NOTE: There will be an informal meet and greet at 6:15 p.m. to meet and greet the two finalists for the Planning, Building, and Community Development Director position.

A. CALL TO ORDER

B. DISCUSSION ITEMS

1. Update to the Design and Construction Standards

C. PUBLIC COMMENT
   Persons wishing to address the council are asked to do so at this time. Those addressing the council are requested to give their name and address for the record. Please limit comments to three minutes.

D. CITY MANAGER, COUNCIL, AND MAYOR REPORTS

E. ADJOURNMENT

UPCOMING SCHEDULE / FOR YOUR INFORMATION

Next Regular Meeting – December 16, 2019, at 7:00 p.m. – Council Chambers

Work Sessions Cancelled – December 23 and 30, 2019

City Offices Closed – December 25, 2019 – Christmas Holiday

Reasonable accommodations will be made to enable individuals with disabilities to attend this meeting. Please notify the City Clerk at 758-7756.
MEMORANDUM

Date: December 4, 2019

TO: Susie Turner, PE – Public Works Director

CC: Doug Russell – City Manager

FROM: Keith Haskins, PE – City Engineer

SUBJECT: Update to the Design and Construction Standards

MEETING: December 9, 2019 – Council Work Session

BACKGROUND: The City periodically updates the Standards for Design and Construction to ensure conformance with current requirements of the State and Federal agencies, to adopt changes in various materials and methods used in construction, to aid in operation and maintenance of public infrastructure, and to ensure the standards reflect the best practices necessary to support a sustainable community. The last time the Standards were updated was February 5, 2018. Administrative amendments were made on April 2, 2019 to incorporate the On-Street Parking Resolution and to make minor corrections to the text.

PROPOSED CHANGES: The following proposed amendments have been identified by staff as areas needing corrected, updated or included into the Design and Construction Standards.

- Requirement for completion of a Post-construction Stormwater Maintenance Permit per adopted City Ordinance 1831.
- Requirement of a Waiver of Right to Protest the creation of a Stormwater Maintenance District for developments not maintaining stormwater infrastructure in accordance with the requirements of the current MS4 permit and adopted City Ordinance 1831.
- Municipal Facilities Exclusions (MFEs) to expire with Preliminary Plat. This condition was added into the Standards in 2015, but inadvertently omitted in the 2018 update. This provision is needed so that approved MFEs are not held in perpetuity as development stalls. This is one of the reasons flows were over allocated to Lift Station 3, requiring a deviation with MDEQ to allow continued development upstream and was one of the promptings of the Westside Sewer Interceptor project.
- Miscellaneous additions / corrections
  - Clarifications
  - Formatting errors
  - Updated material specifications
  - Updated Standard Details

ATTACHMENTS: Draft Update for the Kalispell Standards for Design and Construction with revisions shown.
STANDARDS FOR DESIGN AND CONSTRUCTION
CITY OF KALISPELL, MONTANA

APRIL 2, 2019
JANUARY 20, 2020

Style Definition: TOC 1: Tab stops: 6.49", Right, Leader: ...
Style Definition: TOC 3: Tab stops: 0.92", Left + 6.49", Right, Leader: ...
Republished February 05, 2018 – Amendments:

- Document formatting, topic organization, references and hyperlinks for code, regulatory, design parameters, permits, construction materials, etc.
- Standard drawings, submittal checklists, and forms.
- Design submittal requirements and processes to streamline and coordinate departmental review.
- Water and Sewer Chapters by reorganizing format of design parameters and construction standards.
- Service size and meters sizing requirements.
- Stormwater Chapter to meet MS4 Permit requirements. Reference water quality design criteria from the Montana Storm Water Post-Construction BMP Design Guidance Manual (BMP Manual).
- Transportation chapter by adding street cross-sections, on street parking parameters, and updated light standards.

Republished April 02, 2019 – Amendments:

- Chapter 6 Table 1 – corrected range of 15.18 to 15.21.
- Chapter 7 Section 1.1.B.II.a modified example to include existing and future landscaping areas.
- Chapter 8 Section 1.11- On-Street Parking Resolution 5916
# Table of Contents

Chapter 1 Construction Within City Right-of-Way ................................................................. 1

1.1. General Provisions ............................................................................................................. 1

1.1.1 Standards ......................................................................................................................... 1

1.1.2 Public Right-of-Way Permit ........................................................................................... 1

1.1.3 City Fees ........................................................................................................................ 2

1.1.4 Applicable Laws and Indemnification of the City ............................................................ 3

1.1.5 Interruption of Service ..................................................................................................... 3

1.1.6 Traffic and Pedestrian Control ......................................................................................... 3

1.1.7 Liability Insurance .......................................................................................................... 4

1.1.8 Bonding .......................................................................................................................... 4

1.1.9 Guarantee for Equipment, Materials, and Workmanship ................................................. 5

1.1.10 Excavation and Disposal of Material from Existing Public Right-of-Way and Easement .... 5

1.1.11 Intersection Monuments ............................................................................................... 6

1.1.12 Pollution Controls ......................................................................................................... 6

1.1.13 Pavement Restoration .................................................................................................... 6

1.1.14 Construction Inspection ................................................................................................. 7

1.1.15 Stop Work Order .......................................................................................................... 7

1.1.16 Relocation of Utilities .................................................................................................... 7

1.2. Project Requirements ....................................................................................................... 8

1.2.1 Contractors Requirements ............................................................................................. 8

1.3. Construction Standards ..................................................................................................... 8

1.3.1 Underground Utilities ..................................................................................................... 8

1.4. Construction Inspection, Testing, and Quality Control ....................................................... 9

1.4.1 Construction Inspection ................................................................................................. 9

1.4.2 Compaction Testing ........................................................................................................ 10

1.4.3 Video Inspection ............................................................................................................. 12

1.5. Boulevard Landscaping ..................................................................................................... 12

1.5.1 Requirements ................................................................................................................ 12

1.6. Record Drawings and Project Acceptance ......................................................................... 12

1.6.1 Certification .................................................................................................................. 12
1.6.2 Record Files
1.6.3 Acceptance
1.7 Two-Year Guarantee Inspection
  1.7.1 Requirements
  1.7.2 Warranty Work

Chapter 2 Design Criteria
2.1 Plans
  2.1.1 General Items
  2.1.2 Title Sheet(s) (Shall not exceed 3 Sheets)
  2.1.3 Plan Sheets
  2.1.4 Plan and Profile Sheets
  2.1.5 Detail Sheets
  2.1.6 Road and Drainage Plans
  2.1.7 Drainage Facilities and Swales
  2.1.8 Basin Maps

Chapter 3 Project Submittals
3.1 Process
  3.1.1 Submittals
  3.1.2 Resubmittals
  3.1.3 Delivery
  3.1.4 Fees
3.2 Responsibilities
  3.2.1 Professional Engineer
  3.2.2 Contractor
  3.2.3 City Engineering Staff
  3.2.4 Developer
  3.2.5 All Parties
3.3 Design or Construction Deviation
  3.3.1 Requirements
3.4 Municipal Facilities Exclusion (MFE)
Chapter 4 Development ........................................................................................................... 23
  4.1 Requirements ................................................................................................................. 23
    4.1.1 General .................................................................................................................... 23
    4.1.2 Utilities .................................................................................................................... 23
    4.1.3 Utility Easements: ................................................................................................. 24
Chapter 5 Water System ......................................................................................................... 25
  5.1 Design Standards ............................................................................................................ 25
    5.1.1 Design Report .......................................................................................................... 25
    4.1.2 Water Pipe .............................................................................................................. 25
    5.1.3 Valves ...................................................................................................................... 26
    5.1.4 Fire Hydrants ........................................................................................................... 26
    5.1.5 Water Services ......................................................................................................... 27
  5.2 Construction Standards ................................................................................................. 28
    5.2.1 General .................................................................................................................... 28
    5.2.2 Offsets ..................................................................................................................... 28
    5.2.3 Water Pipe .............................................................................................................. 28
    5.2.4 Valves ...................................................................................................................... 28
    5.2.5 Valve Boxes ............................................................................................................. 29
    5.2.6 Fire Hydrants ........................................................................................................... 29
    5.2.7 Service Saddles ....................................................................................................... 29
    5.2.8 Corporation Stop and Curb Stop Valves ................................................................. 29
    5.2.9 Service Fittings ........................................................................................................ 29
    5.2.10 Curb Boxes ............................................................................................................. 29
    5.2.11 Service Pipe .......................................................................................................... 29
    5.2.12 Meter Pits / Vaults ................................................................................................. 29
    5.2.13 Tapping Sleeves .................................................................................................... 30
    5.2.14 Ductile Iron Fittings .............................................................................................. 30
    5.2.15 Mechanical Joint Restraints ................................................................................ 30
    5.2.16 Pipe Bedding ......................................................................................................... 30
    5.2.17 Warning Tape ...................................................................................................... 30
    5.2.18 Toner Wire ............................................................................................................. 31
    5.2.19 Marker Posts ........................................................................................................ 31
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2.20</td>
<td>Casing</td>
<td>31</td>
</tr>
<tr>
<td>5.2.21</td>
<td>Sanitary Connections</td>
<td>32</td>
</tr>
<tr>
<td>5.2.22</td>
<td>Couplings</td>
<td>32</td>
</tr>
<tr>
<td>6.1</td>
<td>Design Standards</td>
<td>33</td>
</tr>
<tr>
<td>6.1.1</td>
<td>Design Report</td>
<td>33</td>
</tr>
<tr>
<td>6.1.2</td>
<td>Sulfide Generation Analysis</td>
<td>34</td>
</tr>
<tr>
<td>6.1.3</td>
<td>Usage Restriction</td>
<td>34</td>
</tr>
<tr>
<td>6.1.4</td>
<td>Gravity Mains</td>
<td>35</td>
</tr>
<tr>
<td>6.1.5</td>
<td>Manholes</td>
<td>35</td>
</tr>
<tr>
<td>6.1.6</td>
<td>Location</td>
<td>35</td>
</tr>
<tr>
<td>6.1.7</td>
<td>Lift Stations</td>
<td>35</td>
</tr>
<tr>
<td>6.1.8</td>
<td>Force Mains</td>
<td>36</td>
</tr>
<tr>
<td>6.1.9</td>
<td>Service Lines</td>
<td>36</td>
</tr>
<tr>
<td>6.1.10</td>
<td>Grease Interceptors</td>
<td>36</td>
</tr>
<tr>
<td>6.1.11</td>
<td>Sand / Oil Separators</td>
<td>36</td>
</tr>
<tr>
<td>6.1.12</td>
<td>Sample Port</td>
<td>36</td>
</tr>
<tr>
<td>6.2</td>
<td>Construction Standards</td>
<td>36</td>
</tr>
<tr>
<td>6.2.1</td>
<td>General</td>
<td>36</td>
</tr>
<tr>
<td>6.2.2</td>
<td>Offsets</td>
<td>37</td>
</tr>
<tr>
<td>6.2.3</td>
<td>Gravity Sewer Pipe</td>
<td>37</td>
</tr>
<tr>
<td>6.2.4</td>
<td>Force Mains</td>
<td>37</td>
</tr>
<tr>
<td>6.2.5</td>
<td>Service Lines</td>
<td>37</td>
</tr>
<tr>
<td>6.2.6</td>
<td>Detectable Warning Tape</td>
<td>38</td>
</tr>
<tr>
<td>6.2.7</td>
<td>Marker Posts</td>
<td>38</td>
</tr>
<tr>
<td>6.2.8</td>
<td>Manholes</td>
<td>38</td>
</tr>
<tr>
<td>6.2.9</td>
<td>Lift Stations</td>
<td>39</td>
</tr>
<tr>
<td>6.2.10</td>
<td>Grease Interceptors</td>
<td>43</td>
</tr>
<tr>
<td>6.2.11</td>
<td>Sand / Oil Separators</td>
<td>43</td>
</tr>
<tr>
<td>6.2.12</td>
<td>Sample Ports</td>
<td>43</td>
</tr>
<tr>
<td>6.2.13</td>
<td>Pipe Bedding</td>
<td>43</td>
</tr>
<tr>
<td>6.2.14</td>
<td>Casing</td>
<td>43</td>
</tr>
</tbody>
</table>

iv
Chapter 7 Storm Sewer System ................................................................. 4544
  7.1. Design Standards ........................................................................... 4544
    7.1.1 Regulatory Thresholds ............................................................... 4544
    7.1.2 Basic Requirements (BR-1) Drainage Submittal ......................... 4645
    7.1.3 BR-2 Geotechnical Site Characterization ..................................... 5150
    7.1.4 BR-3 Water Quality Treatment .................................................... 6665
    7.1.5 BR-4 Flow Control ................................................................. 6088
    7.1.6 BR-5 Conveyance ...................................................................... 7724
    7.1.7 BR-6 Erosion and Sediment Control ........................................... 8948
    7.1.8 BR-7 Operation and Maintenance (O&M) ................................... 9085
    7.1.9 Parcels and Easements ............................................................. 9388
  7.2. Construction Standards .................................................................. 9589
    7.2.1 General .................................................................................... 9589
    7.2.2 Offsets ...................................................................................... 9589
    7.2.3 Culverts and Storm Main .......................................................... 9589
    7.2.4 Structures ............................................................................... 9690
    7.2.5 Pipe Bedding ............................................................................ 9690
Chapter 8 Transportation System ............................................................. 9794
  8.1. Design Standards .......................................................................... 9794
    8.1.1 General ..................................................................................... 9794
    8.1.2 Traffic Impact Study (TIS) .......................................................... 9794
    8.1.3 Intersections .............................................................................. 9894
    8.1.4 Dead-end Streets ...................................................................... 9894
    8.1.5 Sight Distance .......................................................................... 9994
    8.1.6 Collector and Arterial Streets ...................................................... 9994
    8.1.7 Traffic Control Signs, Street Name Signs and Street Names ....... 9994
    8.1.8 Sidewalks: .............................................................................. 10194
    8.1.9 Boulevard/Open Space ............................................................. 10194
    8.1.10 Multiple Use Paths: ................................................................. 10194
    8.1.11 On-Street Parking: ................................................................. 10294
    8.1.12 Driveways: .............................................................................. 10494
    8.1.13 Placement of Utilities: ............................................................. 10594
8.1.14 Street Lighting .................................................. 105
8.1.15 Traffic Calming Devices ...................................... 107
8.1.16 Mailbox Cluster .................................................. 107
8.2. Construction Standards .......................................... 107
  8.2.1 General .......................................................... 107
  8.2.2 Materials: ....................................................... 107
Glossary of Acronyms and Terms ...................................... 109
Appendix A – Checklist for Identifying Wetlands ...................... 112
Appendix B1 – Swale Flood Test ...................................... 114
Appendix B2 – Pond Flood Test ....................................... 114
Appendix C – BMP T5.100 API (Baffle Type) Separator Bay .......... 115
Appendix D – Flow Spreader Options .................................. 117
Appendix E – Filter Strips Used for Pre-Treatment ................... 122
Appendix F – Planting Guidelines ...................................... 124
Appendix G1 – Example Calculation – Non-Flooded Width .......... 128
Appendix G2 – Example Calculation – Grate Inlet Capacity ........... 129
Appendix H1 – Facility Maintenance Recommendations ............... 131
Appendix H2 – Facility Inspection Checklist .......................... 139
Appendix H3 – Example Waiver to Protest SID ........................ 140
Appendix I – Example Ownership Transfer Letter .................... 143
Appendix J – Example Agreement for Construction Inspection ........ 144
Standard Details – General .............................................. 145
Standard Details – Water System ....................................... 147
Standard Details – Sanitary Sewer System ................................ 152
Standard Details – Storm Sewer System ................................ 162
Standard Details – Transportation System ................................ 169
Chapter 1 Construction Within City Right-of-Way

1.1. GENERAL PROVISIONS

1.1.1 Standards

A. The latest published edition of the Montana Public Works Standard Specifications (MPWSS) are adopted in their entirety, except as amended herein. With respect to the design and/or construction of public facilities, and conflict(s) or difference(s) between the MPWSS, the City of Kalispell (CK) Subdivision Regulations, and the CK Standards for Design and Construction (Standards) shall be resolved in favor of the Standards.

B. New construction will be built under the Standards in effect at the time of construction.

C. If construction of the approved plans is not completed within 18 months from the date of design approval, and updates to the Standards have occurred since the date of approval, the design plans, specifications, and reports shall be resubmitted for City review and approval. City review fees for additional reviews of previously approved plans shall be waived.

1.1.2 Public Right-of-Way Permit

A. All construction, excavation, or other work on public or private property which will necessitate the use of the public right-of-way or easement shall require a Public Right-of-Way Permit issued by the Public Works Department (PWD).

B. The work authorized by the Permit includes, but is not limited to: street construction and repair; water, sewer, and storm system construction and repair; utility connections and repair; and landscaping, sidewalk, curbing and driveway construction and repair.

C. Also included are any other uses of the public right-of-way where there is a possibility of creating a hazard. Examples of hazards are scaffolding, storage of materials or equipment, crane and equipment operations, demolition, sandblasting and painting operations, temporary construction or demolition dumpster placement and any other use deemed a hazard by the PWD.

D. The Permit will not be issued until all insurance and bonding requirements have been met.
E. In an emergency which requires repairs to be made immediately, the Contractor may excavate and complete the repairs without first having obtained a Permit. Prior to beginning work at the site during normal working hours, the Contractor shall notify the PWD at 758-7720. Prior to beginning work after hours, the Contractor shall notify police dispatch at 758-7780. In either case, the Contractor shall describe the circumstances and provide the location of the emergency repairs. The Contractor shall obtain the Permit no later than the next scheduled City workday.

F. All provisions of the Standards shall be complied with regardless of the circumstances of the construction.

G. All steel tracked equipment operating within a public street right-of-way shall be fitted with triple grouser street pads. The Contractor shall be responsible for damages to City infrastructure within the public street right-of-way.

1.1.3 City Fees

A. Water & Sewer Service Connection Fee (Impact Fees)

I. An impact fee shall be paid for the connection of each new water and sewer service to the system. This fee must be paid even if a service line has previously been stubbed to the property line or other accessible location. Impact fees for water and/or sewer must be paid before a Building Permit will be issued by the Building Department and before service is approved. Impact fees may be paid in installments as established by City Ordinance No. 1681.

B. Construction of Water Service.

I. When it is necessary to tap an existing water main for a service connection: the Contractor will excavate around the main and prepare a safe trench from the main to the approved curb stop location; the City will provide the equipment, labor and materials required to tap the main and install the service line from the main to the curb stop valve; the Contractor will install backfill, and restore the pavement surface. The City will charge the Owner for equipment, labor and materials required to complete the work. The Owner will be responsible to construct the service line from the curb stop to the point of service.

C. Construction of Sewer or Storm Service.

I. When it is necessary to tap an existing sewer or storm main for a service connection, the Contractor will provide the equipment, labor and materials required to tap the main, install the service line from the main to the point of use and restore the public right of way to the pre-construction condition meeting minimum City Standards. City personnel shall inspect the tap prior to backfill.

Chapter 1 - Construction Within City Right-of-Way

1.1.4 Applicable Laws and Indemnification of the City
   A. The Contractor shall give all notices and comply with all federal, state and local laws, ordinances and regulations affecting the conduct of the work, and shall indemnify and hold harmless the City against any claim or liability arising from, or based on, the violation of any such law, ordinance, regulation, etc., whether by himself or his employees.

1.1.5 Interruption of Service
   A. Any construction that will interrupt the normal operation of city sewer, water, storm, or transportation facilities requires notification of affected City departments and property owners and/or residents. The Contractor shall notify the CK Police and Fire Departments at least 48 hours prior to any street closures.
   B. All street closures or interruptions of utility services will require the Contractor to provide a news release specifying the location of construction and the duration of the closure. The Contractor shall present the news release to the news media at least 2 workdays prior to the beginning of any construction activity.
   C. The Contractor shall also notify utility users affected by the interruption of the type and duration of the interruption at least 48 hours prior to beginning construction.

1.1.6 Traffic and Pedestrian Control
   A. In the event of an emergency interruption, the Contractor shall notify the PWD, Police and Fire Departments immediately. The Contractor shall immediately dispatch members of his staff to notify affected individuals by telephone or personal contact.
   B. A Traffic and Pedestrian Control Plan shall be submitted to and approved by the PWD for all work within the public right-of-way.
      II. Show the location and description of all Traffic and Pedestrian Control Devices.
      III. No work shall commence on the project until the plan is approved.
      IV. Keep all devices in place and maintained throughout the project.
      V. The PWD reserves the right to reject any device observed to be in substandard condition.
   C. Emergency access to the work area shall be maintained at all times.
Chapter 1 - Construction Within City Right-of-Way

1.1.6D

D. All barricades and obstructions shall be protected at night by suitable signal lights which shall be kept illuminated from sunset to sunrise. Barricades shall be of substantial construction and shall be constructed to increase their visibility at night. Suitable warning signs shall be placed to show in advance where construction, barricades or detours exist. All signs used at night shall be either retro-reflective with a material that has a smooth, sealed outer surface or illuminated to show the same shape and similar color both day and night.

E. If flagging is required, it shall be accomplished by competent and properly equipped flag persons. Flagging shall be accomplished as described in the Montana Department of Transportation Flagger’s Handbook and the MUTCD.1

F. Traffic control devices shall be removed from visual contact with the traveling public when they are not being used for construction activities.

G. The Contractor shall remove all traffic and pedestrian control devices within 24 hours of the conclusion of the project construction.

H. If the Contractor fails to maintain the Traffic and Pedestrian Control Devices in accordance with the approved plan, the City reserves the right to correct the deficiency and all labor, equipment, material and administrative costs will be billed to the Contractor.

1.1.7 Liability Insurance

A. The Contractor shall procure and maintain, at the Contractor’s expense, during the construction period, Contractor’s Liability Insurance in accordance with the Supplementary Conditions to the General Conditions of the MPWSS for work within existing public right-of-way or easement.

1.1.8 Bonding

A. All construction work within the public right-of-way or easement (sidewalk, boulevard, pavement, curb construction, water, storm drainage, sanitary sewer service line installation, repair, etc.) will require the Property Owner/Contractor to provide the City with a Performance Bond. The bond shall be equal to the value of the project and shall remain in force for one year. Contractors annually furnishing the City with a 2-year bond of $5,000 will not be required to furnish additional bonding if the $5,000 bond meets the requirements of these standards.

B. Bonds may be in the form of a Surety Bond, a Certificate of Deposit (CD), a Certified Check or an irrevocable Letter of Credit issued by a bank licensed to do business in the state of Montana.

1.1.9 Guarantee for Equipment, Materials, and Workmanship

A. The Contractor shall guarantee all materials and equipment furnished, and construction work performed for maintenance and repair work on existing city infrastructure for a period of 1-year from the date of written acceptance of the work by the CK.

B. The guarantee for new city infrastructure shall be for a period of 2-years from the date of written acceptance of the work by the CK. In the case of a subdivision, the date of acceptance will be final plat approval or acceptance by the PWD, whichever is later.

C. Guarantees shall be in the form of a Maintenance bond.
   
   I. Required prior to Final Plat or Certificate of Occupancy.
   
   II. Equal to 20% of the total value of public infrastructure constructed.
   
   III. Shall remain in force throughout the guarantee period.
   
   IV. The City reserves the right to draw on the maintenance bond for repairs not completed by the responsible party within 30 calendar days of being advised that repairs are required.
   
   V. Maintenance bonds may be in the form of a Surety Bond, a Certificate of Deposit (CD), a Certified Check or an irrevocable Letter of Credit issued by a bank licensed to do business in the state of Montana.
   
   VI. The Commencement Date for the Maintenance Bond shall be the date set for the completion of the required improvements as stated in the Subdivision Improvements Agreement, the date of Substantial Completion as certified by a Professional Engineer, or the date Final Plat is granted, whichever is later. If the expiration date of the Maintenance Bond falls after November 16, the expiration date of the Maintenance Bond shall be June 30 of the following year.

1.1.10 Excavation and Disposal of Material from Existing Public Right-of-Way and Easement

A. All material unsuitable for trench backfill, sub-base or base construction, excavated from the developed public right-of-way or easement shall be removed from the site and disposed of by the Contractor.

B. The disposal site shall meet regulatory provisions for disposal of the unsuitable excavated material.

C. Unsuitable excavated material shall not be stockpiled on site without the written approval of the PWD.

D. Excavated material shall be confined to the work zone as established during the preconstruction conference or as shown in the contract documents.
1.1.11 Intersection Monuments

A. When a street is to be reconstructed, prior to any excavation, a thorough search shall be made for existing intersection monuments. If found, such monuments and any other survey monuments likely to be disturbed or destroyed, shall be preserved by or under direction of a Professional Land Surveyor in accordance with MCA 70-22-115.

B. All monuments set shall meet the requirements of ARM 24.183.1101. Monuments set in pavement or concrete driving surfaces shall be placed inside of a cast iron monument box.

1.1.12 Pollution Controls

A. The Contractor shall be responsible to maintain the construction site and all haul routes in accordance with the requirements of the CK’s Emission Control Plan (see City Ordinance No. 1139). The Contractor shall obtain a County Air Quality Construction/Demolition Permit prior to beginning construction. The Contractor shall obtain a Construction Stormwater Management Permit for any land disturbance in the CK.

B. No sediment laden or polluted water shall be discharged off any construction or building site. A City Construction Stormwater Management Permit for construction sites is required for land-disturbing activities which include, but are not limited to, excavation, planting, tilling, and grading, which disturbs the natural or improved vegetative or developed ground cover so as to expose soil to the erosive forces of rain, stormwater runoff or wind. All installations and maintenance of franchise utilities such as telephone, gas, electric, etc., shall be considered land disturbing activities.

C. See Section 7.1.7.

1.1.13 Pavement Restoration

A. The Contractor signing the Public Right-of-Way Permit shall be responsible for pavement replacement. The Contractor shall restore all surfaces within 14 calendar days after completing the backfill work.

B. All new roads or reconstructed roads shall be paved with a minimum of 4 inches of Type B asphalt and shall be accomplished in accordance with current MPWSS.
Chapter 1 - Construction Within City Right-of-Way

C. The pavement restoration shall match the pavement structure thickness as shown on CK details ST.1 through ST.4. All excavations within 4 feet of the edge of the asphalt (including the outer edge, the crown, or adjacent seam) shall require removal and replacement from the edge of asphalt to the excavation edge. Asphalt patch areas that fall within the wheel path of the vehicular travel lane shall be increased in size to the center of the lane or adjacent lane. In no circumstance will the edge of a patch area be allowed to fall within the wheel path.

D. Any damage to the existing asphalt surface caused by the Contractor's operations shall be repaired at the expense of the Contractor, including but not limited to gouges, scrapes, outrigger marks, backhoe bucket marks, etc. A slurry seal shall be considered the minimum standard for a repair to existing surfacing.

E. The Contractor shall be responsible for maintaining the area in a smooth and drivable condition until the permanent pavement is placed. If the ground is frozen, the road cut shall be temporarily repaired with a minimum thickness of 2-inches of cold patch material. The temporary repair shall be maintained by the Contractor for safe winter usage. The permanent restoration shall be made as soon as the ground is thawed in the spring, or as directed by the PWD. Pavement repairs shall be in accordance with the Standards.

F. If the Contractor fails to restore the pavement within the 14-day period, or fails to maintain the trench or area as required, the City reserves the right to complete the restoration or maintenance, and all labor, equipment, material and administrative costs will be billed to the Contractor. The City reserves the right to call on the Contractor's Performance Bond if the bill is not paid within 30 days.

1.1.14 Construction Inspection

A. Maintenance and repair work within public right-of-way or easement shall be inspected and approved by the PWD. It is the Contractor's responsibility to notify the PWD of the work requiring inspection at least 24 hours in advance so the PWD may schedule and perform such inspections.

1.1.15 Stop Work Order

A. A written Stop Work Order may be issued by the PWD if the maintenance and repair work in progress does not meet the Standards for the CK, or for any other valid reason. Work may resume only after a written Resume Work Order has been issued by the PWD.

1.1.16 Relocation of Utilities

A. Requests to relocate an existing public utility shall be submitted in writing to the PWD. A sketch shall be included that illustrates the existing location of the utility and the preferred relocation site. The request shall describe in detail the circumstances for the request.
Chapter 1 - Construction Within City Right-of-Way

1.1.16B

B. The PWD may require the utility relocation to be designed by a licensed professional engineer.

C. If the relocation is approved by the PWD, the utility shall be relocated by a bonded and insured utility contractor (see Section 1.1.7 and 1.1.8). Under no circumstances will the CK pay for any costs associated with the relocation of the utility. Relocation of water and sewer may also be subject to MDEQ review and approval.

1.2. PROJECT REQUIREMENTS

1.2.1 Contractors Requirements

A. Registration:
   I. Any Contractor working within an existing Public Right-of-Way or Easement shall be registered with the Montana Department of Labor and Industry, Employment Relations Division.

B. Insurance and Bonding
   I. Insurance and bonding shall be in accordance with Sections 1.1.7 and 1.1.8 as applicable.

C. Preconstruction Meeting:
   I. Prior to the start of any construction, a preconstruction conference shall be held. The PWD, the Project Engineer, the geotechnical firm, the traffic control, the Owner, the Contractor, and any other parties pertinent to the project shall be represented. Items to be discussed at the preconstruction conference are construction schedule, shop drawing submittals, utility installation, materials testing, quality control, maintenance bond, and other items as may be necessary.

D. Shop Drawing Submittal:
   I. If the proposed items to be installed differ from the approved plans and specifications, shop drawings shall be submitted for review not later than 10 business days prior to the proposed installation.

1.3. CONSTRUCTION STANDARDS

1.3.1 Underground Utilities

A. All underground electrical, gas, phone, and TV cable lines must be installed at least 3 feet horizontally from water, sanitary sewer and storm sewer mains and services.
1.4. CONSTRUCTION INSPECTION, TESTING, AND QUALITY CONTROL

1.4.1 Construction Inspection

A. A Professional Engineer, or the Professional Engineer’s designated representative, shall provide construction inspection and testing as required. Failure to submit required testing and other documentation shall be considered valid justification for non-acceptance of construction work and/or public infrastructure. Inspection and testing shall be in accordance with the current edition of the MPWSS\(^1\) and the Standards.

B. The following quality control procedures will apply to all utility and roadway construction projects. The City reserves the right to conduct independent quality assurance testing at the City’s expense during any phase of the construction. The Contractor shall bear the expense of failed tests and the expense of bringing the material into conformance with the required specifications.

I. All water main valves and fittings, fire hydrants, sewer manholes, wet wells and sewer/water main crossings shall be inspected and approved by the Professional Engineer, or his designated representative, prior to backfilling.

II. Water and sewer construction testing shall be performed in accordance with the CK Special Provisions for Water Distribution\(^2\) and Sanitary Sewer Collection System\(^3\).

III. A Professional Engineer, or the Professional Engineer’s designated representative, shall be present for all tests required in Sections 02660, 02720, and 02730 of the MPWSS. A written record of all test results shall be submitted to the PWD and certified by the Professional Engineer of record for the construction.

IV. A Professional Engineer, or the Professional Engineer’s designated representative, shall provide the PWD with photocopies of daily inspection reports, including Proctors and compaction test results for all projects. These reports shall be submitted on a weekly basis and certified by the Professional Engineer of record for the construction.

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1.4.2 Compaction Testing

A. The following minimum compaction testing procedures shall apply to all utility and roadway construction projects. An independent accredited testing laboratory shall be retained to provide the following tests and frequency. Random longitudinal test locations are required. The following are minimum compaction test requirements. The Professional Engineer, or the Professional Engineer’s designated representative, may require additional tests. For projects containing less than 300 linear feet of improvements, a minimum of one compaction test for each improvement shall be required for the improvements listed below.

I. Utility Trenches and Underground Structures:
   a. Set of Tests:
      i. For trenches up to 8 feet in depth, density tests shall be taken at 12 inches above the pipe, at one-half the trench depth, and at the surface.
      ii. For trenches greater than 8 feet in depth, density tests shall be taken at 12 inches above the pipe, at one-third and two-thirds the trench depth levels, and at the surface.
   b. The minimum density shall be 95% Standard Proctor, ± 3% optimum moisture.
   c. Horizontal Frequency:
      i. Utility Mains – One set of tests per 150 feet.
      ii. Service Lines – One set of tests per 3 services, per utility type.
      iii. Open Pit – Minimum of one set of tests (Open Pit – at each manhole, water valve, storm inlet, curb inlet, vault, etc.)
   d. Each test location shall be separated horizontally from a prior test location.

II. Street Subgrade:
   a. All sub-base: 95% Standard Proctor, ± 3% optimum moisture. One random density test, every 100 linear feet of street per lane with random offsets.
   b. All crushed gravel base: 95% Standard Proctor, ± 3% optimum moisture. One random density test, every 100 linear feet of street per lane with random offsets.
Chapter 1 - Construction Within City Right-of-Way

III. Asphalt Surface:
   a. Pavement and material testing requirements shall be in accordance with Section 1.4.1 and MPWSS Section 02510 Paragraph 3.28 and 3.29, except:
      i. Add subsection 3.28H to the standard as follows: “Asphalt compaction samples will be taken according to AASHTO T 230 and tested in accordance with AASHTO T 166. One location per lane per block as determined by the Engineer shall be required.
      ii. Subsection 3.29E shall be replaced with: “The field density and thickness of the pavement is determined by measuring the cores tested. The actual thickness shall not be less than the design thickness, and shall in no case be less than four (4) inches.”
      iii. Subsection 3.29F shall be replaced with: “Asphalt thickness shall be measured using full depth core samples. Thickness shall be measured from the surface of the specimen to the bottom of the uniform plant mix which thickness shall not include foreign materials, seal coat, foundation material, soil, paper or foil. Thickness less than specified thickness as measured on the acceptance sample shall be subject to rejection for the lane and block from which the specimen was taken as determined by the Engineer.”

IV. Concrete:
   a. All tests shall be performed by a technician with a minimum of an ACI Grade I certification.
   b. Air Content, Slump, Unit Weight, and Temperature are required on every truck of structural concrete delivered to the project.
   c. 4-inch or 6-inch concrete compressive strength cylinders shall be cast a minimum of once per day (when concrete is placed) or every 50 cubic yards placed.
   d. Cylinder sets shall include:
      i. One 7-day cylinder
      ii. Two 28-day cylinders
      iii. One hold cylinder (for break error or low break)

1.4.3 Video Inspection

A. A video inspection shall be provided by the contractor for sewer mains.
B. The contractor shall flush the main with dyed water immediately prior to inspection.
C. Manholes and laterals, shall be included in the video inspection. Inspection results shall be provided to the City in an electronic format capable of being viewed, copied, saved and downloaded to standard Microsoft applications.
D. Upon review of the video inspection by the authorized City representative, any deficiencies found shall be corrected by the contractor prior to final acceptance.
E. The CK reserves the right to inspect all underground utility systems by the use of a television camera prior to final acceptance.
F. The cost of all video inspections by city staff will be billed to the contractor.
G. The video shall include the distance traveled so that laterals and items of concern can be accurately located.
H. The camera shall be equipped with a turret in order to inspect all services from a facing view of the camera.
I. The crawler shall be equipped with means of measuring ponded water in bellies that may be in the pipe to meet the minimum requirements of MPWSS.

1.5. BOULEVARD LANDSCAPING

1.5.1 Requirements

A. The Contractor shall place a minimum of 4 inches of topsoil within the boulevard. The finished surface of the topsoil shall provide adequate drainage from the top of the sidewalk to the top of the curb.
B. Topsoil shall be fertile, natural loam surface soil, free of clay, weeds, roots or stones larger than one inch in any dimension.
C. Boulevard landscaping shall be placed in accordance with the CK Street Tree Ordinance! and a plan approved by the CK Parks and Recreation Department (758-7718).

1.6. RECORD DRAWINGS AND PROJECT ACCEPTANCE

1.6.1 Certification

A. Upon project completion and before final acceptance, a Professional Engineer shall certify to the City that the construction of the water, sewer and storm utilities and roadways meet the requirements of the approved construction documents.

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Chapter 1 - Construction Within City Right-of-Way

1.6.2 Record Files
A. The Engineer shall submit one full-size set of record drawings (PDF and DWG digital format) and one set of the test results to the PWD as required under Section 1.4.

1.6.3 Acceptance
A. The City will not accept the project until record drawings and test results have been approved by the City Engineer.
B. The Project Engineer shall provide quantities and unit costs of all City-owned infrastructure.
C. The owner shall submit a letter requesting ownership transfer of the newly constructed public infrastructure to the City (See Appendix I – Example Ownership Transfer Letter).

1.7. TWO-YEAR GUARANTEE INSPECTION

1.7.1 Requirements
A. The Project Engineer, or his designated representative, shall conduct a two-year guarantee inspection, to be attended by a representative from the PWD.
B. The inspection shall take place not less than 90 days or more than 120 days prior to the expiration date of the Maintenance Bond.
C. The maintenance bond will be released when all deficiencies have been corrected to the satisfaction of the City Engineer.

1.7.2 Warranty Work
A. The City Engineer, the Project Engineer, or the designated representative, shall notify the Principal as listed in the Maintenance Bond of any work found to be not in accordance with the approved construction documents.
B. The Principal shall restore the work to meet the requirements of the approved construction documents prior to the release of the Maintenance Bond.
C. The City expressly reserves the right to draft the Maintenance bond for repairs not completed by the Owner, Developer, or Contractor within thirty calendar days of being advised that repairs are required.
Chapter 2- Design Criteria

2.1. PLANS

2.1.1 General Items

A. Coordinate System:
   I. Montana State Plane – International Foot

B. Datum
   I. North American Vertical Datum 1988 (NAVD 88)

C. Contours
   I. Urban Areas
      a. 5-foot major contour interval (max)
      b. 1-foot minor contour interval (max)
      c. The CK reserves the right to request smaller or larger contour intervals for clarity if necessary.

II. Unimproved Areas
    a. 10-foot major contour interval (max)
    b. 2-foot minor contour interval (max)
    c. The CK reserves the right to request smaller or larger contour intervals for clarity if necessary.

III. Existing contours shall use a dashed line-style.

IV. Proposed contours shall use a continuous line-style.

V. Major contour lines shall be thicker than minor contours.

D. Alignment Data
   I. Coordinate data shall be provided for:
      a. Beginning of alignment
      b. Alignment changes in direction
      c. End of alignment
   II. Provide the following curve data:
      a. Length of curve
      b. Curve Radius
      c. Chord length
      d. Chord bearing
Chapter 2- Design Criteria

2.1.4A

III. Bearings and distances:
   a. Provide between points on alignments

2.1.2 Title Sheet(s) (Shall not exceed 3 Sheets):
   A. Project Title
   B. Vicinity Map
      I. Project Limits
      II. Adjacent Street Names
      III. North Arrow
      IV. Scale Bar
   C. Firm or Engineer Information
      I. Name
      II. Address
      III. Telephone Number
   D. MT Professional Engineer Stamp
   E. Point and Line Style Legend
   F. Public Land Survey System Information
      I. Township
      II. Range
      III. Section(s)
         a. If contained within a single section, provide the ½, ¼, or ¼¼ information as applicable (e.g. SW ¼ NE ¼).
   G. Table of Contents

2.1.3 Plan Sheets
   A. Project Title
   B. Sheet Title
   C. Sheet Number
   D. MT Professional Engineer Stamp
   E. Revision Data (See Section 3.1.2)
   F. North Arrow (True North)
   G. Scale Bar
      I. Set to Standard Engineering Scales

2.1.4 Plan and Profile Sheets
   A. Shall be provided for all proposed water main, sanitary sewer main, storm main, and streets.
Chapter 2- Design Criteria

2.1.4B

B. Include all items in Section 2.1.3 above.

C. In profile show:

I. Vertical scale

II. Proposed ground
   a. Continuous line-style

III. Existing ground
   a. Dashed line-style

IV. Crossings of other utilities and separations from them.

V. Parallel utilities shall be shown in greyed line-style.

VI. Pipe
   a. Length
   b. Slope (if gravity)
   c. Material type

VII. Bury depth

VIII. Groundwater depths (if identified)
   a. Include date of recording.

IX. Structures and Appurtenances
   a. For Water:
      i. Valves, fittings, services, fire hydrants, encasement, etc.
         A) Label size and type.
         B) Provide station and offset or coordinates.
      b. For Sanitary Gravity Sewer:
         i. Manholes, services, and other structures
            A) Label invert elevations.
            B) Label rim elevations.
            C) Provide station and offset or coordinates.
      c. For Sanitary Force Mains:
         i. Valves, fittings, air/vacuum valves, and other structures
            A) Label size and type.
            B) Provide station and offset or coordinates.
Chapter 2- Design Criteria

2.1.6 II. c

For Storm Sewer:

i.

Manholes, catch basins, and other structures:

A) Label invert elevations.

B) Label rim and grate elevations.

C) Provide station and offset or coordinates Hydraulic Grade Lines (HGL)

ii.

Streets, roads, and pathways:

a. Grades

b. Vertical curve data

i. VPI Station and elevation

ii. Length

iii. Radius

iv. k-value

XI. Stormwater conveyance system:

a. Show all pipes, culverts, ditches, and connections.

b. Include all sizes, material types, lengths, slopes, and invert elevations.

2.1.5 Detail Sheets

A. Provide applicable CK Standard Details

I. Highlight any additions, deletions, or modifications to CK Standard Details.

B. Include the following:

I. Project Title

II. Sheet Title

III. Sheet Number

IV. Scale

V. MT Professional Engineer Stamp

VI. Revision Data (See Section 3.1.2)

2.1.6 Road and Drainage Plans

I. Include all items in Section 2.1.3 above.

II. Include the following:

III.a. Existing and proposed contours

IV.b. Crest and sump point elevations

V.c. Flow arrows
Chapter 2- Design Criteria

2.1.6 III.d Record drawing information
2.1.6 III.e Construction details or standard detail for all structures
2.1.6 III.f Drainage Easements
   a:i If existing, provide recording number
2.1.6 III.g Where swales, ditches, or channels interfere with driveway locations:
   a:i Driveway locations shall be fixed and shown on the plans.
2.1.6 III.h Existing and proposed lot grading plans

2.1.7 Drainage Facilities and Swales
   A. Include all items in Section 2.1.3 above.
   B. Provide a cross-section of each pond or swale, including the following:
      I. Bottom elevation
      II. Structure elevations
      III. Maximum water surface elevation
      IV. Inlet and outlet elevations
      V. Berm elevations and slopes
   C. Landscaping and vegetation requirements
   D. Compaction requirements
   E. Keyway locations and dimensions
   F. Coordinates and elevations of pond corners, swale/ditch angle points, inlet/outlet pipes, and all drainage structures.
   G. Material gradation, thickness, and dimensions of riprap pads

2.1.8 Basin Maps
   A. Required as part of the Drainage Submittal
   B. Provide Pre-development and Post-development
   C. Minimum elements:
      I. Vicinity map, project boundaries, PLSS information
      II. Basin limits:
         a. Include on-site, off-site, and bypass areas contributing runoff to or from the project.
         b. Engineer shall field-verify basin limits, including off-site areas, and describe how the limits were determined.
         c. Shall be clearly labeled and correlate with calculations
      III. Time of concentration routes with each segment clearly labeled and correlated with calculations.
Chapter 2- Design Criteria

IV. Contours:
   a. Shall extend beyond the project or drainage basin as necessary to confirm basin limits.
   b. Refer to Section 2.1.1C

V. Any drainage way, including natural drainage ways, constructed drainage features, wetlands, creeks, streams, seasonal drainage ways, closed depressions, ditches, culverts, storm drain systems, and drywells.

VI. Floodplain limits as defined by FEMA or other studies.

VII. Geologically hazardous areas

VIII. Proposed drainage features

IX. North arrow and scale

X. Existing and proposed easements, parcel land, open space, and parkland

XI. Adjacent streets
Chapter 3 Project Submittals

3.1. PROCESS

3.1.1 Submittals
   A. Civil Plans:
      I. Shall be provided in PDF format.
      II. If part of a larger plan set (such as a commercial project including
           building, mechanical, electrical, etc.), submit with other plans as a single
           combined set.
      III. The Professional Engineer(s) responsible for the civil design portions of
           the project shall stamp the project cover sheet, or each individual sheet of
           the civil design.
      IV. Include the general checklist as well as other applicable checklists.
         a. Checklists are available here (call 758-7720 for additional info.).
   B. Reports and Specifications:
      I. Shall be provided in PDF format.
      II. Submit separate documents in the following order (as applicable):
          a. Project Manual or Applicable Specifications
          b. Water Design Report
          c. Sanitary Sewer Design Report
          d. Storm Drainage Design Report
          e. Traffic Impact Study
      III. The Professional Engineer(s) responsible for the individual sections
           specified above shall stamp the front cover of each separate document.
   C. Water and sanitary sewer system designs shall be submitted for concurrent
      review to MDEQ.

3.1.2 Resubmittals
   A. Civil Plans
      I. Individual sheets may be provided.
      II. All changes shall include revision bubbles.
      III. Revision notes shall be provided on the sheet including:

Chapter 3- Project Submittals

3.2.4a Field Code Changed

3.3.3 Delivery
   I. Provide digital files to the front desk of the CK Building Department.
   II. Large files may require utilization of the State of Montana File Transfer Service 1.
   III. Call 406-758-7730 for more information.

3.3.4 Fees
   I. A Plan Review Fee of $180.00 shall be submitted to the CK PWD for items covered in this document.
   II. An additional review fee of $180.00 is required for each successive plan review.
   III. Fees will be tabulated and paid for at the time of issuance of a building permit, or if a building permit is not required, after the submittal items have been reviewed and are ready for approval.

3.2. RESPONSIBILITIES

3.2.1 Professional Engineer
   A. Meet the minimum design standards as specified or referenced herein during design.
   B. Verify compliance with the minimum construction standards as specified or referenced herein during construction.

3.2.2 Contractor
   A. Shall not start construction until final plans have been approved by the CK PWD.
   B. Meet the minimum construction standards as specified or referenced herein, or as otherwise required by approved plans.

3.2.3 City Engineering Staff
   A. Review the design and construction to verify compliance with current Standards.

3.2.4 Developer
   A. Employ a Professional Engineer to design the project or development in accordance with the minimum design standards as specified or referenced herein.

1 https://transfer.mt.gov/
3.2.4B Employ a contractor to meet the minimum construction standards as specified or referenced herein.

C. Employ a Professional Engineer to verify compliance with minimum construction standards throughout construction of all proposed CK infrastructure within the development.

3.2.5 All Parties

A. If at any point of design or construction, an unapproved deviation from the Standards is realized by the Engineer, Contractor, the CK, or the Developer, immediate action shall be taken to correct the issue and bring the design or construction into compliance with the standards currently in effect at no cost to the CK.

B. Any changes from approved drawings shall be reviewed and approved in writing by the CK PWD engineering staff, prior to construction.

3.3. DESIGN OR CONSTRUCTION DEVIATION

3.3.1 Requirements:

A. Will only be granted when minimum standards cannot be met or when the proposed item meets or exceeds minimum standards as determined by the City Engineer. Deviations will not be considered on basis of cost, "engineering judgement", or "professional opinion".

B. Requests shall be made in writing and shall:
   I. Identify the specific section of the standards requiring a deviation.
   II. State the standard as currently adopted.
   III. State the standard as proposed for the deviation.
   IV. Provide adequate justification for the deviation.

C. Requests shall be approved by the CK PWD Engineering staff in writing.

D. Deviations from the Standards not individually approved as indicated above are not approved, even if shown in approved plans, specifications, or reports.

3.4. MUNICIPAL FACILITIES EXCLUSION (MFE)

D3.4.1 An MFE is required by DEQ prior to construction. The City’s MFE approval and all capacity allocations shall expire with the expiration of DEQ’s original design approval for construction.
Chapter 4 Development

4.1. REQUIREMENTS

4.1.1 General

A. All subdivisions and developments shall comply with the CK Subdivision Regulations1 and these Standards.

B. Roadways and utilities shall be constructed from the existing facilities to the far property line of the development or such other point within the development that may be specified by the City Engineer.

I. Extension of water mains beyond the property line may be required as determined by the City Engineer for looping and redundancy.

II. All utilities shall be within a public right-of-way or easement to permit free and unobstructed access.

C. Obtain and provide the City with all easements and right-of-ways necessary to extend roadways and utilities to the far property line of the development.

I. Obtain written approval from the Kalispell PWD stating they have reviewed and approved the location of easements for the future extension of roadways and utilities which shall be submitted with the final plat along with an 11 x 17 legible copy of the approved final plat showing the utility and/or easement locations.

D. There shall be reserved along the front lot line and side street lot line of each residential and commercial lot a 10-foot wide utility easement along, contiguous and adjacent to the lot line to provide an area between the lot line and the easement line for the placement of privately owned underground utilities.

4.1.2 Utilities

A. All new utilities shall be placed underground.

B. City utility collection and distribution mains shall be located within the paved portion of the street or alley.

C. Water transmission mains, sewer interceptor mains, and sewer force mains shall be located as approved by the City Engineer.

D. Underground private utilities shall be located on private property between the lot line and the easement line.

E. No underground utilities, except service sweeps to the streetlights shall be placed parallel to the roadway in the boulevard between the back of curb and sidewalk or within a sidewalk itself.

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1 http://kalispell.com/DocumentCenter/View/503/Kalispell-Subdivision-Regulations-PDF
Chapter 4 - Development

4.1.2F

F. No aboveground utility boxes, pedestals, vaults, or transformers shall be placed within any easement, proposed roadway, or access way to any City facility.

G. Streetlights shall be at least 2 feet from the back of curb. All above ground utilities shall be at least 1 foot from the sidewalk.

4.1.3 Utility Easements:

A. All public utility easements shall be a minimum of 15 feet wide for a single pipeline, with the pipe centerline 5 feet from one easement edge.

B. For easements with two pipelines, the minimum width shall be 20 feet with each pipe centerline 5 feet from the easement edge.
Chapter 5 Water System

5.1. DESIGN STANDARDS

5.1.1 Design Report

A. A design report prepared by a professional engineer licensed in the State of Montana which addresses fire and domestic flow requirements shall be submitted to and approved by the CK.

B. The design and design report shall meet the minimum requirements of MDEQ Circular 1.

C. The report shall include flow test results or modeled flow results, as approved by the CK, which show the static pressure and available flow from the hydrant at 20-psi residual pressure.

I. The CK will perform the required hydrant flow testing or provide the modeled flow data to the Design Engineer at no cost, if so requested.

II. The Design Engineer shall be limited to a single hydrant flow test per development per year, unless otherwise approved by the CK.

D. An overall plan of the development, including all areas outside of the study area which would naturally be served through the study area shall be provided.

E. The Design Engineer shall calculate and provide the average day demand, the max day demand, and the required fire flow.

I. Refer to the current Water Facility Plan for design data, including:
   a. Average Day Demand
   b. Peaking Factor
   c. Max Day Demand
   d. Peak Hour Demand

II. Provide demand calculations in units of gpd and ERUs

III. Provide velocity calculations in units of fps

5.1.2 Water Pipe

A. Size

I. Minimum main size shall be 8-inch;

II. Fire hydrant leads shall be 6-inch.

III. The Design Engineer shall refer to the current Water System Facility Plan to determine if oversized mains are required for the development.


Chapter 5- Water System

5.1.2A.IV

IV. Capacity shall meet the max day plus fire flow and peak hour demand.
   a. Required fire flow shall be determined by the CK Fire Department.
V. Velocity shall not exceed 15 feet per second through a public main line.
VI. C value for flow calculations shall be 130.

B. Location
   I. Mains shall be extended to the far property line or such other point within the development that may be specified by the City Engineer. Subdivisions and corner lot developments may be required to extend mains to property lines in multiple directions.
   II. Mains shall be under the paved section of the roadway.
   III. Transmission mains shall be located as approved by the City Engineer.
   IV. Fire hydrant leads shall not exceed 50 feet in length.
   V. Mains shall be buried a minimum of 6-foot and maximum of 8-foot.
      a. Mains with more than 7 feet of bury require extensions at valves with centering donuts.

5.1.3 Valves

A. Size and Type
   I. 12-inch diameter and smaller shall be gate valves.
   II. Larger than 12-inch diameter shall be butterfly valves.

B. Location
   I. Shall be installed at each leg of every tee and cross, and at each intersection crossing.
   II. Maximum spacing shall not exceed 500 feet unless otherwise approved by the City Engineer.
   III. Shall not be located underneath curb and gutters, sidewalks, boulevards, travel route of a multiple use path, or within the wheel path of a vehicular travel lane.

5.1.4 Fire Hydrants

A. Location
   I. Placement is subject to the approval of the Fire Chief
   II. Spacing shall not exceed 500 feet in residential areas
   III. Spacing shall not exceed 300 feet in commercial areas
   IV. Spacing shall not exceed 200 feet in industrial areas
   V. Provide a 2-foot separation from the face of the barrel to the back of curb and from the edge of sidewalk.
   VI. Provide bollards for hydrants unprotected by curb.
5.1.5 Water Services

A. General
   I. Structures containing two or more residences under separate ownership shall have separate service lines from the main, service valves, and meters for each residence.
   II. Structures containing two or more residences, offices, or businesses that are rental units under common ownership shall have one service line, valve, and meter for all occupants within a single structure.
   III. When a lot or parcel is developed to a permitted use, all duplicate, excess, and/or unused water services and fire services, including stub-outs, shall be abandoned at the main.
   IV. Aggregation of parcels will trigger abandonment of unused water and fire services at the main.
   V. New or reconstructed services shall meet current Standards, including location of curb stops and meter pits.
   VI. Domestic water services shall not be tapped on a fire service line or fire hydrant main.

B. Location
   I. Services shall connect to and extend from the main perpendicularly.
   II. Services shall connect to the main on the front door side of the structure if multiple mains are available.

C. Size
   I. The water service tap, corporation stop, service line, and curb stop shall all be the same nominal size for all services larger than 2-inch.
   II. Existing stub-outs 2-inch or smaller may be downsized one CK standard nominal size prior to the meter pit or vault.
      a. A 2-inch service may be reduced to a 1.5-inch service.
      b. A 1.5-inch service may be reduced to a 1-inch service.
      c. A 1-inch service may be reduced to a ¾-inch service.
      d. Reductions in service size outside the reductions listed above shall be submitted via deviation request for individual review and approval.
   III. If a service line size is reduced prior to the meter pit or vault, the design engineer shall provide hydraulic data indicating maximum achievable flow rates at the meter are within the manufacturer’s recommendations.
Chapter 5 - Water System

5.2. CONSTRUCTION STANDARDS

5.2.1 General
A. Water systems shall be constructed in accordance with the current edition of the Standards (this document), the current edition of the MPWSS\(^1\) as modified by the CK Special Provision\(^2\) for Water Distribution and other standards referenced elsewhere in this document. Any conflicts or differences in these documents shall be resolved in favor of the Standards.

5.2.2 Offsets
A. Water mains and appurtenances shall maintain horizontal and vertical offsets as required in MDEQ Circular 1\(^3\).
B. All underground electrical, gas, phone, fiber, and cable lines must be installed at least 3 feet horizontally and 1 foot vertically from water mains and services.

5.2.3 Water Pipe
A. PVC – DR18 pipe conforming to AWWA C-900 Standards.
B. Ductile Iron – Shall meet current MPWSS material and construction requirements.
   I. Only used as approved by the City Engineer.
   II. Joints shall be push-on.
   III. Use nitrile gaskets for areas with hydrocarbon contamination.
C. DR 11 HDPE shall only be used in directional drill applications.
   I. Directionally drilled HDPE shall incorporate engineered expansion and contraction restraints, approved by CK PWD.
   II. Pipe shall be oversized to meet or exceed the inside diameter of connecting pipes.

5.2.4 Valves
A. Gate Valves shall be Mueller Resilient Wedge Gate Valves, or an approved equal, conforming to AWWA C-509 Standards.
   I. Tapping valves shall be MJ x FL for connection to the tapping sleeve.
   II. All other valves shall be MJ x MJ.
B. Butterfly Valves shall be Class 250B MJ x MJ Mueller Lineseal Butterfly Valves, or an equal approved by the PWD, conforming to AWWA C-504 Standards.

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Chapter 5 - Water System

5.2.5 Valve Boxes
   A. Shall be cast iron, 3-piece, slip type adjustment
      I. Tyler 6865-6855, or 7126 series;
      II. Star VR-0007; or
      III. Equal as approved by the CK PW.
   B. Extensions with a centering donut shall be provided and installed on mains with more than 7-foot of bury.

5.2.6 Fire Hydrants
   A. Shall be Red Mueller Super Centurion Fire Hydrants with 5-inch Storz adapter and cap conforming to AWWA C-502 Standards.
   B. Shall be covered until placed in service.

5.2.7 Service Saddles
   A. Shall be BR2 series Mueller Brass, or equal approved by the PWD.

5.2.8 Corporation Stop and Curb Stop Valves
   A. Shall be Mueller 300 series ball valves, or equal approved by the PWD.

5.2.9 Service Fittings
   A. Shall be Mueller Insta-Tite or 110 Series compression fittings, or an equal approved by the PWD.
   B. If larger than 1-inch and smaller than 4-inch, stainless steel inserts shall be used if recommended by manufacturer.

5.2.10 Curb Boxes
   A. Shall be Mueller H-10306, AY McDonald Box 5604, or Ford EA2-65-50 (3/4 or 1-inch service) with and pentagon brass plug
   B. Shall be Mueller H-10310 (1 1/4 - 2-inch service)
   C. Cast iron extension type with arch pattern base
   D. Minimum length 6 1/2 feet
   E. Properly sized Mueller stationary rod
   F. Or equal as approved by the PWD.

5.2.11 Service Pipe
   A. Shall be polyethylene pipe conforming to AWWA C-901 (up to 3-inch diameter).
   B. Shall be DR-18 PVC pipe conforming to AWWA C-900 (greater than 3-inch diameter).
5.2.12 **Meter Pits / Vaults**

A. For new or reconstructed services up to 1-inch in nominal size:
   
   I. Mueller Thermo-coil meter pits with side-locking composite lids and insulation pads (Part No. ###CS##72FS#SN).
   
   II. Ford Coil Ptsetter (PFCBH-###-##-72-FP-NL) meter pits with plastic bottom plate, insulation pads, and side-locking composite lids.

B. Mueller EZ Vault or approved equal with center-locking composite lids and insulation pads shall be used for new 1.5-inch and 2-inch (Part No. ###VS##60FB72FB#N). Meters shall be within 18 inches of the surface.

C. Meters larger than 2-inch will require a custom meter pit sized appropriately to accommodate the isolation valves, meter(s), and pertinent backflow prevention device(s). Proposed meter pit design shall include steps and shall be submitted to PW for review and approval prior to construction.

D. Maintenance bypass lines or other branches shall not be installed before the meter.

D-E. Backflow preventers shall be placed downstream of meters.

5.2.13 **Tapping Sleeves**

A. Shall be Romac SST III or an equal approved by the PWD for service lines or main extensions larger than 4-inch.

B. Bolts for flange connection on tapping sleeves shall be Cor-Ten or Cor-Blue.

5.2.14 **Ductile Iron Fittings**

A. Shall be MJ.

B. Shall meet AWWA C-153 and be Class 350.

C. Provide thrust blocks in accordance with the MPWSS.

5.2.15 **Mechanical Joint Restraints**

A. Shall be Megalug or approved equal.

5.2.16 **Pipe Bedding**

A. Shall be placed in accordance with CK detail G.1.

B. Shall be haunched under pipe with shovel.

C. Shall be a clean sand meeting USCS classification SW, or a Class 1 material as defined in ASTM D 2321 with a max particle size of ¾-inch and meeting the migration requirements of the same standard (Section X.1.8).

5.2.17 **Warning Tape**

A. Shall be a minimum of 5 mils thick.

B. Shall be 3 inches wide.

C. Shall conform to APWA colors.
D. Shall be buried 12 to 24 inches below the final grade.

5.2.18 Toner Wire
A. Shall be 12 gauge HDPE or HMWPE insulated solid core.
B. Shall be approved for direct bury.
C. Shall be taped every 5 feet to the top of the water main.
D. Shall be spliced with moisture displacement connectors.
E. Shall be made accessible in accordance with CK detail W.3.
F. Toner wire used in boring or directional drilling applications shall be 8 gauge hard drawn, high-carbon 1055 grade steel core, extra high-strength copper clad conductor (EHSC-CCS), and insulated with a 45 mil, high-density polyethylene (HDPE). The wire shall have a conductivity rating greater than 21 percent and a break load of greater than 2,500 pounds.

5.2.19 Marker Posts
A. Shall be used when a main is located outside a paved surface.
B. Shall be APWA compliant Rhino TriView™ or approved equal.
C. Shall be installed at a maximum spacing of 150 feet.
D. Shall be installed at every valve or valve cluster and every change in direction.

5.2.20 Casing
A. Minimum casing pipe thickness shall be ½ inch.
B. Carrier pipe:
   I. DR 18 C-900 PVC with joint restraining casing spacers, or
   II. DR 18 C-900 PVC with internal joint restraints,
   III. Certa-Lok or other spline and groove pipe systems are not approved.
C. Casing Spacers:
   I. CCS-JR (joint-restraining) and CCS by Cascade Waterworks
   II. SSI by Advanced Products and Systems
   III. Equal as approved by CK DPW.
D. End Seals:
   I. CCES by Cascade Waterworks
   II. AC by Advanced Products and Systems
   III. Equal as approved by CK DPW.

1 https://www.rhinomarkers.com/product/triview/
5.2.21 Sanitary Connections

A. Defined as a section of new main connecting back to an existing main which cannot be pressure tested or bacteriologically tested.
B. There shall be no fittings within 10 feet of the connection to existing.
C. Restraining couplings shall not be used at connections to existing cast iron pipe.
D. The length of sanitary connections shall be limited as much as possible in length and shall be submitted to CK PWD for review and approval prior to construction.

5.2.22 Couplings

A. Romac Macro series or equal as approved by CK PWD.
B. Restrained couplings shall not be used when connecting to cast iron pipe.
Chapter 6 Sanitary Sewer System

6.1.1 Design Report

A. A design report prepared by a PE licensed in the State of Montana which addresses sewer flows at full build-out of the development shall be submitted to and approved by the CK. An overall plan of the development, including all areas outside of the study area which would naturally be served through the study area shall be included.

B. The design and design report shall meet the minimum requirements of MDEQ Circular 21.

C. Average daily flows, peak hour flow criteria, wastewater flow rates by zoning areas, peaking factors, and other applicable design criteria shall be used as defined in the current Sanitary Sewer Facility Plan.

D. List all improvements or proposed additions to the sanitary sewer system.

E. Assess the ability of the existing collection system to handle the peak design flow from the project and the impact to the Wastewater Treatment Plant.

F. For existing or proposed lift stations, provide the following:

I. A description of the existing and/or proposed wet well, pumping system, and force main;

II. The capacity of the existing and/or proposed pumps and potential for upgrading;

III. A map showing the existing and/or proposed lift station service area;

IV. A list of the existing users and their average design flows;

V. The existing and/or proposed peak design flow and reserve capacity;

VI. The pump run and cycle times for the existing and/or proposed average and peak design flows;

VII. The hydraulic capacity of the existing and/or proposed force main(s);

VIII. A list of the proposed users and their average design flows;

IX. The proposed average and peak design flows to the lift station;

X. The reserve capacity of the lift station with the proposed project at full capacity;

XI. The pump run and cycle times for the proposed average and peak design flows; and

XII. Recommendations for improvements to an existing lift station, if necessary, to enable the lift station to serve the proposed project.

6.1.2 Sulfide Generation Analysis
A. The City Engineer may require a sulfide generation analysis.
B. Non-corrosive linings and special lift station design are required when dissolved sulfide is likely to exceed 0.2 mg/l.

6.1.3 Usage Restriction
A. Usage shall be in accordance with CK Ordinance 8541 or its subsequent amending or replacement ordinance(s).
B. Adhere to the Pretreatment and Surcharge ordinance (Ordinance 10022) or its subsequent amending or replacement ordinance(s).

6.1.4 Gravity Mains
A. Design capacities of sewer mains shall be based on Table 1 as shown below. The effects of the proposed development’s sewer loading on downstream sewer lines shall be analyzed.
B. The minimum diameter shall be 8 inches.
C. Upsizing of mains will not be approved for utilization of minimum slopes to meet elevation restraints.
D. Sewer mains only serving a single property shall be considered private and shall be privately owned and maintained. In such cases, the design will be required to be reviewed outside of the typical MDEQ MFE process.

<table>
<thead>
<tr>
<th>Diameter of Sewer Main (inches)</th>
<th>Depth of Flow / Diameter (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 10</td>
<td>70</td>
</tr>
<tr>
<td>&gt; 10 - 15</td>
<td>73</td>
</tr>
<tr>
<td>&gt; 15 - 21</td>
<td>75</td>
</tr>
<tr>
<td>&gt; 21 - 27</td>
<td>77</td>
</tr>
<tr>
<td>&gt; 27</td>
<td>80</td>
</tr>
</tbody>
</table>

**D.E.** Velocity:
I. Minimum velocity of 2.5 fps
II. Maximum velocity of 15 fps

2 https://time.ci.kalispell.mt.us/WebLink/DocView.aspx?did=15130&searchid=49e0e4-6a50-4b79-b230-1f7a13e0f95&dbid=0
6.1.5 **Manholes**
A. Shall be provided at terminations, changes in pipe diameter, and changes in direction.
B. Shall have a minimum diameter of 4 feet and follow the National Precast Concrete Association *Manhole Sizing Recommendations*.1
C. Inverts:
   I. The invert of the outlet pipe shall be a minimum of 0.1 feet lower than the invert of the lowest inlet pipe for changes in direction less than 45°.
   II. The invert of the outlet pipe shall be a minimum of 0.2 feet lower than the invert of the lowest inlet pipe for changes in direction greater than 45°.
   III. Changes in direction greater than 90° within a single structure are prohibited.
D. When pipe diameters change at the manhole, the design capacity flow depth of the smaller inlet pipe(s) shall be at the same elevation as the design capacity flow depth of the larger outlet pipe. See Table 1 for design capacity flow depths.
E. **Flow channels**:
   I. Are required on all sanitary manholes;
   II. Shall provide smooth transitions between inlet and outlet pipe inverts; and
   III. Shall be as deep as the design capacity depth as shown in Table 1 before the start of the sloped shelf within the manhole.
F. Shall be designed to counteract buoyant forces in areas with groundwater.

6.1.6 **Location**
A. Sanitary sewer gravity mains shall be horizontally located within the paved portion of the street or alley.
B. Sanitary sewer force mains and interceptor mains shall be located as approved by the City Engineer.
C. Bury depth of sanitary sewer shall be in accordance with *MDEQ Circular 2*.2
D. Sewer valves and manhole covers shall not be located in curb and gutters, sidewalks, boulevards, or within the wheel path of a vehicular travel lane.

6.1.7 **Lift Stations**
A. Meet the design requirements of *MDEQ Circular 2*, with the following additional requirements.

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Chapter 6- Sanitary Sewer System

6.1.7B Wet well
   I. Sized to accommodate a maximum of 6 starts per hour.

6.1.8 Force Mains
   A. Design shall be as required per MDEQ Circular 2, except as specified below:
      I. Minimum velocity of 4 fps

6.1.9 Service Lines
   A. A minimum of 1 service per structure is required.
   B. Shall follow the CK Rules and Regulations Governing Sewer Service.

6.1.10 Grease Interceptors:
   A. Shall be provided as required by the Universal Plumbing Code (UPC) and the CK Pretreatment Program Coordinator (758-7817). Any conflicts or differences between the UPC and the CK Pretreatment Program shall be resolved in favor of the CK Pretreatment Program.
   B. Shall be sized according to the UPC.

6.1.11 Sand / Oil Separators:
   A. Shall be provided as required by the UPC and the CK Pretreatment Program Coordinator (758-7817). Any conflicts or differences between the UPC and the CK Pretreatment Program shall be resolved in favor of the CK Pretreatment Program.
   B. Shall be sized according to the Pretreatment Program requirements.

6.1.12 Sample Port
   A. Shall be provided on sewer services downstream of any grease trap, sand/oil separator, sewage pretreatment structure, or as otherwise required by the CK Pretreatment Program Coordinator (758-7817).

6.2. CONSTRUCTION STANDARDS

6.2.1 General
   A. Sewer systems shall be constructed in accordance with the current edition of the Standards (this document), the current edition of the MPWSS, as modified by the CK Special Provision for Sanitary Sewer Collection System and other standards referenced elsewhere in this document. Any conflicts or differences in these documents shall be resolved in favor of the Standards.

2 http://www.kalispell.com/DocumentCenter/View/483/Special-Provision-02730-PDF
6.2.2 **Offsets**
   B. All underground electrical, gas, phone, fiber, and cable lines must be installed at least 3 feet horizontally and 1 foot vertically from sewer mains and services.

6.2.3 **Gravity Sewer Pipe**
   A. Shall be SDR 35 PVC with gasketed joints and fittings.
   B. Connections to existing mains shall be made with PVC gasketed coupling or stainless steel sleeved flexible coupling.
   C. Shall not be directionally drilled.

6.2.4 **Force Mains**
   A. Shall be either DR11 HDPE or DR18 C900 PVC.
   B. Directionally drilled HDPE shall incorporate engineered expansion and contraction restraints, approved by CK PWD.
   C. Service taps shall not be allowed on CK force mains.
   D. Private force mains shall be connected to the sewer collection system at a manhole as shown in Detail SA.8.
   I. Toner Wire shall meet the same requirements as for water main, except:
      I. Force mains burst through existing mains or installed without continuous trench access shall be installed with ¼-inch steel toner cable.

6.2.5 **Service Lines**
   A. Materials
   B. Taps
   I. Shall only be made at the main:
      a. With an appropriately sized PVC wye for new construction; or
      b. With an appropriately sized and installed Inserta Tee® for connections to existing mains.
   C. Low-pressure services shall connect to a standard gravity service line at the right-of-way.
   D. The terminal end of sanitary sewer services at undeveloped lots shall be marked with a steel T-Post buried to within 6” of the surface.

2. [https://www.insertatee.com/](https://www.insertatee.com/)
6.2.5E

Connections between new and existing services of differing materials shall be completed with stainless steel shielded flexible couplings, such as Fernco Shielded Couplings, or equal as approved by CK PWD.

6.2.6 Detectable Warning Tape
A. Shall be installed above all sanitary sewer gravity and force mains.
B. Shall be a minimum of 5 mils thick.
C. Shall be 3 inches wide.
D. Shall conform to APWA colors.
E. Shall be buried 12 to 24 inches below the final grade.

6.2.7 Marker Posts
A. Shall be used when a gravity sewer main or sewer force main is located outside a paved surface.
B. Shall be APWA compliant Rhino TriView™ or approved equal.
C. Shall be installed at a maximum spacing of 150 feet.
D. Shall be installed at every manhole, valve, or change in direction.

6.2.8 Manholes
A. Shall be constructed in accordance with Standard Detail SA.3.
B. Doghouse manholes are prohibited.
C. Manhole Rings and Covers
   I. Shall be as shown in Standard Detail SA.9, or approved equal. Paint is optional.
   II. Watertight gasketed manhole covers shall be used in all locations where flooding may occur.
D. Shall be constructed with one of the following chimney seals:
   I. Whirly Gig® Manhole Riser Collar System;
   II. Cretex External Chimney Seal®;
   III. Cretex Internal Chimney Seal®;
   IV. WrapidSeal™ Manhole Encapsulation System;
   V. Mr. Manhole™; or
   VI. Equal product as approved by the CK PWD.

References:
3. http://wgig.us/
7. https://mrmanhole.com/
Chapter 6- Sanitary Sewer System

6.2.9D

E. Shall be constructed with one of the following joint seals:
   I. Infi-Shield Gator Wrap®;
   II. Press-Seal EZ-WRAP®;
   III. Mar Mac® MacWrap®;
   IV. Riser-Wrap™;
   V. Con-Seal CS-212®; or
   VI. Equal as approved by the CK PWD.

6.2.9 Lift Stations

A. Manufacturer
   I. Gorman Rupp; or
   II. Equal as approved by CK PWD
      a. Design Engineer shall provide all necessary information to justify
         the product as equal;
      b. Design Engineer shall submit a list of 3 lift stations of the type
         proposed which have been in operation at least 5 years; and
      c. The CK reserves the right to accept or reject the proposed lift
         station.

B. Pump Type:
   I. Above ground, self-priming, suction lift; or
   II. Submersible or submersible grinder
      a. Only to be used if Type (I) above cannot be installed due to head
         and flow requirements.

C. Redundancy
   I. Duplex systems
      a. Minimum requirement for all systems.
   II. Triplex systems
      a. May be required by the City Engineer for large lift stations or lift
         stations requiring specialty items.

III. Each motor shall include a motor saver.

D. Wet Well Access

1 http://ssisealingsystems.com/gator-wrap.html
3 http://www.marmac.com/product/macwrap-for-manholes/
4 https://marmac.com/product/macwrap-for-manholes/
Chapter 6- Sanitary Sewer System

6.2.9D.I Halliday Products - H1R3648 with fall through protection for wet wells 6 foot in diameter or smaller.

6.2.9D.II Larger diameter wet wells may require a larger hatch opening for maintenance purposes and shall be approved on a case-by-case basis.

6.2.9E. Influent Pipe
   I. One full joint of Class 50, cement lined, ductile iron.
   II. Spigot end shall extend 6-inches beyond interior of wet well wall.

6.2.9F. Access Road
   I. 12-foot minimum width paved for access by sewer maintenance vehicles.
   II. Access approach from street per Standards.

6.2.9G. Bypass
   I. Shall have a dedicated valve.
   II. Shall connect downstream of the lift station check valves.
   III. Provide a 4-inch cam-lock style connection with cap.

6.2.9H. Electrical
   I. Wiring
      a. Shall be water resistant inside the lift station and enclosure.
   II. Backup Power
      a. Generac or approved equal.
      b. Natural gas fueled.
      c. Noise emissions not to exceed 65 dbA at 20 feet from the power supply.
      d. Shall be installed on concrete pad per manufacturer recommendations
      e. Shall include an appropriately sized transfer switch, manufactured by the same manufacturer as the generator
      f. Shall include an O&M manual
      g. Manufacturer shall perform training at startup.

6.2.9III. Alarms
   a. Manufacturer:
      i. Mission Communications
   b. Model
      i. M-110

1 http://www.hallidayproducts.com/assets/ser-h1r-n-2.pdf
Chapter 6- Sanitary Sewer System

6.2.9I

A) Lift stations with pump motors under 20 horsepower.
   ii) M-800
A) Lift stations with pump motors over 20 horsepower.
B) Include a Digital Expansion Board to add 8 digital inputs
C) Include an Analog Expansion Board to add 4 analog inputs

c. Alarm Conditions
   i) High water
   ii) Low water
   iii) Seal failure
   iv) Power interruption
   v) High motor temp

IV. Controls
   a. Each pump shall have:
      i) Hour meter
      ii) Suction pressure gauge tap and valve
      iii) Discharge pressure gauge tap and valve
   b. Pump run alternator
   c. Amperage meter on each leg of the electrical wiring
   d. Lightning protection for the power supply
   e. Level control
      i) Primary control – Pressure transducer
      ii) Backup control – 5 float mercury switch system
         A) Shall be installed and function if primary control is lost
   f. Transfer switch and control panels shall be placed on a steel frame and embedded in concrete a pad with a pitched roof covering the pad and controls.

V. Lighting
   a. Yard lighting shall be provided and connected to the power supply
   b. Street lighting shall not be considered adequate to meet this requirement.

Enclosures
Chapter 6 - Sanitary Sewer System

6.2.9.I

I. Foundation
   a. Monolithic concrete
   b. Minimum 4 inches thick
   c. Treated sole plate anchored to foundation

II. Roof
   a. Gable style
   b. Trusses spaced at 24-inch maximum
   c. Designed to meet local snow load requirements
   d. 4:12 slope
   e. 5/8-inch OSB sheathing
   f. 30-year 3-tab shingles

III. Walls
   a. 8-foot floor to ceiling height
   b. 6-inch wall studs
   c. R-19 insulation
   d. Exterior
      i. ½-inch OSB sheathing
      ii. Lap siding with 7-inch reveal
   e. Interior
      i. T1-11 siding, primed and painted; or
      ii. 5/8" plywood, primed and painted white

IV. Ceiling
   a. R-49 insulation
   b. 5/8-inch unfinished gypsum board

V. Other
   a. 3068 steel door with deadbolt lock
   b. Heating and air circulation systems
   c. Ceiling mounted industrial lights in protective cages
   d. All other necessary materials for a finished building

VI. Submittals by Design Engineer for CK PWD approval
   a. Structural plans
   b. Mechanical plans
   c. Electrical plans
   d. Heating and air circulation

Field Code Changed
Fencing

I. 6-foot chain link security
II. 3-foot wide personnel gate
III. 12-foot wide gate with two 6-foot leaves
IV. Shall provide adequate room for access and facility maintenance
V. 3-foot minimum offset from all structures and appurtenances
VI. Gate placement shall promote maintenance vehicle access for pump removal.
VII. Gate installations shall include duckbill style gate holdbacks

Landscaping

I. 4-inches of clean 1-inch minus gravel or other landscaping rock as approved by CK PWD for areas outside of public right-of-way.
II. Areas inside public right-of-way shall meet the requirements of the CK Municipal Code 24-911.

6.2.10 Grease Interceptors
A. Shall be commercially manufactured.
B. Shall meet the requirements of Standard Details SA.10 and SA.11.

6.2.11 Sand / Oil Separators
A. Shall be commercially manufactured.
B. Shall meet the requirements of Standard Detail SA.132.

6.2.12 Sample Ports
A. Shall be commercially manufactured.
B. Shall meet the requirements of Standard Detail SA.123.

6.2.13 Pipe Bedding
A. Shall be placed in accordance with CK detail G.1.
B. Shall be haunched under pipe with shovel.
C. Shall be a clean sand meeting USCS classification SW, or a Class 1 material as defined in ASTM D 2321 with a max particle size of ¾-inch and meeting the migration requirements of the same standard (Section X.1.8).

6.2.14 Casing
A. Minimum casing pipe thickness shall be ½ inch.
B. Carrier pipe:
   I. SDR 35 PVC with joint restraining casing spacers, or

I. SDR 35 PVC with internal joint restraints.
II. Certa-Lok or other spline and groove pipe systems are not approved.

C. Casing Spacers:
   I. CCS-IR (joint-restraining) and CCS by Cascade Waterworks
   II. SSI by Advanced Products and Systems
   III. Equal as approved by CK DPW.

D. End Seals:
   I. CCES by Cascade Waterworks
   II. AC by Advanced Products and Systems
   III. Equal as approved by CK DPW.
Chapter 7 Storm Sewer System

7.1 DESIGN STANDARDS

7.1.1 Regulatory Thresholds

A. The regulatory threshold is the “trigger” for requiring compliance with the Basic Requirements of this section and is defined as 10,000 square feet or more of developed area.

B. Development is the conversion of previously undeveloped or permeable surfaces to impervious surfaces and managed landscape areas. Development occurs on vacant land or through expansion of partially developed sites.

I. Development projects that meet or exceed the regulatory threshold shall comply with ALL Basic Requirements (BR1-7).

II. The total developed area is used to determine if the threshold will be exceeded for development projects.

\[ 4,000 + 1,000 + 3,000 + 2,000 + 1,000 + 500 = 11,500 \text{ sf} \]

C. Redevelopment is the replacement of impervious surfaces on a fully developed site. Redevelopment occurs when existing facilities are demolished and rebuilt or substantially improved through reconstruction.

I. For redevelopment, the regulatory threshold applies to the total amount of pollutant generating surfaces replaced or rebuilt. Redevelopment projects that meet the regulatory threshold shall comply with BR-3 Water Quality Treatment.

a. For projects implemented in incremental phases, the threshold applies to the total amount of pollutant generating surface at the end of the current phase.

i. For example, an existing site wishes to replace their 13,500 sf parking lot in three equal phases. Therefore, the threshold would be triggered in the third phase and apply to the total pollutant generating surfaces on the site.

A) Phase 1 – 4,500 sf (no trigger)
Chapter 7 - Storm Sewer System

7.1.1C.I.a.iB)

B) Phase 2 - 4,500 + 4,500 = 9,000 sf (no trigger)

(Phase 3 - 9,000 + 4,500 = 13,500 sf

(Water Quality Treatment is required for all pollutant generating surfaces on the site, the current phase and all future phases of redevelopment on the site).

b. Sites with 100% existing building coverage that are currently connected to a municipally owned storm sewer or discharge to water of the state must be evaluated on a case-by-case basis to continue to be connected without treatment. Additional requirements such as flow restrictors may also be required in such cases.

D. The City Engineer reserves the right to require compliance with any or all of the Basic Requirements regardless of the size of the project or the amount of impervious area added or replaced.

E. Exemptions

I. Projects are exempt from the Basic Requirements when falling under any of the following categories:

a. Actions by a public utility or any other governmental agency to remove or alleviate an emergency condition, restore utility service, or reopen a public thoroughfare to traffic.

b. Projects that, when completed, will not have physically disturbed the land.

c. City right-of-way and City owned property maintenance and reconstruction projects.

d. Chip seals and fog seals.

7.1.2 Basic Requirements (BR-1) Drainage Submittal

A. Report

I. The report shall be inclusive, clear, legible, and reproducible. An uninvolved third party shall be able to review the report and determine whether all applicable standards have been met.

II. Narrative - The narrative of the report shall include the following elements:

a. Project Description: Information about the size of the project, the number of lots proposed, the project location, and background information relevant to drainage design, including topography, surface soils, surface and vegetative conditions, etc;
Chapter 7 - Storm Sewer System

7.1.2A.II.j

b. Geotechnical Information: Summarize the geotechnical site characterization (GSC) for the project including recommended infiltration rates and on-site soil descriptions;

c. Pre-Development Basin Information: Summarize the pre-development drainage patterns for all basins contributing flow to, on, through, and from the site. Include all assumptions and justifications used to determine curve numbers and/or runoff coefficients used in the analysis. Identify and discuss all existing on-site and/or off-site drainage facilities, natural or constructed, including but not limited to NDW, conveyance systems, and any other special features on or near the project;

d. Post-Development Basin Information: Summarize all assumptions used to determine the characteristics of the post-developed basins, such as the size of roofs and driveways, and the curve numbers and/or runoff coefficients used in the analysis. In addition, a table shall be included summarizing the impervious and pervious areas for each sub-basin;

e. Wetland Analysis: A wetland analysis is required for all new development and redevelopment. A wetland checklist (APPENDIX A) is required to be completed and submitted with the drainage report;

f. Down Gradient Analysis: Identify and discuss the probable impacts down-gradient of the project site;

g. Methodology: Discuss the hydraulic methods and storm events used in sizing the drainage facilities, including the BMPs proposed for the project;

h. Water Quality Treatment: Discuss treatment requirements based on the criteria in Section 7.1.3F.III and the CK Stormwater Quality Management Plan;

i. Results: Discuss results of the calculations and a description of the proposed stormwater facilities. Include a table comparing the pre-developed and post-developed conditions including rates and volumes. Provide a table summarizing the maximum water elevation of the facilities for the design storms, outflow structure information, the size of facilities “required” by the calculations, and the size of the facilities “provided” in the proposed design;

j. Operational Characteristics: Provide sufficient information about the operation of the stormwater system so that an uninvolved third party can read the report and understand how the proposed system will function under various conditions;
Chapter 7 - Storm Sewer System

7.1.2A.II.k

k. **Perpetual Maintenance of Facilities:** Include a discussion of the provisions set forth to operate and maintain the drainage facilities. The project owner's mechanism for funding the operation and maintenance for stormwater facilities, including sinking fund calculations, shall be included (refer to Section 7.1.8E for more information);

l. **Off-Site Easements:** Identify the anticipated location of any off-site easements either on the basin map or in a separate schematic. Off-site easements will be required for proposed stormwater conveyance or disposal facilities outside the project boundaries. These easements shall be obtained and recorded prior to the acceptance of the final Drainage Submittal (refer to Section 7.1.9 for more information); and,

m. **Regional Facilities:** A discussion of any expected future impacts on or connections to existing or proposed regional facilities (refer to Section 7.1.5H.X.d).

III. **Figures**

   a. Basin Map (Refer to Section 2.1.8)
   b. Site photos
   c. Soils map
   d. Any graphs, charts, nomographs, maps, or figures used in the design
   e. If a geological site characterization is required:
      i. A geologic cross-section, drawn to scale
      ii. Stormwater facilities superimposed on the cross section
      iii. All relevant geologic units clearly identified including the target disposal layer and limiting layers

B. **Calculations**

   I. Present in a logical format and provide sufficient information to allow an uninvolved third party to reproduce the results. All assumptions, input and output data, and variables listed in computer printouts and hand calculations shall be clearly identified. Basins and design storm events shall be clearly identified on all calculations.

   II. Incorporate all calculations used to determine the size of the facilities.

   III. As a minimum, provide the following, if applicable:

      a. Hydrologic / hydraulic calculations
         i. Pre- and post-development peak rate and volume
         ii. Routing
         iii. Design information for outflow structures
Chapter 7 - Storm Sewer System

7.1.2C.iii.d.i

iv. Orifice information
v. Pond volume rating table or calculations
b. Time of concentration calculations
c. Curve number (CN) or runoff coefficient (C)
d. Water quality treatment calculations
e. Inlet capacity and bypass calculations
f. Detention/retention storage capacities
g. Ditch and drainage way calculations
h. Culvert and pipe calculations
i. Non-flooded width calculations for curb and gutters
j. Energy dissipation calculations

C. Down-Gradient Analysis

I. Inventory natural and constructed down-gradient drainage features a minimum of ¼ mile down gradient.

II. Identify and evaluate adverse down-gradient impacts. Adverse impacts include, but are not limited to:
   a. A down gradient property receiving more standing or floodwater on their property than the pre-developed condition.
   b. Erosion
   c. Flooding
   d. Slope failures
   e. Changed runoff patterns
   f. Reduced groundwater recharge

III. Analysis shall include:
   a. Visual inspection of the site and down-gradient area(s) by the engineer to the location where adverse impacts are anticipated to be negligible.
   b. A site map that clearly identifies the project boundaries, study area boundaries, down-gradient flow path, and any existing or potential areas identified as problematic.
   c. Pre and post-development hydraulic (rate and volume) capacities for the 10-yr and 100-yr 24-hr storm events.
   d. A written summary including:
      i. Existing or potential off-site drainage problems that may be aggravated by the project.
Chapter 7 - Storm Sewer System

7.1.2C.III.d.ii

ii The condition and capacity of the conveyance route including:
   A) All existing and proposed elements
   B) Potential backwater conditions on open channels
   C) Constrictions or low capacity zones
   D) Surcharging of enclosed systems
   E) Localized flooding

iii The presence of existing natural or constructed land features dependent upon pre-developed surface or subsurface drainage patterns.

iv Potential changes to groundwater characteristics that may negatively impact sub-level structures, foundations, or surface areas due to an increased amount, increased frequency, or duration of groundwater intrusion.

v Existing or potential erosive conditions such as scour or unstable slopes on-site or down-gradient of the project.

vi Flood areas identified on FEMA maps.

e. If there is existing or potential off-site drainage problems down-gradient of the project, demonstrate the proposed stormwater disposal system has been designed to meet the following conditions:

i The stormwater runoff (volume and flowrate) enters and leaves the site in the same manner as that of the pre-developed condition.

ii Reduced or increased groundwater recharge has been considered with respect to potential adverse impacts on down-gradient features.

iii The proposed design does not aggravate or impact existing drainage problems or create a new drainage problem.

f. If down-gradient surface release is at a rate or volume greater than the pre-developed condition, then potential adverse impacts on down-gradient property natural or constructed drainage channels due to an increase in stormwater rate, volume, velocity, and flow duration shall also be addressed and mitigated in detail.

D. Other Submittal Elements

I. Provide the following if applicable, required by other sections, or as otherwise required by the City Engineer:

   a. A geotechnical site characterization (refer to 7.1.3)
Chapter 7 - Storm Sewer System

7.1.3 BR-2 Geotechnical Site Characterization

A. Investigation and Assessment Requirements:

I. Provide a surface reconnaissance of the site and adjacent properties to assess potential impacts from the proposed stormwater system and to verify that the conditions are consistent with the mapped information. Typically, the evaluation should extend a quarter of a mile down gradient. Where access to adjacent properties is unavailable, the project owner shall rely upon the best known information for the area, supplemented with information available from the City Engineer, including any existing geotechnical engineering reports or studies for sites in the vicinity;

II. Review available geologic, topographic, and soils, and identify any site conditions that could impact the use of storm drainage systems or the construction of sub-level structures. This review shall include all available previous geotechnical engineering reports or studies for sites in the vicinity; and,

III. Evaluate the potential impacts of groundwater on the proposed storm drainage facilities, roadways and proposed underground structures, when a seasonally high groundwater table is suspected.

B. Report shall include:

I. A brief project description including size and number of lots proposed, project location (section, township and range), and background information relevant for drainage design;

II. A discussion of the study investigations;

III. A description of the soil units on the site and in the vicinity of the site;

IV. A description of the site including surface, soil, and groundwater conditions, etc.; and,

V. Conclusions and recommendations.

C. Site Plan shall include:

I. Project boundaries (including all existing and proposed property lines);

II. Labeled topographic contours, extending beyond the project and drainage basin (See Section 2.1.1C).
Chapter 7- Storm Sewer System

7.1.3C.III

III. Location of the soil units identified;

IV. Location of significant structures, properties or geologic features on site and in the project vicinity;

V. Location of existing natural or constructed drainage features on site and in the project vicinity; and,

VI. Location of proposed site infrastructure including roadways and drainage features such as ponds, drywells, etc.

D. Test Method Documentation. Provide the following:

I. A map with the location of all subsurface field explorations and any in-place field tests;

II. A description of any difficulties encountered during excavation and testing;

III. A description of the equipment used to perform the field explorations or tests. When applicable, describe the type of fabric lining and gravel backfill used;

IV. Logs of subsurface explorations which identify the depth to groundwater, and the presence of any limiting layers and the target soil layer. Include test pit or excavation dimensions, with photographs, where applicable;

V. Test data in a format that includes time of day, flow meter readings, incremental flow rates, observed head levels, water depths and total flow volumes in the test pit or infiltrometer; and,

VI. A description of the condition of any existing facilities being tested, noting any silt build-up, water level, connections to other structures (including distance to inverts of any interconnecting pipes), measured depths and dimensions, etc.

VII. Results of field and laboratory testing conducted, including the grain size analysis represented both graphically and in tabular format;

VIII. A report on the actual and proposed design outflow rates for test pits;

IX. Results of the sub-level structure feasibility study and a summary of the down-gradient analysis as applicable; and,

X. A geologic cross-section of the stormwater disposal area drawn to scale, with the proposed stormwater disposal facilities superimposed on the cross-section. All relevant geologic units shall be clearly identified including the target disposal layer and limiting layers.

E. Field and Laboratory Testing

I. The subsurface exploration, testing, and associated engineering evaluations are necessary to identify permeable soils and to determine the thickness, extent, and variability of the soils. This information is necessary to properly design stormwater disposal facilities.
Chapter 7 - Storm Sewer System

II. Field explorations and laboratory testing shall be conducted under the direct supervision of a civil engineer, a geotechnical engineer, a hydrogeologist, or an engineering geologist.

III. Test Methods
   a. Soil infiltration rates shall be determined using one or more of the following methods for new development or redevelopment with greater than or equal to 10,000 square feet of impervious surface:
      i. The ASTM D 3385-88 Double-ring Infiltrometer Test: This test method is used for field measurement of infiltration rate of soils;
      ii. The Pilot Infiltration Test Procedure: This test method uses field data to estimate the outflow rates of subsurface disposal facilities (refer to the BMP Manual1);
      iii. Additional or alternate test methods, upon approval from the City Engineer.

IV. Minimum Requirements
   a. The following minimum requirements, when applicable, shall be met for field explorations and laboratory testing when subsurface disposal is proposed:
      i. Test borings and/or test pits shall be located within the footprint of proposed stormwater disposal facilities; and,
      ii. For each facility, a minimum of one subsurface exploration shall be performed for up to 1,500 square feet of disposal area. Another subsurface exploration shall be performed for each additional 3,000 square feet, or fraction thereof, of disposal area. For a linear roadside swale, a minimum of one subsurface exploration shall be performed every 500 feet, staggered on both sides of the road, unless site conditions or test results indicate that additional explorations are necessary. Subsurface explorations and sampling shall be conducted according to applicable ASTM standards.

V. Post-Construction Testing
   a. Newly constructed infiltration facilities will require a full-scale successful test prior to project engineer certification. Refer to Appendix B2 – Pond Flood Test for flood test methods. Contact the City Engineer for additional information.


Click to Return to Index
Chapter 7 - Storm Sewer System

F. Sublevel Feasibility
   I. If sub-level structure construction is being considered, a sub-level structure feasibility study is required. Field explorations and laboratory testing shall be conducted under the direct supervision of a geotechnical engineer, or hydrogeologist. Test boring shall be performed per the geotechnical engineer, a hydrogeologist, or an engineering geologist recommendation or at minimum of one per 10,000 square feet. Ground water shall be monitored during seasonal high ground water conditions. The sub-level structure feasibility study shall include the following, at a minimum:
      a. A layout of the site showing lot lines and lot and block numbers;
      b. Identification by lot and block number of sites where sub-level structure construction is feasible. Provide recommendations for maximum below grade floor elevations, minimum drainage system requirements, and any site specific recommendations;
      c. Discussion of the effects of hydrostatic pressure that may lead to basement flooding and recommendations as to the effectiveness of waterproofing;
      d. If infiltration is proposed as a method for stormwater disposal, discussion of any potential adverse impacts on proposed sub-level structures, taking into consideration the contribution of imported water (due to lawn watering, etc.); and,
      e. Identification of locations where sub-level structure construction is not feasible. When field and research data indicate season high ground water is:
         i. Below 15 feet, basements and crawl spaces would be allowed.
         ii. Between 5 feet to 15 feet, basement construction would be prohibited.
         iii. At 5 feet or less, both basement and crawl space would be prohibited.
   II. Language regarding sub-level structure restrictions shall be placed or referenced on the face of the plat. If a potential buyer would like to construct a sub-level structure in an area deemed not feasible, then a site specific geotechnical evaluation shall be performed by a geotechnical engineer for the individual lot prior to a building permit being issued.
### Table 2 - Example Geotechnical Recommendation Summary

<table>
<thead>
<tr>
<th>Block</th>
<th>Lot(s)</th>
<th>Sub-Level Construction Feasible?</th>
<th>Maximum allowable Depth Below Finish Grade</th>
<th>Depth to Limiting Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block 1</td>
<td>Lots 1-8</td>
<td>yes</td>
<td>C= 15 feet GrW=25 feet B=30 feet</td>
<td>Based upon the clean nature of the soils at the sub-level elevations and the depth to groundwater, footing drains are not required. However, below-grade walls shall be well reinforced to reducing cracking and thoroughly damp-proofed with a water-resistant bituminous emulsion or modified cement base coating. Backfill material shall consist of only clean granular material which is free of fine-grained soils, organic material, debris and large rocks.</td>
</tr>
<tr>
<td>Block 2</td>
<td>Lots 1-3</td>
<td>yes</td>
<td>4 feet GrW=13 feet</td>
<td>Below-grade walls shall be well reinforced to reduce cracking and waterproofed with a membrane (per IRC) which is lapped and sealed from the top of the footing to the finished grade. An under slab waterproof membrane (per IBC) which is lapped and sealed shall be integrated with the wall membrane. Backfill material shall consist of only clean granular material which is free of fine-grained soils, organic material, debris and large rocks. Walls and footings shall have a drain system with cleanouts, emptying a minimum of 15 feet in a down-slope direction away from structures. Precautions shall be taken not to excavate a closed depression over rock or clay that is intended to dispose of sump water from a foundation drain system.</td>
</tr>
<tr>
<td>Block 2</td>
<td>Lots 4-8</td>
<td>no</td>
<td>n/a GrW=6 feet B=10 feet</td>
<td>Due to the very shallow presence of groundwater, sub-level structures are not recommended on these lots. If a crawl space is proposed, a drain system with cleanouts shall be provided that empties a minimum of 15 feet in a down-slope direction away from structures. Precautions shall be taken not to excavate a closed depression over rock or clay that is intended to dispose of sump water from foundation drain system.</td>
</tr>
</tbody>
</table>

1. Maximum depth measured from original pre-construction/pre-grading ground surface elevation or existing ground surface, whichever provides a greater distance between the lowest floor elevation and the limiting layer.
2. GrW=groundwater, B=bedrock or basalt, C=clayey-silty soils
3. Refer to the Geotechnical Report for this project for further information, which may include construction details that support these recommendations.

III. Recommendations shall be summarized and provided electronically in Microsoft Excel, per the format found in Table 2.
Chapter 7- Storm Sewer System

7.1.4 **BR-3 Water Quality Treatment**


B. The following known amendments shall be incorporated into the BMP Design Manual:

   I. General:
      a. Infiltrating facilities shall provide a minimum vertical separation of 3 feet between the bottom of the facility and the seasonal high water table.
      b. Infiltrating facilities shall provide a minimum vertical separation of 5 feet between the bottom of the facility and the first limiting layer (bedrock, clay lens, etc.).
      c. Facilities requiring pretreatment shall provide a minimum pretreatment volume equal to 20% of the RTV.
      d. Maintenance access shall be provided in accordance with Section 7.1.8G.
      e. Post-Construction BMPs shall meet the requirements of 7.1.5H.

   II. Bioretention Areas (Amends chapter 5.3):
      a. The maximum contributing area to a single bioretention area is 200,000 sf.
      b. For bioretention areas placed in subsoils having a hydrologic soil group designation of B, C, or D, an underdrain system is required.
      c. Underdrains shall be included in the design when subsoil infiltration rates are less than 1 inch per hour.
      d. The ponding area shall contain the entire volume associated with the Runoff Treatment Volume of 0.5 inches.
      e. The ponding depth shall be designed to be 6 to 12 inches above the filter bed.
      f. Filter Treatment Criteria:
         i. The filter bed shall have a minimum depth of 30 inches.
         ii. The planting soil filter bed shall be sized using a Darcy's Law equation with a filter drain time of 48 hours and a coefficient of permeability (k) of 0.5 feet per day.

---

Chapter 7- Storm Sewer System

iii The required filter bed area \( A_f \) is computed using the following formula:

\[
A_f = \frac{V_{wq} \times d_f}{k \times (h_f + d_f) \times t_f}
\]

Where:
- \( A_f \) = surface area of filter bed (ft\(^2\))
- \( V_{wq} \) = Runoff Treatment Volume (ft\(^3\))
- \( d_f \) = filter bed depth (ft)
- \( k \) = coefficient of permeability of filter media (ft/day)
- \( h_f \) = average height of water above filter bed (ft)
- \( t_f \) = design filter bed drain time (days)

g. Pretreatment Facilities:

i Micro-bioretention (250 - 2,500 sf)
   A) A grass filter strip extending a minimum of 10 feet from the edge of the pavement and at a maximum slope of 5%.

ii Small Scale Bioretention (2,500 to 20,000 sf)
   A) A grass filter strip with a pea gravel diaphram or other flow spreader.
   B) A grass channel with a pea gravel diaphram or other flow spreader.
   C) See additional guidance in Appendix E.

iii Bioretention Basins (20,000 to 200,000 sf)
   A) A pretreatment cell, similar to a forebay, is located at the piped inlets or curb cuts leading to the bioretention area and has a storage volume equivalent to at least 15% of the total RRV.
   B) The design shall have a 2:1 length to width ratio.
   C) The cell can be formed by a wooden or stone dam, or rock berm.

h. Filter Media

i Planting soils media shall consist of a sandy loam, loamy sand, or loam texture per USDA textural triangle with a clay content ranging from 0 to 5%. In addition, the planting soil must have a 3 to 5% organic content.
   A) The recommended planting soil media mixture is:
      I) 85 – 88 % sand. (washed medium sand is sufficient)
Chapter 7 - Storm Sewer System

II) 8 - 12% fines. (Includes both clay (max 5%) and silt

III) 3 - 5% organic matter (leaf compost or peat moss)

B) Small scale bioretention and bioretention basin designs shall use premixed certified media from a vendor that meets the following requirements for phosphorus contend, cation exchange (CEC), and media filtration;
   I) The recommend P-index value is between 10-50;
   II) Soils with CECs exceeding 10 are preferred for pollutant removal; and,
   III) The media should have an infiltration rate of 1 to 2 inches per hour

C) Micro-bioretention (250 to 2,500 sf) soil media can be mixed on site;

D) The minimum filter media depth shall be between 30 to 48 inches; and,

E) Filter media shall be placed in lifts of 12 to 18 inches.

III. Permeable pavement systems are prohibited (removes Chapter 5.4).

IV. Biofiltration Swale (amends Chapter 5.6)
   a. Slope:
      i  The channel slope shall be at least 1% and no greater than 5%. Slopes of 2% to 4% provide the best performance.
      ii When slopes less than 2% are used, an underdrain is required.

   A) A 6-inch-diameter perforated pipe shall be installed in a trench lined with filter fabric and filled with 5/8-inch minus round rocks.

   B) The pipe shall be placed at least 12 inches below the biofiltration channel bed and the bed shall incorporate topsoil that has a proportionately high sand content.
Chapter 7 - Storm Sewer System

b. Geometry:
   i. The maximum bottom width is 10 feet and the minimum width is 3 feet. If the calculated bottom width exceeds 10 feet, parallel biofiltration channels shall be used in conjunction with a device that splits the flow and directs an equal amount to each channel;
   ii. The ideal cross-section is a trapezoid with side slopes no steeper than 3:1. However, a rectangular shape can be proposed if there are topographical constraints or other construction concerns.

c. Velocity:
   i. The maximum flow velocity through the swale under peak 100-year flow conditions shall not exceed 3 feet/second.

d. Level Spreader:
   i. A flow spreader shall be used at the inlet of a swale to dissipate energy and evenly spread runoff as sheet flow over the swale bottom. Flow spreaders are recommended at mid-length of the swale. For detail on flow spreaders see Appendix D – Flow Spreader Options.

V. Wet Detention Basin (Amends Chapter 5.8)
   a. Wet detention basins may be single cells when:
      i. Wetpool volume is less than or equal to 4,000 cubic feet;
      and,
      ii. Length to width ratio is ≥ 4:1.

VI. Proprietary Treatment Devices (Amends Chapter 5.9)
   a. Proprietary treatment devices must be approved by the Washington Department of Ecology (WDOE) through the TAPE process for pretreatment and have a general use level designation.
   b. Treatment devices shall be sized per the guidance of WDOE TAPE approval.
   a-c. Manufacturer must submit documentation that their unit can achieve 80% TSS removal at the WDOE TAPE approved flowrate.

VII. Offsite Treatment Facilities
   a. Onsite treatment is considered paramount by the CK MS4 permit. Onsite treatment options shall be exhausted prior to evaluating offsite treatment.
   b. Approval for offsite treatment will not be granted when based solely on the difficulty or cost of implementation of onsite treatment methods.
Chapter 7- Storm Sewer System

7.1.4B VII.c

c. Offsite treatment will be considered by PW on a case-by-case basis when the following criteria can be firmly established:
   i. Lack of available space
   ii. High groundwater
   iii. Groundwater contamination
   iv. Poorly infiltrating soils
   v. Shallow bedrock
   vi. Prohibitive costs
   vii. A land use inconsistent with capture and reuse or infiltration of stormwater

d. Offsite treatment proposals shall include:
   i. Fiscal plan for routine maintenance.
   ii. Fiscal plan for costs associated with replacement of the facility by the end of its design life.
   iii. A plan for perpetual ownership and maintenance responsibilities.

A) Delegation of ownership, costs, and responsibilities to the CK will not be considered.

7.1.5 BR-4 Flow Control

A. Storm Event Calculations

I. The TR-55 Curve Number Method shall be used to determine Peak Flow Rates, and Flow Control Volumes. The Curve Number Method was developed by the USDA and is available here. The following items are pertinent to and shall be used for Kalispell:

a. 24-Hour Precipitation Depths for Kalispell See Table 3.

b. Post-construction flow rates shall not exceed the Pre-development flow rates for the 10-yr and 100-yr events.

II. Alternative Methods:

a. Used when:

   i. The calculated depth of runoff is less than a 0.5 inch;
   ii. The value of (P-0.2S) is a negative number;
   iii. The weighted CN is less than 40;
   iv. Routing a hydrograph through an existing control structure; or
   v. Sizing a new flow control facility using hydrograph analysis.
b. Rational Method:
   i. See MDT Hydrology Manual, Chapter 7.
   ii. Time of concentration shall be calculated using the TR-55 Curve Number Method and not be less than 5 minutes (i.e., if calculated less than 5 minutes, use 5 minutes).
   iii. Use MDT IDF curves / tables to select intensities.

   c. Level Pool Routing Method
   i. Use for routing a hydrograph through and existing control structure, or for sizing a new flow control facility using hydrograph analysis.
   ii. See Handbook of Applied Hydrology (Chow, Ven Te, 1964)

B. Precipitation:
   I. The design 24-hour precipitation depths and recurrence interval used by Kalispell are provided in the table below. The precipitation isopluvial map data comes from National Oceanic and Atmospheric Administration (NOAA) Atlas 2, Volume IX, 1973.

   .Table 3 - Kalispell Precipitation Depths

<table>
<thead>
<tr>
<th>Recurrence Interval</th>
<th>2-year</th>
<th>10-year</th>
<th>25-year</th>
<th>50-year</th>
<th>100-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-Hour Precipitation Depth (inches)</td>
<td>1.4</td>
<td>2.0</td>
<td>2.4</td>
<td>2.8</td>
<td>3.0</td>
</tr>
</tbody>
</table>

   C. Design Storm Distribution
   I. The NRCS Type I 24-hour storm distribution for the 10 and 100-year storm events shall be used for sizing flow control facilities.

   D. Basin Areas:
   I. The basin area must reflect the actual runoff characteristics as closely as possible and be consistent with the assumptions used. The impervious and pervious areas must be estimated from best available plans, topography, or aerial photography, and verified by field reconnaissance.
Chapter 7- Storm Sewer System

7.1.5E

E. Outflow Control Structures

I. Requirements:
   a. Shall be in a manhole or catch basin.
   b. Shall have a restrictor device to control outflow.
   c. Shall be incorporated into all detention facilities.
   d. Flow shall enter the detention facility through a conveyance system separate from the outflow control structure.
   e. Provide an access road for inspection and maintenance.
   f. Lids shall be locking and the rim elevation shall match finished grade.

II. Types of Flow Control
   a. Multiple Orifice Restrictors
      i. Minimum Orifice size shall be 3 inches.
      ii. Shall be constructed on a baffle or on a tee section
   b. Risers and Weir Restrictor
      i. Must provide for primary overflow of the developed 100-year peak flow discharging to the detention facility.
      ii. A combined orifice and riser overflow may be used if item (i) above is met, assuming the orifices are plugged.
   c. Skimmer (with baffle or without baffle)
      i. Provide skimming up to the 10-year event high water level or greater.
      ii. See CK Standard Detail DR.8 and DR.9

1. http://www.ecy.wa.gov/programs/wq/stormwater/manual/2014SWMMWWinteractive/Content/GeneratedImages/PDFs/2014%20Figure%20III-3-2-2_1.png
iii  Provide flow velocities through the submerged skimmer opening at 1.5 fps or lower under the 10-year event high water level.
Chapter 7- Storm Sewer System

7.1.5E.III

III. Flow Control Calculations
   a. Provide equations, references, coefficients, and assumptions used.
   b. Provide calculations or spreadsheet/table at applicable depths.

Table 4 provides equations for the most common types of weirs and orifices used for flow control.

<table>
<thead>
<tr>
<th>Weir/Orifice Type</th>
<th>Equation</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharp Crested V-notch weir1</td>
<td>[ Q = C \left( \tan \frac{\theta}{2} \right) H^{\frac{1}{2}} ]</td>
<td>0.60</td>
</tr>
<tr>
<td>Broad Crested Suppressed Rectangular Weir</td>
<td>[ Q = CLH^{\frac{3}{2}} ]</td>
<td>0.33</td>
</tr>
<tr>
<td>Rectangular Sharp Crested Weirs:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contracted</td>
<td>[ Q = C(L - 0.2H)H^{\frac{3}{2}} ]</td>
<td>3.27 + 0.40 \frac{H}{Y}</td>
</tr>
<tr>
<td>Suppressed</td>
<td>[ Q = CLH^{\frac{3}{2}} ]</td>
<td>3.367</td>
</tr>
<tr>
<td>Sharp Crested Cipoletti (Trapezoidal) 1:4 Side Slopes</td>
<td>[ Q = C(2g)^{\frac{1}{2}} \left[ \frac{2}{3} LH^{\frac{3}{2}} + \frac{8}{15}(\tan \theta)H^{\frac{5}{2}} \right] ]</td>
<td>0.60</td>
</tr>
<tr>
<td>Broad Crested Trapezoidal Weir</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orifice</td>
<td>[ Q = CA\sqrt{2gH} ]</td>
<td>0.62</td>
</tr>
</tbody>
</table>

IV. Flow Control Structures with overflow risers typically provide the 100-year peak flow for developed conditions.
   a. See Washington State Department of Ecology\(^2\); or
   b. Provide hydraulics reference and calculations.

\(^1\) The weir invert should be set above the pond bottom a height of at least twice the maximum head.
Q = flow (cfs); C = coefficient of discharge; A = area of orifice (square feet); H = hydraulic head (feet); g = gravity (32.2 feet/second\(^2\)); \(\theta\) = angle of side slopes (degrees); Y = storage depth (feet); L = weir length or opening (feet)

\(^2\) [Link](https://fortress.wa.gov/ecy/ezshare/wq/Permits/Flare/2019SWMMWW/2019SWMMWW.htm#Topics/VolumeV/DetentionBMPs/ControlStructureDesign.htm)
Chapter 7- Storm Sewer System

F. Infiltration Facilities
   I. Requirements:
      a. Pretreatment
         i. Required for urban watersheds with more than 0.25 acres of impervious surface before entering the infiltration facility.
         ii. Shall be equal to 20% of WQv. **The pretreatment volume is in addition to the infiltration basin’s WQv sizing requirement.**
      b. Depth to Groundwater and Limiting Layer
         i. The base of the infiltration facility shall be ≥ 5 feet above the limiting layer (bedrock, clay lens, etc.).
         ii. The bottom of the basin shall be at least 3 feet above the seasonal high groundwater table.
            A) The seasonal high water table shall be based on long-term piezometer records during at least one wet season or the mottled soil layer as determined by a licensed geologist, licensed engineer with geotechnical expertise, or hydrogeologist.
      c. Setbacks
         i. ≥ 50 feet upslope and ≥ 20 feet downslope from building foundation to maximum water surface elevation.
         ii. ≥ 50 feet from top of slopes steeper than 15%, or as determined by a licensed geotechnical engineer.
         iii. ≥ 200 feet from springs used for drinking water supply.
         iv. ≥ 100 feet from septic drain fields.
         v. ≥ 100 feet from water supply wells.
         vi. ≥ 20 feet from easements, external tracts, or property lines.
         vii. Outside of the floodplain 10-year High Water Line.
      d. Access
         i. Provide dedicated maintenance access route to the infiltration facility from a public roadway.
         ii. Access route shall be dedicated by maintenance easement or drainage parcel.
Chapter 7- Storm Sewer System

7.1.5.F.II

II. Infiltration Criteria
   a. Short-term rate:
      i. Use methods described in Section 7.1.3.E.III
      ii. Shall be greater than 0.5 inches per hour and less than 20 inches per hour.

   b. Long-term rate:
      i. Shall be determined by dividing the short-term rate by 2.
      ii. When the long-term rate is greater than 2.5 inches per hour, a site-specific analysis shall be performed by a licensed geotechnical engineer to determine pollutant removal to prevent groundwater contamination.
      iii. The maximum infiltration rates for various soils is outlined in Table 5.

<table>
<thead>
<tr>
<th>Soil Texture Class</th>
<th>Maximum Infiltration Rate (in/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Sand, Cobbles</td>
<td>20</td>
</tr>
<tr>
<td>Medium Sand</td>
<td>8</td>
</tr>
<tr>
<td>Fine Sand, Loamy Sand</td>
<td>2.4</td>
</tr>
<tr>
<td>Sandy Loam</td>
<td>1</td>
</tr>
</tbody>
</table>

   c. Drawdown time:
      i. Shall drain dry within 72 hours after the design event using the long-term soil infiltration rate.
      ii. Infiltration basins will need to be refreshed and infiltration rate restored when the actual drawdown time exceeds 72 hours.

III. Planting requirements:
   a. Plant basin with native vegetation containing a mixture of species of varying moisture tolerances. See section Appendix F – Planting Guidelines.

IV. Post-construction verification
   a. Submit an as-built grading plan of the infiltration basin after construction to the CK to verify the design storage volume has been provided.
   b. Perform post-construction testing of actual short-term infiltration rates to ensure the basin functions as designed or corrective action will need to be taken. Refer to Appendix B2 – Pond Flood Test/Appendix B2 – Pond Flood Test.
Chapter 7 - Storm Sewer System

V. Facility volume
   a. The size of the infiltration facility can be determined by routing methods outlined in Section 7.1.2B.III.a.ii.
   b. Infiltration facilities shall be sized to fully infiltrate the post-development NRCS Type I 10-year 24-hour design storm.
   c. The design water surface for all facilities shall be the post-developed 100-year 24-hour water surface elevation.
   d. All overflows (structure or spillway) shall pass the 100-year 24-hour developed peak flow rate.
   e. To prevent the onset of anaerobic condition and mosquito breeding, the infiltration facility shall be designed to drain completely the 10-year 24-hour event within 72 hours and the 100-year 24-hour event within 120 hours after the design storm event.

VI. Location
   a. If the site has potential for contamination or unstable soil, then these conditions shall be investigated and appropriate mitigating measures taken before designing infiltration facilities in these areas.

VII. Underground infiltration facilities
   a. Materials
      i. Shall be designed to withstand HS-20 loading when installed.
   b. Access
      i. The maximum depth from finished grade to invert shall be 10 feet.
      ii. To facilitate cleaning:
         A) A minimum 3 foot access port shall be placed at the inlet of the facility and as otherwise required for proper maintenance.
            1) Access ports shall have a minimum 2-foot sump.
         B) Flushing ports shall be placed at the end of all pipe runs.
         C) Access and flushing ports shall have solid locking lids and be readily accessible by maintenance vehicles.
Chapter 7 - Storm Sewer System

7.1.5G

G. Underground detention facilities

I. Location:
   a. Shall be located downstream of water quality treatment units.
   b. Shall be a minimum of 5 feet from any structure or property boundary.
   c. Shall not be placed under any permanent structures or buildings.

II. Sizing
   a. Pipe segments shall be sufficient in number, diameter, and length to provide the required minimum storage volume for the 100-year event.

III. Materials
   a. Shall be metal, plastic, or concrete pipe or box.
   b. Shall be designed to withstand HS-20 loading when installed in roadways or vehicular traffic areas.
   c. Joints and connections shall be water tight, not soil tight.
   d. Shall have a minimum diameter of 12 inches for pipe or a minimum dimension of 12 inches for boxes.
   e. End caps shall be designed for structural stability at maximum hydrostatic loading conditions.

IV. Flow control structure
   a. The facility outlet pipe(s) shall discharge into a manhole structure.
   b. If an orifice plate is required to control the release rates, the plate shall be hinged to open into the detention pipes to facilitate back flushing of the outlet pipe.
   c. A high flow bypass shall be included to safely pass the 100-year storm event in the event of outlet structure blockage or mechanical failure. The bypass shall be located so that downstream structures will not be impacted by emergency discharges.

V. Buoyancy
   a. In soils where seasonal groundwater may induce flotation, buoyancy tendencies must be balanced either by ballasting with concrete backfill, providing concrete anchors, increasing the total weight, or providing subsurface drains to permanently lower the groundwater table.
   b. Calculations to demonstrate stability must be provided.
Chapter 7- Storm Sewer System

VI. Access
   a. The maximum depth from finished grade to invert shall be 10 feet.
   b. To facilitate cleaning:
      i. A minimum 3-foot access port shall be placed at the inlet and outlet of the facility and as otherwise required for proper maintenance.
      A) Access ports shall have a minimum 2 foot sump.
      ii. Flushing ports shall be placed at the beginning of all pipe runs.
      iii. Access and flushing ports shall have solid locking lids and be readily accessible by maintenance vehicles.

H. Additional requirements for all facilities:
I. General
   a. Pond bottoms shall be located a minimum of 6 inches below the outlet to provide sediment storage. Sediment storage volume shall not be included in the design volume.
   b. Maintain a minimum of 1-foot of separation above high groundwater table elevation unless otherwise stated in applicable sections.
   c. All pond bottoms shall be sloped from 0.5% to 1%. Roadside swales are considered flat if the swale bottom slope is 1% or less. When calculating treatment volume, the designer can assume a flat bottom for swale/pond bottom slopes up to 1%.
   d. Drainage facilities shall be located within a drainage parcel. Refer to Section 7.1.9A for specific information.

II. Setbacks
   a. Any detention pond, swale or ditch (measured from the maximum design operating depth) shall be at least 30 feet when located up-gradient or 20 feet when located down-gradient from septic tanks or drain fields.
   b. Pond overflow structures shall be located a minimum of 10 feet from any structure or property line. The toe of the berm or top of bank shall be a minimum of 5 feet from any structure or property line.
   c. ≥ 50 feet from building foundation to maximum water surface elevation.
   d. ≥ 20 feet from easement or property line to maximum water surface elevation.
   e. Outside of the floodplain 10-year High Water Line.
Chapter 7 - Storm Sewer System

7.1.5H.II.f

f. ≥ 200 feet from schools, day cares, nursing homes, or similar facilities.

III. Drawdown time

a. Shall drain completely within 120 hours after a 100-year storm event.

IV. Side slopes

a. Interior side slopes shall not be steeper than 3H:1V.

b. Pond walls may be vertical retaining walls, provided that:
   i. A fence is provided along the top of the wall for walls 2.5 feet or taller.
   ii. An 8-foot-wide access ramp to the pond bottom is provided, with slopes less than 4H:1V.
   iii. The design is by a professional engineer with structural expertise if the wall is 4 feet or more in height.

V. Emergency overflow spillway

a. Shall be analyzed as a broad crested trapezoidal weir.

b. Shall have the capacity to pass the 100-year developed peak flow.

c. The full width of the spillway shall be armored with riprap and extend downstream to where emergency overflows enter the conveyance system.
   i. The armoring may have 4 inches topsoil and grass cover.

d. Riprap shall extend just beyond the point that bank and streambed erosion occurs:
   i. If the facility is located on an embankment, the overflow spillway shall be armored to a minimum of 10 feet beyond the toe of the embankment.
   ii. The overflow path shall be identified on the construction plans and easements shall be provided as necessary.

e. Engineers may choose to design the detention pond multi-stage outflow structure with an emergency bypass that can route the 100-year storm through the structure and out of the pond directly into the conveyance channel. If the emergency bypass and downstream conveyance is adequately sized to convey the 100-yr storm event, an emergency overflow spillway is not required.

VI. Embankments

a. The height of an embankment is measured from the top of the berm to the catch point of the native soil at the lowest elevation.
Chapter 7 - Storm Sewer System

b. Embankments 4 feet or more in height shall be constructed as recommended by a geotechnical engineer. Depending upon the site, geotechnical recommendations may be necessary for lesser embankment heights.

c. Embankments shall be constructed on native consolidated soil, free of loose surface soil materials, fill, roots, and other organic debris or as recommended by the geotechnical engineer.

d. Energy dissipation and erosion control shall be provided to stabilize the berm and its overflow.

e. The embankment compaction shall produce a dense, low permeability engineered fill that can tolerate post-construction settlements with minimal cracking. The embankment fill shall be placed on a stable subgrade, placed in 6" lifts, and compacted to a minimum of 95% of the Modified Proctor Density (ASTM Procedure D1557).

f. Anti-seepage filter-drain diaphragms shall be considered on all outflow pipes and are required on outflow pipes when design water depths are 8 feet or greater.

g. In the event of a berm fracture or failure, the berm shall allow the passage of water through the berm without additional erosion or failure of the berm structure.

h. Embankments must be constructed by excavating a key.

i Key width shall equal 50 percent of the berm base width.

ii Key depth shall equal 50 percent of the berm height.

iii The berm top width shall be a minimum of 4 feet.

VII. Fencing

a. General:

i Required on:

A) Facilities with the first overflow at 4 or more feet above the pond bottom.

B) Facilities with retaining walls 2.5 feet high or taller.

C) Facilities located at, or adjacent to, schools, nursing homes, day cares, or similar facilities.

ii Fencing is not required for a typical infiltration swale. However, the City Engineer reserves the authority to require a fence along any swale or pond should there be a concern for safety.
Chapter 7 - Storm Sewer System

7.1.5H.VII.a.iii

iii At the discretion of the City Engineer, if a pond is proposed as an amenity, i.e., enhancements to the disposal facility are proposed, such as rocks, boulders, waterfalls, fountains, creative landscaping or plant materials, the design will be reviewed on a case-by-case basis, such that the fencing requirements may be reduced or waived.

iv The City Engineer reserves the authority to waive any and all fencing in commercial areas, as reviewed and accepted on a case-by-case basis.

b. Construction:

i Shall be at least 4 feet tall unless otherwise specified by the City Engineer.

ii Shall provide visual access.

iii Shall provide 12 feet wide locked gate(s) with 2 leaves.

VIII. Planting

a. Exposed earth on the pond bottom and interior side slopes shall be sodded, seeded, or vegetated in a timely manner, taking into account the current season.

b. Unless a dryland grass or other drought tolerant plant material is proposed, irrigation shall be provided.

c. All remaining areas of the tract or easement shall be sodded, planted with dryland grass, or landscaped.

d. Refer to Appendix F – Planting Guidelines.

IX. Landscaping

a. General:

i Landscaping and common use areas shall be integrated with the open drainage features and into the overall stormwater plan.

ii Landscaping and other uses shall be subservient to the primary stormwater needs and functions.

iii Landscaping shall not conflict with the collection, conveyance, treatment, storage, and/or disposal of stormwater.

iv Supplemental landscaping shall be grouped into irregular islands and borders outside of the immediate stormwater facilities and not uniformly dispersed throughout them.

v The constructed stormwater features should be irregular and curved in shape to look natural. Avoid straight lines and regular shapes where possible.
Trees and shrubs shall not be planted on pond liners due to potential leakage from root penetration.

Planting is restricted from berms that impound water either permanently or temporarily during storms.

Trees and shrubs shall not be planted within 10 feet of drainage appurtenances such as outlet control structures, manholes, catch basins, inlets and outlets, spillways, storm drain lines, and underground disposal structures such as drywells or drain-fields. The minimum spacing between the tree or shrub and the drainage structure shall be equal to the crown diameter of the mature plant.

Trees and shrubs shall not be planted within the treatment, storage, and conveyance zones of swales, ponds, or open channels, unless treatment and storage calculations take into account the mature tree size and allow runoff to reach the drainage facilities.

Self-limiting plants shall be used, not spreading or self-seeding types.

Full-size forest trees and trees with aggressive root systems should not be used except where space and circumstances allow. Deciduous trees with heavy shade and leaf-fall should also be avoided to allow the survival of the surrounding grass areas and not plug drainage facilities. Evergreens and smaller ornamental trees are normally better suited to urban conditions.

Shrubs should be upright in form and groundcovers should have neat growth patterns to assist in their maintenance and that of the surrounding grass areas.

The plant selection needs to consider the native soil conditions and altered moisture conditions created by the stormwater facilities. The plants need to be adaptable to the changes in site conditions. Plants that are self-sufficient and self-limiting do not require year-round irrigation and require minimal care are encouraged. Guidelines for plantings are listed in Appendix F – Planting Guidelines.

Floodplains

Floodplain requirements are administered by the City Planning Department. Contact the City Flood Plain Administrator (758-7732) for more information and specific requirements.
When any property is developed in or around identified Special Flood Hazard Areas, all work must conform to the requirements of the CK Flood Plain Management Ordinance.
Chapter 7- Storm Sewer System

7.1.5H.X.c.iA)

b. Wetlands

i  A wetland analysis is required for all new development and redevelopment. A wetland checklist (Appendix A – Checklist for Identifying Wetlands), is required to be completed and submitted with the drainage report. The Wetland checklist helps to identify if wetland resources may be present and further wetland assessment is required. If you check “yes” for any wetland indicators on the checklist, a Wetland Assessment outlined in the Kalispell Stormwater Quality Management Plan is required. The assessment must be performed by a wetland professional trained and familiar with the current US Army Corps of Engineers Regional Supplements for Wetland Delineations and the most recent Army Corps of Engineers guidance for Jurisdictional Determinations.

ii  Protection strategies have been developed to protect wetlands from changes to their hydrology, plant diversity, function and water quality. An on-site wetland assessment is required to determine the stormwater management classification for each wetland. Refer to Stormwater Quality Management Plan Chapter 3.4 for the procedure. The Stormwater Quality Management Plan can be obtained from the PWD.

iii  The protection standards and classifications acknowledge that wetlands demonstrate varying susceptibility to stormwater impacts. The standards for the closest downstream wetland will apply. Unless the wetland discharges into a lake, flow control standards shall apply to discharges leaving the overall site.

c. Closed Depressions

i  Closed depressions are natural low areas that hold a fixed volume of surface water. Depending upon soil characteristics, a closed depression may or may not accumulate surface water during wet periods of the year. Some closed depressions may be classified as wetlands. If so, the engineer shall comply with the wetland criteria specified in this section. Analysis of closed depressions shall include the following at a minimum:

A) Identification of the location of the closed depression on the pre-developed basin map.
Chapter 7- Storm Sewer System

B) A routing analysis of the drainage basins contributing to the closed depression to estimate the peak flow rates and volumes entering the closed depression in the pre-developed condition.

C) An estimation of the storage capacity of the closed depression for the 100-year storm event.

D) If the closed depression will be filled in, a facility shall be provided with capacity to store the 100-year 24-hour volume that was historically intercepted by the closed depression. This is in addition to the drainage facilities required for flow control and treatment due to the increase in stormwater runoff. The construction plans shall include a grading plan of any closed depression areas to be filled in. The grading plan shall show both existing and finish grade contours. The plans shall also specify compaction and fill material requirements.

E) Closed depressions have the same flow control requirement as infiltration facilities.

d. Regional Detention Ponds

i Regional Detention Ponds are located along major stormwater conveyances and natural drainage ways. Most regional facilities serve more than a single development within a given contributing drainage basin. Regional facilities have the potential to lessen flooding in existing drainage problem areas.

ii The CK has adopted the 2008 Stormwater Facility Plan Update with proposed locations for regional stormwater facilities and mapped natural drainage areas within the study area. The updated plan provides design data for drainage basins including basin delineations, drainage areas, and existing natural drainage ways. A quantitative analysis provides approximate pond storage volumes, allowable peak discharge flow rates and potential regional pond locations.

iii Project owners shall coordinate with the City Staff early in the planning process when the project site is in an area for which natural drainage ways and regional detention ponds are featured in the 2008 Stormwater Facility Plan Update.
7.1.6 BR-5 Conveyance

A. Channels:
   I. Analysis to be included in Design Report, when applicable:
      a. Identify all existing and proposed channels
      b. Calculations:
         i. Provide all assumptions, including:
            A) Design peak flow rate(s)
            B) Channel shape
            C) Slope
            D) Manning’s Coefficient
         ii. For each distinct channel segment, provide:
            A) Velocity
            B) Capacity
            C) Froude Number
            D) Channel Protection (if applicable):
               I) Riprap area, size, thickness, and gradation
               II) Filter blanket reinforcement area, type, and anchoring
            • Installation shall conform to manufacturer’s recommendations

   c. Exhibits:
      i. Plans and basin maps shall include:
         A) Centerline
         B) Direction of flow
         C) Stationing at angle points
         D) Froude Number
            I) At beginning and end of channels with significant grades
            II) Identify areas with hydraulic jumps
            III) Propose evenly spaced protective measures to ensure the jump does not erode the conveyance facility
Chapter 7 - Storm Sewer System

7.1.6A.i.d

d. Design Requirements

i) Designed to convey the 100-year design storm peak flow rate assuming developed conditions for on-site tributary areas and existing conditions for off-site tributary areas.

B) Minimum Slope:
   I) 1.0% for asphalt
   II) 0.5% for concrete, graded earth, or close-cropped grass

C) Location:
   I) Shall not be within or between residential lots smaller than 1 acre in size.
   II) Shall be within a drainage parcel.

D) Minimum Depth shall be 1.3 times the flow depth or 1 foot, whichever is greater.

E) Maximum Velocity:
   I) Shall not exceed velocities for “Clear Water” listed in Table 8-3 of Threshold Channel Design by the NRCS.
   II) Where only sparse vegetative cover can be established or maintained – 3 fps
   III) Where vegetative cover is established by seeding – 3 to 4 fps
   IV) Where dense sod can be developed quickly or where normal flow in the channel can be diverted until a vegetative cover is established – 4 to 5 fps
   V) On well-established sod of good quality – 5 to 6 fps

F) Sizing shall utilize Manning’s Formula

Riprap Protection at Outlets

i. If the velocity at a channel or culvert outlet exceeds the maximum permissible velocity for the soil or channel lining, channel protection is required.

ii. Riprap-lined channels are required to have filter fabric under the riprap.

iii. Riprap material shall be blocky in shape rather than elongated. The riprap stone shall have sharp, angular, clean edges.

iv. Riprap stone shall be reasonably well-graded and a minimum size of 6 inches.

**Apron Dimensions:** The length of an apron ($L_a$) is determined using the following empirical relationships that were developed for the U.S. Environmental Protection Agency (ASCE, 1992):

**Equation 2**

$$L_a = \frac{1.8Q}{D_o^2} + (7 + D_o); for \ TW < \frac{D_o}{2}$$

or

**Equation 3**

$$L_a = \frac{2.0Q}{D_o^2} + (7 + D_o); for \ TW \geq \frac{D_o}{2}$$

Where:

- $L_a$ = length of apron (feet)
- $D_o$ = maximum inside culvert width (feet)
- $Q$ = pipe discharge (cfs); and,
- $TW$ = tailwater depth (feet).

v. When there is no well-defined channel downstream of the apron, the width, $W$, of the apron outlet as shown in Figure 1, shall be calculated using Equation 4 or Equation 5.
When there is a well-defined channel downstream of the apron, the bottom width of the apron should be at least equal to the bottom width of the channel and the lining should extend at least 1 foot above the tailwater elevation. The width of the apron at a culvert outlet should be at least 3 times the culvert width.

Figure 1 - Riprap Revetment at Outfall Schematic

Equation 4

\[ W = 3 + D_o + (0.4 + \frac{L_a}{2}) \text{ for } TW \geq \frac{D_o}{2} \]

or

Equation 5

\[ W = 3 + D_o + L_a \text{ for } TW < \frac{D_o}{2} \]

Apartment Materials:

The median stone diameter, \( D_{50} \), is determined from the following equation:

Equation 6

\[ D_{50} = \frac{0.02 + 0.3}{D_o \cdot TW} \]

Where:

- \( D_{50} \) = the diameter of rock, for which 50% of the particles are finer.
The riprap should be reasonably well graded, within the following gradation parameters:

\[
1.25 \leq \frac{D_{\text{max}}}{D_{50}} \leq 1.50 \quad \text{and} \quad \frac{D_{15}}{D_{50}} = 0.5 \quad \text{and} \quad \frac{D_{\text{min}}}{D_{50}} \leq 0.25
\]

Where:

- \(D_{\text{max}}\) = the maximum particle size;
- \(D_{\text{min}}\) = the minimum particle size; and,
- \(D_{15}\) = the diameter of rock, for which 15% of the particles are finer.

Minimum Thickness: The minimum thickness of the riprap layer shall be 12 inches, \(D_{\text{max}}\) or \(1.5D_{50}\), whichever is greater.

Filter Blanket: A filter fabric blanket shall be placed under the riprap. See Detail DR.10 Riprap at Outlets for design and construction layout and dimensions.

B. Preservation of Natural Drainage Ways (NDW)

I. Introduction
   a. New development shall be designed to protect existing natural drainage features that convey or store water or allow it to infiltrate into the ground in its natural location. Preserving the NDW will help ensure that stormwater runoff can continue to be conveyed and disposed of at its natural location. Preservation will also increase the ability to use the predominant systems in conjunction with regional stormwater facilities.

   b. Projects located within the CK shall refer to the CK's 2008 Storm Water Facility Plan Update for specific details with regards to the location of NDW.

II. Definitions
Chapter 7 - Storm Sewer System

7.1.6B.II.a

a. The drainage ways that need to be preserved have been mapped and defined in the CK's 2008 Storm Water Facility Plan Update. Each natural drainage way shall be designed to pass the 100-year 24-hour storm event as described in the Plan Update. Because every site is unique, the City Engineer shall make interpretations, as necessary, based on site visits and technical information as to the exact location on a project site. The City Engineer may also require the project owner to provide engineering information to assist in this determination.

b. The maps denoting these drainage ways are not definitive; a computer program was used to identify the drainage ways. The maps are only one tool that may be used to identify existing natural drainage ways; field verification will typically be required to fully identify the existence of a drainage way and its significance with regard to a natural conveyance system.

c. All projects shall be reviewed for the presence of natural drainage ways mapped in the 2008 Stormwater Facility Plan, and a determination will be made as to their significance with regard to preservation of natural conveyance and potential use as part of a regional system.

III. Protection

a. No cuts or fills shall be allowed in predominant natural drainage ways except for perpendicular driveway or road crossings with engineering plans showing appropriately sized culverts or bridges. Natural drainage ways shall be preserved for stormwater conveyance in their existing location and state, and shall also be considered for use as regional facilities;

b. Less prominent drainage ways in a non-residential development and in a residential development containing lots 1 acre or smaller may be realigned within the development provided that the drainage way will enter and exit the site at the pre-developed location and that discharge will occur in the same manner as prior to development;

c. Realignment of a less prominent drainage way shall be defined as still following the "basic" flow path of the original drainage way. An acceptable example would be if the drainage way is proposed to be realigned such that it will follow a new road within the proposed development, and will be left in its existing state or utilized as part of the project’s on-site stormwater system.

d. Stormwater leaving the site in the same manner shall be defined as replicating the way the stormwater left the site in its existing condition. If the drainage way is preserved in its existing location and is left undisturbed, this goal should be met;
Chapter 7 - Storm Sewer System

7.1.6.C.I.c

If the City Engineer accepts the proposal to allow a less predominant drainage way to be routed through the site via a pipe or approved drainage material, the following additional criteria shall be met:

i. Where the less prominent drainage way enters the site, the design shall ensure that the entire drainage way is "captured" as it enters the site; i.e., the surrounding property shall not be regraded to "neck-down" the drainage way so that it fits into a drainage easement or tract or structure intended to capture and reroute the off-site stormwater runoff;

ii. Where the less prominent drainage way exits the site, the design shall ensure that the stormwater leaves the pipe, pond or structure a significant distance from the edge of the adjacent property so that by the time the stormwater reaches the property boundary, its dispersal shall mimic that of the pre-developed condition; and,

iii. Since some of the less prominent drainage ways may also be useful for managing regional stormwater, if identified as a significant drainage way, i.e., necessary conveyance for flood control, or being considered as a connection to a planned regional facility or conveyance route, then the drainage way may be subject to the same limitations and criteria as a predominant drainage way.

iv. The size of the tract or easement containing the drainage way shall be determined based on an analysis of the existing and proposed stormwater flows directed to these drainage systems and any access and maintenance requirements found in this manual; and,

v. All new development containing lots that are 1 acre or smaller shall be required to set aside the drainage way as open space in a separate parcel. For new development containing lots that are greater than 1 acre, the drainage way may be set aside in either a parcel or an easement.

C. Culverts

I. Analysis – When applicable provide the following as part of the Drainage Report:

a. Design peak flow rate (Qp)

b. Velocities at inlet and outlet

c. Flow control type
Chapter 7 - Storm Sewer System

7.1.6C.i.d

d. Design information
   i. Size
   ii. Slope
   iii. Length
   iv. Material
   v. Manning's coefficient

e. Headwater depths and water surface elevations at Qp

f. Roadway cross-section and roadway profile

g. Location and elevation information of culvert inverts

h. End Treatment

i. Wall thickness

II. Requirements

a. Shall be sized for peak flow rate with a minimum diameter of 12 inches.

b. Water surface for design storm shall not exceed the base course elevation of the roadway.

c. Shall convey the 100-year peak storm event without damage assuming developed conditions for the on-site basin and existing conditions for the off-site basin.

d. Headwater depth shall not exceed:
   i. 2 times the culvert diameter for culverts 18 inches in diameter or less
   ii. 1.5 times the culvert diameter for culverts larger than 18 inches

e. Flows shall maintain a minimum velocity of 2.5 feet per second.

f. Culvert slopes shall be a minimum of 0.5% and shall remain constant.
   i. If a vertical deflection is required for culvert extensions, a manhole shall be provided at the deflection point to facilitate maintenance. Culvert extensions shall be approved by the CK.
   ii. For grades greater than or equal to 20%, anchors are required unless calculations or the manufacturer's recommendations show that they are not necessary.

g. Outfalls shall conform to all federal, state, and local regulations. Erosion control shall be provided at outfalls. See section 7.1.6D.II.g for more information.
Chapter 7- Storm Sewer System

h. Minimum pipe cover of 2 feet shall be maintained or as required by manufacturer recommendations, whichever is greater. Cover shall be measured from the top of the pipe to the bottom of the pavement.

i. Maximum pipe cover shall be in accordance with manufacturer recommendations.

j. End Treatments
   i. Projecting ends shall not be allowed.
   ii. Beveled ends shall not be used on culverts 6 foot in diameter or less.
   iii. Flared ends
       A) Shall not be allowed within the clear zone
       B) Shall only be used on circular or arch pipe
   iv. Headwalls
       A) For culverts 6 to 10 feet in diameter.

v. Wingwalls and Aprons
   A) For reinforced concrete box culverts.

D. Storm Drain System

I. Analysis - When applicable provide the following as part of the Drainage Report:
   a. Basin map showing on-site and off-site basins contributing runoff to each inlet and includes a plan view of the location of the conveyance system.
   b. Design information for each pipe run:
       i. Design peak flow rate
       ii. Velocity at design peak flow
       iii. Hydraulic grade line (HGL) at each inlet, angle point, and outlet
       iv. Size
       v. Slope
       vi. Length
       vii. Material
       viii. Manning’s coefficient
       ix. Minimum depth from finish grade to pipe invert
Chapter 7- Storm Sewer System

II. Requirements:
   a. Pipe Size
      i. Shall be sized to handle the 10-year 24-hour design peak flow rates with a minimum diameter of 12 inches.
      ii. No segment shall have a diameter smaller than the upstream segment.
   b. Provide 0.5 feet of freeboard between the HGL in a structure and the top of grate or cover.
   c. Velocity
      i. Minimum velocity of 2.5 fps under full flow conditions.
      ii. Maximum velocity of 10 fps under full flow conditions.
   d. Length:
      i. No greater than 400 feet between structures.
   e. For grades greater than or equal to 20%, anchors are required unless calculations or the manufacturer's recommendations show that they are not necessary. Pipe anchor locations shall be defined on the plans, and a detail provided.
   f. Location:
      i. No closer than 5 feet to front, side, or rear property lines.
      ii. Shall maintain a 3 foot offset from toe of curb and gutter.
      iii. Shall not be located in the street boulevard.
   g. Outfalls:
      i. Shall be placed in same alignment (flow direction) and grade as the drainage way.
      ii. Shall conform to the requirements of federal, states, and local regulations.
      iii. Shall incorporate erosion control features.
      iv. Shall be placed on the downstream side of culvert crossings.
   h. Cover:
      i. Shall meet minimum cover requirements for AASHTO HS-20 loading criteria as recommended by manufacturer. Cover shall be measured from the top of pipe to the bottom of pavement.
Chapter 7 - Storm Sewer System

i. Junctions:
   i. Downstream pipe invert shall be placed 0.1 feet below the upstream pipe invert.
   ii. If pipes of different size are joined at a junction, the pipe crowns shall be placed at the same elevation.

j. Combined sanitary and storm sewer systems are prohibited.

E. Gutters

I. Analysis – When applicable, provide the following as part of the Drainage Report:
   a. Gutter flow spread and non-flooded road width
      i. Evaluate at low points and intersections
      ii. Utilize Equation 4-2 for flow rate and spread from HEC-22.
   b. Max flow depth
      i. Evaluate at low points and intersections
      ii. Utilize Equation 4-3 for flow depth from HEC-22.

II. Requirements:
   a. Shall be designed to allow for the passage of traffic during the 10-year design storm event by providing non-flooded zones.
   b. Slope:
      i. Minimum longitudinal = 0.5%.
   c. Non-Flooded Road Width
      i. Shall be in accordance with Table 6.

<table>
<thead>
<tr>
<th>Road Classification</th>
<th>Non-Flooded Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Road</td>
<td>12 feet</td>
</tr>
<tr>
<td>Local Street</td>
<td>12 feet</td>
</tr>
<tr>
<td>Collector (2 Lane)</td>
<td>16 feet</td>
</tr>
<tr>
<td>Arterials</td>
<td>Per City Engineer</td>
</tr>
<tr>
<td>Other Road Types</td>
<td>Per City Engineer</td>
</tr>
</tbody>
</table>

d. Flow Depth
   i. Shall not exceed curb height.

Chapter 7- Storm Sewer System

7.1.6F

F. Drainage Inlets:

I. Analysis – When applicable, provide the following as part of the Drainage Report
   a. Inlet Capacity
      i. Provide capacity of each inlet
      ii. Use 35% clogging factor on grates (to approximate debris)
          A) Apply to open area of grate.
      iii. Use HEC-22¹ for inlet flow calculations
   b. Bypass flow
      i. Calculate at all inlets
      ii. Less than 0.1 cfs at intersections and project boundary.

II. Requirements:

   a. Spacing
      i. Maximum of 400 feet regardless of flooded width and flow depth
      ii. First inlet within 600 feet of point where gutter flow originates
      iii. Additional inlets as required to maintain non-flooded road width and max depth.
      iv. Pipe runs shall not exceed 400 feet.
      v. Inlets on grade shall have a minimum spacing of 20 feet to enable bypass water to reestablish its flow against the face of the curb.
   b. Location
      i. Shall be located at intersections to prevent flow from crossing the intersection.
      ii. Shall not be located at an ADA ramp.
      iii. Shall not be located on the curved portion of a curb return.
   c. Grates
      i. Shall be depressed to ensure satisfactory operation; the maximum depression is 1 inch.
      ii. Non-standard grates with larger openings may be used for additional capacity with approval of the City Engineer.

Chapter 7- Storm Sewer System

7.1.7B.1.g

Concrete Aprons

i. Shall be used at all open grate manholes, catch basins, and curb inlets. Aprons shall slope toward the grate as shown in the Standard Details.

ii. A minimum of a 2-foot apron shall be used with inlets when no curb and gutter is present.

G. Structures:

I. Requirements:

a. Shall be placed at all breaks in grade, pipe type changes, diameter changes, and alignment changes.

b. Shall have a 24-inch sump below the lowest pipe invert elevation.

c. Catch basin / drainage inlet combinations shall be used in all public and private roads.

d. Shall be designed to support HS-20 loadings.

7.1.7 BR-6 Erosion and Sediment Control

A. CK Stormwater Management Permit

I. Required when:

a. More than 5 cubic yards of material will be disturbed, stored, disposed of, or used as fill.

b. An activity will disturb more than 1,000 square feet of area.

c. Less than an acre - $10

B. Comply with CK Ordinance 1600

I. Greater than an acre:

a. Develop a Stormwater Pollution Prevention Plan – (SWPPP)

b. Review and submit a Notice of Intent (NOI)

c. Provide the NOI, SWPPP, and approval letter to the CK.

d. Apply for CK Stormwater Management Permit a minimum of 5 days prior to construction ($45).

e. Post a copy of the NOI and SWPPP at the construction site until project completion.

f. Implement the SWPPP prior to any land disturbance.

g. Inspect and maintain BMPs outlined in MTR100000.

References:

Chapter 7 - Storm Sewer System

h. At completion, submit a Notice of Termination (NOT).

II. Less than an acre:
   a. Complete CK Stormwater Management Plan checklist
   b. Provide a narrative of how BMPs will be implemented
   c. Apply for CK Stormwater Management Permit a minimum of 5 days prior to construction ($10).

C. Maintenance Responsibility
   I. The property owner or owner’s agent is responsible to ensure BMPs are used, maintained, and repaired to verify compliance with performance standards.
   II. After all land-disturbing activities are complete and the site has been permanently stabilized, maintenance and the prevention of erosion and sedimentation is the responsibility of the property owner.

D. Inspections and Records
   I. Site Inspections
      a. Permittee shall perform a site inspection every 14 days and after major storm events to ensure all BMPs are constructed and functioning correctly.
      b. Inspections shall be documented in written form, kept on the project site, and made available for review by the CK.

E. Enforcement
   I. See Section 9 of CK Ordinance 1600.

F. Construction Best Management Practices (BMPs)
   I. Refer to:
      a. Erosion and Sediment Control BMP Manual (January 2015) - MDT
      b. Storm Water Management During Construction Field Guide for BMPs - MDEQ

7.1.8 BR-7 Operation and Maintenance (O&M)
A. Responsibilities:
   I. Stormwater structures and conveyance within the CK right-of-way shall be maintained by the CK.

2 http://www.kalispell.com/DocumentCenter/View/1025/Ordinance-1600-PDF
4 https://deq.mt.gov/Portals/112/Water/MPDES/pdfs/montfieldguide.revised4-4-14.pdf
II. The project owner (property owner) shall provide for the perpetual maintenance of all stormwater elements located outside of the right-of-way.

III. High-frequency maintenance of vegetated cover, turf grass, and other landscaping inside the CK right-of-way and within easements that accommodate CK road runoff is the responsibility of the adjacent property owner, Home Owners Association (HOA), or Property Owners Association (POA).

B. HOAs and POAs Requirements
   I. For privately maintained stormwater systems in residential neighborhoods or commercial areas with multiple lot owners, an HOA or POA shall be formed to maintain the facilities located outside the CK right-of-way.
   II. A draft copy of the HOA CC&Rs, or POA Reciprocal Agreement shall be submitted as part of the Drainage Submittal review package. The CC&Rs or Reciprocal Agreement shall:
      a. Summarize the maintenance responsibilities
      b. Summarize the fiscal responsibilities
      c. Reference the O&M Manual
   III. HOAs and POAs are to be non-profit. A standard business license is not acceptable for this purpose.

C. O&M Manual
   I. Requirements:
      a. An O&M Manual is required for all projects meeting the regulatory threshold.
   II. Minimum Content:
      a. Description of the entity responsible for the perpetual maintenance of all facilities associated with the stormwater system, including legal means of successorship;
      b. A list of contact names, phone numbers, and addresses of the entities responsible for the perpetual maintenance of all facilities associated with the stormwater system;
      c. Description of maintenance tasks to be performed and their frequency;
      d. An inspection list to be used for the annual inspections (See Appendix H2 – Facility Inspection Checklist);
      e. A list of the expected design life and replacement schedule of each component of the stormwater system; and
Chapter 7 - Storm Sewer System

7.1.8.C.II.f

f. A general site plan (drawn to scale) showing the overall layout of the site, all the facilities associated with the stormwater system, and their elevations.

D. Maintenance Agreement Permit & Waiver of Protest for SID

I. Requirements:

a. The Stormwater Maintenance Permit Application shall be completed prior to project approval.

b. Annual inspections and 5-yr permit renewals are required.

c. A signed copy of the Maintenance Agreement Waiver to Protest the Formation and Participation in a Special Improvement District shall be submitted as part of the Drainage Submittal (see Appendix H3 – Example Maintenance Agreement to Protest SID).

d. The agreement shall be recorded in the office of the Clerk and Recorder for Flathead County, Montana.

E. Financial Plan

I. Requirements:

a. The financial plan shall be submitted as part of the Drainage Submittal.

b. List all stormwater-related facilities and their expected date of replacement and associated costs;

c. Sinking fund calculations which take into consideration the probable inflation over the life of the infrastructure and estimates the funds that need to be set aside annually;

d. A mechanism for initiating and sustaining the sinking fund account demonstrating that perpetual maintenance of all facilities associated with the stormwater system will be sustained.

F. Failure to Maintain

I. If the required maintenance and repairs are not being performed and inhibit the intended function of the stormwater system, the CK may hire a contractor to perform the required maintenance and bill the HOA, POA, or responsible property owner.

Chapter 7- Storm Sewer System

7.1.9A.I.d

II. In the event that the HOA, POA, or responsible property owner fail to perform the required maintenance and repairs to the stormwater facility and inhibit the intended function of the stormwater system, a stormwater maintenance district program may be formed in accordance with § 7-12-4102 MCA1 incorporating all the lots within a development. The taxes levied within the maintenance district shall be determined by the PWD with approval by the Kalispell City Council.

G. Maintenance Access Requirements

I. Private Access
   a. Required when the stormwater facilities/structures are located 8 feet or more from an all-weather drivable surface.
   b. Horizontal alignment shall accommodate a Single-Unit Truck.2
   c. 12-foot-wide, all-weather drivable surface:
      i. Concrete;
      ii. Asphalt;
      iii. Gravel;
      iv. Reinforced turf (Grasspave 2 by invisible structures, or approved equal).

II. CK Access
   a. Recommended for all accesses, but required for CK maintained facilities.
   b. Provide all items in section I above, and
   c. Turn around required when:
      i. Road is longer than 150 feet.
      ii. Long, winding, or steep conditions where backing would be difficult.

7.1.9 Parcels and Easements

A. Parcels
   I. Required for:
      a. Facilities that serve more than one commercial parcel or ownership.
      b. Flow control and treatment facilities.
      c. Facilities associated with a stormwater system serving a residential development located outside of the public right-of-way.
      d. Drainage ditches located in residential neighborhoods.

1 http://leg.mt.gov/bills/mca/7/12/7-12-4102.htm
2 AASHTO Geometric Design of Highways and Streets
II. Parcel limits may have to be delineated with a permanent fence when located near property lines or a natural drainage way.

B. On-Site Easements
   I. Shall grant rights for access, maintenance, operation, inspection, and repair to the entity in charge of the maintenance and operation of the stormwater system.
   II. Shall grant the CK the right for ingress/egress over the easement for inspection, maintenance, or repair.
   III. Shall be drafted by the project owner for review by the City Engineer and recorded by the project owner.
   IV. If not in a parcel, stormwater elements outside of the public right-of-way shall be placed in drainage easements.

V. For Pipe and Appurtenances:
   a. Shall be wide enough to allow construction of all improvements, including site disturbances, and access to maintain, repair, or replace the pipe and appurtenances without damage to adjacent structures or incurring costs for shoring or special equipment.
      i. Minimum width of 20 feet.
   b. Storm drain shall be centered in the easement 7 feet from either edge of easement.
   c. Shall not straddle property lines.
   d. Shall be offset a minimum of 5 feet from sidewalk.
   e. No storm pipe in a drainage easement shall have its centerline closer than 5 feet to a private rear or side property line.

VI. For ditches and natural drainage ways:
   a. Shall be wide enough to contain the runoff from a 100-yr 24-hr storm event for the contributing stormwater basin.
   b. Shall not straddle property lines.

VII. For access roads and turnarounds:
   a. Shall be a minimum of 20 feet wide.

C. Off-Site Easements
   I. Shall be recorded separately from plat documents, with the clerk and recorder's reception number placed on the face of the plat.
   II. Shall grant the CK the right for ingress/egress over the easement for inspection, maintenance, or repair.
   III. The following shall be submitted to the City Engineer for review and approval:
      a. A legal description of the site stamped and signed by a surveyor;
Chapter 7 - Storm Sewer System

7.2.3 Culverts and Storm Main

A. Corrugated Metal Pipe (CMP)
   I. Shall be rubber gasketed and securely banded
B. Polyvinyl Chloride (PVC)
   I. Pipe shall be installed following procedures outlined in ASTM D2321
   II. Joints shall conform to ASTM D3212, and gasket shall conform to ASTM F477
   III. Pipe must be a minimum of SDR 35 or a constant stiffness thermoplastic pipe and meet the requirements of ASTM D3034 or ASTM F949, respectively.
C. Ductile Iron (DI)
   I. Joints shall be flanged, bell and spigot, or restrained mechanical joint.

2 http://www.kalispell.com/DocumentCenter/View/482/Special-Provision-02720-PDF
D. Reinforced Concrete Pipe (RCP)
   I. Joints shall be rubber gasketed.
E. High Density Polyethylene (HDPE)
   I. Pipes shall have a smooth interior and annular exterior corrugations
   II. Joints shall be watertight according to ASTM D3212. Gaskets shall meet
       ASTM F477
   III. Corrugated couplings shall be split collar, engaging at least 2 full
        corrugations.
   IV. ADS N-12 smooth interior or approved equal.
F. High Density Polypropylene (HDPP)
   I. Pipes shall have a smooth interior and annular exterior corrugations
       meeting ASTM F2736 (12-30") or ASTM F2881 (36" – 60"), and AASHTO
       MP-21.
   II. Joints shall include a gasketed integral bell and spigot joint meeting the
        requirements of ASTM F2736 or ASTM F2881, for the respective
        diameters.
   III. Corrugated couplings shall be split collar, engaging at least 2 full
        corrugations.

7.2.4 Structures
A. Shall be as shown in Standard Details.
B. Open grates shall only be used in paved areas.

7.2.5 Pipe Bedding
A. Shall be placed in accordance with CK detail G.1.
B. Shall be haunched under pipe with shovel.
C. Shall be a clean sand meeting USCS classification SW, or a Class 1 material as
   defined in ASTM D 2321 with a max particle size of ¾-inch and meeting the
   migration requirements of the same standard (Section X.1.8).
Chapter 8 Transportation System

8.1. DESIGN STANDARDS

8.1.1 General

A. Roadway systems, including private roadways, shall be designed in accordance with the current edition of the Standards (this document), the current Manual on Uniform Traffic Control Devices\(^1\), the current Kalispell Area Transportation Plan\(^2\), and the CK Subdivision Regulations\(^3\). Any conflicts or differences in these documents shall be resolved in favor of the Standards.

B. All roads within a proposed subdivision shall be designed by a professional engineer and approved by the City Engineer.

8.1.2 Traffic Impact Study (TIS)

A. Required for developments contributing 300 or more vehicle trips per day to the CK street system per the City Engineer’s analysis of the ITE Trip Generation Manual.

B. Shall be prepared and stamped by a professional engineer with a Professional Traffic Operation Engineer (PTOE) certification.

C. The development shall maintain or improve the existing LOS of the affected roadways.

D. Complete in accordance with MDT requirements and nationally accepted standards.

E. Contents:

   I. The study’s purpose and goals.
   II. A description of the site and study area.
   III. Existing traffic conditions:

   a. Roadway geometries
   b. LOS of each intersection
   c. Traffic counts
   d. Crash analysis
   e. Road capacity analysis

   IV. Anticipated nearby land developments and transportation improvements.
   V. Analysis and discussion of trip generation, distribution, and modal splits.
   VI. The traffic assignment resulting from the proposed development.

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\(^3\) http://kalispell.com/DocumentCenter/View/503/Kalispell-Subdivision-Regulations-PDF

Click to Return to Index
Chapter 8 - Transportation System

8.1.2E.VII

VII. The projection and assignment of future traffic volumes.

VIII. Identify all negative impacts associated with the proposed development including LOS impacts.

IX. Thoroughly detail a mitigation plan for the negative impacts based on nationally accepted standards and resources.

X. Recommendations for off-site improvements to the primary access and related transportation facilities and infrastructure which are directly attributable to the development.

XI. Account for other forms of transportation, including bicycle and pedestrian.

F. Study limits shall be determined by City Engineer.

8.1.3 Intersections

A. Design in accordance with the current version of AASHTO A Policy on Geometric Design of Highways and Streets (AKA AASHTO Green Book).

B. Streets shall intersect at 90° angles, if topography permits, but in no case shall the angle of the intersection be less than 75° for a minimum distance of 60 feet as measured along the centerline, from the right-of-way line at the intersecting street.

C. No more than two streets may intersect at one point.

D. Two streets meeting a third street from opposite sides shall meet at the same point, or their centerlines shall be offset at least 125 feet for local roads and 300 feet for collectors.

E. Intersections of local streets with arterials shall be kept to a minimum.

F. Maximum straight tangent grade of approach to any intersection shall not exceed 2% for a distance of 60 feet as measure from edge of transverse pavement to provide for adequate starting, stopping, and stacking distances.

G. The minimum back of curb radii at street intersections shall meet requirements shown in the standard drawings for street classification.

H. ADA ramps shall be provided on all legs of T-intersections.

8.1.4 Dead-end Streets

A. Dead-end streets shall meet the requirements of Section 28.3.14 of the Subdivision Regulations.

B. Cul-de-sacs shall include a minimum 6-foot boulevard and 5-foot sidewalk.

C. Temporary dead-end streets shall be approved by the Fire Chief and City Engineer.

1 http://kalispell.com/DocumentCenter/View/503/Kalispell-Subdivision-Regulations-PDF
8.1.5 Sight Distance
A. Shall be determined by design speed as required by the AASHTO Green Book.
B. A minimum of 200-feet is required for all horizontal and vertical curves.

8.1.6 Collector and Arterial Streets
A. Location shall comply with the Kalispell Growth Policy¹, the current Area Transportation Plan², or any other major street and highway plan as adopted by the CK.
B. The development of frontage roads or shared accesses serving new developments shall be used along collectors and arterials rather than the use of individual driveways or approaches.

Table 7 - Road Design Standards for Local Subdivision Streets

<table>
<thead>
<tr>
<th>DESIGN STANDARDS</th>
<th>ARTERIAL</th>
<th>COLLECTOR</th>
<th>LOCAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Right-of-Way</td>
<td>80 ft</td>
<td>60 ft.</td>
<td>60 ft</td>
</tr>
<tr>
<td>Pavement Width</td>
<td>As approved by City Engineer</td>
<td>34 ft.³</td>
<td>28 ft.³</td>
</tr>
<tr>
<td>Maximum Grade</td>
<td>8%</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Design Speed</td>
<td>As approved by City Engineer</td>
<td>35 mph</td>
<td>25 mph</td>
</tr>
<tr>
<td>Crest minimum k-value</td>
<td>Based on Design Speed (DS)</td>
<td>Based on DS</td>
<td>12</td>
</tr>
<tr>
<td>Sag minimum k-value</td>
<td>Based on DS</td>
<td>Based on DS</td>
<td>26</td>
</tr>
<tr>
<td>Crest Vertical Curve Length</td>
<td>Based on DS</td>
<td>Based on DS</td>
<td>75 ft (min)</td>
</tr>
<tr>
<td>Sag Vertical Curve Length</td>
<td>Based on DS</td>
<td>Based on DS</td>
<td>75 ft (min)</td>
</tr>
</tbody>
</table>

Cul-de-sac turnaround:

a. Minimum back of curb radius | 47 ft |
b. Minimum right-of-way radius | 58 ft |
c. Maximum length⁴ | 600 ft |

8.1.7 Traffic Control Signs, Street Name Signs and Street Names
A. General
   I. The developer shall provide and install necessary Traffic Control Signs in

³ On street parking governed by City of Kalispell Subdivision Regulations.
⁴ Measured from the centerline of the intersection to the center point of the cul-de-sac.
accordance with the MUTCD.

II. Road Name Signs shall be installed at each intersection.

III. New roads shall be assigned a road name when roads exceed 300 feet in length, or serve 3 or more properties. Alleys shall not be considered roads for consideration of road names.

IV. All proposed road names shall be submitted to the PWD for approval prior to preliminary plat submittal.

V. A road naming assignment by the City to any road shall not constitute or imply jurisdiction, ownership, right of use, guarantee of access, or acceptance into the City road maintenance program. Private roads shall be designated by a PVT suffix to the road name.

B. Road Geometric Guidelines

I. A road shall be essentially continuous, without gaps.

II. If a road has a branch or branches, separate names shall be used for the minor branch(es).

III. Each road shall have the same name throughout its entire length, except that a road name may change when, and only when, there is a substantial intersection or at municipal boundaries.

C. Road Name Guidelines

I. A proposed new road name which duplicates an existing or reserved road name (singular or plural form) in the City of Kalispell or Flathead County shall not be approved.

II. Road names are limited to three words not including the road name suffix.

III. A road name shall not exceed more than 20 characters including spaces and the road name suffix abbreviation.

IV. A new road name shall not include numeric numbers, dashes, apostrophes, or other non-alphabetic characters.

V. Because North, South, East and West are directional features of the addressing system and lead to confusing addresses if included as part of the name, cardinal directions shall not be part of any road name (e.g. Westview Road or Southpoint Dr. shall not be acceptable as new road names).

VI. Articles (the, a, an) shall not be used to begin road names.

VII. Road names cannot contain initials, abbreviations, or single-letters.

VIII. No road name shall be approved which begins with a word that appears as the first word in five or more official road names within Flathead County.

IX. Road names shall not include obscene, racial, or derogatory terms.
The primary name portion of a road shall not be abbreviated (e.g. Mount Charles Dr. not Mt. Charles Dr.)

Where a proposed road is a continuation of, or in alignment with, an approved road, it shall utilize the same road name as the approved road. A new road name shall be required if the proposed road is disconnected from the centerline of the existing road by an offset greater than 60 feet.

Road names should be consistent and singular for any particular road. The road name adopted by the City of Kalispell for roads within its jurisdiction shall be the officially recognized road name.

The use of road name suffixes shall be consistent with the Flathead County Road Naming and Site Addressing Resolution.

**Sidewalks:**

A. All developments shall have sidewalks which will allow pedestrians to safely travel from any part of the development to the boundaries of the development.

B. Developments abutting existing or proposed roadways will be required to have sidewalks within the public right-of-way and parallel to the roadways.

C. The minimum width of a sidewalk shall be 5 feet in City right-of-way and 8 feet in state right-of-way.

D. Sidewalks are required on both sides of the street in all subdivisions.

E. Sidewalks shall be separated from the street by a 6-foot wide boulevard for collectors or 9-foot wide boulevard for local streets.

**Boulevard/Open Space:**

A. Boulevard/open space shall be landscaped in accordance with the CK Tree Ordinance with a plan approved by the Kalispell Parks and Recreation Department (758-7718).

**Multiple Use Paths:**

A. Non-motorized use paths shall be designed with a 20 mph design speed and in accordance with the most recent version of AASHTO’s “Guide for the Development of Bicycle Facilities” and “Guide for the Planning, Design and Operation of Pedestrian Facilities”.

B. Paths shall be a minimum of 10 feet wide.

C. In limited instances, the PWD Director may require the path to be built to accommodate HS-20 loading if the path serves as an emergency or maintenance access route.

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Chapter 8- Transportation System

8.1.10D

D. No catch basins, valve boxes, curb boxes, or other utility appurtenances shall be located within the travel route of a path.

E. Path signage shall conform to the most current MUTCD.

F. In subdivisions, required paths shall be located within common areas owned and maintained by the property owners’ association.

G. The surfacing section required on paths shall be:
   L. 3 inches of asphalt on 8 inches of 3/4 inch minus crushed rock base compacted to 95% max dry density; or
   G.II. 4 inches of concrete on 6 inches of 3/4 inch minus crushed base compacted to 95% max dry density.

H. Landings and ramps shall be constructed of concrete meeting sidewalk standards.

8.1.11 On-Street Parking:

A. At intersections:
   I. Shall be outside of the clear sight triangle as detailed in Standard Details.
   II. The City Engineer reserves the right to increase clear sight triangles based on site specific conditions.

B. Along streets:
   I. Shall not be permitted on:
      a. Arterials
      b. Collectors less than 34 feet in width as measured from edge of asphalt to edge of asphalt.
      c. Local streets less than 28 feet in width as measured from edge of asphalt to edge of asphalt.
      d. Any street with a rural road section.
      e. Streets not meeting sight distance per Section 8.1.5.

C. Road classifications shall be defined as Principal Arterial, Minor Arterial, Collector Street, and Local Street as determined by the following:
   I. The most recent Transportation Plan as adopted by City Council of the City of Kalispell; and
   II. Transportation Impact Studies completed by a PTOE licensed in the State of Montana, reviewed and approved by the City Engineer; and
   III. Transportation analyses performed by Public Works Professional Engineering Staff, reviewed, and approved by the City Engineer.
Chapter 8- Transportation System

D. On-street parking analyses shall be performed by Public Works Professional Engineering staff or a PTOE licensed in the State of Montana, and shall be approved by the City Engineer. Parking restrictions considered in an on-street parking analysis may include:

I. No parking any time;
II. No parking during specified times; and/or
III. No parking on one side of the street.

E. On-street parking minimum standards shall be based on street classification, road width, and geometry as hereby described:

I. Principal Arterials:
   a. For streets outside of the jurisdiction of the City of Kalispell, on-street parking shall be allowed as determined by the appropriate jurisdiction; and
   b. For City of Kalispell streets, on-street parking standards shall be the same as Minor Arterials.

II. Minor Arterials:
   a. On-street parking shall not be allowed unless an on-street parking analysis is completed, recommended by the City Engineer, and approved by the Police Chief, Fire Chief, Public Works Director, and City Manager.

III. Collector Streets:
   a. On-street parking shall not be approved on collector streets with any of the following findings:
      i. Cross section:
         A) Is a rural street (no curbing); or
         B) A face of curb to face of curb width less than thirty-three feet; or
      ii. Geometry:
         A) Sight distances below those required by the current version of the City of Kalispell Design and Construction Standards.
   b. On-street parking may be approved on one side of the street when an on-street parking analysis determines the findings of part a above are not met, and:
      i. Cross section:
         A) The face of curb to face of curb width is less than forty-two feet; and
         B) Parking would not encroach into a travel lane.
c. On-street parking may be approved on both sides of the street when an on-street parking analysis determines the findings of parts a and b above are not met, and:
   i. Cross section:
      A) The face of curb to face of curb width is greater than or equal to forty-two feet.

F. Local Streets:
   I. On-street parking shall not be approved on local streets with any of the following findings:
      a. Cross section:
         i. The pavement width is less than twenty-four feet; or
      b. Geometry:
         i. Sight distances below those required by the current version of the City of Kalispell Design and Construction Standards.
   II. On-street parking may be approved on one side of the street when an on-street parking analysis determines the findings of part I above are not met, and:
      a. Cross section:
         i. The pavement width is less than twenty-eight feet.
   III. On-street parking may be approved on both sides of the street when an on-street parking analysis determines the findings of parts I and II above are not met, and:
      a. Cross section:
         i. The pavement width is greater than or equal to twenty-eight feet.

G. Intersections:
   I. On-street parking shall not be approved:
      a. Within the eighty-foot clear vision triangle for speeds at or below 25 miles per hour unless otherwise indicated by an engineering analysis approved by the City Engineer; or
      b. Within the clear sight triangle for speeds above 25 miles per hour as defined by the most current version of AASHTO – A Policy on the Geometric Design of Highways and Streets, unless otherwise indicated by an engineering analysis approved by the City Engineer.

8.1.12 Driveways:
   A. The nearest edge of any driveway shall be not less than 35 feet from the edge of the pavement to the nearest intersecting street.
Chapter 8 - Transportation System

B. All new driveway locations and modifications to existing driveways shall be reviewed and approved by the PWD (per the Application for Driveway Construction) prior to beginning construction.

C. All driveways shall be constructed per standard drawings ST.11 to ST.15.

D. Maximum driveway widths shall be as follows:
   I. Single family residential: 20-feet
   II. Duplex and multi-family residential: 24-feet
   C. Commercial: 40-feet

8.1.13 Placement of Utilities:
   A. See Section 4.1.2.
   B. All applicable laws, rules and regulations of appropriate regulatory authority having jurisdiction over utilities shall be observed.

8.1.14 Street Lighting
   A. General:
      I. All new streets and subdivisions shall adhere to these standards.
         a. All street lighting shall be designed to Flathead Electric Cooperative’s (FEC) standards (See Table 8), unless the light assemblies are owned and maintained by an entity other than the City of Kalispell, (See Table 9).
      II. All light fixtures shall be full cut off as defined by the Illuminating Engineering Society of North America (IES).
      III. All lighting layouts must be approved by the PWD.
      IV. Light fixtures are required at all intersections, mailbox groups, and pedestrian bus stop locations.
   B. Lighting:
      I. Intersections:
         a. All streets shall have lighting on at least one corner of the intersection. If the street is four or more total lanes, two lights are required at diagonally opposite corners, or sufficient fixtures to provide minimum foot candle levels.
      II. Streets
         a. Street lights shall be in accordance with the following tables and text.

Table 8 - FEC’s Standards

<table>
<thead>
<tr>
<th>Classification</th>
<th>Fixture Type and pole</th>
<th>Lamp wattage and Type</th>
<th>Spacing</th>
</tr>
</thead>
</table>

105
Chapter 8 - Transportation System

<table>
<thead>
<tr>
<th>Classification</th>
<th>Average Illuminance[^1] (foot candles)</th>
<th>Illuminance Uniformity[^1] Ave/Min</th>
<th>Pole Height (ft)</th>
<th>Max lamp Wattage/type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Commercial[^2]</td>
<td>0.6</td>
<td>6 / 1</td>
<td>20-30</td>
<td>80W LED</td>
</tr>
<tr>
<td>Local Residential</td>
<td>0.3</td>
<td>6 / 1</td>
<td>15-30</td>
<td>40W LED</td>
</tr>
</tbody>
</table>

[^1]: Average Illuminance and Illuminance Uniformity are measured in foot candles and are average values and minimum values, respectively.

b. Light placement can vary from table spacing by a maximum of 15% with approval from the PWD.

c. All streets shall be illuminated from both sides of the street.

   - When streets contain less than four total lanes, lights on one side shall be offset from the other side by the spacing criteria.
   - When streets have four or more total lanes, lights on one side shall be offset from the other side by half the spacing criteria.

d. If the road has sharp bends, lighting design must meet the average illuminance and illuminance uniformity criteria established in Table 9.

e. For street lighting applications that do not conform to FEC’s LED cobra head style standards, i.e., developer owned decorative fixtures in a subdivision; a sidewalk photometric plan must be submitted with light placement that meets the criteria shown in Table 9.

f. Exceptions allowed if approved by the PWD.

Table 9 - Owner Metered/Maintained

III. Pedestrian Gathering Areas:

---

1 Commercial as designated by the City of Kalispell.
2 Value to be measured on the sidewalk.
3 Value to be measured on the sidewalk.
Chapter 8- Transportation System

8.2.2A.I

a. At all mailbox groups, bus stops, and pedestrian pathway intersections with streets, a light fixture is required to indicate the location of this area.

C. Submittals:
   I. Street lighting plans shall be submitted to the PWD for approval at the same time as the street plans.
   II. For all designs, submit design layout for placement of light fixtures.
      a. For designs following the criteria established in Table 9, provide the following for approval:
      b. Photometric plan with iso-illuminance lines indicating appropriate foot-candle levels.
      c. On photometric plans, provide a table indicating average foot candles, ave/min ratios, and max to min ratios for roadways, sidewalks, and pedestrian intersections.

8.1.15 Traffic Calming Devices
   A. Shall be recommended by a traffic study completed by a PTOE.
   B. Shall not conflict with any operation and maintenance activities.

8.1.16 Mailbox Cluster
   A. Pullout area shall be concrete.
   B. Shall be ADA accessible.

8.2. CONSTRUCTION STANDARDS

8.2.1 General
   A. Roadway systems, including private roadways, shall be constructed in accordance with the current edition of the Standards (this document), the MPWSS¹ and other standards referenced elsewhere in this document. Any conflicts or differences in these documents shall be resolved in favor of the Standards.
   B. Upon completion of roadway construction, a professional engineer shall certify the construction meets the requirements of the Standards.

8.2.2 Materials:
   A. Asphalt:
      I. All new roads or reconstructed roads shall be paved with a minimum of 4” of Type B (PG 58-28) asphalt binder and shall be accomplished in accordance with current MPWSS.

Chapter 8- Transportation System

B. Street Sub base:
   I. The sub base for streets shall be crushed stone in accordance with MPWSS Section 02234 and may include up to 3" minus material with at least one fractured face. Larger material may be approved on a case-by-case basis, with at least one fractured face.

C. Crushed base:
   I. The crushed base for streets shall be ¾" minus crushed stone in accordance with MPWSS Section 02235 and shall meet all requirements of said section.
### Glossary of Acronyms and Terms

<table>
<thead>
<tr>
<th>TERM</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASHTO</td>
<td>American Association of State Highway and Transportation Officials</td>
</tr>
<tr>
<td>ACI</td>
<td>American Concrete Institute</td>
</tr>
<tr>
<td>APWA</td>
<td>American Public Works Association</td>
</tr>
<tr>
<td>ARC</td>
<td>Antecedent Runoff Condition</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>BMP</td>
<td>Best Management Practice</td>
</tr>
<tr>
<td>CC&amp;R</td>
<td>Conditions, Covenants, and Restrictions</td>
</tr>
<tr>
<td>cfs</td>
<td>Cubic Feet per Second</td>
</tr>
<tr>
<td>CI</td>
<td>Cast Iron</td>
</tr>
<tr>
<td>CMP</td>
<td>Corrugated Metal Pipe</td>
</tr>
<tr>
<td>CN</td>
<td>Curve Number</td>
</tr>
<tr>
<td>CK</td>
<td>City of Kalispell</td>
</tr>
<tr>
<td>DEQ</td>
<td>Department of Environmental Quality</td>
</tr>
<tr>
<td>DIP</td>
<td>Ductile Iron Pipe</td>
</tr>
<tr>
<td>ESC</td>
<td>Erosion and Sediment Control</td>
</tr>
<tr>
<td>FEC</td>
<td>Flathead Electric Cooperative</td>
</tr>
<tr>
<td>FEMA</td>
<td>Federal Emergency Management Agency</td>
</tr>
<tr>
<td>FHWA</td>
<td>Federal Highway Administration</td>
</tr>
<tr>
<td>FIRM</td>
<td>Flood Insurance Rate Map</td>
</tr>
<tr>
<td>fps</td>
<td>feet per second</td>
</tr>
<tr>
<td>FS</td>
<td>Factor of Safety</td>
</tr>
<tr>
<td>GW</td>
<td>Grate Width</td>
</tr>
<tr>
<td>GSC</td>
<td>Geotechnical Site Characterization</td>
</tr>
<tr>
<td>HDPE</td>
<td>High Density Polyethylene</td>
</tr>
<tr>
<td>HDPP</td>
<td>High Density Polypropylene</td>
</tr>
<tr>
<td>HGL</td>
<td>Hydraulic Grade Line</td>
</tr>
<tr>
<td>HOA</td>
<td>Homeowner’s Association</td>
</tr>
<tr>
<td>IBC</td>
<td>International Building Code</td>
</tr>
<tr>
<td>IDF</td>
<td>Intensity Duration Frequency</td>
</tr>
</tbody>
</table>
## Glossary of Acronyms and Terms

<table>
<thead>
<tr>
<th>TERM</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITE</td>
<td>Institute of Transportation Engineers</td>
</tr>
<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
</tr>
<tr>
<td>LOS</td>
<td>Level of Service</td>
</tr>
<tr>
<td>MDEQ</td>
<td>Montana Department of Environmental Quality</td>
</tr>
<tr>
<td>MDT</td>
<td>Montana Department of Transportation</td>
</tr>
<tr>
<td>MFE</td>
<td>Municipal Facilities Exclusion</td>
</tr>
<tr>
<td>MJ</td>
<td>Mechanical Joint</td>
</tr>
<tr>
<td>MPWSS</td>
<td>Montana Public Works Standard Specifications</td>
</tr>
<tr>
<td>NAVD 88</td>
<td>North American Vertical Datum 1988</td>
</tr>
<tr>
<td>NDW</td>
<td>Natural Drainage Way</td>
</tr>
<tr>
<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration</td>
</tr>
<tr>
<td>NPDES</td>
<td>National Pollution Discharge Elimination System</td>
</tr>
<tr>
<td>NRCS</td>
<td>Natural Resources Conservation Service</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>Operation and Maintenance</td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
</tr>
<tr>
<td>POA</td>
<td>Property Owner’s Association</td>
</tr>
<tr>
<td>Pollutant Generating Surface</td>
<td>Any surface where pollutants can be generated including, but not limited to roofs, landscape areas, driving surfaces, and parking areas.</td>
</tr>
<tr>
<td>Professional Engineer</td>
<td>Montana Licensed Professional Engineer (AKA PE, MT PE, or Engineer)</td>
</tr>
<tr>
<td>PTOE</td>
<td>Professional Traffic Operations Engineer</td>
</tr>
<tr>
<td>PVC</td>
<td>Polyvinyl Chloride</td>
</tr>
<tr>
<td>PWD</td>
<td>Public Works Department</td>
</tr>
<tr>
<td>RCP</td>
<td>Reinforced Concrete Pipe</td>
</tr>
<tr>
<td>Rebar</td>
<td>Reinforcing Bar</td>
</tr>
<tr>
<td>SCS</td>
<td>Soil Conservation Service</td>
</tr>
<tr>
<td>sf</td>
<td>Square Foot</td>
</tr>
<tr>
<td>Standards</td>
<td>Current City of Kalispell Standards for Design and Construction</td>
</tr>
<tr>
<td>TMDL</td>
<td>Total Maximum Daily Load</td>
</tr>
<tr>
<td>Stormwater Facility</td>
<td>Any conveyance swale , ditch, pond, storage facility, structure, or BMP</td>
</tr>
<tr>
<td>TPH</td>
<td>Total Petroleum Hydrocarbons</td>
</tr>
<tr>
<td>TSS</td>
<td>Total Suspended Solids</td>
</tr>
<tr>
<td>USCS</td>
<td>Unified Soil Classification System</td>
</tr>
</tbody>
</table>

Field Code Changed
## Glossary of Acronyms and Terms

<table>
<thead>
<tr>
<th>TERM</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>USGS</td>
<td>United States Geological Survey</td>
</tr>
<tr>
<td>VCP</td>
<td>Vitrified Clay Pipe</td>
</tr>
<tr>
<td>WSDOT</td>
<td>Washington State Department of Transportation</td>
</tr>
</tbody>
</table>
# Appendix A – Checklist for Identifying Wetlands

## Site Data
- **Subdivision/Parcel:**
- **Completed by:**
- **Evaluation date:**
- **Site visit date:**
- **Location:** Township _____ Range _____ Section (1/4 1/4) ______
- **Physical Address:**

## Wetland Checklist: Pre Site Visit Survey

The following questions should be answered prior to a site visit using publicly available tools. If the response to any of these questions is yes, it is possible that a wetland is present on the parcel and the Site Visit Survey portion of this checklist should be completed. If no "Yes" answers, wetlands may still be present and wetlands should still be considered during the site visit.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does the parcel or any adjacent parcels include U.S. Fish and Wildlife Service National Wetland Inventory (NWI) mapped wetlands?</td>
<td>Refer to U.S. Fish and Wildlife Service National Wetlands Inventory maps (<a href="http://www.fws.gov/nwi/">http://www.fws.gov/nwi/</a>).</td>
</tr>
<tr>
<td>2. Does an aerial photo of the parcel or any adjacent parcels show surface water?</td>
<td>Refer to current aerial photo of property and other maps including U.S. Geological Survey topographic maps and digital hydrography layers (<a href="http://nhd.usgs.gov/">http://nhd.usgs.gov/</a>).</td>
</tr>
<tr>
<td>3. Is the parcel or any adjacent parcels located within the 100-year floodplain?</td>
<td>Refer to current floodplain maps available through County floodplain administrators.</td>
</tr>
<tr>
<td>4. Are there any streams, canals, ditches, or drainages present on the parcel or any adjacent parcels?</td>
<td>Refer to current aerial photo of property and other maps including U.S. Geological Survey topographic maps and digital hydrography layers (<a href="http://nhd.usgs.gov/">http://nhd.usgs.gov/</a>).</td>
</tr>
<tr>
<td>5. Does the parcel or any adjacent parcels have hydric soils mapped?</td>
<td>Refer to the most current soil survey data available through the Natural Resources Conservation Service (<a href="http://soils.usda.gov">http://soils.usda.gov</a>).</td>
</tr>
<tr>
<td>6. Is there documentation of shallow groundwater on the parcel, or any adjacent parcel?</td>
<td>Refer to groundwater data sets available from County Environmental Health Departments.</td>
</tr>
</tbody>
</table>
Appendix A – Checklist for Identifying Wetlands

<table>
<thead>
<tr>
<th>Wetland Checklist: Site Visit Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetland Indicators</td>
</tr>
</tbody>
</table>

The following questions are for use during a site visit and will help determine if a wetland may be present at the parcel and if it is likely to be regulated by federal, state or local laws or regulations. If you check “yes” for any wetland indicators below, a Wetland Assessment outlined in the Kalispell Stormwater Quality Management Plan is required. The assessment must be performed by a wetland expert. The Stormwater Quality Management Plan can be obtained from the Kalispell Public Works Department.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

**Wetland Hydrology**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>Is standing or flowing water observed at the parcel during the growing season?</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Is the soil waterlogged during the growing season?</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Are there water marks on any trees, shrubs, fencelines, buildings, etc.?</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Optional (if you have had wetland delineation training) are there any primary or secondary hydrology indicators present?</td>
<td></td>
</tr>
</tbody>
</table>

**Wetland Vegetation**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11.</td>
<td>Does the parcel have plant communities that commonly occur in areas having standing water for part of the growing season (e.g. cattail marshes, sedges, bulrush, willows)?</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Are any of the plants shown in the guide to ‘Common Wetland Plants of Western Montana’ present?</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>If the parcel has been cleared of vegetation or mowed, are there adjacent areas that have plant communities or wetland plants connected to the parcel?</td>
<td></td>
</tr>
</tbody>
</table>

**Wetland Soils**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>14.</td>
<td>Does soil show any hydric indicators (consists of predominantly decomposed plant materials, thick layer of decomposing plant material on the surface, sulfur odor, or soil is bluish gray)?</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Is there standing water or is the soil surface either saturated or inundated?</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Are the soils wet at or near the surface during dry summer periods?</td>
<td></td>
</tr>
</tbody>
</table>
Appendix B1 – Swale Flood Test

**Purpose**

The swale flood test verifies the path of flow into a swale and the drawdown time of a bio-infiltration swale. The flood test shall be conducted, when required, after the swale has been constructed and the vegetation has been established, i.e., is not in danger of being washed out when water is introduced into the swale.

**Procedure**

1. Introduce clean water into the swale by directing the water (via hose from a hydrant or other clean water source) along the curb and gutter upstream of the swale inlet.
2. Raise the water level in the swale until it reaches 6 inches in depth (typically to the rim of the drywell or catch basin). Discontinue flow and note the time; this is the beginning of the flood test.
3. If the swale is draining rapidly, the progress is observed, and when the swale is empty, the time is documented, and the flood test has ended.
4. If the swale is not draining, measure the depth of water currently in the swale, documenting the time, and return to the swale site at a later time in order to verify that the swale has completely drained within 72 hours.

Appendix B2 – Pond Flood Test

**Purpose**

The Pond Flood Test Method verifies drawdown time of a stormwater disposal facility, such as a detention pond. The pond flood test shall be conducted, when required, after the pond has been constructed, and after vegetation has been established, i.e., is not in danger of being washed out when water is introduced into the pond.

**Procedure**

1. Introduce clean water into the pond. Use some form of splash-guard or diffuser device to prevent surface erosion of the pond.
2. Raise the water level in the pond until it reaches operational depth, i.e., to the invert elevation of the first outlet device (culvert, orifice, weir, etc.). Discontinue flow.
3. Document the time and measure the depth of water in the pond; this is the beginning of the pond flood test.
4. The pond’s ability to drain is observed. If the pond appears to be emptying rapidly, as soon as the pond is empty, the time is documented, and the flood test has ended.
5. If the pond is not draining, or is draining very slowly, measure the depth of water currently in the pond, documenting the time, and return to the pond site at a later time in order to verify that the pond has completely drained within 72 hours.

**NOTE:** Contact the City Engineer for specific requirements for this Test Method. Some ponds will be large enough that a pond flood test may not be the most efficient method of determining drawdown time or infiltrative ability. Consideration may need to be given to other types of infiltrative test methods, such as the double-ring infiltrometer test.
Appendix C – BMP T5.100 API (Baffle Type) Separator Bay

Design Criteria
The design criteria for small drainages are based on the design velocity, oil rise rate, residence time, width, depth, and length considerations. As a correction factor, the American Petroleum Institute (API) turbulence criterion is applied to increase the length.

Ecology is modifying the API criterion for treating stormwater runoff from small drainage areas (fueling stations, commercial parking lots, etc.) by using the design hydraulic horizontal velocity, $V_h$, for the design $V_h/V_r$ ratio rather than the API minimum of $V_h/V_r = 15$. The API criterion appears applicable for greater than two acres of impervious drainage area. Performance verification of this design basis must be obtained during at least one wet season using the test protocol referenced in Section 5.12 for new technologies.

The following is the sizing procedure using the modified API criterion:

- Determine the oil rise rate, $V_r$ in cm/sec, using Stoke’s Law (Water Pollution Control Federation, 1985), or empirical determination, or 0.033 ft/min for 60°F oil. The application of Stoke’s Law to site-based oil droplet sizes and densities, or empirical rise rate determinations recognizes the need to consider actual site conditions. In those cases the design basis would not be the 60 micron droplet size and the 0.033 ft/min. rise rate.

  - Stoke’s Law equation for rise rate, $V_r$ (cm/sec):
    $$ V_r = g(\sigma_o - \sigma_w)D^3 / 18\eta_o $$
    Where: $g = \text{gravitational constant (981 cm/sec}^2)$$
    $D = \text{diameter of the oil particle in cm}$
    $\sigma_o = \text{0.999 gm/cc at 32°F}$
    $\sigma_w = \text{Select conservatively high oil density, for example:}$
    if diesel oil @ $\sigma_o = 0.85 \text{ gm/cc}$ and motor oil @ $\sigma_w = 0.90 \text{ can be}$
    present, then use $\sigma_w = 0.90 \text{ gm/cc}$
    $\eta_o = \text{0.017921 poise, gm/cm-sec at T_o = 32°F}$
    (See API Publication 421, February, 1990)

  - Use the following separator dimension criteria:
    Separator water depth $d = \text{between 3 and 8 feet to minimize turbulence}$
    (API, 1990; US Army Corps of Engineers, 1994)
    Separator width $w = \text{between 6 and 20 feet (WEF & ASCE, 1998;}$
    King County Surface Water Management, 1998)

---

1 Source Section 5.10.7 of the Stormwater Management Manual for Eastern Washington.
Appendix C – BMP T5.100 API (Baffle Type) Separator Bay

Depth to width ratio d/w = between 0.3 and 0.5 (API, 1990)

For stormwater inflow from drainages less than 2 acres:

- Determine $V_b$ and select depth and width of the separator section based on above criteria.
- Calculate the minimum residence time ($t_{min}$) of the separator at depth (d):
  \[ t_{min} = \frac{d}{V_t} \]
- Calculate the horizontal velocity of the bulk fluid, $V_b$, vertical cross-sectional area, $A_v$, and actual design $V_b/V_i$ (American Petroleum Institute, 1990; US Army Corps of Engineers, 1994).
  \[ V_b = \frac{Q}{dw} = \frac{Q}{A_v} \]
  \[ (V_b \text{ maximum at } < 2.0 \text{ ft/min}; \text{ American Petroleum Institute, 1990}) \]
- $Q = 2.15$ times the water quality design flow rate in ft$^3$/min, at minimum residence time, $t_{min}$.

At $V_b/V_i$ determine $F$, turbulence and short-circuiting factor (Appendix V.D of the SWMMWW) API $F$ factors range from 1.28-1.74. (American Petroleum Institute, 1990)

- Calculate the minimum length of the separator section, $l(s)$, using:
  \[ l(s) = FQt_{int}/wd = F(V_b/V_i)d \]
  \[ l(t) = l(f) + l(s) + l(a) \]
  \[ l(t) = l(f)/3 + l(s) + l(t)/4 \]
  Where:
  \[ l(t) = \text{total length of 3 bays} \]
  \[ l(f) = \text{length of forebay} \]
  \[ l(a) = \text{length of afterbay} \]

- Calculate $V = l(s)wd = FQt_{in}$, and $Ah = ws(s)$
  \[ V = \text{minimum hydraulic design volume} \]
  \[ Ah = \text{minimum horizontal area of the separator} \]
Appendix D – Flow Spreader Options

Flow spreaders function to uniformly spread flows across the inflow portion of water quality facilities.

- Anchored plate (Option A)
- Concrete sump box (Option B)
- Notched curb spreader (Option C)
- Through-curb ports (Option D)
- Level spreader trench (Option E)

Options A through C and E can be used for spreading flows that are concentrated. Any one of these options can be used when spreading is required by the facility design criteria. Options A through C and E can also be used for unconcentrated flows, and in some cases must be used, such as to correct for moderate grade changes along a filter strip.

Options D is only for flows that are already unconcentrated and enter a filter strip or continuous inflow biofiltration swale.

Anchored plate (Option A)

An anchored plate flow spreader shall be preceded by a sump having a minimum depth of 8 inches and minimum width of 24 inches.

The top surface of the flow spreader plate shall be level, projecting a minimum of 2 inches above the ground surface of the water quality facility, or v-notched with notches 6 to 10 inches on center and 1 to 6 inches deep (use shallower notches with closer spacing). Alternative designs are allowed.

A flow spreader plate shall extend horizontally beyond the bottom width of the facility to prevent water from eroding the side slope. The horizontal extent should be such that the bank is protected for all flows up to the 100-year flow or the maximum flow that will enter the WQ facility. Flow spreader plates shall be securely fixed in place.

Flow spreader plates may be made of either wood, metal, fiberglass, reinforce plastic, or other durable material. Anchor posts shall be 4-inch square concrete, tubular stainless steel, or other material resistant to decay.

Concrete sump box (Option B)

The wall of the downstream side of a rectangular concrete sump box shall extend a minimum of 2 inches above the treatment bed. This serves as a weir to spread the flows uniformly across the bed.

The downstream wall of a sump box shall have “wing walls” at both ends. Side walls and returns shall be slightly higher than the weir so that erosion of the side slope is minimized.

Notched curb spreader (Option C)

Concrete for a sump box can be either cast-in-place or precast, but the bottom of the sump shall be reinforced with wire mesh for cast-in-place sumps. Sump boxes shall be placed over bases that consists of 4 inches of crushed rock, 5/8-inch minus to help assure the sump remains level.

Notched curb spreader sections shall be made of extruded concrete (or equivalent) laid side by side and level. Typically five “teeth” per four-foot section provide good spacing. The space between adjacent "teeth" forms a v-notch.
Appendix D – Flow Spreader Options

Through-curb ports (Option D)
Unconcentrated flows from paved areas entering continuous inflow biofiltration swales can use curb ports to allow flows to enter the swale. Curb ports use fabricated openings that allow concrete curbing to be poured or extruded while still providing an opening through the curb to admit water to the WQ facility.

Openings in the curb shall be at regular intervals but at least every 6 feet (minimum). The width of each curb port opening shall be a minimum of 11 inches. Approximately 15 percent or more of the curb section length should be in open ports, and no port should discharge more than about 10 percent of the flow.

Level Spreader Trench-pea gravel (Option E)
The trench shall be a 2’ by 2’ trench filled with pea gravel.

![Diagram of Flow Spreader Option A: Anchored Plate](image)

![Diagram of Alternative Design](image)
Appendix D – Flow Spreader Options

FLOW SPREADER OPTION B: CONCRETE SUMP BOX

Example of a concrete sump flow spreader used with a biofiltration swale (may be used with other WQ facilities).

Note: Extend sides into slope. Height of side wall and wing walls must be sufficient to handle the 100-year flow or the highest flow entering the facility.
Appendix D – Flow Spreader Options

FLOW SPREADER OPTION C: NOTCHED CURB SPREADER

PLAN VIEW

A

B

48" section (typ)

B

12"

FLOW SPREADER OPTION D: THROUGH-CURB PORT

reinforced concrete curb

opening 11" min.

glass filter strip

max @ 0.5

SECTION B

inflow

2 - #5 rebar or

reinforce as necessary

CURB PORT

 sectional (typ)
Appendix D – Flow Spreader Options

Plan View
- Curb Cut
- Riprap Inflow (18" Depth, Class I)
- Level Spreader Trench (Pea Gravel)

Profile View
- Curb Cut
- Riprap Inflow (18" Depth, Class I)
- Level Spreader Trench (Pea Gravel)

Detail: Typical Pea Gravel Level Spreader

Field Code Changed
Appendix E – Filter Strips Used for Pre-Treatment

Bioretention areas may utilize a filter strip as a pre-treatment measure. The required length of the filter strip depends on the drainage area, imperviousness, and the filter strip slope. The table below provides sizing guidance for using filter strips for pre-treatment.

### Sizing of Filter Strips for Pre-treatment

(Source: Adapted from Georgia Stormwater Management Manual)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Impervious Areas[1]</th>
<th>Pervious Areas (Lawns, etc)[2]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum inflow approach length (feet)</td>
<td>35</td>
<td>75</td>
</tr>
<tr>
<td>Filter strip slope (max = 5%)</td>
<td>≤ 2%</td>
<td>&gt; 2%</td>
</tr>
<tr>
<td></td>
<td>≤ 2%</td>
<td>&gt; 2%</td>
</tr>
<tr>
<td>Filter strip minimum length (feet)[3]</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>18</td>
</tr>
</tbody>
</table>

- Flow must enter the filter strip as sheet flow, designed to spread out over the width of the strip with a depth of 1 to 2 inches.
- An effective flow spreader is a pea gravel diaphragm at the top of the slope (ASTM D 448 size no. 6, 1/8” to 3/8”). The pea gravel diaphragm (a small trench running along the top of the filter strip) serves two purposes. First, it acts as a pre-treatment device, settling out sediment particles before they reach the treatment BMP. Second, it acts as a level spreader, maintaining sheet flow as runoff flows over the filter strip. Other types of flow spreaders include a concrete sill and curb stops.

---

1 75 feet maximum impervious area flow length to filter strip.
2 150 feet maximum pervious area flow length to filter strip.
3 At least 25 feet is required for minimum pre-treatment of 10% TSS removal. Fifty feet is required for 50% removal.
Appendix E – Filter Strips Used for Pre-Treatment

Grass Channels Used for Pretreatment:

Bioretention areas may utilize a filter strip as a pre-treatment measure. The length of the grass channel depends on the drainage area, land use, and channel slope. To be used as a pretreatment measure, the grass channel must have a minimum length of 20 feet. The Table below provides minimum lengths for grass channels based on channel slope and percent imperviousness (of the contributing drainage area).

Grass Channel Sizing Guidance
(Source: Georgia Stormwater Management Manual)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>&lt; 33% Impervious</th>
<th>Between 34% and 66% Impervious</th>
<th>≤ 67% Impervious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope (max = 4%)</td>
<td>≤ 2%</td>
<td>&gt; 2%</td>
<td>≤ 2%</td>
</tr>
<tr>
<td>Grass channel min. length (feet)</td>
<td>25</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>assumes 2-ft bottom width</td>
<td>30</td>
<td>45</td>
<td>35</td>
</tr>
</tbody>
</table>

Field Code Changed
## Appendix F – Planting Guidelines

Planting Guidelines for: Detention Pond: Seed mixtures

<table>
<thead>
<tr>
<th>Common &amp; Species Name</th>
<th>Bulk Rate (lb/ac)</th>
<th>% of Mix Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluebunch Wheatgrass - Psuedoroegneria spicata (Goldar)</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>Thickspike Wheatgrass – Elymus lanceolatus (Critana)</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Rough Fescue Festuca scabrella</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Idaho Fescue Festuca idahoensis (Joseph)</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>Prairie Junegrass Koeleria macrantha (crastad)</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td><strong>Grass Totals:</strong></td>
<td><strong>25</strong></td>
<td><strong>100</strong></td>
</tr>
<tr>
<td>Or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slender Wheatgrass Elymus trachycaulus (Revenue)</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Mountain Brome Bromus marginatis (Bromar)</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Annual Ryegrass Lolium multiflorum</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Winter Wheat*</td>
<td>24</td>
<td>60</td>
</tr>
<tr>
<td><strong>Cover Crop Totals:</strong></td>
<td><strong>40</strong></td>
<td><strong>100</strong></td>
</tr>
<tr>
<td><strong>GRAND TOTAL:</strong></td>
<td><strong>65</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
## Planting Guidelines

**Infiltration facilities, Detention facilities, Swales, and Ditches**

<table>
<thead>
<tr>
<th>Common &amp; Species Name</th>
<th>% of Mix Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perennial Rye Grass</td>
<td>15</td>
</tr>
<tr>
<td>Intermediate Wheatgrass</td>
<td>46</td>
</tr>
<tr>
<td>Creeping Fescue</td>
<td>8</td>
</tr>
<tr>
<td>Tall Fescue</td>
<td>31</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Or

<table>
<thead>
<tr>
<th>Common &amp; Species Name</th>
<th>% of Mix Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tall or Meadow Fescue</td>
<td>68</td>
</tr>
<tr>
<td>Seaside/ Creeping Bentgrass</td>
<td>10</td>
</tr>
<tr>
<td>Meadow Foxtail</td>
<td>10</td>
</tr>
<tr>
<td>Alsike Clover</td>
<td>6</td>
</tr>
<tr>
<td>Redtop Bentgrass</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

**Wetponds: Wetland Grasses**

<table>
<thead>
<tr>
<th>Common &amp; Species Name</th>
<th>% of Mix Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redtop Bentgrass</td>
<td>35</td>
</tr>
<tr>
<td>Meadow Foxtail</td>
<td>35</td>
</tr>
<tr>
<td>Russian Wildrye</td>
<td>20</td>
</tr>
<tr>
<td>Red Fescue</td>
<td>7</td>
</tr>
<tr>
<td>Bridsfoot Trefoil</td>
<td>2</td>
</tr>
<tr>
<td>Blackeyed Susan</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Or

<table>
<thead>
<tr>
<th>Common &amp; Species Name</th>
<th>% of Mix Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redtop Bentgrass</td>
<td>35</td>
</tr>
<tr>
<td>Red Fescue</td>
<td>35</td>
</tr>
<tr>
<td>Meadow Foxtail</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
### Appendix F – Planting Guidelines

#### Emergent Wetland Plant Species Recommend for Wetponds

<table>
<thead>
<tr>
<th>Upland Sites</th>
<th>Common Name</th>
<th>Pounds PLS per Acre (pure stand)</th>
<th>% by weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agropyron riparian</td>
<td>streambank wheatgrass</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>Elymus trachycaulus</td>
<td>slender wheatgrass</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Elymus lanceolatus</td>
<td>thicksipe wheatgrass</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Festuca idahoensis</td>
<td>Idaho fescue</td>
<td>3</td>
<td>20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Moist to Wet Sites</th>
<th>Common Name</th>
<th>Pounds PLS per Acre (pure stand)</th>
<th>% by weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elymus glaucus</td>
<td>blue wildrye</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Elymus trachycaulus</td>
<td>slender wheatgrass</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Leymus triticoides</td>
<td>wildrye</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Pascopyrum smithii</td>
<td>western wheatgrass</td>
<td>8</td>
<td>20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Emergent Species (inundated but dry out)</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carex utriculata/rostrata</td>
<td>beaked sedge</td>
</tr>
<tr>
<td>Carex nebrascensis</td>
<td>nebraska sedge</td>
</tr>
<tr>
<td>Carex lanuginosa</td>
<td>wooly sedge</td>
</tr>
<tr>
<td>Eleocharis palustris</td>
<td>creeping spiked rush</td>
</tr>
<tr>
<td>Juncus balticus</td>
<td>baltic rush</td>
</tr>
<tr>
<td>Juncus tenuis</td>
<td>slender rush</td>
</tr>
<tr>
<td>Scirpus actus</td>
<td>hard stemmed rush</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inundated Locations</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bechmania syzigachne</td>
<td>western slough grass</td>
</tr>
<tr>
<td>Carex aquatilis</td>
<td>water sedge</td>
</tr>
<tr>
<td>Carex utriculata/rostrata</td>
<td>beaked sedge</td>
</tr>
<tr>
<td>Eleocharis palustris</td>
<td>creeping spiked rush</td>
</tr>
<tr>
<td>Glyceria striata</td>
<td>fowl mannagrass</td>
</tr>
<tr>
<td>Juncus ensifolius</td>
<td>3 stamen/dagger leaf rush</td>
</tr>
<tr>
<td>Juncus mertensiana</td>
<td>Merten’s rush</td>
</tr>
<tr>
<td>Juncus tenuis</td>
<td>slender rush</td>
</tr>
<tr>
<td>Sagittaria latifolia</td>
<td>arrowhead</td>
</tr>
<tr>
<td>Scirpus microcarpus</td>
<td>small fruited bulrush</td>
</tr>
<tr>
<td>Scirpus americanus</td>
<td>olney’s bulrush</td>
</tr>
<tr>
<td>Scirpus acutus</td>
<td>hardstem bulrush</td>
</tr>
<tr>
<td>Typha latifolia</td>
<td>cattail</td>
</tr>
</tbody>
</table>
## Appendix F – Planting Guidelines

<table>
<thead>
<tr>
<th>shrubs</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Willows- with standing long inundation</strong></td>
<td></td>
</tr>
<tr>
<td>Salix dummondii</td>
<td>Drummond willow</td>
</tr>
<tr>
<td>Salix boothii</td>
<td>Booth’s willow</td>
</tr>
<tr>
<td><strong>Willows- requires longer dry period</strong></td>
<td></td>
</tr>
<tr>
<td>Salix exigua</td>
<td>sandbar/ coyote willow</td>
</tr>
<tr>
<td>Salix bebbiana</td>
<td>Bebb’s willow</td>
</tr>
<tr>
<td>Salix geyeriana</td>
<td>Geyer’s willow</td>
</tr>
<tr>
<td><strong>Moist upland shrubs</strong> - see also recommended species list from Native Plant Society</td>
<td></td>
</tr>
<tr>
<td>Acer glabrum</td>
<td>rocky mountain maple</td>
</tr>
<tr>
<td>Amelanchier alnifolia</td>
<td>serviceberry</td>
</tr>
<tr>
<td>Cornus stolonifer</td>
<td>red osier dogwood</td>
</tr>
<tr>
<td>Eleagnus commutata</td>
<td>silverberry</td>
</tr>
<tr>
<td>Prunus virginiana</td>
<td>chokecherry</td>
</tr>
<tr>
<td>Ribes aurem</td>
<td>golden current</td>
</tr>
<tr>
<td>Sambucus racemosa</td>
<td>elderberry</td>
</tr>
<tr>
<td><strong>Moist to wet forbs</strong></td>
<td></td>
</tr>
<tr>
<td>Iris missouriensis</td>
<td>Rocky Mountain iris</td>
</tr>
<tr>
<td>Mimulus lewisii</td>
<td>red monkeyflower</td>
</tr>
</tbody>
</table>

Notes: Regional distributors for wetland planting are 1) Windriver Seeds, 2) Blackfoot Native Plants, 3) Native West, 4) Western Native Seeds, 5) Wind Flower Native Plants
Appendix G1 – Example Calculation – Non-Flooded Width

**GIVEN**
A crowned road with a uniform gutter section (as illustrated), assuming an equal flow rate on each side of the road:
- Flow rate (Q) = 4.2 cfs
- Gutter width (W) = 1.5 feet
- Road/Gutter cross slope (S_x) = 0.02 feet/foot
- Longitudinal slope (S_L) = 0.01 feet/ft
- Manning’s friction coefficient, n = 0.016
- Road width (RW) = 30 feet

**CALCULATIONS**

1. Calculate the spread (T) for half of the roadway.

\[
T = \left( \frac{Q}{n} \right)^{0.375} = \left( \frac{4.2}{0.016} \right)^{0.375} = 12.4 \text{ feet}
\]

2. Calculate the non-flooded width using the following relationship for crowned roadways, and then verify that the non-flooded width is within the allowable limit.

\[
\text{Non-flooded width} = 2\left(\frac{1}{2}\right)(\text{RW}) + W - T
\]

\[
= 2\left(\frac{1}{2}\right)(30) + 1.5 - 12.4
\]

\[
= 8.2 \text{ feet} < 12 \text{ feet FAIL*}
\]

*The minimum non-flooded width is 12 feet for local roads. Therefore, the design fails to meet the required non-flooded road width criteria. The design will need to be altered, i.e., try an additional inlet placed at an intermediate location, contributing basins redefine, new flow rates calculated, and the above steps repeated.
Appendix G2 – Example Calculation – Grate Inlet Capacity

GIVEN

A crowned private road with a uniform gutter section (as illustrated), assuming an equal flow rate on each side of the road.

- Flow rate (Q) = 2.5 cfs
- Gutter width (W) = 1.5 ft
- Grate width (GW) = 1.67 feet
- Road/Gutter cross slope (Sₓ) = 0.02 feet/foot
- Longitudinal slope (S_L) = 0.03 feet/foot
- Manning’s friction coefficient, n = 0.016
- Road width (RW) = 30 feet

CALCULATIONS

1. Determine the runoff from the contributing basin at the high point to the first inlet;
   - For this example, the design flow rate (Q) is given as 2.5 cfs

2. Select an inlet and note the grate width.
   - For this example, the grate width (GW) is given as 1.67 ft

3. Calculate the spread (T) for half of the roadway.

\[
T = \left( \frac{Q}{0.56 S_x^{0.47} S_L^{0.5}} \right)^{0.375} = \left( \frac{2.5(0.016)}{0.56 (0.02)^{0.47} (0.03)^{0.5}} \right)^{0.375} = 8.31 \text{feet}
\]

4. Calculate the non-flooded width using the following relationship, and then verify that the non-flooded width is within the allowable limit:

   Non-flooded width = \(2[(1/2)(RW) + W - T]\)
   
   = \(2[(1/2)(30) + 1.5 - 8.31]\)
   
   = 16.38 feet > 12 feet \text{OK*}

   *The minimum non-flooded width is 12 feet for private roads. Therefore, design has met the required non-flooded road width criteria.

5. Calculate the inlet bypass flow:
   - With 35% clogging factor, grate width (GW) = 1.67(1 - 0.35) = 1.09’
Appendix G2 – Example Calculation – Grate Inlet Capacity

\[ Q_{BP} = Q \left[ \frac{(T) - (GW)}{(T)} \right]^{\frac{8}{3}} = 2.5 \left[ \frac{8.31 - 1.09}{8.31} \right]^{\frac{8}{3}} = 1.72 \text{ cfs} \]

Therefore the capacity of the inlet = 2.5 – 1.72 = 0.78 cfs

5. Verify that the velocity does not exceed 5 feet/second. The velocity of flow directly over the inlet is calculated:

\[ V = \frac{Q - Q_{BP}}{(d - 0.5(GW)(S_z))} = \frac{2.5 - 1.72}{1.09(8.31)(0.02) - 0.5(1.09)(0.02)} = 4.61 \text{ ft/s} < 5 \text{ ft/second OK}^{**} \]

The analysis is then repeated with the next inlet. The bypass flow \( Q_{BP} \) from the previous inlet shall be added to the flow from the contributing basin to determine the total flow \( Q \) to the inlet at the station being analyzed.
Appendix H1 – Facility Maintenance Recommendations

The following are operation and maintenance tasks for Treatment BMPs and Flood Control Facilities and should be used to create the required Operation and Maintenance Manual. Maintenance of facilities is driven by annual inspections that evaluate the condition and performance of the stormwater facilities. Based on inspection results, specific maintenance tasks will be triggered. An annual maintenance inspection form for facilities can be accessed at CWP website: //www.cwp.org/Resource_Library/Center_Docs/SW/pcguidance/Tool6.pdf. A more detailed maintenance inspection form is also available from Appendix B of CWP (2004) and from the City of Kalispell Public Works Department.

WET POND MAINTENANCE

First-Year Maintenance Operations
Successful establishment of wet ponds requires that certain tasks be undertaken in the first year.

- **Initial Inspections:** For the first six months following construction, the site should be inspected at least twice after storm events that exceed a 1/2 inch.
- **Planting of Benches:** The aquatic benches should be planted with emergent wetland species.
- **Spot Reseeding:** Inspectors should look for bare or eroding areas in the contributing drainage area or around the pond buffer, and make sure they are immediately stabilized with grass cover.
- **Watering:** Trees planted in the pond buffer need watering during the first growing season. In general, consider watering every three days for first month, and then weekly during first year (Apr – Oct), depending on rainfall.

Inspections and Routine Maintenance Tasks
Maintenance of wet ponds is driven by annual inspections that evaluate the condition and performance of the facility (see Table below).

<table>
<thead>
<tr>
<th>Activity</th>
<th>Measure sediment accumulation levels in forebay.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Monitor the growth of wetland plant, tree and shrubs planted. Record species and approximate coverage, and note presence of any invasive plant species.</td>
</tr>
<tr>
<td></td>
<td>Inspect the condition of stormwater inlets to the pond for material damage, erosion or undercutting.</td>
</tr>
<tr>
<td></td>
<td>Inspect upstream and downstream banks for evidence of sloughing, animal burrows, boggy areas, woody growth or gully erosion that may undermine embankment integrity.</td>
</tr>
<tr>
<td></td>
<td>Inspect the pond outfall channel for erosion, undercutting, rip-rap displacement, woody growth, etc.</td>
</tr>
<tr>
<td></td>
<td>Inspect condition of principal spillway and riser for evidence of spalling, joint failure, leakage, corrosion, etc.</td>
</tr>
<tr>
<td></td>
<td>Inspect condition of all trash racks, reverse sloped pipes or flashboard risers for evidence of clogging, leakage, debris accumulation, etc.</td>
</tr>
<tr>
<td></td>
<td>Inspect maintenance access to ensure it is free of woody vegetation and check to see whether valves, manholes or locks can be opened and operated.</td>
</tr>
<tr>
<td></td>
<td>Inspect internal and external pond side slopes for evidence of sparse vegetative cover, erosion or slumping, and repaired immediately.</td>
</tr>
</tbody>
</table>

**Note:** For a more detailed maintenance inspection checklist, see Appendix B in CWP (2004) Stormwater Pond and Wetland Maintenance Guidebook.
Appendix H1 – Facility Maintenance Recommendations

Maintenance is needed so stormwater ponds continue to operate as designed on a long-term basis. Wet ponds normally have less routine maintenance requirements than other stormwater treatment options. Stormwater pond maintenance activities range in terms of the level of effort and expertise required to perform them. Routine stormwater pond maintenance, such as mowing and removing debris or trash, is needed several times each year (See Table below). More significant maintenance such as removing accumulated sediment is needed less frequently, but requires more skilled labor and special equipment. Inspection and repair of critical structural features such as embankments and risers, needs to be performed by a qualified professional (e.g., a structural engineer) that has experience in the construction, inspection, and repair of these features.

The maintenance plan should clearly outline how vegetation in the pond and its buffer will be managed or harvested in the future. Periodic mowing of the stormwater buffer is only required along maintenance rights-of-way and the embankment. The remaining buffer can be managed as a meadow (mowing every other year) or forest. The maintenance plan should schedule a shoreline cleanup at least once a year to remove trash and floatables.

<table>
<thead>
<tr>
<th>Typical Wet Pond Maintenance Tasks and Frequency</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maintenance Items</strong></td>
<td></td>
</tr>
<tr>
<td>• Pond buffer reinforcement plantings and planting of aquatic benches.</td>
<td>One time - After First Year</td>
</tr>
<tr>
<td>• Mowing – twice a year.</td>
<td>Quarterly or After Major Storms (&gt;1 inch)</td>
</tr>
<tr>
<td>• Remove debris and blockages.</td>
<td></td>
</tr>
<tr>
<td>• Repair undercut, eroded, and bare soil areas.</td>
<td></td>
</tr>
<tr>
<td>• Shoreline cleanups to remove trash, debris and floatables.</td>
<td>Annual</td>
</tr>
<tr>
<td>• Full maintenance inspection.</td>
<td></td>
</tr>
<tr>
<td>• Open up riser to access valves.</td>
<td></td>
</tr>
<tr>
<td>• Repair broken mechanical components if needed.</td>
<td></td>
</tr>
<tr>
<td>• Forebay Sediment Removal.</td>
<td>5-7 years</td>
</tr>
<tr>
<td>• Repair pipes, riser and spillway where needed.</td>
<td>5-25 years</td>
</tr>
</tbody>
</table>

Field Code Changed
Appendix H1 – Facility Maintenance Recommendations

INfiltration MAintenance

Maintenance Inspections
Annual site inspections are critical to the performance and longevity of infiltration practices, particularly for small-scale and conventional infiltration practices. Maintenance of infiltration practices is driven by annual inspections that evaluate the condition and performance of the practice (see Table below).

Ongoing Maintenance
Effective long-term operation of infiltration practices requires a dedicated and routine maintenance inspection schedule with clear guidelines and schedules, as shown in the Table below. Where possible, facility maintenance should be integrated into routine landscaping maintenance tasks.

<table>
<thead>
<tr>
<th>Suggested Annual Maintenance Inspection Points for Infiltration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activity</strong></td>
</tr>
<tr>
<td>The drawdown rate should be measured at the observation well for three days following a storm event in excess of 0.5 inch in depth. If standing water is still observed in the well after three days, this is a clear sign that that clogging is a problem.</td>
</tr>
<tr>
<td>Check inlets, pretreatment cells and any flow diversion structures for sediment buildup and structural damage. Note if any sediment needs to be removed.</td>
</tr>
<tr>
<td>Inspect the condition of the observation well and make sure it is still capped.</td>
</tr>
<tr>
<td>Check that no vegetation forms an overhead canopy that may drop leaf litter, fruits and other materials that could clog the device.</td>
</tr>
<tr>
<td>Evaluate the vegetative quality of the adjacent grass buffer and do spot reseeding if cover is less than 90%.</td>
</tr>
<tr>
<td>Generally inspect the upland CDA for any controllable sources of sediment or erosion.</td>
</tr>
<tr>
<td>Look for weedy growth on rock surface that might indicate sediment deposition or clogging.</td>
</tr>
<tr>
<td>Inspect maintenance access to ensure it is free of woody vegetation and check to see whether valves, manholes or locks can be opened and operated.</td>
</tr>
<tr>
<td>Inspect internal and external infiltration side slopes for evidence of sparse vegetative cover, erosion or slumping, and repaired immediately.</td>
</tr>
</tbody>
</table>
## Appendix H1 – Facility Maintenance Recommendations

### Typical Maintenance Activities for Infiltration Practices

<table>
<thead>
<tr>
<th>Activity</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Replace pea gravel/topsoil and top surface filter fabric (when clogged).</td>
<td></td>
</tr>
<tr>
<td>• Mow grass filter strips as necessary and remove clippings.</td>
<td>As needed</td>
</tr>
<tr>
<td>• Ensure that contributing area, practice and inlets are clear of debris.</td>
<td></td>
</tr>
<tr>
<td>• Ensure that the contributing area is stabilized.</td>
<td>Quarterly</td>
</tr>
<tr>
<td>• Remove sediment and oil/grease from pretreatment devices, as well as overflow structures.</td>
<td></td>
</tr>
<tr>
<td>• Repair undercut and eroded areas at inflow and outflow structures.</td>
<td></td>
</tr>
<tr>
<td>• Check observation wells following 3 days of dry weather. Failure to percolate within this time period indicates clogging.</td>
<td></td>
</tr>
<tr>
<td>• Inspect pretreatment devices and diversion structures for sediment build-up and structural damage.</td>
<td></td>
</tr>
<tr>
<td>• Remove trees that start to grow in the vicinity of the trench.</td>
<td>Semi-annual Inspection</td>
</tr>
<tr>
<td>• Clean out accumulated sediments from the pretreatment cell</td>
<td>Annually</td>
</tr>
</tbody>
</table>
Appendix H1 – Facility Maintenance Recommendations

POND MAINTENANCE

Maintenance Inspections
Maintenance of ED ponds is driven by annual inspections that evaluate the condition and performance of the facility (see Table below). Based on inspection results, specific maintenance tasks will be triggered.

Common Maintenance Issues
Ponds are prone to a high clogging risk at the low flow orifice. These aspects of pond plumbing should be inspected at least twice a year after initial construction. The constantly changing water levels in ponds make it difficult to mow or manage vegetative growth. The bottom of ponds often become soggy, and water-loving trees such as willows may take over.

The maintenance plan should clearly outline how vegetation in the pond and its buffer will be managed or harvested in the future. Periodic mowing of the stormwater buffer is only required along maintenance rights-of-way and the embankment. The remaining buffer can be managed as a meadow (mowing every other year) or forest. The maintenance plan should schedule a shoreline cleanup at least once a year to remove trash and floatables that tend to accumulate in the forebay and on the bottom of ponds.

Frequent sediment removal from the forebay or sump area is essential to maintain the function and performance of a pond. Maintenance plans should schedule cleanouts every 5-7 years, or when inspections indicate that 50% of forebay or sump area capacity has been lost.

<table>
<thead>
<tr>
<th>Suggested Annual Maintenance Inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
</tr>
<tr>
<td>Measure sediment accumulation levels in forebay.</td>
</tr>
<tr>
<td>Monitor the growth of wetlands, trees and shrubs planted. Record species and approximate coverage, and note presence of any invasive plant species.</td>
</tr>
<tr>
<td>Inspect the condition of stormwater inlets to the pond for material damage, erosion or undercutting.</td>
</tr>
<tr>
<td>Inspect upstream and downstream banks for evidence of sloughing, animal burrows, boggy areas, woody growth or gully erosion that may undermine embankment integrity.</td>
</tr>
<tr>
<td>Inspect pond outfall channel for erosion, undercutting, rip-rap displacement, woody growth, etc.</td>
</tr>
<tr>
<td>Inspect condition of principal spillway and riser for evidence of spalling, joint failure, leakage, corrosion, etc.</td>
</tr>
<tr>
<td>Inspect condition of all trash racks, reverse sloped pipes or flashboard risers for evidence of clogging, leakage, debris accumulation, etc.</td>
</tr>
<tr>
<td>Inspect maintenance access to ensure it is free of woody vegetation and check to see whether valves, manholes or locks can be opened and operated.</td>
</tr>
<tr>
<td>Inspect internal and external pond side slopes for evidence of sparse vegetative cover, erosion or slumping, and repaired immediately.</td>
</tr>
</tbody>
</table>

Appendix H1 – Facility Maintenance Recommendations

**DRY SWALE MAINTENANCE**

**Maintenance Inspections**
Inspections are used to trigger maintenance operations such as sediment removal, spot revegetation and inlet stabilization. Several key maintenance inspection points are detailed in the Table below. Ideally, inspections should be conducted in the spring of each year.

<table>
<thead>
<tr>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add reinforcement planting to maintain 95% turf cover on vegetation density. Reseed any salt killed vegetation.</td>
</tr>
<tr>
<td>Remove any accumulated sand or sediment deposits on the filter bed surface or in pretreatment cells.</td>
</tr>
<tr>
<td>Inspect upstream and downstream of check dams for evidence of undercutting or erosion, and remove and trash or blockages at weep holes.</td>
</tr>
<tr>
<td>Examine filter beds for evidence of braiding, excessive ponding or dead grass.</td>
</tr>
<tr>
<td>Check inflow points for clogging and remove any sediment.</td>
</tr>
<tr>
<td>Inspect side slopes and grass filter strips for evidence of any rill or gully erosion and repair.</td>
</tr>
<tr>
<td>Look for any bare soil or sediment sources in the contributing drainage area and stabilize.</td>
</tr>
</tbody>
</table>

**Routine Maintenance and Operation**
Once established, dry swales have minimal maintenance needs outside of the spring clean up, regular mowing and pruning and management of trees and shrubs. The surface of the filter bed can become clogged with fine sediment over time, but this can be alleviated through core aeration or deep tilling of the filter bed. Additional effort may be needed to repair check dams, stabilize inlet point and remove deposited sediment from pretreatment cells.

**BIOSWALE AND GRASS CHANNEL MAINTENANCE**

**Maintenance Inspections**
Annual inspections are used to trigger maintenance operations such as sediment removal, spot revegetation and inlet stabilization. Several key maintenance inspection points are detailed in the Table below. Ideally, inspections should be conducted in the spring of each year.

**Ongoing Maintenance**
Once established, bioswales and grass channels have minimal maintenance needs outside of the Spring clean up, regular mowing, repair of check dams and other measures to maintain the hydraulic efficiency of the channel and a dense, healthy grass cover.

<table>
<thead>
<tr>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add reinforcement planting to maintain 90% turf cover. Reseed any salt killed vegetation.</td>
</tr>
<tr>
<td>Remove any accumulated sand or sediment deposits behind check dams.</td>
</tr>
<tr>
<td>Inspect upstream and downstream of check dams for evidence of undercutting or erosion, and remove and trash or blockages at weep holes.</td>
</tr>
<tr>
<td>Examine channel bottom for evidence of erosion, braiding, excessive ponding or dead grass.</td>
</tr>
<tr>
<td>Check inflow points for clogging and remove any sediment.</td>
</tr>
<tr>
<td>Inspect side slopes and grass filter strips for evidence of any rill or gully erosion and repair.</td>
</tr>
<tr>
<td>Look for any bare soil or sediment sources in the contributing drainage area and stabilize immediately.</td>
</tr>
</tbody>
</table>
Appendix H1 – Facility Maintenance Recommendations

BIORETENTION MAINTENANCE

First-Year Maintenance Operations
Successful establishment of bioretention areas requires certain tasks be undertaken in the first year.

- **Initial inspections**: For the first six months following construction, the site should be inspected at least twice after storm events that exceed a half-inch.
- **Spot Re-seeding**: Inspectors should look for bare or eroding areas in the contributing drainage area or around the bioretention area, and make sure they are immediately stabilized with grass cover.
- **Fertilization**: One-time, spot fertilization for initial plantings.
- **Watering**: Once a week during the first two months, and then as needed during the first growing season (Apr – Oct), depending on rainfall.

*Remove and replace dead plants*. Since up to ten percent of plant stock may die off in the first year, construction contracts should include a care and replacement warranty to ensure vegetation is properly established and survives during the first growing season following construction. The typical thresholds for replacement are 85% survival of plant material and 100% survival of trees.

Maintenance Inspections
It is highly recommended that a spring maintenance inspection and cleanup be conducted at each bioretention area. The Table below presents some of the key maintenance problems.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check to see if 90% mulch + vegetative cover has been achieved in the bed, and measure depth of remaining mulch.</td>
<td></td>
</tr>
<tr>
<td>Check for sediment buildup at curb cuts, gravel diaphragms or pavement edges that prevent flow from getting into the bed.</td>
<td></td>
</tr>
<tr>
<td>Check for any winter or salt-killed vegetation and replace with hardier species.</td>
<td></td>
</tr>
<tr>
<td>Note presence of accumulated sand, sediment and trash in pretreatment cell or filter beds and remove.</td>
<td></td>
</tr>
<tr>
<td>Inspect bioretention side slopes and grass filter strips for evidence of any rill or gully erosion and repair.</td>
<td></td>
</tr>
<tr>
<td>Check bioretention bed for evidence of mulch flotation, excessive ponding, dead plants or concentrated flows and take appropriate remedial action.</td>
<td></td>
</tr>
<tr>
<td>Check inflow points for clogging and remove any sediment.</td>
<td></td>
</tr>
<tr>
<td>Look for any bare soil or sediment sources in the contributing drainage area and stabilize immediately.</td>
<td></td>
</tr>
</tbody>
</table>

Routine and Non-Routine Maintenance Tasks
Maintenance of bioretention areas should be integrated into routine landscaping maintenance tasks. If landscaping contractors will be expected to perform maintenance, their contracts should contain specifics on unique bioretention landscaping needs, such as maintaining elevation differences needed for ponding, proper mulching, sediment and trash removal, and limited use of fertilizers and pesticides. A customized maintenance schedule must be prepared for each bioretention facility, since the maintenance tasks will differ depending on the scale of bioretention, the landscaping template chosen, and the nature of surface cover. A generalized summary of common maintenance tasks and their frequency is provided in the Table below.
Appendix H1 – Facility Maintenance Recommendations

<table>
<thead>
<tr>
<th>Maintenance Tasks</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Spring inspection and cleanup.</td>
<td>Annual</td>
</tr>
<tr>
<td>• Add reinforcement planting to maintain desired vegetation density.</td>
<td>As needed</td>
</tr>
<tr>
<td>• Spot weeding, erosion repair, trash removal, and mulch raking.</td>
<td>Twice during growing season</td>
</tr>
<tr>
<td>• Sediment removal in pretreatment cells and inflow points.</td>
<td>Once every two to three years</td>
</tr>
<tr>
<td>• Mowing of grass filter strips and bioretention turf cover.</td>
<td>At least four times a year</td>
</tr>
<tr>
<td>• Remove invasive plants using recommended control methods.</td>
<td>As needed</td>
</tr>
<tr>
<td>• Supplement mulch to maintain a 3-inch layer.</td>
<td>Annual</td>
</tr>
<tr>
<td>• Replace mulch layer.</td>
<td>Every three years</td>
</tr>
<tr>
<td>• Prune trees and shrubs.</td>
<td>Annual</td>
</tr>
<tr>
<td>• Stabilize contributing drainage area to prevent erosion.</td>
<td>When needed</td>
</tr>
</tbody>
</table>

The most common non-routine maintenance problem involves standing water. If water remains on the surface for more than 48 hours after a storm, adjustments to the grading may be needed or underdrain repairs may be needed. The surface of the filter bed should also be checked for accumulated sediment. Core aeration or deep tilling may relieve the problem.
### Appendix H2 – Facility Inspection Checklist

**Stormwater Management Facility Inspection and Maintenance Log (Sample)**

<table>
<thead>
<tr>
<th>Property Address:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inspection Date:</th>
<th>________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Inspection Time:</th>
<th>________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Inspected By:</th>
<th>____________________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Date and Time of Last Rainfall:</th>
<th>____________________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Type of Stormwater Management Facility:</th>
<th>____________________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Location of Facility on Site (in relation to buildings or other structures):</th>
<th>____________________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Water levels and observation (Oil sheen, Smell, Turbidity, etc.):</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sediment accumulation and record of sediment removal:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Condition of Vegetation (Height, survival rates, invasion species present, etc.) and record of replacement and management (mowing, weeding etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Condition of physical properties such as inlets, outlets, piping, fences, irrigation facilities, and side slopes. Record damaged items and replacement activities:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Presence of insects or rodents. Record control activities:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Identify safety hazards present. Record resolution activities:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>
**Appendix H3 – Example Maintenance Agreement Waiver to Protest SID**

**Responsible Party**
List the party that shall be permanently responsible for the maintenance of structural or non-structural measures required by the Operation Manual. (e.g., owner, governmental agency, or other legal established entity)

**Designated personnel for inspection and maintenance:**
Name: _______________________________________________________________
Address: _______________________________________________________________
Contact Phone: ___________________________ Cell: ___________________________

**Property Description**
List legal description of property: ___________________________________________

**Operation and Maintenance**
Has the Operation and Maintenance Manual been created? □ Yes □ No
Responsible Party shall ensure the continued performance of the maintenance obligation in accordance with the Operation and Maintenance Manual.

**Failure to Maintain Stormwater Systems**
If the required maintenance and repairs are not being performed and inhibit the intended function of the stormwater system, the City may hire a contractor to perform the required maintenance and bill the HOA, POA, or responsible property owner.
In the event the HOA, POA, or responsible property owner fail to perform the required maintenance and repairs to the stormwater facility and inhibit the intended function of the stormwater system, a stormwater maintenance district program may be formed in accordance with §7-12-4102 MCA incorporating all the lots within a development. The taxes levied within the maintenance district shall be determined by the Public Works Department with approval by the Kalispell City Council.

By signing the Maintenance Agreement the Responsible Party shall assume full responsibility for the maintenance of the stormwater system.

X _______________________________________________________________
Signature of Responsible Party Date

---

**WAIVER TO PROTEST THE FORMATION AND PARTICIPATION IN A SPECIAL IMPROVEMENT DISTRICT**

Kalispell City Clerk
201 First Avenue East
Kalispell, MT 59901

Please return to:
Kalispell City Clerk
201 First Avenue East
Kalispell, MT 59901
Appendix H3 – Example Maintenance Agreement Waiver to Protest SID

The undersigned hereinafter referred to as Applicant has requested and received the consideration and approval of the City of Kalispell to develop improvements within the City, on private real property as the legally described as follows:

Legal Description:

The City has approved the requisite stormwater facilities to be constructed upon the real property owned by the Applicant upon the conditions that 1) the Applicant shall adequately maintain the stormwater facilities pursuant to City standards and the applicable Stormwater Maintenance Permit and that 2) Applicant shall waive the statutory right it has to protest a future special improvement district as afforded by MCA 7-12-4110 for the maintenance or the reconstruction of the stormwater facilities serving the property in the event the Applicant fails in its maintenance obligation.

The Applicant, therefore, in consideration for the City’s approval of its requisite stormwater facility design, hereby waives right to protest the formation by the City of Kalispell of a special improvement district pursuant to Title 7 Chapter 12 of Montana Code Annotated which the Applicant may have or may hereafter acquire, and waive any and all right to protest any attempt or proceedings made by or on behalf of the City of Kalispell to form such special improvement district.

The Applicant further agrees that this Waiver to Protest to the formation of a Special Improvement District is a covenant which shall run to, with, and be binding upon the title of the said real property, and shall be binding upon any heirs, assigns, successors in interest, purchasers, and any and all subsequent holders or owners of the above described real property.

Dated this _____ day of ________________, 20__

____________________________________
Applicant

STATE OF MONTANA

County of Flathead

On this _______day of _____________, ____, before me, the undersigned, a Notary Public for the State of Montana, personally appeared _________________ known to me to be the person whose name is subscribed to the foregoing instrument and acknowledged to me that he/she executed the same.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my Notary Seal the day and year in this certificate first above written.
Appendix H – Example Maintenance Agreement

Waiver to Protest SID

_______________________________________
Notary Public, State of Montana
Printed Name: ________________________
Residing at ___________________________
My Commission expires:

STATE OF MONTANA ( )
County of Flathead ( )

On this __________ day of __________, __________, before me, the undersigned, a Notary Public for The State of Montana, personally appeared ______________________________________ and __________________________________, the __________________________________, and __________________________________, respectively, of __________________________________, the corporation that executed the foregoing instrument, and the persons who executed said instrument on behalf of said corporation, and acknowledged to me that such corporation executed the same.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my Notary Seal the day and year in this certificate first above written.

_______________________________________
Notary Public, State of Montana
Printed Name: ________________________
Residing at ___________________________
My Commission expires __________________
Appendix I – Example Ownership Transfer Letter

City of Kalispell
P. O. 1997
Kalispell, MT 59901

Re: Name of project/building/subdivision

(I)(We), the undersigned property owner(s), do hereby certify that (I)(We) have caused to be designed, constructed and tested the required infrastructure improvements necessitated by the development of (NAME of project/subdivision) in accordance with the approved plans.

As a condition of this development, we dedicate the improvements to the City of Kalispell. These improvements include all improvements within the City right-of-way including streets; sidewalks; street lighting; storm sewer, sanitary sewer, and water distribution mains; and other associated appurtenances. Also included in the dedication are water and sanitary sewer mains and appurtenances located in easements outside of rights-of-way. Specifically excluded from this dedication are stormwater facilities located outside of the City owned rights-of-way, which shall be owned and maintained by the property owners (or HOA, POA, etc.).

Dated this ________ day of ________, 20___.

(Acknowledged and notarized signatures of all record owners of developed property)
Appendix J – Example Agreement for Construction Inspection

City of Kalispell
P.O. 1997
Kalispell, MT 59901

Re: Name of project/development/building/subdivision

(I)(We), the undersigned property owner(s), in accordance with Section 3.2.4 of the City of Kalispell Design and Construction Standards, do hereby agree to employ a Professional Engineer to witness and verify all construction is in compliance with the approved design and minimum construction standards of all proposed City of Kalispell infrastructure within the project.

Also, (I)(We) agree to complete, either personally or by proxy, all required inspection, testing, and quality control specified in Section 1.4 of the City of Kalispell Design and Construction Standards. Results of all required testing will be provided to the City of Kalispell prior to application for acceptance and transfer of all infrastructure to be owned by the City of Kalispell.

Furthermore, upon completion of construction, (I)(We) agree to employ a Professional Engineer to prepare and provide a certification stating all construction was completed in accordance with the City of Kalispell Design and Construction Standards; to prepare and provide record drawings in accordance with Section 1.6 of said Standards; to prepare and provide quantities and unit costs of all City-owned infrastructure; and to certify the unit costs to aid in the preparation and submittal of the applicable warranty bond for review and approval by the City of Kalispell Public Works Department.

Dated this __________ day of ______________, 20___.

(Acknowledged and notarized signatures of all record owners of developed property)
Standard Details – General

**TYPICAL UTILITY TRENCH SECTION DETAIL**

1. TRENCH 3 FACE FLEXIBLE MARKER POST GREEN IN COLOR AND MARKED SEWER, FOR SEWER, BLUE IN COLOR AND MARKED WATER FOR WATER

2. TRACER WIRE SHALL BE Brought TO SURFACE INSIDE MARKING POST AT EACH POST

**TYPICAL UNDERGROUND MARKER POST**

1. TRACER WIRE MARKER POSTS SHALL BE INSTALLED AT ALL BENDS, VALVES, MANHOLE, AND AT A SPACING OF EVERY 400 FEET FOR ALL WATER MAINS, SEWER MAINS, FORCING MAINS, AND STORM MAINS NOT LOCATED IN PADDED OR CRUSHED AREAS.

2. TRACER WIRE MARKER/TRACING STATIONS SHALL BE LOCATED AT INTERVALS OF EVERY 400 FEET. TRACER WIRE SHALL BE Brought TO SURFACE INSIDE MARKING POST AT EACH POST.

**NOTES**

1. TRENCH 3 FACE MARKER POSTS SHALL BE INSTALLED AT ALL BENDS, VALVES, MANHOLE, AND AT A SPACING OF EVERY 400 FEET FOR ALL WATER MAINS, SEWER MAINS, FORCING MAINS, AND STORM MAINS NOT LOCATED IN PADDED OR CRUSHED AREAS.

2. TRACER WIRE MARKER/TRACING STATIONS SHALL BE LOCATED AT INTERVALS OF EVERY 400 FEET. TRACER WIRE SHALL BE Brought TO SURFACE INSIDE MARKING POST AT EACH POST.
TYPICAL UTILITY CONNECTIONS

1. Service shall extend perpendicularly from the connection at the service main to the property line.
2. Service shall not pass through any adjacent private property.
3. One service is required for each parcel ownership.
4. Service shall extend perpendicularly from the connection at the main in the direction of flow.

WATER SERVICE REQUIREMENTS:
1. Meter pit and curb stop shall be centered in the boulevard. If meter pit is placed in a driveway, a HSG-50 traffic rated ring and cover shall be provided.
2. Service shall extend perpendicularly from the connection at the water main to the property line.
3. Service shall not pass through any adjacent private property.
4. One service is required for each parcel ownership.
Standard Details – Water System

WATER SYSTEM CONSTRUCTION NOTES:

1. THRUST BLOCKING IS REQUIRED AT ALL TEES, BENDS, CAPS, WATER MAIN VALVES, AND FIRE HYDRANTS IN ACCORDANCE WITH MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS.

2. WATER MAINS SHALL BE INSTALLED WITH 1/2 GAUGE SOLID CORE COPPER TONER WIRE WITH NOPE OR HAWNE INSULATION APPROVED BY THE MANUFACTURER FOR DIRECT BURY. THE TONER WIRE SHALL BE TAPPED TO THE TOP OF THE WATER MAIN AT INTERVALS NO MORE THAN 5 FT. TONER WIRE SHALL BE EXTENDED TO THE SURFACE AT ALL FIRE HYDRANT LOCATIONS. TONER WIRE SHALL BE ROUTED UP BEHIND EACH HYDRANT WITH THE LAST 3 FEET OF THE WIRE BELOW THE SURFACE BEING ENCLODED IN 1 INCH CONDUIT. TONER WIRE SHALL BE ACCESSIBLE WITH 3 FT OF EXCESS TO CONNECT WITH TONER EQUIPMENT.

3. ALL IRON FITTINGS AND METAL PARTS SHALL BE WRAPPED IN POLYETHYLENE ENCASMENT.

4. CONCRETE COLLARS SHALL BE INSTALLED AT WATER VALVE BOX RISERS AND MANHOLE RING AND CASTINGS. SEE CITY OF HAVRE, STANDARDS FOR CONSTRUCTION.

5. TEMPORARY WATER SERVICES SHALL BE SUPPLIED DURING CONSTRUCTION WHEN WATER SERVICE WILL BE INTERRUPTED FOR MORE THAN FOUR (4) HOURS. A TEMPORARY WATER SERVICE PLAN SHALL BE SUBMITTED TO AND APPROVED BY THE CITY PRIOR TO THE COMMENCEMENT OF CONSTRUCTION. ALL TEMPORARY WATER SERVICES SHALL COMPLY WITH MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY DESIGN CIRCULAR 1.

6. CONTRACTOR SHALL PERFORM HYDROSTATIC LEAK TESTING IN ACCORDANCE WITH MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS AS MODIFIED BY CITY SPECIAL PROVISION 02600.

7. ALL NEW, CLEANED OR REPAIRED WATER MAINS SHALL BE FLUSHED AND DISINFECTED IN ACCORDANCE WITH MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS AS MODIFIED BY CITY SPECIAL PROVISION 02660.

8. THE CONTRACTOR SHALL BE RESPONSIBLE TO TAKE ALL BAC-T TESTS UNDER THE SUPERVISION OF CITY STAFF. AFTER SAMPLE COLLECTION THE CITY SHALL TAKE CUSTODY OF SAMPLES AND DELIVER TO A CERTIFIED ENVIRONMENTAL LAB. ALL TESTING SHALL BE AT THE EXPENSE OF THE CONTRACTOR.

WATER SERVICE CONNECTION DETAIL

MUELLER SERIES 300 BALL STYLE Curb STOP valve

NOTES:

1. 2" service shall be installed with 632 SERIES SERVICE SADDLES AND PE SERVICE LINE.

2. 4" and LARGER SERVICES SHALL BE INSTALLED WITH A ROMAC 35M STAINLESS STEEL TAPPING SLEEVE AND CLASS 150 PVC SERVICE LINE.

3. MUELLER H-10004 (F = 1" service) OR MUELLER H-10510 (1", 1 1/2", 2", OR 3" services) cast iron extension type with arch pattern base. Minimum length 6 1/2" equipped with a 1" galvanized steel sanitary pipe and a polyethylene bend pipe or equivalent.

4. MUELLER THERMO-CAL METER FITS WITH CENTER LOCKING COMPOSITE LUGS AND INSULATION PADS FOR SERVICES UP TO 1". MUELLER GALV or ANTI-EXPOSED with CENTER LOCKING COMPOSITE LUGS AND INSULATION PADS FOR SERVICES LARGER THAN 1".
Standard Details – Water System

Water Details

WATER MAIN LOWERING SECTION DETAIL

REBAR ANCHOR

NOTES
1. CAT RODS WITH A BITUMINOUS NO. 50 COATING OR EQUIVALENT
2. PRESSURES SHOWN ARE MAXIMUM WORKING PRESSURES IN THE SYSTEM

W.6

STANDARD THRUST BLOCK DIMENSIONS

THRUSt BLOCKING FOR WATER MAIN VALVES

(MPV855 SD No. 32660-2)

Click to Return to Index
Standard Details – Water System

Notes:
1. These tables are based on 150 PSI main pressure & 7200 PSI soil bearing pressure.
2. Wrap all fittings with polyethylene.

<table>
<thead>
<tr>
<th>Fitting Size</th>
<th>1 1/2&quot;</th>
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<th>3&quot;</th>
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<tr>
<td>B</td>
<td>1 1/2&quot;</td>
<td>2&quot;</td>
<td>3&quot;</td>
<td>4&quot;</td>
</tr>
</tbody>
</table>

Thrust Blocking for Water Main Fittings

W.O.S

Water Main and Sewer Main Separation

Note:
1. Specific Montana Department of Environmental Quality Approval is required for a distance less than 10 feet between water and sanitary sewer.
2. No exception to the pipe separation requirement is permitted when the sewage pipe is a force main. At crossings, one full length of water main pipe shall be located so that both joints will be as far from the force main as possible.
3. Less than 18" of separation is permitted when the gravity sewer at the crossing is made from one single 20 foot length of amra pressure pipe and the crossing angle is approximately 0°. Specific Montana Department of Health and Environmental Sciences Approval is required for a vertical separation of less than 18" between water main and sanitary sewer.
4. "L" is the length of pipe as supplied by the manufacturer.
5. Adequate structure support for pipes at crossing shall be provided.

Click to Return to Index
Standard Details – Sanitary Sewer System

SANITARY SEWER SYSTEM CONSTRUCTION NOTES:

1. Roof drains, foundation drains, storm sewers, sump pumps and other clean water connections to the sanitary sewer are strictly prohibited.

2. Gravity sanitary sewer shall be 108” PVC sewer pipe conforming to ASTM D-3034. Pipes shall be constructed meeting the minimum pipe slope requirements of Montana 004 Circular 2.

3. All pipe shall be capped or plugged at the end of each work day.

4. All manholes and foremain valve boxes shall have a concrete collar per City of Kalispell Standards for Design and Construction.

5. Sewer foremain shall be installed with 1/2 gauge solid core copper tubing wire with hoist or hanger insulation approved by the manufacturer for direct bury. The inner wire shall be taped to the top of the foremain at intervals of no more than 5 ft. Tinner wire shall be extended to the surface at all valve boxes, lift stations, and at manhole posts. Tinner wire shall be accessible at the surface with a minimum 2 feet of excess wire.

6. All water and sewer crossings shall be made at perpendicular alignment. A minimum of 18 inches of outside pipe wall separation must be maintained. A minimum of 10 feet of horizontal separation must be maintained between sanitary sewer and potable water mains.

7. The terminal end of all service stubs shall be marked with metal “T” post as indicated in the City of Kalispell Standards for Design and Construction.

8. All gravity sanitary sewer main shall be laid upstream with the spout ends pointing downstream. All pipes shall be set at constant grade and alignment between manholes.

9. Sanitary sewer pipe line and appurtenances shall be cleaned and tested upon completion of backfill operations. All testing shall be under the supervision of the project engineer and representative of the City of Kalispell Public Works Department.

SEWER SYSTEM CONSTRUCTION NOTES

TYPICAL MANHOLE CHANNEL DETAIL
SANITARY SEWER MANHOLE DETAIL

MANHOLE NOTES:
1. ECCENTRIC MANHOLES REQUIRED ON ALL 4 FT DIAMETER MANHOLES GREATER THAN 5 FT IN OVERALL HEIGHT UNLESS SPECIFIED OTHERWISE.
2. ALL JOINTS BETWEEN MANHOLE SECTIONS, ADJUSTING RINGS, MANHOLE RING, AND TOP SECTION, AND AROUND ALL SEWER PIPE IN MANHOLE SHALL BE WATER TIGHT. JOINTING MATERIAL SHALL BE "RAIN-RET" OR EQUAL FOR ALL JOINTS EXCEPT BETWEEN SEWER PIPE AND MANHOLE WALL.
3. FIELD SET COVER TO GRADE WHEN MANHOLE IS LOCATED WITHIN A STREET OR ALLEY.
4. SHELVE SHALL SLOPE AT 1" PER FOOT TOWARD CHANNEL.
5. SEE 6.1.1.5 OF STANDARDS.
Standard Details – Sanitary Sewer System

**TYPICAL SANITARY SERVICE TO EXISTING MAIN**

**TYPICAL SANITARY SEWER SERVICE STUB-OUT**

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**NOTES**

1. No service connections shall be made at manholes.

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**Field Code Changed**
Sanitary Details – Sanitary Sewer System

**TYPICAL SEWER MANHOLE MARKER POST**

- **NOTES:**
  1. Sewer try holes shall be installed for all manholes located outside of paved or gravel areas.

**TYPICAL FORcemain VALVE SECTION DETAIL**

- **NOTES:**
  1. Valves 6" and larger shall have worm gear reduction actuator with 2" square nut.
  2. Valves installed with worm gear shall flow entering seat end of valve and the plug being up in open position.
Standard Details – Sanitary Sewer System

FORCEMAIN DISCHARGE MANHOLE DETAIL

SANITARY MANHOLE COVER
Standard Details – Sanitary Sewer System

Notes:
1. Grease Interceptor Discharge Line
2. Minimum 24" Opening with Ring and Lid
3. Field Code Changed
4. The Operating Level Piping (Must Extend to 50% of Secondary Chamber Operating Level)
5. The Operating Level Piping (Must Extend to 50% of Secondary Chamber Operating Level)
6. The Operating Level Piping (Must Extend to 50% of Secondary Chamber Operating Level)
7. The Operating Level Piping (Must Extend to 50% of Secondary Chamber Operating Level)

For More Information, Contact the Industrial Pretreatment Coordinator's Office At 408-15919791
Sanitary Details – Sanitary Sewer System

1. Field Code Changed

2. Sand & Oil Separator Discharge Line

3. Typical Sand/Oil Separator

4. Sand & Oil Separator Discharge Line

5. Secondary Chamber Outlet Pipe Must Extend to 50% of the Total Volume

6. Primary Chamber Outlet Pipe Must Extend to 35% of the Total Volume

7. Primary Chamber Overflow Pipe Must Extend to 60% of the Total Volume

8. Single Port Maximum 10" Diameter. Provide a 6" Vertical Drop

9. Secondary Chamber Outlet Pipe Must Extend to 65% of the Total Volume

10. Bypass Support

11. Field Code Changed

12. Field Code Changed

13. Field Code Changed

14. Field Code Changed

15. Field Code Changed
LIFT STATION SITE STANDARD DETAIL

NOTES:
1. PROVIDE A MINIMUM OF 7’ OF CLEARANCE BETWEEN PUMPS AND CONTROLS TO INTERIOR WALLS AND APPARATUS (HEATER, AUTOMATIC TRANSFER SWITCH, ETC.)
2. SEE SECTIONS 6.1.7 AND 6.2.9 FOR SPECIFIC DESIGN AND CONSTRUCTION REQUIREMENTS.
3. BUILDING SHALL MEET BUILDING CODES AND BE SUBMITTED TO ARCHITECTURAL REVIEW COMMITTEE, IF REQUIRED.
4. BUILDING COLORS AND ALTERNATIVE ARCHITECTURAL FINISHES SHALL BE APPROVED BY THE CM PWD.
Standard Details – Storm Sewer System

TYPICAL STORMWATER CATCH BASIN DETAIL

TYPICAL STORMWATER MANHOLE DETAIL
EROSION AND SEDIMENT CONTROL NOTES:

1. The contractor shall be responsible to obtain all permits associated with this project and implement and maintain the erosion and sediment control plan and permits requirements until such time as the permits are terminated.

2. The contractor is responsible to maintain or change the erosion and sediment control plan as the project progresses to ensure permit compliance.

3. The contractor shall remove all sediment, mud, and construction debris that may accumulate in the public right of way as a result of this project. Said material shall be removed daily or more frequently per the city’s request.

4. The contractor shall ensure all cut and fill material imported to or exported from this site is properly covered to prevent loss of the material during transport on public rights of way.

5. The contractor shall ensure all cut and fill material imported or exported is not stored in the public right of way.

6. All stockpiled material shall be designated on the erosion and sediment control plan.

7. Temporary BMPs on the erosion plan shall be installed prior to any excavation.

8. Inlet protection BMPs shall be installed prior to any excavation and maintained until paving is complete. Inlet protection BMPs shall be approved by the city of Waldorf prior to installation.

Vehicle Tracking Stone Entrance Requirements:
- 3"-6" diameter washed rock
- Underlying filter fabric to be required as stated

Filter Fabric Requirements:
- Tensile Gram Strength = 2000 lbs (ASTM D4432)
- Elongation Minimum = 15% (ASTM D4432)
- Seam Breaking Strength Minimum = 150 lbs (ASTM D4432)
- Aperture Opening Size Maximum = 0.3 mm (160 sieve) (ASTM D4751)
- Permeability Minimum = 0.5 sec (ASTM D4491)
Standard Details – Storm Sewer System

NOTE:
1. Silt fence shall be used as a temporary sediment control. Fences shall be installed with the contour of the slope.
2. Wood posts shall be hardwood with and minimum cross-section area of three inches.
3. Temporary silt fence shall be removed upon site stabilization with 70% established vegetative cover.

GEOTEXTILE FABRIC REQUIREMENTS:
- Tensile grab strength = 90 lbs (ASTM D1685)
- Elongation maximum = 50% (ASTM D1002)
- Mullen burst strength minimum = 190 lbs (ASTM D3788)
- Puncture strength minimum = 40 lbs (ASTM D791)
- Equivalent opening size maximum = 40-80 US standard sieve sizes
- Ultimate resistance stability = 80 (ASTM D288)

SILT FENCE STORMWATER BMP

EROSION CONTROL BLANKET FOR SLOPE PROTECTION.

1. Prepare soil before installing blankets, including application of fertilizer and seed.
2. Anchor the blanket in a 6" deep x 6" wide trench at top of slope. Backfill and compact the trench after stapling.
3. Roll blankets down, starting at downstream proceeding upstream, horizontally across the slope.
4. Parallel blankets must be stapled with a 4" overlap.
5. Splotch blankets only as necessary. Place blankets end over end with an 12" overlap. Use double row of staggered staples 4" apart to secure blanket.
6. In high flow applications staple with double staggered row every 30' to 40'. Use a row of staples 4" apart over entire width of channel, use second row 4" below the first row in a staggered pattern.
7. The terminal end of the blankets shall be anchored in a 6" x 6" trench. Backfill and compact after stapling.

EROSION CONTROL BLANKET BMP

Field Code Changed
Standard Details – Storm Sewer System

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<tr>
<th>SKIMMER DIAMETER</th>
<th>SKIMMER OPENING (WxH)</th>
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<tr>
<td>3&quot;</td>
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<td>4&quot;x1.5&quot;</td>
</tr>
<tr>
<td>6&quot;</td>
<td>5.5&quot;x1.5&quot;</td>
</tr>
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</table>

Provide 6-1/2 anchor bolts with clips (2)

1 1/4" x 1/2" outer ring

1 3/4" steel bars at 4" o.c.

Grate shall be hinged for maintenance access.

Outlet elevation (g.g.)

Elev= XXX, XX skimmer opening

4 CY class 1 riprap

DIA. VARIES

1" minus aggregate backfill.

NOTES:

1. Center skimmer on O.C. contour and grade in front of skimmer opening as necessary to provide for skimmer opening.
2. Anchor bolts shall be stainless steel (or hot-dipped galvanized) wedge or strike anchors, 3-1/2" min. length.
3. Prefabricated galvanized skimmer grate, plate style by haul industries is an approved equal. (See haulindustries.com)
### Standard Details – Storm Sewer System

<table>
<thead>
<tr>
<th>Skimmer Diameter</th>
<th>Skimmer Opening (WxH)</th>
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<tbody>
<tr>
<td>5&quot;</td>
<td>4&quot; x 1&quot;</td>
</tr>
<tr>
<td>6&quot;</td>
<td>5.5&quot; x 1.5&quot;</td>
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</table>

**Rectangular Skimmer Opening**

- Grate shall be hinged for maintenance access.
- Provide 8-1/2 anchor bolts with cups (2).
- 1 ½" x 8" outer ring.
- 1 ½" x 1" steel bars at 4" O.C.
- Precast wall shall be watertight.
- 1/8" steel bar weld to each member.
- Hot-dipped galvanized grate in 2 sections (3).

**Outlet Elevation (OC)**

- 4 CY Class 1 backfill.
- 0.5" min. opening.
- 5" dia. min.
- Hole for XX" dia. outlet pipe.
- HDPE with 3" minus aggregate backfill.

**Notes:**

1. Center skimmer on O.C. contour and grade in front of skimmer opening as necessary to provide for skimmer opening.
2. Anchor bolts shall be stainless steel (or hot dipped galvanized) wedge or strike anchors, 3-1/2" min. length.
3. Pre-fabricated galvanized skimmer grate, plate style by Haalu Industries is an approved equal. (See HaaluIndustries.com)

**Dr.3**

**Fencing Basin Skimmer Structure with Baffle Wall**
TABLE OF QUANTITIES FOR RIPRAP AT OUTLETS

<table>
<thead>
<tr>
<th>DIA  (IN)</th>
<th>W  (FT)</th>
<th>L  (FT)</th>
<th>GEO. FABRIC (BV)</th>
<th>GRANULAR FILTER (CY)</th>
<th>18&quot; DEPTH RIPRAP (CY)</th>
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</table>

NOTES:
1. RIPRAP 0.5" with 0.25". 
2. PIPE SIZES LARGER THAN SHOWN SHALL HAVE SPECIAL DESIGN SUBMITTED TO CK MD OR FOR REVIEW AND APPROVAL. 
3. GEOTEXTILE FABRIC SHALL COVER THE BOTTOM AND SIDES OF THE AREA EXCAVATED FOR THE RIPRAP AND GRANULAR FILTER MATERIALS.
Standard Details – Transportation System

Utility Note:
All new utilities shall be placed underground, except for sewer and water. Underground utilities, if placed in right of way or easement, shall be located between the back of sidewalk and easement line. No underground utilities shall be placed in the boulevard between the back of curb and sidewalk.

URBAN COLLECTOR

2T1
1. LANE CONFIGURATION AND LENGTHS TO BE DETERMINED BY TRAFFIC ANALYSIS
2. TAPER RATES SHALL BE DETERMINED BY DESIGN SPEED OF THE ROADWAY
3. ALL PAVEMENT MARKINGS SHALL BE EPOXY AND CONFORM TO CURRENT MUTCD STANDARDS

* SEE ROAD CONSTRUCTION GENERAL NOTES FOR MATERIAL SPECIFICATIONS

UTILITY MORG:
ALL NEW UTILITIES SHALL BE PLACED UNDERGROUND.
Utility Note:
All new utilities shall be placed underground, except for sewer and water. Underground utilities, if placed in right of way or easement shall be located between the back of sidewalk and easement line. No underground utilities shall be placed in the boulevard between the back of curb and sidewalk.
Standard Details – Transportation System

Utility Note:
All new utilities shall be placed underground, except for sewer and water. Underground utilities, if placed in right of way or easement shall be located outside of ditch sections, and bike paths. No private underground utilities shall be placed in the public right-of-way.

Note:
1. This cross section may be used only when the area adjacent to the proposed development does not have curbing or established storm drainage systems. This cross section shall only be used in R1 zoning and must be approved by the city council prior to incorporating into the drawings.
2. A 10 ft clear zone must be maintained adjacent to shoulder of road. No address posts or mailboxes may be placed in the clear zone.
3. No parking is allowed along the street.

RURAL LOCAL

ST 4
Standard Details – Transportation System

**ALLEY TYPICAL SECTION**

1. ASPHALT – SHALL BE P058–28 ASPHALT CONCRETE PAVEMENT SURFACE COURSE P058–28 SHALL BE ACCOMPANYING IN ACCORDANCE WITH SECTION 02510 MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS, FIFTH EDITION, APRIL 2010. SEE CITY OF KALISPELL STANDARDS FOR DESIGN AND CONSTRUCTION FOR PAVEMENT AND MATERIAL TESTING REQUIREMENTS.

2. CRUSHED GRAVEL BASE, −3/4" DIAMETER ø95% MAX DRY DENSITY (± 3% OPTIMUM MOISTURE) PER AASHTO T-99.

3. SELECT SUB-BASE ø95% MAX DRY DENSITY (± 3% OPTIMUM MOISTURE) PER AASHTO T-991.

4. CRUSHED GRAVEL SHOULDER, −3/4" DIAMETER ø 95% MAX DRY DENSITY (±/− 3% OPTIMUM MOISTURE) PER AASHTO T-99.

A. THICKNESSES OF ASPHALT, CRUSHED GRAVEL AND SUB-BASE SHALL BE AS SHOWN, UNLESS AN ALTERNATE DESIGN IS APPROVED. THE FINAL STREET DESIGN SHALL BE APPROVED BY THE CITY ENGINEER PRIOR TO START OF CONSTRUCTION.

B. THE WIDTH OF THE RIGHT-OF-WAY MAY BE INCREASED DUE TO UTILITIES OR OTHER REQUIREMENTS.

C. THE MAXIMUM GRADE SHALL BE 8%.

D. ON STREET PARKING GOVERNED BY CITY OF KALISPELL SUBDIVISION REGULATIONS.

**ROAD CONSTRUCTION NOTES AND SPECIFICATIONS**
1. 1/2" EXPANSION JOINT MATERIAL SHALL BE PLACED AT EACH POINT OF CURVATURE AND POINT OF TANGENCY.

2. CONTRACTION JOINTS SHALL BE PLACED AT EVERY 10' OF CURB LENGTH AND SHALL HAVE A MINIMUM DEPTH OF 1/2" AND A MINIMUM WIDTH OF 1/8". CONTRACTION JOINTS SHALL BE CONSTRUCTED BY SAWING OR SCORING A TOOL SHALL BE USED WHICH WILL LEAVE CORNERS ROUNDED AND DESTROY AGGREGATE INTERLOCK FOR THE SPECIFIED MINIMUM DEPTH.

3. EXPOSED EDGES SHALL BE FINISHED TO A RADIUS OF 1/4".

4. CONCRETE SHALL BE M-4000 WITH 3/4" MAXIMUM AGGREGATE, MINIMUM 28-DAY STRENGTH OF 4000 PSI, 6% 1 1/2% AIR ENTRAINMENT, AND MAXIMUM SLUMP OF 4".

5. INDIVIDUAL CONTRACTORS FORMS MAY VARY SLIGHTLY FROM THIS PATTERN. PATTERN DIFFERING MATERIALLY FROM THE ABOVE DIMENSIONS SHALL BE SUBMITTED TO THE CITY FOR REVIEW.

6. FOUR INCHES OF CRUSHED GRAVEL BASE MATERIAL, -3/4" DIAMETER IS REQUIRED FOR THE CURB AND GUTTER FOUNDATION. THE BASE MATERIAL SHALL BE COMPACTED TO 95% DENSITY (± 3% OPTIMUM MOISTURE) PER AASHSTO T-99.

STANDARD CURB AND GUTTER SECTION

1. 1/2" EXPANSION JOINT MATERIAL SHALL BE PLACED AT EACH POINT OF CURVATURE AND POINT OF TANGENCY.

2. CONTRACTION JOINTS SHALL BE PLACED AT EVERY 10' OF CURB LENGTH AND SHALL HAVE A MINIMUM DEPTH OF 1/2" AND A MINIMUM WIDTH OF 1/8". CONTRACTION JOINTS SHALL BE CONSTRUCTED BY SAWING OR SCORING A TOOL SHALL BE USED WHICH WILL LEAVE CORNERS ROUNDED AND DESTROY AGGREGATE INTERLOCK FOR THE SPECIFIED MINIMUM DEPTH.

3. EXPOSED EDGES SHALL BE FINISHED TO A RADIUS OF 1/4".

4. CONCRETE SHALL BE M-4000 WITH 3/4" MAXIMUM AGGREGATE, MINIMUM 28-DAY STRENGTH OF 4000 PSI, 6% 1 1/2% AIR ENTRAINMENT, AND MAXIMUM SLUMP OF 4".

5. INDIVIDUAL CONTRACTORS FORMS MAY VARY SLIGHTLY FROM THIS PATTERN. PATTERN DIFFERING MATERIALLY FROM THE ABOVE DIMENSIONS SHALL BE SUBMITTED TO THE CITY FOR REVIEW.

6. FOUR INCHES OF CRUSHED GRAVEL BASE MATERIAL, -3/4" DIAMETER IS REQUIRED FOR THE CURB AND GUTTER FOUNDATION. THE BASE MATERIAL SHALL BE COMPACTED TO 95% DENSITY (± 3% OPTIMUM MOISTURE) PER AASHSTO T-99.

7. THIS CURB DOES NOT MEET HANDICAPPED ACCESS REQUIREMENTS AND SHALL NOT BE USED FOR ACCESS RAMPS.

STANDARD DRIVE OVER CURB AND GUTTER
Standard Details – Transportation System

1. 1/2” EXPANSION JOINT MATERIAL SHALL BE PLACED AT EACH POINT OF CURVATURE AND POINT OF TANGENCY.
2. CONTRACTION JOINTS SHALL BE PLACED AT EVERY 10’ OF CURB LENGTH AND SHALL HAVE A MINIMUM DEPTH OF 1/2” AND A MINIMUM WIDTH OF 1/8”. CONTRACTION JOINTS SHALL BE CONSTRUCTED BY SAWING OR SCORING. A TOOL SHALL BE USED WHICH WILL LEAVE CORNERS ROUNDED AND DESTROY AGGREGATE INTERLOCK FOR THE SPECIFIED MINIMUM DEPTH.
3. VISIBLE JOINTS SHALL BE FINISHED TO A RADIUS OF 1/4”. INJURY OTHERWISE NOTED.
4. GRADE, ALIGNMENT AND FORMS SHALL BE INSPECTED BY THE CITY PRIOR TO POURING.
5. CONCRETE SHALL BE M-4000 WITH 3/4” MAXIMUM AGGREGATE, MINIMUM 28-DAY STRENGTH OF 4000 PSI, 6% TO 8% AIR ENTRAPMENT, AND MAXIMUM SLUMP OF 4”.
6. INDIVIDUAL CONTRACTORS FORMS MAY VARY SLIGHTLY FROM THE PATTERN. ALL FORMS SHEETING MATERIAL FROM THE ABOVE DIMENSIONS SHALL BE SUBMITTED TO THE CITY FOR REVIEW.
7. FOUR INCHES OF CRUSHED GRAVEL BASE MATERIAL, -3/4” DIAMETER IS REQUIRED FOR THE CURB FOUNDATION. THE BASE MATERIAL SHALL BE COMPACTED TO 95% MOD (+/- 3% MOISTURE) PER AASHTO T-99.
8. IF SLIP-FLY FORMS ARE USED, A TEST SECTION SHALL BE Poured, INSPECTED AND APPROVED BY THE PUBLIC WORKS DEPARTMENT PRIOR TO PLACEMENT OF ANY PERMANENT STRAIGHT CURB.
9. ONLY ALLOWED WITH SPECIFIC APPROVAL OF CITY ENGINEER TO MATCH EXISTING CURB.

STRAIGHT CURB SECTION

1. PRE-FORMED 1/2” EXPANSION JOINT MATERIAL MEETING THE REQUIREMENTS OF AASHTO M-213 SHALL BE PLACED AT 45-FOOT INTERVALS AT ALL CURB JOINTS.
2. CONTRACTION JOINTS SHALL BE SPACED THE APPROPRIATE GAGE DIMENSION AS THE WIDTH, BUT NOT TO EXCEED SIX FEET. CONTRACTION JOINTS SHALL BE CONSTRUCTED BY SAWING OR SCORING. A TOOL SHALL BE USED WHICH WILL LEAVE THE EDGES ROUNDED AND DESTROY AGGREGATE INTERLOCK FOR THE SPECIFIED MINIMUM DEPTH. CONTRACTION JOINTS SHALL BE A MINIMUM OF 4 TIMES THE SIDEWALK THICKNESS.
3. ALL VISIBLE EDGES AND JOINTS SHALL BE ROUNDED WITH AN EDGING TOOL WITH A MINIMUM 1/4” RADIUS.
4. CONCRETE SHALL BE M-4000 WITH 3/4” MAXIMUM AGGREGATE, MINIMUM 28-DAY STRENGTH OF 4000 PSI, 6% TO 8% AIR ENTRAPMENT, AND MAXIMUM SLUMP OF 4”.
5. SIX INCHES OF CRUSHED GRAVEL BASE MATERIAL, -3/4” DIAMETER IS REQUIRED FOR THE SIDEWALK FOUNDATION. THE BASE MATERIAL SHALL BE COMPACTED TO 95% MOD (+/- 3% MOISTURE) PER AASHTO T-99.
6. SIDEWALK MINIMUM THICKNESS:
   - RESIDENTIAL: 4”
   - COMMERCIAL OR AT DRIVE APPROACH: 6”

STANDARD SIDEWALK SECTION
1. Base material shall be crushed gravel, -5/4" diameter compacted to 95% density (+/- 3% optimum moisture) per AASHO T-98.

2. Concrete shall be M-4000 with 3/4" maximum aggregate, minimum 28-day strength of 4000 psi, 6% +/- 1/10% air entrainment, and maximum slump of 4".

**DRIVEWAY DETAIL FOR CURB & GUTTER**

1. Base material shall be crushed gravel, -5/4" diameter compacted to 95% density (+/- 3% optimum moisture) per AASHO T-98.

2. Concrete shall be M-4000 with 3/4" maximum aggregate, minimum 28-day strength of 4000 psi, 6% +/- 1/10% air entrainment, and a maximum slump of 4".

**DRIVEWAY DETAIL FOR STRAIGHT CURB**
Standard Details – Transportation System

1. Base material shall be crushed gravel, 3/4" diameter compacted to 95% density (±3% optimum moisture) per AASHTO T-99.

2. Concrete shall be N-4000 with 3/4" maximum aggregate, minimum 28-day strength of 4000 psi, 6% ± 1.1/2% air entrainment, and maximum slump of 4".

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**DRIVEWAY DETAIL SIDEWALK AT CJRB ALT 1**

1. Base material shall be crushed gravel, 3/4" diameter compacted to 95% density (±3% optimum moisture) per AASHTO T-99.

2. Concrete shall be N-4000 with 3/4" maximum aggregate, minimum 28-day strength of 4000 psi, 6% ± 1.1/2% air entrainment, and maximum slump of 4".

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**DRIVEWAY DETAIL SIDEWALK AT CURB ALT 2**

1. Base material shall be crushed gravel, 3/4" diameter compacted to 95% density (±3% optimum moisture) per AASHTO T-99.

2. Concrete shall be N-4000 with 3/4" maximum aggregate, minimum 28-day strength of 4000 psi, 6% ± 1.1/2% air entrainment, and maximum slump of 4".
Standard Details – Transportation System

DRIVEWAY DETAIL FOR RURAL ROAD

STANDARD STREET SIGN DETAIL

Field Code Changed
1. Pedestrian ramps shall comply with the Americans with Disabilities Act/Accessibility Guidelines for Buildings and Facilities.
2. The least possible slope shall be used for pedestrian ramps. The maximum slope shall be 1:12 (8.33%).
3. The cross slope shall be no greater than 1:48 (2%).
4. A landing area the width of the ramp and at least 36 inches in length shall be provided at the top of the ramp. Slope of the landing shall not exceed 1:48 (2%) in all directions.
5. Alternate designs and locations shall meet the requirements of the Americans with Disabilities Act/Accessibility Guidelines for Buildings and Facilities and shall be approved by the Public Works Department prior to start of construction.
6. Pedestrian ramps shall be a minimum of 60 inches wide.

Typical Pedestrian Ramp Detail
Standard Details – Transportation System

1. Pedestrian ramps shall comply with the Americans with Disabilities Act/Accessibiltiy Guidelines for Buildings and Facilities.
2. The least possible slope shall be used for pedestrian ramps. The maximum slope shall be 1:12 (8.33%).
3. The cross slope shall be no greater than 1:48 (2%).
4. A landing area the width of the ramp and at least 36 inches in length shall be provided at the top of the ramp. Slope of the landing shall not exceed 1:48 (2%) in all directions.
5. Alternate designs and locations shall meet the requirements of the Americans with Disabilities Act/Accessibility Guidelines for Buildings and Facilities and shall be approved by the Public Works Department prior to start of construction.
6. Pedestrian ramps shall be a minimum of 60 inches wide.

TYPICAL COLLECTOR PEDESTRIAN RAMP DETAIL

1. Pedestrian ramps shall comply with the Americans with Disabilities Act/Accessibility Guidelines for Buildings and Facilities.
2. The least possible slope shall be used for pedestrian ramps. The maximum slope shall be 1:12 (8.33%).
3. The cross slope shall be no greater than 1:48 (2%).
4. A landing area the width of the ramp and at least 36 inches in length shall be provided at the top of the ramp. Slope of the landing shall not exceed 1:48 (2%) in all directions.
5. In instances when it will be technically impossible for a pedestrian ramp to be constructed to full and strict compliance with ADA standards, the pedestrian ramp must be installed to provide accessibility to the building and可时 he Public Works Department prior to construction.
6. Pedestrian ramps shall be a minimum of 60 inches wide.

RETROFIT PEDESTRIAN RAMP DETAIL

1. Pedestrian ramps shall comply with the Americans with Disabilities Act/Accessibility Guidelines for Buildings and Facilities.
2. The least possible slope shall be used for pedestrian ramps. The maximum slope shall be 1:12 (8.33%).
3. The cross slope shall be no greater than 1:48 (2%).
4. A landing area the width of the ramp and at least 36 inches in length shall be provided at the top of the ramp. Slope of the landing shall not exceed 1:48 (2%) in all directions.
5. In instances when it will be technically impossible for a pedestrian ramp to be constructed to full and strict compliance with ADA standards, the pedestrian ramp must be installed to provide accessibility to the building and可时 he Public Works Department prior to construction.
6. Pedestrian ramps shall be a minimum of 60 inches wide.
CONCRETE CURB INLET APRON DETAIL

1. Reinforce concrete with 10/10 6 x 6 W. Supported with 3 reinforcing bars at 48" on center each way on 3" high chairs.
2. Construct prior to paving.

CONCRETE COLLAR DETAILS

NOTES:
1. Edges shall be finished with a 1/4" radius edging tool. Joints shall be snap cut.
2. Concrete shall be M-4000 with 3/4" maximum aggregate. Minimum 28 Day strength of 4000 psi. ± 1.5% air entrainment and maximum slump of 4".
3. El self-level manhole and valve boxes may be used in lieu of concrete collars.
4. El self-level manhole covers shall include raised sex custom cover and lettering.
LOCAL STREET CUL-DE-SAC

UTILITY NOTE:
All new utilities shall be placed underground, except for sewer and water. Underground utilities, if placed in right of way or easement shall be located between the back of sidewalk and easement line. No underground utilities shall be placed in the boulevard between the back of curb and sidewalk.