the inlet is greater than the allowable street capacity.

The inlet dimensions evaluated herein are the standards used for Type I and II inlets.

## **4. Sump Condition**

Presented in Figure 11.3 (Appendix) is a capacity nomograph for sump condition with a gutter depression at the inlet. This chart is an adaptation of a Bureau of Public Roads chart and is applicable to both the free flow and the submerged cases.

## **5. Continuous Grade**

For the "continuous grade" condition, the capacity of the inlet is dependent upon many factors including gutter slope, depth of flow in the gutter, height and length of curb opening, street cross slope, and the amount of depression at the inlet. In addition, all of the gutter flow will not be intercepted and some flow will continue past the inlet area ("bypass"). The amount of bypass must be included in the downstream drainage facility evaluation as well as in the design of the inlet.

Inlet size and spacing is dependent upon the allowable use of streets for handling storm runoff. Section 11.6, page 11.17, of this chapter will address pavement encroachment and provide criteria for the maximum width of spread (W) as addressed below.

When the allowable pavement encroachment has been determined, the theoretical gutter capacity for a particular encroachment can be determined by the use of Figure 11.4 (Appendix). To further simplify computations, Figure 11.5 (Appendix) is provided to enable direct determinations for various street sections. Figure 11.4 (Appendix) as well as the charts for inlet capacity provided in the Appendix of these standards will assist the designer in solving for the capacity of an inlet on a continuous grade. The procedure for properly sizing and determining inlet spacing is as follows:

- a. After the design has determined a total runoff discharge ( $Q$ ) flowing upstream of the inlet, enter Figure 11.5 (Appendix) for design  $Q$  and extend a vertical line down to intersect with the longitudinal gutter slope ( $S_o$ ). Extend a horizontal line from the point to the cross slope ( $S_x$ ) of the street being studied and extend a vertical line down from this point to the width of spread ( $W$ ). The depth of flow ( $D$ ) at the curb may also be determined if the vertical line intersecting the cross slope ( $S_x$ ) on the lower portion of the graph is extended horizontally to intercept the depth at the curb.
- b. Select the appropriate capacity chart from the Appendix for the type of inlet (Type I or II), street cross slope ( $S_x$ ) and longitudinal gutter slope ( $S_o$ ).
- c. Type I inlets: Enter the chart for the inlet length selected. Extend a vertical line up to intersect the curve for the width of spread ( $W$ ) determined in Step 1 and extend a horizontal line from this point to the inlet intercept ratio ( $Q_i/Q$ ).

Type II inlets: Enter the chart for the width of spread ( $W$ ) determined in Step 1. Extend a horizontal line across to intersect the line for the longitudinal gutter slope ( $S_o$ ) and extend a vertical line from this point to the inlet intercept ratios ( $Q_i/Q$ ).

- d. Multiply the inlet intercept ratio ( $Q_i/Q$ ) determined in Step 3 times the total discharge ( $Q$ ) carried by the gutter, yields the quantity of water being intercepted by the inlet ( $Q_i$ ). For Type I inlets, the designer may want to repeat Steps 3 and 4 for other lengths of inlets.

After the theoretical capacity has been determined as outlined above, capacity reduction factors must be applied as listed in Table 11.3 (Appendix). The designer will need to choose which type of inlet is most effective based upon both hydraulic and economic considerations.

## 6. Capacity of Grated Inlets in Sump

As previously noted, grated inlets may be used for parking areas and open fields or other areas subject to approval by the City of Dell Rapids. The design procedure presented in the following section is based upon the assumption that the grated inlet is clear from debris and is operating at its maximum efficiency.

For a grated inlet operating under sump conditions, the reduction factors of Table 11.3 (Appendix) shall be applied.

Under sump conditions a grated inlet acts essentially as a series of orifices. Design charts indicate that the application of the orifice formula to the clear opening of the inlets gives satisfactory capacities for a clean inlet. Figure 11.6 (Appendix) shows the results of the tests. The head used shall be determined by the allowable depth of ponding for the installation at the design storm frequency.

## 11.4 Culverts

### 11.4.1 General

Culverts may be of any shape and construction as required by existing topographic features; provided, however, the size, location and type of construction of culverts shall be subject to acceptance by the City of Dell Rapids.

Culverts within major drainageways that are under arterials or railroads shall have sufficient capacity to pass all of the runoff from the 100-year storm considering 20 percent of the inlet plugged, for pipes under 48" diameter.

For all other streets, culverts must be designed to convey a minimum of 10-year flow with no street overtopping and must be large enough so that the 100-year flow over the top of the road does not exceed 18 inches in depth above the invert of the gutter.

### 11.4.2 Design Criteria

1. The following design criteria shall be utilized for all culvert design:
  - a. The culvert including inlet and outlet structures shall properly take care of storm water flow, bed-load and debris at all stages of flow.
  - b. **Inlets.** Culvert inlets shall be designed to minimize entrance and friction losses. Inlets shall be provided with either flared-end sections or head walls with wing walls. Projecting ends will not be acceptable. For large structures provisions shall be made to resist possible structural failure due to hydrostatic uplift forces.
  - c. **Outlets.** Culvert outlets shall be designed to avoid sedimentation, undermining of the culvert, or erosion of the downstream channel. Outlets shall be provided with either flared-end sections or headwalls, with wingwalls. Projecting outlets will not be acceptable. Additional outlet control in the form of rip rap, channel shaping, dissipation structure, etc., may be required where excessively high discharge velocities occur. All structural outlet velocity dissipaters shall be underlain with a suitable filter fabric to protect against scour.
  - d. **Slopes.** Culvert slopes shall be such that neither silting nor excessive velocities and scour occur. Generally, the minimum slope of culverts shall be limited to 0.50 percent.
  - e. **Hydraulic Design.** Culverts shall be analyzed to determine whether discharge is controlled by inlet or outlet conditions for both the initial storm discharge and the major storm discharge. The value of the roughness coefficient (n) used shall not be less than those specified by documentation of the culvert manufacturer. Computations for selected culvert sizes shall be submitted for review.

- f. **Minimum Allowable Size.** The required size of the culvert shall be based upon adequate hydraulic design analysis. In no case, however, will approval be made for round culverts with less than 18 inches inside diameter, or for arched or oval shaped culverts with span-rise dimensions less than 24 inches x 18 inches nominal. Culverts 12 inches or greater in diameter may be used for single-family residential access drives.

The minimum height of a reinforced box culvert should be 3 feet to facilitate cleanout and allow removal of forms during construction.

- f. **Multiple Culvert Installation.** Where physical conditions dictate, multiple culvert installations will be acceptable, provided the minimum size of any culvert to be used shall not be less than the requirements set forth above.
- g. **Structural Design.** The structural design of culverts shall conform to those methods and criteria recommended by the manufacturer of a specific type of culvert dependent upon the type of bedding, the method of installation, and the load.
- h. **Trash and Debris Deflector.** When, in the opinion of the City of Dell Rapids, debris accumulation for a particular drainageway appears to pose a significant probability of culvert plugging, trash racks or debris deflectors will be required.

## 11.5 Open Channel Flow

### 11.5.1 General

Major drainageways and lateral drainageways shall be defined by the City Subdivision Ordinance.

See Figure 11.7A, 11.7B, 11.7C (Appendices) for design standards for channel construction.

All channels will be designed with the 5-year storm frequency and the 100-year storm frequency considered.

Channels shall be designed in such a manner that flows at the critical depth and supercritical flows are avoided.

If increased flows are proposed for any channel, protection as required shall be provided for a natural channel. Channel protection will be designed to withstand forces that attempt to overtop the channel banks, deteriorate the channel lining, erode soils beneath the channel lining and erode unlined areas of the channel.

Open channels conveying storm water shall be designed using the Tractive Force Procedure. The permissible shear stress,  $T_d$ , is the force required to initiate movement of channel lining material. Normal depths in the channel are calculated using Manning's equation. Manning's roughness coefficients for different ranges of depth are provided in Figure 11.7B. The coefficient of roughness generally decreases with increasing flow depth.

Shear stress,  $T$ , at normal depth, is computed for the lining by the following equation:

$$T = yds \quad \text{(Equation 5a)}$$

Where:

- $T$  = shear stress in  $\text{lb/ft}^2$
- $y$  = unit weight of water,  $62.4 \text{ lbs/ft}^3$
- $d$  = flow depth in feet
- $s$  = channel gradient in  $\text{ft/ft}$

If the permissible shear stress,  $T_d$ , given in Figure 11.7C, is greater than the computed shear stress,  $T$ , the chosen channel liner is considered acceptable. If the computed shear stress is too great, select a liner with a higher permissible shear stress and repeat the calculations for normal depth and shear stress. In some cases, it may be necessary to alter the channel dimensions to reduce the shear stress.

All channels shall be designed with proper and adequate erosion control features. When required, drops or check dams shall be installed to control water surface profile slope.

Grass-lined channels or side slopes of concrete-lined channels will be seeded with a mixture as set forth in these Design Standards.

Lateral drainageways without a low flow storm sewer will only be permitted with the acceptance by the City of Dell Rapids.

For channels that cross a roadway and overflow the street section within design standards, it is acceptable to provide an easement for the 12-foot access strip along the backwater area. The remaining channel dedication will be per City Ordinance.

## 11.6 Street Flow Capacity

### 11.6.1 General

The criteria set forth herein will be used in analyzing and approving the adequacy of streets as a function of the drainage system. Both the minor and 100-year storm runoff must be considered and calculations showing such runoff at critical sections shall be submitted. Street, curb and gutter, valley gutters, and curb cuts shall conform to the Standard Specifications or as directed by the City of Dell Rapids.

### 11.6.2 Street Capacity for Minor Storms

Pavement encroachment for the minor design storm shall not exceed the limitations set forth in the following table:

#### Allowable Pavement Encroachment and Depth of Flow for Minor Storm Runoff

Street Classification	Maximum Encroachment*
Local	No curb overtopping. Flow may spread to crown of street.

Collector	No curb overtopping. Flow spread must leave the equivalent of one 10-foot driving lane clear of water (one lane for two-lane street, two lanes for four-lane street).
Arterials	No curb overtopping. Flow spread must leave the equivalent of two 10-foot driving lanes clear of water; one lane in each direction.
Freeways	No encroachment is allowed on any traffic lane.

\*Where no curbing exists, encroachment shall not extend past the property lines.

The storm sewer system shall commence at the point where the maximum allowable encroachment occurs. All storm sewer systems shall be designed for the 5-year storm event.

When the allowable pavement encroachment has been determined, the theoretical gutter carrying capacity for a particular encroachment shall be computed using the modified Manning's formula for flow in a triangular channel as shown in Figure 11.4 (Appendix). To simplify computations, graphs for particular street shapes may be used as shown on Figure 11.5 (Appendix). An "n" value of 0.015 shall be used unless special considerations exist.

### 11.6.3 Street Capacity for Major Storms

The allowable depth of flow and inundated area for the major design storm shall not exceed the limitations set forth in the following table:

#### Allowable Depth of Flow and Inundated Area for 100-Year Storm Runoff

Street Classification	Allowable Depth and Inundated Areas
Local and Collector	Residential dwellings, public, commercial, and industrial buildings shall not be inundated at the ground line. The depth of water over the gutter flow line shall not exceed 18 inches.
Arterial and Freeway	Residential dwellings, public, commercial, and industrial buildings shall not be inundated at the ground line. Depth of water at the street crown shall not exceed 6 inches to allow operation of emergency vehicles. The depth of water over the gutter flow line shall not exceed 18 inches.

### 11.6.4 Cross Street Flow

Cross street flow can occur by two separate means: (1) runoff which has been flowing in a gutter and then flows across the street to the opposite gutter or inlet; (2) water from some external source, such as a drainageway or conduit, will flow across the crown of

the street when the conduit capacity beneath the street is exceeded. The maximum allowable cross street flow depth based on the worst condition shall not exceed the limitation stipulated in the following table.

**Allowable Cross Street Flow**

<b>Street Classification</b>	<b>Minor Storm Runoff</b>	<b>100-Year Design Storm Runoff</b>
Local	6-inch depth at crown or in the valley gutter	18 inches of depth above gutter flowline
Collector	Depth of flow shall not exceed 6 inches above gutter flow line	18 inches of depth above gutter flowline
Arterial	None	6 inches or less over crown
Freeway	None	6 inches or less over crown

**11.6.5 Capacity Calculations**

All theoretical flow capacities shall be reduced by the appropriate reduction factors as shown in Figure 11.8 (Appendix) to obtain allowable flow capacities.

**11.6.6 Drainage Tract Requirements**

All backward draining cul-de-sacs and sump streets are required to have a minimum 20-foot-wide drainage easement shown on the plat for the purpose of conveying drainage. The easement shall meet the applicable requirements for storm sewer easements.

**11.6.7 Sump Pump Collection Systems**

1. When required in accordance with Subdivision Ordinance, drainage systems can be designed with a sump pump system attached to the trunk drainage system.
  - a. It is acceptable for a sump pump collection system to be installed in the street right-of-way or within a backyard easement. If within a backyard easement, the collection pipe shall be installed 1.5 feet south or east of the back property line. If within a front yard easement, the collection pipe shall be installed eight (8) feet from the street right-of-way.
  - b. Services shall not cross the street section.
  - c. Storm sewer can serve as the sump pump collection pipe. RCP storm sewer pipe will be cored drilled for service connections. Polyethylene pipe or PVC pipe service connections will be installed in accordance with manufacturer specifications.
  - d. Service connections shall be installed and capped along the mainline pipe for each individual lot. For backyard installations, service stub-outs shall be centered on the back lot line.

- e. A minimum 24-inch diameter structure shall be installed at a maximum distance of 600 feet. A 5-foot access easement from right-of-way to backyard easement is required for the backyard structures. Corner lots may not require a 5-foot access easement.
  - f. Structures will be installed at the farthest upstream and downstream end. For front yard installations, the structures shall be on the side lot line. For backyard installations, the structures shall be +/- 5 feet from the side lot line.
  - g. Minimum diameter of sump pump collection system pipe shall be 6 inches. Minimum velocity shall be 2 feet/sec.
  - h. Maximum number of homes connected to a sump pump collection system until connected to a trunk storm sewer system is 300 homes.
  - i. The connection of the sump pump collection pipe to the trunk storm sewer system shall be a minimum of 0.4 foot above the structure outfall storm sewer or flow line.
  - j. Depth of cover shall be a minimum of 4 feet. When the minimum cover cannot be established, the collection system shall be insulated per Standard Plates or as directed by the City of Dell Rapids. For those systems that are insulated, a minimum cover of 18 inches in grassed /landscaped areas and 30 inches in asphalt/concrete areas shall be provided from finished grade to the top of the collection system pipe.
  - k. Bends will not be allowed. Minimum radius of curvature shall be 150 feet.
  - l. For backyard installations, if the swale along the back property line is less than 2 percent, the sump pump collection pipe may be a 6 inch min. perforated pipe with a filter fabric sock.
  - m. The minimum slope of collection pipes shall be 0.40 percent.
  - n. Animal guards shall be installed at the end of all collection pipes discharging directly into a public drainageway.
  - o. Sump pump collection pipe diameters less than 12 inches shall only convey groundwater.
2. A regional groundwater collection drain tile system can be installed instead of a sump pump collection system.

## **11.7 Detention Storage**

### **11.7.1 General**

Detention ponds shall be designed and constructed at those locations identified by the City of Dell Rapids. The use of onsite detention is permitted at those locations where the onsite drainage system cannot be tied into an existing drainage system.

Onsite detention may be used if the development cannot provide adequate storm sewer systems to achieve the required storm sewer standards.

Parking lots which serve as detention storage ponds must not have a storage depth of more than 1 foot. It is recommended that notification signs be installed in parking lots which serve as detention ponds. The signs shall be permanent and high quality, meeting SDDOT Specifications for Traffic Signs.

### **11.7.2 Design Storm**

Detention ponds along major drainageways shall be designed for a 100-year design flow.

Other detention ponds shall be designed such that the 5-year return storm is conveyed through the principal outlet assembly and the 100-year return storm is conveyed through the overflow assembly.

### **11.7.3 Release Methods**

Intermittent ponds shall drain completely.

Careful consideration must be given to the discharge of the surface release as to the elimination of erosion potential, and the capacity of the downstream surface water course. The release structure shall be designed to withstand the forces caused by the structure being overtopped during a larger than design storm.

A stage (in feet) versus release rate (in CFS) curve must be provided for the release structure.

### **11.7.4 Maximum Release Rate**

The detention pond volumes and release rate shall be designed to accommodate runoff generated by the development and post-developed upstream properties.

The release rate from the detention pond cannot exceed predevelopment rates for the 5-year and 100-year return storm when discharge is conveyed onto undeveloped property unless City-owned conveyance structures of adequate size are contiguous and downstream of the proposed discharge points.

### **11.7.5 Maintenance Requirements**

Detention ponds and similar areas not required as a necessary part of the major drainage system, may be accepted by the City for maintenance only if such land provides another useful public service such as a public park or wildlife area.

All detention areas shall have a 30-foot-wide access to a public right-of-way if they are not located adjacent to a public right-of-way.

Detention ponds serving properties greater than two (2) acres in size where discharge is generated from publicly maintained infrastructure may be dedicated to the City. Property delineation markers shall be installed upon dedication of the property in locations specified by City. All other detention ponds shall be privately maintained.

### **11.7.6 Adjacent Property Elevations**

The property corner elevation of properties abutting a detention pond shall be 1 foot above the 100-year design storm.

Recommended minimum ground elevations for homes abutting or affected by the detention pond shall be 2 feet above the overflow elevation. Recommended minimum ground elevation for homes abutting or affected by detention ponds will be a minimum of 4 feet above the 100-year pond high water elevation if an overflow system is not available or at an elevation that provides an additional 50 percent storage.

## **11.8 Best Management Practices**

All projects, except those that are less than two acres and have less than one acre of new impervious area, shall meet the requirements of Section 11.8. The following process is recommended for selecting structural BMPs in newly developing and redeveloping urban areas:

### **11.8.1 Employ Runoff Reduction Practices**

To reduce runoff peaks and volumes from urbanizing areas, employ a practice generally called “minimizing directly connected impervious areas” (MDCIA). The principal behind MDCIA is two-fold: to reduce impervious areas and to route runoff from impervious surfaces over grassy areas to slow down runoff, promote infiltration, and reduce costs. The benefits are less runoff, less storm water pollution, and less cost for drainage infrastructure. There are several approaches to reduce the effective imperviousness of a development site. Some examples include, but are not limited to: reduced pavement area, porous pavement, grass buffers, grass swales, and minimizing directly connected impervious areas.

### **11.8.2 Provide Water Quality Capture Volume**

A fundamental requirement for any site addressing storm water quality is to provide water quality capture volume (WQCV). One or more of five types of water quality basins, each draining slowly to provide for long-term settling of sediment particles, may be selected to provide WQCV. These five BMPs include: Porous Landscape Detention, Extended Detention Basin, Sand Filter Extended Detention Basin, Constructed Wetland Basin, and Retention Pond.

The Constructed Wetland Channel BMP must be used with a BMP that meets the WQCV criteria. It does not provide WQCV by itself. It can however provide additional water quality treatment and aesthetic value.

The Water Quality Catch Basins and Water Quality Catch Basin Inserts BMP do not meet the WQCV criteria. They are only intended for use in highly urbanized areas, such as redevelopment conditions, where existing development precludes the ability to meet the WQCV criteria. These BMPs must be approved for use by the City. In determining BMP approval, preference will be given to structural BMPs providing WQCV as listed in this section.

**CHAPTER 11 - DRAINAGE IMPROVEMENTS**

**APPENDIX**

**TABLES AND FIGURES**

## TABLES

**Table 11.1  
Runoff Coefficients for Rational Method**

Land Use or Surface Characteristics	Percent Impervious	Storm Frequency, years		
		5	10	100
<b>Business:</b>				
Commercial Areas	95	.88	.90	.93
Neighborhood Areas	65	.65	.70	.80
<b>Residential:</b>				
Single-Family	40	.45	.50	.70
Multi-Unit (detached)	50	.55	.60	.75
Multi-Unit (attached)	70	.70	.70	.80
1/2 Acre Lot or Larger	30	.40	.45	.65
Apartments	70	.70	.70	.80
<b>Industrial:</b>				
Light Areas	80	.80	.80	.85
Heavy Areas	90	.80	.85	.90
<b>Parks, Cemeteries:</b>	7	.25	.35	.60
<b>Playgrounds:</b>	13	.30	.40	.70
<b>Schools:</b>	50	.55	.60	.75
<b>Railroad Yard Areas:</b>	40	.45	.50	.70
<b>Undeveloped Areas:</b>				
Historic Flow Analysis	2	.20	.30	.60
Greenbelts, Agricultural				
Offsite Flow Analysis (when land use not defined)	45	.50	.55	.72
<b>Streets:</b>				
Paved	100	.88	.90	.93
Gravel	7	.25	.35	.65
<b>Drives and Walks:</b>	96	.87	.90	.92
<b>Roofs:</b>	90	.85	.90	.90
<b>Lawns, Sandy Soil:</b>	0	.10	.20	.50
<b>Lawns, Clay Soil:</b>	0	.20	.30	.60

NOTE: These Rational Formula coefficients do not apply for larger basins where the time-of-concentration exceeds 60 minutes.

REFERENCE: Urban Drainage and Flood Control District Rational Formula Procedure, Hydrology Research Program, August 1979.

**Table 11.2**

Roughness Coefficients (Manning's n) for Sheet Flow

---

Surface Description	n <sup>1</sup>
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Grass: <sup>2</sup>	
Short grass prairie	0.15
Dense grasses	0.24
Bermuda grass	0.41
Range (natural)	0.13
Woods: <sup>3</sup>	
Light underbrush	0.40
Dense underbrush	0.80

---

<sup>1</sup>The n values are a composite of information compiled by Engman (1986).

<sup>2</sup>Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.

<sup>3</sup>When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

**Table 11.3  
Reduction Factors to Apply to Inlets**

<b>Condition</b>	<b>Inlet Type</b>	<b>% of Theoretical Capacity Allowed</b>
Sump	Grated	50%
Sump	Combination	65%
Continuous Grade	Deflector	75%
Continuous Grade	Longitudinal Bar Grate incorporating recessed transverse bars	60%
Continuous Grade	Combination	110% of that listed for type of grate utilized
Sump or Continuous Grade	Curb Opening	
	L = 3'	80%
	L = 6'	88%
	L = 8'	90%
	L = 10'	92%
	L = 15'	95%

## FIGURES

## RAINFALL INTENSITY, in / hr

Tc	5 YEAR	100 YEAR	2 YEAR	10 YEAR	25 YEAR	50 YEAR
15	4.39	7.43	3.53	5.04	6.00	6.72
16	4.27	7.23	3.42	4.9	5.83	6.54
17	4.15	7.05	3.32	4.77	5.68	6.37
18	4.04	6.87	3.23	4.65	5.54	6.21
19	3.93	6.71	3.13	4.53	5.4	6.06
20	3.83	6.55	3.05	4.42	5.27	5.91
<hr/>						
21	3.74	6.40	2.97	4.31	5.14	5.78
22	3.65	6.25	2.89	4.21	5.02	5.64
23	3.57	6.11	2.82	4.12	4.91	5.52
24	3.49	5.98	2.75	4.03	4.80	5.40
25	3.41	5.86	2.68	3.94	4.70	5.28
26	3.34	5.74	2.62	3.86	4.60	5.17
27	3.27	5.62	2.55	3.78	4.50	5.07
28	3.2	5.51	2.5	3.71	4.41	4.97
29	3.14	5.40	2.44	3.63	4.33	4.87
30	3.08	5.30	2.39	3.57	4.24	4.77
<hr/>						
31	3.02	5.20	2.34	3.50	4.16	4.68
32	2.96	5.11	2.29	3.44	4.08	4.60
33	2.91	5.02	2.24	3.37	4.01	4.51
34	2.86	4.93	2.20	3.32	3.94	4.43
35	2.81	4.84	2.15	3.26	3.87	4.36
36	2.76	4.76	2.11	3.20	3.80	4.28
37	2.72	4.68	2.07	3.15	3.74	4.21
38	2.67	4.61	2.03	3.10	3.68	4.14
39	2.63	4.53	2.00	3.05	3.61	4.07
40	2.59	4.46	1.96	3.01	3.56	4.01
<hr/>						
41	2.55	4.39	1.93	2.96	3.50	3.94
42	2.51	4.32	1.89	2.91	3.45	3.88
43	2.47	4.26	1.86	2.87	3.39	3.82
44	2.43	4.20	1.83	2.83	3.34	3.76
45	2.40	4.13	1.80	2.79	3.29	3.71
46	2.36	4.08	1.77	2.75	3.24	3.65
47	2.33	4.02	1.74	2.71	3.20	3.60
48	2.30	3.96	1.71	2.68	3.15	3.55
49	2.27	3.91	1.69	2.64	3.11	3.50
50	2.24	3.85	1.66	2.61	3.06	3.45
<hr/>						
51	2.21	3.80	1.64	2.57	3.02	3.41
52	2.18	3.75	1.61	2.54	2.98	3.36
53	2.15	3.70	1.59	2.51	2.94	3.32
54	2.13	3.66	1.56	2.48	2.90	3.27
55	2.10	3.61	1.54	2.45	2.87	3.23
56	2.07	3.56	1.52	2.42	2.83	3.19
57	2.05	3.52	1.50	2.39	2.80	3.15
58	2.03	3.48	1.48	2.36	2.76	3.11
59	2.00	3.44	1.46	2.33	2.73	3.07
60	1.98	3.39	1.44	2.31	2.69	3.04

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Sources: FHA Circular No. 12, Drainage of Highway Pavements  
Sources: U.S. Weather Bureau, Technical Paper No. 40, 1963.  
NOAA Central Weather Service, Technical Memorandum NWS HYDRO-35, 1977.

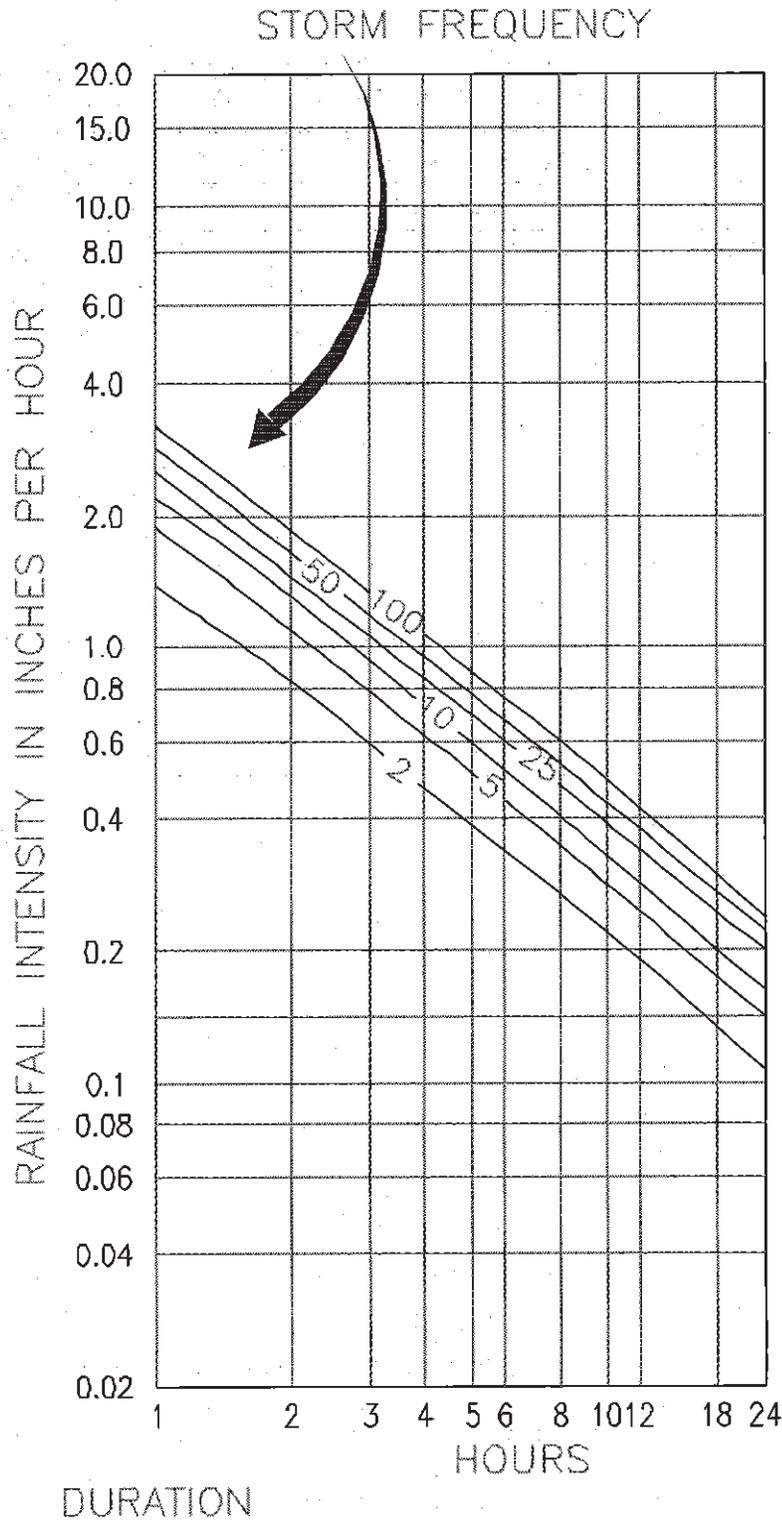
INTENSITY-  
DURATION-  
FREQUENCY  
CHART

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REVISED: \_\_\_\_\_

FIGURE NO.

11.1A



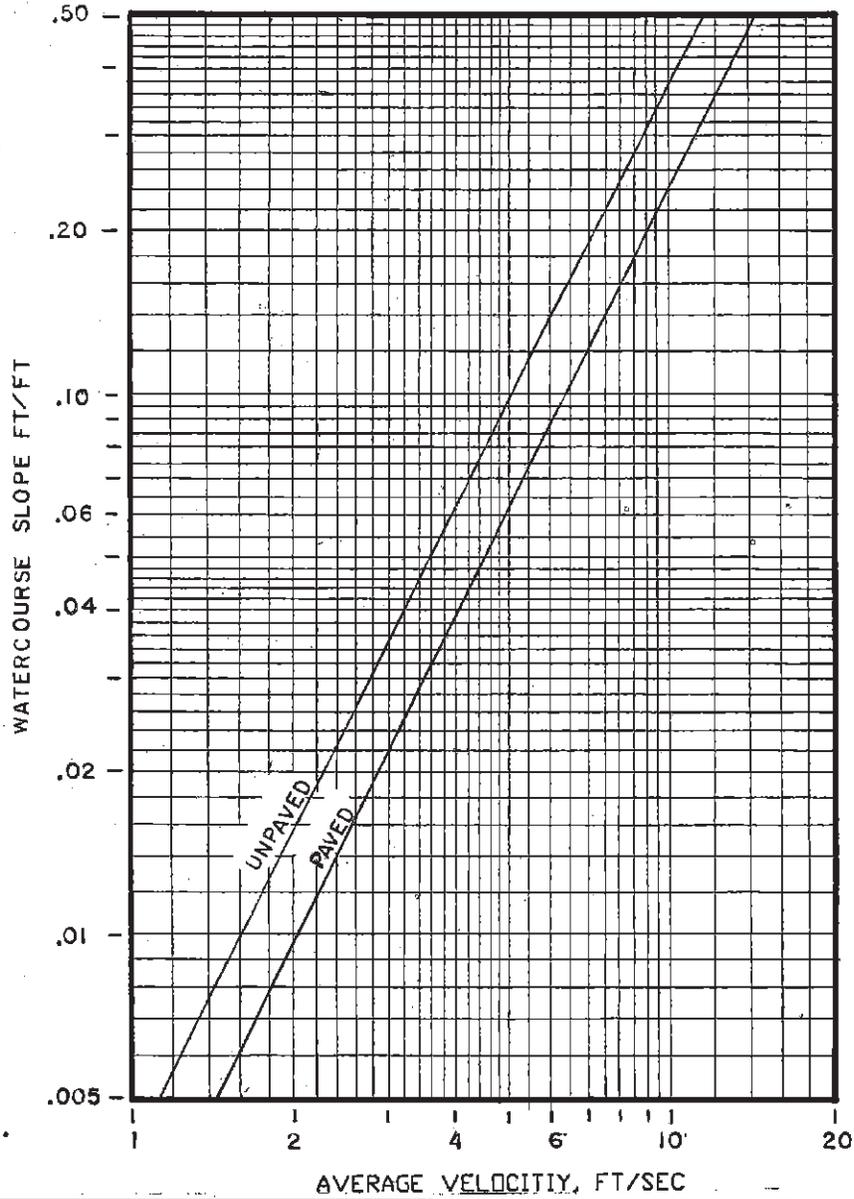
Sources; U.S. Weather Bureau, Technical Paper No. 40, 1963.  
 NOAA Central Weather Service, Technical Memorandum NWS HYDRO-35, 1977.

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INTENSITY-  
 DURATION-  
 FREQUENCY

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 REVISED: JUNE 03  
 FIGURE NO.  
**11.1B**



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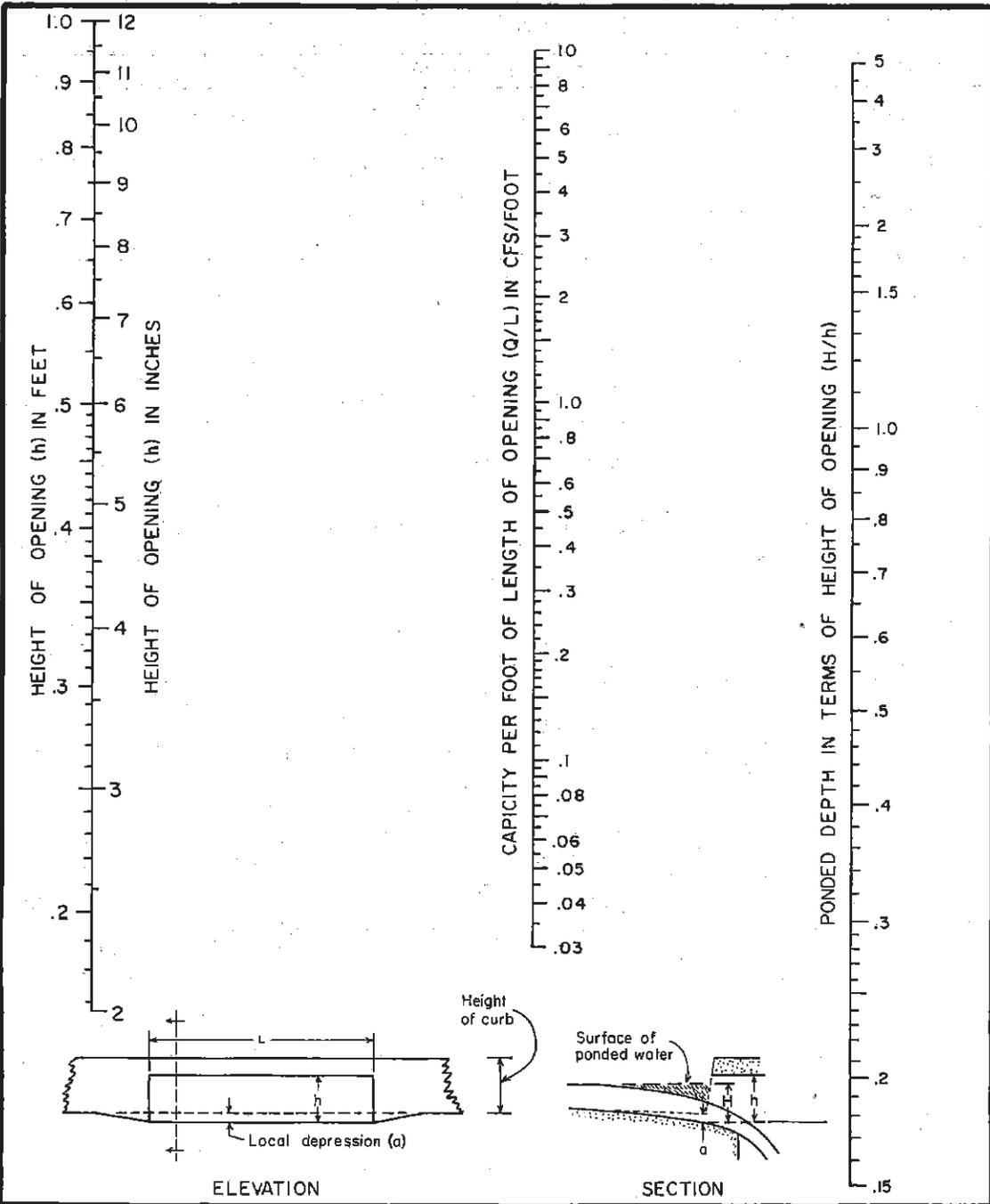


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**AVERAGE VELOCITIES  
 FOR ESTIMATING  
 TRAVEL TIME FOR  
 SHALLOW CONCENTRATED  
 FLOW**

ISSUED: JULY 9, 1999  
 REVISED:

FIGURE NO.  
**11.2**



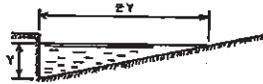
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**CAPACITY OF CURB  
 OPENING INLET  
 AT LOW POINT  
 IN GRADE**

ISSUED: JULY 9, 1999  
 REVISED:  
 FIGURE NO. 11.3



EQUATION:  $Q = 0.56 \left(\frac{Z}{n}\right)^{1/2} S^{1/2} Y^{3/2}$

n is roughness coefficient in Manning formula appropriate to material in bottom of channel.

Z is reciprocal of cross slope

REFERENCE: H.R.B. Proceedings 1948 page 150, equation (14)

EXAMPLE: (see dashed lines)

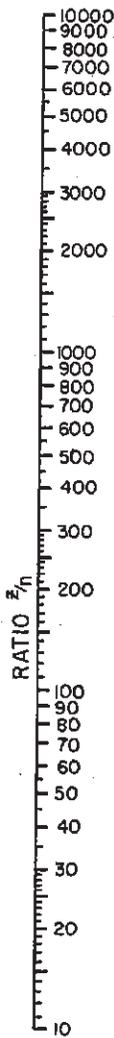
GIVEN:  $S = 0.05$

$Z = 24$

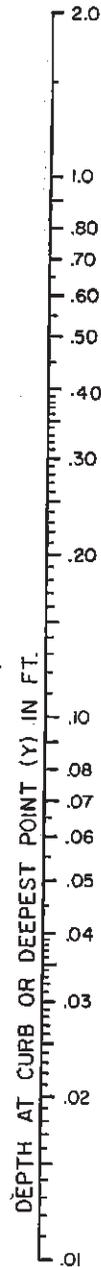
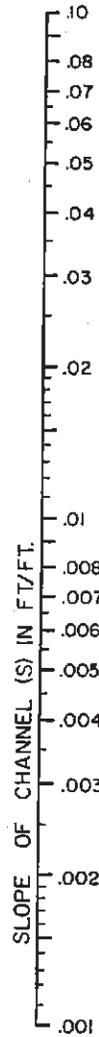
$n = .02$   $Z/n = 1200$

$Y = 0.22$

FIND:  $Q = 20 cfs$



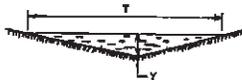
TURNING LINE



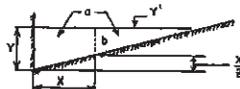
INSTRUCTIONS

1. Connect  $Z/n$  ratio with slope (S) and connect discharge (Q) with depth (Y). These two lines must intersect at turning line for complete solution.

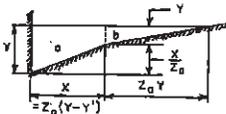
2. For shallow V-shaped channel as shown use nomograph with  $Z = \frac{T}{Y}$



3. To determine discharge  $Q_x$  in portion of channel having width X: determine depth Y for total discharge in entire section a. Then use nomograph to determine  $Q_b$  in section b for depth  $y' = Y \left(\frac{X}{a}\right)$



4. To determine discharge in composite section: follow instruction 3 to obtain discharge in section a of assumed depth Y, obtain  $Q_b$  for slope ratio  $Z_b$  and depth Y then  $Q_T = Q_a + Q_b$



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NOMOGRAPH FOR  
FLOW IN  
TRIANGULAR CHANNELS

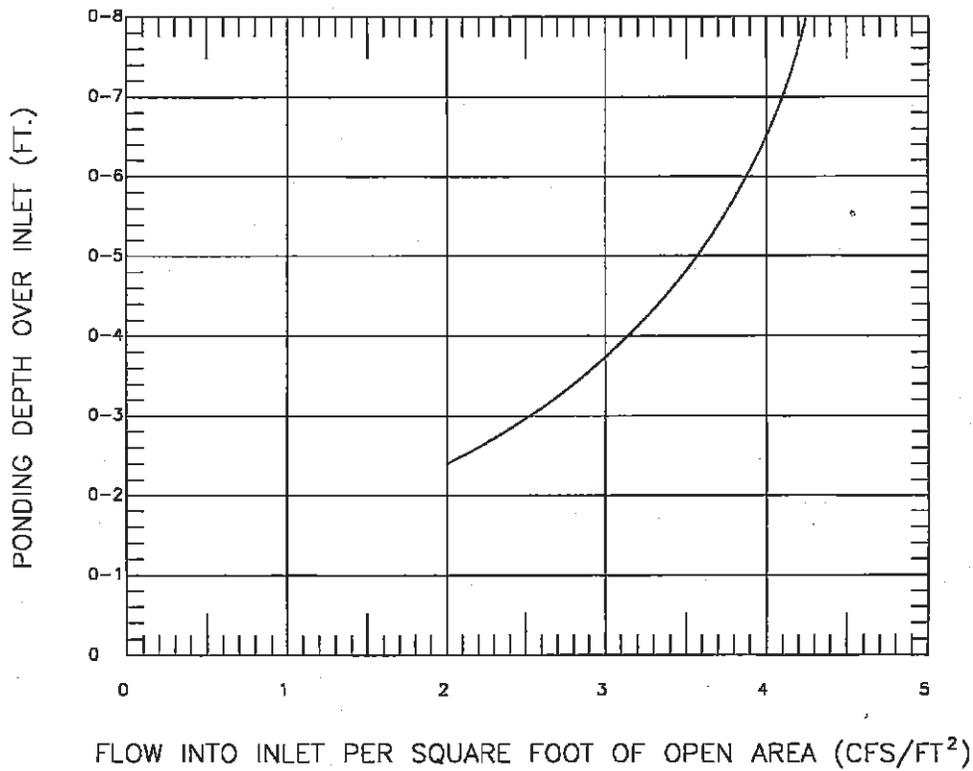
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FIGURE NO.

11.4





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CAPACITY OF A  
 GRATED INLET  
 IN SUMP

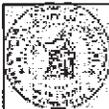
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FIGURE NO.  
**11.6**

DESIGN CRITERIA	RESIDENTIAL LATERAL WITH PIPE	NON-RESIDENTIAL LATERAL / CONCRETE CHANNEL	MAJOR DRAINWAY
GRASS SIDE SLOPES	4:1 OR FLATTER	4:1 OR FLATTER	4:1 OR FLATTER
FREE BOARD (100 YEAR STORM)	0.5 FOOT	0.5 FOOT	$H = 0.5 + V^2/2g$ MIN. 1 FOOT
BOTTOM WIDTH MINIMUM	4 FOOT	6 FOOT	5 X DEPTH OF 100 Yr. FLOW
DEPTH (100 YEAR STORM)	MAX. 2 FOOT	MAX. 2 FOOT	PER MASTER DRAINAGE PLAN
SLOPE MINIMUM	1%	0.5%	0.2% - 0.6% (NATURAL)
LOW FLOW PIPE / CHANNEL	18" MIN. RESIDENTIAL & COMMERCIAL 2 YEAR INDUSTRIAL	2 YEAR CAPACITY CROSS-SLOPE 1/4" PER FOOT	N/A
RADIUS	N/A	N/A	2 X TOP WIDTH AND > 100 FEET CENTERLINE
VELOCITY	N/A	MIN. 2 FOOT/SEC. 5 YEAR	MIN. 2 FOOT/SEC. 5 YEAR

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CHANNEL  
 DESIGN  
 CRITERIA

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 REVISED: 12-17-03  
 FIGURE NO. **11.7A**

MANNINGS "n" VALUE FOR DEPTH RANGES

LINING TYPE	DEPTH		
	0 - 0.5 FEET	0.5 - 2.0 FEET	> 2.0 FEET
WOVEN PAPER NET	0.018	0.015	0.015
JUTE NET	0.028	0.022	0.019
FIBERGLASS ROVING	0.028	0.021	0.019
STRAW WITH NET	0.065	0.033	0.025
CURLED WOOD MAT	0.066	0.035	0.028
SYNTHETIC MAT	0.036	0.025	0.021
GRAVEL RIPRAP (1" D50)	0.044	0.033	0.030
GRAVEL RIPRAP (2" D50)	0.066	0.041	0.034
GRAVEL RIPRAP (6" D50)	0.104	0.069	0.035
GRAVEL RIPRAP (12" D50)	N/A	0.078	0.040

Adapted From FRVA, RES-35, APRIL 1983, page 37

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 PUBLIC WORKS - DIVISION OF ENGINEERING  
 224 W. 9TH STREET - SIOUX FALLS, SD 57104  
 PHONE: (605)387-8601 FAX: (605)387-4310

MANNINGS "n"  
 VALUES FOR  
 CHANNEL  
 PROTECTION  
 CRITERIA

ISSUED: 12-17-03

REVISED: \_\_\_\_\_

FIGURE NO.  
**11.7B**

ALLOWABLE SHEAR STRESSES FOR CHANNEL LININGS

LINING TYPE	COMMENTS	SHEAR STRESS, T <sub>d</sub> (Lbs/Square Foot)
WOVEN PAPER NET	SUBMITTED BY DESIGN ENGINEER	0.15
JUTE NET	SUBMITTED BY DESIGN ENGINEER	0.45
FIBERGLASS ROVING	SUBMITTED BY DESIGN ENGINEER, SINGLE	0.60
FIBERGLASS ROVING	SUBMITTED BY DESIGN ENGINEER, DOUBLE	0.85
STRAW WITH NET	SUBMITTED BY DESIGN ENGINEER	1.45
CURLED WOOD MAT	SUBMITTED BY DESIGN ENGINEER	1.55
SYNTHETIC MAT	SUBMITTED BY DESIGN ENGINEER	2.00
VEGETATIVE, CLASS A	WEeping LOVEGRASS, YELLOW BLUESTEM	3.70
VEGETATIVE, CLASS B	BERMUDA, BLUE GRAMA, NATIVE GRASS MIXTURES	2.10
VEGETATIVE, CLASS C	BERMUDA, KENTUCKY BLUE, CENTIPEDE	1.00
VEGETATIVE, CLASS D	BERMUDA, BUFFALO, GRASS LEGUME	0.60
VEGETATIVE, CLASS E	BERMUDA	0.35
GRAVEL RIPRAP	D50 STONE SIZE = 1 INCH	0.33
GRAVEL RIPRAP	D50 STONE SIZE = 2 INCH	0.67
ROCK RIPRAP	D50 STONE SIZE = 6 INCH	2.00
ROCK RIPRAP	D50 STONE SIZE = 12 INCH	4.00

Adopted From FHWA HEC-10, APRIL 1983, pages 35 and 36

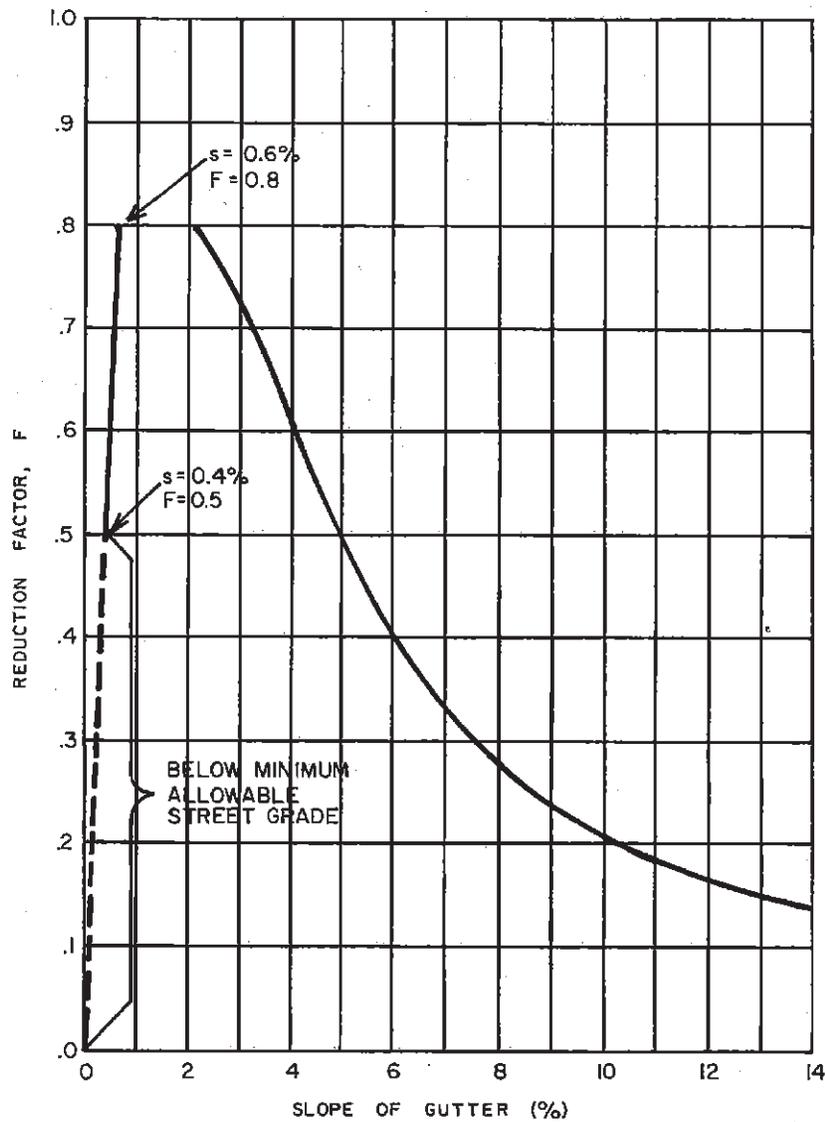
DRAWN BY: RRH  
 CHECKED BY: \_\_\_\_\_  
 APPROVED BY: J.D.



**CITY OF SIOUX FALLS**  
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ALLOWABLE  
 SHEAR  
 STRESSES FOR  
 CHANNEL  
 LINERS

ISSUED: \_\_\_\_\_  
 REVISED: \_\_\_\_\_  
 FIGURE NO.  
**11.7C**



Apply reduction factor for applicable slope to the theoretical gutter capacity to obtain allowable gutter capacity.

DRAWN BY: RLN

CHECKED BY:

APPROVED BY:



**SIoux FALLS**  
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REDUCTION  
 FACTOR FOR  
 ALLOWABLE  
 GUTTER CAPACITY

ISSUED: JULY 9, 1999

REVISED:

FIGURE NO.

11.8

## Chapter 12

### Erosion and Sediment Control

<b>Section</b>	<b>Topic</b>	<b>Page</b>
12.1	Introduction	12.1
12.2	Erosion Control	12.8
12.3	Sediment Control	12.11
12.4	Drainageway Protection	12.16
12.5	Underground Utility Construction	12.19
12.6	Disposition of Temporary Measures	12.19
12.7	Maintenance	12.19
12.8	Pollution Prevention Using Nonstructural BMPs	12.19
12.9	Inspections	12.20
12.10	Construction Control Measures	12.21
12.11	Final Stabilization	12.21

## Chapter 12

### Erosion and Sediment Control

#### 12.1 Introduction

This *Erosion Control Standard* has been developed based on a model prepared by the Urban Drainage and Flood Control District of Denver, Colorado. It has been revised to reflect the needs of the City of Dell Rapids and provides a set of criteria and technical guidance for erosion and sediment control at construction sites. In addition, it describes plan submittal requirements, planning considerations, and general exemptions followed by the City. The practices contained in this document shall be viewed as minimum requirements. A glossary of terms is included in the Appendix, 12A.2.

##### 12.1.1 General

The Environmental Protection Agency (EPA) issued regulations on November 16, 1990, that require steps be taken to improve the quality of storm water from industrial activities, including certain construction activities. These criteria were developed to help mitigate the increased soil erosion and subsequent deposition of sediment offsite during the period of construction from start of earth disturbance until final landscaping and storm water quality measures are effectively in place. Compliance with these criteria will help meet the requirements of the EPA storm water regulations.

Submittal of an *Erosion and Sediment Control Plan* to the City does not supercede the requirement for the applicant to also obtain any required permits from the State of South Dakota, such as a South Dakota Storm Water Discharge Permit for Construction Activities. In most cases, the applicant will also have to submit a Notice of Intent to discharge storm water associated with construction activity to the South Dakota Department of the Environment and Natural Resources (SDDENR) as well as meet the requirements of the South Dakota Storm Water Discharge Permit for Construction Activities.

Implementation and maintenance of erosion control measures are ultimately the responsibility of the property owner. Because site conditions will affect the suitability and effectiveness of erosion control measures, a plan specific to each site is required. In addition, should the approved plan not function as intended, and it is determined by the City that additional measures are needed, the owner will have to provide additional measures needed to reduce soil erosion and sediment discharged from the construction site.

Nothing in these criteria limits the right of the City to impose additional or more stringent standards.

### 12.1.1.1 Exemptions

1. Exemptions from the erosion control planning process will be considered for any of the following; however, exempting the owner from preparing an *Erosion and Sediment Control Plan* and applying for an Excavation and Grading Permit does not exempt the owner from controlling erosion of soil at each construction site through the use of the techniques described in this manual:
  - a. Agricultural use of land.
  - b. Grading or an excavation below finished grade for basements, footings, retaining walls, or other structures on lots of less than one (1) acre in size in existing subdivisions unless required otherwise.
  - c. A sidewalk or driveway.
  - d. Land-disturbing activities involving less than one (1) acre of disturbed area. Individual lots involving less than one (1) acre of disturbed area in a larger subdivision project shall not be considered separate development projects, but rather as a part of the subdivision development as a whole. It will be the responsibility of the homeowner and homebuilder to conform to all requirements of the locally-approved *Erosion and Sediment Control Plan* for the subdivision. As part of any Building Permit for which a specific erosion control plan is not required, the following statement must be included: "We have reviewed the *Erosion and Sediment Control Plan* for (subdivision name) and agree to conform to all requirements contained therein and all erosion control requirements of the City of Dell Rapids. We further agree to construct and maintain all erosion and sediment control measures required on the individual lot(s) subject to this Building Permit and/or in accordance with the provisions of the City of Dell Rapids *Erosion and Sediment Control Standards*."
  - e. Underground utility construction, including the installation, maintenance, and repair of all utilities under hard-surfaced roads, streets, or sidewalks, provided such land-disturbing activity is confined to the hard-surfaced area and provided that runoff and erosion from soil stockpiles are confined and will not enter the drainage system.
  - f. Gravel, sand, dirt, or topsoil removal as authorized pursuant to approval of the South Dakota Board of Minerals and Environment, provided said approval includes an *Erosion and Sediment Control Plan* that meets the minimums specified.

### 12.1.1.2 Variances

The City of Dell Rapids may temporarily waive or modify the standards of this chapter for the entire city due to severe local conditions. Any such citywide waiver must be determined to be necessary to prevent loss of life, personal injury, or severe property damage.

Upon request, the City of Dell Rapids may consider waiving or modifying any of the standards which are deemed inappropriate or too restrictive for site specific conditions by granting a variance. These site specific variances may be granted at the time of plan submission or formal request for plan revision. Request for variances shall include the following and must be submitted in a format that is deemed acceptable by the City of Dell Rapids.

1. The standard from which the applicant seeks a variance.
2. The justification for not complying with the standard.
3. Alternate criteria or standard measures to be used in lieu of the standard. The standards specified with this Chapter relate to the application of specific erosion and sediment control practices. Other practices or modifications to these standards may be used if approved by the City of Dell Rapids prior to installation. Such alternative practice must be thoroughly described and detailed to the satisfaction of the City of Dell Rapids.

To expedite the review and decision on variance requests, the variance request should be submitted with, or submitted prior to the initial *Erosion and Sediment Control Plan* submittal.

### 12.1.2 Performance Objectives

The objectives for erosion and sediment control during construction include the following:

1. Conduct all land-disturbing activities to effectively reduce accelerated soil erosion and reduce sediment movement and deposition offsite.
2. Schedule construction activities to minimize the total amount of soil exposed at any given time to reduce the period of accelerated soil erosion.
3. Establish temporary or permanent cover on areas that have been disturbed as soon as possible after final grading is completed.
4. Design and construct all temporary or permanent facilities for the conveyance of water around, through, or from the disturbed area to limit the flow of water to non-erosive velocities.
5. Remove sediment caused by accelerated soil erosion from surface runoff water before it leaves the site.

6. Stabilize the areas of land disturbance with permanent vegetative cover or storm water quality control measures.

### 12.1.3 *Erosion and Sediment Control Plan*

An *Erosion and Sediment Control Plan* consisting of a written narrative report and a site plan map must be submitted to the City of Dell Rapids for review and approval prior to any unauthorized soil disturbance activities.

A professional engineer must develop the site specific *Erosion and Sediment Control Plan* that is in full compliance with the erosion and sediment control standards established in this chapter.

The approved *Erosion and Sediment Control Plan* must be reviewed to ensure compliance with these standards anytime a site's planned development changes impact the soil disturbance activities. If this review determines that the *Erosion and Sediment Control Plan* needs revision, it must be resubmitted and approved by the City of Dell Rapids prior to the soil disturbance activities caused by the planned development changes.

#### 12.1.3.1 **Erosion and Sediment Control Plan Narrative Report.** The narrative report must contain, or refer to, the drainage report and shall contain the following:

1. **Name, mailing address, email address if available, and telephone number of the responsible parties.** The name, mailing address, email address and telephone number of the professional engineer preparing the *Erosion and Sediment Control Report* shall also be included if different from the applicant.

2. **Project description.** A brief description of the nature and purpose of the land disturbing activity, the total area of the site, the area of disturbance, and project location including township, range, section, and quarter-section, or the latitude and longitude of the approximate center of the project.

3. **Existing site conditions.** A description of the existing topography, vegetation, and drainage; and identify any drainage ways and water bodies (wetlands) on the site.

4. **Adjacent areas.** A description of neighboring areas such as streams, lakes, residential areas, roads, etc., that might be affected by the land disturbance.

5. **Soils.** A brief description of the soils on the site, including information on soil type and names, mapping unit, erodibility, permeability, hydrologic soil group, depth, texture, and soil structure. (This information may be obtained from the soil report for the site, or, if available, from soils reports from adjacent sites.)

6. **Areas.** An estimate of the surface area (in acres) of the proposed disturbance.

**7. Erosion and sediment control measures.** A description of the methods described in the *Erosion and Sediment Control* standard plates or as directed by the City of Dell Rapids, which will be used to control erosion and sediment on the site. The erosion and sediment control narrative should be phased to reflect the major planned construction stages of the project.

- a. Major site grading
- b. Public infrastructure improvements
- c. Individual lot development

Additional measures as necessary to control air emissions like dust from construction activities.

**8. Construction site nonstructural control measures.** A description of the methods described in the Dell Rapids *Erosion and Sediment Control* chapter, which will be used to control storm water pollution, erosion, sediment, and spills on the site. During the construction process, the developer is responsible for maintaining all compliance documentation records.

**9. Time schedule.** A time schedule indicating the anticipated starting and completion time periods of the site grading and/or construction sequence, including workday, week, or date of completion. The schedule will include the installation and removal time periods of erosion and sediment control measures, and the time of exposure of each area prior to the completion of temporary erosion and sediment control measures.

**10. Permanent stabilization.** A brief description, including specifications, of how the site will be stabilized after construction is completed.

**11. Storm water management considerations.** Explain how storm water runoff from and through the site will be handled during construction. Provide a brief description of the post-construction storm water quality control measures to be included as a part of the site development.

**12. Maintenance.** A schedule of regular inspections during construction and repair of erosion and sediment control structures shall be described. A description of routine sediment basin maintenance shall also be included.

**13. Dewatering.** Provide detail on how any planned dewatering shall be managed on the site, or state that no groundwater or surface water dewatering shall occur on site during construction activity.

**14. Variances.** Professional engineer shall list any request for variance of these standards and justification as required in Section 12.1.1.2.

**15. Other information.** Other information or data as may be reasonably required by the City of Dell Rapids. Information required by the SDDENR General Permit for Storm Water Discharges Associated with Construction

Activities in addition to the information listed above shall also be included in the narrative report.

16. **The following note.** “This *Erosion and Sediment Control Plan* appears to fulfill the technical criteria and the criteria for erosion control and requirements of the City of Dell Rapids. I understand that additional erosion and sediment control measures may be needed if unforeseen erosion problems occur or if the submitted plan does not function as intended. The requirements of this plan shall run with the land and be the obligation of the responsible party until such time as the plan is properly completed, modified, or voided.”

17. **Signature page and statement.** Signature page for owner/developer and may also include the general contractor acknowledging the review and acceptance of responsibility for erosion and sediment control, and a statement by the professional engineer acknowledging responsibility for the preparation of the *Erosion and Sediment Control Plan*.

12.1.3.2 ***Erosion and Sediment Control Plan Sheet.*** The *Erosion and Sediment Control Plan Sheet* shall be separate from the narrative report. The plan shall be prepared at a minimum scale of one (1) inch equals one hundred (100) feet and include the following:

1. **Property Line.** The property lines for the site where the work will be performed.
2. **Existing Topography.** Existing topography with one- (1- ) or two-foot (2-) contour intervals, and encompass the area shown on the final drainage plan (drawn to scale). Additional information may be required.
3. **Proposed Topography.** Proposed topography with **one- (1- ) or two-foot (2-)** contour intervals; the map shall show elevations, dimensions (drawn to scale), location, extent, and the slope of all proposed grading.
4. **Existing Facilities.** Location of any existing structures or hydrologic features on the site.
5. **Existing Conditions.** Location of all structures or natural features on the land adjacent to the site as required for the final drainage plan. The plan shall show the location of the street, street right-of-way, storm sewer, channel, or other waters receiving storm water runoff from the site. Any potential wetlands identified on inventory maps or observed shall be clearly shown.
6. **Proposed Facilities.** Show all proposed structures and development on the site.
7. **Proposed Conditions.** The plan shall indicate the proposed changes to the location of street, street right-of-way, storm sewer, channel, wetlands, water bodies or other waters receiving stormwater runoff.

8. **Limits of Construction.** Delineate allowable limits of disturbance for each phase of construction development.
9. **Location of Soil Stockpiles.** Areas designated for topsoil and subsoil storage.
10. **Location of Storage Areas.** Areas designated for equipment, fuel, lubricants, chemical, and waste storage.
11. **Location of Concrete Washout Facilities.** Areas designated for the washout of concrete equipment.
12. **Location of temporary roads.** Designated for use during the construction period.
13. **Plans of all drainage features.** Show all structural and nonstructural erosion controls, paved areas, retaining walls, cribbing, planting, temporary or permanent soil erosion control measures, or other features to be constructed in connection with, or as a part of, the proposed work, together with a map showing the drainage area of land tributary to the site and estimated two-year runoff of the area served by all drains.
14. **Detail drawings.** Design drawings of sediment controls, temporary diversions, and any practices used that are not referenced in these criteria.
15. **Other information.** Other information or data as may be reasonably required by the local jurisdiction.
16. **Detailed schedule.** Detailed schedule of events including dates (workday or week) of completion of the erosion control measures.
17. **Display Requirements.** Provide location for sign that complies with Section 12.8.5.3.

### 12.1.3.3 Erosion Sediment Control for Individual Lots of a Subdivision

Individual lots involving less than one (1) acre of disturbed area in an approved subdivision or larger common plan of development or sale shall not be considered a separate construction project, but rather as a part of the subdivision development as a whole. It will be the responsibility of the locally approved *Erosion and Sediment Control Plan* for the subdivision. Subdivision *Erosion and Sediment Control Plans* must incorporate a separate detail drawing and narrative describing minimum erosion control measures of individual lots within the approved subdivision or larger common place of development or sale. It is understood that the City of Dell Rapids may require additional erosion control measures if unforeseen erosion problems occur or if the submitted *Erosion and Sediment Control Plan* does not function as intended.

#### **12.1.3.4 Acceptance of Erosion and Sediment Control Plan**

An *Erosion and Sediment Control Plan* must be accepted prior to issuance of an Excavation and Grading Permit by the City. Acceptance of the *Erosion and Sediment Control Plan* does not imply acceptance or approval of drainage plans, utility plans, street or road plans, design of retaining walls, or any other aspect of site development.

### **12.2 Erosion Control**

Planning for the installation of permanent or temporary soil erosion controls is needed in advance of all major soil disturbance activities on the construction site. After construction begins, soil surface stabilization shall be applied within 14 days to all disturbed areas that may not be at final grade but will remain dormant (undisturbed) for periods longer than an additional 21 calendar days. Within 14 days after final grade is reached on any portion of the site, permanent or temporary soil surface stabilization shall be applied to disturbed areas and soil stockpiles. When the initiation of stabilization measures are stopped due to snow cover or arid conditions, stabilization measures shall be initiated as soon as possible.

Soil surface stabilization protects soil from the erosive forces of raindrop impact, flowing water, and wind. Erosion control practices include surface roughening, mulching, erosion control blankets, and, establishment of vegetative cover by seeding and mulching, and the early application of gravel base on areas to be paved. Stabilization measures to be used shall be appropriate for the time of year, site conditions, and estimated duration of use. The maximum time limits of land exposure for selection of erosion controls are summarized in Table 12.1 (page 12A.7).

#### **12.2.1 Surface Roughening**

Surface roughening provides temporary stabilization of disturbed areas from wind and water erosion. It is particularly useful where temporary revegetation cannot be immediately established due to seasonal planting limitations.

The soil surface is considered roughened if depressions are created two (2) to four (4) inches deep and are spaced approximately four (4) to six (6) inches apart. If slopes are sufficiently rough after final grading, no further treatment is required. The surface of exposed soil can be roughened by a number of techniques and equipment. A chisel or ripping implement can be used in most soil conditions. Roughening cannot be performed in very sandy or rocky soil.

Surface roughening, also referred to as scarification, shall be performed after final grading. Fill slopes can be constructed with a roughened surface. Cut slopes that have been smooth graded can be roughened as a subsequent operation. Roughening of ridges and depressions shall follow along the contours of the slope. On slopes steeper than 2:1, the tracks left by a dozer working perpendicular to the contour can leave acceptable horizontal depressions.

Care shall be taken not to drive vehicles or equipment over areas that have been scarified. Tire tracks will smooth the roughened surface and encourage runoff to collect into channels. As surface roughening is only a temporary control, additional treatments may be necessary to maintain the soil surface in a roughened condition.

## 12.2.2 Mulching

All disturbed areas shall be mulched, or seeded and mulched, within 14 days after final grade is reached on any portion of the site not otherwise permanently stabilized. Areas that will remain in an interim condition for more than one (1) year shall also be seeded. (See Section 12.2.3.2)

To protect newly seeded areas and to provide temporary cover on other disturbed areas that will not require temporary revegetation or cannot be seeded due to seeding date limitations, a mulch shall be applied consisting of:

1. Clean, weed- and seed-free, long-stemmed grass hay (preferred) or cereal grain straw. Hay is preferred as it is less susceptible to removal by wind. Mulch shall be applied evenly at a rate of two (2) tons per acre. At least 50 percent of the mulch, by weight, shall be ten (10) inches or more in length.

Mulch shall be anchored. This can be accomplished mechanically by crimping or with the aid of tackifiers or nets. Anchoring with a crimping implement is preferred, and is the recommended method for all areas equal to or flatter than 3:1. Mechanical crimpers shall be capable of tucking the long mulch fibers into the soil four (4) inches deep without cutting them.

On small areas sheltered from the wind and from heavy runoff, spraying a tackifier on the mulch is satisfactory for holding it in place. For steep slopes and other special situations, blankets, anchored with staples, may be required instead of mulch.

2. Hydraulic mulching shall be limited to those situations where it is too difficult to apply and anchor a mulch of long-stemmed grass hay or cereal straw; namely, slopes steeper than 3:1 or where access is limited. Wood cellulose fibers shall be mixed with water and a tackifying agent and applied at a rate of one thousand five hundred (1,500) pounds per acre with a hydraulic mulcher.
3. Mats, blankets, and nets are available to help stabilize steep slopes and drainage channels. Depending on the product, these may be used alone or in conjunction with grass or straw mulch. Normally, use of these products will be restricted to relatively small areas. Mats made of jute, coconut fiber, or various geosynthetic fibers can be used instead of mulch. Blankets are straw mulch that have been woven and oftentimes include a synthetic layer or net. Plastic netting may be used to anchor mulch.
4. Some synthetic tackifiers or binders may be used to anchor mulch. Caution shall be used to prevent the introduction of any potentially harmful material into the environment. Manufacturer's recommendations shall be followed at all times.

## 12.2.3 Revegetation

A viable vegetative cover shall be established within one (1) year on all disturbed areas and soil stockpiles not otherwise permanently stabilized. Vegetation is not considered established until a uniform vegetative ground cover with a density of

at least 70% is achieved, or which, in the opinion of the City, is sufficiently mature to control soil erosion and can survive severe weather conditions.

**12.2.3.1 Seedbed Preparation.** Areas to be revegetated shall have soil conditions capable of supporting vegetation. Overlot grading will oftentimes bring to the surface subsoils that have low nutrient value, little organic matter content, few soil microorganisms, and conditions less conducive to infiltration of precipitation. Under certain conditions, soil amendments and treatments may be necessary to provide an adequate growth medium to sustain vegetation.

Whenever possible, topsoil shall be salvaged for respreading on areas to be revegetated. The depth of soil stripping is determined by the depth of available topsoil.

The rooting zone of most semi-arid grasslands is six (6) to eighteen (18) inches. At a minimum, the upper six (6) inches of topsoil can be stripped and stockpiled, and respread to a thicker depth on surfaces not planned for buildings or impervious areas. If the surface is compacted, ripping of subsoils prior to topsoiling is recommended. Scarification will assist in placement of a stable topsoil layer on steeper slopes, and allow percolation and root penetration to greater depth.

Fertilizer can be added to improve nutrient levels necessary for plant growth. Other treatments, such as liming, can be used to adjust soil conditions as necessary with amendments. Soil testing is recommended to determine appropriate amendments required.

A suitable seedbed will enhance the success of revegetation efforts. The upper layer of soil shall be in a condition suitable for seeding at the proper depth and conducive to plant growth.

**12.2.3.2 Temporary Revegetation.** Temporary revegetation is required on all disturbed areas having a period of exposure prior to final stabilization of one (1) year or longer. All temporary seeding shall be protected with mulch.

To provide temporary vegetative cover on disturbed areas that will not be paved, built upon, or fully landscaped within 12 months but will be completed within 24 months, plant an appropriate annual grass and mulch the planted areas. The annual grasses generally suitable for this area are listed in Table 12.2. These are to be considered only as a general recommendation whenever specific design guidance for a particular site is not available.

**12.2.3.3 Permanent Revegetation.** To provide vegetative cover on disturbed areas not paved or built upon for two (2) years or longer, or for an indeterminate length of time, a perennial grass mix shall be planted. Each site will have different characteristics, and a landscape professional should be contacted to determine the most suitable seed mix for a specific site. In lieu of a specific mix and for planning purposes, one of the perennial grass mixes listed in Table 12.3 can be used. The Pure Live Seed (PLS) rates of application recommended in these tables are considered to be

absolute minimum rates for seed applied using proper drill-seeding equipment. All permanent seeding shall be protected with mulch.

#### **12.2.4 Roads and Soil Stockpiles**

Road cuts, road fills, and parking lot areas shall be covered with the appropriate aggregate base course on the surfaces to be paved in lieu of mulching. Early application of road base is suitable where a layer of course aggregate is specified for final road or parking lot construction. This practice may not be desirable in all instances, and is not needed when final pavement construction will take place within 30 days of grading to final contours. All non-paved portions of road cut, fill, and parking lot areas shall be seeded and mulched as soon as possible after final grading has occurred, but in no case later than 14 days after grading has been completed.

Soils planned to be stockpiled for more than 60 days shall be seeded with a temporary or permanent grass cover within 14 days after completion of stockpile construction. Mulching is recommended to assure vegetation establishment. If stockpiles are located within close proximity to a drainageway (i.e., one hundred [100] feet), additional sediment control measures, such as a temporary diversion dike or silt fence, shall be provided. (See Section 12.3)

### **12.3 Sediment Control**

Installation of Sediment Control Measures. All construction sites must install necessary perimeter sediment control measures in their approved *Erosion and Sediment Control Plan* prior to the issuance of an Excavation and Grading Permit by the City of Dell Rapids. This only allows the minimum amount of soil disturbance necessary that is directly related to the installation of these sediment control measures. Construction sites may be required to be inspected to verify that these sediment control measures have been properly installed prior to the issuance of an Excavation and Grading Permit by the City of Dell Rapids.

The installation of all other sediment entrapment and control facilities shall begin before major land disturbance activities begin on a construction site in accordance with their time schedule established in their *Erosion and Sediment Control Plan*.

Sediment control will be site specific (located on the site under construction unless designated and approved by the City of Dell Rapids) and can include vehicle tracking controls; sod buffer strips around the lower perimeter of the land disturbance; sediment barriers, filters, dikes, traps, or sediment basins; or a combination of any or all of these measures.

Sediment controls shall be constructed before land disturbance takes place. Earthen structures such as dams, dikes, and diversions shall be mulched within 14 days of installation. Earthen structures that are expected to remain in place for more than one (1) year shall be seeded and mulched.

#### **12.3.1 Vehicle Tracking**

Wherever construction vehicles enter onto paved public roads, provisions shall be made to prevent the transport of sediment (mud and dirt) by vehicles tracking onto the paved surface. It is recommended that coarse-aggregate rock surfacing

be provided to keep most construction traffic from coming into contact with mud and dirt. In other words, stabilized access, parking, staging, and loading and unloading areas will reduce the likelihood that vehicles will come into contact with mud. Sites that have not voluntarily implemented these practices may be required to construct a stabilized vehicle tracking control device.

For sites greater than one (1) acre, a stabilized vehicle tracking control shall be constructed. Whenever deemed necessary by the City, wash racks shall be installed to remove mud and dirt from the vehicle and its tires before it enters onto public roads.

Whenever sediment is transported onto a public road, regardless of the size of the site, the road shall be cleaned at the end of each day. Sediment shall be removed from roads by shoveling or sweeping and be transported to a controlled sediment disposal area. Street washing shall not be allowed until after sediment is removed in this manner. Storm sewer inlet protective measures shall be in place at the time of street washing.

### 12.3.2 Slope–Length and Runoff Considerations

Cut-and-fill slopes shall be designed and constructed to minimize erosion. This requires consideration of the length and steepness of the slope, the soil type, upslope drainage area, groundwater conditions, and other applicable factors. Slopes that are found to be eroding excessively will require additional slope stabilization until the problem is corrected. The following guidelines shall assist site planners and plan reviewers in developing an adequate design:

1. Rough soil surfaces are preferred over smooth surfaces on slopes (see Section 12.2.1).
2. Temporary slope diversion dikes (as discussed in Section 12.3.2.1) can be constructed at the top of long or steep slopes, or hillslopes that have an upslope tributary drainage area over five (5) acres. Diversion dikes or terraces (Sections 12.3.2.1 and 12.3.2.3) may also be used to reduce slope length within the disturbed area.

Temporary diversion dikes shall be provided whenever:

$$S^2L > 2.5 \quad \text{(Equation 1)}$$

Where: S = slope of the upstream tributary area (in feet/foot); and  
L = length of the upstream slope (in feet)

3. Concentrated storm water shall not be allowed to flow down cut or fill slopes unless contained within an adequately-sized temporary channel diversion, a permanent channel, or temporary slope drain (see Section 12.3.2.4).
4. Wherever a slope face crosses a water seepage plane that endangers the stability of the slope, adequate drainage shall be provided.
5. Provide sediment traps, basins, or barriers (silt fences or straw bale dikes) below slopes to reduce off-site sediment transport or to reduce slope lengths (see Section 12.3.3).

**12.3.2.1 Slope Diversion Dikes.** A temporary slope diversion dike is a horizontal ridge of soil placed perpendicular to the slope and angled slightly to provide drainage along the contour. Temporary diversion dikes can be constructed by excavation of a V-shaped trench or ditch and placement of the fill on the downslope side of the cut.

There are two types of temporary slope diversion dikes:

1. A diversion dike located at the top of a slope to divert upland runoff away from the disturbed area. The discharge from undisturbed or previously-developed upland areas collected by these diversion dikes may be directed to a permanent channel or temporary channel diversion. (See Section 12.4.2)
2. A diversion dike located at the base or midslope of a disturbed area to divert sediment-laden water to a sediment trap or basin. The discharge from these diversion dikes may be directed to a temporary slope drain or sediment basin.

**12.3.2.2 Roads and Roadside Swales.** The drainage system provided for roads will define to some extent the length and area of individual slope segments within the disturbed area. A number of smaller hillslope segments will be created by construction of roads. These areas shall require erosion control as described in Section 12.2.4, and sediment controls dependent on the size of upslope tributary area. (See Section 12.3.3)

For road areas that are not paved within 30 days of final grading, and have not received early application of roadbase (see Section 12.2.4), rough-cut street controls shall be used. These are runoff barriers that are constructed at intervals down the road. The barrier projects perpendicular to the longitudinal slope from the outer edge of the roadside swale to the crown of the road. The barriers are positioned alternately from the right and left side of the road to allow construction traffic to pass in the unbarricaded lane.

**12.3.2.3 Terracing.** Sediment can be controlled on slopes that are particularly steep by using terracing. During grading, relatively flat sections, or terraces, are created and separated at intervals by steep slope segments. The steep slope segments are prone to erosion, however, and must be stabilized in some manner. Retaining walls, gabions, cribbing, deadman anchors, rock-filled slope mattresses, and other types of soil retention systems are available for use. These shall be specified in the plan and installed according to manufacturer's instructions.

**12.3.2.4 Slope Drains.** There are certain instances when runoff must be directed down a slope within the disturbed area. A temporary slope drain can be used to protect these hillslope areas from scour and additional erosion. A number of alternative designs and materials can be used for a slope drain.

The sizing of temporary slope drains shall be defined but do not need rigorous hydraulic analysis. Slope drains shall be sized for a two-year

storm event. The discharge from all slope drains shall be directed to a stabilized outlet. (See Section 12.4.3)

### 12.3.3 Sediment Entrapment Facilities

Sediment entrapment facilities are necessary to reduce sediment discharges to downstream properties and receiving waters. Sediment entrapment facilities include straw bale barriers, silt fences, sod filter strips, sediment traps, sediment basins, silt ditches, and wattles. The type of sediment entrapment facility to be used depends on the tributary area, basin slope, and slope length of the upstream area. Table 12.4 summarizes the recommended maximum tributary areas, slope lengths, and slopes for four types of sediment entrapment facilities.

All runoff leaving a disturbed area shall pass through a sediment entrapment facility before it exits the site and flows downstream.

An established green filter strip may be adequate for small sites, provided the limits for tributary slope are not exceeded and the flow is not concentrated. Straw bale barriers or silt fences may be used for somewhat larger areas, depending on the upslope drainage area. When the tributary area is less than five (5) acres but greater than that allowed for straw bale barriers or silt fences, runoff shall be collected in diversion swales and routed through temporary sediment traps.

**12.3.3.1 Silt Fence.** A silt fence is made of a woven synthetic material that filters runoff. Silt fence can be placed as a temporary barrier at the base of a disturbed area but is not recommended for use in a channel or swale. The material is durable and will last for more than one season if properly installed and maintained.

**12.3.3.2 Filter Strips.** Vegetated filter strips cause deposition of sediment within the area of vegetation. Buffer strips of natural vegetation can be left at the time of site grading, or can be created by using sod. A dense ground cover is necessary or runoff will channelize within the area. A minimum width of 20 feet is recommended.

**12.3.3.3 Sediment Traps.** A sediment trap is a temporary structure that is designed to fill with sediment. A sediment trap can be constructed by either excavating below grade or building an embankment across a swale. Excavated traps are less prone to failure than embankments. No pipe is used at the outlet, as in a sediment basin, and an open-channel spillway shall be included in the design. A minimum of 3,600 cubic feet of storage volume shall be provided for each tributary acre.

If sediment traps are incorporated into the erosion control plan, provide the following guidance for the contractor:

- Sediment volume required and provided.
- Length, width, and depth of the trap.
- Provide the top elevation of the berm, and length, and elevation for the overflow assembly.

**12.3.3.4 Sediment Basins.** Areas draining more than ten (10) acres shall be routed through a sediment basin. Sediment basins shall be designed to a minimum 3,600 cubic feet of volume per tributary acre and be cleaned out prior to becoming half full.

Tributary acres shall be the total potential disturbed acres at one time drained to the sediment basin from a construction site or larger common plan of development or sale. This does not have to apply to storm water flows from acres that are:

- Undisturbed onsite areas with no erosion and sediment control issues.
- Previously disturbed onsite areas that have achieved final stabilization.
- Disturbed or undisturbed areas not within the construction site or larger common plan of development or sale.

Performance Standard: If the storm water flows from acreages that do not apply to this standard are sufficient to cause significant hydraulic overloads that impact the sediment basins designed performance, then alternative measures should be considered (e.g. divert flows from areas that do not apply around the disturbed areas and sediment basin or build sediment basin off-line of main drainageway and divert only disturbed areas to sediment basin).

If the site is to include a post construction storm water quality or flood control detention facility, the permanent detention facility may be used as the temporary sediment basin, provided the outlets are designed for construction activities and are later modified for post construction activities upon completion of construction and final stabilization of disturbed soils. Such permanent detention facilities or post construction water quality BMP's shall be restored to design grades, volumes, and configurations after site development is completed and the project is finalized. The outlet from a sediment basin shall be designed to empty its volume in no less than 16 hours; namely, to have an average outflow rate of 28.0 gallons/minute/tributary acre, or less. The basin length shall be no less than twice the basin width. The inflow structures at the entrance of the basin shall be designed to dissipate inflow energy and to spread the flow so as to achieve uniform flow throughout the basin's width. The gravel and rip rap horseshoe sediment basin should be utilized when drainage culverts are already in place prior to site construction activities since existing culverts and roadway fill sections readily afford sediment storage area.

If sediment basins are incorporated into the *Erosion and Sediment Control Plan*, provide the following information in the plan to provide necessary guidance for the contractor:

- Delineate the tributary drainage area to each sediment basin on the erosion control plan.
- Sediment volume required and provided.

- Length, width, and depth of the basin.
- For sediment basins, give the top elevation of the berm, and length, and elevation for the overflow assembly. The outlet structure size and invert elevations will also be provided.

For drainage locations serving less than ten (10) acres, a sediment basin or a combination of sediment basin(s) and sediment traps providing storage for three thousand six hundred (3,600) cubic feet of storage per acre drained may be required along with silt fences, silt ditches, or equivalent sediment controls on all sideslope and downslope boundaries of the construction area.

**12.3.3.5 Silt Ditch.** A silt ditch is constructed by excavating a small channel along and parallel to the existing contours of the land. Silt ditch can be placed as a temporary barrier at the base of a disturbed area but is not recommended for use in a channel or swale. Silt ditch shall be designed to a minimum 3,600 cubic feet of volume per tributary acre. The berm constructed on the downstream side of the excavated channel shall be seeded and mulched immediately after construction.

**12.3.3.6 Sediment Control Wattles.** A sediment control wattle is used to provide a flexible, lightweight, and porous sediment entrapment device. It is typically manufactured of a straw and coconut matrix, is 6-20 inches in diameter and is 10 feet long. The wattle is staked into the ground. Sediment control wattles are useful for control of sediment transport in ditch bottoms, swales, and waterways. The wattles may be used in lieu of, or in conjunction with silt fence, rock check dams, or silt ditch. Refer to Table 12.4 for wattle spacing criteria.

## 12.4 Drainageway Protection

At times, construction activities must occur adjacent to or within a drainageway. Whenever this occurs, bottom sediments will be disturbed and transported downstream to minimize the movement of sediments resulting from construction activities that take place within any drainageway. Temporary facilities can be installed to divert flowing water around such sediment-generating construction activities within drainageways.

### 12.4.1 Working Within or Crossing a Waterway

Whenever work occurs within a waterway, the following shall be considered as appropriate:

1. Construction vehicles shall be kept out of a waterway to the maximum extent practicable. Where in-channel work is necessary, steps, such as temporary channel diversions, shall be taken to stabilize the work area during construction to control erosion. The channel (including bed and banks) shall be restabilized immediately after in-channel work is completed.
2. Where an actively-flowing watercourse must be crossed regularly by construction vehicles, a temporary crossing shall be provided. Two primary methods are available: a culverted crossing and a stream ford.

A culverted crossing shall be designed to pass the two-year design flow.

A ford shall be lined with a minimum six- (6-) inch thick layer of one and a half-(1.5-) inch diameter rock.

A permit is required for placement of fill in a waterway under Section 404 of the Clean Water Act. The Corps of Engineers office in Pierre, South Dakota, shall be contacted about the requirements for obtaining a 404 permit.

3. Whenever feasible, a temporary channel diversion (see Section 12.4.2) shall be used to bypass the work areas when work takes place within a channel.
4. Whenever possible, construction in a waterway shall be sequenced to begin at the most downstream point and work progressively upstream installing required channel and grade control facilities.
5. Complete work in small segments, exposing as little of the channel at a time as possible.
6. Where possible, perform all in-channel work between September 15 and April 15.

#### **12.4.2 Temporary Channel Diversions**

Limiting construction activities within actively-flowing water will significantly reduce sediment movement downstream from these activities. This can be done by using a temporary diversion facility that carries water around construction activities taking place within a waterway.

Permanent drainage channels shall be constructed at the earliest possible stage of development. Temporary channel diversions shall not remain in place for more than two years prior to removal or replacement by permanent facilities.

- 12.4.2.1 Stability Considerations.** Temporary channels are not likely to be in service long enough to establish adequate vegetative lining. Temporary channel diversions must be designed to be stable for the design flow with the channel shear stress less than the critical tractive shear stress for the channel lining material. Unlined channels shall not be used unless it can be demonstrated that an unlined channel will not erode during the design flow. Design procedures for temporary channels are described in detail in the Hydraulic Engineering Circular No. 15 published by the Federal Highway Administration.

#### **12.4.3 Outlet Protection**

The outlets of slope drains, culverts, sediment traps, and sediment basins shall be protected from erosion and scour. Outlet protection shall be provided where the velocity of flow will exceed the maximum permissible velocity of the material where discharge occurs. This may require the use of a riprap apron at the outlet location.

Check dams can be used in ditches or swales and downstream of the outlets of temporary slope drains, culverts, sediment traps, and sediment basins. Check dams reduce the velocity of concentrated flows and trap sediment eroded from the upstream ditch or swale. They are not a primary sediment trapping facility and are a temporary flow-control structure.

Check dams may be used under the following conditions:

1. In temporary or permanent swales that need protection during the establishment of grasses;
2. In permanent swales that need protection prior to installation of a non-erodible lining;
3. In temporary ditches or swales that need protection where construction of a non-erodible lining is not practicable.

Check dams shall be constructed of four- (4-) to six- (6-) inch angular rock to a maximum height of two (2) feet. The center of the top of the dam shall be six (6) inches lower than the sides to concentrate the flow to the channel center. Where multiple check dams are used, the top of the lower dam shall be at the same topographical elevation as the toe of the upper dam.

Sediment that collects behind a check dam shall be removed when the sediment reaches the spillway level. Check dams constructed in permanent swales shall be removed when perennial grasses have become established, or immediately prior to installation of a non-erodible lining. All of the rock and accumulated sediment shall be removed, and the area seeded and mulched, or otherwise stabilized.

#### **12.4.4 Inlet Protection**

All storm sewer inlets that are made operable during construction shall be protected to prevent sediment-laden runoff from entering the conveyance system without first being filtered or otherwise treated to remove sediment.

Inlets may be temporarily blocked to prevent sediment-laden runoff from entering storm sewers. Inlet protection measures shall be removed after upstream disturbed areas are stabilized.

Caution must be used in temporarily blocking inlets to assure that localized flooding conditions do not develop.

Inlet protection shall be removed from storm sewer inlets within paved street sections or parking lots during the winter months between December 1 and February 15. The City may require removals earlier than December 1 or installations later than February. During the period when inlet protection has been removed, alternate erosion control methods for inlet protection must be employed if ground is not stabilized by frozen conditions.

## **12.5 Underground Utility Construction**

The construction of underground utility lines that are not exempted (see Section 12.1.1.1.e) shall be subject to the following criteria:

1. No more than three hundred (300) feet of trench are to be opened at one time.
2. Where consistent with safety and space considerations, excavated material is to be placed on the uphill side of trenches.
3. Trench dewatering devices shall discharge in a manner that will not adversely affect flowing streams, wetlands, drainage systems, or offsite from the property. Site dewatering permit requirements shall be discussed with the South Dakota Department of Environment and Natural Resources.
4. Provide storm sewer inlet protection (see Section 12.4.4) whenever soil erosion from the excavated material has the potential for entering the storm drainage system.

## **12.6 Disposition of Temporary Measures**

All temporary erosion and sediment control measures shall be removed and disposed within 30 days after final site stabilization is achieved, or after the temporary measure are no longer needed, whichever occurs earliest, or as authorized by the City of Dell Rapids. For example, a site containing only one building shall have temporary erosion control measures removed after building construction is complete and final landscaping is in place. Temporary erosion control measures shall be removed from a commercial construction site or residential subdivision only after streets are paved and all areas have achieved final stabilization. Trapped sediment and disturbed soil areas resulting from the disposal of temporary measures shall be returned to final plan grades and permanently stabilized to prevent further soil erosion.

The professional engineer preparing the *Erosion and Sediment Control Plan* shall submit a schedule of removal dates for temporary control measures. The schedule shall be consistent with key construction items such as street paving, final stabilization of disturbed areas, or installation of structural storm water controls.

## **12.7 Maintenance**

All temporary and permanent erosion and sediment control practices shall be maintained and repaired by the owner during the construction phase as needed to assure continued performance of their intended function. Silt fences and wattles may require periodic replacement and all sediment accumulated behind them shall be removed and disposed of properly. Sediment traps and basins will require periodic sediment removal when the design storage level is half full. All facilities shall be inspected in accordance with Section 12.9 by the responsible party or their representative.

## **12.8 Pollution Prevention Using Nonstructural BMPs**

Nonstructural BMPs are to be a part of construction activities.

### **12.8.1 Objectives in the Use of Nonstructural BMPs**

Nonstructural BMPs differ from the structural BMPs because they focus on activities to control water quality rather than physical structures. Because they rely on actions and not structures, nonstructural BMPs must be implemented

constantly and repetitively over time. There are two main objectives of using nonstructural BMPs. These are:

1. Reduce or eliminate the pollutants that impact water quality at their source, thus reducing the need for structural control requirements. The use of nonstructural BMP practices may assist structural BMP efficiency and may eliminate the need for additional storm water treatment.
2. Address water quality concerns that are not considered cost-effective by structural controls such as implementing a spill prevention and containment program.

## 12.8.2 Good Housekeeping

**12.8.2.1 Application.** Good housekeeping practices are designed to maintain a clean and orderly work environment. The most effective first steps towards preventing pollution in storm water from work sites simply involves using good common sense to improve the facility's basic housekeeping methods. Some simple procedures a site can use to promote good housekeeping are improved operation and maintenance of machinery and processes, material storage practices, material inventory controls, routine and regular cleanup schedules, maintaining well organized work areas, signage, and educational programs for employees and the general public about all of these practices.

**12.8.2.2 Contact Information Display Requirement.** The permittee shall post a 24-hour, 7 days-a-week sign with the contractor contact name and contractor phone number readily visible at the development site entrance. A City of Dell Rapids approved 24-hour contact number to register complaints must also be included on the sign. The contact information shall be clearly readable, securely anchored, and appropriately weatherproofed to assure its integrity throughout construction. The following or similar format shall be used:

1. To report an erosion, sediment, spill, or other problem at this construction site to the responsible contractor call:

Contractor Name  
Contractor Phone

To register a complaint about this construction site to the City of Dell Rapids call:

Approved City of Dell Rapids Contact Number

## 12.9 Inspections

The permittee shall assure that qualified personnel inspect the site at least once every seven calendar days and within 24 hours of the end of a storm that is 0.5 inch or greater or snow melt event that cause surface erosion to confirm plan compliance. Where runoff is unlikely due to winter conditions, such inspections shall be conducted at least once per month. Based on the results of the inspection, the plan shall be revised and implemented, in no case later than seven calendar days following the inspection.

The inspection shall look for evidence of or the potential for pollutants entering the drainage system or leaving the site and shall include disturbed areas of the construction site that have not been finally stabilized, areas used for storage of materials, structural and nonstructural control measures, and locations where vehicles enter or exit the site.

A report summarizing the areas inspected, name(s) and title(s) of personnel making the inspection, the date(s) of the inspection, major observations, and corrective actions taken shall be made and retained as part of the plan for a least three years. Such reports shall identify any incidents of noncompliance. Where an inspection does not identify any incidents of noncompliance, the report shall contain a certification that the site is in compliance with the plan and permit. The report shall be dated and signed by the responsible party or their authorized representative.

Compliance documentation is the responsibility of the Owner/Developer/Contractor as identified in Section 12.1.3.1.

## **12.10 Construction Control Measures**

### **12.10.1 Concrete Washout Area**

Concrete washout areas shall be constructed during any period of planned development where concrete is being used and allowed to be disposed of on site. The use of a vehicle tracking control in conjunction with concrete washout area is required unless the concrete washout area is protected by the site's vehicle tracking control.

### **12.10.2 Limits of Construction**

Plan shall clearly delineate allowable limits of disturbance for each phase of construction. Limits of construction are designed to delineate construction site perimeters, protect and preserve stabilized areas, drainageways, regulated water bodies (wetlands), environmental sensitive areas, historical areas, erosion and sediment control measures and other resources.

## **12.11 Final Stabilization**

All erosion and sediment control measures accepted in the *Erosion and Sediment Control Plan* must be maintained until final stabilization is reached which means that either:

1. All planned soil disturbing activities at the site have been completed and a uniform perennial vegetative cover with a density of 70 percent of the native cover or an equivalent permanent stabilization measure has been employed on any pervious areas of the site; or
2. A specific alternative to final stabilization as described in this chapter; or
3. A specific alternative approved by the S.D. DENR general permit for storm water discharges associated with construction activities.

## Appendix

Glossary		12A.2
General Criteria Guidelines		12A.3
Table 12.1	Maximum Time Limits of Land Exposure for Selection of Erosion Controls	12A.4
Table 12.2	Seeding Rates for Annual Grasses	12A.5
Table 12.3	Minimum Drill Seeding Rates for Perennial Grasses	12A.6
Table 12.4	Sediment Entrapment Facility Limitations	12A.9
Table 12.5	Nonstructural BMP Requirements for Various Projects	12A.10
Table 12.6	Advantages and Disadvantages of BMPs for Spill Prevention and Response BMPs	12A.11

## Glossary of Terms

**Erodibility:** The susceptibility of a particular soil type to erosion by water or wind.

**Erosion:** The wearing away of the land surface by water, wind, ice, or other geological agents, including the detachment and movement of soil or rock fragments by water, wind, ice, or gravity.

**Erosion Control Measures:** Practices that slow or stop erosion.

**Final Stabilization:** Completion of all land disturbing activities, removal of all temporary sediment controls, establishment of vegetative cover on exposed soil areas, and installation of permanent roads and structural storm water quality best management practices.

**Land Disturbing Activity:** Grading, cut, fill, stockpiling of dirt, removal of vegetation, or any other alteration or disturbance of the ambient land surface.

**Mapping Unit:** Soil name and symbol given in the Soil Conservation Service Soil Survey for each soil type.

**Permanent:** Installation of land-surface cover, or erosion and sediment control measures that will remain in place for a long period of time.

**Sedimentation:** The process of solid materials, both inorganic (mineral) and organic, coming to rest on the earth's surface either above or below sea level.

**Sediment:** Particulate solid material, either inorganic or organic, that will settle or be deposited in a liquid under the force of gravity.

**Sediment Barrier:** Silt fence or wattle.

**Sediment Basin:** A depression, either excavated or formed by a dam, that holds water and debris and facilitates sedimentation of soil particles. Normally used for drainage areas equal to and greater than 5.0 acres.

**Sediment Trap:** A small depression that holds water and debris and facilitates sedimentation. Normally used for drainage areas less than 5.0 acres.

**Temporary:** Installation of erosion or sediment control measures, either structural or nonstructural, that are planned to be removed or inactivated after a period of time.

**Viable Vegetative Cover:** A measure of performance for establishment of appropriate vegetative cover (or density) on sites planned for revegetation for the period of duration or successful growth as accepted by the City and county of jurisdiction.

**General Criteria 1 and 2.**

**GC-1 Stabilization of Disturbed Areas and Soil Stockpiles**

- A. Permanent or temporary soil stabilization shall be applied to disturbed areas within two weeks after rough grading. Soil stabilization refers to measures which protect soil from erosive forces of raindrop impact and flowing water. Applicable practices include vegetative establishment, mulching, and early application of gravel base on areas to be paved. Soil stabilization measures selected shall be appropriate for the time of year, site conditions, and estimated duration of use.
- B. Soil stockpiles shall be established or protected with sediment-trapping measures to prevent soil loss.

**GC-2 Establishment of Permanent Vegetation**

A permanent vegetative cover must be established on denuded areas not otherwise permanently stabilized. Permanent vegetation is not to be considered established until a ground cover is achieved which is mature enough to control erosion satisfactorily.

Will construction be absent two years or more?

Protect with 12.2.3.2 Temporary Revegetation, or 12.2.2 Mulching

**Yes**

See 12.2.3.3 Permanent Revegetation

Is a seed mix available for the time of year seeding will take place?

Protect with 12.2.2 Mulching or 12.2.3.2 Temporary Revegetation until permanent seeding date.

**Yes**

Seed according to Table 12.3 Perennial Grasses

Are slopes 3:1 or greater?

Consider use of blanket mulch in 12.2.2 Mulching, for critical areas.

**No**

Mulch according to 12.2.2 Mulching

**Table 12.1  
Maximum Time Limits of Land Exposures for Selection of Erosion Controls**

<b>Erosion Control Method</b>	<b>Maximum Allowable Period of Exposure (Months)</b>
Surface Roughening *	1
Mulching	12
Temporary Revegetation	12–24
Permanent Revegetation	24 or more
Soil Stockpile Revegetation	2
Early Application of Road Base	1

\* The surface-roughening erosion control method may be extended up to the maximum of three months on a case-by-case basis if the City has determined that the site demonstrates the following:

- Appropriate soil conditions exist for this method of control.
- Disturbed areas will be seeded and mulched within three months.
- Seasonal planting limitations exist.
- Soil stabilization method has demonstrated its effectiveness.

**Table 12.2  
Minimum Drill Seeding Rates for Annual Grasses<sup>a</sup>**

<b>Species</b>	<b>Growth Season</b>	<b>Pounds of Pure Live Seed (PLS)/acre<sup>b</sup></b>
Annual ryegrass	Cool	20
Cereal rye	Cool	30
Winter wheat/barley	Cool	30
Spring wheat/barley	Cool	30
Millet	Warm	20
Oats		60

<sup>a</sup> Successful seeding of annual grass resulting in adequate plant growth will usually produce enough dead-plant material residue to provide protection from wind and water erosion for an additional year. This assumes that the cover is not disturbed or mowed closer than 8 inches.

Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1 or where access limitations exist. When hydraulic seeding is used, hydraulic mulching shall be done as a separate operation to prevent the seeds from being encapsulated in the mulch.

<sup>b</sup> Seeding rates shall be increased by 50 percent if seeding is done by hydraulic seeding or using a Brillion Drill; or doubled if seed is broadcast.

If irrigation water is available and applied in an appropriate manner, seeding dates for annual grasses can be extended throughout most of the growing season.

**Table 12.3**  
**Minimum Drill Seeding Rates for Perennial Grasses<sup>a</sup>**

<b>Pounds of PLS/acre</b>	
<b>Alkali Soil Seed Mix</b>	
Alkar tall wheatgrass	<u>28.0</u>
	Total: 28.0
<b>Fertile Loamy Soil Seed Mix</b>	
<b>Option 1</b>	
Lincoln smooth brome	4.0
Bonilla big bluestem	4.0
Forestburg switchgrass	2.0
Pierre sideoats grama	<u>4.0</u>
	Total: 14.0
<b>Option 2</b>	
Matua bromegrass	4.0
Western wheatgrass	4.0
Forestburg switchgrass	2.0
Pierre sideoats grama	<u>4.0</u>
	Total: 14.0
<b>High Water Table Soil Seed Mix</b>	
<b>Option 1</b>	
Garrison creeping foxtail	1.0
Reed canarygrass	1.0
Lincoln smooth brome	3.0
Forestburg switchgrass	1.0
Alkar tall wheatgrass	<u>5.5</u>
	Total: 11.50
<b>Option 2</b>	
Garrison creeping foxtail	5.75
Reed canarygrass	<u>5.75</u>
	Total: 11.50

**Table 12.3**  
**Minimum Drill Seeding Rates for Perennial Grasses<sup>a</sup>**

<b>Pounds of PLS/acre</b>	
<b>Transition Turf Seed Mix<sup>b</sup></b>	
<b>Option 1</b>	
Kentucky bluegrass	0.5
Durar hard fescue	1.0
Perennial ryegrass	3.0
Lincoln smooth brome	<u>3.0</u>
	Total: 7.5
<b>Option 2</b>	
Kentucky bluegrass	1.0
Seville perennial ryegrass	3.5
Matua bromegrass	<u>3.0</u>
	Total: 7.5
<b>Sandy Soil Seed Mix</b>	
<b>Option 1</b>	
Bonilla big bluestem	3.0
Pierre sideoats grama	3.0
Lincoln smooth brome	4.0
Forestburg switchgrass	1.0
Indian grass	<u>1.0</u>
	Total: 12.0
<b>Option 2</b>	
Pennlawn red fescue	6.0
Hard fescue	3.0
Chewings fescue	<u>3.0</u>
	Total: 12.0
<b>Heavy Clay, Rocky Foothill Seed Mix</b>	
<b>Option 1</b>	
Alkar tall wheatgrass	9.0
Pierre sideoats grama	4.0
Lincoln smooth brome	<u>5.0</u>
	Total: 18.0

<b>Table 12.3<sup>a</sup></b>	
<b>Minimum Drill Seeding Rates for Perennial Grasses</b>	
<b>Pounds of PLS/acre</b>	
<b>Option 2</b>	
Alkar tall wheatgrass	9.0
Pierre sideoats grama	4.0
Matua bromegrass	<u>5.0</u>
	Total: 18.0

**Footnotes:**

<sup>a</sup> All of the above seeding mixes and rates are based on drill seeding followed by crimped hay or straw mulch. These rates shall be doubled if seed is broadcast and shall be increased by 50 percent if the seeding is done using a Brillion Drill or is applied through hydraulic seeding. Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1. If hydraulic seeding is used, hydraulic mulching shall be done as a separate operation.

<sup>b</sup> If the site is to be irrigated, the transition turf seed rates shall be doubled.

**Notes:**

To provide temporary erosion control between the seeding dates, use surface roughening (on the contour or perpendicular to prevailing winds) and apply a mulch as specified above.

Perennial grasses can be seeded using a drill seeder in areas previously planted with a temporary grass cover. In this case, the annual grass may need to be mowed before perennial grasses are seeded. Broadcast seeding or hydroseeding shall not be done on areas that have a live crop of annual grasses without first reworking and preparing the topsoil.

Seeding options are to be identified on the plan drawings.

**Table 12.4  
Sediment Entrapment Facility Limitations**

Sediment Control Facility	Allowable Maximum Limit		
	Tributary Drainage Areas (ac)	Tributary Slope Length (ft)	Tributary Slope Gradient
Sod Filter Strips	n/a	50	6:1 (17%)
Wattles	n/a	100	<4:1 (25%)
		40	4:1 (25%)
		30	3:1 (33%)
		20	2:1 (50%)
		10	1:1 (100%)
Silt Fence	**0.5 per 100 lineal ft	200	2:1 (50%)
Silt Ditch	*0.5 per 100 lineal ft	n/a	n/a
Sediment Trap	5.0	n/a	n/a
Sediment Basin	n/a	n/a	n/a

\*The loading to the silt ditch may be increased if the typical section is greater than 2 feet in depth and 5-foot bottom width.

\*\*No silt fence shall be constructed in live streams or in swales or ditch lines where flows are likely to exceed 1.0 cfs for a 2-year return storm event.

**Table 12.5**  
**Nonstructural BMP Requirements for Various Projects**

<b>Nonstructural BMP</b>	<b>Project Description and Requirement</b>
Good Housekeeping	Required for all projects.
Spill Prevention and Response	<p>Small projects with nonreportable quantities of hazardous materials: select BMPs as appropriate.</p> <p>Medium sized projects with nonreportable quantities of hazardous materials: selected BMPs as appropriate; spill prevention plan reviewed on case by case basis.</p> <p>Reportable quantities of hazardous materials or large projects: spill prevention plan required.</p>

**Table 12.6**

**Advantages and Disadvantages of BMPs for  
Spill Prevention and Response BMPs**

**Best Management Practice Advantages Disadvantages**

**Drip pans.** Pans used to contain small volumes of leaks. Inexpensive; simple installation and operation; possible reuse/recycle of material; empty/discarded containers can be used as drip pans. Small volumes; inspected and cleaned frequently; must be secured during poor weather conditions, and personnel must be trained in proper disposal methods.

**Covering.** Enclosure of outdoor materials, equipment, containers, or processes. Simple and effective; usually inexpensive. Frequent inspection, possible health/safety problems if built over certain activities, large structures can be expensive.

**Vehicle positioning.** Locating trucks or rail cars to prevent spills during transfer of materials. Inexpensive, easy, effective. May require redesign of loading and unloading areas, requires signage to designated areas.

**Loading/Unloading by Air**

**Pressure or Vacuum.** For transfer of dry chemicals or solids. Quick and simple; economical if materials can be recovered; minimize exposure of pollutants to storm water. Costly to install and maintain; may be inappropriate for denser materials, site-specific design; dust collectors may need permit under Clean Air Act.

**Sweeping.** With brooms to remove small quantities of dry chemicals/solids exposed to precipitation. Inexpensive, no special training; recycling opportunities. Labor-intensive; limited to small releases of dry materials, requires disposal to solid waste container.

**Shoveling.** For removal of large quantities of dry materials, wet solids and sludge. Inexpensive; recycling opportunities, remediate larger releases; wet and dry releases. Labor-intensive; not appropriate for large spills, requires backfill of excavated areas to maintain grade.

**Excavation.** By plow or backhoe for large releases of dry material and contaminated areas. Cost-effective for cleaning up dry materials release; common and simple. Less precise, less recycling and reuse opportunities, may require imported material for backfill.

**Dust Control (Industrial).** Water spraying, negative pressure systems, collector systems, filter systems, street sweeping. May reduce respiratory problems in employees around the site; may cause less loss of material and save money; efficient collection of larger dust particles. More expensive than manual systems; difficult to maintain by plant personnel; labor and equipment intensive; street sweepers may not be effective for all pollutants.

**Signs and Labels.** Inexpensive and easily used. Must be updated/maintained so they are legible, subject to vandalism and loss.

**Table 12.6**

**Advantages and Disadvantages of BMPs for  
Spill Prevention and Response BMPs**

**Security.** To prevent accidental or intentional release of materials. Preventative safeguard; easier detection of vandals, thieves, spills, leaks, releases; prevents spills with better lighting, no unauthorized access to facility. May not be feasible for smaller facilities; may be costly; may increase energy costs due to increased lighting; dispersed locations require individuals enclosures, requires maintenance.

**Area Control Measures.** Good housekeeping measures, brushing off clothing before leaving area, etc. Easy to implement; results in cleaner facility and improved work environment. May be seen as tedious by employees and may not be followed.

**Preservation of Natural Vegetation**

Can handle more storm water runoff than newly seeded areas; effective immediately; increases filter capacity; enhances aesthetics; provides areas for infiltration; wildlife can remain undisturbed; provides noise buffers; less maintenance than new vegetation. Planning required to preserve and maintain existing vegetation; may not be cost-effective with high land costs; may constrict area available for construction activities, may require signage or fencing, subject to disturbance.

**Temporary Seeding.** Short-term vegetative cover on disturbed areas. Inexpensive and easy to do; establishes plant cover quickly in good conditions; stabilizes soils well; aesthetic; sedimentation controls for other site areas; helps reduce maintenance costs of other controls. Requires soil preparation, may require mulching or reseeded of failed areas, seasonally limited, may require signage or fencing, subject to disturbance.

## Chapter 13

### Construction Plans

<b>Section</b>	<b>Topic</b>	<b>Page</b>
13.1	General	13.1
13.2	Subdivision Plans	13.1
13.3	General Plan Sheet Requirements	13.10
13.4	Title Sheet	13.10
13.5	General Information to Be Shown on Detailed Plans	13.11
13.6	Street and Storm Sewer Plans	13.12
13.7	Sanitary Sewer Plans	13.13
13.8	Drainage Ditch and Drainageway Plans	13.14
13.9	Water Main Plans	13.14
13.10	Erosion Control Plan	13.15

## Chapter 13

### Construction Plans

#### 13.1 General

Detailed reproducible plans, prepared by or under the direct supervision with the signature, seal, and date of the licensed Professional Engineer in the State of South Dakota, shall be filed with the City Of Dell Rapids or all work involved in public improvement contracts. Detailed plans shall conform to the City of Dell Rapids Ordinances and to the following requirements.

#### 13.2 Subdivision Plans

It is the purpose of the Engineering Design Standards to facilitate the orderly and responsible subdivision of land so as to coordinate streets/roads with other subdivisions and uses, to provide reliable water and sanitary sewer services, to afford proper drainage and flood control, and to do so in a manner that best protects the natural environment.

To achieve this, the subdivision of land shall require the submittal of a Concept Plan, Preliminary Plan, Development Engineering Plan, Plat and Construction Plan.

**13.2.1 Concept Plan.** Unless waived by the City of Dell Rapids, a Concept Plan must be submitted to the City for review. A Concept Plan shall include the following information:

1. The general layout of streets and access points to adjacent street systems; location of major drainageways, approximate flow paths and detention ponds; waterline locations; sanitary sewer line locations; natural features and amenities and preservation of public land, proposed zoning districts; and pedestrian connectivity.
2. The proposed name of the subdivision.
3. Any utilities or streets for which the applicant is expecting City reimbursement.
4. Vicinity map to scale, showing locations of the Concept Plan and other property for at least 660 feet in every direction.

**13.2.2 Preliminary Plan.** A Preliminary Plan shall be submitted to the City for review. The Preliminary Plan shall be in conformance with the Engineering Design Standards and shall include all information from the Concept Plan as well as the following information:

##### 13.2.2.1 General

1. The proposed name of the subdivision.
2. The names of all adjoining subdivisions, showing connectivity with lot and block lines, easements and right-of-way. Adjoining unplatted property shall be labeled as such.

3. Vicinity map to scale showing location of the Preliminary Plan and other property for at least 660 feet in every direction.
4. The owner, developer and engineer's names, addresses, and telephone numbers.
5. The legal description and notations stating acreage, scale, and north arrow.
6. The proposed zoning districts.
7. A systematic lot and block numbering pattern, lot lines, and street/road names.
8. Location and widths of all existing and proposed easements.
9. Existing contours.
10. Location and size of all public facilities, schools, libraries, fire stations, parks, tree masses, and other significant natural features.
11. Any expectations for City reimbursements.
12. Proposed phasing for the development with estimated timelines.

#### **13.2.2.2**

#### **Streets**

1. Compliance with Major Street Plan.
2. Adjacent property information: access points, right-of-way, city limits, development plans, and any other pertinent information needed for review.
3. Street right-of-way widths.
4. Identify minor and major collectors with conformance to Chapter 8 of the Engineering Design Standards.
5. Transportation connectivity within the development as well as connectivity with the surrounding properties. This also includes pedestrian connectivity.
6. Consideration of lots that front on the arterial streets and where their access points will be allowed. Note: Assessments will be required, if they are approved.
7. Note if access to the development is from a city street or a county highway.

### **13.2.2.3 Sanitary Sewer**

1. Compliance with existing officially recognized large-scale plans (Infrastructure Facilities Plan, Dell Rapids 2008-2028 Comprehensive Plan) prepared by the City of Dell Rapids.
2. Major individual commercial or industrial occupants (if any).
  - a. Type of sewage produced by major contributors identified above (if atypical).
  - b. Volume of sewage produced by major contributors identified above (if atypical).
3. Can developments and properties adjacent to the development under study be served by the existing sewer (from the standpoint of geography, gradient, and capacity)? (Note: City of Dell Rapids will furnish the design engineer with any available existing flow information within 30 working days of receipt of a written request.)
4. Estimated flow in planned sewer (cfs, mgd, or other unit).
5. Proposed pipe size for planned sewer.
6. Proposed pipe size for force main, if applicable.
7. If pumping station is being proposed, list the type and capacity.
8. Adequacy of receiving sewer system.
9. Manhole locations with manholes numbered.
10. Flow direction, connections to existing system and extensions to adjacent properties.
11. Extension of sanitary sewer to the adjacent upstream users.
12. Sanitary sewer shall be limited to a depth no greater than 15 feet.

### **13.2.2.4 Water**

1. Compliance with Water Distribution System Master Plan.
2. Show valves, fire hydrants, and other water main appurtenance locations.
3. Extension of water lines to perimeter of the development.
4. Proposed pipe sizes.

### 13.2.2.5 Drainage

1. The developer shall submit a drainage plan for the drainage basin(s) of which the development is included. Scales as small as 1 inch equals 500 may be used to show the entire development.
2. The following information shall be included in the submittal:
  - a. A route outlet map will be required. This map shall show how the drainage from the proposed development will be transmitted to the nearest major drainageway. The map shall show any existing structure(s) which may limit the flow en route to the major drainageway. The route outlet map shall show the drainage area upstream of the proposed development and the estimate of flow under current conditions presently draining onto and through the development.
  - b. Data for minor and major storm flows within the proposed development for all drainage basins and sub-basins.
  - c. Identification of drainage problems with proposed solutions to deal with the problems within the development.
  - d. Identification of downstream and upstream facilities as shown on the route outlet map.
  - e. Locations and size of proposed detention ponds within the development shall be identified.
  - f. General locations and size of potential wetlands shall be identified. Include copy of correspondence with United States Army Corps of Engineers (USACOE) requesting wetland determination and any responses. Also, note if any mitigated wetlands will be created.
  - g. Any and all existing 100-year floodplains must be identified, as shown by FEMA maps.
  - h. Existing contours.
  - i. Location and size of existing open channels, bridges, culverts, storm sewers, and ponding areas within the development.
  - j. Location of streets.
  - k. Identification of all drainage basins tributary to the development.
  - l. Drainage patterns within the proposed development.
  - m. Provide adequate information as to the effect of the drainage pattern on adjacent property. Provide survey data as required for adequate information. Identify the storm water path to the major drainageway.

### **13.2.2.6 Street Lighting**

1. Reserved for future.

**13.2.3 Development Engineering Plan.** The Development Engineering Plan shall be submitted to the City of Dell Rapids for review. The Development Engineering Plan shall include all information from the approved Preliminary Plan as well as the following information:

#### **13.2.3.1 General**

1. Compliance with conditions and approval requirements of the Preliminary Plan.
2. Existing and proposed easements shown and dimensioned from property lines and utilities.

#### **13.2.3.2 Streets**

1. Conformance with Chapters 5 and 8 of the Engineering Design Standards.
2. Note if street width conforms to street designation.
3. Conformance to traffic calming practices shown in Chapter 8 of the Engineering Design Standards.
4. Inclusion of horizontal curve data for streets and radii.
5. Show proper driveway/intersection spacing.
6. Note if the arterial the development will be using is improved paved, improved to urban standard, or gravel. If gravel, development will need to petition for street improvements before development can continue. If rural section, petition will need to be submitted.
7. Development conforms to existing geography and with City approved grade line for arterial streets.

#### **13.2.3.3 Sanitary Sewer**

1. Conformance with Chapter 9 of the Engineering Design Standards.
2. Manhole depths.
3. Manhole rim and invert elevations, including existing manholes that are being connected into.
4. Proposed basement locations.
5. Connections to existing system.

#### **13.2.3.4 Water**

1. Conformance with Chapter 10 of the Engineering Design Standards.

#### **13.2.3.5 Drainage**

1. The Final Drainage Plan shall be a detailed plan of the proposed development phase, as defined per Subdivision Ordinance. It shall include detailed data for all runoff within the proposed development phase and detailed data for the design of all drainage structures within the development phase.
2. Drawings and data (actual calculations may be required with submittal) comprising of the Final Drainage Plan shall comply with Chapter 2 - Submittal Procedures, and shall include but not be limited to the following information. Scale will be 1 inch equals 100 feet maximum.
  - a. Proposed contours and arrows indicated drainage paths for each lot.
  - b. Location and elevations of Bench Marks and lot corners.
  - c. Property lines.
  - d. Streets, names and grades.
  - e. Existing drainage facilities and structures, including existing roadside ditches, drainageways, gutter flow directions, culverts, etc. All pertinent information such as size, shape, slope, location, etc. shall also be included to facilitate review and approval of drainage plans. Flow areas will be delineated.
  - f. Proposed storm sewers and open drainageways, easement and right-of-way requirements, including proposed inlets, manholes and culverts. General notes concerning erosion control and energy dissipation shall be provided.
  - g. Proposed outfall point for runoff from the development phase.
  - h. Routing and accumulative flows at various critical points for the minor and major storm runoff.
  - i. 100-year flood level in all streets in which the curb is overtopped during the 100-year storm for sump condition or other critical points.
  - j. Identify 100-year flood elevations for major and lateral drainageways.
  - k. Inlet flow data.
  - l. Pipe flow data.

- m. All floodplains, identified by FEMA maps, within the proposed development phase.
- n. Location and size of potential wetlands.
  - 1) Provide copy of correspondence with state and federal agencies related to the potential impact to wetlands or other cultural resources. This includes:
    - a) Wetland determination for USACOE.
    - b) Wetland mitigation plan.
    - c) Any restrictive covenants that would prevent the City from performing maintenance activities such as excavating within the wetlands.
- o. Hydrological data for each drainage area.
  - 1) Areas. Show areas of the subdivision which will not be routing storm water to a water quality BMP structure.
  - 2) Watershed lengths, elevations, time of concentration.
  - 3) Rainfall intensity.
  - 4) Runoff coefficients.
  - 5) Projected land uses and existing physical features of areas contributing runoff.
  - 6) Storm duration.
  - 7) Runoff (Q) (Note: This list of criteria assumes use of Rational Formula. If a different method is used, all relevant factors are to be enumerated.).
  - 8) If subdivision will discharge storm water onto undeveloped land, show peak flow rates for the 5- and 100-year return storm for predevelopment conditions and post development conditions.
  - 9) If project size is over five acres and zoned non-single family residential, all discharge from site must be at single-family rates.
- p. Major drainageways.
  - 1) Note if applicant intends to dedicate the drainageway.
  - 2) Alignments and profiles including existing and proposed.

- 3) "n" values (Manning).
  - 4) Calculations of rainfall intensity and duration, acreage, volume and velocities.
  - 5) Soils analysis with a discussion of the proposed channel erosion potential.
  - 6) Shear Stress.
- q. Design recommendations.
- 1) Dikes.
  - 2) Filling low areas.
  - 3) Provision of easements.
  - 4) Minimum recommended ground elevation for buildings, lowest recommended floor elevation, and recommendations against building in certain areas.
  - 5) Provisions for on-site retention and detention. Notate whether or not these retention and detention ponds will be dedicated to the City.
  - 6) Other as appropriate for conditions.

### 3. Sump Pump Collection System

- a. A sump pump collection system along with necessary structures shall be shown attached to the trunk drainage system.

#### 13.2.3.6 Street Lighting

1. Reserved for future.

**13.2.4 Plat.** The plat shall be submitted to the City. One mylar, two paper copies, one reduced 8.5 x 11 copy, and one electronic PDF and one DWG file shall be submitted. All copies shall comply with state statutes. The plan shall include the following information:

1. Comply with the Development Engineering Plan for layout of lot, block, right-of-way and easements.
2. Name of subdivision.
3. Names of adjoining subdivisions showing lots, blocks and easements. Unplatted property shall be labeled.
4. Site location map.
5. Drawn to a scale appropriate for the size of the parcel.

6. Lot and block numbering pattern, lot lines, street names and square footage of all lots.
7. Location of all monuments, permanent control points and survey pins.
8. All dimensions, linear and angular, necessary for locating the boundaries of the subdivision lots, roadways, easements and other areas for public and private use. For curves, this shall include radii, chords, length of curve and point of tangency.
9. Identification and delineation of any portions of the property to be dedicated or granted for public use such as schools, parks, drainageways, BMPs, or other.
10. Existing and proposed easements or right-of-way dimensioned from property lines or known points.
11. Boundary lines of the floodway and 100-year flood zones along with the base flood elevation on each lot as delineated on the Flood Insurance Rate Maps (FIRM).
12. Surveyor's certificate.
13. Acknowledgement by the owner of any restrictions, as well as use of common areas.
14. Formal irrevocable offers of dedication.
15. Approved assurance agreements or development agreements.
16. Certificates of approval for endorsement by the City of Dell Rapids.

**13.2.5 Construction Plans.** Construction Plans shall be submitted to the City. Construction Plans shall include all information from the Development Engineering Plan as well as the following information:

1. Plans shall conform to all chapters of the Dell Rapids Engineering Design Standards, Supplemental Specifications, and shall include all necessary Standard Plates.
2. All plans shall be submitted as 11- x 17-inch electronic format plans with the proper scaling.
3. The final approved Construction Plans shall be submitted in a single electronic DWG file for insertion into GIS database.
4. Final Construction Plans shall be submitted in accordance with Chapter 2 of the Engineering Design Standards.
5. Update of proposed phasing for development if known.

### **13.3 General Plan Sheet Requirements**

**13.3.1 Plan Sheet Size.** Prepare plans on sheets 11 inches by 17 inches in size, except for special layout sheets when specifically accepted by the City of Dell Rapids. Review plans may be submitted on sheets 22 inches by 34 inches. The maximum width of any sheet shall not be greater than 36 inches.

**13.3.2 Names on Sheets.** All persons designing, detailing, and checking plans shall legibly place their names on the plan sheets in a space provided for this purpose.

**13.3.3 Title Block.** A title block listing the name of the project, Owner, and Engineer along with sheet title, date, sheet number, and space to denote revisions. Title block shall go in lower right corner or right edge of each sheet except the title sheet so as to be read from the bottom or right side. Page numbers shall be in the lower right corner of each sheet.

**13.3.4 Precision and Detail.** Plans shall be prepared with such precision and in such detail as to be within the customary degree of accuracy for work of this kind and so permit the convenient layout in the field for construction and for other purposes. They shall also be of such character as to provide for the production of an accurate estimate of quantities for the several pertinent items of work to be performed in the construction of the improvement.

**13.3.5 Special Provisions.** Plans shall include special provisions for items of work included in the plans which are not covered by the Standard Specifications and accepted special provisions of the South Dakota Department of Transportation and the City of Dell Rapids as may be required to properly cover the work contemplated by the plans. Special provisions may be prepared on 8 1/2-inch by 11-inch paper and bound with other bid documents.

### **13.4 Title Sheet**

The following information shall be shown when applicable.

1. Project name and location.
2. Type of project.
3. Small scale map showing project location. Plan and profile sheet layout shall be shown on location map.
4. Index (a complete sheet index is to be shown).
5. File number (to be filed at the City Hall).
6. Engineer's firm name and address.
7. Estimate of quantities (may be placed on second sheet). Development plan shall contain utility quantities only.
8. Design Engineer's certification, registration number, and date certified.

9. General Notes (show all general notes pertaining to construction. Include a general note that project shall be constructed in accordance with the Standard Specifications or as directed by the City of Dell Rapids).
10. Legend (define all symbols shown in the plans).
11. Legal Description, including section, township, and range.

### **13.5 General Information to be Shown on Detailed Plans**

The following information shall be shown when applicable.

1. Construction limits.
2. Benchmarks.
3. Street names.
4. Right-of-way widths.
5. Removal of large trees, buildings, pavement, structures, or other features as required.
6. Horizontal and Vertical Control. Alignment notes and benchmark descriptions are to be located on the plan portion of the sheets. All vertical control shall be based on NAVD 1988 vertical datum.
7. Lot and block numbers and subdivision name in new subdivisions. Otherwise, show property addresses.
8. Lot dimensions (along rights-of-way or easements).
9. Show scale (usually 1" = 20' horizontal and 1" = 5' vertical reduced to 1" = 40' horizontal and 1" = 10' vertical) using a bar type diagram and standard north arrow together. Show arrow on right-hand side pointing to top or left of sheet.
10. Existing and proposed utilities—type, size, and location. (Show existing features less prominently or dashed.)
11. Pavement widths.
12. Where stationing is continuous from one sheet to the next, the last station on one sheet is to be the first station shown on the next. If possible, locate on the sheet to avoid “breaking” the plan and profile.
13. Existing trees, fences, walks, drainage structures, ditches, pavements, buildings, and other obstacles or improvements that are in or near the work area. (Show existing features less prominently or dashed.)
14. Survey line or reference line shall be shown on plan view.
15. Temporary and permanent easements.

16. Special details and special notes when required.
17. Plan view and profile shall line up whenever possible.
18. Symbols and abbreviations used on plans if different from those shown in Standard Specifications.
19. Any soils information available. (Show test hole locations on plan and profile sheets.)
20. When it is required by the City of Dell Rapids, a traffic control plan shall be shown on plans.
21. Other information deemed necessary by the Design Professional certifying the plans.
22. Revision block showing description, date, and by.

### **13.6 Street and Storm Sewer Plans**

The following information shall be shown when applicable.

1. Show BEGIN STA. and END STA.
2. Storm sewer plans shall be shown on the same sheets as paving unless it is a major installation.
3. Match lines to other plan and profile sheets where they do not follow in order in the plans such as at an intersection.
4. Horizontal curve data near curve or code for clarity if several are to be shown or if the sheet is crowded. Show Point of Intersection (PI) Station, angle, degree, radius, tangent, length, and superelevation, if any. Show Point of Curvature (PC), Point of Intersection (PI), and Point of Tangent (PT) station on the plan. For vertical curves show stationing, length, and elevations of Point of Vertical Curvature (PVC), Point of Vertical Intersection (PVI), and Point of Vertical Tangent (PVT). Also show "K" value as defined in *A Policy on Geometric Design of Highways and Streets* published by AASHTO, latest English edition.
5. Drainage arrows designating direction of runoff.
6. Stationing of paving projects will generally run from north to south or from west to east so that the north arrow will point to the top or lefthand side of the sheet.
7. New construction and information notes in accordance with standard "Typical Notes."
8. Show profile of existing ground or proposed street high enough to allow for storm sewer information and profile grades below. Show street profile grade elevations every 25 feet, typical. Label the existing ground line and show percent of grade on the new grade line (usually top of curb).
9. Show profile flow line elevations on all inlets, catch basins, pipes, and culverts. Show size, type, class (if necessary), and percent of grade on storm sewer pipes.

10. Show intersection details to the extent necessary to insure proper horizontal and vertical alignment. The following additional information is required:
  - a. Spot elevations along center lines and along curb lines extended through the intersection.
  - b. Drainage arrows showing direction of storm water flow.

Additional geometric information may be required including key distances, stations, angles, curve data, and elevations necessary for design and staking.

11. Show typical sections as required including information on the following:
  - a. Shoulder slopes, back slopes, side slopes
  - b. Paving widths, thicknesses, and types
  - c. Lane widths
  - d. Pavement cross slopes
  - e. Sidewalks and slopes
  - f. Subgrades and paving treatment
  - g. Typical right-of-way lines
  - h. Other typical details of paving or grading sections as appropriate not otherwise covered on the standard paving details.

Typical sections may be waived for private development plans if it is a standard section.

### **13.7 Sanitary Sewer Plans**

The following information shall be shown when applicable.

1. Stationing, location, and type of all manholes, intakes, or other structures. Type of structures shall be in conformance with the Standard Specifications.
2. Details shall be shown for all structures that are not in accordance with City of Dell Rapids standards.
3. Plan and profiles of all sewer lines (including existing ground profile and proposed finished grade profile).
4. Size, length, and grade of sewers.
5. Type of pipe materials and strengths (if necessary).
6. Invert elevations at all intakes, manholes, and other structures.
7. On reconstruction projects, location, size, and type of all sewer stubouts, wyes, or tees. Stubout locations shall be referenced to lot corners. When risers are to be installed, riser location and size shall be shown on reconstruction plans.
8. Estimates shall include stubout quantities when they are to be constructed by City contract.
9. Rim and invert elevations of existing and proposed manholes and structures.

10. Manholes shall be identified with numbering system on plan and profile.
11. Class of pipe bedding if necessary.
12. Existing underground utilities such as cables, water, sewer, or gas lines or any other underground features that cross or are near the proposed sewer. Show exact elevations, if possible, where there may be conflict with new construction.

### **13.8 Drainage Ditch and Drainageway Plans**

The following information shall be shown when applicable.

1. Stationing and flow line elevation at beginning and end of ditch construction.
2. Size, type, length, and grade of ditch.
3. Typical sections showing ditch dimensions, backslopes, and invert and slope treatment.
4. Invert elevations at all structures.
5. All special structures shall be detailed on plans.
6. Drainage design data.
7. Cross-sections and topographic map showing existing ground and finished grade at intervals of 100'.

### **13.9 Water Main Plans**

The following information shall be shown when applicable.

1. Stationing, location, and type of all water lines, manholes, valves, fire hydrants, or other appurtenances.
  - a. Stationing and type of structure shall be shown on station bar.
  - b. Location shall be shown on plan or on station bar if referenced to survey line or center line.
  - c. Type of structures shall be in conformance with Standard Specifications, Standard Plates, or as directed by the City of Dell Rapids.
2. Details shall be shown for all structures that are not in Standard Specifications, Standard Plates, or as directed by the City of Dell Rapids.
3. Plan and profiles of all water lines where future changes in grade are possible.
4. Size and length of water lines.
5. Type of pipe materials and strengths if necessary.
6. Top of pipe grade to be six (6) feet below finished grade.

7. On reconstruction projects, location, size, and type of all water stubs, wyes, or tees. Stub locations shall be referenced to lot corners and stubbed to property line.
8. Estimates shall include stubout quantities when they are to be constructed by City contract.
9. Curb elevations at all hydrant locations.
10. All castings shall be City standard where maintained by the City.
11. Class of pipe bedding if necessary.

### **13.10 Erosion Control Plan**

An erosion control plan shall be submitted as detailed in Chapter 12 of these Design Standards.

## Chapter 14

### Acceptance Procedures and Requirements For Private Construction of Public Improvements

Section	Topic	Page
14.1	Application of Standards	14.1
14.2	Acceptance Procedure	14.1
14.3	General Policy	14.2

## Chapter 14

### Acceptance Procedures and Requirements for Private Construction of Public Improvements

#### 14.1 Application of Standards

The requirements contained herein shall apply to all new private development construction and site development construction within City dedicated right-of-way and easement areas that is planned for or subject to public use within the jurisdiction of the City of Dell Rapids. This acceptance shall consist of all improvements included in the Owner submitted construction plans accepted by the City.

**14.1.1 Acceptance Limitation.** The acceptance of an improvement shall in no way constitute an assumption by the City of liability for defects in the improvement. By accepting the improvement, the City does not warrant or guarantee that the improvement has been properly designed or constructed. Any errors or omission of the Owner/Developer/Engineer shall not be the responsibility of the City.

#### 14.2 Acceptance Procedure

The acceptance process will proceed in two phases. The first phase will consist of Utility Acceptance which includes the water main, sanitary sewer, and storm sewer facilities.

The second phase or Final Acceptance shall consist of all other public improvements including but not limited to grading, crushed base, curb and gutter, and surfacing. All items identified during the final inspection shall be complete before the final acceptance.

**14.2.1 Utility Acceptance.** A Utility Warranty Report shall be sent to the developer's representative when the water main, sanitary sewer, and storm sewer facilities are complete and accepted by the City of Dell Rapids. Storm sewer facilities shall include storm sewer pipe, storm sewer inlets, and storm sewer junction boxes. The warranty start date shall be shown on the Utility Warranty Report.

The warranty start date shall be the date the two-year warranty period commences for the water main, sanitary sewer, storm sewer pipe, storm sewer inlets, and storm sewer junction boxes.

**14.2.2 Final Acceptance.** The City of Dell Rapids or an authorized representative shall notify the developer's representative when all public improvements are complete and accepted by the City. The date the improvements are accepted shall be included in this notification. This date shall be the date the one-year warranty period commences for all improvements included in the final acceptance.

After the City grants final acceptance, the City will assume all maintenance responsibilities for the public improvements.

### **14.3 General Policy**

The City shall provide snow removal service on streets where the lower lift of asphalt has been placed. The City shall not provide snow removal services on streets where manholes, valve boxes, and any other items protrude above the roadway surface.

Prior to the final acceptance, the Owner shall maintain the improvements and repair or correct any deficiencies that may occur before final acceptance is granted.

The City will accept responsibility for damage to curb and gutter caused by snow plow operations provided notification is given prior to the final lift of asphalt being placed.

The Owner shall be responsible for installation and maintenance of any barricades or warning signs required until final acceptance is granted.

**Chapter 15**  
**Street Lighting**

<b>Section</b>	<b>Topic</b>	<b>Page</b>
15.1	General	15.1
15.2	Street Light Locations and Spacing	15.1
15.3	Junction Boxes	15.2
15.4	Conduits	15.2
15.5	Concrete Street Light Footings	15.3
15.6	Direct Bury Street Lights	15.3
15.7	Meters and Meter Pedestals	15.3
15.8	Power Supply	15.4
15.9	Material Specifications	15.4
15.10	Easements	15.4

## Chapter 15

### Street Lighting

#### 15.1 General

**15.1.1** This chapter sets forth the design and technical criteria to be used in the preparation of all street lighting plans. Where design information is not provided herein, the following standards (most current edition) shall be used:

1. National Electrical Safety Code (NESC)
2. National Electrical Code (NEC)
3. City of Dell Rapids Design Standards, Supplemental Specifications, and Standard Detail Plates
4. Requirements and Standards of the State of South Dakota

**15.1.2** Where a conflict occurs between the above standards, the most restrictive requirement shall apply.

**15.1.3** Street lights shall be placed on lot/property lines that are perpendicular to street centerline where applicable.

**15.1.4** Street lighting on cul-de-sacs must terminate with a street light on the lot line nearest where the turnaround begins.

**15.1.5** Street lights, junction boxes, meter pedestals, and conduit shall be free and clear of any permanent obstructions, which would impair the ability of future maintenance operations. Layout of street lighting must also consider vertical and horizontal alignment with respect to other utilities that might conflict with the installation of the street lighting system.

**15.1.6** Street lighting wires will be furnished by the utility company. Wire installation and wire terminations and connections will be completed by the utility company.

**15.1.7** Design of street lighting systems will typically consist of installation of street lights in areas that have concrete curb and gutter installed. If concrete curb and gutter has not been installed, a street lighting system will not necessarily be required. The City of Dell Rapids will evaluate each project before final design is complete.

**15.1.8** If necessary, removal of street lights shall be coordinated with the owner of the electrical utility. All materials removed will become the property of said utility unless otherwise noted.

#### 15.2 Street Light Locations and Spacing

**15.2.1** Street lights shall be installed as indicated in Chapter 4 of the *City of Dell Rapids Design Standards for Public Improvements* or as specified below.

- 15.2.2 Residential lighting shall be spaced 175-250 feet apart with a nonstaggered pattern and located at intersections.
- 15.2.3 Local, Collector, or Arterial (minor) lighting shall be spaced 200-275 feet apart with a nonstaggered pattern and located at intersections.
- 15.2.4 Commercial lighting, or Arterial (major), shall be spaced 175-250 feet apart located at intersections and with a staggered pattern if possible.
- 15.2.5 Generally, street lights will be located within the public right-of-way two (2) feet from the back of curb unless otherwise noted. Street lights shall be located on a lot line whenever possible. Streets that have sidewalks installed behind the curb and gutter will require street lights to be installed behind the sidewalk but still within the public right-of-way. If street lights cannot be installed within the public right-of-way, a utility easement will be required.
- 15.2.6 When street light locations are being considered, overhead obstructions must be evaluated prior to placement location. In general, street lights shall maintain a minimum clear distance of eight (8) feet from any overhead electrical power lines. Other overhead obstructions such as trees, cable television lines, communications lines, etc., shall be evaluated on a case-by-case basis.

### **15.3 Junction Boxes**

- 15.3.1 Junction boxes shall be spaced a maximum of 275 feet from the furthest street light or junction box.
- 15.3.2 Standard size junction box is 18 inches. The need for larger junction boxes will be determined by owner of the electrical utility.
- 15.3.3 Generally, junction boxes will be located within the public right-of-way two (2) feet from the back of curb, unless otherwise noted, and on a lot line whenever possible.
- 15.3.4 Junction boxes shall generally be located such that they will not be in driveways.
- 15.3.5 Maximum number of conduits entering into a junction box shall not exceed six (6) and the minimum number of conduits shall not be less than two (2) into an 18-inch junction box.
- 15.3.6 All street light junction box lids shall be labeled "Electric."

### **15.4 Conduits**

- 15.4.1 All street lighting conduit shall be 2-inch diameter,.
- 15.4.2 Conduit shall have a minimum depth of bury of 24 inches from finished grade.
- 15.4.3 All conduit installation shall be in compliance with the National Electrical Code.
- 15.4.4 Generally, conduit will be located within the public right-of-way two (2) feet from the back of curb unless otherwise noted.

**15.4.5** When bends are required on any conduit run, no more than four (4) 90° bends will be allowed in one given conduit run.

**15.4.6** Conduits or direct buried wire must have 18 inches of horizontal clearance from fire hydrants, inlets, cable boxes etc.

**15.4.7** Street light conduit and traffic conduit may be buried in the same trench.

## **15.5 Concrete Street Light Footings**

**15.5.1** Generally, street light footings will be located within the public right-of-way two (2) feet behind the back of curb unless otherwise noted and on a lot line whenever possible. Streets that have sidewalks installed behind the curb and gutter will require street light footings to be installed behind the sidewalk, but still within the public right-of-way. If streetlight footings cannot be installed within the public right-of-way, a utility easement will be required.

**15.5.2** The maximum number of conduits within a streetlight footing shall not exceed four (4). Included in the total number of conduits will be one spare conduit that will generally be installed facing away from the curb for future lighting needs.

**15.5.3** Types of footings will be based on the desired location and the physical constraints which are encountered during design of the footing. Typically, the standard street light footing will be sufficient; however, specialty footings shall be used when necessary. Specialty footings consist of spread footings, historical footings, special footings for 25-foot brown fiberglass poles, and post top footings.

**15.5.4** When street lighting is installed near a location of pedestrian traffic, ADA clearance requirements will need to be met.

## **15.6 Direct Bury Street Lights**

**15.6.1** Generally, direct bury street lighting may be used for lighting at the beginning and end of construction projects through the transition zones. Locations are dependent on each specific project; however, standard locations shall be utilized whenever possible. Typical wire depth for direct bury lighting systems shall be a minimum of 24 inches from finished grade.

**15.6.2** Direct bury streetlights are used for all new residential areas and are designed in partnership with other electrical utilities.

## **15.7 Meters and Meter Pedestals**

**15.7.1** Electrical meters will be furnished and installed by the electrical utility if necessary.

**15.7.2** When necessary, pedestals shall be installed at a location as determined by the electrical utility.

## **15.8 Power Supply**

- 15.8.1** All street lighting plans shall indicate a designated power supply feed point. The power supply shall be installed from the designated supply point to a meter pedestal, if required.
- 15.8.2** The design engineer will be required to determine which power company will be utilized to supply power for street lighting.
- 15.8.3** Power supply lines will need to be installed in two- (2) inch schedule 80 PVC conduit up power pole within two (2) feet of secondary wire. Additionally, the power supply lines will need to be installed in two- (2) inch conduit from the power supply source to the meter pedestal.
- 15.8.4** Power supplies shall be centrally located within project boundaries for street lighting layouts whenever possible.

## **15.9 Material Specifications**

- 15.9.1** Material specifications are as specified in the Standard Specifications or as directed by the City of Dell Rapids.

## **15.10 Easements**

- 15.10.1** Lighting and power easements shall be obtained for all lighting and power lines located on private and public property. Lighting and power easements shall have a minimum width of ten (10) feet. In addition, temporary easements may be required for construction. Lighting and power easements shall be accessible for maintenance workers to maintain the lighting and power system.

**Chapter 16**  
**Inspection and Testing**

<b>Section</b>	<b>Topic</b>	<b>Page</b>
16.1	General	16.1
16.2	Submittals	16.1
16.3	Testing Schedule	16.1
16.4	Inspection Schedule	16.2

## Chapter 16

### Inspection and Testing

#### 16.1 General

In order to insure satisfactory completion and conformance with city standards, the City shall conduct inspections and require testing during construction. It is the responsibility of the contractor to abide by the proposed testing and inspection schedules set forth in this section and to notify the city when work is ready for inspection. In the event that the proposed schedules are not met, construction on the project shall cease until the items that are out of compliance are resolved.

All projects shall be constructed and tested in accordance with Engineering Design Standards, Standard Specifications, or as directed by the City of Dell Rapids.

#### 16.2 Submittals:

The contractor shall submit shop drawings of all materials to be constructed to the City of Dell Rapids for approval. Four (4) complete sets of original drawings plus any number the Contractor wishes to maintain shall be submitted. One complete set of shop drawings shall include all submittals for the project. Each set shall be bound into a single document with a cover page attached listing the following information.

1. Project Name
2. Submittal Date
3. Contact information for the Contractor

#### 16.3 Testing Schedule:

The following tests shall be scheduled by the contractor and performed by a certified testing agency. All results shall be forwarded to the City of Dell Rapids. Tests shall be performed as detailed in the current version of the SDDOT Materials Manual or current ASTM Standards.

1. Asphalt Paving - Density tests shall be performed at the frequency of 1 per 900 lane feet per lift. Density tests shall be performed using the cut out (core) or nuclear gauge method. The nuclear gage method shall only be used for acceptance testing if it is calibrated with cores as detailed in the Materials Manual. A standard density (Rice) test shall be performed once per project and when there is a change in the mix. Testing may be waived by the engineer when the total project quantity for asphalt is less than 500 tons.
2. PCC Concrete Streets - An air content test shall be performed on the first truck before pouring is begun. An air test, slump test, and at least four concrete cylinders (1 for an early break, 2 for 28 day breaks, and one backup) shall be made for every 150 cubic yards of pouring.

3. Sidewalks, Curb & Gutter, Concrete Fillets, Valley Gutters, Inlets, and other Miscellaneous Concrete - An air test, slump test and a strength test shall be performed for every 100 cubic yards of pouring. Additional strength tests should be run when needed to determine when concrete is ready to carry traffic.
4. Structural Concrete - Air tests, slump tests, and strength tests shall be run at the frequency specified by the current version of the SDDOT Materials Manual in the Minimum Sampling and Testing Requirements section.
5. Subgrade - Soil density and moisture content tests shall be performed on all pavement subgrade and roadway fills a minimum of one (1) per city block or every 600 feet, whichever is less, per four (4) feet of depth. A minimum of one (1) standard density and optimum moisture determination shall be made for the project and one (1) additional test for each change in the soil type.
6. Utility Trenches - Density tests on trench backfill shall be performed in accordance with the City's Standard Specifications for Construction. In general, a minimum of one density test and moisture content shall be made for every 500 lineal feet of trench per four (4) feet of depth. A minimum of one (1) standard density and optimum moisture determination shall be made for the project and one (1) additional test for each change in the backfill.
7. Base Course, Select Granular Backfill, Aggregates, and other Granular Materials - A minimum of one (1) gradation shall be run per project per type of material. Density tests shall be run on base course for roadways a minimum of one (1) per city block or every 600 feet, whichever is less. Testing may be waived by the engineer when the total project quantity for each type of material is less than 500 tons.

The engineer may at any time order additional testing above and beyond the minimum required. The contractor and supplier are encouraged to perform testing as needed to monitor their own quality control. This testing, however, will not be used in determining acceptance of the installed material. When testing will be destructive to the final product, such as coring asphalt pavement, approval must be obtained from the engineer prior to testing.

#### **16.4 Inspection Schedule:**

Listed below is a summary of inspections that shall require written documentation of approval by the City of Dell Rapids. The Contractor shall schedule all inspections with the City of Dell Rapids.

##### **16.4.1 Streets:**

1. Subgrade Stability: The contractor shall schedule an inspection with the City of Dell Rapids to inspect the subgrade stability. The inspection shall be completed once the subgrade has been compacted into place and prior to placing the base course. The contractor will be required to proof roll the subgrade with equipment approved by the City of Dell Rapids. Unstable areas shall be repaired by the contractor.

2. **Base Course Stability:** The contractor shall schedule an inspection with the City of Dell Rapids to inspect the base course stability. The inspection shall be completed once the base course has been compacted into place and prior to placing surfacing. The contractor will be required to proof roll the base course with equipment approved by the City of Dell Rapids. Unstable areas shall be repaired by the contractor.
3. **Bottom Lift Asphalt Stability:** The contractor shall schedule an inspection with the City of Dell Rapids to inspect the stability of the bottom lift of asphalt. The inspection shall be completed prior to placement of the second lift. The City of Dell Rapids shall visually inspect the bottom lift for any failures or depressions. In areas of failure and excessive depression the existing asphalt shall be removed, the underlying grade stabilized and new asphalt patched back into place. In areas of moderate depression, a leveling course shall be installed prior to placement of the second lift.

**16.4.2 Sanitary Sewer:** Newly constructed sanitary sewer systems shall be tested as described in the City's Standard Specifications or as directed by the City of Dell Rapids.

1. Pipe Inspection
2. Pipe Leakage
3. Manhole Leakage
4. Pipe Deflection Test
5. Television Inspection

**16.4.3 Water:** Newly constructed water main systems shall be tested as described in the City's Standard Specifications or as directed by the City of Dell Rapids.

1. Pipe Inspection
2. Disinfection and Bacteriological Testing
3. Hydrostatic Pressure Testing

**16.4.4 Drainage:** Newly constructed storm sewer systems shall be tested as described in the City's Standard Specifications or as directed by the City of Dell Rapids.

1. Pipe Inspection
2. Pipe Deflection Test
3. Television Inspection

**16.4.5 Final Inspection:** The City of Dell Rapids shall conduct a final inspection once all improvements are complete. If all work appears substantially complete, an acceptance letter shall be forwarded to the contractor. If needed a punch list of items to be repaired or completed shall be attached to the acceptance letter.

**16.4.6 Warranty Inspections:** The City of Dell Rapids shall conduct inspections as necessary throughout the warranty process. If needed a punch list of items to be repaired shall be generated and forwarded to the contractor. At the end of the warranty period, the City of Dell Rapids shall forward a letter documenting the expiration of the warranty.

## INFORMATION SOURCES

These Design Standards are a compilation of information taken from several different sources. The main sources used to develop these standards are as follows:

- City of Dell Rapids Ordinances and Subdivision Regulations
- DeWild Grant Reckert and Associates Company Construction Specifications
- The City of Sioux Falls Design Standards for Public Improvements
- The South Dakota Department of Environment and Natural Resources
- South Dakota Department of Transportation