DESIGN STANDARDS

AND

SPECIFICATIONS POLICY

CITY OF BOZEMAN, MONTANA

CITY ENGINEERING DIVISION

MARCH 2004

ADOPTED: April 5, 2004, Ordinance 1611

Including: Addendum No. 1 approved 7/19/05
Addendum No. 2 approved 6/28/06
Addendum No. 3 approved 2/20/08
Addendum No. 4 approved 3/31/11
Addendum No. 5 approved 8/26/13

CITY OF BOZEMAN

DESIGN STANDARDS AND SPECIFICATIONS POLICY

Prepared by

City Engineering Department

March 2004
Revised: 7/19/05; 6/28/06; 2/20/08; 3/31/11; 8/26/13

****

Contents — Page

Contents (cont.) Page

FOREWORD

This document has been prepared to assist design engineers, architects, developers, contractors, or other interested individuals with the preparation of plans and specifications for public infrastructure improvements so that they will meet the requirements of the City of Bozeman (COB). The requirements specified herein have been established through the subdivision regulations, municipal code, or City policies.

It is the intent of the COB to revise this document on an as-needed basis as regulations and policies are modified. Written comments on this "Design Standards and Specifications Policy" are encouraged and may be submitted to the City Engineer.

If any portion of this document is found to conflict with the Bozeman Municipal Code (BMC), the provisions of the BMC shall supersede this Guide.

Abbreviations Used

AASHTO - American Association of State Highway and Transportation Officials
ADA - Americans with Disabilities Act
ASTM - American Society for Testing and Materials
AWWA - American Water Works Association
BMC - Bozeman Municipal Code
BUDO – Bozeman Unified Development Ordinance
COB - City of Bozeman
DEQ - Department of Environmental Quality
ESAL - Equivalent Single Axle Load
FSP - Final Site Plan
MPWSS - Montana Public Works Standard Specifications
MUTCD - Manual of Uniform Traffic Control Devices
PUD - Planned Unit Development
RCP - Reinforced Concrete Pipe
WQB - Water Quality Bureau

CITY OF BOZEMAN

PLANS AND SPECIFICATIONS REVIEW POLICY

A. Standard Process

1. Initial submittal of plans and specifications, and all subsequent correspondence and submittals for public infrastructure improvements including, but not limited to, sanitary sewer and water mains, storm sewer mains, street and transportation improvements, are to be made to the City Engineer's Office, 20 E. Olive Street, P.O. Box 1230, Bozeman, Montana, 59771-1230. Prior to submission of infrastructure plans and specifications, project approval (preliminary plat, Planned Unit Developments (PUD's), and in some cases Final Site Plans (FSP's)) from the City Commission must be obtained.

2. The minimum number of complete sets of plans and specifications which must be submitted for each review are as follows:

Type of Project	Number*	Reviewers
Water and Sewer Main Extensions	4 Sets	Eng., W/S
Fire Service Lines	2 Sets	Eng., W/S
Streets and/or Storm Sewers	4 Sets	Eng., W/S, ST
Water & Sewer Mains with Streets and/or Storm Sewers	4 Sets	Eng., W/S, ST

Eng. = Engineering Department
W/S = Water and Sewer Department
ST = Street Department

* See Paragraph 8 below

3. The COB shall attempt to complete the initial review and provide written comments to the Engineer/Owner within thirty (30) calendar days of receiving the initial submittal. A review meeting may be scheduled with the design Engineer and City representatives to discuss review comments if the design Engineer desires. Pre-design and interim meetings with the design Engineer and City Engineering staff are encouraged.

4. To expedite the review process each submittal of revised plans and specifications shall be accompanied by a written response from the Design Engineer which addresses each item in the COB review comment letter. The revised documents will be distributed and reviewed as described above in item 2. Generally, "red-lined" copies of the plans and specifications will be provided to the Design Engineer to facilitate revisions of the documents. Red-lines must be returned with each subsequent re-submittal.

5. The COB shall attempt to complete each review of revised plans and specifications within fourteen (14) calendar days of receiving the revisions. A review comment letter may be mailed to the Engineer/Owner at the completion of each review.

6. All COB review comments must be adequately addressed and resolved before the final plans and specifications are approved by the City Engineer for construction.

7. The plans and specifications for water or sewer projects will not be considered for approval by the City Engineer without written approval of the final plans and specifications from the Superintendent of Water and Sewer or his designated representative.

8. Once all COB review comments have been adequately addressed and resolved the City Engineer must be supplied with four (4) complete sets of the final plans and specifications, signed and stamped by a Professional Engineer licensed in the State of Montana, and one half-size set of plans. Specification manuals are to be bound and contain the most current version of the revised documents and plan sheets are to be the most current version. The four (4) final full-size sets and one ½ size set of plans and specifications submitted for City approval will be reviewed by the City Engineer to ensure that all requested modifications are included. An electronic version of the approved plans shall also be provided in either Autocad or PDF format.

9. For projects subject to Department of Environmental Quality (DEQ) review and approval, a copy of the project approval letter from DEQ must be submitted to the City Engineer prior to the preconstruction meeting.

10. The City Engineer will either approve or disapprove the submitted documents. An approval or disapproval letter will be sent to the Engineer/Owner.

11. Final stamped and approved plans and specifications will be distributed as follows:
    a. One set returned to the Engineer/Owner.
    b. One set and ½ size set to the COB Water/Sewer Department.
    c. One set for the COB Engineering Department.
    d. One set for the COB Engineering Department Field Inspector.

12. No work is to begin on the project prior to obtaining the COB's and DEQ's written approval of the plans and specifications, and the completion of a preconstruction meeting conducted by the Owner's Engineer and attended by the Contractor(s) and COB

representative(s). A "Pre-construction Meeting Checklist" will typically be included with the approval letter specifying additional documents which must be submitted prior to scheduling a pre-construction meeting.

B. Self-certification Process

1. Introduction/Intent

A. Plans and specifications submitted using this process will not be reviewed in detail by the City Engineering Department. **Fire service lines and domestic service lines are specifically excluded from this process**. The City's existing review process will remain in place, and will be used unless the submittal conforms with the self-certification process and is accompanied by a completed self-certification Checklist.

B. The intention of this policy is that plans and specifications stamped and signed by a Professional Engineer registered in the State of Montana, submitted in conformance with this policy, and accompanied by the required checklists and certifications, will be acceptable to the City.

C. The following are specifically excluded from the self-certification process: force mains, lift stations, booster stations, pressure reducing valves, and traffic signals.

2 Applicable Standards

All infrastructure projects shall comply with the following design standards in order of precedence:

A. COB Design Standards and Specifications Policy
B. COB Modifications to Montana Public Works Standard Specifications (MPWSS)
C. Bozeman Unified Development Ordinance
D. DEQ Circulars 1 and 2
E. City Adopted MPWSS and Adopted Addenda

The most recently adopted versions of the City Water and Wastewater Facilities Plans shall govern sewer and water trunk main design and sizing. The Storm Water Master Plan and Transportation Plan shall govern their respective service area issues.

3. Submittal Requirements

Prior to submission of infrastructure plans and specifications, project approval (preliminary plat, Planned Unit Developments (PUD's), and in some cases Final Site Plans (FSP's)) from the City

Commission must be obtained.

The following shall be submitted to the City Engineering Department and approved by the Public Service Department (through the City Engineer):

Prior to Plan and Specification Submittal;

A. Water and Sewer Utilities Design Report as detailed in the project conditions of approval. Subsequent to receipt and approval of this report, the City will issue a water/sewer capacity letter if warranted.

B. Pavement Design Report and Traffic Impact Analysis (if required).

C. Stormwater Facilities Design Report.

D. A schematic signage plan for the subdivision, noting any proposed traffic calming measures.

With plans and specifications;

E. Four (4) sets of plans and specifications (24" x 36" sheets only) stamped and signed by a P.E., registered in the State of Montana, one ½ size set of plans, and an electronic version of the plans in either Autocad or PDF format.

F. A completed and signed COB Plan and Specification Checklist.

G. Any easements which may be required. Easements must be properly executed.

4. City Review and Disposition

A. Upon receipt of the plans and specifications and checklist, one complete set will be sent to the City Water/Sewer Superintendent and one set to the City Street Superintendent.

B. Upon review and approval of the Checklist, Plans, and Specifications, the City Engineering Department will provide the engineer with a letter of approval and one set of plans and specifications stamped "Approved For One Year From This Date".

C. *Estimated* time frames for City approval:

With Deviations requested on City Checklist	*2 weeks; this is a guideline only*
Without Deviations or with pre-approved variance	*1 week*

D. No construction may begin prior to a pre-construction meeting which must be

attended by the applicant's engineer, the contractor and the City. All preconstruction meeting requirements currently in place will remain in place.

E. Any changes to the approved plans must be reviewed and approved by the City Engineering Department and the Water/Sewer Superintendent.

5. Project Audits

A. The intent of the self certification process is to place upon the design engineer the sole and significant burden and expectation that Public infrastructure plans and work completed within Bozeman fully comply with the City's infrastructure standards and requirements. The process necessitates a high degree of trust by the City and certainty by the design engineer that the plans and specifications fully meet the City's requirements.

B. Deficiencies in plans which are discovered during project construction are inherently much more costly to the project schedule and budget than design deficiencies or issues resolved and addressed prior to construction. Subsequent to the City's approval of self certified plans and specifications, selected project plans will undergo audit review to assure compliance. Deficiencies discovered during the audit review or during construction may require revised plans to be submitted and approved, and may further require untimely and expensive correction or replacement of noncompliant work installed on the project. Project design self certification falsely or indiscriminately provided may be referred to the Montana Board of Professional Licensing.

C. Project engineers with a history of design deficiencies or whose track record demonstrates repeated problems in their ability to design and complete projects adequately meeting the City's design standards will be more frequently audited, and may be prohibited from utilizing the self-certification process until adequate proficiency is demonstrated. As such, engineers are strongly encouraged to work closely with the City's engineering, field and operations staff throughout the pre-design, design and construction phases of a project. Engineers without adequate experience with the City's design and infrastructure standards and who have not previous successfully completed infrastructure projects within the City are advised to utilize the City's full design review process in lieu of the self certification process.

C. CONSTRUCTION COORDINATION

1. Pre-construction Meeting

Following approval of infrastructure plans and specifications, the Engineer shall schedule a pre-construction meeting with the City of Bozeman, Contractor(s), and if applicable, other affected utilities or governmental agencies. A "Preconstruction Meeting Checklist" will be included with the letter of approval which lists submittals that must be received by the City of Bozeman prior to scheduling a preconstruction meeting.

2. Shop/Fabrication Drawings

Any required shop/fabrication drawings shall be submitted by the Contractor to the Engineer. Upon approval, the Engineer shall submit four sets of the shop/fabrication drawings to the City Engineer a minimum of two days prior to the preconstruction meeting.

3. Bonding

All new infrastructure that will be publicly maintained shall be bonded. Prior to initiation of construction, copies of the Contractor's Performance and Payment Bonds, each in an amount equal to 100% of the contract amount, in favor of the Owner, shall be filed with the Owner and the City of Bozeman. Prior to acceptance of the publicly maintained infrastructure, the Contractor shall post a Maintenance Bond with the Owner equal to 20% of the actual cost of the improvements to correct any deficiencies in workmanship and/or materials which are found within the two-year warranty period. The City of Bozeman shall be named as a dual oblige on the bond. The City of Bozeman expressly reserves the right to draft the Maintenance Bond for repairs not completed by the Property Owner, Developer, or Contractor within thirty calendar days of being advised that repairs are required. The Commencement Date for the Maintenance Bond shall be the date of acceptance by the City of Bozeman on the Certificate of Completion and Acceptance. The Maintenance Bond shall remain in full force for the two-year period following this date, however 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. Maintenance Bonds may be in the form of a Surety Bond or a Certified Check.

4. Engineer's Status/Responsibility During Construction

The Engineer will furnish a qualified Resident Project Representative (RPR) and other field staff to assist the Engineer in observing the performance of the work. The RPR will act as directed by and under the supervision of the Engineer, and will confer with the Engineer regarding the RPR's actions. The RPR shall not authorize any deviation from the approved plans and specifications or substitution of materials or equipment, unless authorized by the Engineer.

Duties of RPR. The RPR and/or other field staff of the Engineer will:

- Conduct extensive on-site observations of the work in progress and field checks of materials and equipment to provide protection against defects and deficiencies in the work of the Contractor.
- Perform construction observation, documentation, and required testing of all critical construction work including, but not limited to: all underground or buried work including placement and connection of utility lines and appurtenances, trench backfill and compaction, placement of geotextile fabric membranes, placement of fill or embankments; placement of curb and gutter and other surface drainage improvements; placement of pavement base and surface courses; and placement of sidewalks.
- Advise the Engineer and Contractor of the commencement of any work requiring Shop Drawings or sample if the submittal has not been approved by the

Engineer.

- Report to the Engineer whenever RPR believes that any work is unsatisfactory, faulty, or defective or does not conform to the approved plans and specifications, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made.
- Advise the Engineer of work that the RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection, or approval.
- Verify that all tests are conducted in the presence of appropriate personnel, and observe, record and report to the Engineer appropriate details relative to testing procedures.
- Accompany visiting inspectors representing the City of Bozeman or other public agencies having jurisdiction over the project.
- Maintain at the job site orderly files for correspondence, reports of job conferences, Shop Drawings and samples, reproductions of original Contract Documents including all Work Directive Changes, Addenda, Change Orders, Field Orders, additional Drawings issued subsequent to the execution of the contract or beginning of work, Engineer's clarifications and interpretations of the Contract Documents, and other Project related documents.
- Keep a detailed and accurate diary or log book, recording Contractor hours on the job site, weather conditions, prime and subcontractor daily work force, daily log of equipment onsite or standby, data relative to questions of Work Directive Changes, Change Orders, or changed conditions, list of job site visitors, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures.
- Furnish Engineer with periodic reports of progress of the work.
- Furnish Engineer and Contractor a list of observed items requiring completion or correction before Engineer may issue a Certificate of Substantial Completion, assess completion or correction of said items, advising Engineer on their status, and make recommendation to Engineer regarding issuance of a Certificate of Substantial Completion.
- Conduct final inspection of the project in the company of Engineer, Owner, Contractor, and City of Bozeman, and prepare final list of items to be completed or corrected.
- Verify that all items on final list have been completed or corrected and make recommendations to Engineer concerning final acceptance.

Duties of Engineer: The Engineer will:

- Issue written clarifications or interpretations of the requirements of the Contract Documents (i.e. plans and specifications).
- Disapprove or reject work which Engineer believes to be defective, and require special inspection or testing of the work whether or not the work is fabricated, installed, or completed.
- Review Shop Drawings and samples for compliance with the Contract Documents.

- Review proposed changes in work and submit such changes to the City of Bozeman or other public agencies having jurisdiction for review.
- Issue Certificate of Substantial Completion and Certificate of Completion and Acceptance.

5. Testing and Documentation Requirements for Infrastructure Improvements

In order to better document the inspection and certification of public infrastructure improvements, the City Engineering Division shall require the following information for all projects approved for construction. This documentation shall be required prior to final acceptance of sanitary sewer, water main, storm drain, Portland cement concrete, and bituminous pavement improvements within City right-of-way or easements.
THE FOLLOWING DOCUMENTATION SHALL BE REQUIRED ON ALL PROJECTS APPROVED BY THE CITY ENGINEERING DIVISION:

A. The Engineer shall submit a letter to the City certifying that the public improvements (i.e. sanitary sewers, water mains, drainage structures and streets) were installed in accordance with the approved plans and specifications and shall be accompanied by Record Drawings for the project.

B. Dates of acceptable tests for sanitary sewer, which shall include TV inspection by the City of Bozeman, cleaning, exfiltration by air or water, and manhole testing, shall be included in the certification letter. This information shall be required for all public sewer main extensions.

C. Dates of acceptable tests for water mains, which shall include hydrostatic and leakage testing, bacteriological testing, and continuity testing shall be included in the certification letter. This information shall be required for all public water main extensions.

D. Benchmark elevations shall be established for all new hydrants on the project. Benchmarks shall be set on the hydrant bonnet bolt closest to the point of the operating arrow on Mueller hydrants and on the bury depth tag on Waterous hydrants. Said elevations shall be certified by either a P.E. or L.S. registered in the state of Montana. Elevations shall also be provided for the top of the water main at 50' intervals. The datum used as the basis for the elevations shall be clearly identified.

E. Verification that all thrust blocking was installed in accordance with the approved plans and specifications shall be included in the certification letter. If mechanical restraints are used in lieu of thrust blocks, verification that the restrained length as installed meets or exceeds the manufacturers recommendations shall be included.

F. An accurate record of the location of all sanitary sewer service connections as installed, and the length and slope of all service lines installed must be provided

by the Engineer. Elevations at the end of dry service line stub-ins is required. Sanitary sewer service connections shall be tied to manholes. This information shall be required for all public sewer main extensions and service connections to existing mains.

G. The Engineer shall furnish documentation of tests in accordance with methods prescribed by AASHTO for theoretical maximum density, optimum moisture content, and sieve analysis for the sub-base course, crushed base course, pit run, and native backfill and subgrade material within the right-of-way. This information shall be required for all public sewer main, water main, storm drain and street extensions.

H. The Engineer shall furnish documentation of in-place field density tests. In-place density tests for trenches and embankments shall, as a minimum, be required for the first lift of backfill to set a pattern of compaction, shall be provided daily, and as backfill material changes. In-place density tests for roadways shall, as a minimum, be required at intervals of 50 feet. Tests for roadways shall be provided for subgrade, sub-base course and/or pit run, and crushed base course materials. A minimum of the top 6 inches of subgrade which are to be paved or covered with curb, gutter, or sidewalk, shall be field density tested. All trench backfill material in improved areas and all embankments shall be compacted for the full depth and shall be compacted to 95% of the theoretical maximum proctor density as determined by AASHTO-T-99. This information shall be required for all public sewer main, water main, storm drain, and street extensions.

I. The Engineer shall furnish a dated job-mix formula for hot plant mix bituminous pavement which conforms to the procedures of the Asphalt Institute's MS-2 manual. The job mix formula shall be no older than one year, and shall have the same aggregate and asphalt sources and grades as the mix used for the public improvements. The Engineer shall furnish certified results of a Marshall Test showing the bulk specific gravity determination, stability and flow data, and density and void analysis. The engineer shall furnish a minimum of one "field Marshall Test" per 2000 tons of mixture placed to check for variations from the job-mix formula. In addition, test results of ASTM D 1075 for the effect of water on cohesion of compacted bituminous material shall be provided by the Engineer. This information shall be required for all public street extensions.

J. The Engineer shall furnish asphalt core samples for bituminous pavement in the public right-of-way. Four core sample shall be required for every 1000 tons of mixture placed, with a minimum of three samples for projects that use less than 1000 tons. The location of the core samples shall be determined on a random basis using a system of random numbers, so that each ton of material has the same probability of being selected. For random locations falling near the pavement joints, obtain the core as close to the location as possible without having any part of the core circumference coming closer than 12 inches to the pavement edge or

joint. The Engineer may take additional core samples at locations where he/she has, based on observations of the paving process and/or the results of nuclear density tests, reasonable belief that the in-place material is unsatisfactory. The Engineer shall submit the sampling plan to the City Engineer upon completion of the paving, prior to taking cores. (An example for one method of determining random sample locations is included in the appendix of these Design Standards). The Engineer shall provide a certified laboratory report from the samples taken as to thickness and actual density. Testing laboratories shall meet the requirements of ASTM D3666 (Evaluating and Qualifying Agencies Testing and Inspecting Bituminous Paving Materials). The engineer shall certify that the core holes have been patched with hot plant mix asphalt. This information shall be required for all public street extensions.

K. The Engineer shall furnish Portland cement concrete tests for concrete placed in the public right-of-way and concrete incorporated into public infrastructure improvements. One set of tests shall be required for every 50 cubic yards of concrete placed with a minimum of one set of tests per project. The concrete shall be sampled, specimens made, and compliance determined in accordance with the following:

Sampling Fresh Concrete	ASTM C-172
Slump	ASTM C-143 or AASHTO T119
Air Content	ASTM C-231 or C-173 or C-138 or AASHTO T152
Compressive Strength	ASTM C-39 or AASHTO T22
Making and Curing Test Specimens in the Field	ASTM C-31 or AASHTO T23

Sampling and testing shall be done by persons that are currently certified as ACI Concrete Field Testing Technicians, Grade 1. This information shall be required for all public street extensions.

6. Pre-Paving Inspection

The Engineer shall conduct a pre-paving inspection for any projects that have paved streets as part of the improvements. The Contractor and a representative from the City shall attend the inspection.

7. Acceptance/Correction of Deficient Pavement Improvements

Acceptance tests shall be evaluated by the Engineer for conformance with the specifications. Any results that indicate the in-place material does not conform with the specifications shall be immediately reported to the City Engineer, along with a recommendation of corrective action to bring the material into compliance with the specifications. The City Engineer shall determine what corrective action is necessary in order for the improvements to be accepted by the City of Bozeman. Corrective action may include total removal and replacement of the deficient

material, partial removal and replacement, placing additional material, or in lieu of corrective action, payment of a penalty to the City of Bozeman in certain instances.

A. Portland Cement Concrete

If an individual strength test (average of two cylinders tested at 28 days) falls below the specified strength by more than 500 psi, the in-place material represented by the failed test shall immediately be randomly cored for acceptance testing. A minimum of three and maximum of six cores shall be taken. If the average strength tests of the acceptance cores are deficient in strength by more than 500 psi but not more than 1000 psi, the Contractor shall remove and replace the deficient concrete or pay the City of Bozeman 0.25 times the unit price bid times the area determined to be deficient in strength; if the average strength tests are deficient by more than 1000 psi, the area of the concrete determined to be deficient shall be removed and replaced.

B. Asphaltic Concrete Pavement

The asphaltic concrete pavement shall be tested and evaluated for acceptance on a lot basis, with one lot being 1000 tons of material.

1. Thickness. If the average thickness of the pavement cores is more than ¼" below the plan thickness, or if any one individual core is more than ½" below the plan thickness, corrective action or payment of a penalty will be required.

a. Average Thickness Deficiencies. If the average thickness deficiency is between ¼" and ½", corrective action such as placement of additional material (i.e. overlay or chip seal), as determined by the City Engineer, will be required. In lieu of placing additional material, the City Engineer may allow the payment of a penalty to the City of Bozeman in the amount of 0.25 times the unit price bid of the asphalt pavement times the amount of pavement determined to be deficient. If the average thickness deficiency is more than ½", an overlay will be required, along with cold milling of the existing pavement to provide for a minimum overlay thickness of 1.5".

b. Individual Core Thickness Deficiency. If any one core thickness is determined to be more than ½" below plan thickness, additional cores shall be taken at 10 foot intervals parallel to the centerline in each direction from the affected location until, in each direction, a core is found which is not deficient by more than ¼", in order to determine the extent of the deficient pavement. If the thickness deficiency is more than ¾", the area that is deficient shall be removed from pavement edge to pavement edge and replaced to bring the non-complying areas to planned thickness. If the thickness deficiency is not more than ¾", the deficient area will either be removed and replaced to the planned thickness, or a penalty will be paid to the City of Bozeman in the amount of 1.5 times the unit price bid times the amount of pavement that is deficient in thickness.

2. Density. The average density of the pavement cores shall equal or exceed 93% of the maximum density as determined by ASTM D2041 (Rice's density). If the average density is less than 93% but more than 90.9%, the pavement that has

deficient compaction shall be milled and overlaid (1.5" minimum depth), or a penalty in the amount of 0.10 times the unit price bid for the pavement material times the amount of pavement that has deficient compaction shall be paid to the City of Bozeman. If the average density is 90.9% or less, the pavement area affected will be removed and replaced or overlaid as determined by the City Engineer. If any one core is determined to have a density of less than 86%, additional cores shall be taken at 10 foot intervals parallel to the centerline in each direction from the affected location until, in each direction, a core is found which has a density of at least 91%. The area that is determined to have deficient compaction shall be removed from pavement edge to pavement edge and replaced, or a penalty will be paid to the City of Bozeman in the amount of 1.5 times the unit price bid times the amount of pavement that is deficient in density.

C. Unit Prices

If unit prices for the project are unavailable, unit prices shall be as determined from time to time by the City Engineer for the various items of work.

8. Project Close-out and Acceptance

Upon completion of the work, the following documentation shall be submitted to the City Engineer:

A. An executed "Certificate of Completion and Acceptance" (included in the Appendix of this Policy).

B. Project Inspection Diary and Testing Records.

C. Certified Checklist for Testing and Documentation Requirements.

Within 90-days of project completion, the Engineer shall sign and submit record drawings to the City Engineer. The drawings shall be full-size and consist of one reproducible set, two blueprint sets, and one digital (Autocad) copy.
Failure to provide all of the necessary close-out documentation within the 90-day period may result in delaying approval for future projects submitted by the Engineer until such time as the necessary documents are provided.

9. Two-Year Warranty Inspection

The Project Engineer, or his designated representative, shall conduct a two-year warranty inspection to be attended by a least one representative from the Public Works Department. The inspection shall take place not less than seventy-five (75) or more than one hundred and twenty (120) days prior to the expiration date of the Maintenance Bond. The Maintenance Bond will be released when all deficiencies have been corrected to the satisfaction of the City Engineer.

The City Engineer, the Project Engineer, or the designated representative shall notify the Principal and Bonding Company as listed in the Maintenance Bond of any work found to be deficient. The Principal shall restore the work to meet the requirements of the approved construction documents prior to release of the Maintenance Bond. The City of Bozeman 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.

DESIGN STANDARDS AND SPECIFICATIONS

I. CONSTRUCTION PLANS AND SPECIFICATIONS REQUIREMENTS

A. GENERAL REQUIREMENTS

1. Any required design reports must be submitted and approved prior to submittal of plans and specifications when the self-certification process is utilized. If the standard review process is utilized, design reports may be submitted prior to or along with submittal of the plans and specifications.

2. Project plans and specifications will not be accepted until the project has been approved by the City of Bozeman.

3. All project infrastructure plans must be submitted at the same time. Separate approval of infrastructure elements may be provided if necessary.

4. Where existing infrastructure is being extended, existing material, size, elevation, horizontal alignment, and grade shall be field verified, and all critical utility crossings shall be field verified, prior to plan and specification submittal.

5. All full-sized plans shall be on 24-inch by 36-inch plan sheets or 22-inch by 34-inch plan sheets. Reduced scale plans may be submitted for review if approved by the City Engineer, but all plans for final approval (excepting the one required ½ size set) and all record drawings shall be full-sized. All plans submitted for review and approval will be stamped, signed, and dated by a professional engineer licensed in the State of Montana.

6. Separate plans shall be submitted for water facilities and sanitary sewer facilities. Plans for storm sewer facilities may be included with plans for street facilities.

7. All plans will have both plan and profile views of the proposed improvements. A general location map shall be provided showing the relationship of each page to the overall development.

8. Project datum and benchmarks shall be clearly identified on the plans.

9. English units are required.

B. SPECIFICATIONS REQUIREMENTS

1. The City of Bozeman has adopted "Montana Public Works Standard Specifications" (MPWSS) as the standard specifications for new construction. A separate document, "City of Bozeman Modifications to MPWSS" has been adopted which supplements and supercedes MPWSS. All project manuals must incorporate, preferably by reference, MPWSS (latest adopted edition) and the "City of Bozeman Modifications to MPWSS", including any addenda.

2. Additions or changes to the above standard specifications must be done through Special Provisions or similar supplemental sections in the project manual.

C. DRAWING SCALES

The following scales are required. Other scales will be considered on a case by case basis if all information can be clearly shown.

1.	Plan View:	1" = 50'
2.	Profile View, Horizontal:	1" = 50' (or match plan view scale)
	Profile View, Vertical:	1" = 5'
3.	Stationing interval:	100 feet or 50 feet

D. PLAN REQUIREMENTS

The following items will be required on all plans. Existing features should be shown dashed or with a lighter shading than proposed new features. All construction will be tied to the centerline of a City right-of-way, to the centerline of a City easement, to a platted property line, or to section lines.

1. Plan View
   - North Arrow.
   - Legend of Symbols.
   - Property lines and ownership or subdivision information.
   - Street names and easements with width dimensions.
   - Project Stationing.
   - Limits of existing paved or graveled surfaces.
   - Monument boxes.
   - Culverts.

- Existing and proposed utilities and structures, including:
  Line size and material where appropriate;

Water lines (main lines and service lines), valves, and hydrants;
Sanitary sewer lines (main lines and service lines) and manholes;
Storm sewer lines, manholes, and inlets;
Gas lines;
Electric lines, poles, transformers;
Telephone lines, manholes, junction boxes;
Cable T.V. lines, junction boxes;
Irrigation ditches and structures;
Irrigation systems;
Fiber optic lines, manholes, junction boxes;
Street lights;
Proposed method of restoration of all areas disturbed during construction.

2. Profile View
   - Vertical and horizontal grids to scales.
   - Final grade (solid).
   - Existing grade (dashed).
   - Existing utility lines where crossed.
   - Project Stationing
   - Utility crossings

E. UTILITY PLAN REQUIREMENTS

1. The following general notes must appear on all plan sets:

   a. All construction will conform to MPWSS, (Latest) Edition, and COB Modifications to MPWSS.

   b. Any existing or new valves which control the COB's water supply shall be operated by COB personnel only.

   c. The Contractor shall notify the Water Department a minimum of 24-hours prior to beginning any work.

   d. Contractor shall field-verify line and grade of existing connections.

2. Plans for water facilities shall show the following:
   -Size, type and structural class of proposed new water line(s), including AWWA specifications.
   -Bedding class.
   -Type of excavation and backfill.
   -Existing water lines including size and material.
   -Proposed valves, fittings, fire hydrants, and service lines, with stationing.
   -Depth of cover from finish grade to proposed water line(s).

-Requirements for pipe deflection, if necessary.
-Type of joint restraint, if required.
-Size of gravity thrust blocks based on calculated design.
-Existing or proposed pressure reducing valves.

3. Plans for sanitary sewer facilities shall show the following:
-Size, type, and structural class of proposed new sewer line(s), including American Society for Testing and Materials (ASTM) specifications.
-Slope of each proposed pipeline segment.
-Bedding class.
-Type of excavation and backfill.
-Existing sewer lines and manholes including size, material, field-verified invert elevations, and field-verified slopes.
-Proposed manholes with stationing and rim and invert elevations.
-Existing and proposed sewer service lines with size and stationing.
-Existing and proposed cleanouts.

4. Plans for storm sewer facilities shall show the following:
-Size, type, and structural class of proposed new storm sewer line(s), including ASTM specifications.
-Slope of each proposed pipeline segment.
-Bedding class.
-Type of excavation and backfill.
-Proposed manholes with stationing and rim and invert elevations.
-Proposed inlets and inlet service lines with stationing and invert elevations.
-Points of stormwater discharge.

F. ROADWAY PLAN REQUIREMENTS

1. Plans for streets or roadways shall show the following:
-Limit of cut or fill.
-Existing and proposed utilities, including manholes and valves.
-Proposed new construction, including paving width and limits, curb and gutter, crosspans, sidewalks, and pedestrian ramps.
-Existing and finished grades, with finished grade slopes.
-Vertical and horizontal curves, with curve data:
Horizontal curves - R, Δ, L, PC and PT Stationing
Vertical curves - K, L, Station of PT's
-Profile of centerline.
-Profiles of left and right curb lines, if they are not the same.
-Any required utility adjustments.
-Existing and proposed signs and pavement markings.
-Existing and proposed storm drainage facilities, including culverts, pipes, inlets, sidewalk chases, ditches and detention/retention ponds, with

invert and/or spot elevations.

-Top of curb elevations at P.C.s, P.T.s, and inlets.

-Existing and proposed street monuments.

-Typical roadway section(s), dimensioned and drawn to scale, showing:

- -Right-of-way
- -Backslopes
- -Sidewalks
- -Curb and gutter
- -Pavement thickness
- -Base and sub-base thickness
- -Compaction requirements
- -Cross-slopes

II. DRAINAGE POLICY

A. GENERAL DESIGN CRITERIA

A Stormwater Drainage Plan is required for all new developments. The following criteria shall be used in the design of all Drainage Plans:

1. The stormwater drainage plan shall be designed to limit stormwater runoff from the development site to the pre-development runoff rates. The pre-developed rate calculations shall be included as part of the required facility design calculations. Adequate on-site stormwater detention shall be provided for design storm runoff exceeding the pre-development rate.

2. The stormwater storage and treatment facilities shall be designed to remove solids, silt, oils, grease, and other pollutants. Where required, oil/water separators shall be provided in the facility design.

3. Where the storm drainage plan includes storm sewers they shall meet the following minimum requirements:

    a. Alignment between manholes shall be straight.

    b. The sewers shall be uniformly sloped to maintain a minimum velocity of 3-fps at the design storm depth of flow, or when flowing full, to prevent sediment deposits.

    c. Pond inlet and outlet piping shall be protected and designed to prevent erosion (i.e. splash pads, rip rap, etc.).

    d. Publicly maintained storm sewers located in the public right-of-way shall be constructed of reinforced concrete pipe (RCP) or solid-wall or corrugated PVC pipe, complying and installed in accordance with the current edition of MPWSS as modified by the COB. PVC pipe may only be used for pipe sizes of 36" diameter or less. Other pipe materials may be considered for private storm sewer facilities. Use 12-inch minimum pipe size for inlet structures and 15-inch minimum pipe size within the storm drain system.

    e. Storm sewer facilities shall be designed to handle a 25-year storm event.

    f. Inlets and manholes shall have 9-inch sumps for sediment collection unless otherwise approved by the City Engineer.

4. For all new development or redevelopment projects greater than or equal to

one acre, the drainage plan shall include, to the greatest extent feasible, low impact development practices that infiltrate, evapotranspire, or capture for reuse the runoff generated from the first 0.5 inches of rainfall from a 24-hour storm preceded by 48 hours of no measurable precipitation.

B. STORM DRAINAGE PLAN

A Storm Drainage Plan shall be submitted to the City Engineer for all new developments. The plan shall include the following:

1. A map or plat showing building site(s), open areas, drainage ways, ditches, culverts, bridges, storm sewers, inlets, storage ponds, roads, streets, and any other drainage improvements. The map shall also include identification and square foot coverage of the various ground surfaces (i.e. vegetation, gravel, pavement, structures).

2. Topographic contours (one-foot intervals) and sufficient spot elevation data.

3. Description of the ultimate destination of stormwater runoff from the project and an evaluation of its impact on downslope drainage facilities and water quality.

4. Design calculations determining runoff quantities and storage requirements.

5. A storm drainage facilities maintenance plan. The plan shall:

    a. Identify ownership of all facilities.

    b. Establish a schedule for maintenance activities necessary to keep the system operationally effective.

    c. Identify the responsible party in charge of the specific maintenance duties.

6. Details and specifications (including invert and other pertinent elevation information) for all storm drainage improvements, such as storm sewers, manholes, inlets, discharge structures; and retention/detention pond dimensions and volume, side slope, and top, bottom, and maximum water surface elevations.

C. STORAGE/TREATMENT FACILITIES

Detention is the storage and gradual release of runoff to a storm sewer system, waterway, or a soil of high porosity. Detention facilities dampen peak runoff rates and provide treatment of runoff flows. For new development, on-site detention with release rates limited to pre-development runoff rates is required. Complete retention facilities may be

provided or required where discharge is not feasible or desirable. Retention ponds shall be sized based on a 10-year, 2-hour storm intensity.

1. Detention Basins: Detention basins utilize natural or manmade depressions or ponds for storage. Release of water is controlled by specially designed outlet structures (Figure A-2 in the Appendix of this Guide).

2. Basin Sizing: A minimum basin area of 145-square feet per 1-cfs release rate is required for sediment control. The controlling basin volume is determined by subtracting the total basin release volume from the runoff volume at different storm durations. The release rate is equivalent to the pre-development runoff rate at the piping system design frequency (Table I-3). The runoff rate is determined at the piping system design frequency using development runoff coefficients. Where the potential for major property damage exists due to downstream flooding and the terrain and availability of land permit the construction of a large detention basin, a 100-year design frequency should be used for sizing the pond. Basins located in areas accessible to the public shall have a maximum water depth of 1½-feet and a maximum basin depth of 2½- feet. Deep basins designed only for stormwater detention shall be placed in remote areas and fenced. A sample problem for sizing detention basins is included in the Appendix of this Policy.

3. Basin Location: Basins serving multiple lots shall be located in common open space owned by a Homeowners or Property Owners Association. Locating a basin within an easement on a lot will not be permitted unless approved by the governing body. Public park land shall not be used for storm water detention or retention ponds unless approved by the Superintendent of Facilities and Lands.

4. Additional Requirements: The following additional requirements apply to the design of above ground earth formed detention basins:

    a. To prevent short circuiting, basin length shall be at least three times the width and inlet velocities should be dissipated.

    b. Basin slopes shall be 4:1 or flatter. (UDO 18.48.050)

    c. Vegetative channels shall be utilized wherever possible to remove wastewater contaminants.

    d. Basins in floodplains shall have adequate erosion protection on the embankments.

    e. Overflows shall be provided to prevent overtopping of dike walls.

5. Retention volumes shall be calculated using the following formulas:

$$Q = CIA$$

$$V = 7200Q \text{ (cf)}$$

Where : C = Weighted C Factor
I = 0.41 in/hr (see figure I-2, I-3 for 10 year 2 hr storm)
A = Area (acres)
Q = runoff (cfs)
V = volume (cf)

D. DISCHARGE STRUCTURES

1. A design detail shall be provided including adequate elevation information. Discharge structures shall be adequately protected from damage. A typical discharge structure is shown in Figure A-2 in the Appendix of this Policy.

2. Orifice or weir calculations shall be provided for controlling the discharge to the pre-development rate. For discharge structures similar to that in Figure A-2 of the Appendix, the slot width shall be sized using the equation:

$$Q = CLH^{3/2}$$

Where: Q = Discharge (cfs)
C = Weir Coefficient = 3.33
L = Horizontal Length (feet)
H = Head (feet)

3. Failsafe features shall be provided including:

   a. An emergency free-flowing overflow for rates exceeding design storm events.

b. Discharge piping shall be a minimum of six (6) inches in diameter for maintenance, and capable of conveying a 25-year storm event.

c. Ponds shall be designed so as to avoid long-term standing water in the pond.

E. ESTIMATION OF RUNOFF

1. GENERAL

The rational method shall be used to determine peak runoff rates with a slight modification of the method to determine runoff volumes. The basic assumptions that apply to the rational method are:

a. Rainfall is uniformly distributed over the area for the duration of the storm.

b. The peak runoff rate occurs when the duration of the storm equals the time of concentration.

c. The runoff coefficient for a particular watershed is constant for a similar land use.

The method is based on the Rational Formula:

$$Q = CiA$$

Q - Peak runoff rate (cfs)
C - Runoff coefficient
i - Average rainfall intensity (in./hr.)
A - Drainage area (acres)

2. RUNOFF COEFFICIENTS

The runoff coefficients shown in Table I-1 are recommended for design. Coefficients from other engineering texts may be considered for specific applications such as concrete, asphalt, roofs, etc..

TABLE I-1
RUNOFF COEFFICIENTS (C) FOR USE IN THE RATIONAL FORMULA

LAND USE	RUNOFF COEFFICIENTS (C)
Open Land	0.20
Low to Medium Density Residential	0.35
Dense Residential	0.50
Commercial Neighborhood	0.60
Commercial Downtown	0.80
Industrial	0.80

Source: City of Bozeman Stormwater Master Plan, Thomas Dean & Hoskins, Inc., 1982

3. TIME OF CONCENTRATION

A basic assumption of the rational method is that the peak runoff rate occurs when the duration of the storm equals the time of concentration. The time of concentration is the flow time from the most remote point in the drainage to the point in question. It generally consists of overland flow time and channel flow time. Overland flow time may be estimated from the nomograph in Figure I-1.

Channel flow time in gutters, ditches, or pipes may be determined by estimating velocities with the Manning equation:

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

V - Mean velocity (ft/sec.)

n - Manning roughness coefficient (typical values in Table I-2)

R - Hydraulic radius* = $\frac{\text{cross sectional area}}{\text{wetted perimeter}}$

TABLE I-2
MANNING EQUATION - TYPICAL "n" VALUES

Channel Type	"n" Factor
Open Unlined Channels	0.035
Concrete and RCP Pipe	0.013
Corrugated Steel Pipe	0.024
PVC pipe	0.013

4. STORM INTENSITY

The intensity of the storm is determined from Figure I-2 or I-3. Duration is assumed to be equal to the time of concentration. The values in Table I-3 are the City of Bozeman design frequencies.

TABLE I-3
RAINFALL FREQUENCY FOR USE IN THE RATIONAL FORMULA

Land Use	Design Rainfall Frequency
Open Land	2-year
Residential	10-year
Commercial or Industrial	10-year

5. RUNOFF RATES AND VOLUMES

The rational formula provides a peak runoff rate which occurs at the time of concentration. The modified rational method approach shall be used to compute runoff volume for storm durations equal to or greater than the time of concentration. This method assumes the maximum runoff rate begins at the time of concentration and continues to the end of the storm. Maximum runoff rates for durations greater than the time of concentration are less than the peak runoff rate because average storm intensity decreases as duration increases. Total runoff volume is computed by multiplying the duration of the storm by the runoff rate.

6. RAINFALL INTENSITY DURATION CURVE

In order to use the rainfall intensity duration curve, the time of concentration must be known. This can be determined either by the following equation or Figure I-1:

$$Tc = \frac{1.87\,(1.1 - CC_f)\,D^{1/2}}{S^{1/3}}$$

Where Tc = Time of concentration, minutes
S = Slope of Basin, %
C = Rational Method Runoff Coefficient
D = Length of Basin, feet
C_f = Frequency Adjustment Factor[1]

Time of concentration calculations should reflect channel and storm sewer velocities as well as overland flow times.

---

[1]RATIONAL METHOD FREQUENCY ADJUSTMENT FACTORS

Storm Return Period (years)	Frequency Factors C_f
2 to 10	1.00
11to 25	1.10
26 to 50	1.20
51 to 100	1.25

Note: The product of C times C_f shall not exceed 1.00.

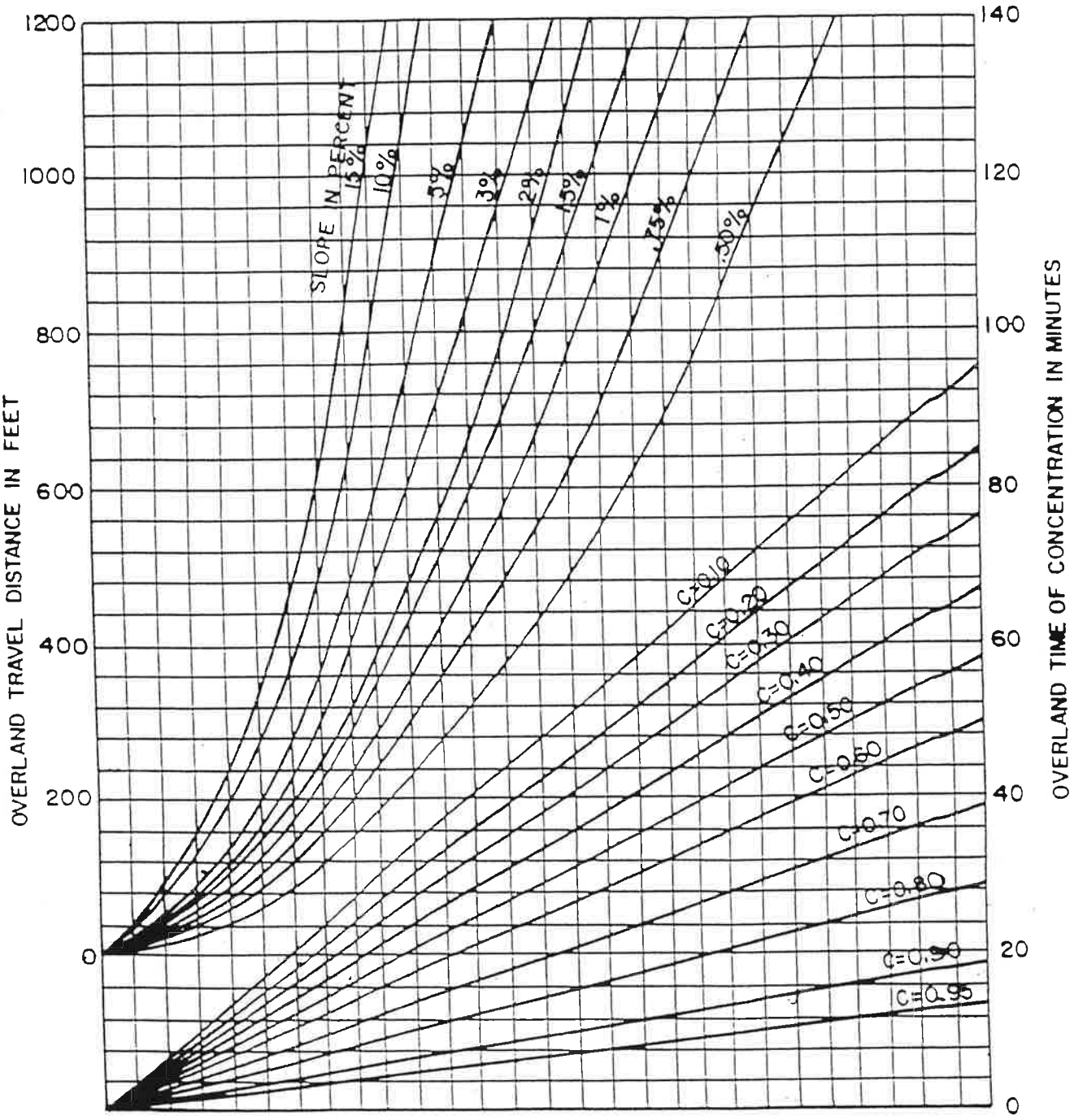


FIGURE I-1 TIME OF CONCENTRATION (Rational Formula)

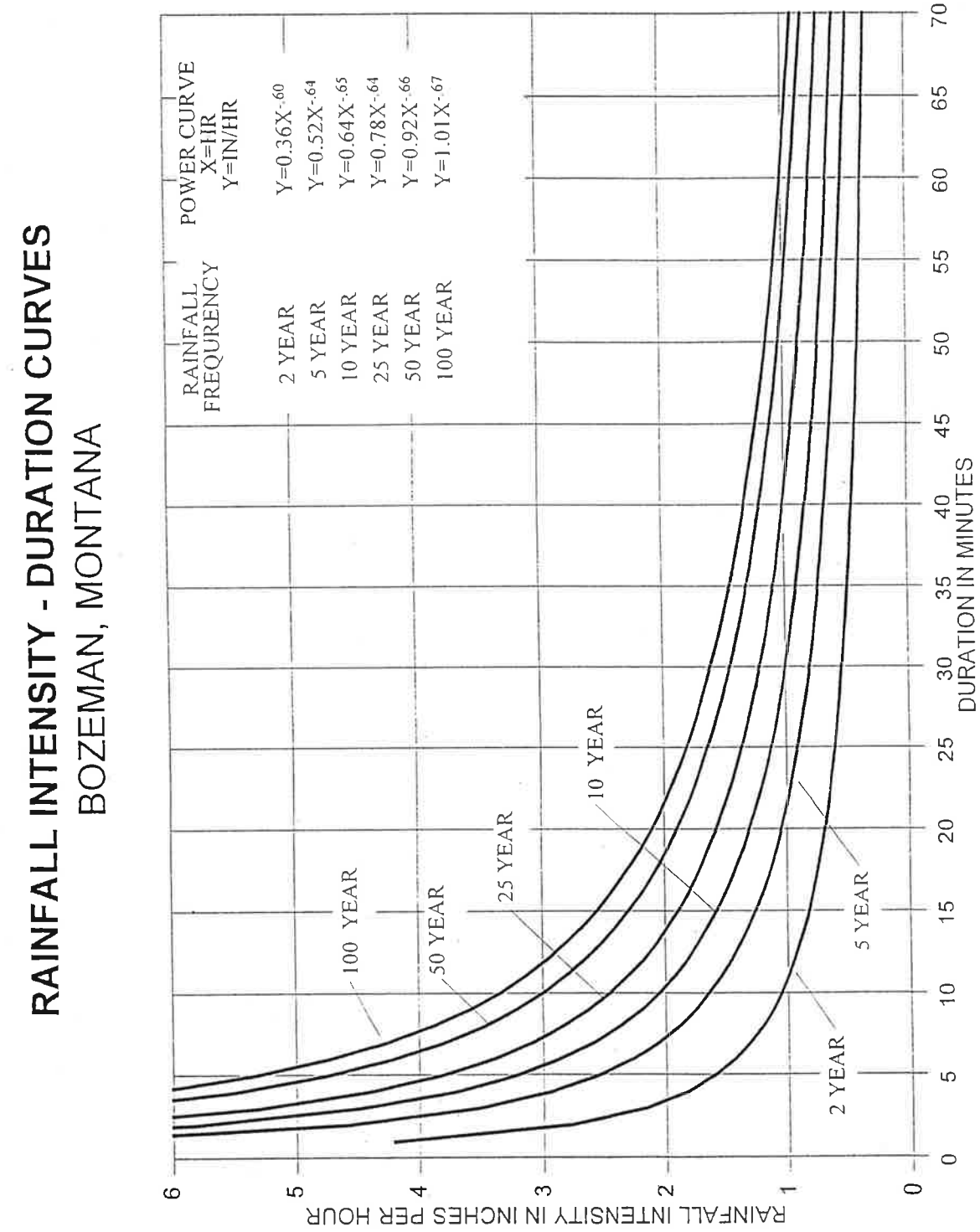


FIGURE I-2 RAINFALL INTENSITY – DURATION IN MINUTES

RAINFALL INTENSITY - DURATION CURVES

BOZEMAN, MONTANA

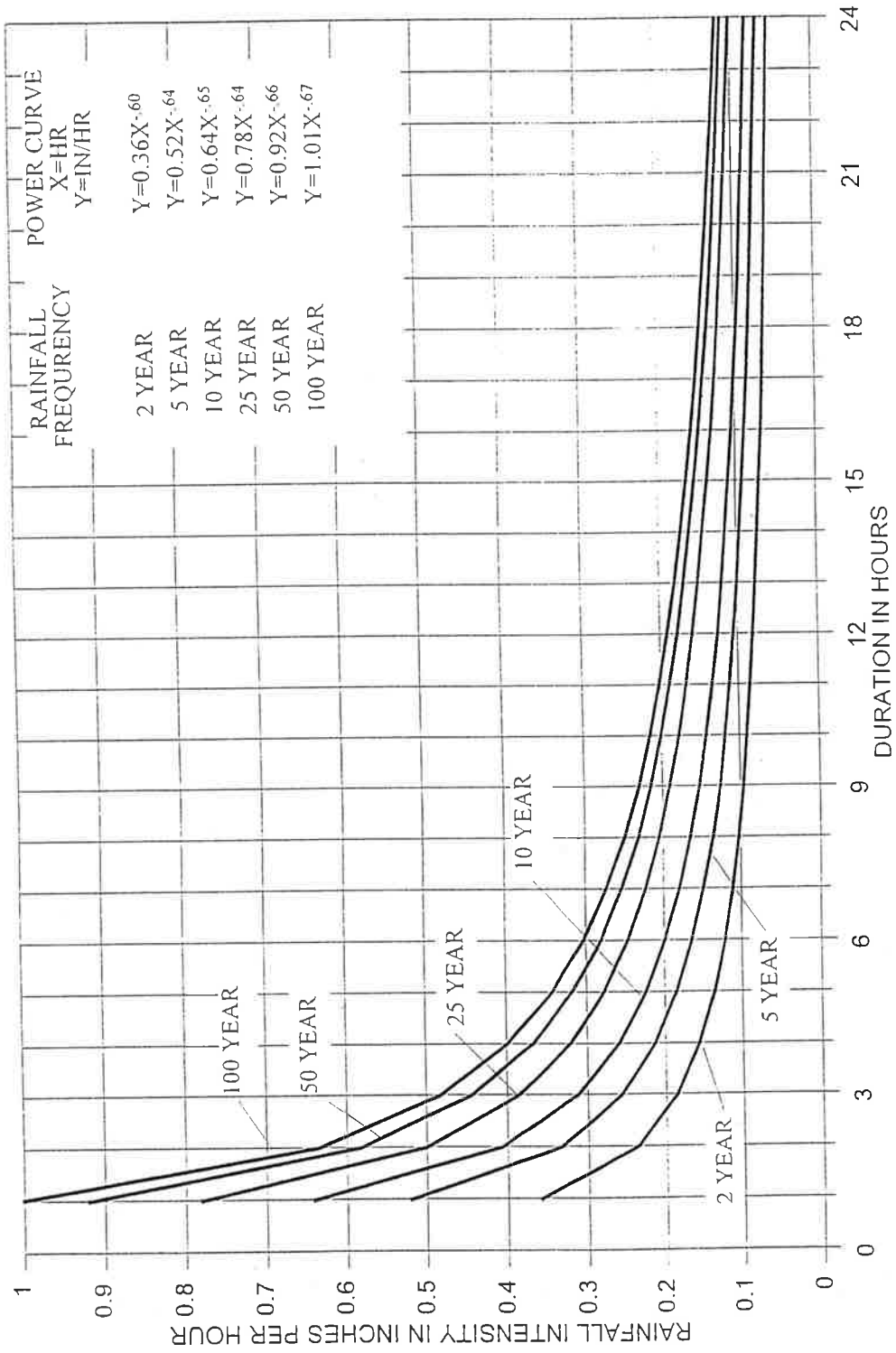


FIGURE I-3 RAINFALL INTENSITY – DURATION IN HOURS

III. FLOODPLAIN REGULATIONS

A. GENERAL

Floodplain regulations are detailed in Chapter 18.58 of the BUDO. These regulations are intended to protect the public health, welfare and safety in order that citizens and property owners can remain under the national flood insurance program. All proposed developments shall conform to the requirements of Chapter 18.58 of the BUDO.

IV. ROADWAY DESIGN AND TECHNICAL CRITERIA

A. GENERAL.

This section sets forth the minimum design and technical criteria and specifications to be used in the preparation of all roadway plans. All roadway plans should also be designed in conformance with MPWSS; City of Bozeman Modifications to MPWSS; Americans With Disabilities Act; and City of Bozeman Sidewalk Policy.

B. SIDEWALKS, CURBS AND GUTTERS AND DRIVEWAYS

1. Roadway typical sections are detailed in Figure A-1 in the Appendix of this Policy. Roadway typical sections shall conform to conditions of approval for the project.

2. Concrete sidewalks shall be constructed on both sides of all roadways unless otherwise approved by action of City Commission. Sidewalks shall be 6-inches thick across driveways, and 4-inches thick elsewhere. Sidewalk design and construction shall be in accordance with the "City of Bozeman Sidewalk Policy".

3. All sidewalks shall have a minimum width of five (5) feet, except the minimum width shall be ten (10) feet in the central business district. All sidewalks that are to be publicly-maintained and all sidewalks along arterial streets shall have a minimum width of six (6) feet and shall be 6-inches thick reinforced concrete. Publicly-maintained sidewalks are sidewalks along all parks, and any public facilities or city-owned structures which are anticipated to be maintained by the City of Bozeman.

4. Integral curb and gutter shall be used on all roadways.

5. Pedestrian ramps shall be installed at all intersections and at certain mid-block locations for all new construction or reconstruction of curb and sidewalk. Pedestrian ramps shall be constructed in accordance with City of Bozeman Standard Drawings and Americans with Disabilities Act (ADA) requirements. Pedestrian ramps may be shown at all curb returns or called out by a general note on the development plans.

6. Guardrails may be required in certain situations. Guardrails shall be designed and constructed in accordance with AASHTO Standards or as directed by the City Engineer.

7. Drop-curbs for driveways may only be installed with the initial curb construction when the final building locations have been determined. Driveway locations shall conform to Section 18.44.090, BUDO.

8. Curb transitions for curb bulbs shall be accomplished using 35' minimum radius curves to achieve the desired pavement narrowing. All curb bulbs shall be adequately marked with flexible roadway delineators and yellow curb paint as necessary. The minimum curb bulb throat width is 24 feet (back of curb to back of curb).

C. DRAINAGE

Drainage systems shall be designed in accordance with these Design Standards and Specifications, Section II, Drainage Policy. Development plans, including a drainage report, for the drainage system are required for concurrent review with, and shall be considered part of roadway design.

1. Crosspans. Crosspans (valley gutters) shall be constructed in accordance with City of Bozeman Standard Drawings. Crosspans are not allowed across collector or arterial roadways, nor are they allowed on roadways with storm sewer systems.

   Crosspans may be used parallel with collector or arterial roadways to convey storm runoff across residential roadways. The use of crosspans elsewhere is discouraged, and will only be allowed after all other alternatives have been investigated.

2. Inlets:

   a. Inlets shall be located to intercept the major curb flow at intervals sufficient to ensure the depth of flow in the curb line is a maximum of 0.15' below the top of curb. This will result in a maximum spread width of approximately 9.5'. Inlets should be aligned with lot lines wherever possible.

   b. Inlets shall also be installed to intercept cross-pavement flows at points of transition in super elevation. Due to the presence of pedestrian ramps, inlets are not allowed in the curb return, but will be located at the tangent points of the curb returns.

   c. All inlets within the public right-of-way, or to be maintained by the City of Bozeman, shall be constructed in accordance with City of Bozeman Standard Drawings.

3. Cross Slope: Except at intersections, or where super-elevation is required, roadways shall be level from top of curb to top of curb and shall have a three (3)percent crown as measured from centerline to lip of curb, or lip of median curb to lip of outside curb on roadways with raised center islands. Parabolic or curve crowns are not allowed. Maximum pavement cross slope allowed is

five (5) percent at warped intersections, as measured above. In no case shall the pavement cross slope at warped intersections exceed the grade of the through street. When warping side streets at intersections, the crown transition should be completed within 75-feet horizontally for local streets, 100-feet horizontally for collector streets, and 150-feet horizontally for arterial streets. The crown of the through street shall be decreased to 1.5% through intersections, with the crown transitions being accomplished within 100 feet on either side of the intersections. Quarter crowning may be accepted on a case by case basis needing prior approval from the City Engineer.

4. Temporary Erosion Control: Temporary erosion control is required at the ends of all roadways that are not completed due to project phasing, subdivision boundaries, etc. Prevention of erosion at the roadway terminus shall be by methods approved by the City Engineer.

5. Sidewalk Chases:

   a. Storm waters from concentrated points of discharge shall not be allowed to flow over sidewalks, but shall drain to the roadway by the use of chase sections. The use of sidewalk chases is discouraged, and their use is limited to situations where it is not possible to use standard storm inlets and piping.

   b. Chase sections shall not be located within a curb cut of driveway. Chase sections shall be identified by station and elevation.

   c. Sidewalk chase sections are to be constructed in accordance with the City of Bozeman Standard Drawings.

D. HORIZONTAL ALIGNMENT

1. Turning Radius: All roadways shall intersect at right angles as nearly as possible. In no case shall the angle of intersection be less than seventy-five degrees (75°).

2. Curb Return Radius: Minimum curb returns shall be as shown in Table IV-1 of these specifications. A larger radius may be used with the approval of the City Engineer.

3. Design Speed: Design speed shall be as shown in Table IV-2 of these specifications.

4. Horizontal Curves: The minimum centerline radius for horizontal curves shall be as shown in Table IV-2 of these specifications. Variances from the requirements of Table IV-2 for local streets only may be considered on a case by case basis.

5. Two streets meeting a third street from opposite sides shall meet at the same point, or their centerlines shall be off-set at least 125 feet.

TABLE IV-1
CURB RETURN RADIUS AT INTERSECTIONS*

	LOCAL	COLLECTOR	MINOR ARTERIAL	MAJOR ARTERIAL
LOCAL OR PRIVATE ST.	15'	15'	15'	15'
COLLECTOR	15'	25'	25'	25'
MINOR ARTERIAL	15'	25'	**	**
PRINCIPAL ARTERIAL	15'	25'	**	**

* Measured from back of curb
** Per AASHTO Standards

TABLE IV-2

MINIMUM STREET DESIGN STANDARDS FOR CITY STREETS

STREET TYPE	PRINCIPAL ARTERIAL	MINOR ARTERIAL	COLLECTOR	LOCAL	RURAL
Right-of-way width	110' - 120'[3]	100'	90'	60'	90' – 110'[3]
Centerline radius on curves	[1]	[1]	300'	150'	300'
Tangent length between reverse curves	[1]	[1]	100'	50'	100'
Stopping sight distance	[1]	[1]	300'	200'	300'
Angle at intersection centerline	[1]	[1]	>75°	>75°	>75°
Curb radius at intersections	[2]	[2]	[2]	[2]	N/A
Length of tangent at intersection	[1]	[1]	150'	100'	150'
Back of curb to back of curb	82'	50', 63', 71'[3]	45', 48', 52',62'[3]	31', 33', 35'[3]	33', 39', 62'[3, 4]
Length of cul-de-sac[5]	N/A	N/A	N/A	500'	N/A
Outside radius on cul-de-sac right-of-way[5]	[5]	[5]	N/A	50'	N/A
Grade – maximum	[1]	[1]	7%	10%	10%
Grade – minimum	0.5%	0.5%	0.5%	0.5%	0.5%
Grade within 150 feet of intersecting centerlines	[1]	[1]	3%	3%	3%
Design Speed (MPH)	50	45	45	30	45
K Factor (minimum)					
Crest	[1]	[1]	105	50	105
Sag	[1]	[1]	65	35	65
Minimum VCL					
Crest	[1]	[1]	90	50	90
Sag	[1]	[1]	70	50	70

[1] *All design criteria shall meet AASHTO standards.*
[2] *See Table IV-1*
[3] *The specific right-of-way and back of curb to back of curb street width will be determined on a case by case basis through the subdivision review process, and will be based on the specific needs, impacts and context of the development proposal.*
[4] *The rural street standard does not include curb and gutter. The street width is measured from the edge of pavement to the edge of pavement.*
[5] *Cul-de-sacs are generally not allowed. The City Engineer may consider and approve the installation of a cul-de-sac only when necessary due to topography, the presence of critical lands, access control, adjacency to parks or open space, or similar site constraints.*

6. Super-elevation: Super-elevation may be required for arterial roadways and selected collector roadways. Horizontal curve radius and super-elevation shall be in accordance with the recommendations of AASHTO.

   Super-elevation shall not be used on local roadways.

7. Spiral Curves: Spiral curves shall not be used on road-ways within the COB (State highways excluded) except by written approval of the City Engineer.

8. Railroad Crossing: All railroad crossings on streets shall be steel reinforced rubber for the full width of the roadway.

9. Barricades: Whenever roadways terminate due to project phasing, subdivision boundaries, etc., barricades are required in accordance with the Manual of Uniform Traffic Control Devices (MUTCD) and City standards.

E. VERTICAL ALIGNMENT

Design controls for vertical alignment are shown in Table IV-2.

1. Permissible Roadway Grades: The minimum allowable grade for any roadway or alley is one-half (0.5) percent. The maximum allowable grade for any roadway is shown in Table IV-2 of this Policy. The maximum grade for an alley is subject to the approval of the City Engineer.

2. Changing Grades: Continuous grade changes or "roller-coastering" shall not be permitted. The use of grade breaks, in lieu of vertical curves, is not encouraged. Where the algebraic difference in grade (A) exceeds one percent (1.0%), a vertical curve is to be used.

3. Vertical Curves: All vertical curves shall be symmetrical. Design criteria for vertical curves are found in Table IV-2. The minimum grade within a sag (sump) vertical curve is five-tenths (0.50) of a percent. Minimum length of a vertical curve is shown in Table IV-2. All vertical curves shall be labeled, in the profile, with length of curve (L) and K (=L/A).

4. Intersections: The following additional criteria shall apply at intersections.
   a. The grade of the "through" street shall take precedence at intersections. At intersections of roadways with the same classification, the more important roadway, as determined by the COB Engineering Department, shall have this precedence. Warp side streets to match through streets. See Section IV.C. 3 above.

   b. The elevation at the point of tangency (PT) of the curb return on the through street is always set by the grade of the through street in conjunction with normal pavement cross slope.

   c. Carrying the crown of the side street into the intersecting through street is not permitted.

   d. At an arterial-arterial intersection, a more detailed review of the entire intersection's drive ability will be done.

5. Curb returns: Minimum fall around curb returns, when turning water, shall be three-tenths (0.3) of a foot for a fifteen (15) foot radius; four-tenths (0.4) of a foot for a twenty (20) foot radius; one-half (0.5) of a foot for a twenty-five (25) foot radius. For all other curb return radii use a grade of 1.25-percent within the return to establish minimum fall when turning water. The maximum fall around a curb return is 3.00-percent. Show and label high point location, elevation and intersection of flow line in plan view if applicable.

6. Connection with Existing Roadways: Connections with existing roadways shall be smooth transitions conforming to normal vertical curve criteria if the algebraic difference in grade (A) between the existing and proposed grade exceeds one percent (1.0%). When a vertical curve is used to make this transition, it shall be fully accomplished prior to the connection with the existing improvement. Field-verified slope and elevation of existing roadways shall be shown on the plans.

7. Offsite Design and Construction: The design grade, and existing ground at that design grade, of all roadways that dead end due to project phasing, subdivision boundaries, etc., shall be continued in the same plan and profile as the proposed design for at least three hundred (300) feet or to its intersection with an arterial roadway. This limit shall be extended to six hundred (600) feet when arterial roadways are being designed. If the offsite roadway adjacent to the proposed development is not fully improved, the developer is responsible for the design and construction of a transition with a 4-foot road base shoulder for the safe conveyance of traffic from his improved section to the existing roadway. The following formula shall be applied to the taper or land change necessary for this transition:

Speed Limit	
40 MPH or Less	$L = WS^2/60$
45 MPH or Greater	$L = WxS$

where

L = length of transition in feet
W = width of offset in feet
S = speed limit or 85th percentile speed

The City of Bozeman Engineering Department should be consulted for any unusual transition conditions. Grade breaks greater than 1-percent are not allowed when matching existing dirt or gravel streets.

8. The cost of offsite pavement transitions shall be borne by the developer.

F. MEDIAN TREATMENT

Median curbs should be integral curb and gutter (with spill curb) unless otherwise approved. Medians less than eight (8) feet wide should be capped with M-4000 concrete a minimum of three (3) inches thick. Wider medians should be top soiled and seeded with an approved seed mix. The minimum median width is 4 feet. All medians or raised islands should be made clearly visible at night through the use of adequate reflectorization and/or illumination. Flexible delineators shall be placed at the beginning and end of all medians, and at the point of any horizontal alignment change. All median curbs and island curbs shall be painted yellow with epoxy paint.

G. ROADWAY SPECIFICATIONS

Following are the requirements of the minimum roadway surfacing standards:

Surfacing. The pavement thickness design will be based on the current AASHTO Guide for Design of Pavement Structures, or the current Asphalt Institute Manual Series No. 1 (MS-1) for thickness design. A Pavement Design Report, based upon specific site soil data and design-year traffic loading conditions, prepared by a Professional Engineer, or other qualified professional approved by the City Engineer, shall be submitted to the City Engineer for approval prior to plan and specification submittal if using the self-certification process or with the plans and specifications if using the standard process. The design shall be based on at least a 20-year performance period traffic volume; however, the minimum design lane Equivalent 18,000-lb Single Axle Load (ESAL) used in the pavement design shall not be less than 50,000-ESAL. The minimum asphalt pavement thickness for any new local roadway shall be three (3) inches. The minimum asphalt pavement

thickness for any new collector or arterial roadway shall be four (4) inches. A minimum of six (6) inches of high quality untreated aggregate base shall be provided for designs utilizing asphalt pavement over untreated aggregate base. Where full-depth asphalt is designed, an adequate stabilizer lift shall be included, consistent with unpaved roadway design practices, to provide a suitable sub-base capable of withstanding the traffic required for the initial construction of the roadway. The City Engineer may require intersections with roundabouts or traffic circles to be constructed with Portland Cement Concrete surfacing.

H. SIGNS and MARKINGS

1. Street identification signs shall be installed at all new intersections in accordance with City of Bozeman Modifications to MPWSS. The design Engineer should consider, and the City Engineer may require, regulatory traffic control signs and pavement markings in accordance with the MUTCD. Stop signs shall be installed on local streets when they intersect with any collector or arterial streets.

2. Unless otherwise approved, all transverse markings, words and symbols, and 8" or larger lane line pavement markings shall be inlaid thermoplastic or pre-formed plastic tape. All other markings may be either inlaid or preformed thermoplastic or epoxy paint. The materials proposed for all markings shall be specified on the plans.

3. Crosswalk markings should not be used indiscriminately. An engineering study should be performed before they are installed at locations away from traffic signals or stop signs. Mid-block crosswalks are discouraged.

    a. All marked crosswalks for designated school crossings shall be longitudinal white bars ("City of Bozeman Type B" style). "School Crossing" signs and "School Advance Warning" signs shall be installed at all designated school crossings.

    b. At stop or signal controlled intersections, marked crosswalks shall be two 8" white lines, 8' apart typically, installed transverse to traffic and in-line with sidewalks, if any ("City of Bozeman Type A" style).

    c. Marked crosswalks at uncontrolled intersections, and all mid-block crosswalks shall be "Type B", with "Pedestrian Crossing" signs. "Pedestrian Crossing Advance Warning" signs should be installed if deemed warranted by engineering judgment.

    d. Parking shall be restricted by the use of signs and curb markings within 20 feet of crosswalks at a minimum, or longer based on

engineering judgment.

e. All crosswalk signs and advance crosswalk signs shall have a fluorescent yellow green background.

4. All signs shall comply with the "Standard Highway Signs" book (FHWA).

5. Street name signs for publicly-maintained roadways shall consist of white letters on a green background. Street name signs for privately-maintained roadways shall consist of white letters on a blue background.

I. MONUMENTATION

1. Monuments in monument boxes shall be provided in new or reconstructed streets at all section corners, quarter corners, and sixteenth corners.

J. LIGHTING

The design engineer shall consider the need for roadway lighting in the development of plans for any new or reconstructed roadways.

Street lighting consists of street lighting and pathway intersection lighting, and shall comply with the following requirements:

1. General.

a. All street lighting shall be operated and maintained through the creation of a new SILD, through the annexation to an existing SILD or through some other equivalent means approved by the City of Bozeman. The application to create or annex to an existing SILD shall be submitted to the City within 2 months of preliminary approval of the development. The approval to create or annex to an SILD shall be granted prior to final plat for a subdivision or Occupancy if a final plat is not required.

b. Street lighting shall be installed per 38.39.030 B, BMC (in regards to completion time for improvements).

c. Individual yard lights on private property shall not be used for street lighting.

d. Unless otherwise specified herein, installation of equipment for lighting shall conform to the requirements of "Standard Specifications for Road and Bridge Construction", latest edition, published by the Montana Department of Transportation.

2. Street Lights at Intersections.

a. Illumination Requirements.

(1) Single Installation. The illumination requirement for an intersection street light, where only one light is required, shall be determined from Table IV-3 based on the functional classification of the street upon which the light is located.

(2) Multiple Installation. For all intersections where more than one street light is required, all lights shall be within the same range for measured lumens. The illumination requirement shall be determined from Table IV-3 for the functional classification of the leg of the intersection with the highest requirement.

b. Non-Signalized Intersections. A street light shall be installed at each non-signalized street intersection with the exceptions contained in subsections (1) and (2) below.

(1) At intersections where the width of one or more of the approaches is greater than or equal to 50 feet, as measured to the back of curb or edge of pavement, then two street lights shall be installed on diagonally opposite corners.

(2) At the intersection of two local streets a street light may be omitted if its installation would violate the spacing criteria contained in Table IV-3.

c. Signalized Intersections. At signalized intersections where all approaches are narrower than 50 feet, as measured to the back of curb or edge of pavement, two street lights shall be installed on the diagonally opposite corners. At signalized intersections where the width of one or more of the approaches is greater than or equal to 50 feet, four street lights shall be installed, one on each corner.

3. Spacing of Street Lights. In addition to intersection locations, street lights shall be spaced along streets in accordance with Table IV-3.

Table IV-3

Functional Classification	Through Lanes	Pedestrian Conflict	Maintained Lumens (Minimum Maintained Average Values)	Spacing
Arterial	4/2	High	33000-22500	225/225
	4/2	Low	22500-13500	300/275
Collector	4/2	High	22500-13500	250/225
	4/2	Low	22500-8000	300/275
Local	2	Low	9500-8000	N/A[1]
Arterial - Commercial Center	4/2	High	33000-22500	200/175
Collector - Commercial Center	4/2	High	22500-13500	225/175
Local -Commercial Center	2	High	9500-8000	150

[1] *Street lights are only required at intersections on local streets.*

4. Street Light Location and Placement of Equipment. In addition to spacing requirements, the following layout criteria shall be used:

   a. When a street light location falls near an unlit intersection, the light shall be located at the intersection;

   b. Street lights shall be located at property lines to the greatest extent possible, but not in conflict with other utility service providers;

   c. Pole spacing along a street may vary from the criteria of Table IV-3 by up to 15 percent. For the uniformity of appearance, the variance in spacing between adjacent spans should not be more than 15 percent;

   d. All proposed streets within the proposed subdivision, having a curve of 300 feet or longer in length, shall have a street light in the middle of the horizontal curve or as required by the City Engineer;

   e. A street light shall be placed at the terminal ends of center median islands having trees and/or other fixed objects not having a breakaway design for speeds of 25 miles per hour or greater;

   f. Wiring for street lights shall be underground and in 2" minimum diameter conduit. Conduits shall typically be placed 2 feet from back of curb. All wiring shall be installed to meet the National Electric Code. Pull boxes shall be reinforced concrete and shall be located to not impede access to properties.

   g. Additional street lights may be required by the City Commission when potential traffic hazards are identified during plan review; and

   h. For streets that are wider than 70 feet (from back of curb) the required street lights shall alternate on either side of the street.

5. Street Light Support Structures.

a. Unless a variance is granted by the City Commission, the use of "Montana Angle", "Budget Angle", or similar style street light poles is prohibited.

b. All poles, mast arms, and light fixtures for street lights and signal poles shall be powder coated or painted.

c. Unless a variance is granted, all future ARTERIAL AND COLLECTOR street and signal light poles and fixtures shall be "Hunter Green" (RAL#6005) or similar in color, excepting that all future street and signal light poles and fixtures in the Downtown Business District and North 7th Avenue TIF District shall be black, and further excepting that entryway streets into Montana State University (i.e. S. 8th Avenue, College Street, Kagy Boulevard, and S. 11th Avenue) may be dark Bobcat Blue.

d. All street light poles shall be galvanized steel.

e. All street light poles shall be installed on a concrete foundation with breakaway bases. All poles, foundations, and breakaway bases shall meet the criteria set forth in the AASHTO publication Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

f. Street light poles shall be placed as far away from the edge of roadway as practical, typically no closer than 5 feet from back of curb.

g. The ballasts; pole type, strength and anchor bolts; and pole foundation shall be appropriate for the proposed lighting and shall be installed per the manufacturer's recommendations. Mounting heights shall be measured from the grade of the street at the edge of the travelled way and shall comply with the requirements of Table IV-4.

Table IV-4

Maintained Lumens (Minimum Maintained Average Values)	Mounting Height
9500-8000	25 feet
22500-9500	35 feet
33000-22500	38 feet

6. Pathway Intersection Lighting. Pathway lights shall be installed at all intersections of pathways and streets, located within the proposed development or along existing streets or roads abutting the development, if said intersection is located in areas other than lighted intersections. All pathway lights shall comply with City of Bozeman specifications.

Table IV-5

	Average Horizontal Illuminance at Pathway in Maintained Footcandles
Mixed vehicle and pedestrian	2.0
Pedestrian only	1.0

Source: Roadway Lighting (RP-8-00), Illuminating Engineering Society of North American, 2000.

7. Luminaires and service equipment.

   a. Luminaires (light fixtures) shall meet IESNA "full cutoff" criteria (no light output emitted above 90 degrees at any lateral angle around the fixture).
   b. Luminaires shall have either high pressure or low pressure sodium lamps. Luminaires shall be wired to match the voltage of the operating system.
   c. Street lighting circuits shall be automatically controlled with turn lock mounting delayed response photo cells. One photo cell shall be installed per circuit, mounted at 8 feet at the service panel.
   d. All street lighting systems shall be metered separately from other uses, with the exception of street lights installed in conjunction with traffic signal poles.
   e. Electric services shall use NEMA Type 3R cabinets with hinged, lockable covers and 3/8" holes for a padlock. Locks shall be supplied by the City for city-maintained systems. Meters shall be installed a minimum of 4 feet and maximum of 5 feet above grade.
   f. Services shall be equipped with 3-way switches for auto-on/on/off operation.

8. Record drawings shall be provided to the City for all new and re-constructed lighting systems that are to be maintained by the City.

K. BIKE LANES/PATHS

All bike lanes/paths shall be designed in accordance with the "Guide for the Development of Bicycle Facilities" (AASHTO, latest edition). Bike lanes shall be marked and signed in accordance with the MUTCD.

V. UTILITY DESIGN CRITERIA

A. WATER DISTRIBUTION LINES DESIGN CRITERIA

1. All additions or modifications to the COB water system will be designed in accordance with the criteria set forth in this and other sections of this Policy as approved by the City Engineer. Ductile Iron Pipe (DIP) shall be used exclusively unless special approval, in writing, of alternate materials is given by the City Engineer. All additions to the water system will be designed and installed in accordance with the Water Quality Bureau (WQB) Circular No. 1; MPWSS; COB Modifications to MPWSS; COB Water Facility Plan; and COB Fire Service Line Standard.

2. Master Water Plan: A master water plan shall be submitted for each subdivision or other major development prior to approval of any portion of the water system. 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 submitted.

3. A design report prepared by a professional engineer licensed in the State of Montana demonstrating compliance with these requirements shall be submitted to and approved by the City of Bozeman prior to plan and specification submittal if using the self-certification process or with the plans and specifications if using the standard process for any new development. Design parameters and the critical conditions shall be shown on a overall plan of the study area. 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.

4. Main Size: The water distribution system shall be designed to meet the maximum demand plus fire flow and the peak hour demand. The design shall be based on a maximum hour to average day ratio of 3:1 (maximum day to average day ratio of 2.3:1 for an average daily usage of 170-gallons per day per person), plus fire flow demand as determined by ISO (Insurance Services Office) criteria. A "C" Factor of 130 shall be used in modeling system designs. The working residual water pressure shall not be less than 20-psi at any point in the water distribution system under maximum day plus fire flow. The velocity of the water in the system shall not exceed 15-feet per second through a public main line. The minimum diameter for any new main is 8-inch, unless specific approval in writing is obtained from the City of Bozeman for smaller diameters.

5. Main Extensions: All main extensions shall be looped, where possible. All dead end 8" mains shall end with a fire hydrant or 2" blowoff. Larger diameter dead end mains shall end with a fire hydrant. Permanent dead-end

mains shall not exceed 500-feet long. Temporary dead-end mains scheduled for future extension may end with a blow-off in lieu of a fire hydrant.

6. Services

a. A water line is designated as either a service line or water main based on its use, not its size. Generally, a line serving a single building or facility is considered a service line; a line serving more than one building, or intended to serve more than one building or facility is generally designated a water main. The standard sizes of service lines are 3/4-, 1-, 1½-, 2-, 4-, 6-, or 8-inch. The minimum size of a fire service line is 1-inch. The minimum size of a service line stub is 1", to allow for the potential use of the domestic supply for a fire sprinkler system.

b. Service pipe shall be type "K" copper for sizes less than 4-inch, and ductile iron for services 4-inch and larger. Plans and specifications prepared by a Professional Engineer licensed in the State of Montana shall be submitted for 4-inch and larger service lines.

c. The service stubs shall be installed in accordance with the COB Standard Drawings for service lines. The service line stubs shall be installed at the center of each lot unless otherwise approved by the Water Superintendent.

d. No service line shall be extended into a building until an "Application for Service" has been completed and a Plumbing Permit has been obtained from the Building Department.

e. Backflow prevention devices as required by the Water Superintendent shall be installed on each fire and domestic service line. Meters will be installed inside the building by the Water Department on all service lines except for fire service lines. Meter pits shall not be used unless specifically approved by the Water Superintendent.

f. All service connections shall be uniform size from the service line tap to the building structure or structures unless otherwise approved or required by the Water Superintendent. The Water Department shall reserve the right to require a larger service connection to any building, structure or development if the water requirements when calculated by the fixture unit method, as specified in the Uniform Plumbing Code, cause the service line velocity to exceed ten (10) feet per second. Each service line and meter shall supply a specific building.

g. All service line stubs shall be sized to adequately serve the maximum anticipated demand for the property being served.

h. The Water Superintendent may require the termination of any existing service stubs (either for domestic or fire service) that are not utilized for service upon the development of the lot. Lines to be terminated shall be capped or plugged at the main, and any curb boxes or valve boxes on the line shall be removed.

7. Valves: Valves shall be installed in accordance with the following unless otherwise approved or required by the Water Superintendent:

a. All connections to an existing water main will begin with a new valve.

b. Valves shall be located at not more than 500-foot intervals in commercial districts and at not more than one block or 800-foot intervals in other districts.

c. Every leg of a main intersection shall have a valve.

d. Valves shall be placed so that main shut-downs can be accomplished with only one fire hydrant being out of service at a time.

8. Hydrants: Hydrants shall be provided at each street intersection and at intermediate points so that hydrants are spaced from 350- to 600-feet depending on the area being served. Mid-block hydrants shall be installed in line with lot lines.

9. Air Relief: Air relief shall be provided at all high points in the line where air can accumulate by means of hydrants, services, or air relief valves.

10. Pressure Reducing Valves: Pressure reducing valves shall be installed when the anticipated average-day line pressure exceeds 120 psi.

11. Thrust Restraint: All thrust restraint shall be designed to withstand the test pressure or the working pressure plus surge allowance, whichever is larger. Adequate factors of safety shall be employed in the design.

B. SANITARY SEWER SYSTEM DESIGN CRITERIA

1. All additions or modifications to the COB sanitary sewer system will be designed in accordance with the criteria set forth in this and other sections of

this Guide as approved by the City Engineer. All additions to the sewer system will be designed and installed in accordance with WQB Circular No. 2; MPWSS; COB Modifications to MPWSS; the Uniform Plumbing Code; and the COB Wastewater Facility Plan.

2. A design report prepared by a professional engineer licensed in the State of Montana demonstrating compliance with these requirements shall be submitted to and approved by the City of Bozeman prior to plan and specification submittal if using the self-certification process or with the plans and specifications if using the standard process for any new development. Design parameters and the critical conditions shall be shown on an overall plan of the study area. 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.

3. New sewer lines shall be sized to flow at no more than 75-percent of full capacity at peak hour conditions upon the full build-out of the development. The effects of the proposed development's sewer loading on existing downstream sewer lines shall be analyzed.

4. New sanitary sewer lines to serve residential areas shall be designed to accommodate an average daily flow rate of 2.11 people per dwelling unit and 89-gallons per capita per day. An infiltration rate of 150-gallons/acre/day shall be added to all flow calculations when designing new sewers.

5. New sanitary sewer lines shall be designed to accommodate the average daily flows as shown in Table V-1, V-2, and V-3 of this Policy.

6. A Manning's friction factor of 0.013 shall be used in designing new sewers. A peaking factor shall be calculated for each pipe segment based on the following formula;

$$\frac{Q_{max}}{Q_{Ave}} = \frac{18 + P^{1/2}}{4 + P^{1/2}} \quad (P = \text{Population/thousands})$$

For non-residential flows an equivalent population shall be calculated for use in the peaking factor formula.

To evaluate future collection needs, wastewater loading needs to be assigned to areas based on anticipated future land use characteristics. In areas within the City limits the assigned zoning provides the best tool to approximate future wastewater loadings. Table V-1 shows the recommended wastewater flow rates based on a per acre basis for zoned areas. Detailed information on how the flow rates were developed is located in Appendix 2A of the "City of Bozeman Wastewater Facilities Plan, 2007."

TABLE V-1 WASTEWATER FLOW RATE FOR ZONED UNDEVELOPED AREAS[1]

Designation	Dwelling Units per Acre	GAL./ACRE/DAY
R-S	6.5	1,220
R-1	3.9	730
R-2	5.2	980
R-3	6.5	1,220
R-4	10.4	1,950
R-O	5.2	980
R-MH	5.2	980
B-1		1,000
B-2		2,000
B-3		3,000
M-1		960
M-2		960
B-P		960
NEHMU	6.5	1,220
PLI		1,030

[1] The flow allocation in this table is based on gross area.

In areas within the 2020 Plan Boundary that have a defined land use, wastewater flows can be allocated on the land use designation. Table V-2 provides the recommended wastewater flow rate by land use designation.

TABLE V-2 WASTEWATER FLOW RATE BY LAND USE DESIGNATION[1]

Designation	Dwelling Units per Acre	GAL./ACRE/DAY
Industrial	-	960
Neighborhood Commercial	-	1,200
Community Commercial	-	2,400
Regional Commercial	-	1,600
Business Park	-	960
Public Institutions	-	1,030
Residential	5.5	1,030
Suburban Residential	1.3	240
Park and Open Space	-	25
Other Public Lands	-	1,030
Golf Course	-	30
MSU	-	2,780
MSU West	-	1,030

[1] The flow allocation in this table is based on gross area as land area.

Table V-3 identifies the recommended flow allocation for areas that are defiend as future urban by the 2020 Plan or are areas outside of the 2020 Plan Boundary. These areas are the least defined in terms of land use. As such, the projected flows are based on equivalent residential dwelling unit densities. Additional detail is provided in Appendix 2A of the "City of Bozeman Wastewater Facilities Plan, 2007".

TABLE V-3 WASTEWATER FLOW RATE FOR UNDEFINED LAND USE DESIGNATIONS[1]

Designation	Dwelling Units per Acre	GAL./ACRE/DAY
Future Urban	5.5	1,030
Future Expansion Area	5.5	1,030

[1]The flow allocation in this table is based on gross area.

7. Manhole Spacing: The maximum distance between manholes shall be as follows:

SANITARY SEWER

PIPE SIZE	MAXIMUM DISTANCE
8" to 15"	400'
18" to 30"	500'
larger than 30"	600'

8. Barrel Size: The alignment and number of pipes into the manhole will determine the barrel size for the size of pipe used. All 48-inch manholes will have eccentric cone top sections if total manhole height is greater than six feet. All other manholes will have flat tops. All drop manholes shall be "inside drop" with a minimum barrel diameter of 60-inch. The internal diameter of the manhole barrel shall be typically as follows:

SANITARY SEWER

PIPE SIZE	BARREL SIZE
12" or less	48"
15" to 27"	60"
30" to 48"	72"

Manholes larger than seventy-two (72) inches may be allowed with specific approval by the City Engineer.

9. Manhole Channels: All manholes shall have full-depth channels. When a smaller main is being connected to a larger main at a manhole, the manhole inverts shall be set so that the 8/10 depth of flow of each main is equal in elevation. The minimum drop across a manhole (invert in to invert out) is 0.2'(cut-in manholes excepted).

10. Sanitary Sewer Mains: The minimum diameter of a sewer main is 8-inches. Main lines shall be sized for design flow, not available slope. PVC pipe shall be used for all gravity flow main lines unless other materials are specifically approved.

11. Sanitary Sewer Services: The minimum diameter of a service is 4-inch. Services shall connect to the main with in-line gasketed wyes. The service line stub, from the main to the property line or easement line, shall be installed with a maximum slope of ½-inch per foot. The minimum slope of a 4-inch service line stub is 1/4-inch per foot. The minimum slope of a 6-inch service line stub is 1/8-inch per foot. Sewer service line stubs will typically be installed 15-feet from the downstream lot line. Services are to be installed perpendicular to the main.

Each building shall have a separate service line from the building to the sewer main, with the following exception: Accessory Dwelling Units (ADUs) may share sewer service with the service from the primary dwelling unit on the lot, provided that the service is television inspected at the owner's expense, and the Water/Sewer Superintendent determines that the service is in an acceptable condition for shared use.

12. Access Roads: A 12'-wide all-weather gravel access road, with turn-arounds if needed, shall be constructed to provide access to all sanitary sewer manholes not located within a paved public or private street or parking lot.

13. Cut-in Manholes: Pre-cast manhole bases are preferred for cut-in manholes. Poured-in-place cut-in manholes may be used if approved by the Sewer Superintendent.

C. STORM SEWERS

1. Materials: RCP (reinforced concrete pipe) or PVC pipe may be used, however PVC pipe may only be used for pipes sized 36" diameter and smaller. PVC pipe shall have a minimum stiffness of 46 PSI. Structural strength shall withstand HS-20 design load. If PVC pipe is used, all pipe exposed to sunlight shall be protected with concrete headwalls or prefabricated end sections in accordance with MPWSS Section 02725.

2. Minimum Sizes: Storm sewer mains shall not be less than 15-inch diameter. Privately owned storm sewers may be smaller, but shall still be designed in accordance with section C.5 below.

3. Manhole Spacing and Size:

Storm Sewer Pipe Diameter or Vertical Rise	Maximum Manhole Spacing (Ft.)
15" - 36"	400
42" - 60"	500
66" and Larger	750

Storm Sewer Pipe Diameter	Barrel Size* (Ft.)
15" - 18"	4
20" - 28"	5
30" - 48"	6

* Multiple pipe penetrations may require larger manhole barrels

4. Storm Inlets

   a. Publicly owned storm inlets shall comply with the applicable standard drawing in the COB Modifications to MPWSS. Where inadequate overflow paths are provided, inlets must be oversized 50-percent to accommodate plugging.

   b. The size of outlet pipes from storm water inlets shall be based upon the design capacity of the inlet, but shall not be less than 12-inches in diameter. The outlet pipes shall connect to the storm sewer main with a manhole.

   c. Computations for storm sewer design and storm inlet designs shall be submitted prior to plan and specification submittal if using the self-certification process or with the plans and specifications if using the standard process. Adequate details of inlets, manholes and other appurtenances shall be included in the overall drainage plan submitted for approval.

   d. Combination manhole/inlets may be used where approved as detailed in the City of Bozeman Modifications to MPWSS.

5. Hydraulic Design

Storm sewers shall be designed to convey the 25 year storm event with no surcharging (i.e. pipe full with no head). Inlets and sidewalk chases shall be designed to convey the 25 year storm flow with a maximum water surface elevation of 0.15' below the top of curb.

Drainage reports shall include hydraulic grade line calculations including losses from friction and transitions. Approved erosion control shall be designed and installed at all outlets.

6. Alignment

   a. Manholes are required wherever there is change in size, direction, elevation, grade or at sewer main junctions.
   b. The minimum vertical clearance between a potable water main and a storm sewer main is 1.5-feet. The minimum horizontal clearance between a potable water main and a storm sewer main is 10-feet.
   c. Horizontal alignment between manholes shall be straight.

7. Culverts

   a. A culvert is considered to be any structure which connects two

open channels. The culvert is to be designed to convey the 25-year frequency flow of the tributary drainage basin. The headwater depth will be limited by upstream conditions, but in no case shall exceed 1.5 times the culvert diameter. Excessive ponding above culvert entrances will not be acceptable if damage appears likely to surrounding property or to the roadway.

b. Culverts shall be designed with an emergency overflow path. The emergency overflow capacity shall be 100-percent of the whole culvert for the major storm for culverts with area less than twenty square feet and for culverts with area greater than or equal twenty square feet, the overflow capacity shall be 100-percent of the capacity provided by the first twenty square feet plus 20-percent of the capacity provided for the additional area as established by the formula:

$$\% \text{ overflow} = (110\%) \frac{20+(A-20).20}{A}$$, where "A" is the area of the culvert opening.

If the culvert is located in a low point in the road the required overflow capacity can be provided by overtopping the road, as long as this does not result in more than 50 feet of street being flooded. Where the culvert is not in a low point, or where more than 50 feet will be flooded, the overflow capacity shall be provided by either increasing the culvert size, or additional culverts.

8. Culvert Hydraulics

a. The culvert including inlet and outlet structures shall convey water, sediment and debris at all stages of flow.

b. End Treatment: Flared end sections or headwalls with wingwalls are required. Inlets are to be designed to minimize head losses. Approved erosion control is to be provided at all culvert outlets and inlets. Trash racks should be used for culverts greater than 100-feet in length.

c. Slopes: Culvert slopes shall prevent silting, yet avoid excessive velocities. Generally, the minimum culvert slope is 0.50-percent. Minimum barrel velocity is 3-fps and maximum is 12-fps.

d. Hydraulic Analysis: Inlet and outlet control conditions shall be analyzed. Calculations shall be submitted with the design report.

e. Minimum Size: Culverts crossing a roadway shall not be smaller

than 24-inch equivalent diameter. Driveway approach culverts shall not be smaller than 15-inch equivalent diameter. Culvert length shall be adequate to provide back slopes of 4:1 or less from pipe inverts to finished street section, including existing or future sidewalks.

f. Materials: Culverts shall be RCP unless otherwise approved by the City.

g. All culverts shall be designed to withstand HS-20 loading in accordance with American Association of State Highway and Transportation Officials (AASHTO) "Standard Specifications for Highway Bridges" and with the pipe manufacturers recommendation.

9. Utility Culverts

a. Conduits placed in right-of-way to facilitate placement of future gas, electric, communication, or other utility lines shall have the structural strength to withstand HS-20 loading. Conduits shall have a minimum stiffness of 46 PSI. Conduits shall be adequately sized to accommodate all anticipated utility lines. HDPE utility culverts shall not be placed within any public right-of-way.

D. ALIGNMENT, DEPTH, AND EASEMENTS

1. General: Water mains, sanitary sewers, and storm sewers within the proposed development shall be arranged to allow the suitable development of any adjoining un-developed land, and shall be constructed to the boundary lines of the tract being developed, unless prevented by topography or other physical conditions, in which case a variance must be approved by the City of Bozeman. The alignment of all water, sanitary sewer, and storm sewer mains and services lines shall be arranged so that there is a minimum of ten (10) feet of horizontal separation between these lines and with any gas lines, power lines, communication lines, utility poles or other above-grade utility structures, and street lights.

2. Water Mains:

a. Water mains located in public street right-of-way shall be placed nineteen (19) feet off the north or west right-of-way lines for streets 35 feet in width or greater (back of curb to back of curb). For streets less than 35 feet in width, water mains shall be placed 5.5 feet west and north of the street centerline. On curvilinear street alignments, water mains will be a minimum of two (2) feet

from the edge of the concrete gutters at all locations.

b. A minimum depth of cover of six and one-half (6 ½) feet below final grade will be maintained over all water mains.

c. When water mains cross sanitary or storm sewer mains, the water line must have an eighteen (18) inch minimum vertical separation, with all water pipe joints no closer than ten (10) feet horizontal from the sewer pipe centerline, and the crossing will be perpendicular to the sewer line. A minimum of ten (10) feet horizontal separation shall be maintained between any water main and any sanitary or storm sewer main.

3. Sanitary Sewer Mains:

a. Sanitary sewer mains located in public street right-of-way shall be placed along the centerline of the street for streets 35 feet in width or greater (back of curb to back of curb). For streets less that 35 feet in width, sewer mains shall be located 5.5 feet east and south of the street centerline. On curvilinear street alignments, sewer mains will be a minimum of two (2) feet from the edge of the concrete gutters at all locations.

b. Sewer mains shall have a minimum depth of cover of four (4) feet below final grade. All sewer mains and services with less than five (5) feet of cover will be adequately insulated.

c. Where streets are curvilinear, manholes should be located in the center of the street wherever possible, however non-centerline locations that are not in vehicle wheel paths are acceptable if it will reduce the total number of manholes required.

4. Storm Sewer Mains

a. Storm sewer mains located in public street right-of-way shall typically be located on the opposite side of the street from the water main. Storm sewers may be located beneath curb and gutter if combination inlet/manholes are used.

b. Storm sewer mains shall have a minimum depth of cover of two (2) feet below final grade, provided that the pipe material shall withstand the design load. Storm sewers shall be placed to maintain a minimum horizontal clearance of five (5) feet and a vertical clearance of six (6) inches from any sanitary sewer main.

c. Manholes shall not be located in vehicle wheel paths.

5. Easements:

a. A "utility easement" granted to the public is required for all public utility mains not located within public street right-of-way. An easement shall be a minimum of thirty (30) feet wide for one or two utility mains. An additional ten (10) feet is required for each additional main that occupies the easement. Wider easements may be required at the discretion of the City of Bozeman for large utility lines. Easements not established by plat will be executed on standard forms available from the City Engineer.

b. At no time will the utility line in question be less than nine (9) feet from the edge of the easement or less than ten (10) feet from a parallel utility line. Utility easements will also be required for all meter pits and fire hydrants maintained by the City of Bozeman.

c. No permanent structures shall be placed within a utility easement unless an encroachment permit has been obtained. Trees or other significant landscaping features shall not be placed within ten (10) feet of any utility main or service lines.

d. All easements documents must conform to City of Bozeman requirements and must meet the formatting requirements of the Gallatin County Clerk and Recorder's office.

APPENDIX

City of Bozeman Fire Service Line Standard

Certificate of Completion and Acceptance

Figure A-1 Standard Roadway Typical Sections

Figure A-2 Typical Stormwater Detention Pond Concrete Outlet Structure

Sample Detention Basin Sizing Problem

Pre-construction Meeting Checklist

Plan and Specification Certified Checklist

Certified Checklist for Testing and Documentation Requirements

Random Sampling Example

City of Bozeman Street Naming and Addressing Policy

CITY OF BOZEMAN
FIRE SERVICE LINE STANDARD
MARCH 31, 1997
Revised March 31, 2011

1. For all fire service lines (regardless of size) a City of Bozeman water service application must be completed prior to beginning work on the fire service line. Applications may be obtained at the City Building Department located at 20 E. Olive St..

2. Plans for all fire service lines will be reviewed by the City of Bozeman. The review and subsequent approval or denial will be for that portion of the proposed fire service line that starts at the point of connection to the City of Bozeman distribution system up to and including the backflow preventer and the flow detection device. The plans will be reviewed by the city of Bozeman Water Department, Fire Marshall, and Engineering Department. Upon satisfactory completion of the review process, the plans will be forwarded to the City Engineer with a recommendation for approval. The City Engineer will review the plans and either approve or deny the project. ***Installation of the fire service will not begin until the plans have been approved by the City of Bozeman and a City of Bozeman water service application has been completed.*** For maintenance of the fire service line after City of Bozeman final acceptance refer to Item 16 of this Standard. The Owner shall be completely responsible for assuring the fire service line is properly/adequately sized to provide the flows necessary for the fire protection system being serviced by the proposed fire service line.

3. Plans for all proposed fire service lines shall be drawn to scale on 24" x 36" plan sheet(s) and shall include all essential details such as:

   a. Size and location of all water supplies.
   b. Size and location of all piping indicating, where possible, the class, type and depth of existing pipe, the class and type of new pipe to be installed, and the depth to which it will be buried. For proposed fire service liens 4" in diameter and larger the plans must include a profile drawing of the proposed fire service line from the point of connection at the existing main up to and including the system riser. The profile drawing must show the finished grade, depth of cover for the line, and if applicable, all other utilities which the fire service line will cross or be adjacent to.
   c. Size, type and location of valves.
   d. Classification of the system (See Attachment A).
   e. Sprinkler and standpipe riser to be supplied by the system.
   f. Location of fire department connections.
   g. Size of orifice necessary to achieve the flushing flows required under NFPA 24.

4. All fire service lines not installed by the City of Bozeman Water Department shall be designed, inspected and certified by a Professional Engineer.

5. Fire service lines 4" in diameter and larger shall be installed, tested, and disinfected by a single Contractor from the point of connection at the City water main (or existing stub) to the first control valve (OS&Y) inside of the building. (Note Item 16 of this Standard for maintenance of the fire line.)

6. For all fire service lines 2" in diameter and smaller where no stub exists, a licensed contractor shall install the line from the main up to and including the first control valve (OS&Y) and double check valve inside the building. The Water Department shall tap the main at the owner's expense and inspect the line under line pressure before it is backfilled. A curb stop and box shall be installed at a point 8' past property line unless otherwise directed by the Water Superintendent. Installation of the fire service line will not begin until the plans for the project have received City of Bozeman approval and a City of Bozeman water service application has been completed.

7. The City of Bozeman will only accept fire service lines which are 1", 1 ½", 2", 4", 6", or 8" in diameter, unless specifically approved by the Engineering and Water Departments.

8. When tapping tees are used for the fire service line connection to the main, the Contractor shall install the tapping tee and valve and the City of Bozeman shall make the actual tap to the main at the Owner's expense.

   The fire service line connection to the City water main without the use of a tapping tee will be made by the Contractor installing the appropriate sized tee in the water main. The Water Department will operate all valves for the shut down of the line to install the tee and must be provided with a minimum of 24 hours advance notice before work is scheduled to begin. The Contractor shall notify all affected water customers of the water shut down a minimum of 24 hours before the work begins. Temporary water service shall be provided to all affected water customers if the shut down period is anticipated to exceed four hours. The City of Bozeman reserves the right to determine the likely extent of the main shut down based on the proposed work and Contractor experience, and require the installation of temporary water services by the Contractor.

9. Material and installation of fire service lines shall comply with the following standards:
   a. **Montana Public Works Standard Specifications, Fifth Edition, March 2003.**
   b. **City of Bozeman Modifications to the Montana Public Works Standard Specifications.**
   c. **City of Bozeman Standard Drawings 02660-13 and 02660-14.**
   d. **City of Bozeman Fire Service Line Standard.**
   e. **NFPA 24, Installation of Private Fire Service Mains and Their Appurtenances, (latest edition).**

10. The City of Bozeman's requirements for the installation of double check valve assemblies and reduced pressure backflow prevention assemblies are as follows:

    a. The first fitting inside of the building shall be a UL listed flanged American Flow

Control, Kennedy or Mueller OS&Y valve the same size as the fire service line, for lines 4" and larger. For lines 2" and smaller, the first fitting inside the building shall be a NIBCO T-104-0 OS&Y valve.

b. All double check valve assemblies and reduced pressure backflow prevention assemblies shall be:

1. UL or FM listed
2. Approved by the University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USCFCCCHR) for operation in the proposed position (vertical or horizontal) as shown on the approved plans.
3. Installed as shown on the approved plans.

c. A flow detection device shall be installed immediately following the double check valve assembly or the reduced pressure backflow prevention assembly (alarm check valve, flow/sensor alarm, meter, etc.) as shown on the approved plans.

d. A double detector check valve assembly may be used with a standard City of Bozeman meter (for Class I, II and III systems only). The meter loop of the double detector check valve shall have a double check valve assembly installed which meets the same installation criteria specified above in requirement b.

e. Horizontal installations must be a minimum of 2 feet clear above the finished floor.

f. The fire service riser must be a minimum of 2 feet clear from any outside wall.

g. The incoming fire service line shall be a minimum of 6.5 feet and a maximum of 7.5 feet below the finished grade.

h. All fire service lines appurtenances shall have a minimum pressure rating of 175 p.s.i.

i. All fire service lines 4" ands larger shall be Class 51 ductile iron pipe.

j. Line Sizing: The double check valve assembly or reduced pressure backflow prevention assembly shall be equal in size to the outgoing pipe diameter (downstream).

11. Prior the City of Bozeman's initial acceptance of the new fire service line (4" in diameter and larger) the line must be disinfected in accordance with Montana Public Works Specifications and City of Bozeman requirements. Flushing and pressure testing of the line shall be done in accordance with NFPA 24. Two (2) copies of the bacteriological tests results are to be submitted to the City Engineering Department, who will forward a

copy to the City Water Department.

12. Prior the City of Bozeman's initial acceptance of the new fire service line (4" in diameter and larger) the "Contractor's Material and Test Certificate for Underground Piping" (See Attachment B) must be completed and two (2) copies submitted to the City Engineering Department, who will forward a copy to the City Water Department.

13. Prior to the City of Bozeman's initial acceptance and activation of the fire service line (i.e., putting the line into service) a final inspection will be conducted by the City of Bozeman Water Superintendent, or his designated representative, to confirm that the installation is in accordance with the approved application and the approved plans. A Certificate of Inspection (see Attachment C) will be completed by the Water Superintendent, or his designated representative, upon completion of the final inspection, with copies of the Owner, Contractor, and Engineering Department. Installations that are in conformance with the approved plans for the project and have passed all required tests (see sections 11 and 12) will be initially accepted by the City of Bozeman as noted on the Certificate of Inspection. Installations that are not in conformance with the approved plans for the project will not be initially accepted by the City of Bozeman and the line will not be activated (i.e., placed in service) until the installation is in conformance with the approved plans and all required tests have been taken and passed.

14. The required two-year warranty period for the fire service line begins on the date of initial acceptance as noted on the Certificate of Inspection completed by the City of Bozeman Water Department.

15. Upon the City's initial acceptance (see Section 13) of the fire service line, the following must be submitted by the Project/Design Engineer to the City Engineer within thirty (30) days:

    a. Two (2) sets of accurate blue line record drawings signed by the Engineer.

    b. A letter of certification from the project Engineer stating that the fire service line was installed in accordance with the approved plans.

    The City of Bozeman's final acceptance of the fire service line will be based on the letter of certification, record drawings, and correction of any deficiencies noted during the two-year warranty period.

16. Following the expiration of the two-year warranty period, the City of Bozeman will maintain, at its expense, the fire service line from the main up to the curb stop or curb valve, or to the property line or easement line, whichever is more.
Any maintenance or repairs to the fire service line or its appurtenances beyond the point of City of Bozeman responsibility specified above shall be by a licensed contractor at the

Owner's expense. The building owner shall also be responsible for maintenance, repairs, and testing of all fire service line piping and appurtenances beyond the first control valve (OS&Y) inside the building.

17. The building owner may operate the first control valve (OS&Y) inside of the building when necessary for maintenance or repairs. When the first control valve (OS&Y) inside of the building is shut off for any reason, the City of Bozeman Fire Department must be notified immediately and informed of the shut down date, time and duration. **The building owner is completely responsible to ensure that this valve remains open at all times (except for maintenance or repairs) for the proper operation of the buildings fire protection system.**

18. Use of the fire service line shall be restricted to fire fighting use, emergency use and approved auxiliary (e.g., closed loop heating/cooling systems) including routine testing and flushing. Combined use lines (i.e., domestic and fire) are not acceptable for all buildings except single-family residences (SFRs). Separate service lines must be installed for individual domestic and fire services, except for SFRs. Fire sprinkler systems for SFRs may connect to the domestic supply inside the residence. Such connection must be made downstream of the backflow preventer. The backflow preventer must be a testable backflow preventer approved by the City of Bozeman's Backflow Prevention Specialist.

19. Bonding Requirements. The Owner shall require the Contractor to furnish Performance and Payment Bonds in favor of the Owner in an amount equal to one-hundred percent (100%) of the Agreement amount.

    The bonds shall be signed by a surety company authorized to do business in the State of Montana, and acceptable as a surety to the Owner and countersigned by a Montana Resident Agent.

    The bonds shall be filed with the Owner and the City of Bozeman and shall include a copy of Power of Attorney certified to include the date of the bonds.

20. Insurance Requirements. The Owner shall require the Contractor to secure and maintain such insurance from and insurance company (or companies) authorized to write insurance in the State of Montana, with a minimum "A.M. Best Rating" of B+, VI, as will protect himself, his subcontractors, the Owner, and the City of Bozeman and their respective agents and employees from claims for bodily injury, death, or property damage which may arise from operations and completed operations under the Agreement. The types and limits of coverage shall comply with the current edition of "Montana Public Works Standard Specifications". The Owner shall not authorize, nor shall the Contractor commence work under the Agreement until such insurance has been obtained and certificates of insurance, with binders, or certified copies of the insurance policy, have been filed with the Owner and the City of Bozeman.

All insurance coverages shall remain in effect throughout the life of the Agreement, except that the Contractor shall maintain the Commercial General Liability coverage for a period of at least one year following the substantial completion date for property damage resulting from occurrences during the Agreement period.

Each insurance policy shall contain a clause providing that it will not be cancelled by the insurance company without 30 days written notice to the Owner, and the City of Bozeman, of intention to cancel.

21. Warranty Period. If, within two years after initial acceptance of the work by the City of Bozeman, any of the work is found to be defective or not in accordance with the Contact Documents, and upon written notice from the City of Bozeman, the Owner shall cause the Contractor to correct any work within seven (7) calendar days of said written notice. Should the Owner or Contractor fail to the written notice within the designated time, the city of Bozeman may correct the work at the expense of the Owner/Contractor.

ATTACHMENT A

Backflow Prevention and System Classification

The City of Bozeman requires that the plans for the proposed fire service line include a description of the system including the "Class" of the system and the backflow prevention to be installed with the system. This Attachment provides standards for determining the Class of the proposed system and the required backflow protection to accompany the specific system. The standards in this Attachment are based on recommendations in American Water Works Association Manual M14, *Recommended Practice for Backflow Prevention and Cross-Connection Control,* and City of Bozeman requirements.

Classification for Backflow Protection

Class 1. Direct connections from public water mains only; no pumps, tanks, or reservoirs; no physical connection from other water supplies; no antifreeze or other additives of any kind; all sprinkler drains discharging to atmosphere, dry wells or other safe outlets.

Class 2. Same as Class 1 except that booster pumps may be installed in the building after the first interior control valve (OS&Y).

Class 3. Direct connection from public water supply mains, plus one or more of the following: elevated storage tanks, fire pumps taking suction from aboveground covered reservoir or tanks; and pressure tanks. (All storage facilities are filled or connected to public water only, the water in the tanks is to be maintained in a potable condition. Otherwise, Class 3 systems are the same as Class 1.)

Class 4. Directly supplied from public mains, similar to Class 1 and Class 2, with an auxiliary water supply dedicated to fire department use and available to the premises, such as an auxiliary supply located within 1700 feet of the pumper connection.

Class 5. Directly supplied from public mains and interconnected with auxiliary supplies, such as pumps taking suction from reservoirs exposed to contamination, or rivers and ponds; driven wells; mills or other industrial water systems; or where antifreeze or other additives are used.

Class 6. Combined industrial and fire protection systems supplied from the public water mains only, with or without gravity storage or pump suction tanks.

Required Protection

All systems regardless of Class require a means of flow detection which must be approved by the City of Bozeman.

Class 1. Minimum backflow protection requirement for a Class 1 system is an approved testable double check valve assembly to prevent water from backflowing into the public potable water system. The double check valve assembly should be the same size as the fire service line to the building and installed immediately following the first interior OS&Y control valve as shown on the approved plans. (Refer to City of Bozeman Standard Drawing 02660-13 for specific requirements.)

Exception: Special conditions may exist on the site of Class 1 fire systems such that actual or potential contamination hazards are presented to the domestic water supply. Under these conditions an approved reduced pressure backflow prevention assembly, or an appropriately sized air gap, may be warranted and/or required by the City of Bozeman.

Class 2. Minimum backflow protection requirement for a Class 2 system is an approved

testable double check valve assembly to prevent water from backflowing into the public potable water system. The double check valve assembly should be the same size as the fire service line to the building and installed immediately following the first interior OS&Y control valve as shown on the approved plans. (Refer to City of Bozeman Standard Drawing 02660-13 for specific requirements.)

Exception: Special conditions may exist on the site of Class 2 fire systems such that actual or potential contamination hazards are presented to the domestic water supply. Under these conditions an approved reduced pressure backflow prevention assembly, or an appropriately sized air gap, may be warranted and/or required by the City of Bozeman.

Class 3. Minimum backflow protection requirement for a Class 3 system is an approved testable double check valve assembly to prevent water from backflowing into the public potable water system. The double check valve assembly should be the same size as the fire service line to the building and installed immediately following the first interior OS&Y control valve as shown on the approved plan. (Refer to city of Bozeman Standard Drawing 02660-13 for specific requirements.)

Exception: Special conditions may exist on the site of Class 3 fire systems such that actual or potential contamination hazards are presented to the domestic water supply. Under these conditions an approved reduced pressure backflow prevention assembly, or an appropriately sized air gap, may be warranted and/or required by the City of Bozeman.

Class 4. The type of backflow protection for Class 4 systems will depend on the quality of the auxiliary supply. The type of backflow protection will be one of the following approved by the City of Bozeman: air gap or reduced-pressure backflow-prevention assembly. Reduced-pressure backflow-prevention assemblies should be the same size as the fire service line to the building and installed immediately following the first interior OS&Y control valve as shown on the approved plans. (Refer to city of Bozeman Standard Drawing 02660-14 for specific requirements.)

Class 5. The type of backflow protection for Class 5 systems will be either a reduced-pressure backflow-prevention assembly or an air gap. Reduced-pressure backflow-prevention assemblies should be the same size as the fire service line to the building and installed immediately following the first interior OS&Y control valve as shown on the approved plans. (Refer to City of Bozeman Standard Drawing 02660-14 for specific requirements.)

Class 6. Class 6 system protection would depend on the requirements of both industry and fire protection and could only be determined by a survey of the premises.

ATTACHMENT B

Contractor's Material and Test Certificate for Underground Piping

Contractor's Material and Test Certificate for Underground Piping

PROCEDURE

Upon completion of work, inspection and tests shall be made by the contractor's representative and witnessed by an owner's representative. All defects shall be corrected and system left in service before contractor's personnel finally leave the job.

A certificate shall be filled out and signed by both representatives. Copies shall be prepared for approving authorities, owners, and contractor. It is understood the owner's representative's signature in no way prejudices any claim against contractor for faulty material, poor workmanship, or failure to comply with approving authority's requirements or local ordinances.

Property name	Date
Property address	

Plans	Accepted by approving authorities (names)	
	Address	
	Installation conforms to accepted plans	❑ Yes ❑ No
	Equipment used is approved	❑ Yes ❑ No
	If no, state deviations	
Instructions	Has person in charge of fire equipment been instructed as to location of control valves and care and maintenance of this new equipment?	❑ Yes ❑ No
	If no, explain	
	Have copies of appropriate instructions and care and maintenance charts been left on premises?	❑ Yes ❑ No
	If no, explain	
Location	Supplies buildings	
Underground pipes and joints	Pipe types and class / Type joint	
	Pipe conforms to _____ standard	❑ Yes ❑ No
	Fittings conform to _____ standard	❑ Yes ❑ No
	If no, explain	
	Joints needing anchorage clamped, strapped, or blocked in accordance with _____ standard	❑ Yes ❑ No
	If no, explain	
Test description	Flushing: Flow the required rate until water is clear as indicated by no collection of foreign material in burlap bags at outlets such as hydrants and blow-offs. Flush at one of the flow rates as specified in 10.10.2.1.3.	
	Hydrostatic: All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at 200 psi (13.8 bar) or 50 psi (3.5 bar) in excess of the system working pressure, whichever is greater, and shall maintain that pressure ±5 psi (0.35 bar) for 2 hours.	
	Hydrostatic Testing Allowance: Where additional water is added to the system to maintain the test pressures required by 10.10.2.2.1, the amount of water shall be measured and shall not exceed the limits of the following equation (for metric equation, see 10.10.2.2.6):	
	$L = \frac{SD\sqrt{P}}{148{,}000}$	L = testing allowance (makeup water), in gallons per hour S = length of pipe tested, in feet D = nominal diameter of the pipe, in inches P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)
Flushing tests	New underground piping flushed according to NFPA-24 standard by (company)	❑ Yes ❑ No
	If no, explain	
	How flushing flow was obtained: ❑ Public water ❑ Tank or reservoir ❑ Fire pump	Through what type opening: ❑ Hydrant butt ❑ Open pipe
	Lead-ins flushed according to _____ standard by (company)	❑ Yes ❑ No
	If no, explain	
	How flushing flow was obtained: ❑ Public water ❑ Tank or reservoir ❑ Fire pump	Through what type opening: ❑ Y connection to flange and spigot ❑ Open pipe

© 2012 National Fire Protection Association

FIGURE 10.10.1 Sample of Contractor's Material and Test Certificate for Underground Piping.

Hydrostatic test	All new underground piping hydrostatically tested at _____ psi for _____ hours	Joints covered ❑ Yes ❑ No
Leakage test	Total amount of leakage measured _____ gallons _____ hours	
	Allowable leakage _____ gallons _____ hours	
Forward flow test of backflow preventer	~~Foward flow test performed in accordance~~ with 10.10.2.5.2: ❑ Yes ❑ No	
Hydrants	Number installed / Type and make	All operate satisfactorily ❑ Yes ❑ No
Control valves	Water control valves left wide open If no, state reason	❑ Yes ❑ No
	Hose threads of fire department connections and hydrants interchangeable with those of fire department answering alarm	❑ Yes ❑ No
Remarks	Date left in service	
Signatures	Name of installing contractor	
	Tests witnessed by	
	For property owner (signed) / Title / Date	
	For installing contractor (signed) / Title / Date	

Additional explanation and notes

© 2012 National Fire Protection Association NFPA 24 (p. 2 of 2)

FIGURE 10.10.1 *Continued*

ATTACHMENT C

Certificate of Inspection

CERTIFICATE OF INSPECTION
FOR
FIRE SERVICE LINE INSTALLATION

Date:_____ Time:_____

City of Bozeman Water Department Inspector:_____

This is the 1st 2nd 3rd inspection of this installation.

Fire Service Line Installed For:

Owner of Building:_____
Owner's Address:_____
Owner's Phone:_____ Building Phone:_____
Building Address:_____
Building Name:_____

Fire Service Line Installed By:

Name of Contractor:_____
Contractor's Address:_____
Contractor's Phone:_____
Person to Contact:_____

The following were present during this inspection:

_____
_____
_____
_____

The fire service line is installed in accordance with City of Bozeman requirements for the project: **YES** **NO**

Bacteriological Tests have been completed and passed: **YES** **NO**

The "Contractor's Material & Test Certificate for Underground Piping" has been completed and submitted to the City Engineer (i.e. pressure tests have been conducted and passed): **YES** **NO**

If the answer to <u>all</u> the above items is "YES" then the City of Bozeman initially accepts the fire service line and the two year warranty period begins on the date of this inspection.

The fire service line was activated (placed into service) during this inspection: **YES** **NO**

(If "NO" indicate below the reason and the date it is to be activated.)

The first interior valve (OS&Y) was left in the OPEN CLOSED position at the completion of this inspection.

OWNER NOTE: When the first control valve (OS&Y) inside of the building is shut off for <u>any</u> reason, the City of Bozeman Fire Department must be notified immediately and informed of the shut down date, time, and duration.

==========

Comments:_____

_____

_____

_____

_____

_____

_____

_____

cc: Owner
Contractor
City Engineer's Office

CERTIFICATE OF
COMPLETION AND ACCEPTANCE

OWNER:_____ PROJECT TITLE:_____

DATE OF ACCEPTANCE:_____ PROJECT NO.: _____

PROJECT DESCRIPTION: _____

PROJECT LOCATION: _____

CONTRACTOR:_____

ENGINEER: _____

Substantial Completion Date:_____ Two-year warranty expiration date: _____

The Work performed under the Contract for the above Project has been inspected by a representative of the Owner, Contractor, City of Bozeman, and Engineer and has been found to substantially comply with the approved Contract Documents and is hereby declared complete. Acceptance by the Owner and City of Bozeman and recommendation thereto by the Engineer does not affect the "Contractor's Continuing Obligation" as described in Article 14.15 of the Standard General Conditions of the Construction Contract, or the Owner's contractual obligations.

ENGINEER'S RECOMMENDATION

On the basis of observation of the Work during construction, final inspection and review of project testing, final application for payment and accompanying documents, the Engineer is satisfied and hereby certifies that the Work has been completed in accordance with the approved Contract Documents. This acceptance shall not relieve the Contractor of his obligations under the Contract Documents.

_____ By:_____
Engineer Printed Name:_____
P.E. #_____ Date _____

CONTRACTOR'S CONCURRENCE WITH ENGINEER'S RECOMMENDATION

_____ By:_____
Contractor Printed Name:_____
Title:_____
Date:_____

OWNER'S ACCEPTANCE AND GRANT OF POSSESSION

On the basis of independent observations and inspections and the recommendations of the Engineer, the Owner accepts the Project as complete. This acceptance does not relieve the Contractor of continuing obligations as described above. The Contractor is reminded this Project is under warranty beginning _____ and that bonds shall remain in effect for two years after the Date of Acceptance specified above. The Owner hereby grants possession of all public infrastructure improvements completed by this Project to the City of Bozeman and warrants against defects in these improvements for a period of two years from the Date of Acceptance specified above.

_____ By: _____

Owner Printed Name: _____

Title: _____

Date: _____

CITY OF BOZEMAN'S ACCEPTANCE

The City of Bozeman hereby accepts possession of all public infrastructure improvements, subject to the above indicated warranty. This acceptance does not relieve the Owner or Contractor of his continuing obligations for this work as described above or otherwise required through Improvement Agreements, conditions of plat approval, or his other contractual commitments.

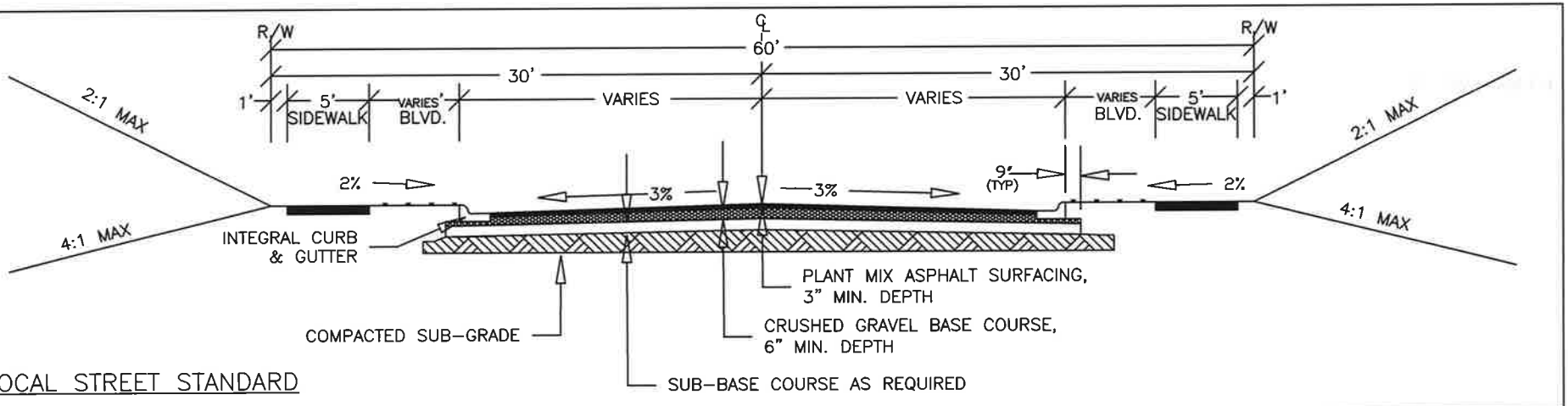
City of Bozeman B y: _____

Title: _____

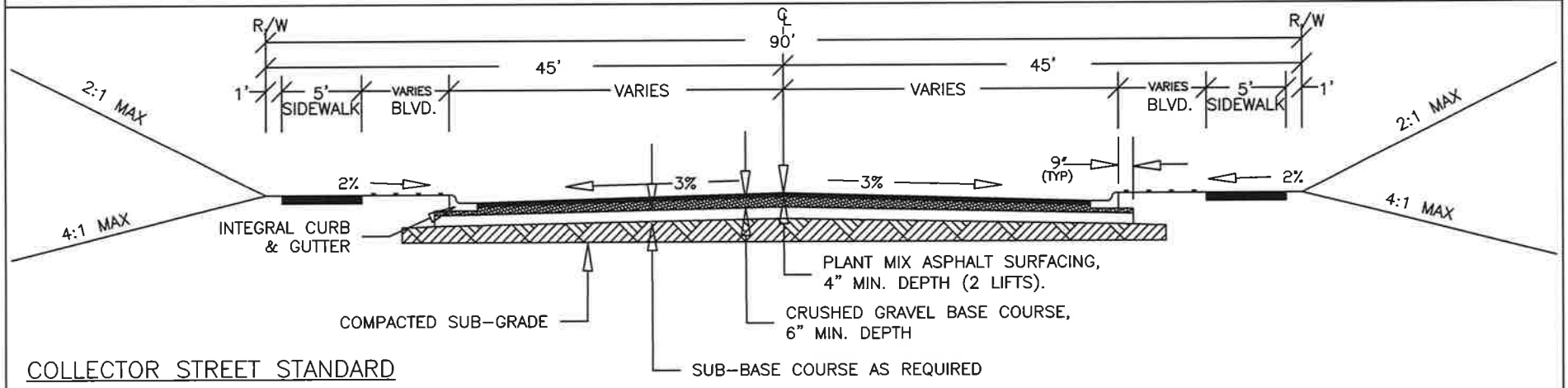
Date: _____

CITY OF BOZEMAN DESIGN STANDARDS & SPECIFICATIONS POLICY

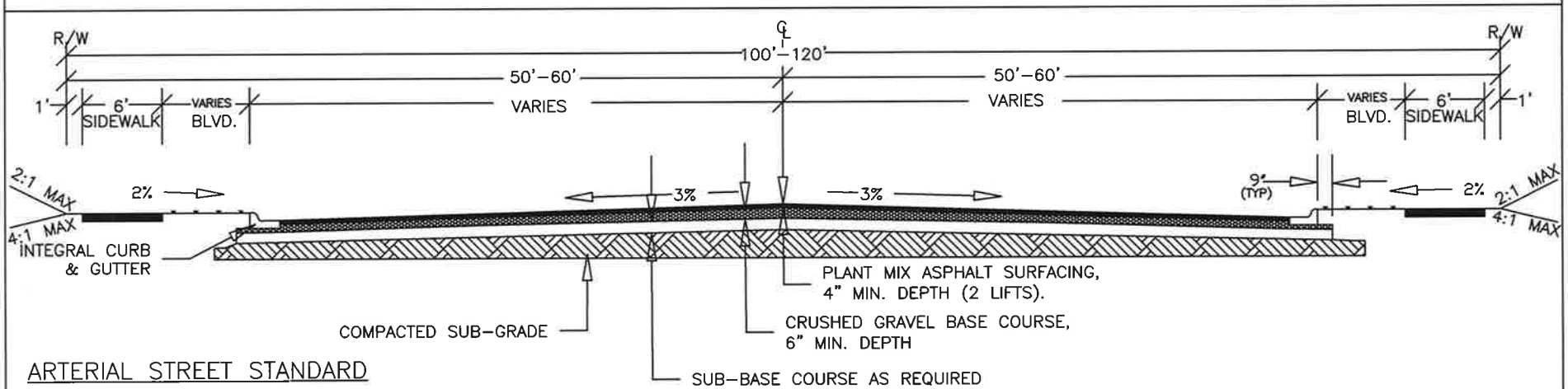
FIGURE A-1: TYPICAL ROADWAY SECTIONS



LOCAL STREET STANDARD



COLLECTOR STREET STANDARD

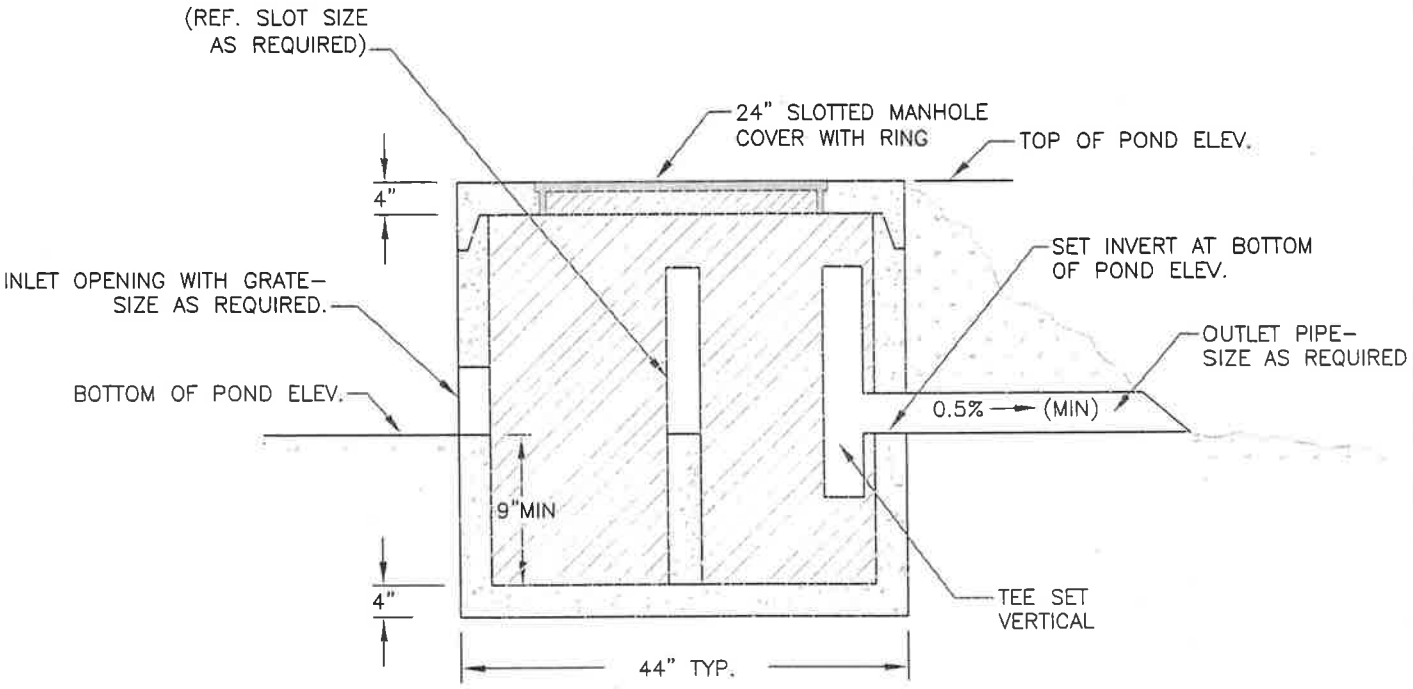


ARTERIAL STREET STANDARD

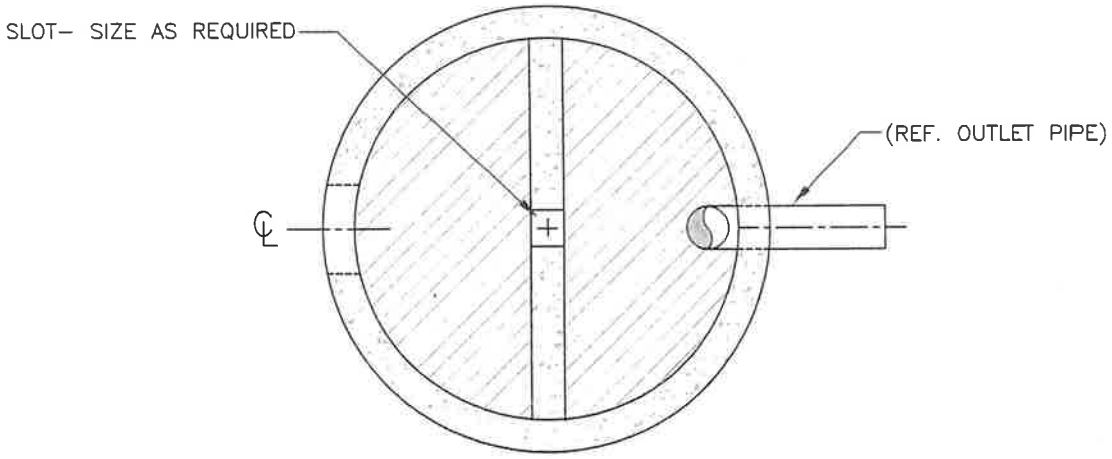
NOTE: PAVEMENT AND BASE COURSE THICKNESS SHALL BE DETERMINED BY THE DESIGN ENGINEER BASED ON SITE SOIL CONDITIONS AND AT LEAST THE 20 YEAR PERFORMANCE PERIOD TRAFFIC VOLUME.

NOTE: THE SPECIFIC RIGHT-OF-WAY AND BACK OF CURB STREET WIDTH WILL BE DETERMINED ON A CASE BY CASE BASIS THROUGH THE SUBDIVISION REVIEW PROCESS.

REV. JAN 2011



SIDE VIEW



TOP VIEW

CITY OF BOZEMAN DESIGN STANDARDS	SCALE: NONE	TYPICAL CONCRETE OUTLET STRUCTURE FOR STORMWATER DETENTION PONDS	FIG. A-2 MAY 2001

SIZING DETENTION BASINS – SAMPLE PROBLEM
(Rational Method)

Given: Existing Land Use:	Agricultural
Proposed Land Use:	Industrial
Drainage Area:	5 Acres
Slope:	1%
Overland Travel Distance to Channel:	120 feet
Channel Time:	4 minutes
Max. Basin Water Depth Allowable:	1 foot

Problem:

Size a detention basin to control runoff to pre-development levels and to remove sediment (40 micron particle).

Solution:

Existing Situation

Land Use:	Agricultural
Area:	5 Acres
C =	0.20 (Table I-1)
Time of Concentration:	16 minutes (Figure I-1) + 4 minutes = 20 minutes
Design Storm Frequency:	10 year (Table I-3) (Based on Future use Design Frequency)
Intensity at Tc:	1.3071 in/hr (Figure I-3)
Peak Runoff Rate:	(0.20) (1.3071) (5) = 1.31 cfs

Future Situation

Land Use:	Industrial
Area:	5 Acres
C =	0.80 (Table I-1)
Time of Concentration:	6 minutes (Figure I-1) + 4 minutes = 10 minutes
Design Storm Frequency:	10 year (Table I-3)

Detention Basin Sizing

Design Release Rate:	1.31 cfs

MINIMUM VOLUME

Storm Duration (Minutes)	Intensity (in/hr)	Future Runoff Rate (Q = CiA) (cfs)	Runoff Volume (cf)	Release Volume (cf)	Required Storage (cf)
25	1.1306	4.52	6780	1965	4815
27	1.0755	4.30	6966	2122	4844
29	1.0266	4.11	7175	2279	4872
31	0.9831	3.93	7310	2437	4873
33	0.9439	3.78	7484	2594	4890*
35	0.9085	3.63	7623	2751	4872

* Minimum Volume Required – 4890 cf

Note: 1. If controlling volume falls at a storm duration less than the future time of concentration, use the volume at the time of concentration.
2. Based on Minimum Volume and using 1 foot depth, Surface Area = 4890 sf.

MINIMUM AREA

Assumptions:

1. Non-flocculant particles.
2. Settling velocity of 40 micron particles = 0.0069 ft/sec.

Design Release Rate: 1.31 cfs

Minimum Area Required: 1.31 cfs ÷ 0.0069 ft/sec = 190 sf

(Since 4890 > 190 sf, use 4890 sf)

BASIN SIZING

Water Depth:	1 foot
Surface Area:	4890 sf
Volume:	4890 cf
Length:	123 ft.
Width:	40 ft.

PRECONSTRUCTION MEETING CRITERIA CHECKLIST

PROJECT NAME: _____

PROJECT TYPE: _____

(water, sanitary sewer, storm sewer, streets)

OWNER/DEVELOPER: _____

ENGINEER: _____

CONTRACTOR: _____

PRECONSTRUCTION CONFERENCE SUBMITTALS CHECKLIST

REQUIRED SUBMITTAL	REQUIRED	DATE REC.	COMMENTS
Approved Plans & Specifications: DEQ Approval COB Approval			
Executed Easements			
Abandoned Easements			
Shop/Fabrication Drawings ** (submit two days before precon. mtg.)			
Traffic Control Plan (submit one week before precon. mtg.)			
Electronic Plans on CD (.dwg or .PDF) (submit two days before precon.mtg.)			
Copy of Contractor's Bonds			Bonds shall be in effect until 2 yrs after the date of final completion and acceptance by the City.
Copy of Contractor's Insurance			
PERMITS: Dewatering Discharge Permit (MDHES) *			
310 Permit (SCS/FWP) *			
404 Permit (Corps) *			
Stormwater Control Permit (MDHES) *			
Street Cut Permit (COB/County) *			
Utility Occupancy Permit (MDOT/County) *			
Flood Plain (COB) *			

PRECONSTRUCTION MEETING DATE:

(Will not be scheduled until <u>all</u> above applicable submittals are received.)

** Note: Shop/Fabrication Drawings shall bear Engineer's approval when submitted.

* Note: To be determined by design engineer.

CITY OF BOZEMAN
PLAN AND SPECIFICATION CERTIFIED CHECKLIST

Project Name:

Engineer:

Reports Received:
☐ Utilities Design Report
☐ Traffic Impact Analysis
☐ Stormwater Facilities Design

CHECKLIST SUBMITTAL INSTRUCTIONS

This checklist may be used in lieu of a complete department review when the conditions listed below are met. The department reviews all certified checklists for completeness and accuracy and must approve all deviation requests. Deviation requests will result in slower turn-around by the department. Construction may not begin until approval of the certified checklist is granted by the department, and a preconstruction meeting is held. Department approval will be issued in a letter to the design engineer submitting the plans and specifications.

All sections of the certified checklist must be completed. *The answer yes may be checked when all the requirements of the section being addressed are satisfied.* Where a yes answer cannot be given, a deviation must be requested or the applicant must explain why that section of the standard is not applicable. All deviation requests must be justified by the design engineer and supported with appropriate documentation.

All infrastructure certified checklists must be signed and stamped by the professional engineer responsible for the design of the project. In addition, four sets of plans and specifications signed and stamped by a professional engineer must be included.

The plans and specifications for the above referenced project are in compliance with the following sections of the City of Bozeman Design Standards.

	PRELIMINARY REQUIREMENTS			
	1.	**Project approval obtained from City Commission**		
			☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	2.	**All conditions of project approval have been addressed**		
			☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:

I.	CONSTRUCTION PLANS AND SPECIFICATIONS REQUIREMENTS			
	A.	**General Requirements**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		6.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		7.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		8.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		9.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	B.	**Specification Requirements**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	C.	**Drawing Scales**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	D.	**Plan Requirements**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	E.	**Utility Plan Requirements**		
		1.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		1.b.	☐ Yes	☐ Deviation Requested:

			☐ NA	Explain:
		1.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		1.d.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	F.	**Roadway Plan Requirements**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
II.	**DRAINAGE POLICY**			
	A.	**General Design Criteria**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.d	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.e.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.f.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	B.	**Storm Drainage Plan**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:

		4.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		6.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	C.	**Storage/Treatment Facilities**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.d.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.e.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	D.	**Discharge Structures**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:

	E.	**Estimation of Runoff**		
		1.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		1.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		1.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		6	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
III.	**FLOODPLAIN REGULATIONS**			
	A.	**General**		
			☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
IV.	**ROADWAY DESIGN AND TECHNICAL CRITERIA**			
	A.	**General**		
			☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	B.	**Sidewalks, curbs and gutters and driveways**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		6.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		7.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:

		8.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	C.	**Drainage**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	D.	**Horizontal Alignment**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		6.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		7.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		8.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		9.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	E.	**Vertical Alignment**		

		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.d.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		6.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		7.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		8.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	F.	**Median Treatment**		
			☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	G.	**Roadway Specifications**		
			☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	H.	**Signs and Markings**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.a	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.b	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.c	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.d	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:

		3.e	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	I.	**Monumentation**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	J.	**Lighting**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		7.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		8.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	K.	**Bike Lanes/Paths**		
			☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
V.	**UTILITY DESIGN CRITERIA**			
	A.	**Water Distribution Lines**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		6.a	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:

		6.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		6.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		6.d.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		6.e.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		6.f.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		6.g.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		6.h.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		7.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		7.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		7.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		7.d.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		8.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		9.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		10.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		11.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	B.	**Sanitary Sewer System Design Criteria**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:

		6.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		7.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		8.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		9.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		10.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		11.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		12.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		13.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	C.	**Storm Sewers**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.d.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		6.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		6.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		6.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		7.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:

		7.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		8.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		8.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		8.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		8.d.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		8.e.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		8.f.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		8.g.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		9.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
	D.	**Alignment, Depth, and Easements**		
		1.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		2.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		3.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		4.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.a.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:

		5.b.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.c.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:
		5.d.	☐ Yes	☐ Deviation Requested:
			☐ NA	Explain:

Certified By: _____ Date: _____
(Signature of Professional Engineer)

Montana P.E. Number: _____

CERTIFIED CHECKLIST FOR TESTING & DOCUMENTATION REQUIREMENTS FOR INFRASTRUCTURE IMPROVEMENTS

All sections of the certified checklist must be completed. *The answer yes may be checked when all the requirements of the section being addressed are satisfied.* Where a yes answer cannot be given, a deviation must be requested or the applicant must explain why that section of the standard is not applicable. All deviation requests must be justified by the design engineer and supported with appropriate documentation. All infrastructure certified checklists must be signed and stamped by a professional engineer licensed in the state of Montana.

A.	☐ Yes	☐ Deviation Requested:
	☐ NA	Explain:
B.	☐ Yes	☐ Deviation Requested:
	☐ NA	Explain:
C.	☐ Yes	☐ Deviation Requested:
	☐ NA	Explain:
D.	☐ Yes	☐ Deviation Requested:
	☐ NA	Explain:
E.	☐ Yes	☐ Deviation Requested:
	☐ NA	Explain:
F.	☐ Yes	☐ Deviation Requested:
	☐ NA	Explain:
G.	☐ Yes	☐ Deviation Requested:
	☐ NA	Explain:
H.	☐ Yes	☐ Deviation Requested:
	☐ NA	Explain:
I.	☐ Yes	☐ Deviation Requested:
	☐ NA	Explain:
J.	☐ Yes	☐ Deviation Requested:
	☐ NA	Explain:
K.	☐ Yes	☐ Deviation Requested:
	☐ NA	Explain:

Certified By: _____ Date: _____
(Signature of Professional Engineer)

Montana P.E. Number: _____

SAMPLING MATERIALS BY RANDOM NUMBER SAMPLING

1. SCOPE - This method provides a procedure, in the form of several examples, for selecting samples on an approximately random basis using a system of random numbers. To accomplish this selection, choose the random sample so that each unit of material (i.e., cubic yard, square yard, ton, etc.) has the same probability of being selected. Divide each material sampled into lots, and establish a frequency of sampling.

2. PROCEDURE -

2.1. Random numbers can be generated by some calculators by planting a seed number such as date, time of day, etc., expressed as a decimal between 0 and 1. Included in this method are two tables of random numbers for use. Enter the table in a random method, such as a blind placement of a pencil. After choosing the first random number in this manner, choose consecutive numbers, following a column (or row), until the entire table has been used. At that time, repeat the initial process of random entry into the table of numbers. This method will reduce the possibility of using a value from the table more than once.

2.2. Following are examples related to particular phases of highway construction:

2.2.1. EXAMPLE NO. 1

In this example, select station numbers for density coring of a 0.75-in. nominal-maximum mixture. Specifications require four density cores for each 1 000 tons of mixture placed. The sublot size is 1000 tons with a frequency of four cores per sublot. The sublot of mixture in question will be placed on a 12-ft.-wide lane that is 4545 ft. long. The lift thickness of the 0.75-in. nominal-maximum mixture is 3.0 in. The job starts at Station No. 0+00.

Since four density cores are required for the entire 4545-ft. length, obtain one core for each 1136.25 ft. of pavement. Use the following steps to determine the station number and offset for each density core:

2.2.1.1. Refer to the random number table (see p. 5 for example).

2.2.1.2. Enter the table at any point. Select four consecutive numbers from the random number table. Use these numbers for finding the station number of the core site in each 1136.25-ft. section.

Multiply each random number by 1136.25 to determine the station number at which to obtain the density core. After determining the

location of the first core, for each of the remaining cores, add increments of 1136.25 ft., increasing with each core, to provide locations throughout the entire sublot length.

SAMPLE NO.	RANDOM NUMBER CALCULATION	STATION NUMBER
1	0.420 x 1136.25 = 477.23 + 0.00 = 477	4 + 77
2	0.859 x 1136.25 = 976.04 + 1136.25* = 2112	21 + 12
3	0.011 x 1136.25 = 12.50 + 2272.50 = 2285	22 + 85
4	0.762 x 1136.25 = 865.82 + 3408.75 = 4275	42 + 75

*1136.25-ft. increments, as determined by the sublot length, provide resultant numbers throughout the entire sublot length.

According to Subsection 402.03.02 of the *Standard Specifications*, obtain cores no closer than three inches from the pavement edge or joint. To select the transverse distance from the pavement edge (left or right), select four additional consecutive numbers from the random number table (see p. 5 for example), and multiply each random number by 11.5 (12-ft. lane width minus the 0.25-ft. offset from each side). For this example, calculate the distance from 0.25 ft. inside of the right edge of the pavement.

SAMPLE NO.	RANDOM NO. CALCULATION	OFFSET FROM RIGHT EDGE
1	0.062 x 11.5 + 0.25 =	1.0 ft.
2	0.100 x 11.5 + 0.25 =	1.4 ft.
3	0.409 x 11.5 + 0.25 =	5.0 ft.
4	0.784 x 11.5 + 0.25 =	9.3 ft.

Therefore, from the calculations above, conform to the coring schedule given below for this sublot:

SAMPLE NO.	STATION NUMBER	OFFSET FROM RIGHT EDGE
1	4 + 77	1.0 ft.
2	21 + 12	1.4 ft.
3	22 + 85	5.0 ft.
4	42 + 75	9.3 ft.

With respect to this example, in other cases, the paving length and width will vary, but use the same procedure for obtaining random locations.

2.2.2. EXAMPLE NO. 2

In this example, select trucks to sample for running air content, slump, and concrete cylinders on Class AA Concrete for a bridge deck pour.

The pour will consist of 250 cubic yards of concrete. The trucks will be hauling 10 cubic yards each. The testing frequency is one test for each 50 cubic yards; therefore, perform five tests. There will be at least five tests required. Use the following steps to select the trucks to sample:

2.2.2.1. Refer to the random number table (see p. 5 for example).

2.2.2.2. Select five consecutive numbers from the random number table. Use these numbers to determine which trucks to sample. Multiply each number by 50 (a lot size of 50 cubic yards), and divide the answer by 10 (cubic yards per truck) to determine which trucks to sample.

SAMPLE NUMBER	RANDOM NUMBER	CALCULATED VOLUME (cubic yards)	TRUCK SAMPLED
1	0.007	x 50 = 0.35 + 0 = 0.35 ??10 = 0.04*	1st
2	0.922	x 50 = 46.1 + 50** = 96.1 ? 10 = 9.6	10th
3	0.729	x 50 = 36.5 + 100 = 136.5 ? 10 = 13.7	14th
4	0.949	x 50 = 47.5 + 150 = 197.5 ? 10 = 19.8	20th
5	0.606	x 50 = 30.3 + 200 = 230.3 ? 10 = 23.03	24th

*When this answer contains a decimal, always round upward to the next highest whole number to determine the truck number.

**Add increments of 50 cubic yards (lot size), increasing with each sample, in order to provide sampling throughout the full 250 cubic yards.

2.2.3. EXAMPLE NO. 3

In this example, select the accumulated tonnage of Crushed Stone Base for gradation testing. The frequency for gradation testing of aggregate bases is one test per 2000 tons of material. Plan quantities show 10,000 tons of Crushed Stone Base exist on this project. This quantity will require five gradation tests.

Again, select five consecutive random numbers from the random number table (see p. 5 for example). Use these numbers to determine the accumulated tonnage at which to select the sample.

Multiply each number by 2000 to determine the accumulated tonnage for sampling. Add increments of 2000 tons (lot size), increasing with each sample, in order to provide sampling throughout the full 10,000 tons.

SAMPLE NUMBER	RANDOM NUMBER CALCULATION	ACCUMULATED TONNAGE
1	0.658 x 2000 = 1316 + 0 =	1316
2	0.747 x 2000 = 1494 + 2000 =	3494
3	0.270 x 2000 = 540 + 4000 =	4540
4	0.715 x 2000 = 1430 + 6000 =	7430
5	0.418 x 2000 = 836 + 8000 =	8836

Obtain samples as near the above-listed accumulated tonnages as possible.

2.3. The system of selecting random samples can be related to periods of time, number of pieces, tons, etc. The key to randomness, using this method, relies heavily on the manner of entering the table. Do not use the same set of numbers repeatedly.

km113.doc

TABLE 1
RANDOM NUMBERS

.600	.504	.248	.230	.996	.462	.422	.054	.224	.121
.116	.227	.802	.349	.241	.956	.079	.632	.126	.677
.098	.726	.507	.607	.963	.410	.572	.777	.237	.851
.147	.867	.802	.416	.370	.377	.775	.256	.348	.148
.644	.067	.001	.158	.702	.148	.667	.217	.421	.149
.310	.531	.520	.560	.888	E.287	.567	.251	.593	.571
.493	.235	.886	.178	.490	X.007	.640	.343	.894	.079
.788	.272	.484	.487	.277	A.922	.435	.716	.924	.304
.652	.523	.317	.601	.705	M.729	.669	.435	.984	.239
.816	.045	.423	.943	.227	#.949	.395	.931	.887	.242
.086	.585	.177	.851	.513	2.606	.911	.253	.669	.328
.689	.755	.027	.183	.024	E.658	.041	.512	.518	.910
.117	.029	.309	.017	.926	X.747	.584	.570	.212	.504
.700	.989	.980	.532	E.640	A.270	.610	.257	.996	.978
.321	.431	.370	.814	X.420	M.715	.548	.148	.953	.450
.515	.775	.759	.438	A.859	#.418	.689	.924	.350	.724
.543	.575	.633	.097	M.011	3 .170	.357	.429	.899	.087
.629	.502	.503	.036	#.762	.280	.605	.518	.275	.017
.221	.882	.206	.415	1 .776	.548	.520	.417	.253	.808
.751	.446	.189	.776	.465	.936	.970	.467	.371	.077
.553	.160	.464	.309	.298	.304	.613	.512	.816	.270
.384	.778	.284	.435	.246	.319	.078	.695	.152	.637
.969	.740	.102	.093	.055	.155	.225	.782	.226	.250
.085	.125	.750	.900	.991	.887	.993	.183	.096	.542
.667	.355	.784	.803	E.072	.206	.508	.385	.691	.127
.076	.968	.527	.749	X.062	.075	.526	.292	.176	.310
.788	.943	.091	.141	A.100	.040	.750	.870	.249	.345
.165	.422	.601	.095	M.409	.897	.963	.271	.770	.100
.472	.201	.558	.725	#.784	.025	.943	.040	.984	.011
.668	.708	.776	.490	1 .270	.868	.658	.954	.916	.955

TABLE 1
RANDOM NUMBERS

.600	.504	.248	.230	.996	.462	.422	.054	.224	.121
.116	.227	.802	.349	.241	.956	.079	.632	.126	.677
.098	.726	.507	.607	.963	.410	.572	.777	.237	.851
.147	.867	.802	.416	.370	.377	.775	.256	.348	.148
.644	.067	.001	.158	.702	.148	.667	.217	.421	.149
.310	.531	.520	.560	.888	.287	.567	.251	.593	.571
.493	.235	.886	.178	.490	.007	.640	.343	.894	.079
.788	.272	.484	.487	.277	.922	.435	.716	.924	.304
.652	.523	.317	.601	.705	.729	.669	.435	.984	.239
.816	.045	.423	.943	.227	.949	.395	.931	.887	.242
.086	.585	.177	.851	.513	.606	.911	.253	.669	.328
.689	.755	.027	.183	.024	.658	.041	.512	.518	.910
.117	.029	.309	.017	.926	.747	.584	.570	.212	.504
.700	.989	.980	.532	.640	.270	.610	.257	.996	.978
.321	.431	.370	.814	.420	.715	.548	.148	.953	.450
.515	.775	.759	.438	.859	.418	.689	.924	.350	.724
.543	.575	.633	.097	.011	.170	.357	.429	.899	.087
.629	.502	.503	.036	.762	.280	.605	.518	.275	.017
.221	.882	.206	.415	.776	.548	.520	.417	.253	.808
.751	.446	.189	.776	.465	.936	.970	.467	.371	.077
.553	.160	.464	.309	.298	.304	.613	.512	.816	.270
.384	.778	.284	.435	.246	.319	.078	.695	.152	.637
.969	.740	.102	.093	.055	.155	.225	.782	.226	.250
.085	.125	.750	.900	.991	.887	.993	.183	.096	.542
.667	.355	.784	.803	.072	.206	.508	.385	.691	.127
.076	.968	.527	.749	.062	.075	.526	.292	.176	.310
.788	.943	.091	.141	.100	.040	.750	.870	.249	.345
.165	.422	.601	.095	.409	.897	.963	.271	.770	.100
.472	.201	.558	.725	.784	.025	.943	.040	.984	.011
.668	.708	.776	.490	.270	.868	.658	.954	.916	.955

TABLE 2
RANDOM NUMBERS

.605	.973	.319	.294	.236	.572	.216	.973	.931	.870
.720	.497	.679	.634	.299	.578	.743	.835	.062	.200
.918	.295	.295	.777	.854	.281	.867	.864	.374	.748
.294	.396	.441	.321	.655	.191	.205	.899	.807	.186
.089	.927	.802	.530	.937	.257	.530	.005	.539	.999
.591	.409	.668	.967	.993	.920	.812	.018	.578	.618
.494	.808	.410	.097	.633	.149	.547	.895	.829	.953
.021	.699	.597	.286	.982	.953	.913	.422	.291	.979
.926	.085	.758	.624	.491	.694	.496	.490	.949	.457
.351	.709	.461	.093	.498	.377	.639	.801	.388	.334
.329	.857	.949	.550	.095	.906	.596	.462	.891	.758
.126	.525	.834	.677	.045	.699	.568	.147	.902	.664
.572	.101	.066	.147	.069	.006	.979	.259	.765	.460
.728	.374	.402	.679	.601	.492	.002	.512	.529	.089
.524	.346	.698	.133	.013	.907	.992	.453	.883	.684
.176	.870	.306	.179	.071	.854	.086	.414	.973	.785
.031	.437	.512	.107	.842	.507	.458	.018	.881	.506
.826	.110	.065	.878	.182	.460	.442	.504	.075	.027
.945	.640	.283	.330	.163	.496	.767	.543	.921	.923
.948	.890	.677	.328	.075	.752	.207	.692	.268	.204
.232	.639	.425	.434	.795	.329	.941	.026	.867	.035
.896	.502	.074	.092	.203	.625	.541	.505	.835	.021
.643	.838	.357	.294	.592	.440	.676	.186	.304	.212
.552	.892	.843	.851	.685	.847	.963	.189	.604	.634
.623	.955	.024	.718	.534	.978	.962	.208	.645	.811
.988	.648	.182	.983	.128	.784	.606	.138	.208	.337
.326	.500	.874	.958	.826	.523	.462	.823	.955	.773
.130	.545	.756	.164	.418	.817	.707	.882	.984	.903
.907	.419	.705	.597	.655	.566	.546	.738	.614	.373
.859	.365	.476	.351	.154	.458	.645	.303	.631	.832

City of Bozeman Street Naming and Addressing Policy

A. All new street names, for both public and private streets, shall be approved by the City Engineering Department and the Gallatin County GIS Department.

B. Street names will not be reserved. Street names shall be approved prior to preliminary plat and final plat approval. Street names become effective upon filing of the final plat.

C. Street Name Selection

1. A new street shall assume the name of the street on which it aligns unless the street does not and cannot in the future connect to an existing street segment along the alignment.

2. Duplication of street names will not be permitted. Proposed street names that have the same primary name of an existing street but a different suffix (e.g. Smith Drive and Smith Lane) are considered duplicates and will not be permitted.

3. Similar (text or phonetic) or confusing spelling of street names will not be permitted (e.g. Briar Lane / Brier Lane; Allen Lane / Alan Lane; Beech Street / Peach Street).

4. Only the common spelling of street names will be accepted (e.g. Jane not Jayne, Green not Greene)

5. Names that tend to be slurred or difficult to pronounce shall not be used.

6. Do not use special characters in street names such as hyphens, apostrophes, or dashes.

7. No new street names shall consist of more than two (2) words or contain more than fifteen (15) characters, excluding the suffix (street, avenue, etc.) and directional prefix, if any.

8. Wherever possible, new north-south streets that are west of the east-west zero line (Tracy Ave.) shall be designated as the appropriate numbered avenue.

9. No street name shall begin with an article.

D. Directional Prefixes

1. All streets that cross the east-west zero baseline shall be designated with the appropriate east or west directional prefix. The east-west zero baseline

is Tracy Avenue as extended and shown on the City of Bozeman's address grid map.

2. All streets that cross the north-south zero baseline shall be designated with the appropriate north or south directional prefix. The north-south zero baseline is Main Street as extended and shown on the City of Bozeman's address grid map.

E. Street Type Designations

1. Street type designations should reflect the size and function of a street. Street types are contained in the suffix of the street name.

2. Approved street type descriptions and abbreviations are as follows:

a) Avenue (AVE): a continuous street with a definite north-south directional course.

b) Boulevard (BLVD): a wide arterial or collector type roadway, typically with a median.

c) Circle (CIR): a street that intersects another street only once and terminates in a closed loop.

d) Court (CT): a relatively short, uninterrupted dead-end street.

e) Drive (DR): a curvilinear or winding street which continues through to other rights-of-way.

f) Lane (LN): a minor roadway within a subdivision.

g) Loop (LOOP): a relatively short, uninterrupted street that begins and ends on the same parent street at two different points, or a street that connects to two intersecting perpendicular streets.

h) Parkway (PKWY): same as boulevard.

i) Place (PL): a relatively short, uninterrupted dead-end street.

j) Road (RD): an arterial or collector type roadway that may run in any direction. This street type designation should not be used for new streets in the City of Bozeman, unless the new street is an extension of an existing street designated as a road.

k) Street (ST): a continuous street with a definite east-west directional course.

l) Way (WAY): a minor roadway within a subdivision.

3. Private roads should use the designations Place or Way.

F. Cul-de-sacs and bubbles

1. When a cul-de-sac is located at the end of an existing street right-of-way or alignment, it shall be given the name of that street, including the suffix, whether the cul-de-sac is straight, curves, or meanders.

2. When two cul-de-sacs approach each other from opposite directions and are in the same alignment but do not join in any manner, they shall be assigned different street names.

3. Cul-de-sac or bubble streets less than 100 feet in length that provide frontage for three or fewer lots shall not be named, but shall take the name and numbering of the street adjoining.

G. Addressing

1. Subdivision developers shall make arrangements with the Engineering Department to assign addresses for all individual lots in the subdivision prior to filing of the final plat. A copy of the proposed final plat showing approved street names shall be submitted for use in assigning addresses. Unless the proposed project has been designated for concurrent construction, the lot addresses will not be entered into the City address database until the final plat has been filed.

2. One street address number will be assigned for each separate building by the Engineering Department. For projects with multiple buildings on a single lot, a site plan showing the proposed buildings shall be submitted to the Engineering Department for address assignment prior to site plan approval. Developers of multi-unit buildings shall assign the unit or suite numbers. A floor plan showing the proposed unit or suite designations shall be submitted for approval to the City Engineer's office prior to site plan or building permit approval. Unit/suite numbers shall be assigned based on the following guidelines:

a) Multi-unit residential buildings (including condominiums) on separate lots: assign consecutive unit numbers (Unit 1, Unit 2, etc.) or unit letters (Unit A, Unit B, etc.) for each unit.

b) Multi-unit residential buildings (including condominiums) on one lot: assign consecutive unit numbers for all the units in the

development, beginning at the building closest to the main roadway entrance and continuing in a logical manner through all of the buildings (i.e.: first building: 2301 Smith Street, Units 1, 2, 3, 4; second building: 2305 Smith Street, Units 5, 6, 7, 8). Use a counter-clockwise circular sweep starting from the right side of the primary entryway as you enter. Systematically increment numbers throughout all buildings on the site so as to end at the left side of the same entryway. Avoid oscillating back and forth across the site as much as possible. If the buildings have dwelling units on separate floors, use 3-digit numbers for all of the units, with the first number being the floor level. All building accesses shall clearly identify which units are served by the access.

c) Multi-unit commercial buildings: use 3-digit numbers for the units or suites, with the first number being the floor level of the unit.

d) Accessory dwelling units shall be assigned a separate street number, however if there are no remaining street numbers available, the main dwelling unit on the property shall be designated unit A and the accessory dwelling unit shall be designated Unit B.