Posted for Public Notice: May 31, 2023

City of Bend Standards and Specification Summary of 2023 Revisions

Provided below is a summary of revisions to the **City of Bend Standards and Specifications**, adopted April 15, 2022. Text in **<u>underlined</u>** has been added. Text in ~~strikethrough~~ has been removed.

Revisions in this notice will be effective **July 2, 3023**

IMPORTANT NOTICE:
Standards and Specifications 2023 Update

Provided below is a summary of the 2023 Draft Revisions to the **City of Bend Standards and Specifications**, adopted April 15, 2022. Text in underline has been added. Text in ~~strikethrough~~ has been removed.

Revised Sections include:

Section 00110- Organization, Conventions, Abbreviations, and Definitions

- 00110.20 Definitions

Section 00150 – Control of Work

- 00150.50 Cooperation with Utilities

Section 00180 – Prosecution and Progress

- 00180.50 (c)(2)

SP00100 (Special Provisions for the 2021 Book) (Last updated: January 2022)

PART 00100 – GENERAL CONDITIONS

(Follow all instructions and make all edits with "Track Changes" turned on. If there are no instructions [orange text] above a subsection, paragraph, sentence, or bullet, then include it in the project. Delete all orange text before preparing the final document.)

Section 00110 – Organization, Conventions, Abbreviations and Definitions

Comply with Section 00100 of the Standard Specifications modified as follows:

00110.10 Abbreviations – Add the following:

NFPA - National Fire Protection Association
OSS – 2021 Oregon Standard Specifications for Construction
UIC – Underground Injection Control
WPCF - Water Pollution Control Facility

00110.20 Definitions - Modify as follows:

As Approved –Add the following:
The words "as approved", unless otherwise qualified, shall be understood to be followed by the words "by the City".

Agency – Replace with the following
The City of Bend

City – Add the following:
The City of Bend, Oregon, including its duly authorized representatives. The City is described as the Agency in the OSS documents.

City Project Representative – Add the following:
The authorized representative of the City, with primary responsibility for administering the Public Improvement Contract

Contract Documents – Delete in its entirety. Contract Documents are as defined in the CITY OF BEND PUBLIC IMPROVEMENT CONTRACT.

Design - perform architectural or engineering, or both, design professional services, including but not limited to planning, designing, observing, consulting, evaluating and other related services, for the construction of the Work.

Engineer – Replace with the following:
The City's project manager if the individual is registered as a professional engineer in the State of Oregon. If the City's project manager is not a professional engineer, the Engineer is the Engineering and Infrastructure Planning Department (EIPD) Director. In both cases, the City's project manager and EIPD Director may designate the Engineer.

Furnish - supply and deliver services, materials, or equipment to the Work site (or other specified location) ready for use or installation and in usable or operable condition.

Install - put into use or place in final position services, materials, or equipment complete and ready for intended use.

Laboratory - Add the following**:**
Any laboratory used or approved by the City. This may or may not be the same testing laboratory as designated in the OSS.

Legal Holiday – Add the following:
The following, subject to subsequent change by law, are legal holidays for the City /Agency: Sunday, New Year's Day, Martin Luther King Jr. Day, President's Day, Memorial Day, Juneteenth, Independence Day, Labor Day, Veteran's Day, Thanksgiving and the day after Thanksgiving, Christmas, and those days declared as holidays by the City. When a legal holiday falls on Saturday, the Friday proceeding Saturday is a legal holiday. When a legal holiday falls on Sunday, the immediate following Monday is a legal holiday.

Other references to Legal Holidays in the OSS will comply with the modified definition of "Legal Holiday". Such as in Section 00170.65, 00180.41, 00220.60 and 00290.32.

Work on Saturdays, Sundays, and City's legal holidays will not be permitted unless written approval is granted by the City.

Perform or provide – when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

Plans – Delete and replace with the following:
The term "Plans" refers to the official plans, profiles, cross-sections, elevations, details, and other working drawings and supplementary drawings, or reproductions thereof, signed by the duly licensed design professional (Professional Engineer, Architect, or Landscape Architect), that show the location, character, dimensions and details for the work to be performed. Plans may either be bound in the same book as the balance of the Contract Documents, or bound in separate sets, and are a part of the Contract Documents regardless of the method of binding. Plans are Standard and Supplemental Drawings, and approved Unstamped and reviewed and accepted Stamped Working Drawings (see 00150.35 in the Special Provisions).

Quality Control Personnel – Add the following:
In addition to the ODOT technical certifications listed throughout the OSS, the following certifications are approved alternatives:

- ACI Concrete Field Testing Technician – Grade 1
- ACI Concrete Strength Testing Technician
- ICC Reinforced Concrete Special Inspector
- ICC Soils Special Inspector
- WAQTC certifications

Addition certifications may be submitted and approved on a case-by-case basis.

Working Day – Add the following:
The City working day is any and every calendar day excluding Saturdays, Sundays, and legal holidays. Unless otherwise permitted, a working day occurs between the hours of 7:00 a.m. and 6:30 p.m.

End of Section

Section 00150 – Control of Work

Comply with Section 00150 of the Standard Specifications modified as follows:

(Consider if project would benefit from a Partnering arrangement and consider if this should be specified into the contract vs. offered informally after award. City has had experience with formal partnering, however, good value with low investment of time can be obtained in informal setting with a couple of the project management staff and the Contractor's leadership to discuss project challenges, concerns, solutions, etc,)

00150.05 Cooperative Arrangement - Delete in its entirety.

00150.10 Coordination of Contract Documents - Delete subparagraph (a) in its entirety. Coordination of Specifications and Plans (Order of Precedence) is stated in the Bid/contact Documents.

Add the following subsection:

00150.11 General Requirements for Sequence and Scheduling of Work -

- ***(Use the following subsections (a) through (h) to define the general requirements for sequencing and scheduling of work. Add, delete, or replace subsections as necessary to define the requirements of the work.)***

- ***(Optional clause. Project Segments could be a useful way to divide linear projects with discrete constraints, or where work in one area must be complete prior to work in other areas. Item (a) only identifies the segments, and subsequent subsections describe how the work is constrained within the segments)***

(a) Project Segments – The Project is divided into segments with the following limits:

- ***(Add project segments)***

- ***(Optional clause. Construction limits could include items like requirements for franchise utility work, special timing or sequence constraints)***

(b) Construction Limits – The Contractor shall limit active construction areas as described below:

(1) The following constraints are applicable to all Segments.

- ***(Add construction constraints)***

(2) Segment 1

- ***(Add construction constraints)***

(3) Segment 2

- ***(Add construction constraints)***

(c) Temporary Pumping Plan – Temporary pumping plans are required for the following existing sewers:

- ***(Add temporary pumping plan)***

(d) Gravity Sewers

(1) Existing Facilities – Existing gravity sewer facilities affected by construction shall remain operation at all times. Contractor shall plan and sequence all construction activities and provide all means and methods to maintain continuous operation of the existing gravity sewer facilities. The Contractor shall maintain continuous service to all customers connected to existing sewer facilities affected by construction and sequence the work to maintain uninterrupted service.

(2) New Facilities - ***(Add gravity sewer requirements)***

(e) Temporary Water Service – ***(Add temporary water service requirements)***

(f) Utilities – Contractor shall sequence all work activities with known utility conflicts and any unanticipated utility conflicts that are encountered during construction. The Contractor shall modify the schedule and sequencing for all work items including, but not limited to: traffic control, temporary utility re-routing and support, private residence access, maintenance of utility service to customers, and construction of the proposed improvements, as necessary to coordinate with existing and relocated utilities.

Contractor shall sequence and schedule the work to maintain the function of all utilities during construction and make accommodations as necessary to allow utilities to maintain services to all customers served by the affected utilities.

Contractor shall coordinate with utilities where relocation or modification of utilities is to be performed by the utility company during Contractor's work in the vicinity.

(g) Protection of Work – It is the Contractor's responsibility to adequately protect and barricade all elements of the work from potential accidents or injury to the public at all times during both working hours and shutdown periods such as overnights, weekends, and holidays.

(h) Landscape Restoration – ***(Add landscape restoration requirements)***

(Optional clause. In some circumstances it may be appropriate to restrict blasting. The following clause may be used to do this. Note, other construction techniques can still cause significant vibration and could have higher risk of damage than allowing controlled blasting. Engineer of Record should carefully consider appropriate use of this clause.)

(i) Nonblasting Areas – Drawings may depict areas where nonblasting excavations methods may be required. Contractor shall comply with all such nonblasting requirements.

Specific nonblasting areas include, but are not necessarily limited to, the following station locations: A purpose for the nonblasting requirement is noted in parenthesis next to the station location(s):

EXAMPLE STA X+XX to Y+YY	(gas)
EXAMPLE STA X+XX to Y+YY	(water main)

(Include (j) when special utility potholes are identified in the plans and included in SP00498. Add time requirements for special utility potholes.)

(j) Special Utility Potholes – ***(Add special utility pothole time requirements)***

Add the following subsection:

00150.12 General Requirements for Work Areas - ***(Add general work area requirements. This may include clause related to work within easements, protection of structures, property access for third parties adjacent to work areas, and other requirements.)***

(See Section 00305 and the ODOT Survey Policy and Procedure manual (https://www.oregon.gov/ODOT/ETA/Documents_Geometronics/Survey-Policy-Procedure-Manual.pdf). The specifier must review 305 and understand the duties of City and Contractor with respect to surveying.)

00150.15 Construction Stakes, Lines and Grades - Delete and replace this section as follows:

Contractor shall perform all project surveying. See Section 00305.

Add the following subsection:

00150.19 Site Visits and Inspection - Engineer and/or Inspector will make periodic visits to the site to observe the progress and quality of the executed Work and to determine, in general, if the Work is proceeding in accordance with the Contract Documents. They will not be required to make exhaustive or continuous onsite inspections to check the quality or quantity of the Work. Their efforts are directed toward providing assurance for the City that the completed project will conform to the requirements of the Contract Documents. On the basis of their onsite observations, they will keep City informed on the progress of the Work and will endeavor to guard City against defects and deficiencies in the work of Contractors.

(Include the following sentence for Private Development Projects)

Contractor shall schedule daily inspections through City View Portal for Private Development projects and or work shall be “STOPPED” by direction of the City Engineer.

Add the following subsection:

00150.26 Right to Retain Imperfect Work - If any work done or material furnished under this Agreement shall prove defective and not in accordance with the Plans and Specifications, and if the imperfection is not of sufficient magnitude or importance to make the work dangerous or undesirable, or if the removal of the work will create conditions that are dangerous or undesirable, the City shall have the right and authority to retain the defective work and adjust the amount to be paid for the imperfect work. This section is intended to be complementary to, and does not alter or supersede, rights and responsibilities described in other sections of this Agreement, including 00170.80.

Add the following subsection:

00150.27 Use of Completed Portions - The City shall have the right to take possession of and use any completed or partially completed portions of the Work, notwithstanding the time for completing the entire Work or such portions that may not have expired. Such taking possession and use shall not be deemed an acceptance of any work not completed in accordance with the Contract Documents.

Add the following subsection:

00150.34 Schedule of Working Drawings and Sample Submittals - Prepare and submit a schedule of all specified Working Drawings and Sample Submittals identifying Specification Section number, anticipated submittal date, proposed title of submittal, location or facility to which submittal applies, and subcontractor or supplier (if other than Contractor) that is responsible for preparing submittal for Contractor, and earliest date (per contractor's critical path schedule) by which products or materials that are subject of Working Drawings or Samples are required on-site for incorporation in the work.

00150.35 Plans, 3D Engineered Models, Working Drawings, and 3D Construction Models – Delete and replace this subsection as follows:

Contractor shall submit Working Drawings to Engineer for review and approval in accordance with the accepted schedule of Working Drawings and Sample submittals. All submittals will be identified as Engineer may require and in the number of copies specified in the General Requirements. The data shown on the Working Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information. The Agency will provide a web-based tool for handling submittals, Working Drawings, requests for information, and other communications. Contractor shall use this tool for communication on the project to maximum extent practicable.

Contractor shall also submit Samples to Engineer for review and approval in accordance with the accepted schedule of Working Drawings and Sample submittals. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalog numbers, and the use for which intended and otherwise as Engineer may require to enable Engineer to review the submittal. The numbers of each Sample to be submitted will be as specified in the Specifications.

Where a Working Drawing or Sample is required by the Contract Documents or the schedule of Working Drawings and Sample submittals accepted by Engineer as required, any related Work performed prior to Engineer 's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

Before submitting each Working Drawing or Sample, Contractor shall have determined and verified: all field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto; all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; all information relative to means, methods, techniques, sequences, and procedures of construction and safety precautions and programs incident thereto; and Contractor shall also have reviewed and coordinated each Working Drawing or Sample with other Working Drawings and Samples and with the requirements of the Work and the Contract Documents.

Each submittal shall bear a stamp or specific written indication that Contractor has satisfied Contractor’s obligations under the Contract Documents with respect to Contractor’s review and approval of that submittal.

At the time of each submittal, Contractor shall give Engineer specific written notice of such variations, if any, that the Working Drawing or Sample submitted may have varied from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Working Drawing and Sample submitted to Engineer for review and approval of each such variation.

Engineer will timely review and approve Working Drawings and Samples in accordance with the schedule of Working Drawings and Sample submittals accepted by ENGINEER. Engineer’s review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

Engineer 's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

Engineer 's review and approval of Working Drawings or Samples shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has in writing called Engineer’s attention to each such variation at the time of each submittal as required and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Working Drawing or Sample approval; nor will any approval by Engineer relieve Contractor from responsibility for complying with the requirements.

Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Working Drawings and submit as required new Samples for review and

approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

(a) Plans - The Agency-prepared Plans will show details of lines, grades, Cross Sections, and Typical Section of the Roadway, and locations and design details of Structures.

(b) Working Drawings - The Contractor shall supplement the Agency-prepared Plans with stamped Working Drawings, or unstamped Working Drawings that show all information necessary to complete the Work. The applicable Section or Subsection of the Standard Specifications will indicate the supplemental information required and whether the drawings are to be stamped or unstamped. Stamped Working Drawings, unstamped Working Drawings, are defined as follows:

(1) Stamped Working Drawings - Working Drawings, calculations, and other data which are prepared by or under the direction of a Professional Engineer licensed in the State of Oregon, and which bear the engineer's signature, seal, and expiration date.

(2) Unstamped Working Drawings - Working Drawings, calculations, and other data that do not bear an engineering seal.

(3) 3D Construction Models – (not used)

(c) Number, Size, and Format of Working Drawings - The Contractor shall submit Working Drawings according to one of the following methods:

(1) Paper Submittal – not permitted. If Special Provisions refer to paper submittals, Contractor shall substitute PDF, or other electronic media as directed by Engineer to satisfactorily depict the requirements of the submittal.

(2) Electronic Submittal - The Contractor shall submit electronic Working Drawings as required in 00170.08 and submit via electronic Project Document Tracking System Software.

(d) Processing Working Drawings - The Engineer will process Working Drawings as follows:

(1) Stamped Working Drawings - Stamped Working Drawings will be designated as "reviewed", "reviewed with comments", by the Engineer. If stamped Working Drawings are “reviewed with comments”, the Contractor shall address all comments and resubmit the stamped Working Drawings.

(2) Unstamped Working Drawings - Unstamped Working Drawings will be designated as "approved", "approved as noted", or "returned for correction" by the Engineer. If unstamped Working Drawings are returned for correction by the Engineer, the Contractor shall address all comments and resubmit the unstamped Working Drawings.

(3) 3D Construction Models – not used.

The Contractor shall not fabricate or construct any structural components until the stamped or unstamped Working Drawings are returned by the Engineer with a written designation of "accepted", "accepted with comments", "approved", or "approved as noted", as applicable for the Working Drawings.

The Engineer's processing of the Working Drawings does not amend any contractual obligations of the parties.

The Engineer will process and return Working Drawings within 21 Calendar Days (65 Calendar Days if Railroad approval is required) after receipt by the Engineer. If the Engineer fails to return such drawings or models within this period of time, the Engineer will consider granting a Contract Time extension according to 00180.80. If the Contractor is required to resubmit Working Drawings to the Engineer, the Engineer will process and return the Working Drawings within 21 Calendar Days (65 Calendar Days if Railroad approval is required) after receipt of the resubmitted Working Drawings by the Engineer.

00150.40 Cooperation and Superintendence by the Contractor- Add the following bullet after the fourth bullet within this section:

- Maintain on the job site, and make available to the Engineer upon request, one current marked-up set of the Design Drawings that accurately indicate all approved variations in the completed Work that differ from the original design information shown on the Drawings.

Add the following bullet after the final bullet in this section:

- Contractor shall reasonably provide access for City staff and City representatives to City facilities and the Work at all times, shall not unreasonably restrict access upon request.

Add the following subsection:

00150.41 Construction Management Forms and Communication

CONSTRUCTION PROJECT MANAGEMENT DOCUMENTATION

This item covers all project management and documentation efforts.

Project Document Tracking System Software:

All correspondence, including but not limited to meeting minutes, DCVRs, Field orders, Work Change Directives, Contract Modifications, Submittals, manufacturer's catalog cuts and materials information, data sheets, and similar required informational or documentary submittals, shall be provided in either 8-1/2 inch by 11 inch or 11 inch by 17 inch PDF format, and shall be provided to the Engineer and Agency's Representative electronically using the City's project management application software rather than in paper form. All documents referencing financial requirements can be processed through the City's project document tracking system. The Software and Training shall be paid for by the Agency.

The following forms shall be used to administer the Work.

Construction forms:

(a) Design Clarification Verification Request (DCVR)

This form is to be used to ask questions as to the design intent or make clarification of the design by the Contractor. This form can also be used by the Engineer to clarify the design intent.

When using EADOC (See 000170.08), the EADOC DCVR tab will substitute for this Transmittal Form.

(b) Work Change Directive (WCD)

It is understood that this work change directive will not change the contract price or schedule, but is evidence that the parties expect a change order to be subsequently issued reflecting any changes.

(c) Field Order

The intent of this Field Order is to authorize minor variations to the contract documents not involving a change in contract price or contract schedule and which are compatible with the design concept of the completed project. This Field Order is binding upon Agency and upon Contractor who will perform the work promptly. If Agency or Contractor believes an adjustment to the contract price or contract schedule is necessary, the party may make a claim therefore in accordance with the general conditions.

(d) Removal From Service (RFS) Request Form

This form shall be used for requesting and documenting significant operations interruptions or requests from the Contractor to make modifications to existing infrastructure that is in operation typically

(e) Request for Quotation

Requests contractor's proposal of cost and times to perform Agency's contemplated changes in the work.

Formally issued by the Agency; may be prepared by the engineer as the agent of the City of Bend.

NOT to be utilized for authorization to proceed with the change. Scope of work must be complete with all sketches, specifications, etc. required for contractor to estimate fully the work required. Lower portion of form to be completed and returned by contractor.

(f) Substitution Request: See section 00180.31(b)

This form shall be used for requesting substitutions to the specified products. All requests shall provide data which includes product description, specifications,

drawings, photographs, performance and test adequate for evaluation of the request. Applicable portions of the data shall clearly identified.

(g) Submittal Transmittal Form

This form shall be used for submitting Construction submittal information, Project submittal according to the project specification and for submittal tracking purposes.

When using EADOC (See 00170.08), the EADOC submittal tab will substitute for this Transmittal Form.

(Use the following subsection .50(f) when listing utility information.)

Add the following subsection:

00150.50 Cooperation with Utilities

(Add the following subsections.)

(f) Utility Information:

(Use the following paragraph when no anticipated utility conflicts exist.)

There are no anticipated conflicts with the Utilities listed below. Contact those Utilities having buried facilities and request that they locate and mark them for protection prior to construction.

Utility	Contact Person's Name and Phone Number
1.	
2.	
3.	
4.	

(Use the following paragraph when utility adjustments are the responsibility of the City.)

Arrangements for removing, relocating, or adjusting Utilities on the Project are the responsibility of the City. Contact the City for information regarding these arrangements.

(Use the following paragraph on projects with organizations that may be adjusting utilities.)

The following organizations may be adjusting Utilities within the limits of the Project during the period of the Contract, with relocation work estimated to be completed by the following dates (times):

Utility	Estimated Completion Date (Time)
(Utility company – "Gas Company")	

(Contact person's name and
(Phone number)

(Use the following paragraph when high-pressure gas lines exist on site.)

In the immediate area of the high-pressure gas lines, when moving any Equipment, excavating, driving piles, pounding guardrail posts, boring, or other road construction activities, the Contractor shall increase the tolerance zone from 24 inches, as defined in OAR 952-001-0010~~10952001010~~, to 10 feet. Exceptions require written approval from the Gas Utility. The Contractor shall provide the Engineer a copy of the written approval of the exception before beginning Work.

(Repeat as needed – "Power Company")

(Use the following paragraph when power lines overhang work areas.)

Energized power lines overhang portions of the Work with a minimum vertical clearance of 18 feet. Contractor shall maintain at least 10 feet of safety clearance.

This Project is located within the Oregon Utility Notification Center area, which is a Utilities notification system for notifying owners of Utilities about work being performed in the vicinity of their facilities. The Utilities notification system telephone number is 811 (or use the old number, which is 1-800-332-2344).

(Use the following subsection .55 when there is an existing specific City contract that will be performed within the project site and the Contractor is required to cooperate with the other City contractor. List the contract name, the contractor's name and on-site contact number, and the estimated time the other specific contract work will be taking place within the project limits. Delete the example.)

00150.55 Cooperation with Other Contractors – Add the following paragraph at the end of the subsection:

The following contract work will be ongoing within the Project site during the following times:

Contract Name (Contractor's Name)	**Estimated Times (From – To)**
(For example – Your project's bid opening is July 5, 2021, so:	
OR99E Howell Prairie Rd-Wauconda Rd.	***Aug 2021 to Oct 31, 2021***
Dewey Cheatum Construction Inc. 541.123.4567 (On-Site))	

00150.55 Cooperation with Other Contractors – Add the following paragraph at the end of the subsection:

If any part of the Contractor's work depends, for proper execution or results, upon the work of any other contractor, the Contractor shall inspect and promptly report to the Engineer any defects in the other work that render it unsuitable for proper execution and results. The Contractor's failure to so inspect and report shall constitute an acceptance of the other contractor's Work as fit and proper for the reception of its work, except as to defects that may develop in the other contractor's work after execution of its work.

Add the following subsection:

00150.76 Protection of Property - The Contractor shall adopt every practical means and comply with all laws, ordinances, and regulations in order to minimize interference to traffic and inconveniences, discomfort, and damage to the public, including the provision of adequate dust control measures. All obstructions to traffic shall be guarded in accordance with the "Manual on Uniform Traffic Control Devices."

The Contractor shall not trespass upon private property and shall be responsible for all injury or damage to persons or property, directly or indirectly, resulting from its operations in completing this Work. They shall comply with the laws and regulations of the City, county and state, relating to the safety of persons and property, and will be held responsible and required to make good any injury or damage to persons or property caused by carelessness or neglect on the part of the Contractor or Subcontractor(s), or any agent or employee of either during the progress of the Work and until its final acceptance.

The Contractor shall protect property, public and/or private, encountered in this Work except as stipulated elsewhere herein. The Contractor shall be responsible and liable for any damage. The Contractor shall protect its work and materials from damage or the elements, until the completion and acceptance of the Work. All loss or damages arising under the terms of these Contract Documents, or from any unforeseen obstruction or defects that may be encountered in the prosecution of the Work, or from the action of the elements, shall be sustained by the Contractor.

In an emergency affecting human health or safety, the Contractor shall act to prevent or mitigate the risk or threat. Any compensation claimed by the Contractor on account of emergency work shall be determined by agreement or as covered under the Section "Change Orders".

Add the following subsection:

00150.77 Unforeseen Difficulties - The Contractor shall protect its work and materials from damage resulting from the nature of the work, the elements, carelessness of other contractors, or from any cause whatever until the completion and acceptance of the Work. All loss or damage arising out of the nature of the work to be done under these Contract Documents, or from any unseen obstruction or defects that may be encountered in the prosecution of the Work, or from the action of the elements, shall be sustained by the Contractor.

This clause is complementary to Section 00170.80 and excludes repairs necessitated by damaged caused by

- Acts of God or Nature, as defined in Section 00110; or
- Actions of governmental authorities.

Add the following subsection:

00150.99 Public Safety and Convenience - The Contractor shall conduct the project with proper regard for the safety and convenience of the public. When the project involves use of public ways, the Contractor shall provide certified Flaggers when directed, a temporary traffic

control plan approved by the Engineer, and shall install and maintain means of free access to all property. Private residential driveways shall be closed only with approval of the Engineer or specific permission of the property owner. The Contractor shall not interfere with normal operation of public transit vehicles unless otherwise authorized. The Contractor shall not obstruct or interfere with travel over any public street or sidewalk without approval. Where detours are necessary, they shall be maintained with good surface and shall be clearly marked. The Contractor shall provide open trenches and excavations with adequate barricades of an approved type that can be seen from a reasonable distance.

(Note requirement to backfill all open trenches at night, which may be unreasonable and costly for very deep excavations. Review end-of-shift backfill requirements. If night work is expected and trenches would be backfilled during the day time, update text as required to indicate "end of daily work shift" or similar)

At night, the Contractor shall backfill all open trenches, unless otherwise specified, and mark all construction areas with signs and lighted barricades (Type A Low Intensity Flashing Warning Light on a Type I or II barricade, typical) in accordance with the *Manual of Uniform Traffic Control Devices* (MUTCD). Steel plates will not be permitted within the travel way between November 1st and March 1st. The Contractor shall install and maintain all necessary signs, lights, flares, barricades, railings, runways, stairs, bridges, and facilities. The Contractor shall observe all safety instructions received from the Engineer or governmental authorities, but following of instructions shall not relieve the Contractor from the responsibility or liability for accidents to workers or damage or injury to persons or property.

Emergency traffic such as police, fire, and disaster units shall be provided reasonable access to the work area at all times.

The Contractor shall be liable for any damages that may result from failure to provide reasonable access or failure to notify the appropriate authority.

Design Clarification Verification Request

PROJECT _____ **REQUEST NO.** _____

CONTRACTOR _____ **DATE** _____

PROJECT NO. _____

Clarification/Interpretation Requested by _____

Regarding: Plan sheet_____ of _____ Spec. Section _____

DESCRIPTION:

_____
_____
_____
_____
_____
_____

_____
Prepared by

_____
Date

RESPONSE ASSIGNED TO:

☐ Project Manager

☐ Project Design Manager

☐ Other_____

_____
Signed

_____
Date

CITY OF BEND PUBLIC WORKS

WORK CHANGE DIRECTIVE

ENGINEERING

CONTRACTOR:: _____ **WCD NO.:** _____

PROJECT: _____ **PROJECT NO.** _____

AGENCY: _____

ENGINEER: _____

The following additions, deletions or revisions to the work have been ordered and authorized:

Description of Work:

Reason for change(s):

Attachments (List supporting documents):

It is understood that this work change directive will not change the contract price or schedule, but is evidence that the parties expect a change order to be subsequently issued reflecting any changes.

ORDERED BY: _____ **DATE:** _____

RECOMMENEDED BY: _____ **DATE:** _____

FIELD ORDER

CONTRACTOR _____ **FIELD ORDER NO.** _____

PROJECT _____ **PROJECT NO.** _____

AGENCY _____ **ENGINEER** _____

The following minor changes in the work have been ordered and authorized:

Description of Changes:

Reason for field order:

Reference Drawing sheets and section(s) or detail(s): Reference Specification section(s) /paragraph(s):

The intent of this Field Order is to authorize minor variations to the contract documents not involving a change in contract price or contract schedule and which are compatible with the design concept of the completed project. This Field Order is binding upon AGENCY and upon CONTRACTOR who will perform the work promptly. If AGENCY or CONTRACTOR believes an adjustment to the contract price or contract schedule is necessary, the party may make a claim therefore in accordance with the general conditions.

Issued by Engineer	**Contractor Receipt Acknowledgement**
By:	**By:**
Title:	**Title:**
Date:	**Date:**

REMOVAL FROM SERVICE (RFS) REQUEST FORM

PROJECT: DATE:_____
PROJECT NUMBER:

BUILDING/AREA AFFECTED _____

SYSTEMS/EQUIPMENT AFFECTED _____

DAY OF SHUTDOWN _____TIME _____ DURATION _____

WORK TO BE ACCOMPLISHED _____

_____

_____

_____

FOREMAN IN CHARGE _____ CREW SIZE _____

SHUTDOWN ACTIVITIES	START TIME	SPECIAL REQUIREMENTS
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

WORK THAT REQUIRES CITY STAFF PARTICIPATION

_____

PROBLEMS THAT MAY BE ENCOUNTERED AND CORRECTIVE ACTION

_____

_____

_____

_____

_____

	Initial
Contractor Superintendent	_____
Inspector COB	_____
Operations COB	_____

☐ Post on EADOC (Per 00170.08)

REQUEST FOR QUOTATION

QUOTATION NO. _____

TO: _____ DATE _____

FROM: _____ PROJECT: _____

KEYWORD DESCRIPTION: _____

_____

DATE QUOTATION REQUIRED _____

The following modification to the contract has been identified. Pursuant to the General Conditions, following the order of precedence, please provide a quotation for the alteration as described in Item 1. The quotation should include an itemized breakdown of contractor and subcontractor costs, including labor, materials, rentals, approved services, overhead, and profit. This request shall not be considered authorization to proceed with the work herein described.

TO BE COMPLETED BY INITIATOR OF REQUEST

1. Scope of Work: (include list of attachments)
2. Reason(s) for Modification:
3. Approval of Request:

City of Bend _____ Date _____

Engineer _____ Date _____

TO BE COMPLETED BY CONTRACTOR

1. Total cost of modification (attach detailed breakdown) $ _____
2. Will a modification to the contract time be requires ☐ Yes ☐ No
    a. If so, trade(s) _____
    b. Number of personnel _____
    c. Duration _____(calendar days)
3. Attachment identification: (list) _____
4. Quotation is in effect until: (date) _____
5. Approval of Quotation _____

Contractor Date

SUBSTITUTION REQUEST (SR)

PROJECT: _____ **SR NO.** _____

CONTRACTOR: _____ **CONTRACT NO.** _____

ORIGINATOR: _____ **SPEC. SECTION:** _____

DATE SUBMITTED: _____ **DRAWING NO** _____ **SHEET:** _____ **OF** _____

SPECIFIED ITEM:

SECTION	**PAGE**	**PARAGRAPH**	**DESCRIPTION**

The undersigned requests consideration for the following:

PROPOSED SUBSTITUTION: _____

Attached data includes product description, specifications, drawings, photographs, performance and test adequate for evaluation of the request. Applicable portions of the data are clearly identified.

The undersigned states that the following paragraphs, unless modified on attachments, are correct:

1. The proposed substitution does not affect dimensions shown on drawings and will not require any change in any of the contract documents.

2. The undersigned will pay for changes to the design, including engineering design, detailing and construction costs caused by the requested substitution, estimated to be $ _____.

3. The proposed substitution will have no adverse effect on other contractors, the construction schedule (specifically the date of substantial completion), or specified warranty requirements.

4. Maintenance and service parts will be locally available for the proposed substitution.

5. The incorporation or use of the substitution in connection with the work is not subject to payment of any license fee or royalty.

The undersigned further states that the function, appearance and quality of the proposed substitution are equivalent or superior to the specified item.

Submitted by CONTRACTOR	**Reviewed by ENGINEER**

Signature: _____

Firm: _____

Date: _____

Telephone: _____

By: _____

☐ **Accepted**
☐ **Accepted as Noted**
☐ **Not accepted**
☐ **Received too Late**

Attachments: _____ **Title:** _____

_____ **Date:** _____

_____ **Remarks:** _____

SUBMITTAL – TRANSMITTAL FORMS (Need to attach to each submittal)	DATE _____
City of Bend Project Name: _____ Project Number: _____ ☐ New Submittal ☐ Re-submittal Submittal No: _____ Specification Section No.: _____ (One transmittal per section) Schedule Date of Submittal _____	Design Engineer: _____ Contractor: _____ _____
Submittal Type ☐ Shop Drawing ☐ Sample ☐ Informational ☐ Deferred	

The following items are hereby submitted:

No. of Copies	Description (Type, Size, Model No., Etc.)	Spec. & Para No.	Drawing No.	Contains Variation to Contract	
				No	Yes

Contractor hereby certifies that Contractor has complied with the requirements of Contact Documents in preparation, review, and submission of designated Submittal and the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By: _____
Contractor (Authorized Signature)

Section 00180 – Prosecution and Progress

Comply with Section 00180 of the Standard Specifications modified as follows:

00180.05 Assignment/Delegation of Contract - Delete and replace first sentence of this paragraph as follows:

Unless the Agency gives prior written consent, which may be withheld in the City's sole, discretion, the Contractor shall not assign, delegate, sell, or otherwise transfer or dispose of any rights or obligations under the Contract, whether voluntarily or involuntarily, and whether by merger, consolidation, dissolution, operation of law, or any other manner, including, without limitation:

- The power to execute or duty to perform the Contract; or
- Any of its right, title or interest in the Contract.

00180.30 Materials, Equipment, and Work Force – Add the following above the paragraph starting with "The work force shall…":

The Contractor at all times shall enforce strict discipline and good order among its employees. The Contractor shall comply with all applicable labor rules, wage scales, and regulations, including nondiscriminatory laws, of the Government of the United States, the State, County, and City or Town in which the Work is performed.

00180.31 Required Materials, Equipment, and Methods – Delete (b) and (c) and replace with the following:

00180.31(b) Substitution and "Or-Equal" Products - The Agency will not consider substitute or "or-equal" products during the bid period, but only after Contract award. Whenever materials or equipment are specified or described in the Contract Documents by using the name of a particular manufacturer or supplier, the naming of the item is intended to establish the type, function, and quality required. If the name is followed by the words "or equal", indicating that substitution is permitted, materials or equipment of alternate manufacturers or suppliers may be accepted by the Engineer if sufficient information is provided by the Contractor to allow the Engineer to determine that the material or equipment proposed is equivalent or equal to the named manufacturer's material or equipment. The proposed substitutes or "or equal" submittal procedure also applies to Equipment Manufacturers/Suppliers originally listed by the Contractor in the Bid Proposal Attachment that are not named in the specifications. Submittals are subject to the following requirements:

> The burden of proof as to the type, function, and quality of any such substitute material or equipment shall be upon the Contractor.
>
> The Engineer shall be the sole judge as to the type, function, and quality of any such substitute material or equipment, and the Engineer's decision shall be final.
>
> The Engineer may require the Contractor to furnish, at the Contractor's sole expense, additional data about the proposed substitute.

The Agency may require the Contractor to furnish, at the Contractor's sole expense, a special five-year performance guarantee or other surety with respect to the substitute material or equipment.

Acceptance by the Engineer of a substitute item proposed by the Contractor shall not relieve the Contractor of the responsibility for full compliance with the Contract Documents and the adequacy of the substitute item.

The Contractor shall be responsible for resultant changes and all additional costs which the accepted substitution requires in the Contractor's work, the work of the Contractor's Subcontractors, and all other Contractor's; and the Contractor shall accomplish such changes without cost to the Agency or Engineer.

Procedure for review by the Engineer will include the following:

If the Contractor proposes to furnish or use a substitute item of material or equipment, the Contractor shall make written application to the Engineer on the "Substitution Request Form" included in these Supplementary Conditions for acceptance thereof.

Unless otherwise provided by law or authorized in writing by the Engineer, the "Substitution Request Form" shall be submitted within the 35-day period after Award of the Contract.

Whenever a proposed substitute material or equipment has not been submitted within the said 35-day period, or whatever submission of a proposed substitute material or equipment has been judged to be unacceptable by the Engineer, the Contractor shall provide the material or equipment named in the Contract Documents.

The Contractor shall certify that the proposed substitute shall perform adequately the function and achieve the results called for by the general design, be similar and of equal substance to that specified, and be suited to the same use as that specified.

The Engineer shall be allowed a reasonable time within which to evaluate each proposed substitute.

As applicable, no shop drawing submittals shall be made for a substitute item, nor will any substitute item be ordered, installed, or used without the Engineer's prior acceptance of the Contractor's "Substitution Request Form" (00150.40(2)), which will be evidenced by a change order.

The Contractor's Application using the "Substitution Request Form" shall contain the following statements and/or information which shall be considered by the Engineer in evaluating the proposed substitution:

> The evaluation and acceptance of the proposed substitute shall not prejudice the Contractor's achievement of substantial completion on time.
>
> Whether or not acceptance of the substitute for use in the work will require a change in any of the Contract Documents to adopt the design to the proposed substitute.

Whether or not incorporation or use of the substitute item in connection with the work is subject to payment of any license fee or royalty

All variations of the proposed substitute for that specified shall be identified.

Available maintenance, repair and replacement costs and services shall be included. Itemized estimate of all costs that may result directly or indirectly from the acceptance of such substitute, including costs of redesign and claims from other Contractors affected by the resulting change.

Within 35 calendar days following the Contract Date, the Contractor shall furnish to the Engineer, a complete list of proposed substitutions together with shop drawings and/or such technical data as is defined in the Contract Documents, submittal procedures.

(Use the following subsection .40(b) when limitations prevent all contractor work before a specified date. Fill in the specific date.)

00180.40(b) On-Site Work - Add the following after the bullet that begins with "Assembled all Materials":

The Contractor shall not begin On-Site Work before ___(Date)____, unless approved by the Engineer.

(Use the following lead in sentence and subsection .40(c) when limitations are included in the Special Provisions. Delete the limitations that do not apply.)

Add the following subsection:

00180.40(c) Specific Limitations - Limitations of operations specified in these Special Provisions include, but are not limited to, the following:

Limitations	Subsection
Cooperation with Utilities	00150.50
Cooperation with Other Contractors	00150.55
Railways	00170.01(e)
Contract Time	00180.50(h)
Right-of-Way and Access Delays	00180.65
Closed Lanes	00220.40(e)(1)
Special Events	00220.40(e)(2)(b)
Limited Duration Road Closure	00220.40(f)
Road Closure Using Rolling Slowdown Method	00220.40(g)
Regulated Work Areas	00290.34(a)
Noise Control	00290.32
Maintenance Under Traffic	00620.43

Opening Sections to Traffic.....00744.51

Opening Sections to Traffic.....00745.51

(Use the following paragraphs when the project is within irrigation districts. Obtain information from the relevant irrigation district .)

[Begin irrigation paragraphs]

When submitting the supplemental "look ahead" Project Work schedule, the Contractor shall show all Work that impacts the __(insert irrigation district name)__ canals and channels.

Irrigators have legal rights to use irrigation water from the canals and channels of the __(insert irrigation district name)__ in __(insert contact office location of the irrigation district for the project)__ .

During the irrigation season of __(insert date: example April 1)__ through __(insert date: example October 31)__, the Contractor shall not restrict the flow of water or contaminate the water of the __(insert irrigation district name)__ .

During the non-irrigation season of __(insert date: example November 1)__ through __(insert date: example May 31)__, the Contractor shall allow a __(insert number of days)__ day stock water run approximately every 30 Days. The Contractor shall contact the __(insert irrigation district name)__ for the stock water run times.

[End irrigation paragraphs]

(Use the following paragraph when limitations prevent contractor work within the limits of the project, before a specified date, or for a duration. Fill in the specific dates.)

Be aware of the schedule limitations in the Standard Specifications that are not listed in this subsection.

00180.41 Project Work Schedules - After the paragraph that begins "Contractor's activity…" Add the following paragraph:

(City Project Manager shall determine the type of schedule ("A," "B", or "C") from the project Scheduler. Insert the type in the blank.)

In addition to the "look ahead" Project Work schedule, a Type _____ schedule as detailed in the Standard Specifications is required on this Contract.

(For most projects, use the following subsections .41(b-2) when a Type "B" Schedule is required. For complex multidisciplinary projects use of Primavera P6 high performance scheduling software is appropriate and could be considered the industry standard scheduling software for these large/complex projects. Certain consulting and construction management firms have expertise in evaluation of various schedule submissions (in Primavera P6) and are capable of supporting the City identifying changes, and schedule characteristics (like float suppression) that should be carefully evaluated and responded to in the course of construction

administration. Consider retaining Primavera P6, as per OSS, for these complex projects.)

00180.41(b)(2) Detailed Schedule – Delete ”the current version of Primavera P6 by Oracle,”

(Use the following subsections .41(c-1) .41(c-2) when a Type "C" Schedule is required.)

00180.41(c)(1) Detailed Schedule – Delete ”the current version of Primavera P6 by Oracle,”

00180.41(c) (2) Detailed Schedule – Delete ”the current version of Primavera P6 by Oracle,”

(Specification Sections 00150.50 an 00150.55 contemplate work of other utilities in coordination with the Work. this clause below is intended to require contractor to invite said utilities to the Preconstruction Conference and to show/incorporate their work in the schedule presented at the Preconstruction Conference.)

00180.42 Preconstruction Conference – Add the following to the end of this subsection as follows:

If Utility work is part of the Contract, Contractor shall contact representatives from the utility companies involved with this project. Contractor shall incorporate the utility’s work into the Contractor’s schedule prior to the preconstruction conference.

00180.50(c)(2) Calendar Day Calculation Delete and replace as follows:

When the Contract Time is stated in Calendar Days, counting of Contract Calendar Days will begin on the day stated in the Notice to Proceed.

00180.50(d) Recording Contract time. Delete and replace as follows:

All Contract time will be recorded and charged to the nearest one-half day.

(Use one of the following .50(h) lead-in sentence options, according to the number of completion times to be used. NOTE: contract times are detailed in the Contract. Use caution in this sentence when re-stating any contract times.)

Note: If either durable pavement markings (00865) or high performance pavement markings (00866) are required, and the completion date is after September 15, check with the Scheduler and request multiple completion times.

Note: If permanent seeding (01030) or planting (01040) is required, and the completion date is outside the planting seasons (see 01030.43(b) or 01040.41 and .42), check with the Scheduler and request multiple completion times.)

[Begin lead-in sentence options]

[Option 1 - Use to specify one completion time.]

00180.50(h) Contract Time - There is one Contract Time on this Project as follows:

[Option 2 - Use to specify two completion times.]

00180.50(h) Contract Time - There are two Contract Times on this Project as follows:

[Option 3 - Use to specify three completion times.]

00180.50(h) Contract Time - There are three Contract Times on this Project as follows:

[End lead-in sentence Options]

(Use one or more of the following paragraphs as needed to specify one or more INTERIM completion dates. Fill in the blanks. Copy one of the paragraphs if needed for projects with two interim completion times. Delete paragraphs that do not apply. Replace "X" with a sequential number, starting with "1" for the first paragraph used.)

[Begin interim completion date options.]

(X) The Contractor shall complete all Work to be done under the Contract, except for _____, not later than _____.

(X) The Contractor shall complete all Work to be done under the Contract required to _____ not later than _____.

(X) The Contractor shall complete all Work to be done under the Contract, except for _____, before the elapse of ___ Calendar Days, or not later than _____, whichever occurs first.

(X) The Contractor shall complete all Work to be done under the Contract required to _____ before the elapse of ___ Calendar Days, or not later than _____, whichever occurs first.

[Example: "The Contractor shall complete all Work to be done under the Contract required to remove and replace Span 5 of Bridge No. 02025, including reinstalled end panel, final ACP wearing course, and permanent bridge rails; and reopen the Santiam Highway (US20) to two traffic lanes, before the elapse of 110 Calendar Days, or not later than July 31, 2016, whichever occurs first."]

[End interim completion date options.]

(Use ONE of the following paragraphs to specify a single completion time, or as the FINAL paragraph for projects with multiple completion times. Fill in the blanks. Delete paragraphs that do not apply. Remove parentheses. Replace "X" with a sequential number when there are multiple completion times, or delete "(X)" entirely when there is only one completion time.)

[Begin final completion date options.]

(X) The Contractor shall complete all Work to be done under the Contract, except for (seeding establishment) (and) (plant establishment), before the elapse of ___ Calendar Days, or not later than _____, whichever occurs first.

(X) The Contractor shall complete all Work to be done under the Contract before the elapse of ___ Calendar Days, or not later than _____, whichever occurs first.

(X) The Contractor shall complete all Work to be done under the Contract, except for (seeding establishment) (and) (plant establishment), not later than _____.

(X) The Contractor shall complete all Work to be done under the Contract not later than _____.

[End final completion date options.]

00180.65 Right-of-Way and Access Delays - Add the following paragraphs:

- Temporary or Permanent easements that are the City's responsibility to obtain under the Contract Documents.

It is anticipated that the ending date of an anticipated delay for the following properties will be as shown:

File ___(R/W file number) (Stations right and left)____ not later than ___(Date)___.

Add the following subsection:

00180.66 Delays and Extension of Time

If the Contractor shall be delayed at any time in the progress of the Work by any act or neglect of the City; or of any employee of the City; or by any separate contractor employed by the City; or by changes ordered in the Work; or by strikes, lockouts, fire, unavoidable casualties, or any cause beyond the Contractor's control that justified the delay, or by any delay authorized in writing by the Engineer; then the date for completion of the Work shall be extended. Within 14 days after the Contractor submits to the Engineer a written request for an extension of time, the Engineer will determine the number of days extension due to the Contractor. The City will make the final decision on all requests for extension of time.

No extension shall be made for delays occurring more than 7 days before claim is made in writing to the Engineer. In case of a continuing cause of delay, only one claim is necessary.

No extension of time will be granted to the Contractor for delays occurring to parts of the Work that have no measurable impact on the completion of the total Work under this Agreement

No extension of time will be considered for weather conditions normal to the area in which the work is being performed. Unusual weather conditions, if determined by the Engineer to be of a severity that would stop all progress of the work, may be considered as cause for an extension of Agreement completion time.

Delays in delivery of equipment or material purchased by the Contractor or its Subcontractors shall not be considered as a just cause for delay. The Contractor shall be fully responsible

for the timely ordering, scheduling, expediting, delivery, and installation of all equipment and materials.

The contract time may only be changed by a Change Order.

****

(City Project Manager shall prepare computation of liquidated damages for projects exceeding $1,000,000 and have this on-file prior to bid.)

****

00180.85(b)(1) Single Contract Time - Replace this subsection, except for the subsection number and title, with the following:

The Liquidated Damages per Calendar Day* are 15.0 percent of C divided by T as defined in this Section.

C = The Contractor's Bid amount for the Contract.
T = The total Calendar Days between the latest completion date or time listed under 00180.50(h) in the Solicitation Documents and the Bid Opening that will result in the greatest value for T.

* Calendar Day amounts are applicable when the Contract time is expressed on the Calendar Day or fixed date basis.

00180.90 Termination of Contract and Substituted Performance - Delete this Section in its entirety. See Public Improvement Contract for termination provisions.

End of Section

IMPORTANT NOTICE:
Standards and Specifications 2023 Update

Provided below is a summary of the 2023 Revisions to the **City of Bend Standards and Specifications**, adopted April 15, 2022. Text in blue underline has been added. Text in blue ~~strikethrough~~ has been removed.

Revised Sections include:

Chapter 3 – Streets

- 3.6.1 Sidewalks, Shared-use Paths, Trails, and Low-Stress Routes
- 3.6.2 Curb Ramps and Crosswalks
- 3.6.2.2 Number and Direction of Curb Ramps
- 3.6.4 Driveways
- 3.8.6 Full, Modified, and T-Cut Patching Standards
- 3.8.7 Potholing

Chapter 4 – Sanitary Sewer Systems

- 4.1 Sewer Main
- 4.1.18 Sewer System Abandonment
- 4.3 Sewer Services
- 4.5 Vacuum Sewer
- 4.5.1 Valve Pit Design
- 4.5.2 Valve Pit Construction

Chapter 5 – Water

- 5.1 Main Line
- 5.1.8 Thrust and Restrained Joints
- 5.1.10 Water System Abandonment
- 5.3.1 Valve Location

Chapter 6 - Stormwater

- 6.4 Conveyance
- 6.4.7 Stormwater System Abandonment

Chapter 7 – Grading and Erosion Control

- 7 Grading and Erosion Control

Chapter 8 – Franchise Utilities

- 8.6 Removal of Abandoned Facilities

Chapter 10 – Surveying

- 10.6.2 Construction Staking

Chapter 11 – Geotechnical Engineering

- 11.4 Pavement Design

3 Streets

The City of Bend plans and implements an interconnected network of complete streets and trails that provide safe, optimized travel for all modes. The system is intended to increase connectivity, safety, and travel time reliability while encouraging walking, biking, and opportunities for using transit. All new and reconstructed streets in the City of Bend, public or private, will be complete streets.

Complete Streets allow the City of Bend to meet its transportation goals by providing safe and efficient spaces for different travel modes. As transportation technology evolves there is an increase in people choosing to use a wider variety of human, electric, and other powered devices to travel. Additionally, automated vehicles are developing at an accelerated pace. Designers are challenged to categorize the various nuances of each of the travel options and incorporate them into designs for today while providing infrastructure resiliency for the future. For the purpose of these standards and to simplify references to all the different travel modes, the following three mode types are referenced:

- Drivers - people driving or riding in motor vehicles, electric cars, automated vehicles, delivery vehicles, transit, trucks, emergency vehicles, and other vehicles operating at a motor vehicle speed and scale

- Pedestrians – people walking, using mobility devices, or using other devices (such as skateboard, manual scooter, etc.) that operate at a pedestrian speed and scale

- Bicyclists – people riding bicycles or using other devices (electric scooter, one-wheel, etc.) that operate at a bicycle speed and scale

Transit users are not listed as a separate category; they are typically a combination of one or more other modes: drivers, pedestrians, and/or bicyclists.

A complete street in the City of Bend is a street that serves people of all ages and abilities traveling safely using a variety of modes. It is a street designed and operated to prioritize safety, comfort, and access to destinations for people walking, biking, driving, and taking transit. A key element of complete street design is creating travel routes that are more comfortable for people walking and biking, including easier ways to cross the street.

While it is the intent that every street serve all modes (driving, walking, biking, and transit), the priority and range of modes served will vary by classification, location, and other factors. Some streets may be more oriented toward the pedestrian with slower and fewer vehicles, and others may provide enhanced bike lanes and shared use paths with higher vehicle volumes and speeds. Trucks, buses, and emergency vehicles are accommodated in different ways depending on the context and need.

The following street standards are required to be used when planning, designing and constructing public and private street facilities in right-of-way and public access facilities within the City of Bend.

These street standards shall be used to support the design and construction of land use requirements, exactions and mitigations within the City of Bend as well as public works projects implemented outside of the land use process.

3.1 References

Designs shall conform to the City of Bend Standards and Specifications, as well as current versions of additional references specified in various subsections. Roadway design shall comply with minimum design standards as shown in the standard drawings. Additional references include, but are not limited to:

- City Development Code and Ordinances of the City of Bend
- A Policy on Geometric Design of Highways and Streets (AASHTO)
- Manual of Uniform Traffic Control Devices (MUTCD)
- Oregon Supplements to the MUTCD
- Highway Capacity Manual (TRB)
- Roadside Design Guide (AASHTO)
- Public Right-of-way Accessible Guidelines (U.S. Access Board)
- City of Bend Roundabout Design Manual
- City of Bend Signing and Marking Manual
- City of Bend Complete Streets Guide
- Oregon Standard Specifications
- Oregon Traffic Line Manual
- ODOT Analysis and Procedures Manual Chapter 14 Multimodal Analysis,
- Low Stress Bicycle Network (Transportation System Plan Figure 5-1),
- Pedestrian Connector Routes and Crossings Map (Part VI – Appendix C)
- All other referenced documents cited herein

3.2 Deviation from Streets Standards

The City of Bend provides for roadway designs that are flexible and reflective of their context while meeting current safety and operations standards. There may be times when compliance with the City of Bend Standards and Specifications is not possible and the City's design standard deviation process shall be followed to receive approval from the City Engineer. The City Engineer may delegate review authority.

This standards deviation process shall not be used to override a requirement of a land use decision once finalized. The City's Bend Development Code has provisions for requesting modifications to land use requirements. Except as provided elsewhere in other City codes, resolutions and land use actions, written requests for deviations from these streets standards shall be reviewed and may be granted by the City Engineer according to the

criteria outlined in Part I - Section 2 as well as the following additional review criteria for Streets Standards:

- The deviation is required due to extreme topography or natural resource constraints
- The deviation is required due to inconsistencies with the function of the street and the adjoining land uses
- The proposed alternate provides a complete street and meets low stress network requirements or includes appropriate mitigation
- The request specifically addresses the deviation review criteria found in 1.2 - Deviations, Waivers, or Modifications and those review criteria for the subject standard as provided within this section.

3.3 Design Considerations

3.3.1 Traffic Studies

The City requires two types of traffic studies:

- Land use traffic studies
    - Transportation Facilities Report – study required with development applications per the Bend Development Code Chapter 4.7.4
    - Transportation Impact Analysis – study required with development applications per the Bend Development Code Chapter 4.7.5
- Design Traffic Study
    - Design Traffic Study – study required to support street and intersection design per this section

This section defines Design Traffic Study requirements for public and private roadway and intersection projects. The Design Traffic Study, as opposed to a Traffic Impact Analysis Study provided within a land use action, is used to guide all design and construction aspects of the project. The Design Traffic Study will be used to identify concept designs, intersection control type, lane configurations, queue storage, access management needs and pedestrian crossing needs, pavement design, roadway geometrics, drainage methodology and right-of-way needs, etc. The Design Traffic Study shall identify a need for higher order intersection control and as provided for herein, shall identify and study control warrants. The Traffic Study will identify the type and location of any required low traffic stress route or crossing along with any connector routes or crossings.

The Traffic Study will identify and evaluate the following elements as part of the complete street network design:

- Safety
- Existing volumes

- Forecast volumes
- System context (relationship of land uses with transportation system)
- Local context (ROW, design vehicle)
- Anticipated users of various modes including passenger vehicles, trucks, bicyclists, pedestrians, and transit
- Operations
- Corridor influences (upstream and downstream controls, railroad crossings, etc.).
- Any design elements or mitigation measures identified in the TFR/ TIA
- Connectivity to adjacent streets, sidewalks/shared-use paths, bike facilities, and transit routes including low stress routes and connector routes

These should be identified and evaluated in order to facilitate a context sensitive design that implements current design standards, safety features, and efficient operations to serve all road users including drivers, pedestrians, bicyclists, and transit users.

Operational analysis shall be provided for the existing traffic conditions, as well as the design year of the project, which is typically based upon the City's current twenty year planning model. Lane configurations, vehicle delays, queuing, and level of service results should be provided to support concept development as well as for the final chosen configuration.

Turn lane storage length shall be separately accounted for when providing the tapers and shall be based on the analysis of the design year's 95th percentile queuing.

Operational analysis for traffic control other than roundabouts (i.e. traffic signals, stop signs) shall be performed using Highway Capacity Manual methodologies except as otherwise allowed by the City Engineer.

Operational analysis for roundabouts shall be performed using methodologies in the City's Roundabout Evaluation and Design Guidelines, 2010, (Update Pending) except as otherwise allowed by the City Engineer.

Complete the Intersection Form Evaluation in the Roundabout Evaluation and Design Guidelines, 2010, (Update Pending) and submit for City Engineer approval of the traffic control as part of the operational analysis for roundabouts, traffic signals, and all way stops on collector and arterial streets.

Where traffic signals are the recommended form of traffic control, optimized signal phasing shall be developed as part of the operational analysis and incorporated into the design. Impacts to system performance shall also be evaluated for traffic signals proposed within signalized corridors.

3.3.2 Intersection Controls

Intersection controls provide right-of-way guidance to street users at intersections. Traffic control shall be provided per the MUTCD, these standards, the Roundabout Evaluation

and Design Guidelines, 2010, (Update Pending), and the approved intersection Form Evaluation. Additional information on stop control is provided in the Signing and Marking manual.

Roundabouts are the preferred intersection form over a traffic signal for safety benefits (fewer and less severe crashes). The intersection Form Evaluation is required to confirm the capacity, traffic flow, and overall benefits between a roundabout and a signal and to present a recommendation for City Engineer approval.

Traffic signals will be considered only where shown to meet MUTCD warrants, and where overall intersection safety and operation will be improved, as indicated by the traffic study and approved Intersection Form Evaluation. Emphasis is placed on the satisfaction of Warrant 1, Eight-Hour Vehicular Volume, and Warrant 7, Crash Experience (using the three most recent years for which crash data is available). Warrant analysis should be performed using 14-hour traffic volumes based on actual counts.

3.3.3 Design Speed

Design speeds are geared towards incorporating multi-modal compatibility into roadway designs. To this end, the City's standards recognize the impacts design and operating speeds and other design features have on bicyclist and pedestrian safety and operations.

Standard design speeds are provided below for each of the City's roadway classification designations.

Roadway Classification	Design Speed
Major Arterials	40 mph
Minor Arterials	35 mph
Collectors	30 mph
Local Streets	25 mph
Alleys	15 mph

Design speeds shall be consistent throughout a cohesive segment of a roadway corridor. Changes in design speeds from one segment to another shall be strongly identified through design feature changes to encourage compliance with posted speeds and to model the street form after the abutting land use form.

A standards deviation to utilize lower speeds may be requested of the City Engineer to reflect existing speeds on a corridor or changes in context (abutting land use, multi-modal use and crossings, etc.) following the general criteria in the Oregon Department of Transportation (ODOT) Speed Zone Manual for setting speed limits, but should not be utilized to reduce the design speed for individual design elements within a cohesive roadway segment (e.g., a single horizontal or vertical curve). A street may be posted for a lower speed limit via the official speed order issued by ODOT, but horizontal, vertical, and sight distance is to be based on the speed design table above unless otherwise approved by the City Engineer.

While the local street design speed is 25 mph, a local street being modified as a Greenway may add traffic calming elements based on a 20 mph design speed where the greenway meets the criteria and a 20 mph speed sign will be posted.

See the Signing and Marking manual for posting speed limits (statutory limits and requests for new limits or changes to existing limits). Speed limits are set following the Oregon State speed rules.

3.3.4 Sight Distance

A driver's ability to see ahead is of the utmost importance in the safe and efficient operation of a vehicle on a roadway. Designers should provide sight distance of sufficient length for a driver to control the operation of a vehicle to avoid striking an unexpected object in the traveled way.

3.3.4.1 Stopping Sight Distance, Decision Sight Distance

All streets shall be designed to provide adequate Stopping Sight Distance (SSD) continuously along the roadway, based on the design speed and in accordance with the Table 3-1 and 3-2, AASHTO "A Policy on Geometric Design for Highways and Streets", 7th Edition (2018).

Design Speed (mph)	Brake reaction distance (ft)	Braking distance on level (ft)	Stopping sight distance – level		Stopping sight distance on Grades					
			Calculated (ft)	Design (ft)	Downgrades			Upgrades		
					3%	6%	9%	3%	6%	9%
15	55.1	21.6	76.7	80	80	82	85	75	74	73
20	73.5	38.4	111.9	115	116	120	126	109	107	104
25	91.9	60.0	151.9	155	158	165	173	147	143	140
30	110.3	86.4	196.7	200	205	215	227	200	184	179
35	128.6	117.6	246.2	250	257	271	287	237	229	222
40	147.0	153.6	300.6	305	315	333	354	289	279	269
45	165.4	194.4	359.8	360	378	400	427	344	331	320

Adjustments for grade and truck traffic shall be made when pertinent. Longer sight distances are desirable, particularly at locations where unexpected, complex, or cluttered conditions exist. AASHTO Table 3-3 provides Decision Sight Distances (DSD), which offer drivers additional margin for error and afford them sufficient length to maneuver their vehicles at the same or reduced speed. The Engineer of Record shall make the determination if SSD is sufficient for design criteria or if DSD should be used, dependent on the complexity of the corridor and typical traffic types/flow.

Both sight distances are based on a height of driver's eye equal to 3.5 feet, and an object height of 2.0 feet, equivalent to the taillight height of a passenger car.

Designers should coordinate with other disciplines as necessary to ensure that other roadway elements such as median or planter strip landscaping, do not obstruct the required sight lines.

3.3.4.2 Intersection Sight Distance

Sight distance at intersections is provided to allow drivers to perceive the presence of potentially conflicting vehicles, and to allow drivers of stopped vehicles a sufficient view of the intersecting roadway to determine whether to enter or cross it. Although Stopping Sight Distance allows drivers to anticipate and avoid collisions, drivers of major road vehicles may be required to stop or slow to avoid a collision with a minor road vehicle. Designing

for longer Intersection Sight Distance enhances traffic operations and is required for all new intersections and driveways. Adjustments for design vehicles and grades shall be made as appropriate.

To provide adequate intersection sight distance, specified areas along intersection approach legs and across their included corners should be clear of obstructions. The dimensions of the legs of these “Intersection Sight Triangles” are dependent on design speeds and type of intersection control. Refer to the 2018 AASHTO “A Policy on Geometric Design of Highways and Streets”, Chapter 9, and Figures 9-16 and 9-17 for information on these areas, (called Clear Sight Triangles in the manual).

3.3.4.3 Intersection Sight Distance vs. Clear Vision Area

Similar to Intersection Sight Triangles, Clear Vision Areas are triangular areas adjacent to intersections intended to provide sight distance for conflicting traffic movements by establishing a prescribed area in which to prohibit sight obstructions. Note that Clear Vision Areas are a planning level tool and are described by fixed dimensions based on road type and land use zones. Clear Vision Areas do not take into account vehicular speeds or intersection control, as do Intersection Sight Triangles. Intersection Clear Vision area is dictated by the Bend Development Code and City of Bend standard drawing R-2.

3.3.4.4 Sight Distance Obstructions

Intersection Sight Triangles and Clear Vision Areas should be identified early in the design process and shown on the plans. Sight obstructions between sight lines two (2) and eight (8) feet above curb grades are not permitted within these areas. Existing obstructions shall be shown on the plans and identified for removal or relocation. Designers may be required to provide sight distance profiles, if deemed necessary by the engineer, to demonstrate that AASHTO requirements are met.

Where sight triangles extend across private property, acquisition and execution of a recorded “Intersection Sight Triangle” easement is required. Such easements shall be granted to the City of Bend and limit the height of vertical features, including but not limited to utility infrastructure, buildings, walls, fences, berms, signs, roadside terrain and trees/vegetation. Where intersection sight distance cannot be provided, alternative roadway alignments may be necessary.

3.3.5 Level of Traffic Stress

3.3.5.1 Definition and Level of Traffic Stress Calculation

Level of traffic stress (LTS) is a qualitative measure of the discomfort people feel when they bike or walk close to vehicle traffic. Separate walking and/or biking facilities farther away from traffic are low stress and facilities adjacent to higher speed and volume travel lanes are high stress.

The City follows the methodology listed in the ODOT Analysis and Procedures Manual Chapter 14 to determine the bike and walking LTS for routes and crossings. The LTS evaluation provides a quick way to quantify, compare, and select facilities that provide the target LTS. The different LTS levels include:

- LTS 1 (the lowest) represents little traffic stress and requires less attention so it is suitable for all users including children that are safely trained to travel along streets

and cross intersections as well as people using wheeled mobility devices. LTS 1 facilities are most often separate and detached.

- LTS 2 represents low traffic stress but requires more attention than young children would be expected to deal with and is more suitable for teen and adults with moderate biking skills or conditions may limit some people from walking. This may include a buffered bike lane or a greenway

- LTS 3 represents moderate stress and is a bike facility suitable for most adult observant cyclists or a sidewalk that pedestrians may feel uncomfortable but safe using. This may be an attached shared-use path or an on-street bike lane that is not buffered.

- LTS 4 represents high stress and is a bike facility suitable for experienced and skilled cyclists or a sidewalk that people with limited other choices tend to use. This is a bike lane on a multi-lane road or a higher volume shared street.

Bicycle LTS – Determine the Bicycle LTS (BLTS) for segments, intersection approaches, and intersection crossings by using the look up tables and the proposed conditions. Then determine the route LTS by using the highest number rating of the three elements. That is if the segment is LTS 1 but the crossing is LTS 4, most people still will not find the route low stress, and the overall rating is considered LTS 4.

Pedestrian LTS – Determine the Pedestrian LTS (PLTS) for segments using the look up tables and the proposed conditions. Determine the PLTS based on sidewalk condition, physical buffer, and total buffer width. Determine the PLTS of the crossings. Then determine the route LTS by using the highest number rating of the elements. That is if the segment is LTS 1 but the crossing or condition is LTS 4, most people still will not find the route low stress, and the overall rating is considered LTS 4.

3.3.5.2 Low Stress, Key, and Connector Routes

A low stress route is a street, bikeway, and/or access corridor alignment identified in the TSP (Figure 5-1) designed to meets the requirements in these standards for providing LTS 1 or LTS 2, including any required arterial or collector street crossings. Low stress routes are located approximately every 1/2 mile north-south and east-west to provide continuous route for people to access homes, work, parks, schools, and major destinations.

The Key Routes are a subset of the low stress bicycle routes shown on TSP Figure 5-3b that provide cross-town bicycle connections, complete missing pedestrian facilities, extend the reach of existing trails and greenways, and form a backbone for the overall low stress bicycle network. There are twelve key routes identified across the City that provide both east-west and north-south connections. The key routes were identified in the TSP as priority segments to complete, and were highlighted to target TSP capital project funding. From a design standards perspective they fall under the same requirements as the overall low stress network, except as noted in 3.6.1.1 - Low Stress Routes regarding preference for higher levels of separated design.

A connector route is a priority low stress pedestrian routes as shown on the Connector Routes and Crossings Map (Part VI – Appendix C). This map identifies:

- Connections to and across arterial or collector streets along primary routes to school

- Primary connections and arterial or collector crossings from neighborhoods to area parks

- More direct connections from subdivisions to the low stress networks such as connector trails from the back of cul-de-sacs

Where feasible the map combined connections to schools and parks with transit stops, and may include additional crossings at other high use transit stop locations. This map includes routes and crossings that are not part of the bicycle network, and may also include some portions of the bicycle network that are priority links for the pedestrian network. While not specifically listed on the connector map, depending on the type of bicycle facility many of the low stress bicycle facilities also serve as low stress pedestrian routes.

3.6.1 - Sidewalks, Shared-Use Paths, Trails, and Low Stress Routes provides more detail on the design of the low stress bicycle and pedestrian networks.

3.3.5.3 Target LTS

The City of Bend targets LTS 1 on bicycle low stress routes and connector routes adjacent to, and within ¼ mile of, schools and parks. LTS 2 is targeted on other low stress and connector routes. To serve the full spectrum of bicyclist skill levels, the City of Bend requires both buffered bike lanes and shared-use paths on arterial and collector streets. If the target LTS is met by a shared use path, the buffered bike lane is still required. In that case, the buffered bike lane is preferred to, but is not required to also meet the target LTS.

3.4 Roadway Design Elements

3.4.1 Right-of-way

Rights-of-way shall be dedicated to the public and are utilized for transportation, transit, and bike and pedestrian facilities as well as for above and underground utilities.

Standard right-of-way widths for the roadway classifications are contained in the Bend Development Code, and by reference incorporated as the City of Bend's standards. They are also shown on the standard street cross-sections in the Standard Drawings. Rights-of-way are established to provide paved street width, sidewalk and bike facilities, planter strips, drainage facilities, and other street elements as noted in the following sections.

In limited cases where the standard right-of-way cannot be accommodated due to unique site constraints, deviations from right-of-way standards shall proceed through a standards deviation review process with the City Engineer as identified in 3.2 – Deviation from Streets Standards and the following additional specific right-of-way considerations:

- Safety and operations

- Accommodation of complete streets elements and all modes including the Low stress network, connector routes, or other required pedestrian and bicycle facilities, stormwater, and landscaping

- Abutting land use

3.4.2 Paved Street Widths and Lane Widths

Lane configurations shall incorporate complete street design principles and provide for vehicle, pedestrian, bicycle, and transit, and include pedestrian and bicycle crossing facilities. Standard Street cross-sections for the various street types are shown in the Standard Drawings. The pavement design shall comply with 11.4 – Pavement Design. Where design standards and standard drawings are in conflict with the Bend Development Code, the Bend Development Code will mandate the design unless a Waiver to Public Improvement Standards is approved per Bend Development Code Chapter 3.4. Where existing ground cross slopes exceed 12 percent, see 3.4.7 - Hillside.

3.4.2.1 Arterial and Collector Roadways

Arterial and collector roadway locations are identified in the TSP, the Bend Development Code, and these standards. The standard cross-sections for all new and reconstructed arterial and collector roadways are shown in the Standard Drawings. Arterials and collectors with raised medians shall be designed to accommodate a curb-to-curb clear width of 20 feet minimum for Oregon Fire Code fire lane requirements. See 3.4.5 – Medians for raised median requirements. Sidewalks/shared-use paths shall be located property-line-tight, on both sides and permitted to meander to avoid barriers (utilities, trees, etc.). There is a minimum one-half foot construction tolerance to the right-of-way line. Sidewalks/shared-use paths and bike lanes are required on all arterial and collector streets, additional detail provided in 3.6.1 – Sidewalks, Shared-Use Paths, Trails, and Low Stress Routes.

The planter strip or landscape strip is the area located between a sidewalk/shared-use path and the curb. Planter strips vary per the standard drawings but shall never be less than 5 feet, as required for tree planting unless otherwise approved. Planter strips shall contain street trees or other approved vegetation when required by the Bend Development Code and the City's landscaping requirements found in 12 – Landscape Architecture and Irrigation Systems.

Shy distance is measured from the face of raised-median-curb to the center of the abutting yellow stripe, where applicable. The standard, and minimum, shy distance is 1.5 feet; maximum is 2 feet. The standard drawings include the following arterial and collector cross-sections:

Cross Section	Right-of-Way Width	Curb-to-Curb Width
5 Lane Arterial – No Parking	100'	72'
3 Lane Arterial – Parking Both Sides	100'	72'
3 Lane Arterial – No Parking	100'	56'
2 Lane Major Collector – Parking Both Sides	80'	62'
2 Lane Major Collector – No Parking	80'	48'
2 Lane Minor Collector – Parking Both Sides	80'	62'
2 Lane Minor Collector – No Parking	80'	46'

Cross sections with parking on one side are allowed by combining the applicable half street sections of the No Parking and Parking Both Sides from the same classification. Parking is not permitted in areas where the median is needed to provide an enhanced crossing. See section 3.6.10 – On-Street Parking for on-street parking requirements.

The collector roadways shown on the TSP are major collectors, designated streets required by OAR 660-012-0020(b). Minor collectors are identified through site planning and design based on the street layout and adjacent land use. It typically has more access points, lower volumes, and serves less through traffic than a major collector. Minor collector traffic volumes do not warrant turn lanes.

3.4.2.1.1 Standard Deviation Request – Raised Median

Designers may request a standards deviation review by the City Engineer to eliminate the raised median portion of the arterial or collector roadway while still maintaining the required standard street width. The deviation request to convert the raised median area to a striped median (double yellow, two-way-left-turn lane, or turn bay) is reviewed under the review criteria of 3.2 – Deviation from Streets Standards and the following specific review criteria:

- Driveway spacing less than 10 driveways per mile
- Left turn demand is less than 50 trips per hour at each driveway
- Road is a 3-lane road
- Raised median is not required to provide enhanced crossing refuge island as required per the crosswalk design standards (to serve a low stress route, to serve a non-low stress enhanced crossing, or as directed by the City Engineer)
- Sight lines meeting AASHTO for the design speed are available for driveways and access roads

3.4.2.1.2 Standards Deviation – Elimination of Median

Designers may request a standards deviation review to eliminate the entire median width on arterial and collector streets under the review criteria of 3.2 – Deviation from Streets Standards. The following specific review criteria shall also be utilized:

- There is one, and not more than one, through travel lane in each direction
- Left turn volumes are below the threshold for a separate left turn lane and turn volumes can be accommodated from the through travel lane
- A raised median enhanced crossing refuge island is not required per the crosswalk design standards (to serve a low stress route, to serve a non-low stress route enhanced crossing, or as required by the City Engineer), or, if required, an island will be provided at the identified crossing locations
- The arterial or roadway intersection that would remain open due to the elimination of the raised median does not experience significant crashes due to turning movements that would be eliminated by the installation of the median
- The horizontal and vertical roadway alignment is adequate to create adequate left-turn intersection sight distance along the roadway segment

- Adequate distance is provided for the transition taper where matching existing median sections

3.4.2.1.3 Standards Deviation – Additional Travel Lanes

Designers may request a standards deviation review for additional travel lanes to accommodate existing or projected vehicle demand on arterial and collector streets under the review criteria of 3.2 – Deviation from Streets Standards. The City's policy is to manage congestion/corridor demand before adding motor vehicle lanes (not including center turn lanes). Adding travel lanes for motor vehicles will be considered only after the City has evaluated:

a. The safety effects for all users and modes of travel

b. The potential to add capacity through intersection improvements

c. The potential to add capacity through increasing system connectivity with parallel routes

d. Whether appropriate transit, bicycle and pedestrian facilities, including safe crossings can be provided as part of a travel lane project

e. The effect of transportation demand management or other tools

f. The full cost of property acquisition in monetary and social terms

g. The potential to add capacity through technologies such as upgraded traffic control devices and other intelligent transportation system applications.

Additionally Bend Development Code Chapter 3.4.200(F)(3)(b) identifies certain road segments that are not eligible for travel lane expansion. The alternate cross-section shall be in accordance with a standard cross-section.

New four-lane roadways are not allowed because they don't provide the target LTS for crossings and the inefficiency of the inside travel lanes to accommodate both through traffic and left turning traffic.

3.4.2.2 Local Streets

The Bend Development Code requires fully-gridded local street systems with short block lengths. Block access may also be provided by alleys. The City recognizes that increasing grid and connectivity optimizes emergency vehicle routing, enhances walkability and bikeability and reduces traffic volumes on any one local street. The local street layout design seeks to minimize concentrating neighborhood traffic on one street and to minimize through traffic from arterial and collector streets, especially if the local street is a designated low stress route (TSP Figure 5-1). Local streets are identified during site development or construction plan preparation to continue the existing grid and to serve new development per the provisions in the Bend Development Code.

The standard drawings include the local street cross-sections and the Standard Curb-to-Curb Width shown in the following table:

Cross Section	Right-of-Way Width	Curb-to-Curb Width
Local Road – No Parking	60’	24’
Local Road 28 ft – Parking Both Sides*	60’	28’
Local Road 32 ft – Parking Both Sides*	60’	32’
Local Road 36 ft – Parking Both Sides	60’	36’
Industrial Local – No Parking	60’	36’
Industrial Local – Parking Both Sides	60’	44’

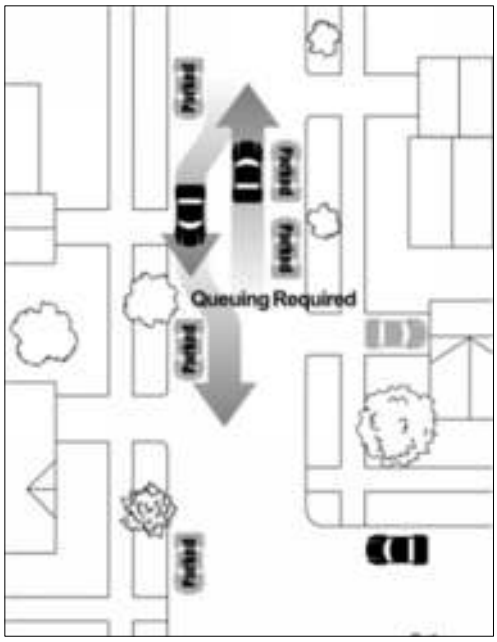
* Indicates a queuing street

In most cases, parking is required on both sides of the street. Alternate sections with no parking, or parking on one side, may be approved through land use planning where adjacent and immediate vicinity land use or other unique factors demonstrate the reduced need for parking. A cross-section with parking on one-side should be determined by adding half of the 24 foot no parking street section to half of the applicable street section with parking. For example, a section with parking on one side, based on the 36 foot street section, would include 12 feet (from ½ of the 24 foot street) plus 18 feet (half of the 36 foot street) for a total 30 foot street. The street would be built so the two half-street sections meet at the right-of-way centerline. In the example above, the right-of-way centerline would be 12 feet from curb on the no parking side and 18 feet from the curb on the side with parking. Where parking is restricted, “No Parking” signs shall be posted per the Signing and Marking Manual.

The cross-sections were developed to reduce vehicle speed, avoid construction of excessive pavement and create livable neighborhoods. In general, these standards provide for a hierarchy of narrower streets, on-street parking, and sidewalks/shared-use paths. The selection of street cross-sections will be determined during land use, or site design (in the absence of land use), and will be based on “right sizing” the street for the context. Generally wider local streets are used to serve higher densities with higher traffic volumes and as the primary residential or commercial connection to arterial and collector streets. The narrower 28 foot and 32 foot street sections are typically used on one to two block segments that don’t connect to an arterial or collector street and have very low traffic volumes. More detail on the different sections follows:

The queuing streets listed in the table above provide travel ways less than 10 feet wide in each direction. In these instances, the cross section may not meet minimum requirements of the Oregon Fire Code. When a proposed design does not meet the minimum requirements of the currently adopted *Oregon Fire Code*, the *fire code official* shall determine the adequacy of the proposed fire apparatus access. When the *fire code official* determines the proposed design to be inadequate, Uniform Alternate Construction Standards (UACS) shall apply as outlined in ORS 455.610 and detailed Oregon Administrative Rules (OAR) 918-480-0125 to remedy the inadequacy of the proposed fire apparatus access.

The 28 foot local road cross-section provides for parking on both sides with one lane of travel that serves very low traffic volumes. Two way traffic is served by vehicles waiting at the upstream approach, pulling over in a parking space or driveway area to let an oncoming vehicle or bicycle pass. This type of street is called a queuing street. People riding bicycles ride in line with vehicles in the travel lane. To allow space for queuing, these streets are used in short segments, where parking demand is lower, or where driveways allow spaces for queuing as shown in the figure to the right[1].



The 32 foot local road cross-section has a 16 foot travel way that provides two narrow, eight foot travel lanes or one wider lane used as a queuing street, depending on the speed and confidence level of the drivers. This street section is typically used within single family residential areas on shorter block segments (less than three to five blocks long), on streets that are not continuous between arterial and/or collector streets, street sections with multiple curves or shorter horizontal radii, and streets not adjacent to high density developments such as apartment buildings

The 24 foot local road with no parking is used where there is no on-street, or adjacent area need for parking, and may be approved through land use.

Where the 36 foot local road cross-section is used, curb extensions may be used at intersections except where left turn lanes are required with the development or may be required in the future to serve projected traffic volumes.

Where City standard street cross-sections are not used, such as for certain private streets, lanes, t-courts, or internal commercial access drives, the Fire Code requires 26 feet road width around hydrants.

The Industrial local road cross-section is used in industrial zones.

Bike lanes are generally not provided on local streets.

A minimum 6-foot detached, property-tight sidewalk is required on both sides of all local streets except where waived per the Bend Development Code. Where a local street serves as a low stress route, but does not meet the criteria for a greenway, an 8-foot sidewalk or shared-use path may be required on one side. Sidewalks/shared-use paths are permitted to meander to avoid barriers (utilities, trees, etc.). Sidewalks/shared-use paths are permitted to be placed curb-tight when a site can meet one of the following criteria:

- The existing ground cross slopes exceed 12 percent, see 3.4.7 - Hillside.

[1] Neighborhood Street Design Guidelines, TGM/ ODOT, June 2001.

- Placement around cul-de-sac bulb
- As determined by the City Engineer during permit or land use review

Curb-tight sidewalks must not be less than 6 feet wide to allow for a minimum 2-foot door swing, or street sign installation, while still meeting the 4-foot minimum ADA width requirement.

Additional sidewalk width may be required based on mailbox, signs or other obstacles to obtain accessible widths. All sidewalks must conform to accessibility standards within the right-of-way or under a public access easement.

The planter strip width will vary depending on the street width. Planter strips shall contain street trees when required by the Bend Development Code. Where sidewalks/shared-use paths are curb-tight, street trees will be placed behind the sidewalk/shared-use path or on private property as determined during land use and/or permit review. Street trees shall conform to 12.2.3 – Street Trees and Plants. Planter strip design standards are contained in 3.6.2.12 – Planter Strip.

3.4.2.3 Alleys

Alleys are built to serve rear loaded properties. Alleys shall be built per the Standard Drawing R-1G

Where existing alleys are being paved or reconstructed, pavement width can be reduced by 12 inches on each side of the property line/right-of-way (24 inches narrower) to aid in matching existing grade during construction. The alley is not to be less than 14 feet wide. No parking is allowed within alleys. The City may require that alleys be designed and stamped by a professional engineer as part of any right-of-way permit application.

3.4.2.4 Cul-de-Sacs and Turnarounds

The standard cul-de-sac design does not include a center island. Landscaped center islands may be approved by the City Engineer where designed to accommodate snow storage. Parking is prohibited in all cul-de-sacs and tee turnarounds. Attached sidewalks are permitted around the bulb of the cul-de-sac. Tee turn arounds are only permissible as a temporary turn around, see Standard Drawing R-1H.

Where cul-de-sacs are proposed to be installed with mountable curbs, the curb-tight sidewalk shall be 6 feet wide around the entire bulb. Mountable curbs will not be permitted on streets at low points unless additional stormwater infrastructure and catchment can be provided.

3.4.3 Roundabout Design

See City of Bend Roundabout Design Manual.

3.4.4 Traffic Signal Design

3.3.2 – Intersection Controls identifies selection parameters for traffic signals. Traffic signal locations are approved by the City Engineer. Traffic signals will be considered only where a traffic study documents that a signal is warranted in conformance with the Manual on Uniform Traffic Control Devices (MUTCD), and that a traffic signal is recommended over the City's preferred roundabout intersection control.

Traffic signal installations shall conform to the current edition of the MUTCD with Oregon Supplements and City Standards and Specifications. ODOT approval is required for traffic signal installations on state highways within City limits.

All traffic signal plans shall be prepared in substantial conformance with the ODOT Traffic Signal Design Manual. For road improvement projects with existing traffic signals, temporary signals or temporary relocation of existing signal heads may be required to maintain proper signal head alignment during construction.

Unless otherwise directed by the City Engineer, all new or reconstructed traffic signals shall include the following:

- Mast arm type signal poles
- ODOT Type 6L – vertical four section head with left turn arrows for dedicated left turn lanes with protected and protected/ permitted phasing
- Illumination with luminaires mounted for each approach on signal pole luminaire arms at standard orientation over the mast arms
- Vehicle and bicycle detection system (radar detection unless otherwise directed)
- Pedestrian crosswalks and curb ramps at all corners
- Bike crossing features (separate bike crosswalks or other bike crossing enhancements and associated bike features such as ramps, two-stage bike box, raised islands, etc.) unless otherwise approved by the City Engineer
- Accessible Pedestrian Signals (APS) with pushbuttons which provide audio and vibrotactile walk indications.
- Countdown Pedestrian Signals
- Emergency vehicle preemption system
- ITS components including communications structure and interconnect to the signal system and to adjacent signals on a signalized corridor. Confirm available communications infrastructure (fiber optic, wireless, etc.) with Engineer
- Mast-arm-mounted street name signs
- Controller cabinet prints and optimized traffic signal timing shall be prepared for all new traffic signal or signal modification designs.

Separated traffic signal designs are encouraged on designated low-stress routes and may be considered with City Engineer approval.

3.4.5 Medians

A median is defined as the area between opposing traffic lanes. A median may be raised or striped (two way left turn lane, painted median, or turn bay). The median includes both the shy line distances as well as raised medians. Medians are installed as required by the standard cross-sections, to provide an enhanced crossing refuge in accordance with the

crosswalk marking standard (to serve a low stress route or to serve a non-low stress route enhanced crossing), at a location required to enforce access management and turn restrictions, or as required by the City Engineer. Medians only at the intersection are considered islands per 3.4.6 – Raised Islands.

Raised medians implement access management by reducing conflicting turning movements to improve traffic safety and roadway capacity, however, they should be designed utilizing a system approach in coordination with the affected properties on a corridor segment basis.

Medians can also improve traffic safety by restricting turns from driveways or intersecting roadways that have inadequate sight lines. Medians can also serve as refuges for pedestrians, facilitate roadway aesthetics and provide space to accommodate left turn lanes. Medians can also be used for storm retention and roadway drainage facilities. Medians also serve to reduce the heat island effect of large expanses of asphalt pavement. Medians can be planted or installed as an impervious surface, typically as stamped concrete. The median landscape design parameters are determined during land use and/or construction plan review.

Median end treatments shall have offsets and gradual approach tapers as shown in the Standard Details. The design reduces the possibility of vehicles striking the leading edge of the median.

Crosswalks through medians shall have a minimum curb-to-curb length of travel of 6 feet as described in 3.4.6 - Raised Islands. The width shall match the width of the standard approach sidewalk/shared-use path. Median pedestrian island refuges shall meet accessibility and PROWAG standards.

3.4.6 Raised Islands

Within the intersection area, the raised element separating traffic movements is considered an island.

Island end treatments shall have offsets and gradual approach tapers as shown in the Standard Drawings. The design reduces the possibility of vehicles striking the leading edge of the island.

Islands are installed as required by the standard cross-sections; to provide a pedestrian refuge in accordance with the crosswalk design guide (low stress route or a non-low stress route enhanced crossing) or as required by the City Engineer. On existing streets with constrained right-of-way, width shall not be less than 6 feet curb-to-curb to allow for two sets of detectable warning surfaces (each 2 feet wide) plus a 2-foot clear distance between the domes meeting ADA requirements. If the cut through is flush (no ramping up and down), the entire edge of the detectable warning surfaces must be placed at the face of curb, not at the back of curb as is typical at curb ramps. The island opening shall match the width of the design standard width of the approach sidewalk/shared-use path. All islands must be installed with standard curb construction – no doweling into pavement unless otherwise approved by the City Engineer.

Islands may be permitted on a local street approach to an arterial or collector as a traffic calming tool.

3.4.7 Hillside

Where existing ground cross slopes exceed 12 percent, sidewalk installation may be placed curb-tight. Planter strips are not required on those portions of the street that qualify as hillside.

3.5 Roadway Geometry

Roadways including the travel lanes, sidewalks and paths, and bike facilities shall be designed to extend to and through adjoining properties. Designers shall demonstrate with centerline profiles for horizontal and vertical geometry that the roadway can be extended while meeting the City's standards or shall adjust the design to allow for the continuation of the roadway.

3.5.1 Intersections

3.5.1.1 Geometry

Street intersections shall be as near right angles as possible except where topography or existing geometric constraints requires a lesser angle. In no case shall the acute angle be less than 80 degrees.

All intersections shall be designed to provide the required AASHTO intersection sight distance for all movements. At complex intersections, or where unusual or unexpected maneuvers are likely, decision sight distance as shown in AASHTO 2018 Exhibit 3-3 is required. Design shall take into consideration the back of the planning year's 95th percentile queues.

Intersection sight triangles shall be provided at all approaches and necessary grading and clearing performed. At times this will require a sight line easement to be created and purchased. Traffic control devices shall not eliminate the need for the appropriate sight lines without first receiving a design standards deviation from the City Engineer. The design deviation review for intersection sight distances shall include the following criteria:

- Ability to design intersection at a different location that provides adequate sight distance
- Ability to provide sight triangles across adjacent property
- Complexity and level of uniqueness of proposed intersection
- Extent of access control, number of accesses within functional area of intersection
- Concentration of travel demand in area
- Amount of visual clutter or distractions
- Crash history in the vicinity of the proposed intersection
- Prevailing speeds on all uncontrolled approaches
- Traffic volumes and truck percentages

- Tangent approaches shall be required at all intersections

Cross streets that intersect arterial or collector roadways shall have their centerlines aligned, with no off-sets allowed unless there is a median on the arterial or collector roadway that creates two tee-intersections. Tee intersections may also be allowed in order to construct a refuge island to serve a low stress route, non-low stress route network crossing, or as required by the City Engineer. Tee intersections must meet intersection offset requirements.

Curb returns and corresponding grades and transitions shall be designed to meet curb ramp requirements and ensure drainage of the intersection, with no standing water. Grades shall be noted on each quarter delta of the curb return.

Dedicated right turn lanes on approaches to signalized and roundabout intersections shall be designed to incorporate pedestrian islands to minimize the impact of the additional crossing width of the roadway and intersection. Dedicated right turn lanes are not permitted for driveways and any unsignalized intersection.

Turn lanes are not easily navigated by pedestrians with total blindness. Adequate way-finding, orienteering, and reduced speed approach speeds must be provided in order to be fully accessible. Gap identification supplements may be necessary.

3.5.1.2 Curb Radius and Curb Returns

The minimum curb radius shall be as follows:

Curb Return Type	Minimum Curb Radius
Local-Local	15 feet
Local-Collector	20 feet
Local-Arterial	20 feet
Collector-Collector	25 feet
Collector-Arterial	35 feet
Arterial–Arterial	55 feet

Where a radius larger than 35 feet is desired, or where site constraints warrant, a 3-centered symmetric compound curve shall be used. Three-centered symmetric compound curves shall be designed only on right-of-way sufficiently large to accommodate 12 feet minimum between curb face and the property line. The radii of the 3-centered symmetric compound curve shall be 120-feet, 40-feet, and 120-feet. The offset of the 40-foot radius shall be determined by the design vehicle as follows:

Design Vehicle	Offset
SU	2 feet

BUS	3 feet
WB-40	4 feet
WB-50	5 feet
WB-67	6 feet

Where fire access is required, the City shall receive a design from a registered engineer showing turning templates. Turning templates shall have a fire truck movement having a 25-foot interior radius with an exterior 45-foot radius, or as otherwise directed by the City Fire Marshall.

Curb returns must be designed and installed with slopes meeting the requirements for curb ramp construction. The curb ramp construction may not be required by a particular project, but slopes must be considered to avoid the regrading of an intersection during a future development. Refer to 3.6.2 – Curb Ramps and Crosswalks.

3.5.2 Horizontal Alignment

3.5.2.1 Cross slope

Standard normal cross slope is 2-percent straight line with a crown in the center of the roadway. Unless approved by the City Engineer, cross slopes shall not exceed 4 percent. Standard roadway alignment shall place the centerline of the roadway at the centerline of the right-of-way. This may lead to a negative superelevation for some relatively flat curves. Particular attention shall be paid to the design of downhill left turns and downhill left turns on rightward turning curves to ensure overturning hazards are eliminated.

3.5.2.2 Superelevation

Superelevation is to be used only as a design element to enhance drivability of horizontal curves on arterial and collector roadways. Superelevation design is typically around the road centerline in conformance with Section 3.3 of the 2018 AASHTO “A Policy on Geometric Design of Highways and Streets”. The use of superelevation for other purposes, or on local streets, shall require a design deviation from the City Engineer.

The maximum design superelevation shall be 0.060 ft/ft, however in conditions where traffic operations frequently limit travel speeds to below the design speed, the maximum design superelevation shall be 0.040 ft/ft (4.0%) to reduce the possibility of sliding during snow and ice conditions. Minimum design superelevation shall be 0.020 ft/ft (2.0%).

3.5.2.3 Horizontal Curves

The minimum radius of curvature for a particular superelevation rate shall be calculated using AASHTO’s 2018 Equation 3-7 and those values presented in AASHTO’s 2018 Table 3-13.

Street Class	Design Speed (mph)	Friction Factor (f)	Super Elevation, e (%)						
			-2.0	0.0	2.0	3.0	4.0	5.0	6.0
Local	15	0.38	50	47	44	43	42		

	20	0.27	107	99	92	89	86	Not Recommended	
	25	0.25	198	181	167	160	154		
Collector	30	0.20	333	300	273	261	250		
	35	0.18	510	454	408	389	371		
Arterial	40	0.16	762	667	593	561	533	508	485
	45	0.15	1039	900	794	750	711	675	643

Compound horizontal curves should be avoided on streets having a design speed of greater than 30 mph. If a compound curve is necessary, the ratio of the flatter radius to the sharper radius should not exceed the following:

- 31 – 49 mph design speed 2 : 1
- 50+ mph design speed 1.5 : 1

Where the ratio exceeds these limits, a suitable length of spiral or a circular arc of intermediate radius shall be inserted between the two curves.

Adjustments for traveled way widths shall be provided based on AASHTO's 2018 Table 3-24a and 3-25 in order to reduce the amount of off-lane tracking on horizontal curves for the design vehicles ranging from bus to semi-tractor trailer combinations.

On all streets having a design speed greater than 30 mph there shall be a minimum 100-foot tangent section between reverse horizontal curves.

3.5.2.4 Pavement Width Transitions

At times there are transitions that need to be accommodated to widen or reduce pavement widths. These transitions shall utilize the recommended MUTCD taper length formulas as follows:

For speeds 45 mph or greater; L=WS and

For speeds less than 45 mph; $L=WS^2/60$

Where:

L = length of the taper (in feet)

W = off-set distance of the travel lane (in feet)

S = design speed of the roadway (in mph)

Reviews shall include identification and mitigation for downstream roadside obstacles when pavement widths are narrowing.

3.5.2.5 Deceleration Tapers for Auxiliary lanes

AASHTO's 2018 Figure 9-34a (L=149 feet or L=102 when approved by City Engineer) is the City's standard to provide for entry into left turn lanes and right turn lanes on curbed

urban streets. This asymmetrical reverse curve system provides for urban speeds, reduces the possibility for snow plow damage, and reduces the possibility that drivers can hit the leading edge of the taper resulting in loss of control of the vehicle.

Turn lane storage length shall be separately accounted for when providing the deceleration tapers and shall be based on the analysis of the design year's 95th percentile queuing.

3.5.2.6 Sight Distance

Standard AASHTO 2018 Table 3-1 stopping sight distances for the design speed shall be provided continuously along a roadway including provision of stopping sight distance sight lines through medians and park strips around horizontal curves.

3.5.3 Vertical Alignment

3.5.3.1 Sight Distance

Vertical curves shall conform to the AASHTO design criteria and be designed to provide at least the stopping sight distance shown in AASHTO 2018 Table 3-2. These distances are considered minimums; additional sight distance is recommended to provide drivers with additional margin for error. Longer decision sight distance is needed at critical locations such as those with concentrated demand that are visually cluttered, at changes in cross-section, or at intersections where unexpected or unusual maneuvers are required. AASHTO 2018 Table 3-3 provides decision sight distances for various maneuver types.

3.5.3.2 Minimum Grades

To allow for adequate drainage, the minimum longitudinal tangent grade is 1.0 percent for all roadways. Where the 1.0 percent minimum cannot be met, the grade may be reduced to a minimum of 0.5 percent and requires curb and gutter in place of standard curb.

3.5.3.3 Maximum Grades

Street grades shall be determined with consideration of topographical conditions and relation to existing and planned streets. Where intersections occur on roadway sections with moderate to steep grades, grades shall be reduced through the intersection wherever practical to facilitate vehicular turning movements and reduce the potential for crashes.

Roadway Classification	Maximum Permissible Grade
Local Streets and Alleys	10%*
Collectors	8%*
Arterials	6%*

*Exceptions:
1. Grade breaks – Grade breaks are permitted within a corridor, but are not to exceed 1.0% every 100-feet.
2. Hillsides – Street grades on hillsides exceeding 12% slope may exceed maximum street grades, subject to Fire Department approval.

Where grades exceed 6%, use combination catch basin inlets (Standard Drawing STRM-13B).

3.5.3.4 Sag Vertical Curves

Minimum lengths of sag vertical curves shall be determined in accordance with AASHTO 2018 requirements, using equations 3-48 and 3-50 and Figure 3-37, using stopping sight distances as the value of S. These minimum lengths provide for headlight sight distance.

Design controls in terms of (K), rate of curvature, for each design speed and corresponding stopping sight distance, are shown in AASHTO Table 3-37. To provide for adequate drainage, K values for sag curves shall not exceed K = 167.

Design Speed (mph)	Stopping sight distance (ft)	Rate of vertical curvature, K
15	80	10
20	115	17
25	155	26
30	200	37
35	250	49
40	305	64
45	360	79

3.5.3.5 Crest Vertical Curves

Crest vertical curves shall be designed to provide at least the stopping sight distance for the design speed of the road. Equations to calculate these minimum lengths, based on differential in grade for a given design speed are shown in AASHTO 2018 Equations 3-42 through 3-45. Figure 3-36 provides a graphical representation of minimum curve lengths based on rounded values determined from these equations. Design controls for stopping sight distance and crest vertical curves expressed in terms of terms rates of curvature (K) are provided in Table 3-35.

Design Speed (mph)	Stopping sight distance (ft)	Rate of vertical curvature, K
15	80	3
20	115	7
25	155	12
30	200	19
35	250	29
40	305	44
45	360	61

3.5.3.6 Intersections

At intersections, the grade break permitted at the gutter line is not to exceed 4 percent. This allows for a -2 percent standard crown thru-street to grade break and max slope up at +2 percent for an accessible crossing between curb ramps. Thru streets (nonstop-controlled) cannot exceed 4.5 percent, unless otherwise approved, in order to conform to the maximum street grades required for accessible crossing between curb ramps.

Only at stop controlled intersections can the vertical curve “K” be less than AASHTO standards dictated in 3.5.3.4 – Sag Vertical Curves and 3.5.3.5 – Crest Vertical Curves.

The vertical curve at the intersection must have a minimum 50-foot length and not be less than the 15 mph “K” value.

3.6 Other Right-of-Way Design Elements

3.6.1 Sidewalks, Shared-Use Paths, Trails, and Low Stress Routes

The City developed the following design guidelines and policy in association with the United States Code of Federal Regulations (CFR) (See 28 CFR 35). The City has adopted PROWAG for all accessible routes within the public right-of-way and public access easements. Maintenance operations or approved privately funded (public) improvements may require upgrades, roadway surface alterations or addition of ADA facilities.

The width, details, and construction location of the various types of pedestrian and shared-use facilities identified in the Bend Development Code (sidewalks, primary shared-use paths, connector shared-use paths, primary trails, connector trails, and single track trails) are shown in the standard cross-sections and standard details. Trails are a type of shared-use path that may be owned and maintained by the Bend Parks and Recreation District, or another agency, or by a private party (the city typically does not build trails). Private trails with a public access easement should be designed to one of the standard trail sections.

Sidewalks and shared-use paths shall be designed to meet the following:

a. Surfaces – Sidewalks and curb-tight shared-use paths must be concrete. Separated shared-use paths may be asphalt or concrete, primary and connector trails are asphalt unless approved by the Bend Park and Recreation District or City Engineer as soft surface. Where a street is adjacent to a park or an area with a trail, it is not desirable to have two parallel facilities (sidewalk and trail) therefore, when eliminating the sidewalk to serve the street with a trail, the trail shall conform and meet all sidewalk requirements as outlined herein.

b. Location – Sidewalks and shared-use paths shall be located within the right-of-way unless approved by the City Engineer to meander in a dedicated public access easement. Trails shall be located in land or easements dedicated to the Bend Park and Recreation District unless otherwise approved by the City Engineer. If design deviations to this location are desired then a request shall be made of the City Engineer. Deviation considerations shall include the review criteria from 1.2 – Deviations, Waivers, or Modifications as well as these specific criteria:

- The centerline of the sidewalk shall not meander more than 35 feet from the street curb line
- Where topographical or vegetation limitations require, 15-foot public access easements (7.5 feet each side of centerline) shall be provided
- Shared-use paths shall not be narrower than 8 feet
- Sidewalks shall not be narrower than 6 feet

- Where existing sidewalk exists and is being repaired, the sidewalk may be replaced to match the adjacent connecting sidewalk width provided the width is not less than 5 feet.

- If sidewalk installation is more than 40 feet or the full frontage of a lot, the sidewalk must be constructed to comply to current City standard width

Sidewalks and shared-use paths are the responsibility of the property owner fronting them per Bend Code 3.30.020 to maintain in working order and unobstructed. They can be repaired/maintained in the right-of-way either by replacement of full sidewalk panels or by grinding under a City right-of-way permit. In all situations where a curb ramp or refuge panels is damaged, the entire curb ramp is required to be replaced. Refer to 3.6.2 – Curb Ramps and Crosswalks.

Grinding sidewalk or concrete shared-use path or trail is only permitted where repairs do not exceed 1 inch of concrete removal, the lifted sidewalk is perpendicular to the flow of pedestrian traffic, and the sidewalk has not been previously ground. A 3-inch minimum concrete thickness shall remain after the grinding. The edge of the grinding must meet the requirements of PROWAG R302.7.2: maximum 0.5-inch vertical discontinuity and a beveled slope not steeper than 50 percent. Grinding within a driveway apron or in a curb ramp or refuge panel shall not exceed 3/16 inch. If during grinding aggregate becomes dis-lodged, edges spall, or sidewalk falls out of conformance with PROWAG or concrete thickness requirements, the full sidewalk panel removal will be required.

Sidewalk, shared-use path, trail, driveway aprons, or accessible curb ramps and other elements within the right-of-way that are damaged during construction must be repaired to City standards.

3.6.1.1 Low Stress Routes Design

Low stress bicycle routes are required per TSP Figure 5-1, and are approximately every ½ mile north-south and east-west to provide continuous route for people to access homes, work, parks, schools, and major destinations. Where a new or reconstructed street is shown in the TSP as a low stress route, or for larger undeveloped areas or future expansion areas where the TSP does not show a preferred low stress route and there is not a route within ½ mile serving north-south, and east-west travel, the adjacent development is required to provide a connected low stress facility.

Low stress bicycle route types shall not vary indiscriminately and shall change at logical transition points. Types of low stress bicycle facilities are generally shown in the standard drawings and may include:

- 8-foot to 10-foot shared-use path/shared use trail (trail is typically outside of the right of way and managed privately or by another agency)
- lane only bike lane
- buffered bike lane/painted buffer
- separated bike lane
    - parking separated bike lane

    - device separated bike lane (curb sections, “armadillo”, bollard, delineator, or planter)

- raised bike lane (designs case-by-case; no standard drawing shown)
- shared use street
    - basic shared use street
    - greenway
- enhanced crossing (designs vary; see Signing and Marking manual)
- separated intersection (designs vary by intersection; no standard drawing shown

Select the type of facility based on the design parameters required to meet LTS 1 or LTS 2 for the speed, volume, condition, and configuration of the street cross-section. In most cases, the standard cross-section should meet the requirements. If the standard cross-section does not meet the target LTS, modify the design to meet the target. In some locations on the map the low stress routes are not in alignment with a street, but instead are required as an off-street multi-use path. For existing streets, City staff can provide the initial type of low stress facility identified with the TSP as a starting point for the reconstruction/ modification design.

On key routes, in addition to meeting the LTS, new and reconstructed bike lanes shall target providing the highest level of separation feasible.

3.6.1.2 Connector Routes

Connector routes are required per the Connector Routes and Crossings Map (Part VI – Appendix C), the Bend Development Code Chapter 3.1.300, and as identified by the City Engineer. These are generally infill sidewalks, multi-use paths, or trails. The type of facility is determined from the applicable standard cross-section, modified as needed to meet the target LTS.

The connector route map is established to work with the low stress route map and to coordinate systematic implementation of arterial and collector crossings at ½ to ¼ mile spacing where they serve the most users and destinations. Connector routes are required as identified in the Bend Development Code for larger undeveloped areas or future expansion areas.

3.6.1.3 Low Stress and Enhanced Crossings

Where a low stress route crosses an arterial or collector intersection, or a crossing is identified on the Connector Routes and Crossings map, enhanced crossings may be required to provide the target LTS 1 or LTS 2 crossing.

Enhanced crossings may also be required at crossing that serve higher volumes of pedestrians as identified in the standard for marking crosswalks or per the City Engineer. See the Signing and Marking manual for Enhanced Crossing Design.

New intersections and intersection approaches must be designed to achieve the target LTS. For existing intersections, the reconfiguration of intersection lanes, addition of full

width medians, reduction of speeds, or modification of traffic control required to modify an existing intersection or crossing to achieve an LTS 1 or 2 may not be feasible within existing off site right of way, within the scope of a city project, or within the nexus of a development. In those cases, designers must work with the City Engineer to identify alternative mitigation. One example is providing a bike exit ramp for bicyclists at an LTS 3 or 4 intersection approach to have the option to access an LTS 1/2 multi-use path to travel through the intersection.

3.6.1.4 Obstructions

Structures and obstructions including but not limited to fire hydrants, street signs, utilities, utility poles, signal poles, central delivery mailboxes, and individual mailboxes shall not be located in the accessible path of travel portion of the sidewalk. Sidewalks, multi-use paths, and trails having obstructions shall either be made wider to allow for accessible travel widths defined by PROWAG or have the obstruction removed.

3.6.1.5 Horizontal Alignment

Sidewalks/shared-use paths shall be constructed abutting the property line (back of walk at 6 inches from property line). Designers may meander the sidewalk/shared-use path from the property line when necessary due to topographical or vegetation issues, rather than economical or other design issues.

The sidewalk/shared-use path shall generally follow a smooth and gradual alignment free of sharp angles or bends; horizontal curves shall not be less than 20’ radius.

3.6.1.6 Vertical Alignment

Sidewalk/shared-use path grades shall comply with PROWAG guidelines. Changes in vertical elevation of the sidewalk with respect to the roadway’s running curb elevation can lead to difficulties in achieving ADA compliance with running slopes and ramp slopes.

For separated sidewalks/shared-use paths, the total vertical separation between the top of curb and the top of the sidewalk/shared-use path may vary based on the allowable planter strip slope per 3.6.2.12 – Planter Strip, however the running slope must not exceed the general grade of the road per PROWAG R302.5.

For curb-tight sidewalks/shared-use paths, the total vertical separation between the top of curb and the top of sidewalk shall be zero feet – the sidewalk shall be flush with the curb.

3.6.1.7 Surface Alterations

A roadway alteration includes activities such as reconstruction, rehabilitation, resurfacing, widening, and projects of similar scale and effect (See 2010 ADA Accessibility Standards, section 106.5). Maintenance activities such as filling potholes, minor pavement patching, and limited trench cuts for utilities are not typically considered alterations. However, any of these activities that occur within a street level pedestrian walkway (a marked or unmarked crosswalk) may not reduce the path’s accessibility (See 28 CFR 35.133(a). A street level pedestrian walkway (e.g., marked or unmarked crosswalk) is where the pedestrian would cross an intersecting road, regardless if curb ramps are currently present.

3.6.1.8 Sidewalks/Shared-Use Paths Through Driveways

Sidewalks/shared-use paths shall travel through City standard driveway aprons at sidewalk/shared-use path grade, with the driveway being segmented by the sidewalk/shared-use path. To maintain their effectiveness, detectable warning surfaces should not typically be used where an accessible route of travel intersects a residential or commercial driveway entrance or within a parking lot. However, where commercial driveways are provided with yield or stop control, detectable warning surfaces should be provided at the junction between the pedestrian route and the vehicular route per PROWAG 208.1. The typical sidewalk width is 6 feet (8 feet or wider for shared-use paths), the width may be reduced to a minimum of 4 feet where constrained by grades.

3.6.2 Curb Ramps and Crosswalks

All required curb ramps must meet the requirements of PROWAG published by the U.S. Access Board. The City, by this reference, adopts PROWAG into its standards.

Curb ramps shall be as wide as the sidewalk or shared-use path they serve.

Curb ramps are only required where there is a pedestrian walkway (e.g., a sidewalk or trail/path) with a prepared surface that intersects a roadway. Prepared surfaces may include concrete, asphalt, or other compacted materials such as soil and granite. Concrete and asphalt are the two most common prepared surfaces found in Bend.

Conditions for curb ramp construction:

- If any work (new construction or reconstruction) impacts a curb where there is a pedestrian walkway (e.g., a sidewalk or trail/path) intersecting a roadway then a new ramp or replacement of an existing non-compliant curb ramp must be constructed.

- If any work includes resurfacing through a street level pedestrian walkway (e.g., marked or unmarked crosswalk), even if the work is not the full width of the roadway, curb ramps must be built or reconstructed on both ends of the crosswalk.

- If any sidewalk work connecting to an existing non-compliant ramp that requires any modification to any portion of the ramp to meet current sidewalk design standards, then the entire ramp shall be reconstructed to current standards.

- If any utility trench work impacts a curb at a cross walk, with or without a ramp, the replacement of an existing non-compliant curb ramp must be constructed.

- If utility trench work does not impact a curb ramp but is “limited to a portion of the pavement, including a portion of the cross walk” replacement of an existing non-compliant curb ramp may not be required (dependent on overall project scope and required pavement restoration limits).

- Any Land Use application for new development that includes requirements for sidewalk construction or frontage improvements meeting current City Standards, all curb ramps along the property frontages shall be reviewed for compliance with current standards. Any non-compliant curb ramps or sidewalks along the property frontage must be brought into compliance. This requirement must be included as a Condition of Approval in the Land Use Decision.

- If constructing a new ramp, any existing receiving ramp, if applicable, must align. The construction of a new ramp must not make an existing ramp, either along a project site or directly across the street, non-compliant.

3.6.2.1 Marked and Enhanced Crosswalks

See the Signing and Marking Manual for crosswalk marking and enhancing requirements.

3.6.2.2 Number and Direction of Curb Ramps

The City requires each new intersection to be designed with two (paired) curb ramps per corner allowing for all directions of travel, unless site conditions require modification. These are often referred to as **directional** ramps. If site conditions prevent the use of directional ramps, the design engineer must provide documentation to the City Engineer for review and approval as described in 3.6.2.3 - Type of Ramps Preferred and Documentation.

An example of "all directions of travel" in this case means six curb ramps at a T or three legged intersection. This would be two curb ramps at each corner (one per crosswalk) and two on the "top of the T" allowing for crossing of both roadways.

At a four legged intersection this would be eight curb ramps (two at each corner, one per crosswalk). Each ramp shall run parallel to (in line with) each crosswalk (regardless of if the crossing is marked or unmarked).

On collector and arterial streets, where pedestrians are crossing un-signalized intersections, having two pedestrian crossings across the higher classification street can be waived by the City Engineer to reduce the conflict points or sight distance concerns. Where this occurs, pedestrian closure signs/barriers must be installed on the intersection leg where the crossing is not proposed, and the sidewalk is curb-tight.

Where a development installs a curb ramp along a site frontage, a ~~connector ramp~~receiving ramp will not be required where sidewalk/shared-use path does not exist or is not proposed with the development. A connector ramp will not be installed unless there is a receiving ramp on the other side of the road.

3.6.2.3 Type of Ramps Preferred and Documentation

A perpendicular curb ramp for each crosswalk is the City's most preferred design because it does not present unnecessary grade changes in the path of travel for pedestrians that are not crossing the roadway.

If existing site constraints such as the required use of a curb-tight sidewalk/shared-use path prevent the use of perpendicular curb ramps, the next most preferred and allowable design options include parallel or combined perpendicular/parallel curb ramps which still provide a separate and distinct curb ramp for each crosswalk. Documentation in writing of existing site constraints preventing the use of a perpendicular curb ramp and instead utilizing parallel or combined perpendicular/parallel curb ramp design must be provided to and approved by the City prior to construction.

A single diagonal curb ramp or sidewalk/shared-use path depressed corner may only be used when significant existing site constraints do not allow two ramps to be installed (one per crosswalk). Documentation in writing of these significant existing site constraints must be provided to and approved by the City prior to construction. To summarize the City's

requirements for selecting an appropriate curb ramp design, the following flow chart shows ramps in order of preference:

1) Required: **Perpendicular** curb ramp for each crosswalk (two per corner)
2) **Parallel** curb ramp for each crosswalk (two per corner)*
3) **Combined** perpendicular/parallel curb ramp (this provides a separate and distinct curb ramp for each crosswalk)*
4) Least preferred: **Diagonal** curb ramps or blended transitions shared by two crosswalks (only allowed with significant existing site constraints that shall be fully documented, provided in writing to and approved by the City prior to construction)*

*Allowable only if constraints dictate, such as the required use of curb-tight sidewalk/shared-use path. Documentation in writing shall be submitted to and must be approved by the City prior to design and construction.

3.6.2.4 Existing Physical Constraints

Where existing physical constraints make it impracticable for altered elements, spaces, or facilities to fully comply with the requirements for new construction, compliance is required to the extent practical within the scope of the project. If the engineer of record deems the work is not practical due to existing constraints, the City Engineer will decide whether any deviation or claim of impracticality is justified. (For more information on existing physical constraints, see below).

A common example of “within the scope of the project” would be when all work related to a project is restricted to one corner of an intersection. In this case the project would only be responsible for providing two accessible curb ramps at this location (regardless of what was present in the existing conditions). The project would not be responsible for constructing new or altering existing curb ramps on the other corners of the intersection outside of the project limits.

Existing physical constraints can include, but are not limited to, underlying terrain and topography, right-of-way availability, underground structures, adjacent developed facilities, drainage, or the presence of a notable natural or historic feature.

3.6.2.5 Design Details

Curb ramps must be designed to fit the site and must be detailed on construction plans. The design must provide sufficient horizontal and vertical control and the drawings annotated to ensure that ramp conforms to federal, state, and local accessibility standards. Curb ramps with corresponding grades and transitions must be designed to ensure proper drainage of the intersection. Grades including running slopes and cross slopes must be noted on each quarter delta of the curb return. The City may require that curb ramps be designed and stamped by a professional engineer as part of any permit application.

To assist in the City’s review of plans and for contractors and inspection staff to ensure compliant and quality ramp construction, the following information is required to be shown in plans:

- **Running slope** (parallel to path of travel) percentage and direction

- **Cross slope** (perpendicular to path of travel) percentage and direction
- **Control points** with finished grade and top of curb (where applicable) elevation information*
- **Dimensions** of features (e.g., length and widths of ramps and landings)

*Control points may include throats of ramps, top and bottom of ramps and landings, tie-in points to match existing or other proposed features, and any wings or curb returns.

Per PROWAG, the absolute legal maximum constructed slopes allowed are:

- 8.3%* (or 12:1 run/rise) for a **running slope** (parallel to the direction of travel); and
- 2.0% (or 48:1 run/rise) for **cross slope** (perpendicular to the direction of travel).

Since the City recognizes that when curb ramps are constructed in the field some tolerances from the design may occur, designers are directed to use the following maximum design values to ensure the constructed ramps and sidewalk/shared-use paths will be below the following PROWAG required absolute legal maximum slopes:

- For **running slope** (parallel to direction of travel) the maximum design value should be 7.5%*
- For **cross slope** (perpendicular to direction of travel) the maximum design value should be 1.5%

*Per PROWAG, curb ramps and transition ramps are not required to be longer than 15 feet.

3.6.2.6 Perpendicular Curb Ramps

Perpendicular curb ramps have a running slope that cuts through a curb along the direction of the pedestrian access route. A landing is required at the top of a perpendicular ramp per PROWAG. The term perpendicular does not differentiate between directional or diagonal ramps. A single perpendicular curb ramp could be used at an intersection corner as a diagonal ramp, but only where there are documented constraints and with the approval of the City.

3.6.2.6.1 Ramp Running Slope

Perpendicular curb ramps have running slopes of 5 percent or greater and 8.3 percent or less but shall not require the ramp length to exceed 15.0 feet. If a ramp's running slope will be less than 5 percent, it is considered a blended transition instead of a perpendicular curb ramp and therefore a top landing is not required unless there are intersecting sidewalks/shared-use paths and/or ramps sharing a common area, in which case a landing is required where they intersect. For additional discussion on blended transitions, see PROWAG. Grade breaks are not permitted within the ramp.

Where physical constrains require the ramp to slope down from the road, place a catch basin, or inlet, just upstream of the ramp to limit the amount of water entering the ramp throat.

3.6.2.6.2 Ramp Cross Slope

Ramp cross slopes shall typically not exceed the 2 percent maximum required for a pedestrian access route. Where ramps lead to a pedestrian street crossing without yield or stop control, or a mid-block pedestrian street crossing, the cross slope may transition along the length of the ramp from 2 percent maximum at the landing to the maximum slope allowed per 3.6.2.9 - Pedestrian Street Crossings at the curb.

3.6.2.6.3 Ramp Width

No changes in width are allowed through perpendicular curb ramps, between the top and bottom. The widest dimension shall be held the entire way through the ramp. Again, the mistake that is often made is attempting to align with joints previously made in curbs or sidewalks/landings that were poured separately. This is not required.

All perpendicular ramps shall have the same width as the sidewalk or shared-use path that they are serving or intersecting (e.g., if the sidewalk is 6 feet wide, the ramp shall be 6 feet wide). See exception in 3.6.2.8 – Ramp/Landing Width Exception.

3.6.2.6.4 Direction of Ramp

No changes in direction are allowed through perpendicular ramps, between the top and bottom. This means that the edges of the ramp shall be aligned with the detectable warning surface tile and the direction of travel from the top landing and crosswalk direction to the receiving ramp on the other side of the intersection. The mistake that is often made is attempting to align with joints previously made in curbs or sidewalks/landings that were poured separately. This is not required.

3.6.2.6.5 Flared Sides and Returned Curbs

Flared sides (commonly referred to as wings) are preferred on the sides of perpendicular ramps wherever possible to reduce the likelihood of damage from snowplows, minimize tripping hazards, and make maintenance of surrounding landscaping easier (e.g., allow for passage of mowing equipment over the ramps and flared sides). Try to locate features such as hydrant pads, catch basins, drywells, meter boxes, etc. at a distance such that a flared side between the ramp and these features is still possible and a returned curb is not needed. If a flared side is possible on only one side of the ramp, the run-off side is the most important to try and achieve this on since this is the side most likely to be struck by a snowplow blade. When flared sides are within the pedestrian circulation path, the maximum slope shall be 10 percent. When flared sides are adjacent to a non-traversable area, such as landscaping, the slope may exceed 10 percent. When this is the case, a typical 3-foot wide flared side should be utilized for consistency. Flared sides should extend up the entire length of a ramp to add strength, especially at intersection corner locations where ramps are exposed to over-tracking from turning vehicles and can crack.

3.6.2.6.6 Landing

Perpendicular ramps shall have landings at the top of the ramp. Landings shall be squared off to the ramp and direction of travel through it. While the jointing may be different and the ramp dimensions may be wider/longer than the ramp width itself (this is often the case with landings shared by more than one ramp at an intersection corner), it must not be on an angle or curve that is not perpendicular to the intersecting ramp. For additional

discussion on landings see PROWAG. The landing's finished surface slope shall not exceed 2 percent in the direction of travel or the cross slope.

3.6.2.6.7 Detectable Warning Surface

In the case of perpendicular ramps located along a street edge/curb line that is angled or changing due to an intersection/corner radius, typically the detectable warning surface should be installed perpendicular to the edges of the ramp and direction of travel through the ramp. In this case a grade break shall be provided along the bottom edge of the detectable warning surface. Everything above this grade break is considered the curb ramp and shall be a continuous slope with no grade breaks until the top landing is reached from where the tie in with the sidewalk/shared-use path will occur. Everything below the bottom edge of the detectable warning surface is considered the pedestrian access route (see PROWAG R302) and therefore shall have a running slope of less than 5 percent. Further, the detectable warning surface shall be located so that one corner is no more than a 2-inch distance from the back of the adjacent street curb and the other edge is no more than a 5-foot distance.

3.6.2.6.8 Transition to Sidewalk

From the landing to the adjacent connecting sidewalk/shared-use path, transition the sidewalk/shared-use path to the requirements of 3.6.1.5 - Horizontal Alignment and 3.6.1.6 - Vertical Alignment over as long a distances as necessary to meet the requirements of a pedestrian access route. If the running slope exceeds 5 percent, the path is considered a ramp and landings are required after every 15 feet of ramp.

Where connecting to an existing sidewalk/shared-use path with a cross slope greater than 2 percent, construct a cross slope transition panel where new meets existing. The length of the cross slope transition panel shall be as necessary, minimum 5 feet, to transition to the existing cross slope at a warp rate of not more the 0.5 percent per foot.

3.6.2.7 Parallel Curb Ramps

Parallel curb ramps have a running slope that is in line with the direction of sidewalk travel and lower the sidewalk to a landing where a turn is made to enter the pedestrian street crossing. A landing area is required at the bottom of the ramp per PROWAG. The term parallel does not differentiate between directional or diagonal ramps. A single parallel curb ramp could be used at an intersection corner as a diagonal ramp, but only where there are documented constraints and with the approval of the City.

3.6.2.7.1 Ramp Running Slope

Parallel curb ramps have running slopes of 5 percent or greater and 8.3 percent or less but shall not require the ramp length to exceed 15.0 feet. If the ramp's running slope will be less than 5 percent, it is considered a blended transition instead of a parallel curb ramp and therefore a landing is not required unless there is a change in direction of travel at the bottom of the ramps to enter the street and crossing. Note there typically is a change of direction in travel in the case of parallel curb ramps because of the nature of their design and use, therefore bottom landings are almost always required. For additional discussion on blended transitions, see PROWAG. Grade breaks are not permitted within the ramp.

3.6.2.7.2 Ramp Cross Slope

The cross slope for parallel ramps shall not exceed 2 percent.

3.6.2.7.3 Ramp Width

All parallel ramps shall have the same width as the sidewalk or shared-use path that they are serving (e.g., if the sidewalk is 6 feet wide, the ramp shall be 6 feet wide).

3.6.2.7.4 Back of Walk Curb

Back of walk curbs are typically utilized in the design/construction of parallel curb ramps. It is best practice to always include a back of walk curb along the ramp(s) and landing even if located in a fill section - over time adjacent ground and landscaping can erode onto the ramp(s) and landing and property owners may also modify or add landscaping that may encroach. The back of walk curb shall be installed entirely outside of the ramp and landing so not to reduce width of the pedestrian access route (e.g., if the sidewalk is 6' wide, the curb should be installed beyond the back of walk to maintain the 6-foot width through the ramp and landing). Exposure of the back of walk curb shall vary with the largest exposure at the landing to zero where the top of ramp meetings the adjacent sidewalk/shared-use path. If unable to transition to zero exposure due to constraints, the curb can be transitioned on the end to taper over a 1-foot distance to avoid creating a tripping hazard or blunt end.

3.6.2.7.5 Landing

The bottom landing on parallel curb ramps will sometimes be located on intersection/corner radii which will cause them to change dimensions from the back to the front of the landing as they radiate out. The narrowest dimension, at the back of the landing, shall match the width of the sidewalk/shared-use path the ramp is located along and in no cases be less than 5 feet unless there are constraints that have been documented by the designer and approved by the City. See exception in 3.6.2.8 – Ramp/Landing Width Exception.

The landing's finished surface slope shall typically not exceed 2 percent in any direction. Where a landing abuts a pedestrian street crossing without yield or stop control, or a mid-block pedestrian street crossing, the slope parallel to the curb may match the maximum slope allowed per 3.6.2.9 – Pedestrian Street Crossings.

3.6.2.7.6 Transition to Sidewalk

Transitions from the top of parallel ramps to the adjacent connecting sidewalk/shared-use path shall follow the same requirements outlined in 3.6.2.6.8 – Transition to Sidewalk beyond the top landing.

3.6.2.8 Ramp/Landing Width Exception

At pedestrian street crossings where the sidewalk/shared-use path width differs on each side of the road, the narrower width may be used for both ramps.

3.6.2.9 Pedestrian Street Crossings

The cross slope of pedestrian street crossings shall be per PROWAG R302.6 which is summarized in the following table:

Crossing Type	Maximum Cross Slope
Intersection **WITH** Yield or Stop Control	2%
Intersection **WITHOUT** Yield or Stop Control	5%
Mid-block Crossings	Road Grade

3.6.2.10 Miscellaneous/Special Cases

The designer/Engineer of Record shall provide written documentation for why a particular design (e.g., curb ramp, sidewalk/shared-use path, etc.) cannot meet the requirements of PROWAG, City Design Standards, City standard drawings etc.) that will be reviewed by the City and if approved will be included with the curb ramp inspection forms that will be uploaded and stored in the City's asset management system.

Combination curb ramps are often utilized in many designs. They are called this because they include elements of both perpendicular and parallel curb ramps. An example includes ramping down sidewalk/shared-use path to a landing (e.g., parallel design element) before coming off of the landing with an intersecting curb ramp down to street level (e.g., perpendicular design element). When designing or constructing combination ramps, follow the relevant requirements for both types (e.g., utilize a back of walk curb behind the landing elements, meet the running slope requirements on all ramp elements, square off all grade breaks, utilize flared sides where possible on ramps that intersect the street with adjacent landscaping buffers, etc.)

If a project is only replacing curb ramps and is tying into existing sidewalk/shared-use path that is not being replaced and this sidewalk/shared-use path is currently narrower than the City's standard/requirement for the street's classification or zoning for the area the street is within, the curb ramps should be designed/constructed as the width that would be required for new construction if adequate right-of-way is available or can be obtained within the scope of the project. Transition panels back to the width of the remaining narrower existing sidewalk/shared-use path should then be provided.

In certain situations, the City will allow a depressed corner with one combined landing and two separate detectable warning surfaces to orient the directions of crossing at an intersection. In order to provide separation between them, a vertical curb should be installed along the street corner. Where possible this curb should have a 6-inch exposure and be 12 inches wide for strength since it will likely be driven over by over tracking vehicles. Additionally, painting the inside and top of this curb yellow can minimize the possibility of this non-standard feature on a corner becoming a tripping hazard since it might otherwise visually blend in with all of the other surrounding gray concrete.

When a sidewalk/shared-use path has been constructed as part of a City project, private development, etc. but does not end at an intersection, provide an end of walk curb ramp per ODOT standard drawing RD952 for street level access. Detectable warning surfaces are typically not required but the grades of the transition must meet curb ramp slope requirements for accessibility. The City may waive the requirement for this transition in some instances with an appropriate submittal and approval.

With new and retrofit roundabout projects, extending the sidewalk/shared-use path to a point beyond the bike ramp before terminating the sidewalk/shared-use path with an end of walk curb ramp is preferred over utilizing the bike ramps for pedestrian access to the

roadway. If it is necessary to utilize the bike ramps for pedestrian access until a future time when a sidewalk/shared-use path is extended beyond the roundabout, bike ramps must be designed to meet accessible grades for curb ramps.

3.6.2.11 Additional Definitions and Requirements

ORS 801.220 defines crosswalks as any portion of a roadway at an intersection or elsewhere that is distinctly indicated for pedestrian crossing by lines or other markings on the surface of the roadway. Where no marked crosswalk exists, a crosswalk is every crossing of an intersection.

In general, when a feature in the public right-of-way is altered, the requirements for new construction must be applied to the maximum extent feasible. Any design that does not meet the accessibility requirements for new construction must be documented in writing, submitted to, and approved by the City prior to construction. Note approved deviations on the appropriate construction drawing.

Detectable warning surfaces are required on all accessible curb ramps, and where the pedestrian paths of travel cross intersecting roadways, such as a paved trail intersecting a roadway with no curb. PROWAG refers to this as a blended transition. Detectable warning surfaces must extend for the full width of the curb ramp or blended transition.

3.6.2.12 Planter Strip

The planter strip is the portion of the roadside that is located between the curb and the sidewalk/shared-use path. Planter strips are required to conform to roadside safety requirements in terms of slope, landscaping, appurtenances, utilities, etc.

The landscaped portion of the planter strip must be a minimum of 5 feet wide, unless otherwise approved by the City Engineer, except where the sidewalk/shared-use path meanders to be adjacent to the curb. In order to prevent sharp re-entrant angles in the landscaped portion of the planter strip, an edge not less than 8 inches long and squared to the curb must be constructed at the juncture of the sidewalk/shared-use path to the curb.

Planter strips must contain street trees when required by the Bend Development Code. Street trees shall conform to the City's landscaping requirements found in 12 - Landscape Architecture and Irrigation Systems and sight distance requirements found in 3.3 - Design Considerations. Planter strips may be utilized for swales or landscaping and shall conform to the applicable Bend Development Code provision. When used for landscaping, the landscaping shall conform to the City's landscape provisions found in 12 - Landscape Architecture and Irrigation Systems.

The cross-slope of the planting strip between the curb and the right-of-way must not be steeper than 4H:1V to provide a recoverable roadside slope. All appurtenances, utilities and structures located within the planter strip that are roadside safety obstacles must comply with roadside safety principles of 1.5 - Roadside Safety. Obstacles must be located as far from the roadway as possible and be designed with recoverable slopes or breakaway foundations complying with AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, with interim revisions."

The planter strip must not contain stairs. Stairs are not allowed to be located within the public way. Deviations to this standard may be submitted to the City Engineer for design standard deviation review per the requirements of 3.2 - Deviation from Streets Standards.

Where existing ground cross slopes exceed 12 percent, see 3.4.7 - Hillside.

3.6.2.13 Exceptions

This section identifies exceptions to the ADA requirements. The City's Transition plan outlines requirements for operation of the ADA program. This design guideline does not set direction of maintenance activities or operational goals outlined in the transition plan. However, when a ramp upgrade or installation is required, it must meet these requirements unless otherwise stated in a project scope or contract.

3.6.3 Transit Facilities

Bus stop locations, bus pull-out locations and transit facilities located within the public right-of-way shall be approved by the City Engineer.

When evaluating bus stop locations or a corridor of stops, the impact on roadway operations and safety shall also be considered. Analysis inputs should include: dwell time; bike lane and travel lane blockage effects; transit vehicles ability to enter and exit the flow of traffic; convenience and safety of passengers; and convenience and safety of pedestrians accessing the bus stop.

Transit facilities shall be designed to incorporate roadside safety features by locating benches and shelters far away from the traveled edge of the roadway, as close to the right-of-way line as possible. Deviations in sidewalk/shared-use path alignment to facilitate the installation of transit facilities shall be designed to comply with the horizontal alignment requirements of this chapter. Consideration should be given to using breakaway support features to reduce the crash severity of vehicle run off the road events when elements cannot be located with adequate clearance to the traveled way.

3.6.3.1 Bus Stop Locations

A Transit or bus stop is a designated place along a transit route typically in the street right-of-way where a public transit vehicle stops to load and unload passengers. The following are design guidelines for the locations of bus stops:

- Distance between stops is typically 800 feet
- Stops are located in areas where passengers have a safe and direct access to sidewalk/shared-use paths, walkways and waiting areas
- Passengers have access to an accessible route to and from the bus stop and onto the bus
- Convenient access for pedestrians
- Stops are located in proximity to marked crosswalks and low stress routes or in locations that are consistent with systematic crossing spacing on the roadways;
- A properly developed and located bus stop allows for safe movement by the bus in to and out of the main traffic flow and minimize conflicts with the bike lane

3.6.3.2 Types of bus stop locations

3.6.3.2.1 Far-side

A far-side bus stop is a stop that is located immediately following an intersection and is recommended for all traffic signals and when:

- Traffic in the direction the bus is traveling is heavier approaching the intersection than leaving the intersection
- There is high demand for right turns in the direction the bus is traveling
- The crossing street is a one-way street where traffic flows from left to right
- The location is one that offers a clear advantage for transit riders by providing improved access to a major destination or to other intersecting bus routes
- Priority control at the traffic signal is utilized to maintain bus schedules

3.6.3.2.2 Near-side

A near-side bus stop is a stop that is located immediately before an intersection and is recommended for all roundabouts and when:

- Traffic in the direction the bus is traveling is heavier leaving the intersection than approaching the intersection
- The cross street is one-way where traffic flows from the right to left
- The location is one that offers a clear advantage for transit riders by providing improved access to a major destination or to other intersecting bus routes

3.6.3.2.3 Mid-block

A mid-block bus stop is a stop that is generally located 100 feet or more before or beyond an intersection and is generally not recommended. Mid-block locations may be considered when:

- The distance between intersections far exceed the standard for bus stop spacing
- Traffic or physical street characteristics prevent siting a stop close to an intersection
- The bus stop serves large businesses, housing developments, or other significant trip generators
- An analysis is conducted to determine if additional crosswalk enhancements or sidewalk/ shared-use path connectivity is required to provide access to a safe crossing location so that riders do not cross mid-block in an unmarked location

3.6.3.3 Bus Stop Turnouts

Bus stop turnouts are not standard for arterial and collector roadways. Design standard deviations review shall consider the following criteria:

- Bus dwell time
- Dwell time impact on bicyclists
- Width of roadway and impact of following vehicles passing bus during dwell time on arterial or collector roadway operations and safety

When approved, bus turnouts shall be designed in accordance with the current standards set forth in AASHTO.

3.6.3.4 Mobility Hubs

Mobility hubs are physical centers that connect transportation modes and may provide an integrated suite of services, information, and amenities. The Bend development code defines mobility hubs, and TSP Figure 5-2 identifies target mobility hub locations. Mobility hubs are established in conjunction with Cascades East Transit. In addition to the mobility hub, a larger center that connects multiple transportation modes and may provide mobility services and information; there is neighborhood mobility points. Neighborhood mobility points are smaller scale than a mobility hub with less services and fewer amenities. Neighborhood mobility points are typically located along transit and/ or low stress routes at locations with higher density or at intersections where higher volumes of people may change modes. They range in size (small, medium, large) based on the space used and number of services provided and can be all in the public right-of-way, all on private property with a public access easement or a combination. Mobility points are small facilities, typically the size of one or a few parking spaces that may provide micromobility services, electric vehicle charging, and car share loading/unloading. All types of mobility hubs generally include some type of kiosk providing information about the services at the hub.

The design of each mobility hub will be site-specific, and determined by the City Engineer. Example layouts for mobility points is provided in Standard Drawings R-50A and R-50B. The standards for neighborhood mobility points are shown in the following table:

Type	Urban Context	Size	Shared Mobility Elements	Future Transit Elements	Other Elements /Amenities
Small	Neighborhood commercial centers, parks, commercial destinations	1 parallel parking space	- Bikeshare and dockless parking zone	- Microtransit stop	- Bench - Info Kiosk and wayfinding
Medium	Neighborhood commercial centers, midsize to larger parks, commercial destinations	2 parallel parking space	- Bikeshare and dockless parking zone - Carsharing: 1 space for TNC/paxi pickup	- Microtransit stop	- Bench - Info Kiosk and wayfinding
Medium+	Neighborhood commercial centers, midsize to larger parks, commercial destinations	3 parallel /angled parking space – or 2 parallel spaces plus end of block	- Bikeshare and dockless parking zone - Carsharing: 1 space for TNC/paxi pickup	- Microtransit stop - Shuttle Stop	- Bench - Info Kiosk and wayfinding - Covered Shelter - EV Charging space
Large	Off street parking on Commercial Centers. (High density: outlying city neighborhoods, suburban transit centers, shopping/ commercial areas (parking away from destinations), destination centers)	Min of 6 parking spaces in an off-street location	- Bikeshare and dockless parking zone - Carsharing: 2 space for TNC/paxi pickup - 2 Carpool parking spaces	- Microtransit stop - Shuttle Stop	- Bench - Info Kiosk and wayfinding - Covered Shelter - EV Charging space - Placemaking element such as food truck w/ outdoor seating, playscape, pedestrian plaza, etc.

3.6.4 Driveways

The locations of new driveways shall be approved through land use (e.g., part of a master plan, subdivision, or site plan) and through a right-of-way permitting process. Driveways shall be reviewed with the following considerations:

- There is a valid land use approval for the driveway (or it is confirmed that no land use approval is necessary for the driveway in question);

- There is only a single access point to the property unless:

    - The lot is on a corner lot

    - Higher density developments (multi-family, industrial, commercial) require additional access points for onsite large truck circulation. Access approved by the City Engineer.

        - Duplexes are allowed up to two aprons with an aggregate maximum width of 32 feet

        - Triplexes are allowed up to three aprons with an aggregate maximum width of 32 feet

        - Quadplexes are allowed up to four aprons with an aggregate maximum width of 32 feet

    - The lot has a wide street frontage per the Bend Development Code Chapter 3.1.400

- The access is to the lowest classified roadway facility abutting the property (order of classification (lowest to highest): alley, local, collector, arterial)

    - New residential developments will be required to abandon existing driveway access from local streets if they have access to an alley access unless:

        - Access to an existing permanent garage structure would be removed
        - Removal of the access would make the site non-conforming – removing parking requirements for the existing site use
        - The alley is not accessible

    - Where adjacent to two streets and one street is designated as a low stress route as shown on Figure 5-1 of the TSP, access shall typically be from the street that is not a low stress route

- Adequate intersection sight distance for all turning movements in and out of the proposed driveway are provided

- The driveway meets the following minimum spacing (10 feet apart (bottom of curb drop to bottom of curb drop)), unless otherwise approved by the City Engineer where sufficient separation from utilities (existing or proposed) exists

- Maximum distance to an intersection is provided given the lot configuration and site layout

- Driveways shall not compromise safety and operations

- Where a driveway is proposed across the street from another driveway, alley, or street, the path of travel should be aligned or sufficiently offset, where possible

- No drywells, sedimentation manholes, water meters, valves, manholes or pressure sewer valves/pits or any other utility structures will be permitted within the driveway apron or driveway landing unless otherwise approved by the City Engineer. No utility structures will be permitted in sidewalks or applicable path of accessible travel.

Concrete driveway approaches are required on all new construction or reconstruction where sidewalk/shared-use path and/or curb is existing or proposed. Asphalt driveways are permitted where sidewalk/shared-use path or curb is not existing or proposed. New alleys or reconstructed alleys must have a driveway approach at the intersection of the alley and roadway. Site drainage will be permitted into the right of way for the first 20 feet, inclusive of the driveway approach landing. All other private site drainage to be captured and contained on the private site in conformance to City Code Title 16." ~~. The driveway approach shall be designed to ensure that all drainage is contained on site.~~ Design standards deviation requests to consider a curb return rather than a driveway approach may be considered by the City Engineer in accordance with 1.2 - Deviations, Waivers, or Modifications and the following specific driveway review criteria:

- The design vehicle for the site is too large to accommodate turns within the standard driveway apron

- A pork-chop or other traffic mitigation measure is to be installed at the site entrance

- ~~All site drainage is contained on-site~~

The minimum sidewalk width is 4 feet through driveways and 8 feet for shared-use paths. The design shall provide sufficient horizontal and vertical control and the drawings annotated to ensure that driveway conforms to federal, state, and local accessibility standards.

Driveways and/or mountable curbs must be avoided at low points whenever possible. Where driveways are located at the bottom of a cul-de-sac or other dead end roadway, driveways shall be relocated outside the low point to prevent stormwater flowing from the street down into a private property. Additional catch basins or other infrastructure may be required at these areas to further protect the private properties.

3.6.5 Signing

No sign shall be designed for, or installed, within public right-of-way unless it has first been reviewed and approved by the City Engineer or designee.

Street signs and barricades shall be designed per the City of Bend Signing and Marking Manual. Street signs and barricades shall be designed and installed according to City of Bend Standards and Specifications, and meet the requirements of the most current edition of the MUTCD as well as the Oregon Supplements to the MUTCD. This applies to signs and traffic control devices on all streets open to public travel, whether publicly or privately owned or maintained.

To provide appropriate roadside safety, ground-mounted signposts shall be breakaway in compliance with the current AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, with interim revisions."

New signs shall be installed, and existing signs modified, to reflect new lane configurations and in coordination with existing or revised pavement markings. Remove and replace signs beyond the project limits as necessary to reflect changes implemented with the project.

Existing signs within project limits that are not in compliance with these requirements in terms of offsets, siting, physical condition, and applicability shall be updated to bring them into compliance.

Plans shall reference signs by MUTCD type, and include designs for all non-standard signs. Designs for standard signs are provided in FHWA's Standard Highway Signs manual; ODOT's Sign Policy and Guidelines and the City's Standard Details include designs for Oregon- and City-specific sign designs not found in the federal manual.

Before any new highway, detour, or temporary route is opened to traffic, all necessary signs and barricades shall be in place. Signs necessitated by road conditions or restrictions shall be removed when those conditions cease to exist or the restrictions are withdrawn. Temporary TRAFFIC CONTROL CHANGE AHEAD signs, installed on wood posts, shall be installed on any project that changes traffic control type.

3.6.6 Pavement Marking/Striping

Pavement marking and striping information is provided in the Signing and Marking Manual. Plans shall show and identify a minimum of 300 feet of existing striping beyond the project limits, to ensure proper tie-in to existing striping. Where project limits occur within 500 feet of existing pavement or striping tapers, limits of striping plans shall be extended to include the full taper. Plans shall show and identify all existing striping and include all striping removal necessary to implement new striping as shown.

Turn lane storage shall reflect 95th percentile queues as determined in a queuing analysis, which shall be submitted with the striping plan.

3.6.7 Mailboxes

Mailboxes located within roadway right-of-way must obtain a right-of-way permit prior to installation. The City reviews the location to confirm clear vision does not conflict with bike facilities, vision, accessibility requirements, and utility avoidance. A developer and homeowner must work with the United States Postal System for location and installation specifications. New subdivision developments must not install individual mail boxes but rather cluster box units.

Foundations and support structures of individual and cluster postal delivery boxes shall meet the current AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, with interim revisions."

The mailbox shall be firmly secured to the post to ensure that the impact of a vehicle does not loosen the box which could then become a flying object hazard.

Mailboxes shall not require that users cross an arterial or collector roadway. Mailboxes shall be located on the users side of arterial and collector roadways. Where feasible locate mailboxes near fire hydrants, where parking is already limited, to reduce the conflict between parked vehicles and mail pick up. (There is no state law or city code that prohibits parking in front of mail boxes.)

For all new and reconstructed roadway projects, rural delivery mailbox styles shall be considered for consolidation into cluster postal delivery boxes.

The location of cluster postal delivery boxes shall be shown on the engineered plan submittal drawings for review and approval. The United States Postal Service will approve the location of cluster postal delivery boxes.

An accessible pedestrian path of travel must be designed and constructed to the mailbox per PROWAG requirements.

An accessible pedestrian path of travel must be maintained on sidewalk/shared-use paths adjacent to cluster boxes per PROWAG standards.

Cluster postal delivery boxes shall not be located on arterial and collector streets, unless otherwise approved by the City Engineer. Their location shall be shifted to nearby and convenient local streets. When locating the cluster postal deliver box care should be taken to locate it in an area that minimizes impact on abutting properties.

The back edge of the sidewalk/shared-use path shall smoothly meander back from the central delivery mailbox station to provide a 5-foot wide unobstructed pathway. The edge of the mailbox shall comply with Clear Zone requirements.

3.6.8 Illumination

Street lights (luminaires) are required at all street intersections with collectors and arterials, including private street intersections with collectors and arterials. Lights must be placed to illuminate the arterial/collector crossing, not the local street. This requirement does not extend to alley intersections. Enhanced crosswalks (marked, signed at a minimum) including mid-block crosswalks shall be illuminated on both approaches

At crossings, a luminaire will be installed a half to one luminaire pole height distance before the crossing. Typical luminaire mounting height is 28 feet. Luminaires should not be placed directly over the crossing, rather, before the crossing to provide front lighting unless otherwise approved.

Luminaire shields are not typically installed on City lights unless the luminaire impacts a residence.

Requests for street lights at other locations shall be reviewed in conformance with the Transportation Division's Standard Operating Procedure and installed only with City Engineer approval.

Separate street lighting plans are not required for most projects although proposed street lights shall be shown on plan and profile or utility sheets. Plans must include the following:

- Proposed pole locations shall comply with the City's Roadside Safety requirements
- Power supply shall be provided via underground wiring and conduit systems conforming to power company requirements
- Fixtures shall be cut-off fixtures to minimize light pollution and up-lighting
- Light poles and fixtures shall be approved and maintained by the power company

Street lights in the City of Bend are operated and maintained by either Pacific Power Corp or Central Electric Cooperative in accordance with the City's franchise agreements. Lighting infrastructure shall be per the appropriate agencies requirements. While there are some existing street lights operated and maintained by the City of Bend, all new lights must be owned and maintained by one of the power companies.

On private development projects, all costs of installation shall be borne by the developer for installation. The City will pay for ongoing power and maintenance expenses for public street lighting. Ongoing expenses for private street lighting (including power costs) shall be borne by the developer or homeowner's association.

Decorative lighting and solar lighting within City right-of-way will not be permitted without special approval and maintenance agreements signed by the City Engineer and approved by the TMD Director.

3.6.9 Drainage

Roadways shall comply with the storm drainage requirements of 6 - Stormwater.

The standard drainage inlet feature for arterials and collectors shall be curb inlet when bike lanes are present.

Where roadway grades exceed 6%, drainage systems must be reviewed to ensure stormwater is not bypassing catch basins.

3.6.10 On-Street Parking

On-street parking shall be designed to accommodate parking parallel to the curb. There may be instances when head in or back in angle parking is desirable. The City will consider these instances on a case-by-case basis, usually only permitted at locations to service a park or trail head where traffic volumes are low. Backing into traffic should be avoided whenever possible to avoid vehicular conflicts with multi-modal and other vehicles using the street corridor. Where on-street parking is striped, accessible parking must be considered and accounted for within the right-of-way.

Where parking is permitted on arterial or collector streets, as classified by the City's TSP, per the Bend Development Code, parking permitted must be located outside of permitted clear vision areas or where intersection sight distance is provided for the speed limit. Curb extensions are required at intersections to create parking bays and improve visibility of pedestrians.

Parking bays on arterial and collector streets are limited to a maximum length of 220 feet as required to provide curb extensions at the end of the block and mid-block (depending on block length) to help define parking lane and to allow space for landscaping and utilities.

Where parking is adjacent to a bike lane, a parking separated bike lane configuration may be used. While supported, there is no standard detail for a parking separated bike lane since the design parameters vary based on location. Parking separated bike lane design will be reviewed on a case-by case basis by the City Engineer with consideration for the location (number of driveways, length and continuity of parking, etc.), the transition of the bike lane through the intersection, and other applicable factors.

3.6.11 Traffic Calming Devices

Traffic calming devices in the context of the standards, means specific traffic calming devices designed to restrict travel speeds over, or through, a specific location and reduce volumes. Traffic calming devices include neighborhood traffic circles (which are very specifically not roundabouts), speed humps, raised pedestrian crossings, curb extensions, and other items noted in the following tables. Within the context of this document, traffic calming devices are not medians, roundabouts, signals, stop signs or crosswalks as these are typical operational or cross-sectional elements of roadway design.

City standards provide for arterial and collector roadway designs that are reflective of their abutting land use zoning and are designed to serve their surrounding context. The installation of traffic calming devices, other than those listed in Table 1 below, are not allowed on arterial and collector roadways due to their negative impacts on emergency vehicle routing, maintenance issues, and truck circulation issues.

The standard local street cross sections provide a hierarchy of local streets with narrower widths to encourage travel at slower speeds. New local street systems shall be designed to provide connectivity without creating long straight streets that facilitate higher speeds or direct short-cut connections between arterial and collector streets. Where geometric and site design constraints limit alternate options on new designs or reconstructions, traffic calming may be approved by the City Engineer. Traffic calming devices should not be used on local industrial streets.

Table 1 – the following traffic calming tools may be used on all streets except local industrial:

1) Curb extensions – may be used on streets with parking or wider travel lane sections to narrow the travel width, reduce the crossing distance, and increase pedestrian visibility. Curb extensions must provide a minimum 22-foot travel width on local streets and the minimum standard cross-section width including bike lanes and buffer on arterial and collector streets. Curb extensions must be designed to provide the required curb radius and serve the specified design vehicles.

2) On-street parking modifications – parking bays or lanes may be added to wide streets per the dimensions on the standard street sections. Where one-sided parking exists on local streets, alternate parking layouts can be used.

3) Additional landscaping or vertical elements to narrow the field of vision – except where restricted for clear vision, sight distance, sign visibility, additional street side vertical elements may be added to narrow the view corridor such as landscaping, fencing or other treatments approved by the City Engineer. This may include landscaping or art in traffic circles and roundabouts.

4) Narrowing wider travel lanes to standard widths - 11-foot minimum travel lanes on arterial or collector streets, local street widths may be narrower per standard cross-sections (note that 10-foot minimum travel lanes may be used for short segments, typically less than 100 feet, on arterial or collector streets to accommodate an enhanced crossing island on an existing street that includes a one and a one half foot shy line on each side).

5) Centerline treatments – islands/medians, traffic circles, mini/urban roundabouts or roundabout. See design criteria for each element in other sections of these standards.

The following traffic calming elements may only be considered on local street sections that are part of the low stress network, have an uncontrolled length in excess of three blocks, vehicle volumes over 400 Average Daily Traffic (ADT), and 85th percentile speeds more than 5 mph over the posted speed limit.

Table 2 – traffic calming on certain local streets

1) Travel path narrowing (chicanes) - raised curb islands or center medians may be used to narrow travel path widths to standard widths for the local street type; parking may be removed for short segments on one or both sides in order to create travel path narrowing using raised islands or medians

2) Speed humps (Standard Drawing R-32) - speed humps are one tool that may be used on designated greenways to reduce vehicle speed and volumes as part of the greenway corridor construction. Speed humps may be considered on existing streets designated as greenways where volume counts are more than 1,000 vehicles per day and 85th percentile speeds less than 30 miles per hour (greenways are typically posted with 20 mph speed limits). Speed hump design shall include:

    a. 400-foot spacing along all or target portions of the route.

    b. Locate speed humps more than 50 feet away from an intersection and 10 feet minimum to either side of a driveway or alley

    c. Speed hump design must accommodate and not adversely impact storm water drainage

    d. Where installed on a street with no sidewalk, speed humps extents must be designed to allow a minimum 4-foot accessible passage on each side of the street. In this case, parking must also be restricted for 10 feet on either side of the speed hump to allow access to the accessible way.

3) Alternating parking – where parking is provided on one side, it may be alternated to create a chicane effect. The side selected for parking should favor the side with more curb line (i.e., fewer driveways and more parking spaces) as feasible.

Table 3 – the following traffic calming tools may be used on all local streets

Raised crosswalk (Standard Drawing R-33) - raised crosswalks may be constructed at the primary local street crossing on the main walking route to access a school (the area of the school property where the primary student entrance is located) and may be required when the local street is a residential connector (the main through street) or higher type local street

Traffic calming can be an effective tool when an area has only one longer and/or wider street with higher speeds and volumes. Where more than one street in an area has been identified with speeding issues or serves the same through route, a traffic evaluation is required to develop a systematic installation such that construction of traffic calming on

one street does not push the issue to an adjacent street. A traffic evaluation may be required in other areas where there is potential for shifting traffic to create similar impacts on adjacent local streets. The traffic evaluation scope will be confirmed by the City Engineer and will include pre and post traffic and speed counts, estimated traffic on adjacent routes, and a systematic traffic calming design recommendation.

All traffic calming devices require fire department review and approval of the City Engineer. Traffic calming will generally not be permitted on primary access routes to hospital or medical facilities.

3.6.12 Railroad Crossings

All new or reconstructed rail crossings shall be built to Federal Rail Administration standards and approved as quiet zones.

3.7 Temporary Traffic Control

The primary function of temporary traffic control is to provide safe and efficient movement of all road users through or around work zones while protecting those within the work zone. The City requires temporary traffic control, based on a City-approved Traffic Control Plan, for all improvement projects, public or private, performed within, or impacting travel on, public right-of-way.

Traffic Control Plans (TCP's) shall be provided for review with the ROW permit submittal.

All traffic control shall comply with the current edition of the Oregon Temporary Traffic Control Handbook, where traffic control is being implemented for three or fewer days.

Sidewalk/shared-use path and bikeways shall be made accessible at all times during construction. When the traffic control exceeds the "temporary traffic control" of three or fewer days, a pedestrian path or approved detour shall be implemented. Sidewalk/shared-use paths may be detoured around the construction site if the detour route exists in complains with ADA/PROWAG requirements. Pedestrian and bike detours should be at the same level of traffic stress or better than the existing route without creating excessive out of direction travel.

Traffic Control Plans shall be developed according to the following:

TCP's must be in substantial compliance with:

- The Manual on Uniform Traffic Control Devices (MUTCD), current edition; Chapter 6

The Oregon Supplements to the MUTCD

- The Oregon Temporary Traffic Control Handbook for Operations of Three Days or Less (OTTCH), when applicable

Additional Resources:

- ODOT Standard Drawings, TM 800 series – contains additional information and details for traffic control scenarios not found in the OTTCH

Non-project related TCP's need not be CAD-drawn, but must be legible and scaled or dimensioned to clearly indicate relevant spacings and distances. Figures from the references listed in this section may be utilized whenever applicable, and customized as necessary. At a minimum, TCP's must show the following:

- Existing features within 300 feet of the work area (# of lanes, turn lanes or medians, bike lanes, sidewalk/shared-use paths, stop signs, traffic signals). (Extend to 500 feet if work area is within 500 feet of a traffic signal.)

- All proposed Traffic Control Devices, including signs, cones/tubular markers, barrels, barricades, etc. Identify devices by MUTCD types or Legends/Colors, and size.

- Posted speed. Work zone area component lengths and device spacings are dependent upon prevailing speeds of area traffic. Speed signs for speeds less than the permanently posted or statutory speeds may only be implemented with a Temporary Speed Zone Reduction approved by the City Engineer.

- Spacing of all Traffic Control Devices. See Chapter 2.3 of the Oregon Temporary Traffic Control Handbook

- Lengths of the Temporary Traffic Control Zone Area components, including the Advance Warning Area, Transition Area, Activity Area (Buffer Zone + Work Zone), and Termination Area. See Chapter 2.1 of the Oregon Temporary Traffic Control Handbook or Section 6C of the MUTCD for required lengths

- Proximity to nearest intersection. Site specific drawings are required for all work zones within 500 feet of a signalized intersection. Note that Oregon law prohibits flagging through an operating traffic signal (except for uniformed traffic control officers). Lane reductions through an operational, signalized intersection may be permitted on multi-lane facilities.

- Accommodations for non-motorized vehicles and pedestrians within a work zone must be provided – see Chapter 1.6 of the OTTCH. A minimum 4-foot wide path of travel must be maintained on all pedestrian or bicycle ways left open to users. Closures of pedestrian ways and bicycle lanes must be clearly indicated, and users diverted upstream at appropriate locations. Signs used shall be MUTCD compliant.

- Existing traffic control devices, including stop signs and traffic signals, within 300 feet of the work area. Detour signing must show each proposed sign, and include signing adequate to direct motorists through the complete detour route and back to the original roadway. Detours shall be used only with an approved Street Closure Permit approved by the City Manager.

Modifications to approved traffic control shall be made during construction, if deemed necessary and directed by the City Engineer.

Temporary Traffic Signals - Plans for temporary traffic signals shall include the same information required for permanent installations.

Traffic Signal Removal Plan/Traffic Signal Staging Plan – such plans, when deemed necessary by the City, shall be prepared in the same format and including the same information referenced above.

3.8 Pavement Restoration Requirements

3.8.1 Grades

The City of Bend establishes a "Grade" based pavement cut standards system developed on the date of construction, the last qualifying pavement treatment applied and the Pavement Condition Index (PCI) rating of a pavement. These standards will be in effect for any City roadway from initial construction or from the time the most recent qualifying pavement treatment was applied. The PCI and road classification (Arterial, Collector or Local road) will determine which Grade must be used.

Qualifying pavement treatments include the following but are not limited to: mill and overlay, removal and replacement, thin lift overlay, large area patches half a block in length, and half a lane in width or full street reconstruction. Slurry seals, chip seals, and fog seals are not considered qualifying pavement treatments; they are considered a maintenance treatment.

Grade 1 - Pavement Cut Restriction Standard (PCI 100-60, qualifying pavement treatments < 5 years): Pavement cuts will only be allowed on an emergency basis or through the waiver process defined in Part I - Section 2. No planned or permitted cuts will be allowed when these standards apply. If pavement cutting is necessary for emergencies, pavement restoration will be curb-to-curb for 30 feet centered over improvements.

Grade 2 – Full Standard (PCI 100-60, qualifying pavement treatments > 5 years): Pavement cuts must be full depth and extend 12 inches beyond the nominal trench edge longitudinally and transversely (Standard Drawing R-11) and be the width of the roller plus two inches, four-foot minimum width. Pavement cuts must be at lane or skip line. Transverse trenches (perpendicular to the centerline) constructed with less than 10-foot separation between cut lines shall be patched as one patch incorporating both trenches. If three or more transverse trenches are within one pavement section or block, all three trenches shall be patched as one patch.

Restoration must extend from one of the following depending on how far the trench extends into the roadway:

- Curb-to-fog/bike lane line (5-7 feet from curb)
- Curb-to-centerline (if cut is past fog/bike lane line)
- Curb-to-curb (if past centerline)

Grade 3 - Modified Standard (PCI 59-40): Pavement cuts must be full depth and extend 12 inches beyond the nominal trench edge longitudinally and transversely (Standard Drawing R-11) and be the width of the roller plus two inches, four-foot minimum width. Pavement cuts must be at the lane line, skip line, or center of travel lane. Transverse

trenches (perpendicular to the centerline) constructed with less than 10-foot separation between cut lines shall be patched as one patch incorporating both trenches.

Restoration must extend from one of the following depending on how far the trench extends into the roadway:

- Curb-to-fog/bike lane line (5-7 feet from curb);
- Fog/bike lane line to center of travel lane
- Center of travel lane to centerline
- Fog/bike lane line to centerline
- Curb-to-curb (if past centerline)

All pavement restoration must be shown on the permit plans and approved prior to construction. Half lane improvement are on a case-by-case basis and as approved.

T-Cut Standard (PCI 39-0): Pavement cuts must be full depth and extend 12 inches beyond the nominal trench edge longitudinally and transversely (Standard Drawing R-11 and be the width of the roller plus two inches, four-foot minimum width.

Applicable standards based on Grade (number of years since last qualifying pavement treatment) and City Street Classification is established in the following table:

TABLE 1- RESTORATION REQUIREMENTS BY CLASSIFICATION AND TIER

Classification	PCI 100 - 60 < 5 years	PCI 100-60	PCI 60-40	PCI 40 - 0
Local	Grade 1	Grade 2	Grade 3	T - Cut
Collector	Grade 1	Grade 2	Grade 3	Grade 3
Arterial	Grade 1	Grade 2	Grade 2	Grade 3

Grade 1 - Pavement Cut Restriction Standard

Grade 2 - Full Standard

Grade 3 - Modified Standard; T - Cut Standard (ACP Only)

Note: Proposals to deviate from the standards described above may be allowed at the discretion of the City Engineer and will require approval in advance by the City Engineer. See 3.8.8 - Pavement Cut Restriction (Exception Process) for the exemption process. During the permit review process, the City Engineer will determine the applicable standard based on the above table.

3.8.2 Permits

As part of obtaining a Right-of-Way permit per Bend Code Chapter 3.40, Permittee must submit a complete application to Community Development Department for review and approval. A Right-of-Way application is available on the City website. The City Engineer will determine the restoration requirements in accordance with these Standards. The Permittee must provide the City Engineer at least 24 hours' notice prior to completing final restoration to allow for inspection. The Permittee shall notify the City within 48 hours after completion of the work (Bend Code Chapter 3.40.025). Warranty period will not begin unless the final inspection has been completed. Permittee is responsible for all work until the permit is closed and the warranty period begins.

If the City Engineer determines, in the City Engineer's discretion, that previous violations of these Standards exist, future construction work may be disallowed until the Permittee has fulfilled all obligations. Written notification by the City Engineer will be sent prior to this action.

3.8.3 Responsible Party

The Permittee shall be responsible for all construction and warranty requirements of these standards even when the work is done by a Permittee-retained contractor.

3.8.4 General Requirements

Materials must comply with the City of Bend Standards and Specifications.

a. All patching materials and construction requirements not addressed in this document must conform to the Specification Section 00744 – Asphalt Concrete Pavement.

b. To the extent Controlled Low Strength Material (CLSM aka CDF) is required for a particular repair, the Permittee must follow Specification Section 00442 – Controlled Low Strength Materials.

3.8.5 Pavement Sections

Pavement sections must meet the pavement design standards in 11.4 - Pavement Design and comply with the cross sections in the Standard Drawings, or as specified in a stamped geotechnical report as approved by the City Engineer.

3.8.6 Full, Modified, and T-Cut Patching Standards

Patching must comply with the following standards:

a. Longitudinal cuts that extend through multiple grade classifications require discussion with the City Engineer to determine the appropriate patching approach. In principle, each road section will be patched according to the applicable standard and grade in which it is ranked, however, the City retains the right to require a higher level grade at its discretion.

b. For all full depth asphalt repairs on local roads, the minimum asphalt thickness shall be 4 inches, or match the existing depth of asphalt, whichever is greater

c. Existing base rock disturbed within full depth asphalt repairs must be re-compacted prior to paving. For trench backfill requirements, see Standard Drawing R-10

d. All cold-planed surfaces must be swept and kept clean at all times. All cold-planed materials must be removed and disposed off-site at the cost of the Permittee.

e. If a new patch adjoins an existing patch, the existing patch will need to be replaced up to 20 feet from the edge of the new patch. This will be on a case-by-case basis and will be at the discretion of the City Engineer.

f. If any part of the excavation, patch or damaged area intrudes into an adjacent lane, that lane must also be replaced

g. New patches adjacent to any existing patch must be combined into one patch if there is less than 4 feet separation

h. When two or more patches on the same project are constructed with less than 10-foot separation between cut lines shall be patched as one patch incorporating both trenches at the expense of the Permittee. The total number of street cuts should be kept to a minimum. If there are three or more street cuts within a block every effort must be made to combine all three into one patch. It is at the discretion of the City Engineer to determine the final pavement restoration limits of a project.

i. All restoration shall be shown on approved permit plans, otherwise the grade standards apply in full

j. Pavement cuts must be straight and clean and must be either parallel or perpendicular with respect to the travel lane. No jagged, broken or undermined edges will be allowed unless otherwise approved by the City Engineer.

~~j.~~k. Where saw cutting into concrete roadways, the entire concrete panel disturbed by the excavation must be removed and replaced to conform with original design specifications for the road. The City will refer to the design/asbuilt drawings to determine the concrete's structural section for replacement, including doweling and reinforcement requirements, where applicable, or as determined by the City Engineer.

~~k.~~l. All joints where new pavement meets existing pavement shall be sealed per Specification Section 00746 - Crack Sealing Flexible Pavements

~~l.~~m. Contractors must use ODOT approved release agents and tack when placing multiple lifts of ACP unless placing during the same shift

~~m.~~n. The top lift of asphalt for all longitudinal repairs with a length that exceeds 30 feet must be placed using a paving machine with a screed or an asphalt spreader box

~~n.~~o. The completed surface of all courses must be of uniform texture; smooth, uniform as to crown and grade and free from defects. Tolerance exceptions and corrective measures due to existing roadway conditions or other reasons must be approved by the City Engineer.

~~o.~~p. All areas outside of the travel lanes or shoulders that are affected by the work must be restored to their original condition

3.8.7 Pot Holing

~~3.8.7~~ Potholing to find utilities shall be exempt from patching requirements of these standards. To be exempt, it is preferred that all potholes are cut with a core/hole saw. If a larger asphalt pothole is required, the pavement cuts must be less than two (2) feet square with no joints in the wheel path, bike lane or sidewalk. Aggregate backfill and compaction, per the City's trenching standards, is preferred for larger potholes and excavations, with application of CLSM fill in small potholes where compaction cannot be performed. CLSM fill shall be placed twelve (12) inches above the utility to bottom of asphalt. Core coupons (removed asphalt or concrete circles), if not damaged, maybe grouted/epoxied back into the existing pavement with an approved method and material. Only core/hole saw pot holing is permitted in concrete roadways. Where potholes occur within concrete streets, the coupon must not exceed 8-inch diameter. The concrete core coupon must be retained and epoxied into the pothole. If the hole exceeds 8-inches or the coupon is damaged or disposed of, the entire concrete panel will be removed and replaced. Cuts or potholes within concrete sidewalks must have the damaged sidewalk panel removed and replaced. Pot holing outside of paved surfaces must conform to the City's trenching standards for backfill and compaction.

3.8.8 Traffic Control

Permittee must follow 3.7 - Temporary Traffic Control for all temporary traffic control.

3.8.9 Pavement Cut Restriction (Exception Process)

After any street has been constructed, reconstructed, paved or overlaid by the City, the pavement surface must not thereafter be cut or opened for a period of 5 years or as directed by the City Engineer or Director of Streets & Operations. It is understood that field conditions or emergencies may warrant an exception to this Policy. However, the exception process in NO WAY obligates the City to allow cutting or opening the Street Cut Restriction Street, and any such decisions are at the City's discretion.

A utility desiring to perform work in Street Cut Restriction streets must schedule a meeting with City staff prior to submittal of a permit application. If an exception is granted, the Private Development Engineering Department will make a concerted effort to protect the integrity of the pavement structure, and to ensure a high quality replacement patch or overlay. Additional restoration requirements and extended limits will apply.

When granting exceptions to this policy, the Streets Director or City Engineer may impose conditions determined appropriate to insure the rapid and complete restoration of the street and the surface paving.

Valve and manhole repairs are exempt from the patching requirements of these standards. Valve and manhole patching requirements are in accordance with City Standards. All warranty and construction requirements must be met. No longitudinal construction joints must be allowed in the wheel path.

Potholing to find utilities must be exempt from patching requirements of these standards. To be exempt, it is preferred that all potholes are cut with a core/hole saw. If a larger pot hole is required the pavement cuts must be less than 2-feet square with no joints in the

wheel path and must be backfilled with CLSM or other City approved fill from 12 inches above the utility to bottom of asphalt. Core holes must be hot patched in the existing pavement.

City capital improvement projects will be subject to testing and warranty requirements that are established under the applicable public procurement contracts.

An exception from the street cut restrictions standards may be granted if the City Engineer determines that impacts to vehicle, bicycle, and/or pedestrian traffic would negate the public benefit of this standard.

3.8.9.1 Exception Request

Permittee may seek an exception of these Standards as follows:

a. Permittee must submit an exception request to the City Engineer identifying the proposed project, the impact the project will have on the roadway, the timeline for completion and explaining how all alternative solutions including avoidance have been exhausted

b. A meeting with the City Engineer to discuss the project may be required and the City may request additional information

c. The City Engineer must accept or deny any such request. If a request is accepted, the City Engineer may attach conditions of approval that require additional restoration of the area affected and/or special inspections, the cost of which shall be borne by the Permittee.

3.8.10 Permits for Non-Street Cut Restriction Streets and Street Cut Restriction Streets with Approved Exception

No excavation or tunneling may be performed under any area within public rights-of-way prior to first obtaining the applicable permit from the City (permits for emergency work may be issued after the fact per this policy).

Applications for utility permits must be made on forms provided by the City. The applicant must describe the purpose, location, and size of the anticipated construction project (work), the name of the person/firm performing the actual work, and the name of the person/firm for whom the utility work is being performed. The application must be endorsed by the person/firm for whom the work is being performed or the person's/firm's agent. By signing the application, it is understood that the person/firm performing the utility work will comply with the requirements of this policy and any conditions imposed upon the work.

Depending on the impact to traffic, pedestrians, businesses or residents, public notification plans (signs, advertisements, flyers, public service announcement, etc.) may be necessary and submitted as part of the permit application. It is the responsibility of the permit applicant or the duly authorized representative to coordinate with all affected neighbors. A pedestrian detour route shall be clearly delineated whenever sidewalk/shared-use paths are obstructed.

Emergency utility or service lateral repair work necessary for the immediate preservation of life or property is acceptable; provided that any person making such emergency repair work they call for emergency locates. Permittee must notify the City Engineer of emergency repairs not later than the next business day. The ROW restoration for such emergency repairs must be in conformance with the criteria stated in this policy. Note, work necessary to locate faulting utilities, conduits or pipes during the emergency situation is considered part of the emergency repairs. Permittee must make every reasonable effort to restore the roadway quickly.

When the City Engineer determines that traffic conditions, safety or convenience of the public necessitates ROW utility or service lateral construction and repair be performed as quickly as possible, the City Engineer will require the Permittee to provide adequate personnel, equipment, and facilities on a 24-hour basis such that the utility or service lateral work be completed as soon as practicable. This may include, but is not limited to, flaggers, temporary traffic control signs and devices, lighting, etc. The Permittee must be responsible for the cost of providing the necessary personnel, equipment, and facilities.

If work is being performed within Highway 20 & 97 (including Parkway 3rd St and Greenwood), coordination with ODOT may be necessary and the applicant must comply with their requirements for all work solely in the ODOT jurisdiction. For any work in that is jointly permitted, the Utility/Permittee must provide a copy of the ODOT permit to in conjunction with the City's permit application.

3.8.11 Special Requirements for Concrete Roads

All concrete road cuts must be pre-approved before beginning work (except in the case of an emergency situation). Concrete roads must require full panel replacement unless approved otherwise by the City Engineer. All concrete joints must require an approved tie bar and dowel retrofit. Depth of concrete replacement must match the existing thickness or as directed by the City. Care must be made not to undermine the existing panels. If the adjacent panels are disturbed or damaged, they also must be replaced at the City Engineer's direction. All joints must be sealed with material approved by the City Engineer. Where concrete roads are overlaid with asphalt, the concrete must be replaced as described above and the asphalt portion of the cut must be constructed according to the pavement standard.

3.8.12 New Development

These standards are minimum standards applicable to all cuts made in existing roadways. For new development, additional requirements may apply. Contact the Community Development Department for specific additional requirements.

3.8.13 Temporary Pavement Restoration

Pavement must be restored with temporary patches before the road is reopened to traffic as defined below. The Permittee must maintain the temporary patch until the patch has been permanently restored. Gravel surfacing is not acceptable as a temporary patch.

An immediate patch may be used to open the roadway to traffic. Immediate patches may include the use of steel plates with signs or be a minimum of 2 inches thick cold mix asphalt on 2 inches thick crushed surfacing. Immediate patches will only be allowed while work is being completed and must be replaced with an interim or permanent patch within 7 days after placement. Steel plates must be pinned and ramped with cold mix asphalt. At the

direction of the City staff or City Engineer, Steel plates may not be used from November 1st to March 10th. Higher classification roads are on a case-by-case basis. Steel plates may only be used for less than 5 working days.

When a permanent patch cannot be completed within 7 days of an immediate patch, an interim patch must be used to keep the roadway open to traffic. Interim patches must be a minimum of 2 inches thick ACP on 2 inches thick crushed surfacing. Interim patches must be replaced with a final patch within 30 days after placement.

Material exceptions may be requested in the event that the ACP Plants have shut down for the season or at the discretion of the City Engineer. Material exception forms must be submitted with the final inspection. Permittee is responsible for making final restoration within 45 days of the ACP plants opening for the season or as directed by the City. Permittee must submit photo documentation, and street location of all street cuts with material exceptions 5 days prior to completing the work

3.8.14 Testing and Warranty Requirements

ACP testing must be in accordance with Bend Standards and Specifications. Patches greater than 8 feet in width will require density testing per the Bend Standards and Specifications. The City reserves the right to require density testing on a case-by-case basis if field observations indicate minimum compactive efforts are not being achieved as required in the Bend Standards and Specifications.

Pavement restoration on roadways under all pavement cut standards will have a minimum warranty period of one year and up to 2 years. The patch must be repaired if necessary until the warranty has passed.

All warranties will become void if the road receives a qualifying pavement treatment within the patching limits.

All warranty work requires that a City inspector be on site. The Permittee must be required to coordinate inspection with the City Engineer.

The following minimum defects identified by the City Engineer must be covered by warranty (but not limited to):

a. Sunken pavement patches greater than or equal to 1/4 inch (measured by a 12-foot straight edge)

b. Surface raveling or oxidation due to deficiencies with the asphalt material

c. Poor workmanship

d. Inadequate compaction per Bend Standards and Specifications

Notice of Repairs

e. If emergency repairs are needed due to safety concerns, the Permittee must immediately make such repairs and give notice to the City Engineer

f. For non-emergency repairs on arterial or collector streets, the Permittee has 48 hours in which to make such repairs from time of verbal notice by the City Engineer. For residential streets, the Permittee has up to 7 days to make such repairs.

g. The City may undertake the repairs if not completed within the specified timeframes above. The City Engineer must notify Permittee of non-compliance and Permittee must make all identified repairs within 2 business days of notification of noncompliance. Repairs involving public safety maybe made by the City without notice. Permittee will be assessed all costs associated with the City performed repairs, plus 15 percent overhead fees.

h. If repairs are made other than seam sealing to the warranted patch, a new warranty will be implemented for the new patch

3.8.15 No Dig/Trenchless Technology

To minimize damage to road surfaces and other surface infrastructure, implementation of no dig/trenchless technology is the preferred method for most utility work.

3.8.15.1 Trenchless Technology Plan Requirements

Applicants for work in the ROW planning to use trenchless technology must submit plans prepared by a qualified professional. Any qualified professional, as defined in this policy, experienced in trenchless utility installation may prepare plans for simple work. Typical “simple work” includes borings of 100 feet or less perpendicular to street alignment and borings of 200 feet or less parallel to road and sidewalk/shared-use path surfaces. For longer distances, the applicant must meet with Department staff to discuss the proposed operations. The City Engineer may require the plan to be prepared by a qualified registered civil engineer, geotechnical engineer or geological engineer licensed in the State of Oregon and require additional studies or information than those required for “simple work”. The plans for “simple work”, at a minimum, must address/consider the following:

a. The proposed bore path (bore plan and profile must be provided) should be planned to allow sufficient room from other utilities or structures for workers to perform maintenance or operations on adjacent utilities. There must be a 5-foot minimum horizontal and 18-inch vertical separation between the proposed utility and City sewers or as otherwise directed. However, additional separation may be required depending upon depth of new utility installation, environmental factors, and engineering conditions.

b. The locations of other utilities within or adjacent to the proposed bore path (within 5 feet) must be shown. Include proposed potholing locations

c. In preparing the plan, location of other structures such as manhole covers, valve box covers, meter boxes, telephone and cable television boxes, electrical transformers, conduit, or droplines from utility poles, pavement patches, previous locator markers, heating oil tanks, utility vaults, and sewer lateral cleanouts must be considered.

d. Include pavement restoration details (as needed) according to this policy. This includes repair of borehole entry pits and potholes.

3.8.15.2 Drilling Fluid Handling

The trenchless technology contractor must contain, handle, and dispose of drilling fluids in accordance with industry and Oregon Department of Environmental Quality standards. Excess drilling fluid must be confined in a containment pit at the entry and exit locations until recycled or removed from the site. Precautions must be taken to insure that drilling fluid does not enter roadways, streams, municipal storm or sanitary sewer lines, and/or any other drainage system or body of water. Unintended surfacing of drilling fluid must be contained at the point of discharge and recycled or removed from the site. Drilling fluids that are not recycled and reused must be removed from the site and disposed at an approved disposal site. Any damage as a result of using trenchless technologies is the sole responsibility of the Permittee.

3.8.15.3 Settlement/Heaving Monitoring

Trenchless technologies must be performed in a manner that will minimize the movement of the ground in front of, above, and surrounding the boring operation; and will minimize disturbance of the surface above and in the vicinity of the boring. The applicant must be responsible for the repair to City infrastructure resulting from heave or settlement caused by the use of the trenchless technology. All operations must stop immediately whenever a vertical change in elevation of ½ inch or more, or any surface disruption is observed. The Permittee must then immediately report the amount of settlement to the Engineering Inspector, Street Department or Utility Department.

3.8.15.4 Trenchless Technology Operations Guidelines

All construction work must be performed in accordance with City requirements and industry standards. The Permittee must ensure that all cleanup and restoration is in compliance with the City requirements for right-of-way restoration. In some cases determined by the Department, the Permittee will televise, in the presence of Department staff, the City stormwater and wastewater components within five feet parallel to boring activity or crossed by the boring activity.

3.8.15.5 Compliance

As part of the notice of noncompliance, the City Engineer will include a notice to comply within 5 working days or all future permits may be denied until the problems have been corrected. A meeting must be arranged with the City Engineer and a plan of action to prevent future noncompliance must be presented before issuance of any new permits.

Noncompliance Activities include:

a. Failure to obtain a permit

b. Failure to maintain temporary patches

c. Failure to make permanent repairs

d. Failure to make emergency repairs

e. Failure to make warranty repairs

f. Failure to inform the City of asphalt completion date

g. Failure to follow traffic control measures, as required

h. Failure to meet specified timeline for any repairs

3.9 Performance Bonding

Under the Bend Development Code Chapter 4.3.400.J, bonding/financial security is permitted in lieu of construction when approved by the City Engineer or as approved by a land use decision for a development. Bonding is typically allowed under the following situations:

1) Prior to occupancy/project completion (Performance bonds):

   a) Commercial and Industrial. All infrastructure (water, sewer, sidewalk/shared-use paths, streets, etc.) must be complete. During winter conditions, if approved by the City Engineer, must abide by the cold weather concrete standards and material exception processes apply. Bonding may be considered on a case-by-case basis for asphalt paving.

   b) Residential:

      i) Sidewalk/shared-use paths. Bonding will not be permitted for sidewalks/shared-use paths:

         (1) Along arterials or collectors

            i. Sidewalks/shared-use paths that abut mountable curb. ADA accessibility challenges usually exist at the transition between mountable curb and standard raised curb and because of the thickened sidewalk/shared-use path section requirements.

         (2) Accessible curb ramps are to be installed and are not permitted to be bonded

      ii) Driveway aprons. Driveway aprons must be constructed prior to occupancy of a residential dwellings. Bonding for driveway aprons will not be permitted unless approved by the City Engineer under a material exception due to extreme weather conditions.

   c) Work within an arterial / collector. At time of land use or right-of-way permit review the City Engineer may determine bonding be required for work being performed within an existing arterial / collector street. In these situations, notice to proceed may not be provided until the bond is placed with the City.

   d) Street trees. Bonding for street trees is at the Planning Department's discretion. Unless otherwise approved by the Planning Department Manager, trees are only to be bonded when ground is frozen.

Construction documents and record drawings must clearly identify which sidewalks/shared-use paths are being installed and which are being bonded.

4 Sanitary Sewer Systems

Minimum design standards for sewer facilities are defined by the Oregon Department of Environmental Quality (DEQ) regulations as detailed in the appropriate OAR, Division 52. City of Bend Design Standards may be more stringent. In cases where the City of Bend Standards are different from the requirements specified by DEQ, the City of Bend Design Standards will be used. In cases where the City of Bend lacks a design standard, designers shall refer to OAR Division 52, Appendix A – Sewer Pipelines, and OAR Division 52, Appendix B – Raw Sewage Lift Stations, for detailed criteria.

The City of Bend requires gravity sewers. The City has made this requirement due to the expense of long term operational and maintenance costs associated with non-gravity sewer systems. This has been evaluated in the City's Collection System Master Plan (CSMP) and will continue to be evaluated in future updates of the CSMP. In places where a gravity solution is not possible, two solutions exist, pressure sewers, and a regional pump station with force main. Regional pump stations will be determined through the City's CSMP. Where a regional pump station is defined in the CSMP, all sewer flowing to the wet well will be by gravity. No pumping from one pump station to another pump station will be allowed. In addition, no lines or pump stations will be allowed to connect to the discharge line (force main) of any City owned pump station, until the first manhole at which force main line becomes a gravity flow line.

Pressure sewers may be proposed as an alternative. Pressure sewers are defined as an area where each lot is served with a privately owned, operated, and maintained sewer pump that feeds to a pressure line in the public right-of-way. No City-owned or operated pump stations will be connected to a pressure sewer system. Each pressure sewer will be evaluated on a case-by-case basis by the City Engineer or designee. Pressure sewers are not allowed to connect to the discharge line of any City-owned pump station and the City is only responsible for the main line that individual pressure pumps connect to. Multiple lots are not allowed to be served by a single pump station on a pressure sewer system, therefore each lot is required to have its own privately owned and operated pressure pump. The City is not responsible for any maintenance or operation of any privately owned pump station. When determining if a gravity system is not possible, the City will consider the long term operational and maintenance costs associated with any pressure sewer solution.

Additional flow into the City sewer system is not permitted where the system has no capacity. Capacity is defined as having the ability to adequately convey additional sewer flow during peak flow periods without violating criteria for surcharge, wet well capacity, or velocity. Distance from a municipal sewer line that has capacity is not a limitation on providing service. If, and only if, the City lacks capacity to provide sewer service to any development, the property owner can elect to consider on-site treatment and disposal for interim sewer needs until city sewer capacity is available. On-site treatment includes, but is not necessarily limited to, traditional septic tanks and leach fields or advanced treatment systems such as membrane technology. The process selected for treatment must be approved by the City of Bend, Deschutes County and DEQ, and shall comply with local, state, and federal laws and regulations. On-site treatment is allowed only after the City Engineer determines in writing that the City's sewer system lacks capacity to provide sewer when the property owner needs the service.

Any system that is designed to treat and dispose of sewer on-site must be designed to be connected to City sewer at a later date. In addition, any on-site treatment system owner will be required to enter into an agreement with the City that clearly identifies the owner's responsibility to maintain and operate the facility. The agreement will also provide that the City is not required to maintain or operate these systems and that should they fail, the land owner is responsible for any necessary repairs or requirements to satisfy State and Federal law even if the laws have been amended since contract initiation with the City. Any federal and/or state permits to operate an on-site system shall be included as an attachment to the agreement. The agreement shall be recorded against the subject property and shall remain in effect even if the property is transferred. The City may elect that a trust, contract to operate the system, or similar permanent financial mechanism, be established to cover repair and maintenance costs for the system to remain in compliance for perpetuity.

Approval for use of any alternative to gravity sewer shall be requested through the waiver process identified in Part I - Section 2 - Change Process.

All design calculations and studies of wastewater conveyance systems shall be submitted in an organized, legible, and professional form for review. These calculations, bearing the signature and stamp of a registered professional engineer, shall also include a thorough list of assumptions used in making the calculations. Submittals that are not legible, poorly organized, are inaccurate in the assumptions for the calculations, or are otherwise not in accordance with submittal requirements will be returned to the applicant for correction and re-submittal. Any work done on City sewer lines requires a Right-of-Way (ROW) permit.

4.1 Sewer Main

Sewer facilities shall be designed using alignments in public rights-of-way. Sanitary sewer mains shall be located within frontage streets rather than alleys unless approved by the City Engineer. Sewer mains shall be located as close to the roadway centerline as possible or centered within the right-of-way when no roadway exists. Sewers on curved roadways may vary from the centerline to minimize the use of manholes; however, the manholes themselves shall be located as close to the roadway centerline as possible. On narrow streets, 32-foot curb-to-curb width or narrower, locate the manholes in the center of the travel lane, typically 5 to 6 feet from the roadway centerline.

All sewer improvements shall terminate at a sewer manhole. Stubbing sewer pipe for future extension will be permitted for approved multi-phased, master planned developments only where approved by the City Engineer.

Sewers shall maintain a minimum 10-foot horizontal separation from all water mains and water services.

Franchise utilities shall maintain a 10-foot horizontal separation, and 12-inch vertical separation from sewer mains. For sewer services, the horizontal separation may be reduced to 2 feet. 6-inch vertical separation from franchise utilities may be granted on a case-by-case basis.

Ninety degree fittings for sewer mains are not permitted, unless otherwise specified.

Public sewer mains shall not be extended onto private property, even within an easement, unless it is done to serve multiple properties. Where sewer needs to be extended onto

private property to service a single property or use, a private service will be extended in accordance with all applicable state building/plumbing codes.

Sewer mains within private property, outside City of Bend right-of-way, shall be within a recorded sewer easement not less than 20 feet wide, with the pipe centered in the easement. Additional easement width may be required as determined by sewer depth and topographic conditions, as determined by the City Engineer.

Sewer mains that are unused and that have no approved current or future anticipated use shall be removed from the right of way or abandoned in place per Section 4.1.18. Sewer mains within City sewer easement, on private property, are preferred to be removed but can be abandoned in place, with approval from the City Engineer, provided the sewer easement is extinguished.~~Sewer mains that are unused shall be removed from the right-of-way. Sewer mains within City sewer easement, on private property, are preferred to be removed but can be abandoned in place, with approval from the City Engineer, provided the sewer easement is extinguished.~~

4.1.1 Depth

Minimum cover from finished grade to the outside top of the pipe for all sewer lines, except sewer services, shall be 36 inches. If conditions do not allow for a 36-inch depth consideration will be given from the City of Bend on a case-by-case basis.

4.1.2 Minimum Diameter

For gravity sewer mains, the minimum inside diameter shall be 8 inches, unless otherwise approved by the City Engineer. Minimum size for pressure collection system lines shall be 4 inches, unless otherwise approved by the City Engineer.

4.1.3 Flow Calculation

Average sanitary sewage flows shall be calculated using the most current land use zoning, and applying the unit rates shown in Table 4-1.

Flows generated by unusual land uses such as institutional or heavy industrial shall be based on actual (preferred) or estimated water consumption records. Estimates must be based on either an industry standard, or water consumption from a similar use.

Projected flows for a development are based on the Collection Sewer Master Plan (CSMP) and Equivalent Dwelling Units (EDUs). Any subdivision building or proposing a community swimming pool that is connected to a sewer lift station shall be required to provide flow calculations and general information pertaining to volumes being discharged into the City's collection system for cleaning purposes. Additionally, there shall be a requirement to mandate this procedure being done during off peak hours. Furthermore, the pool maintenance staff shall be required to notify the City Collections staff prior to performing this work.

TABLE 4-1

Basis for Sanitary Sewage Flow Estimation

Land Use	Average Daily Flow
Residential	130 Gallons / Unit / Day
Non-Residential	427 Gallons / Acre / Day
School	347 Gallons / Acre / Day
Medical District Overlay	490 Gallons / Acre / Day
OSU-Cascades	490 Gallons / Acres / Day
Central Business District	185 Gallons / Unit / Day

Equivalent Dwelling Unit Calculations for known site conditions
130 Gallons / EDU / Day

Residential Use	
Single Family Dwelling	1 EDU
Two Family or Duplex Unit	2 EDU
Multi-Family	0.8 EDU / unit

Institutional Use	
Schools	
Kindergarten	0.05 EDU / person
Elementary	0.08 EDU / person
Junior & Senior	0.10 EDU / person
College	0.15 EDU / student
Nursing Home	0.65 EDU / bed
Hospital	0.75 EDU / bed
Library	1 EDU

Commercial Use	
Retail	1.0 EDU for first 2,000 SF floor area 0.5 EDU / Each additional 2,000 SF
Service & Repair Shop	1.0 EDU for first 1,800 SF floor area 0.5 EDU / Each additional 18,000 SF
Bank & Office	1 EDU / 2,000 SF
Medical, Dental, Veterinary	1.0 EDU / 1,000 SF floor area
Restaurant	1.0 EDU / 600 SF
Automobile service station	2 EDU
Barber Shop	0.30 EDU / Chair
Beauty Shop	0.38 EDU / Chair
Industrial, Manufacturing, Beverage Processor & Commercial Warehouse	0.09 EDU / person
Commercial laundry	2.58 EDU / 1000 Gallons of water use
Laundromat	1 EDU / machine
Theater	0.009 EDU / seat
Parks with restroom	1 EDU
Stadium	2 EDU
Swimming Pool	6 EDU
Dry Cleaners	3.10 EDU / 1,000 SF floor area
Recreational Roller Rink, Dance Hall	0.27 EDU / 1,000 SF floor area
Spa & Athletic facilities	6.67 EDU / 1,000 SF floor area
Armory	1 EDU
Carwash	1.17 EDU / wash stall
Pet Grooming	0.67 EDU / 1,000 SF floor area
Motel, Dormitories	0.40 EDU / room

4.1.4 Peak Factor (Domestic Flows Only)

Sanitary sewage design flows are calculated by applying a peaking factor to the average daily flow. This is done by accumulating flows from the upper reaches of the system and multiplying the accumulated average daily flow at specific nodes.

Apply the following peaking factors to obtain the design peak flow at that point:

Average Domestic Flow	Peaking Factor
< 1.0 mgd	3.0
1.0 – 2.5 mgd	2.5
2.5 – 5.0 mgd	2.25
> 5.0 mgd	2.0

Peaking flows for large institutional, commercial, or heavy industrial point sources shall be determined by analysis by a qualified professional engineer and require approval by the City Engineer, or designee.

Flow calculations shall be based on Manning's equation using the following values for n:

Pipe Material	Mannings 'n'
PVC pipe	0.011
HDPE pipe	0.015

4.1.5 Line Diameter and Velocity

Line diameters shall be computed using the procedures above to calculate the peak flow and selecting a diameter that will flow eighty percent full at that peak design flow [sewage depth/inside diameter (d/D >= 0.8)]. For example:

- A 6-inch line @ 0.006 ft/ft minimum grade flowing half full = 115.3 gpm
- An 8-inch line @ 0.004 ft/ft minimum grade flowing half full = 202.7 gpm

Slopes and diameters for gravity sewers shall be designed to maintain a minimum velocity of 2 feet per second (fps) at the average daily flow rate. However, no design shall ever exceed 8 fps, to ensure the liquids do not surpass the solids.

4.1.6 Minimum Grade (Gravity)

Designers shall use the following minimum grades (based on PVC Manning's n=0.011, velocity 2 fps at 50 percent flowing full). Reference OAR 340 Division 52 for additional information:

Pipe Inner Diameter (inches)	Slope (feet per 100 feet)
4	1.5 min, 2 typ
6	0.75
8	0.40
10	0.25
12	0.19
16	0.14
18	0.11
21	0.09
24	0.08
30	0.06

4.1.7 Inverted Siphons

Inverted siphons shall not be permitted. If there are no practical alternatives for gravity sewer service without a siphon the designer may request a waiver using the process described in Part I - Section 2 - Change Process.

4.1.8 Flows in Pressure Sewers

Flow calculations for pressure systems shall be based on the Hazen and William's equation using the following value for *C*:

Material	C Value
PVC	135

4.1.9 Minimum Velocity

Line diameters for pressure sewers and force mains shall be selected to maintain a minimum velocity of 3 fps at the minimum pumping flow rate for variable flow pumps.

4.1.10 Maximum Velocity

Maximum velocity along any point in pressure sewers, including force mains, shall be 8 fps.

4.1.11 Pressure Sewer Appurtenances

Pressure sewers and force mains shall be designed with a constant downstream elevation rise, with the discharge being the highest point in the line. Pumping downhill (the discharge elevation being lower than the pump elevation) is not allowed. Variable grades shall require a waiver as described in Part I - Section 2 - Change Process for any pressure sewer of force main that is unable to achieve a constant downstream rise. In cases where a waiver is granted for maintaining a constant downstream rise, designers shall include

air release/vacuum relief devices at high points and cleanout facilities on pressure sewer or force mains over 500 feet long.

All air or air/vacuum relief valves shall be provided with freeze protection including insulated enclosures and designed by a professional engineer. Designers shall assume -10 °F sustained outside temperature. Design calculations for air release valves shall be submitted with the plans.

4.1.12 Waterline Crossings

Sanitary sewer line and water line crossings shall be designed per OAR 333-061-0050 and/or AWWA standards, whichever is most stringent.

In situations involving a water and non-potable water or lateral crossings, the separation between the two shall be as follows (all non-potable lines shall be treated as “sewer” lines as described in OAR 333-061-0050):

- A water and non-potable water crossing shall always be perpendicular unless otherwise approved by the City Engineer.

- Whenever possible, the bottom of the water lines shall be 1.5 feet or more above the top of the non-potable line. Where the crossing occurs, the water shall have one full length of water pipe centered at the non-potable crossing.

- Where the water line crosses over the non-potable line but with a clearance less than 1.5 feet, the non-potable line shall be exposed to the non-potable pipe joints on both sides of the crossing to permit examination of the non-potable pipe. The examination shall be conducted by the City’s Inspector/Public Works and the project’s Engineer of Record to verify the condition of the non-potable pipe. If the non-potable pipe is in good condition and there is no evidence of leakage, the 1.5-foot separation may be reduced to not less than 6 inches. However, in this situation, the contractor must center one full stick of water pipe at the crossing. The Engineer of Record must prepare a written report of the findings and indicate the reasons for reducing the separation. If the contractor and Engineer of Record determines that the conditions are not favorable or finds evidence of leakage from the non-potable line, the non-potable line shall be replaced with a full length of pipe centered at the crossing point. The pipe shall be AWWA C900 or other pipe material as approved by the City Engineer. As approved by public works and the City Engineer, under the OAR’s the non-potable pipe can be encased in a reinforced concrete jacket for a distance of 10 feet on both sides of the crossing. This is not a permitted practice unless there are no other options and is approved by the City Engineer.

- Where the water line crosses under the non-potable line, the contractor shall expose the non-potable line to the nearest joints on both sides of the crossing to permit examination of the non-potable pipe. The examination shall be conducted by the City’s Inspector/Public Works and the project’s Engineer of Record to verify the condition of the non-potable pipe. If conditions are favorable and there is no evidence of leakage from the non-potable line, the non-potable line may be left in place, but special precautions must be taken to assure that the backfill material over the water line in the vicinity of the crossing is thoroughly tamped in order to prevent settlement which could result in the leakage of non-potable water. In this situation, the contractor must center one length of the water line at the crossing and the

Engineer of Record must prepare a written report recording the manner in which the non-potable line was supported at the crossing and the material and methods used in backfilling and tamping to prevent settlement of the non-potable line. If the contractor and Engineer of Record determines that the conditions are not favorable or finds evidence of leakage from the non-potable line, the non-potable pipe shall be replaced with a full length of pipe centered at the crossing point. The pipe shall be AWWA C900 or other pipe material as approved by the City Engineer; or the non-potable shall be encased in a reinforced concrete jacket for a distance of 10 feet on both sides of the crossing, the latter being the least desirable and requiring City Engineer approval.

The City considers a non-potable line favorable if the following conditions are met:

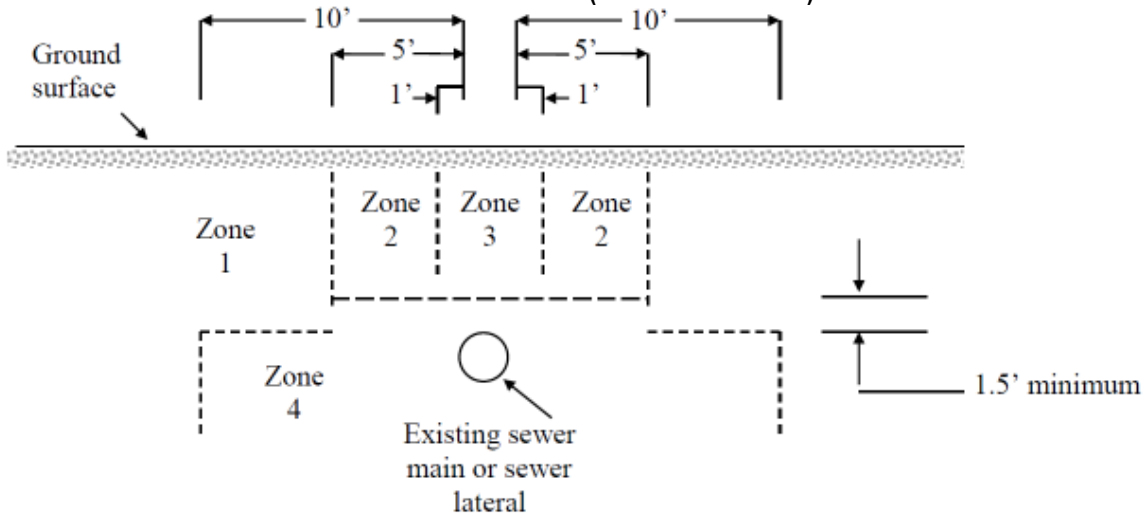
- No signs of non-potable leakage for the joints. This may be determined from visual drips, smell, or contaminated soils in the vicinity of the pipe (discoloration, mold, etc.)

- The non-potable pipe is not cracked, broken or otherwise damaged. The City may elect to review the inside of the pipe with a camera to verify pipe integrity.

Where separation is compromised, the City may request that a CCTV inspection be performed on existing non-potable pipe prior to work at the crossing and again after the work is complete to ensure the pipe condition was not compromised during compaction and final trench restoration within the crossing vicinity.

Minimum vertical pipe separation shall be 12 inches, with reduction to 6 inches vertical separation with approval from the City Engineer.

WATER LINE – SEWER LINE SEPARATION FIGURE (OAR 333-061-0050)



Zone 1: Only crossing restrictions apply

Zone 2: Case-by-case determination

Zone 3: Parallel water line prohibited

Zone 4: Parallel water line prohibited

4.1.13 Marking Tape and Locate Wire

Marking tape will be minimum 2-inches wide, APWA green and stretchable to a minimum of seven times its original size.

Marking tape is required on all mains and laterals. The marking tape shall be installed 12 inches above the pipe.

In addition to the marking tape requirement described above, pressure and vacuum sewer mains shall be wrapped with marking tape a minimum of 4 wraps per 20 lineal feet of main.

A #10 minimum tracer locate wire shall be centered on the top of vacuum and pressure sewer mains. Tracer wire is not required on gravity main installations. Tracer wire shall be installed directly above all sewer services (gravity, vacuum, and pressure) per Specification Section 00445. Tracer locate wire shall be tested for continuity prior to pipe burial.

Sewer Type	Marking Tape	Tracer Wire
Gravity Main	12 inches above	None
Gravity Service	12 inches above	Centered on top of pipe
Pressure Main	12 inches above and 4 wraps per 20 LF of main	Centered on top of pipe
Pressure Service	12 inches above	Centered on top of pipe
Vacuum Main	12 inches above and 4 wraps per 20 LF of main	Centered on top of pipe
Vacuum Service	12 inches above	Centered on top of pipe

4.1.14 Materials

Gravity sewer mains and services shall be constructed of ASTM D3034, dimension ratio not to exceed 35, or ASTM F679, minimum pipe stiffness 46, sewer pipe. Where minimum cover cannot be maintained, or where directed by the Engineer, pipe shall be AWWA C900 Specifications. Where rigid PVC pipe is to be used, gravity sewer pipe shall conform to ASTM D1784.

Pressure main lines and force mains shall be Schedule 40 (under 4-inch pipe) or AWWA C900 pipe and have a minimum DR of 18 (4-inch and larger pipe). Vacuum mains shall be constructed of SDR 21 PVC.

4.1.15 Construction

Construction of a sewer in an unimproved street shall include bringing the street to subgrade elevation to ensure that adequate bury, depth of cover, and utility separation is acquired. The street must be fully improved within six months after sewer is installed. If the street cannot be improved within the six months after sewer is installed, a 14-foot wide 2 inch thick paved all weather access road, with a 6-inch base, or as approved by the City Engineer, shall be installed centered over the sewer line with a 6-foot square asphalt or concrete pad around manholes. If the access road requires a vehicle turn around, adequate space shall be included for an all-weather access road.

If the street is to be improved more than six months after construction approval, the designer shall require that the street be properly staked to the approved design prior to the commencement of sewer line construction.

4.1.16 Septic System and Municipal Sewer Extensions

All sewer connection and/or septic use in the City of Bend must be in accordance with Bend Code Title 15. In most cases, the City will permit existing septic systems to be maintained if they are functioning and no development is proposed on the lot. In the event of minor additions to a residential lot, the City will defer to Deschutes County for connection requirements, if not adjacent to a functioning and available City main, based on the existing septic size and capacity and Oregon State and DEQ requirements.

Deschutes County, when reviewing permits for conformance and the ability to maintain their existing system, will review each situation individually in accordance with OAR 340-071-0160, requiring denial of a Construction, Installation, Alteration, and Repair Permit for a septic system serving:

- A single family dwelling or other establishment with a maximum daily sewage flow not exceeding 899 gallons if the nearest municipal sewer connection point is within 300 feet of the closest property line to be served
- A proposed subdivision or group of two to five single family dwellings or other establishment with the equivalent projected daily sewage flow if the nearest municipal sewer connection point from the closest property line to be served is not further than 200 feet multiplied by the number of dwellings or dwelling equivalents
- For proposed subdivisions or other developments with more than five single-family dwellings or equivalent flows, the City Engineer will determine municipal sewer availability

Any sewer extension required to bring a lot off septic will require installed to the property and a minimum one stick of sewer pipe, or 20 feet, into beyond the property line.

The property owner will be required to incur all costs to design, permit and construct an extension of the public sewer system to serve the property unless other agreements and/or funding arrangements have been approved by the City.

4.1.17 Sewer System Extension Requirements

If a sewer extension is required to service a lot, the property owner shall be required to extend the City sewer main a distance sufficient to establish a standard perpendicular service connection into the property, requiring a minimum 20-foot installation beyond the private property line.

For all other developments (partitions, subdivisions, etc.), sewer mains shall be required to be extended to, and through, the length of the property frontage.

4.1.18 Sewer System Abandonment

No unused existing utility system elements may be abandoned in place within the City right of way or City controlled easements unless a waiver to allow

abandonment is approved by the City Engineer. A waiver may be granted for the instances that meet all of the following criteria;

- System elements with more than six feet of bury depth.
- System elements located at least four feet (outside of pipe to outside of pipe) apart from any project proposed systems regardless of depth, located within the City of Bend ROWs.
    - For system elements within City of Bend controlled easement(s), that remain active, the measurement shall be increased to ten feet of any proposed utilities.

The City Engineer may also approve systems elements to be abandoned in place, at their discretion.

When a system element is to be abandoned in place the following requirements must be followed;

- The City of Bend shall be notified whenever a system element is abandoned and shall be inspected to ensure conformance with the City of Bend Standards and Specifications.
- Submit full surveyed as-built plans in accordance with Part V of the City of Bend Standards and Specifications and comply with ORS dig law requirements for all abandoned underground, out of service and un-locatable facilities within the project limits.
- System elements with no approved future anticipated use, fill abandoned pipes completely with approved non-shrinking grout to prevent future loss of pipe integrity and roadway damage.
- Standard manhole structures will be removed to a minimum depth of six feet. Below a depth of six feet, the structures will be filled with approved road base rock material.

4.2 Manholes (Gravity)

Manholes shall be located in a manner to provide unobstructed access for maintenance and inspection, to prevent stormwater infiltration, and to minimize the possibility of damage from vehicles or injury to pedestrians. Sewer mains shall be extended as necessary to place new manholes at street intersections. Manhole location with regard to centerline shall be per 4.1 - Sewer Main. Manholes shall be placed at intersections and spaced no more than 500 feet apart.

Manholes shall not be located within 25 feet of street sag low points. At the end of cul-de-sacs, storm drainage is to be designed to prevent manhole placement adjacent to catch basins.

Manholes located on mains larger than 12 inches in diameter, or at a pressure/gravity sewer intersection, may be required to be corrosion resistant manholes. Types of corrosion resistant manholes include, but are not limited to, polymer concrete, crystalline waterproofing additive, and thermoplastic lined manholes.

Manholes for all piping in excess of 12-inch diameter, or manholes that have three or more inverts must be 60-inch in diameter and use an eccentric cone configuration with the manhole opening located over a point opposite the outlet pipe. All other manholes shall be a minimum of 48-inch-diameter and use an eccentric cone configuration with the manhole opening located over a point opposite the outlet pipe.

Existing 48-inch-diameter manholes are not required to be replaced with 60-inch-diameter manholes when additional invert(s) are added. The existing and new inverts shall be separated by a minimum of 12 inches in all directions.

Each manhole shall be designed with a minimum fall through the invert of not less than 0.1 feet. Invert fall through manholes that divert flow more than 45 degrees or are 60-inch diameter shall have a fall through the invert of not less than 0.2 feet. At no time shall manholes direct flow more than 90 degrees unless approved by the City Engineer.

Manhole channels must be reviewed by the Engineer of Record during design to meet the following requirements. Where inverts cannot meet the conditions below, a detail of the manhole channels may be requested by the City at time of permit review.

1) The flow channel shall be made to conform to the slope and shape of the sewer pipe entering and exiting the manhole.
2) The channel shall be formed from cast-in-place concrete to a cross-section matching the circular pipes.
3) The channel shall be constructed with vertical walls from a point one half the pipe diameter above the channel flow line as shown in the standard drawing.
4) At intersections with other lines, channels shall be formed with a curve to minimize turbulence.
5) The flow channel shall be constructed to have a minimum depth equal to the pipe diameter.

All manhole channels must be detailed where new sewer is connecting into existing manholes. The design must incorporate how the channels will be formed in the existing manhole and how the existing flow within the manhole will not surcharge into the new pipe. The City will require that all new connections have an invert into the manhole located half the outlet pipe diameter higher than the outlet invert elevation (e.g., 8-inch pipe invert out at 3630.30 feet – new pipe invert 4 inches higher at 3630.63 feet) or that field investigation be conducted to determine the peak flow depths to set the invert. Inverts installed too low in the manhole, incurring surcharge into the new pipe, will not be accepted.

At no time, unless otherwise approved by the City Engineer, will the invert into the manhole be installed higher than the outflow pipe's crown.

For pipes that are larger than 8-inch diameter, internal invert drops are limited to not more than 2.0-foot differential between the invert-in and the invert-out without installation of a

drop manhole. For pipes that are 8-inch diameter and smaller the internal invert drop is limited to 1.0-foot differential between the invert-in and the invert-out without installation of a drop manhole. These are maximum inverts through the manholes and must have manhole channel design by the project Engineer of Record where the inverts fall outside the channel requirements above. The City encourages designs that avoid the use of external drops through the adjustment of the grade of the pipe entering the manhole.

4.2.1 Drop Manholes

For sewer mains larger than 12-inches in diameter with invert differentials large enough to require a drop manhole, an outside drop will be installed per Standard Drawing S-4. For sewer mains 12-inches in diameter and smaller with invert differentials large enough to require a drop manhole, an inside drop will be installed per Standard Drawing S-4A. Inside drop manholes are required to have a minimum diameter of 60 inches to allow sufficient room for maintenance. The manhole opening shall be positioned directly over the top of the inside drop structure.

4.2.2 Manhole Placement

Where manholes are adjacent to but outside paved right-of-way, a paved access pad sufficient for service equipment to operate without blocking the traveled way shall be constructed. Where manholes are away from paved right-of-way, a 14-foot wide 2 inch thick paved all weather access road, with a 6-inch base shall be installed centered over the sewer line with 6-foot square asphalt or concrete pad around manholes. This paved access road shall be a minimum of 14 feet wide. Support facilities such as, but not limited to, vehicle turnaround or fencing with a lockable gate, may be required at certain manhole locations. These requirements will be at the determination of the City Engineer or designee.

Location of manhole frame and covers in a vehicle wheel track is not acceptable. Location of the center of manholes within 5 feet of the curb line is not acceptable. Location of manholes outside of paved areas is not acceptable.

Composite frames and covers are permitted in non-traffic areas only.

4.2.3 Manholes (Pressure to Gravity Sewer)

Manholes shall be placed where pressure sewers connect to gravity main lines after the point at which the pressure line is in laminar non-pressurized flow. A minimum of one joint of gravity pipe shall be installed prior to the manhole. The joint of gravity pipe shall be installed at minimum grade, as practical.

4.2.4 Pressure Sewer Manholes

Manholes are required in all pressure sewers where cleanouts, air release, or vacuum relief devices are placed. Cleanout manholes shall not be more than 500 feet apart. As with gravity manholes, manholes shall be located on or near to pavement centerline.

4.3 Sewer Services

Sewer services shall be placed perpendicular to the main sewer whenever possible and shall not be connected into any manhole. All sewer services shall have tracer wire and marking tape per 4.1.13 - Marking Tape and Locate Wire.

Sewer services shall be installed in conformance to City standard drawings. For new sewer mains 12-inch diameter and smaller, services shall be installed using wye fittings. For new sewer mains larger than 12-inch diameter, services shall be installed using tee fittings. Where new sewer mains are installed within a cul-de-sac or dead-end mains with low flow, service wye fittings must be used regardless of the main size.

Services from existing mains smaller than 12-inch diameter may be cut-in fittings or saddle connections. Services from existing mains 12-inch diameter and larger must be cut-in fittings.

Service lines 8-in diameter or larger shall connect to the main line using a standard manhole per 4.2 Manholes (Gravity).

Size-on-size hots taps are not permitted.

Gravity sewer services are not to be less than 4-inches in diameter. All commercial/industrial properties must have a minimum 6-inch gravity sewer service installed. All gravity sewer services and all pressure sewer services shall be design for the appropriate diameter for the application as specified by the designer and approved by the City Engineer.

Sewer services shall have not less than 24-inches of cover at the property line. If the service crosses a roadside ditch, or any low area, 24-inches of clearance must be obtained at the crossing, measured for where solid compacted backfill was placed.

For all residential, commercial, industrial, or institutional parcels, each lot can only have a single service. On lots with multiple buildings, each building is required to have at least one service, but those services can only feed to a single service connected to a sewer main.

Sewer services that cross property lines are discouraged and require approval from the City of Bend Building official and City Engineer. Private sewer service lines shall not be installed across multiple property lines unless all of the following can be shown to exist:

1) The service line is located outside the building envelope (placed within building setbacks as defined by the Development Code's zoned property line setbacks)
2) There is no "practical means" of bringing a lateral service from the property's right-of-way frontage
3) A 10-foot private utility easement can be secured and recorded with Deschutes County, by plat or other recordable document, prior to any plumbing permit acceptance to the City. The easement width of the private service can be reduced as approved by the City's Building official – width dependent on depth and size of service line being installed.

"Practical means" is defined by the inability to provide a main/service installation to City standards because existing utility conflicts or creating a non-conforming installation that contradicts City standards, not having sufficient City of Bend right-of-way to perform the work, or known existing/future conflicts within the right-of-way that prevent the work (bridges or other geographical barriers that cannot be crossed/removed by general construction means – excavation within wetlands/fragile ecosystems, City ASI's, etc.). A property that is in conformance, with no existing utilities crossing property lines, cannot be

made non-conforming through any lot line adjustment, partition or subdivision land use process unless an exception can be made by the City Engineer, allowing private utilities to cross multiple property lines. Where an existing private sewer is already crossing property lines, and there is a recorded easement around the service, the property owner can continue to utilize that existing right.

All unused or abandoned service pipes within the right-of-way shall be cut and capped at the main. The unused service pipe shall be completely removed within the right-of-way. The pipe that remains on private property may remain or be removed at the property owner's discretion.

Sewer services are the ownership of the property owner they service. The property owner is responsible for the maintenance of the sewer service from the main into the property, including any private pumps required for pressure sewer systems.

Where properties have sewer service provided from a pressure sewer system, a check valve shall be installed on private property at the right-of-way line. Beyond the check valve an individual pump with sump shall be installed in conformance to the Oregon State Plumbing Code under a City plumbing permit. All private pumps are owned and maintained by the homeowner or homeowner group. No lots shall pump into a force main (a sewer main with a City pump station) without the approval from the City Engineer.

When services are installed for future use, install cleanout and tail at property line per Standard Drawing S-2C. If a PUE exists, install the cleanout at the property line and extend the tail to the back of the PUE.

4.3.1 Cleanouts

Permanent cleanouts within the right-of-way are not acceptable on gravity mains unless approved by the City Engineer. Cleanouts are permitted on private property per the Oregon Specialty Plumbing Code.

4.3.2 Sample Manhole

Sample manholes must be located on private property, unless otherwise approved by the City Engineer. Sample manholes shall be located in a manner to provide complete accessibility, to prevent stormwater infiltration and to minimize the possibility of damage from vehicles or injury to pedestrians. Sample manholes shall be located away from traffic and parking. Sample manhole placement shall allow easy access 24 hours per day. Fences or walls shall never be erected around the manhole blocking access. Where sample manholes are constructed in unpaved areas, a 6-foot square concrete pad shall be constructed around the rim.

Sample manholes shall be constructed on all commercial and industrial properties. Where there are multiple buildings on a site, the City Engineer may require each building's service lateral to have a sample manhole. Sample manholes shall always be installed downstream of a grease trap or oil water separators, when applicable.

Sample manholes do not require sulfide resistant material. Drops between the inlet and outlet invert shall be 5% minimum or match existing pipe slope where installed on an existing service line.

When sample manholes are located on private property, the Building Department will inspect the sample manhole. The sample manhole will be inspected per Standard Drawing S-15 and Oregon Specialty Plumbing Code.

Sample tees will be permitted:

1) When approved by the City Engineer
2) As retrofits. All new development must install manholes.
3) Where the user is not fabricating or potentially discharging high strength chemicals into the system

4.3.3 Sample Manholes on Pressure Sewer Systems

Sample manholes connected to pressure sewer systems shall be placed prior to the on-site pressure sewer manhole.

4.4 Sewage Pump Station Design

The City's policy is to install gravity sewer in all situations unless it can be demonstrated to the City that gravity cannot service an area. The City of Bend recognizes that there may be cases where a sewer pump station will be required due to topography or other reasons. In any case where a sewer pump station is being proposed, it needs to be verified in the most currently adopted Collections System Master Plan (CSMP) that it is also showing the need for a pump station in the proposed location. There may be times where the CSMP does not reflect the desired location of a pump station in which case a waiver must be requested through the waiver process in Part I - Section 2 - Change Process. In such cases where a sewer pump station is being requested through a waiver process, the designer should allow additional time for review. In no case will a pump station be allowed to connect to another force main or pressure sewer. Any pump station must have a dedicated force main that flows to a gravity manhole.

The City of Bend requires strict compliance with Oregon Revised Statute 672 for Professional Engineers. The professional design engineer must have had prior experience in designing similar systems. Unless otherwise indicated by the City, prior to the initiation of a study for any new pump station and/or sewer project, the Design Engineer shall submit qualifications for review, and approval by the City.

Design of pressure sewer facilities and sewage pumping stations shall conform to the City of Bend Standards and Specifications and the Oregon Department of Environmental Quality (DEQ) regulations as detailed in the appropriate Oregon Administrative Rules (OAR), Division 52. Designers shall refer OAR Appendix B – Raw Sewage Lift Stations, for detailed criteria.

All raw sewage pump stations shall use submersible pumps in the wet well. In some cases, immersible pumps designed in a wet/dry well configuration will be allowed. This will be determined at pre-design.

All pump station mechanical equipment shall be provided by a single provider, including the pumps, base, guide rails, etc. All electrical devices must be UL or CSA approved, and meet all NFPA and NEC codes and NFPA codes regarding classified areas. All pump stations are subject to submittal to DEQ for approval.

City maintained pump stations shall be located in dedicated tracts of land owned by the City or, when approved by the City Engineer, in a City of Bend easement. A hydrant shall be located at the frontage of the tracts/easement for cleaning the pump station wet well.

The Design Engineer shall provide pump operating data, including pump curve, total dynamic head and calculations used to derive peak flow rate.

A pre-design meeting shall be scheduled with the City. At the pre-design meeting the City will provide a list of requirements for the pump station improvements. The Design Engineer shall come to the meeting with the design service area and anticipated flow rate information development by the service area. Prior to beginning the final design, the Design Engineer shall submit a pre-design report to the City for review, covering all aspects of the Pump Station Design, as described in the pre-design meeting and herein.

The following additional guidelines supplement the Oregon Standards.

4.4.1 Wetwells

All wetwells, shall be concrete epoxy lined self-cleaning design per ASTM standards. A precast, circular wetwell design is required unless otherwise approved by the City Engineer. Pre-packaged pump stations with fiber glass wet wells will be reviewed on a case-by-case basis, complying with Flygt standards or approved equal. Joints shall be keyed rubber ring per ASTM 443 with mastic gaskets and be water proof. A leak test shall be conducted by the Design Engineer and witnessed by the City Inspectors with written documentation of the test provided.

Floors shall be sloped to drain to pump at a minimum of 45 degrees.

The top of the wetwell and associated valve pit shall be flush with the surrounding pavement. Top deck and lid of wetwell and valve pit shall be flush with the surrounding pavement/grade with properly sized 316 Stainless Steel gooseneck vent installed in top of wetwell.

The invert of the lowest influent pipe to the wetwell will enter no more than 1-foot above the lead pump's on setting, to reduce the turbulence in the wetwell. This may require the pipe be sloped outside the wetwell from the normal pipe depth with maximum slope of 22.5 percent. The emergency storage time in the wetwell may be calculated to the invert elevation of the influent pipe in the last manhole prior to the sloped section.

The Design Engineer shall calculate the buoyancy potential for the wetwell assuming ground water level at the ground surface and an empty wetwell. A factor of safety of a minimum of 1.25 shall be used in the calculation and as deemed appropriate by the Design Engineer and approved by the City. Invert of inlet above operating flow level and designed to reduce turbulence.

4.4.1.1 Working Capacity

The minimum working capacity of the wetwell, from pump off to pumps on, shall be determined at pre-design based upon estimated peak inflow rates and pump manufacturers recommendations.

4.4.1.2 Emergency Capacity

The emergency capacity of a wet well may be required under certain circumstances and shall be reviewed and approved by the City on a case-by-case basis and the City shall provide design criteria that must be met. This will be determined at pre-design.

4.4.1.3 Design Flow

Pumping stations and related components shall be designed to discharge Peak Hourly Flow (PHF), Final design PHF shall be reviewed and approved by the City. The PHF shall be calculated using a combination of the following parameters:

- Average Residential Per Capita Flow per the City of Bend Collection System Master Plan.
- Infiltration and Inflow Allowance per the City of Bend Collection System Master Plan.
- Peak Hour (Diurnal) Flow Peaking Factor per the City of Bend Collection System Master Plan.
- Non-Residential Flow Factors per the City of Bend Collection System Master Plan.
- Seasonal Peaking Factors shall be applied per the City of Bend Collection System Master Plan.

The Design Engineer shall review the City's Collection System Master Plan and DEQ guidelines for pump stations and develop the flow calculations for review and approval by the City of Bend in the Preliminary Design Report.

4.4.1.4 Design Life

Wetwells shall be designed and sized to accommodate for the build-out within the identified basin(s) contributing to the pump station, unless otherwise approved by the City. Pumps, motors, electrical systems and related components shall be designed and sized for a minimum 20-year service life, unless otherwise approved or required by the City. Structures shall be capable of a minimum 75-year design life.

4.4.1.5 Wetwell Wiring

Submersible pump power and control cables shall be continuous from pump to termination in panel, and penetrations into the panel shall be made with a cable gland sized to the as-furnished cables (Crouse Hinds CGB Cord Grip, or equal). Confirm number of power and control cables per pump. (Larger horsepower pumps may have more than a single cable.) Provide an open penetration (core drill or precast) through the precast concrete wet well wall near the wet well top. The hole must be large enough to accommodate the pump cables and instrumentation cables and provide a minimum of 2 inches of separation between the pump and instrumentation cables. Pump and instrumentation cables shall exit through the open penetration near the top of the concrete wet well wall and travel through an aluminum cable tray with a hinged, locking lid to an electrical isolation pedestal or to the control panel. The cable tray shall include a 20-gauge (minimum) aluminum barrier between the wet well and the electrical isolation pedestal (or control panel). The aluminum barrier in the cable tray shall be grounded. Pump and instrumentation cables shall be separated by a minimum of 2 inches as they enter and exit the cable tray and shall be located on opposite sides of the cable tray barrier from one another.

4.4.1.6 Level Control

Level control shall be provided by the use of a submersible level transducer or radar sensor located inside the wet well. A redundant level sensor shall be provided.

One High-High level sensing float-switch type alarm shall be provided in the wetwell to provide backup pump start control and alarming in the event the primary level sensors become inoperable. This float switch will start the lead pump to insure the contents of the wetwell are pumped out in the event of a primary level control failure.

Float controls shall be utilized as a redundant high and low alarm device and pump control capable of by-passing the control circuit, unless as determined by the City of Bend. The high level PLC and redundant float set point shall initiate the operation of the standby pump along with the high level alarm. Separate contacts shall be used for the alarm and operational points. Float controls shall be intrinsically safe and motor starters shall be NEMA rated. Float switches shall be of a weighted design, which do not require tying off in order to tip and operate properly. Floats shall be individually hung, at a distance no less than 8 inches apart from each other, from stainless steel uni-strut fastened to the concrete with stainless steel hardware and installed in such a manner as not to interfere with pulling pumps for maintenance and free of water turbulence. Floats and other level control shall be intrinsically safe, run in their own conduit system, and terminate in their own explosion proof J-box. All clamps, straps, fasteners and other hardware shall be stainless steel.

All applicable NEC and NFPA 820 requirements for explosive environments must be utilized.

4.4.1.7 Hardware

All hardware and fasteners inside the wetwell shall be stainless steel. Hatch assembly shall align with the slide rail system for pump removal. Rails shall be one piece, solid stainless steel construction of a two rail design. Wetwell and valve pit access lid shall be as manufactured by Utility Vault 4872AL 4 feet x 6 feet Double Door Aluminum suitable for H20 loading with no cross bar (no manhole lids).

All wet well hatches will include an OSHA approved fall protection grating. It will be a minimum of T-316 stainless steel, two piece, with a latch to hold it in the open position. Suggested manufacturers are Flygt and Halliday Products. All hatches shall be full traffic rated suitable for H20 loading.

4.4.2 Pumps

All pump stations that are to be owned and maintained by the City of Bend shall be of immersible motor construction, unless otherwise determined by the City of Bend. Pumps shall be designed for continuous operating service for pumping raw, unscreened sewage, constructed to meet the intended service

The pumps shall be mounted on a 316 stainless steel guide rail lift out system provided by the manufacturer. The pump shall meet NFPA 820 and NEC requirements, be explosion proof, and shall be capable of passing a minimum 3inch solid diameter sphere. Three phase services are to be specified. Single phase power may only be specified for pumps with a maximum power of 5 horsepower only as explicitly approved by the City.

The pumps shall be supplied by a distributor authorized to service them throughout warranty period and afterwards. The pumps shall be warranted by the manufacturer for a minimum period of two years after the City has accepted them into service. Certified pump tests shall be provided by the manufacturer for each pump provided.

All wetted parts shall be compatible and suitable for application with municipal raw wastewater and the corrosive environment associated with a typical municipal pump station, in addition to the specific materials requirements specified herein.

Each pump shall be provided with a stainless steel, stamped nameplate indicating the serial number, rated head and flow, impellor size, pump speed and manufacturer's name and model number.

Compatibility-Pumps and pump station equipment shall be selected considering compatibility with other City Pump Stations and final selections shall meet the approval of the City of Bend.

The Design Engineer shall provide system curves that indicate the required pump operating conditions. System curves shall be developed for static head and dynamic losses due to suction and discharge piping, valving, and other sources of head loss.

The Design Engineer shall select pump(s) that operate under the determined system curve conditions with the highest efficiency possible. Pumps selected shall operate under the manufacturer's recommended operating conditions and limitations. All system and pump curve information shall be submitted for approval by the City Engineer.

4.4.2.1 Pump Types

Immersible pumps shall be supplied by one of the following approved manufacturers:

1) Flygt (N-type impellor)
2) Approved equal

Self-priming pump stations are not permitted.

4.4.3 Reliability and Redundancy

All pump stations shall be designed to meet the EPA Class I reliability requirements, which includes pump redundancy, standby power provisions, and a telemetry/SCADA system.

Pump redundancy shall mean adequate pump capacity to discharge the PHF with one unit out of service. All pump stations shall be constructed with a three pump system (minimum 2 pumps operating alternately and an additional pump as an installed backup) unless otherwise determined by the City of Bend. All installed pumps shall be capable of assuming a lead, lag, or standby role.

Pumping facilities shall be equipped with a backup control system, which shall operate the pumps in the event the primary power and/or control system fails.

Standby power and telemetry systems shall be provided per these standards.

All new, expanded, or upgraded pump stations shall be supplied with a permanently installed onsite generator with a functional automatic transfer switch with the capacity to

operate all pumps, controls, lights and any other necessary equipment to operate the station simultaneously. The backup generator shall automatically transfer during loss of power and automatically re-transfer upon resumption of electrical utility power. The generator set shall be equipped with outputs capable of integrating pertinent information via the City of Bend SCADA system. Those outputs shall be, but are not limited to: generator run, generator low temperature, generator low oil pressure, generator failed to start, amperage, and voltage. The backup generators shall be fueled by natural gas unless otherwise approved by the City of Bend.

Allowable Generator Manufacturers:

1) Katolight
2) Kohler
3) Or approved equal

4.4.4 Telemetry and SCADA

The telemetry system shall be designed, installed and approved by the City of Bend. Ancillary telemetry systems may be required in addition to the standard data transmission telemetry. Additional hardware and software may be required as determined by the City.

Supervisory Control And Data Acquisition (SCADA) software may be required as determined by the City of Bend. The software shall be installed in a panel mounted Human Machine Interface (HMI). The HMI shall be industrial quality with a touchscreen view panel as approved by the City of Bend. Allen Bradley is currently the only HMI allowed in the City of Bend.

4.4.5 Pump Control Panels

Pump panel shall be manufactured using discrete components by a nationally recognized manufacturer. Pump operation shall be controlled by an Allen Bradley Programmable Logic Controller (PLC) unless otherwise determined by the City of Bend. The PLC shall be programmed for alternating pumping sequences and utilizing the Lead, Lag, Standby concept. The PLC shall be capable of integration with the current City of Bend Utility SCADA system. The PLC shall interface with an intrinsically safe level sensor that produces an isolated 4-20 mA signal for pump control. In all selected applications, redundant level controllers will be required with PLC programming to include operator selection and differential alarm settings.

Panels shall include hand, off, auto selector switches, alternating switch with lead selection capability, if applicable, phase failure/reversal relay, starter auxiliary contacts for telemetry use, elapsed time meters, and high level alarm contacts for telemetry. HOA switches, alternating switches, handles for pump breakers, branch and control circuit breaker, reset buttons, overtemp and seal lights and resets shall be operable from the exterior of the control panel door. All electrical power transfer switches shall be mounted externally to the control panel and inside the pump station enclosure. All wires shall be properly labeled; tie wrapped, and laid in wire way as to maintain a professional installation. Cut sheet for products along with computer generated wiring schematics, and equipment layout diagrams all properly labeled showing the entire system shall be approved through the permit process and submitted to Public Works prior to startup of the system. In addition, all operational, maintenance, warranty, and informational

documentation including pump curve, electrical schematics, and pump information plate as provided by the manufacturer shall be supplied at start-up to the City.

All pump stations shall be designed for 3 phase power. All stations receiving 240 volt 3 phase line power will be wired so the high leg is on B phase at the first connection after the utility company connection, with clockwise rotation, wired and labeled according to the NEC. If the pumps require counterclockwise rotation, the change will be made at the pump starter. All 460 volt stations will be wired according to the NEC with clockwise rotation. If the rotation must be changed for the pumps, it will be changed at the pump starter.

Allowed Panel Manufacturers: Powers of Automation, Renco, Pump Tech.

Circuit breaker and contactor permitted: Cutler Hammer, Square ”D”, General Electric.

4.4.6 Electrical Enclosure

All electrical devices must be UL or CSA approved, meet NEC codes and NFPA codes regarding classified areas. All pump stations are subject to submittal to D.E.Q. for approval. All electrical components (Pump panel, telemetry, circuit breaker panel, transfer switches, etc.) shall be installed in a free standing, floor mounted, 2 door, and Nema 12 enclosure. The size shall be a minimum of 72 inches x 72 inches x 20 inches deep and shall include a back panel to mount equipment on. A paddle lockable hasp shall be mounted above the exterior handle. The panel shall be on 12-inch high floor stands and securely mounted to a poured concrete base, which extends at least 12 inches past the edge of the panel on all sides.

The panel shall be located outside of the Class 1 Division 2 area as defined by NFPA 820. In no case shall the panel be less than 60 inches from any wetwell hatch or electrical hatch opening and 60 inches from any wetwell vent.

Acceptable Products:

1) Hoffman A-727220ULP Enclosure
2) Hoffman A-72P72 Back Panel
3) Or approved equal

The enclosure shall contain a 200 cfm; thermostatically controlled cooling fan located in the lower right or left hand sidewall. A seven-inch by seven-inch louvered plate with filter shall be located on the upper wall opposite the cooling fan. There shall also be an 800-watt, 120-volt electric fan forced heater with separate thermostat. Baseboard and residential can type heaters shall not be acceptable, nor shall open unguarded axial type cooling fans. A toggle switch controlled porcelain keyless fixture with 100-watt bulb installed on the upper back wall shall be included along with a 15-amp GFI receptacle. Next to the outlet box shall be a 4-Square steel box with raised steel switch cover for use as a telemetry power switch. The power source for the telemetry switch shall be fed from the pump panel control circuit.

All this and other utilization and distribution equipment including air compressors, light and heat shall be wired from or to a source other than the pump control panel, control circuit and/or control transformer. This will require adding a small 6 or 8 circuit panel tapped off

the load side of the pump control panel disconnecting. In the case of a 480-volt pump station a properly sized step down transformer with disconnects shall be required.

All these components shall be wired in EMT conduit, rigid steel conduit, or liquid tight metallic flex.

Acceptable Products:

1) Cooling fan Hoffman A-PA6AXFN
2) Louver / filter Hoffman A-VX66, AFLT66
3) Heater Hoffman D-AH8001B
4) Light Lithonia 9875
5) Electrical panels may be required to be enclosed in a pump station building as determined by the type and quantity of the equipment used.

4.4.6.1 Standby Generator Receptacle

The pump station panel enclosure shall include a Crouse Hinds reverse contact (S22) generator receptacle with back box. Sized appropriately for the pumps and station and wired through a manual transfer switch in such a manner as to back up power to the entire station using the City of Bend standard generator set. The receptacle shall be mounted no less than 36 inches above grade and shall be securely fastened to the enclosure using minimum 5/16-inch diameter bolts. The wiring configuration must conform to the City standard.

The receptacle shall be installed as an additional electrical backup system and shall be installed in accordance with all applicable codes.

Acceptable products:

1) 240 Volt Crouse Hinds, reverse service, 200 Amp AREA 204126S22
2) Appleton AR 200 44 RS
3) lt; Appleton 200 Amp 22 Deg. Turn, Reverse Service, AP 200 44 P4RS

4.4.7 Hydrogen Sulfide Protection

Each station may require a chemical treatment basin per City specification, but each odor/ corrosion control system will be approved for the individual station. Odor containment systems may include valves, tanks, pumps, piping, containment, secondary containment, and other pertinent appurtenances as required by the City of Bend.

4.4.8 Station Access

All pump stations shall be designed to allow for ease of access for equipment and operation of equipment.

4.4.8.1 Equipment Access

Design drawings and specifications shall incorporate all applicable and reasonable provisions to maximize efficient removal, replacement and maintenance of all equipment.

This includes but is not limited to adequate clearances, sufficient anchorage, hoists, hatches and platforms as necessary.

4.4.8.2 Site Access

Site Access shall be provided such that a maintenance vehicle and/or vactor truck may be parked off-road and on the pump station site without hindering area traffic. Paved access shall be provided to the station at all times. The access shall allow a vehicle, including the City's Jet Rodder Combination Truck (20-foot W.B. 10-foot overhang, front/back) to park over the wetwell without blocking any traffic lanes or pedestrian walkways. Access shall be as level as possible, but shaped to drain away from wetwell. All paving shall be shown on construction plans and approved by the Engineering Division prior to construction. A 10-foot clear space shall be required between existing, proposed, or future equipment (including 12-foot by 20-foot designated generator area) and fencing on all sides of the pump station.

4.4.9 Station Fencing

The stations shall be enclosed with a chain link fence with 16-foot wide gate with sight screening vinyl slats. There shall be a double gate at least 16 feet wide. There shall be sufficient room inside the fence for a concrete pad 6 feet wide and 9 feet long next to the wetwell and electrical panel. Each installation shall be reviewed and approved on an individual basis. All gates shall be supported by wheels; alternate fencing materials will be considered on an individual basis. Fencing shall be at the tract property line and there shall be a minimum 10-foot clear space between the fence line and any existing, proposed or future pump station equipment/structures. Alternate fences shall be considered if maintained by adjacent HOA.

4.4.10 Force Main Cleanout

Each station shall have a pig launch with a 1-inch ball valve with a brass swivel fitting with brass plug mounted in the center of the flange to permit the attachment of jet rodder hose. There shall be a plug valve on the discharge side of the pig launch.

4.4.11 Flow Metering

Each sewer pump station will have an inline-electromagnetic flowmeter installed on the station discharge main in the vault. There must be no moving parts, or obstruction in the flow. The flowmeter can be used A.C. or D.C. model signal, using a 120-volt A.C. power source. The meter must be designed for and approved for wastewater use with an accuracy of 1 percent. The meter must be programmable with a built-in keypad, with data storage. The transmitter is to be mounted in the station enclosure. There must be 4-20 mA inputs and outputs, with an interface capable of communicating with the City's RTUs and/or SCADA system. The meter must be installed according to the manufacturers specifications with the O and M manual supplied to the City. All necessary conduit and wires for electrical power and communications must be installed and connected. A downstream plug valve must be installed downstream from the meter at a distance required by the manufacturer of the meter for accurate operation and a properly sized spool piece of the same piping material must be provided to facilitate removal of the flow meter.

Acceptable manufacturers are: Krohne, Endress & Hauser, Yokogawa, or approved equal

4.4.12 Bypass System

Each pumping station shall be equipped with a sewage bypass system unless otherwise determined by the City. The Bypass System shall consist of a manhole prior to the pumping station wet well and a discharge port located on the discharge pressure pipe. The manhole shall be readily accessible and located on the site of the pumping station. No manhole will be allowed under cover or inside any of the on-site buildings. The discharge port shall be installed on the discharge pipe immediately after exiting the pumping station. The discharge port shall be readily accessible and on the same site as the pumping station. It shall be constructed of 6-inch ductile iron and extended vertically 12 inches above grade. A 6-inch plug valve shall be installed with a 4-inch by 6-inch cast iron, flanged concentric reducer and a 4-inch aluminum camlock fitting with a lockable cover.

4.4.13 Safety Systems

Each pumping station must conform to all applicable OSHA safety regulations. Additional safety devices such as fall protection and atmosphere monitoring devices may be required as determined by the City of Bend.

4.4.14 Lift Station Standards

An example plan set for lift station design is provided as Part VI – Appendix B – Example Lift Station Plan Set.

4.5 Vacuum Sewer

Vacuum Sewer is currently only within the City's Wood River Village subdivision, located south of Reed Market Road, west of Brookswood Boulevard and east of the Deschutes River. No additional vacuum systems, or extensions of the existing system, will be permitted in the City of Bend unless otherwise approved by the City Engineer. The vacuum sewer system, manufactured by AirVac, functions on vacuum instead of a standard gravity or pressure system - it utilizes vacuum to pull sewer from each induvial lot to a centralized pump station. Each lot uses a gravity service that follows into a vacuum pit. The pit contains a valve that opens when the pit fills. When the valve opens, because of the system has a vacuum, it sucks everything out of the pit and into the main. Eventually the vacuum will pull everything down to the pump station and pump it to a gravity main elsewhere in the City's system. If you have too many connections to a valve pit or have too much sewer flow to a valve pit, the valve pit is opening more often, reducing the vacuum in the mainline system. With reduced vacuum, you reduce the system's ability to move the sewer to the station and cause the pumps in the pump station to run more frequently. The system was installed initially for the single family and mobile home development densities that existed with the systems construction. Because the AirVac system is designed for these relatively small flows into the pits, additional density in the area requires additional pit installations, often reducing the number of connections to pits that are permitted by the manufacturer.

4.5.1 Valve Pit Design

When a lot is being developed and/or divided, valve pits must be reviewed for capacity. Each valve pit will be permitted only 2.5 sewer lateral connections (average) per single pit.

Connection options – based on averages:
1 valve pit can serve two single family homes
1 valve pit can serve a single triplex
2 valve pits are required for a single four plex.

An Accessory Dwelling Unit (ADU) can be considered ½ a connection, but generally a new valve pit is not required for construction of an ADU.

With any development, the City Engineer has the discretion to require a new valve pit based on review of fixture units that would discharge to the valve pit. AirVac recommends a discharge flow that does not exceed approximately 3 gallons per minute (gpm) into the valve pit, providing approximately 22 minutes of storage in the pit.

Unless approved by the City Engineer, lots should not use pressure systems to discharge into the valve pit.

4.5.2 Valve Pit Construction

Installation of all valve pits must be to the specifications of the manufacturer. The contractor must work with the City during the installation of a new pit, requiring the City to turn off the pump station temporarily to have the wye installation on the mainline.

Connection of a service lateral to the valve pit must be conducted under a right of way permit. Construction of the private discharge service on private property must be conducted under a plumbing permit and installed in conformance to Oregon Plumbing Code or applicable building code. An air intake assembly (sometimes referred to as a "candy cane") must be installed, usually consisting of a standpipe on private property. The vacuum system relies on the air intake pipe to function, siphoning air into the system to maintain vacuum when the valve in the pit opens. Removal of the air intake pipe can result in a system that fails to discharge sewer or can cause damage to the private property piping systems.

Valve pits must be constructed outside of driveways, sidewalks and roadways, and must be located so that they are accessible by City maintenance personnel. Unless otherwise approved by the City Engineer during right of way permit review, the valve pipe should be located to allow from construction of property tight sidewalks, locating the rim so that is 7 feet from the property line, falling within a landscape strip. Installation of valve pits on private property will require the recording of City sewer easements around the pit. The sewer easement could potentially extend along the frontage of the lot to allow for connection by adjacent lots if the valve pit is identified as having additional capacity for future connections.

5 Water

Materials and procedures for water facilities shall conform to the most current Oregon Standard Specifications for Construction as supplemented and/or modified by the City of Bend's Special Provisions. The Oregon Health Division Administrative Rules, and American Water Works Association (AWWA) standards, may also be referenced.

Designers shall note that some areas within the City limits are served by private water utilities (Roats and Avion). The private water utilities shall be shown on the infrastructure plans. The design standards require these private utilities apply for a right-of-way permit (Tier II or Tier III/Infrastructure depending on work being performed) when water infrastructure is being installed for ultimate ownership by the private utility and requires their approval.

All design elements below are minimum requirements. Any exception will require a waiver request as outlined in Part I - Section 2 - Change Process.

5.1 Main Line

The City's water distribution system is designed to meet peak hour demands and all fire flow requirements with minimal impacts to City of Bend water customers. All new elements added to the existing system need to be designed with these requirements in mind. Where new water infrastructure is being constructed, water systems shall be looped into existing water pipes in the project vicinity or as directed by the City Engineer.

City of Bend water mains and services in the City's right-of-way that are not in use and that have no approved current or future anticipated use shall be removed completely unless a waiver to allow abandonment is approved by the City Engineer per Section 5.1.10. Where water mains and services within a City utility easement (outside of public right-of-way) on private property is to be decommissioned, it is preferred to have all pipes removed, however with the City Engineer's approval, they can be abandoned in place when the easement is extinguished and the City releases liability of the abandoned pipeline to the property owner. Existing water services to be abandoned must be cut at the corporation stop and removed from the right of way. Place a watertight cap on the existing corporation stop. Corporation stops on services larger than 1 inch shall be removed and replaced with a plug at the water main. Fittings and valves shall be removed from the right of way.

City of Bend water pipe shall be constructed in a trench with Class B compacted backfill within the pipe zone in conformance with the standard drawings. Water mains shall not be constructed on blocks.

If a water extension is required for fire service or domestic service, the property owner shall be required to extend the City water main a distance sufficient to establish a standard perpendicular service connection into the property or 20 feet, whichever is greater. For all other development, water mains shall be required to be extended to and through the length of the property frontage unless otherwise determined by the City Engineer. Exceptions may exist due to pressure zone or service area boundary constraints.

5.1.1 Minimum Size

The minimum pipeline diameter for distribution mainlines shall be 8 inches. Distribution mains shall be either 8 inches or 12 inches in diameter. New 10-inch diameter mains will not be permitted unless otherwise approved by the City Engineer. Transmission mains shall be minimum 16 inches in diameter. Fire hydrant lines shall be 6 inches in diameter and have a 400-foot maximum running length. All mainline extensions and system designs shall meet required minimum fire flow for that zoning, see 5.6.1 - Fire Flow Requirements.

5.1.2 Marking Tape

Marking tape is required on all mains. Marking tape must be minimum 2 inches wide, APWA blue, and stretchable to a minimum of seven times its original size. The marking tape must be installed at the top of the pipe zone material, 12 inches minimum above the main, centered on the main. Refer to Standard Drawing W-1.

5.1.3 Materials

Ductile iron is the only material approved for construction of water lines and fittings in the City of Bend system. Adequate controls and protective equipment shall be provided so that the level of pressure rise resulting from surges and other variations from normal operations shall not exceed the internal design pressure at any point in the piping system and equipment by more than ten percent. Surge analysis calculations shall be provided on request for City review and shall be included with any design submittals.

Minimum class requirements:

Pipe Diameter (I.D.)	Class
4-inch to 12-inch	52
14-inch and larger	50

5.1.4 Location

All water lines must be located in public right-of-way, unless otherwise approved by the City Engineer. Public easements for water mains and hydrants across private property will not be allowed unless approved by the City Engineer. Any public water lines (domestic water services, fire services, or private water mains) entering into private property requires premise isolation (backflow devices) at the right-of-way. The location of the premise isolation shall be on private property directly adjacent to the right-of-way or easement line, unless otherwise approved by the City Engineer. Backflow devices will be permitted within a building on a case-by-case basis, but shall not be permitted if the premise isolation is located more than 20 feet from the right-of-way without City Engineer approval (i.e. installation of the premise isolation 20 feet from the right-of-way within the building immediately adjacent to the building's pipe penetration may be permitted on a case-by-case basis).

Water mains shall be located 10 feet from roadway centerline. Water mains shall be offset a minimum 6 feet from the centerline where located on streets 32 feet or less in width (curb-to-curb). Water mains shall be constructed a minimum 3 feet from the curb.

A 10-foot minimum horizontal separation from non-potable lines and underground utilities shall be maintained. At non-potable crossings, the bottom of the water line shall be 1.5

feet or more above the top of the non-potable utility. Where a 1.5-foot vertical separation cannot be obtained at the crossing, the non-potable utility pipe at the crossing shall be constructed such that one full 20-foot stick of water pipe is centered at the crossing. Separation from sanitary sewer lines is established by Oregon Administrative Rule (OAR) 333-061-0050. All non-potable lines shall be treated as "sewer" lines as described in OAR 333-061-0050. Dry utility crossings are to maintain a typical 12-inch vertical separation from all water crossings, with minimum 6-inch vertical separation permitted with City approval.

All water lines shall have a minimum of 36 inches of cover measured from the top of the outside pipe to the top of the roadway surface. Maximum depth of a water main shall not exceed 6 feet. If greater depth is needed the Design Engineer shall provide vertical deflection up to establish a 6-foot depth maximum at all branch and hydrant valves.

5.1.5 Velocities

Normal working velocities (Average Day Demand) shall not exceed 5 feet per second. In no case will velocities exceed 12 feet per second. Consideration for surges from higher velocities must be considered in the design.

5.1.6 Pressures and Flow Calculations

The City of Bend has numerous pressure zones around the City, each with unique pressures. The City strongly recommends that the designer understand the pressure zone they are in and the specific requirements associated with that zone.

The following table identifies the City of Bend requirements for pressures:

Condition	Pressure (PSI)
Minimum Service Pressure Under Fire Flow	20
Maximum Service Pressure without PRV	80
Maximum Service Pressure with PRV	120

The City of Bend is required to ensure required fire flows can be obtained at 20 psi. Pressures higher than 20 psi are not guaranteed, and the designer should consider how pressures may change over time as additional development is added beyond any proposed tie in or extension of the existing water distribution system.

Normal service pressures are defined as static pressures on peak day demand. Pressures below 40 psi typically generate complaints. To avoid complaints, the designer is required to design facilities to provide a minimum pressure of 40 psi. If normal service pressures cannot be met, each service line will require an individual and private pressure pump located a minimum of six feet past the City premise isolation and shall not be located on City Right-Of-Way, and/or the title to the property that the service line is serving shall be modified to state:

> *"Known low water pressure area. The City of Bend is not responsible for inadequate service pressures associated with this property. If pressures are unsatisfactory to the property owner, the property owner at their discretion can install a pressure pump on the downstream side of the City Meter at the owner's*

expense. The pump shall be located at a minimum of six feet past the premise isolation and shall not be located on City Right-Of-Way. In no situation is the City responsible for maintenance, service, or replacement of this pump."

Maximum service pressures that are at, or exceed, 80 psi on City owned mainlines will require a pressure reducing valve and vault. The designer will need to meet with the City to determine exact location, orientation, size, and type to be installed. Water service lines past the City owned meter must meet plumbing code requirements for maximum pressure. It is strongly suggested that service lines that are within 10 percent of maximum pressure as determined by plumbing code install individual pressure reducing valves.

5.1.7 Bends and Joint Deflection

All bends shall be called out on the plan and profile by station and offsets, including size, number, and designation (90°, 45°, 22-1/2°, 11-1/4°) of each. When applicable, joint deflection shall be called out in the number of degrees per joint and radius of curvature when several joints in succession are to be deflected.

5.1.8 Thrust and Restrained Joints

The City requires mechanical restrained joints. Concrete thrust blocks are required behind hot taps 4-inch and larger on existing watermains, sized appropriately on the construction documents by the engineer of record. Thrust blocks will not be used when a mechanical restrained design can be implemented unless otherwise approved by the City Engineer~~Concrete thrust blocks are acceptable only behind hot taps on existing watermains as required by the engineer of record~~, ~~sized appropriately on the construction documents.~~ Any other thrust restraints require a waiver request as specified above. All restrained systems shall be in conformance with Specification Section 01140.

The Engineer shall provide calculated restrained lengths for all bends, tees and appurtenances requiring thrust restraint. Calculations shall be run under the following minimum requirements, as per AWWA standard: 2:1 safety factor, type 5 trench, 3-foot bury, 150 psi test pressure (or higher as needed) and soils consistent with the site geology (typically a GM – Silty gravel, or as determined by the engineer of record). All improvement plans shall have a restraint table stating the applicable restrain lengths for pipe size and fittings used, calculation inputs and installation notes.

5.1.9 Pressure Reducing Vaults

Pressure reducing vault designs shall be coordinated with the City on a case-by-case basis.

5.1.10 Water System Abandonment

No unused existing utility system elements may be abandoned in place within the City right of way or City controlled easements unless a waiver to allow abandonment is approved by the City Engineer.

When a system element is to be abandoned in place the following requirements must be followed;

The City of Bend shall be notified whenever a system element is abandoned and shall be inspected to ensure conformance with the City of Bend Standards and Specifications.

Submit full surveyed as-built plans in accordance with Part V of the City of Bend Standards and Specifications and comply with ORS dig law requirements for all abandoned underground, out of service and un-locatable facilities within the project limits.

System elements with no approved future anticipated use, fill abandoned pipes completely with approved non-shrinking grout to prevent future loss of pipe integrity and roadway damage.

All water valves boxes will be removed to a minimum depth of six feet. Below a depth of six feet, valve boxes will be filled with approved road base rock material.

5.2 Service Lines

The minimum water service line size is 1-inch diameter to the meter. This line size may be reduced through the meter as required for domestic service in conformance with the Oregon Plumbing code and any other applicable state building codes. The water meter shall be the same size or one size smaller than the water service line. No more than one service line per taxlot is permitted unless otherwise approved by the City Engineer.

Where an existing 3/4-inch water service exists between the main and the meter, the service will be permitted to remain unless; 1) the service line is a different pipe material other than copper or 2) additional demand is added to the service because of a new use. Any new building or single family residence with an existing service line that is out of conformance to current standards shall install/replace the service to meet current City standards.

Service lines shall be installed as shown on the Standard Drawings. All service runs shall be one continuous run of copper within the City's right-of-way. All service lines shall have a minimum of 3 feet of cover. When services are installed for future use, extend the tail to the property line, or back of the PUE, if a PUE exists.

Marking tape shall be installed a minimum of 12 inches above the service line at the top of the pipe zone material, centered on the service line.

Service taps at the main shall not exceed one tap every 2 feet and be a minimum 2 feet from bends or bells on the mainline. Water services are to maintain 10 feet separation from franchise utilities and non-potable water when within the right-of-way or in a utility easement.

Services 2-inches and larger shall be hot tapped with a minimum 2-inch corporation stop, using the appropriate tapping saddle and appurtenances as called out by the Engineer of Record. Service connections to existing pipe may utilize a saddle tap and valve. All water service lines shall be placed perpendicular to the water main.

New service connections greater than 2 inches shall be designed by a Professional Engineer. 3-inch service lines are not permitted, requiring 4-inch ductile iron water lines with the ability to reduce to 3-inch service lines at the meter.

Connections to transmission lines are not permitted. A separate distribution line shall be required to provide single services unless otherwise approved by the City Engineer.

Where water services are permitted off of transmission mains, the taps must be performed by tapping sleeves and not corporation stops due to the thinner walled pipe. Additional tapping requirements may be required by the City with tapping of transmission mains dependent on the situation and location of the tap.

City standard is that services are to be provided directly to property with meters and premise isolation installed within the right-of-way for residential application. Reference Standard Drawings W-4, W-4A, and W-4B for residential service installation. Service connections beyond the premise isolation, installed within the property shall be considered private and will be reviewed in accordance to the Oregon Plumbing code and all other applicable Oregon state building codes, installed under a City Building Department permit. The City is not responsible for maintenance beyond the meter. Reference Standard Drawings W-5 through W-5D for commercial service installation.

Private water service lines shall not be installed across multiple property lines unless all of the following can be shown to exist:

1) The service line is located outside the building envelope (placed within building setbacks as defined by the Development Code's zoned property line setbacks)
2) There is no "practical means" of bringing a lateral service from the property's right-of-way frontage
3) A 10-foot private utility easement can be secured and recorded with Deschutes County, by plat or other recordable document, prior to any plumbing permit acceptance to the City. The easement width of the private service can be reduced as approved by the City's Building official – width is dependent on depth and size of service line being installed.

"Practical means" is defined by the inability to provide a main/service installation to City standards because of existing utility conflicts or creating a non-conforming installation that contradicts City standards, not having sufficient City of Bend right-of-way to perform the work, or known existing/future conflicts within the right-of-way that prevent the work (bridges or other geographical barriers that cannot be crossed/removed by general construction means – excavation within wetlands/fragile ecosystems, City ASI's, etc.). A property that is in conformance, with no existing utilities crossing property lines, cannot be made non-conforming through any lot line adjustment, partition or subdivision land use process unless an exception can be made by the City Engineer, allowing private utilities to cross multiple property lines. Where an existing private water service already crosses property lines, and there is a recorded easement around the service, the property owner can continue to utilize that existing right. Water services not in use, needing to be upsized or needing to be relocated within a parcel are required to be removed back to the main and the pipe removed from the right-of-way. The City requires that the corporation stop shall be removed from the main and the main be plugged, unless otherwise approved by the City Engineer or designee.

If the meter assembly/box or service line is damaged during construction/site improvement activities, during the warranty period, or if the existing meter box or service line does not meet current City Standards, the developer/property owner shall upgrade the components of the service that is out of conformance.

For all non-residential potable services a minimum of a D.C.V.A. (Double Check Valve Assembly) shall be required for Premise Isolation. The Premise Isolation Assembly shall be installed in accordance with O.A.R. (Oregon Administrative Rules) 333-061-0071, Oregon Plumbing Specialty Code Chapter 6, and City of Bend Standards and Specifications before a meter is set by City of Bend Utilities Personnel. The premise isolation shall be placed on private property directly behind the right-of-way line. The degree of hazard of each service connection shall be identified and verified by City of Bend Safe Drinking Water Program. Health Hazard connections shall be required to either utilize an approved In-Premise Backflow Prevention Assembly that is commensurate with the degree of hazard (Air Gap or Reduced Pressure Principle Backflow Prevention Assembly) or install the Health Hazard Assembly as Premise Isolation. A Reduced Pressure Backflow Assembly will be required at the service connection when non-potable, non-domestic water services (i.e., COID/Swalley/Arnold/NUID irrigation) and City water services exist at the same project site, per ORS 33-061-0070 and all other applicable State regulations.

All residential water services shall have the backflow assembly/meter loop installed by City of Bend Utilities Personnel after construction and inspection approval of the service pipe and water meter box.

5.2.1 Services Off of Fire Lines

The City of Bend will not permit fire hydrant or fire sprinkler lines to be used as the domestic service line. Potable water services must be tapped from the main separate from the fire line. Fire sprinkler services shall not connect to fire hydrant lines unless approved by the City Engineer.

Fire sprinkler lines must have a Double Check Detector Assembly (DCDA) installed with leak detection meter. The City's ownership of the fire sprinkler lines terminate at the right-of-way line with the installation of a gate valve per Standard Drawing W-13B. All fire sprinkler lines and fire sprinkler vaults shall be reviewed by the Building Department when on private property to be in conformance with plumbing and fire code regulations. Fire sprinkler vaults are required at the right-of-way when the building exceeds 20 feet from the right-of-way line. In the instance where the building is within 20 feet of the right-of-way, the developer has the option of installing a fire sprinkler vault or installing the fire sprinkler plumbing (DCDA, Post Indicator Valves, and Fire Department Connections) within the building as approved by the Building Official.

Fire sprinkler services that use any chemical additions shall require an approved R.P.D.A. (Reduced Pressure Principle Detector Assembly). Fire services, vaults and backflow prevention assemblies shall be installed in accordance with O.A.R. (Oregon Administrative Rules) 333-061-0071, Oregon Plumbing Specialty Code and City of Bend Standards and Specifications.

Unless approved otherwise, fire hydrant lines on private property shall have premise isolation at the right-of-way. The hydrant main and hydrant is privately owned and maintained by the property owner beyond the premise isolation.

5.3 Valves

Main line valves shall be located in the public right-of-way. The maximum distance between valves is 1,000 feet on transmission mains and 500 feet on distribution mains.

Valve locations to be determined by the City. Typically, transmission mains are defined as lines that have no other services or distribution connections to them and are typically coming from one of the sources of water. All other lines are distribution lines.

5.3.1 Valve Location

Valves shall be located outside the normal path of wheel travel, bike lanes, and accessible travel path. No valve shall be located within a sidewalk/shared-use path/path or within 3 feet of an existing or proposed street gutter line and shall fall minimum 12 inches beyond the gutter pan where curb and gutter exists. All valves shall have a minimum distance of 18 inches measured from the top of the valve body to the top of the road surface. Where valves fall outside paved roadways, a concrete collar shall be constructed not less than 4 inches deep and centered in a 2-foot by 2-foot pad.

At all tee and cross fittings within an intersection, two valves shall be installed on tees and three valves installed on crosses. Valves on the main line at hydrant tees are only required where valve spacing requires the valve installation. At the direction of the City Engineer, additional valves may be required on at fittings where deemed necessary for maintenance of the system. In cases where the legs of the branches of the fitting are of different sizes, a valve shall be placed on the smaller diameter first. All valves shall be located within 5 feet of the cross or tee fitting unless on an arterial or collector street where valves may be required to be placed outside the intersection near the flow line of the local street intersection.

Valves should always be installed at valve clusters around a tee or cross and never in the middle of a corridor, unless otherwise approved by the City Engineer.~~At all tee and cross fittings, valves shall be installed on every branch of the fitting unless otherwise approved by the City Engineer. In cases where the legs of the branches of the fitting are of different sizes, a valve shall be placed on the smaller diameter first. All valves shall be located within 5 feet of the cross or tee fitting.~~

All dead-end lines shall be terminated using a valve and blow off, except on mains 12-inches and larger, ending in a hydrant.

Hot taps to existing watermains shall be permitted depending on the location of existing valves in the vicinity. Where valves are not adequate to the existing system, a cut in tee will be required with valves installed on all branches, or as determined by the City Engineer. Size-on-size taps will not be permitted unless approved by the City Engineer.

5.3.2 Valve Types

Gate valves are required on all waterlines 8-inches and smaller. Butterfly valves shall be used on all waterlines of 10-inch diameter or larger; or on smaller diameter lines where 18 inches of cover to the top of a gate valve body cannot be obtained. Butterfly valves shall be mounted with the stem vertical and on the “curb” side of the main.

Air-Vac/Air Release valves shall be considered during design. Typically these will be located at all elevation rises and elevation high points. Typically, 1-inch Air-Vac valves shall be installed for water mains 12 inches and smaller and 2-inch Air-Vac/Air Release valves installed for water mains larger than 12 inches all larger water mains, however the

sizing shall be verified against manufacturer's recommendation. All Air-Vac/Air Release valves shall be designed to be insulated to protect against a sustained temperature of -10 °F. Hydrants are not considered Air-Vac or air release.

5.3.3 Pressure Reducing Valves

Projects requiring a PRV station shall set up a meeting with operations staff to discuss design requirements. The design must follow the standard drawing but may deviate depending on the system pressures, flows and location.

5.3.4 Blow-Offs

Blow off valves shall be located on all dead end lines. New lines that are connecting to existing lines at both ends will require a temporary blow-off for chlorination purposes. In no cases shall hydrant spacing be modified to use as a blow off. Design shall address how water from blow offs and flushing will be handled and disposed of to prevent any erosion or landscape damage.

5.4 All-Weather Access

Where water facilities requiring maintenance access outside paved right-of-way, a paved access pad or road sufficient for service equipment to operate without blocking the traveled way shall be constructed. Where water facilities (such as fire hydrants and valves) are away from paved right-of-way, a 14-foot wide, 2-inch thick, paved all weather access road, with a 6-inch base, or as approved by the City Engineer, shall be installed to provide access. If the access road requires a vehicle turn around, adequate space shall be included for an all-weather access road.

Where water facilities not requiring maintenance access (such as transmission lines) lie away from paved right-of-way, an all-weather access road shall be constructed over the line. This all-weather access road shall be a minimum of 14 feet wide and shall be surfaced with a minimum of 6-inches of compacted aggregate base. The road shall be shaped to promote drainage and shall not cause the ponding of storm runoff.

5.5 Meters

All water service lines must have a meter box and assembly placed a minimum of 1 foot outside of hard surfaces (concrete and asphalt) unless approved by the City Engineer. Where meter boxes are unable to be located outside hardscape, an expansion joint shall be installed 12 inches around the entire perimeter of the meter box. When meter boxes are located in sidewalk/shared-use paths with tree wells, the meter box shall be located a minimum of 6 feet from the tree well. Fire lines no longer require meters but are required to have double detector check assemblies (DCDA) to detect low-flow events. Any service line that is providing water from the City of Bend distribution system for purposes other than fire flow must have the entire amount of water used measured. Water meters shall be sized to the water service line size or one size smaller.

New meters installed at commercial and industrial properties must be 1-inch minimum.

Commercial water meters shall be installed on residential projects that have three dwelling units or more.

Meters that are 3 inches or larger will be either a Sensus Omni or HbMag. All accessories, except the MTU, need to be included to ensure the meter functions properly.

For domestic water services, the City's ownership ends at the meter. City's ownership for fire services ends at the right-of-way.

5.5.1 Automatic Meter Reading Systems

The City requires the STAR Network AMI system as manufactured by Aclara on all metered services.

All meters shall include an Aclara/STAR meter transmission unit. The transmission unit shall be installed on the bottom of the meter box lid as shown in the Standard Details.

5.5.2 Standard Meters

All water meters 2-inch and smaller shall be installed by the City of Bend. Meters shall be approved by the City prior to installation.

5.5.3 Vaults and Meter Boxes, Including Insulation

Commercial vaults and meter boxes shall typically be installed 3 feet to 5 feet off of the corner property line in each direction. Residential meter boxes shall typically be installed 1.5 feet to 5 feet off of the corner property line in each direction. Vaults and meter boxes are to be installed outside of hard surfaces.

Meter banks, multiple meters placed in close proximity to one another to provide multiple lot services, are permitted with approval from the City Engineer. Water taps shall be spaced a minimum of 2-feet apart at the main. Stamped or engraved stainless steel or brass address tags shall be on each meter box in the meter bank to identify which meter services which address. Refer to Standard Drawing W-4.

The following, or an approved equal, are the only approved meter boxes for services for 2-inch and smaller. All meter boxes must be tier 8 or equal. Meter boxes shall not have mouseholes.

Brand	Box	Lid
Armorcast	BOX –17 x 30 x 18	LID-1730 Polymer with cast iron meter reader lid
Quazite	Polymer concrete; flared L 17 x 30 x 18	Quazite H20 17 x 30 with hinged cast iron reader door

For all meters larger than 2-inch, the designer will determine the appropriate meter box or vault. All meter boxes and vaults must be traffic rated. See Standard Details for 3-inch and larger meters.

All meter vaults and boxes must be installed to the correct finish grade. Any that do not meet this requirement, including requirements for correct depth of meter stops and service line, will not be activated and locked off with a City of Bend lock.

Closed cell foam insulation shall be installed with the meter stop as shown on the Standard Drawings.

5.6 Fire Services, Flows and Hydrants

The City of Bend requires all new developments or extension of existing facilities to have a fire flow analysis performed. This analysis must be performed by the City of Bend. All relevant information to the proposed development or extension of services must be provided. Forms and fees for this service are available from the permit center in the Community Development Department (CDD) or on the City's website.

The fire flow analysis uses a calibrated hydraulic model to determine available flow. The analysis uses the peak day demand in the distribution system with storage tanks at half full to determine the available flow, static pressures, and residual pressures.

No other analysis for fire flow can be substituted for the analysis performed by the City using its calibrated hydraulic model.

5.6.1 Fire Flow Requirements

The following table lists the required fire flows based on land use and development type:

Land Use Code	Development Type	Required Fire Flow (GPM)
AOD	Airport Operations District	2,500
ARID	Aviation Related Industrial District	2,500
ASD	Aviation Support District	2,500
ASDRA	Aviation Support District Reserve Area	2,500
CB	Central Business District (CBD)	3,500
CC	Convenience Commercial District	2,500
CG	General Commercial District	2,500
CL	Commercial Limited	2,500
CN	Commercial Neighborhood	2,500
EFUTRB	Exclusive Farm Use	1,500
IG	General Industrial District	2,500
IL	Light Industrial District	2,500
IP	Industrial Park	2,500
ME	Mixed Employment	2,500
MR	Mixed-use Riverfront	2,500
PF	Public Facilities	2,500
PO	Professional Office	2,500
PO/RM/RS	Mixed Use Office/Residential	2,500
RH	High Density Residential	1,500
RL	Low Density Residential	1,500
RM	Medium Density Residential	1,500
RR10	Medium-10 Density Residential	1,500
RS	Standard Density Residential	1,500
SM	Surface Mining District	2,500
SR2-1/2	Suburban Low Density Residential	1,500
UAR10	Area Reserve District	1,500

5.6.2 Fire Service Lines

The City of Bend requires all fire service lines be designed by a registered Professional Engineer up to the right-of-way and submitted through a right-of-way plan review and approval process. The fire service backflow/premise isolation device shall be designed in accordance to all applicable building/fire/plumbing codes under a building department permit. Where the building is located within 20 feet of the right-of-way line, the developer has the option of installing the premise isolation within the building, otherwise it shall be placed in a vault near the right-of-way line. All fire service lines will be installed from the nearest water main with a valve located adjacent to the tap/tee. Fire Department Connections (FDCs) and Indicator Valves (PIVs or WIVs) can be located on building walls with fire and building department approval. PIV's and FDC's must be located on private property, unless otherwise approved by the City Engineer. If approved by the City Engineer to be located within the right-of-way, the PIVs and FDCs shall be a minimum 5 feet from roadways/curb. Construction documents shall provide a plan and profile of the fire service installation up to the right-of-way line. Standard Drawing W-13B for fire lines is a minimum standard only.

All fire service lines will require a DCDA around the backflow preventer.

Backflow Assembly vaults shall comply with the Uniform Plumbing Code requirement for electrical and heat for freeze protection as determined by the Building Department.

5.6.3 Hydrants General

Each hydrant shall be connected to the main with a 6-inch-diameter ductile iron branch with a 6-inch shutoff gate valve using a restrained MJ x MJ connection. Breakaway flange shall be no higher than 3 inches above the surrounding surface for Roadside Design compliance. See Specification 01160.10(a) and Standard Drawing W-7. No valve shall be located closer than 48 inches to the hydrant. When the hydrant branch line exceeds 100 feet in length, the hydrant lateral pipe must increase to 8 inch diameter and two valves shall be required: one near the hydrant, and one at the main.

Hydrants shall comply with AWWA C502-64 with a dry top, left-hand opening, and have one 5 1/4-inch steamer nozzle and two 2 1/2-inch hose nozzles. The steamer nozzle should always face the street with the exception of parking lots.

Hydrant extensions are not allowed on new hydrants but can be utilized on existing hydrants at the discretion of the City Engineer and the City of Bend Utilities Department. Extensions shall be from the manufacturer or approved equal, with a maximum of one extension per hydrant. Hydrant extensions shall not exceed 12 inches. All hydrant extensions shall be inspected during installation and approved by a City inspector. Hydrant drains will be surrounded by a washed gravel pocket, wrapped with filter fabric or 12 millimeter plastic, to provide drainage. No hydrant drains will be connected to either the sanitary or storm sewer system.

Hydrants are not to be used in lieu if air release or air-vac valves.

5.6.4 Location

Fire hydrant placement shall be outside the pedestrian path of travel. Hydrants shall be spaced at no more than 400-foot intervals measured as the hose would lay within right-of-way. Any further spacing requires approval of the Bend Fire Department.

Hydrants shall be located such that maintenance staff has complete access. They shall also be located to minimize the possibility of damage from vehicles or injury to pedestrians, with location preferred near intersections not directly on the corner. Hydrants located in parking areas must be protected, preferably by placing hydrants in a curbed landscape median/island. Concrete filled steel bollards are not preferred. Unless otherwise approved by the City Engineer, hydrants placed onsite shall have a premise isolation valve installed at the right-of-way line. All plumbing onsite shall be privately owned and maintained by the property owner.

A hydrant shall be positioned within 100 feet of an FDC when required by the Fire Marshall.

Where a fire hydrant is located on a fire apparatus access road, the minimum road with shall be 26 feet, exclusive of shoulders.

5.6.5 Concrete Pad

Concrete hydrant pads shall be required around all hydrants (See Standard Drawings W-7 and W-8).

Stormwater

Table of Contents

6 Stormwater

To meet the City goals for stormwater management, stormwater drainage and stormwater quality as prescribed in the City of Bend Stormwater Master Plan, the City has adopted best management practices for addressing stormwater drainage in the City of Bend.

Designs of stormwater facilities and conveyance systems shall conform to the City of Bend Standards and Specifications and the applicable Oregon Department of Environmental Quality (DEQ) regulations. Where a conflict is discovered between City and DEQ requirements, the Design Engineer shall notify the City Engineer of the issue and the most stringent practice shall apply.

The City recognizes the current Central Oregon Stormwater Manual (COSM) as a standard design manual for stormwater and incorporates it into these Design Standards except as modified or otherwise prescribed herein. The following sections summarize key elements of the City design requirements. Stormwater design professionals are required to be familiar with the specific requirements and practices of the Manual and implement them fully into their designs for City approval.

6.1 Design Storm

All stormwater designs for new development or redevelopment projects shall address and comply with the eight basic requirements prescribed in the COSM. Any deviation from the Basic Requirements, or other provisions of the COSM must be fully demonstrated and documented in writing by the design professional through the drainage submittal process.

6.1.1 Water Quality Design Storm

The six-month National Resource Conservation Service (NRCS) Type I, 24-hour storm event is the designated water quality storm event to be utilized for both volume based and flow rate-based water quality best management practices (BMP's). The six-month design storm rainfall depth can be estimated as 2/3 of the 2-year, 24-hour storm depth. When 2/3 of the 2-year, 24-hour rainfall depth is less than 0.5 inches, the rainfall depth shall be set at 0.5 inches.

6.1.2 Water Quality Design Volume

Volume-based treatment BMPs are sized the same whether located upstream or downstream from detention facilities. The water quality design volume is defined as the volume of runoff predicted for the proposed conditions Pollutant Generating Surface (PGS) areas from the NRCS Type I, 24-hour storm with a 6-month return frequency.

6.1.3 Water Quality Design Flow

For runoff treatment facilities preceding detention facilities or when detention facilities are not used, the water quality design flow is defined as the peak flow rate predicted for the proposed conditions PGS areas from the NRCS Type I, 24-hour storm with a 6-month return frequency.

For runoff treatment facilities located downstream of detention facilities, the water quality design flow is defined as the full 2-year release rate of the detention facility.

6.1.4 Flow Control and Conveyance

At a minimum, the 25-year design storm shall be required. Additionally, safe passage shall be provided for the 100-year event storm via an overflow path that drains toward the natural discharge point of the contributing basin, away from adjacent buildings and residences.

High-risk areas, as defined by the City Engineer, with the potential for extensive flooding, safety, or other concern, the design capacity shall be provided for a 50-year storm with safe passage for a 100-year storm. Low/sag points within roadways shall be designed to a minimum 100-year storm event.

Flow control facilities must be sized based on the total developed site area (both impervious and pervious areas, regardless of pollution generation) and take into account the immediate drainage basin(s) wherein the site lies.

6.2 Hydrologic Basis of Design

The following methods shall be used for the design of flow control and conveyance systems, in compliance with the COSM. The Engineer shall take into account soil types and geotechnical conditions into the design.

- National Resource Conservation Service (NRCS) Urban Hydrograph Method (TR-55)
- Santa Barbara Urban Hydrograph Method
- Level Pool Routing Method
- Rational Method / Bowstring Method

Other testing methods shall not be used in calculating facility sizes unless approved by the City Engineer.

6.2.1 Hydrologic Design Criteria

The Engineer shall use the following information in performing storm water design, originating from the Central Oregon Storm Water Manual.

City of Bend 24-hour Storm Depths (inches)

6-Month	2-Year	10-Year	25-Year	50-Year	100-Year
1.0	1.5	2.0	2.5	2.8	3.0

The Rational and Bowstring Methods are not to be used for basins exceeding 10 acres. Rainfall intensities shall be based on the COSM's Appendix 5C Intensity-Duration-Frequency Curves, which have been tabulated from Bend in the following table.

City of Bend Rainfall Intensity (I, inches per hour)

Tc (min)	5	10	20	30	40	50	60	70	80	90	100
2 yr	1.30	1.05	0.78	0.60	0.49	0.42	0.37	0.34	0.30	0.28	0.26
10 yr	2.45	1.95	1.50	1.10	0.86	0.71	0.61	0.55	0.48	0.46	0.42
25 yr	3.25	2.65	1.90	1.50	1.25	0.95	0.82	0.71	0.65	0.60	0.55
100 yr	5.20	4.10	3.00	2.35	1.80	1.30	1.20	1.10	0.95	0.88	0.79

Time of Concentration (Tc) shall be no less than 5 minutes, with overland flow segments not exceeding 300 feet.

All applicable coefficients and design valves (Manning n, Time of Concentration value, etc.) are found in the COSM's Chapter 5.

Within the public right-of-way, storm delineation basins shall detain storm volumes no larger than 25,000 gallons (3,342 cubic feet) based on the 25-year storm event for drywells outside a sag low point. Where within a sag low point, the basin shall detain the 100-year storm event of not more than 25,000 gallons (3,342 cubic feet). Catch basins, curb cuts and all applicable storm detention infrastructure shall be designed to reduce the basin size, avoid sag low points, and connect basins with overflow piping when conditions allow.

Public street design shall incorporate the storm water catchment basin to extend a minimum of 20 feet into the private lot. Calculations on the private lots must account for driveway impervious surface and possible reduced permeability. If topography is such that stormwater will never enter the right-of-way after the private lot's development, the Engineer of Record shall design the basin to the right-of-way. Calculations shall incorporate appropriate curve numbers or runoff coefficients for anticipated future impervious surface within the first 20 feet.

Where a regional storm basin (collecting private property into a public street) is to be employed in design or as determined necessary by the City Engineer, the larger basin design shall require geotechnical infiltration investigation specific for the drainage facility for use in design and have overflow structures installed to convey the 100-year storm event for the basin. The overflow is to be a separate structure from the 25-year containment facility, providing redundancy to the system. Regional systems are not permitted to flow and discharge stormwater outside the regional area / development limits.

Stormwater facilities (swales, UICs, etc.) within the public right-of-way cannot be designed or installed to be on top of franchise utilities. No stormwater facilities are permitted within PUEs unless otherwise approved. Swales will be required to have an overflow unless a 100-year storm event can be contained.

Private sites, that meet the COSM review requirements (COSM Chapter 2.1 criteria), will be reviewed by the City to ensure a 25-year, 24-hour storm event is contained onsite and will not flow into the public right-of-way or an adjacent property. The size of private drainage facilities (UICs or swales) do not have a maximum size unless there is the potential of the drywell to flow into the public right-of-way or a neighboring private property. If said conditions exist, storm facilities shall not exceed 25,000 gallons (3,342 cubic feet) as determined by a 25-year, 24-hour storm event.

6.2.2 Drainage Facility Testing

Prior to approval of any private or public right-of-way project, the Engineer of Record (EOR) shall oversee the construction and testing of the drainage facilities on the approved construction documents.

Public drywell facilities shall conform to the following testing criteria:

1. Install the drywell per the approved plans, specifications and applicable construction guidelines. The EOR shall witness the construction of these facilities to ensure that the drain rock quantity is being placed, drain rock has sufficient voids, and the construction is per the City of Bend's standards and specifications. Pictures shall be taken and provided with the EOR's certification.
2. Inspect drywell prior to testing, making sure the drywell is clean and free of sediments.
3. Field check the accuracy of the flow meter by filling up a suitable container with known volume; for example a calibrated 55-gallon barrel.
4. Introduce clean water into the drywell and monitor using an in-line flow meter.
    a. If the drywell total inflow design volume is 10,000 gallons (1,336 CF) or less, place the design volume in the drywell within a 1-hour period and verify that the water either, disappears immediately or, if standing water exists after the test, document the depth and complete the test using the COSM Appendix 4B, Full Scale Drywell Test Method.
    b. If the drywell total inflow design volume is between 10,000-25,000 gallons (1,336-3,342 CF), place an initial 10,000 gallons (1,336 CF) into the drywell within 1 hour. If any standing water is present at the end of the 10,000-gallon test, then the City will require the full design inflow volume and/or a Full Scale 2-hour Drywell test per COSM Appendix 4B.
    c. 25 percent of the drywells, or as otherwise determined by the City Engineer based on soil conditions, shall be tested to the COSM Full Scale drywell test. The drywells to be tested will be selected at random by the City inspector and tested by the EOR (or EOR representative).
5. Public and private swale facilities shall conform to the following testing criteria:
    a. Install the swale per the approved plans, specifications and applicable construction guidelines. The EOR shall witness the construction of these facilities to ensure the drain rock quantity is being placed per the design, has sufficient void capacity, and is constructed per the City of Bend's standards and specifications, if applicable. Pictures shall be taken and provided with the EOR's certification.
    b. Test the infiltration rate of the swale per Specification Section 01012.71.
6. Infiltration testing. Post-construction infiltration testing is required. Regardless of infiltration determination/testing, it is required that the EOR certify that all stormwater infiltrate from drywells/swales within 72 hours per COSM requirements.
    a. For drywells, draw down measurements shall be performed to determine infiltration rate and recorded during the drywell testing, tested in 5-minute increments for 20 minutes (obtaining 4 recorded draw down measurements). An average infiltration will be determined from the draw

down measurements and compared to the design infiltration used in the calculations.

b. For swales, infiltration shall be tested in conformance to the COSM Appendix 4D (Single-Ring Infiltrometer test), or other City approved method
    i. If design infiltration rates are not met during testing, the EOR shall determine how to 1) increase infiltration rates or 2) back calculate the facility design with the measured infiltration rate to determine if the facility has adequate capacity including a safety factor.

7. At the project closeout, private or public, the EOR will be required to certify the testing and construction of the drainage facilities, that they meet the performance standards under the stamped and approved design. Stormwater certification shall include
    a. All testing documents
        i. Recorded amount of water discharged into the facility, with start time and end time.
        ii. Draw down measurements. Depth of water at end of test with depth of water at 5-foot increments for 20 minutes duration, or until the facility is dry.
        iii. Construction inspection forms and pictures. Private and public project will not be approved by the City without this certification.
    b. Certification letter. The letter shall be stamped by the project EOR on company letterhead as conforming to the approved construction document and identifying design assumptions are true in the completed facility.

Swale and drywell failure is determined if the facility cannot 1) contain volumes during the test, 2) if the facility is unable to infiltrate at the design infiltration rate (dictated in the construction documents or the storm water report) and 3) if the stormwater rises to the highest perforation in the drywell. In any case, the total volume and rate injected into the drywell or swale does not need to exceed the design storm volume. It is the burden of the EOR to have the drainage facilities perform in accordance to the design criteria approved on the construction documents.

Private and Public drainage facilities shall be tested for volume in conformance to a method determined by the EOR in conformance with the City of Bend standards and COSM and that all storm systems work in conformance to the engineer's design.

6.3 Water Quality Treatment

Water quality treatment design shall comply with Chapter 6 of the COSM with the following modifications:

The City of Bend is subject to Oregon Department of Environmental Quality (DEQ) regulations for piped discharges to surface water bodies and for underground injection control (UIC) systems. All UIC systems installed shall meet rule-authorization requirements. All rule-authorized UIC systems must have a pre-treatment barrier, or other appropriate control(s) in place to treat stormwater prior to discharge into the subsurface. Additionally, UIC systems shall not be installed within 500 feet of any water wells, within drinking water protection two year time of travel areas, or in locations where the injected stormwater could affect contaminated soils or DEQ cleanup sites. UIC separation from water wells must be maintained unless a more stringent guideline is imposed by DEQ.

At no time can discharge from garbage containers/dumpsters or other polluting sources be discharged to a UIC. Proper containment of those systems and safe discharge must be designed by the project's engineer.

6.3.1 Treatment Controls

The following treatment controls are required by the City, in descending order of preference. The treatment controls selected for a specific site shall address the pollutants expected for that site, along with the specific geotechnical conditions of the site. Projects within major drainage basins adjacent to the river or drainage basins containing MS4 system shall address pollutants of concerns for the river, which is nitrogen limited. Pollutants of concern in the river through the City of Bend related to stormwater include: sediment/turbidity, pH, dissolved oxygen, and chlorophyll a. Pretreatment for Underground Injection Controls should focus on spill control. These controls shall be designed to the guidelines included in the standard drawings, and the COSM, with the City's standard drawings configurations and sizing taking precedence in case of a discrepancy. Treatment trains are encouraged as appropriate.

Given the importance of water quality, the City wishes to see preferred strategies in different areas of the City.

TABLE 6-1. PREFERRED STORMWATER STRATEGIES BY AREA

Area	Strategy	Types of Controls
Areas that drain to surface water	• Reduce flows to river/surface waters • Provide highest level treatment for remaining • Minimize sediment • Prevent facility clogging	• Drywells or infiltration trench with spill protection • Bioretention/Infiltration swale, pond, basin, planter box
Wellhead Protection Areas (One through 10 year Time of Travel)	• Spill Protection • Surface Infiltration Controls • Direct runoff to outside area if can for UIC use • Prevent facility clogging	• Water Quality Sediment Manholes, Oil/water separator TAPE approved manufactured spill control • Bioretention/ infiltration swale, pond, basin with treatment vegetation, planter boxes
Other Areas	• Dispersed System • UICs and regional controls • Prevent facility clogging	• Drywell or infiltration trench with spill protection (e.g., Water Quality Sediment Manholes) • Bioretention/infiltration, swale, pond, or basin • Planter boxes • Vegetated filter strip • Grassy swale

The City of Bend requires the installation of sedimentation manholes, per City of Bend standard drawing STRM-7, to be constructed prior to UIC's discharge unless otherwise approved by the City Engineer. Direct discharge from a swale into a drywell shall not be permitted without the installation of a sedimentation manhole upstream. STRM-7A provides for an optional deep sump catch basin special inlet that the City will accept only where conflicts do not allow for the installation of a standard sedimentation manhole. Sedimentation manholes provide for a convenient method to trap contaminated spills and to manage sediment loads prior to injection into the UIC.

Where development is occurring adjacent to an existing drywell, a sedimentation manhole may be required to be installed between the catch basin and the drywell unless otherwise approved by the City Engineer.

TABLE 6-2. PREFERRED TREATMENT CONTROLS

Treatment Type	UIC Pretreatment	Basic Treatment (TSS)	Oil Control (TPH)	Metals Treatment	Nitrogen[3]
Bioretention Systems—Storm Water Planters	X	X	X	X	X
Vegetated Infiltration Swales	X	X	X	X	X
Bioretention Systems—Landscape Detention	X	X	X	X	X
Extended Detention Dry Ponds	X	X	X	X	X
Grassy Swales	X	X		X	
Vegetated Filter Strips	X	X	X[1]	X[1]	
Sedimentation Manholes	X	X	X	X	

1) Vegetated filter strips are only applicable for oil control and metals when installed in series with an above ground flow control facility, such as a detention or evaporation pond. Such designs will be evaluated on a case-by-case basis.

2) Treatment controls for Nitrogen were determined using the International Stormwater BMP Database, 2014 BMP Performance Summaries.

6.4 Conveyance

A conveyance system includes all natural or constructed components of a storm drain system that collects stormwater runoff and conveys it in a manner that adequately drains areas, sites, structures, and roadways, minimizing the potential for flooding and erosion.

Stormwater conveyance systems that are unused and that have no approved current or future anticipated use shall be removed from the right of way or abandoned in place per Section 6.4.7. Stormwater mains within City stormwater easement, on private property, are preferred to be removed but can be abandoned in place, with approval from the City Engineer, provided the stormwater easement is extinguished.

The City defines an underground injection control, UIC, system as a drywell. The Department of Environmental Quality (DEQ) defines a UIC as structures that are deeper than wide at the land surface and utilize infiltration by a perforated pipe or drain field. UIC regulations do not apply to swales, french drains, or footing drains. UICs are to be placed outside the groundwater 2-year time of travel zones for drinking water source areas and not within 500 feet of a water well.

Drillholes are not permitted within the City of Bend right-of-way. Projects that contribute to or front an existing drillhole will either be decommissioned in accordance to DEQ requirements or have upstream infrastructure (sedimentation manholes and/or City of Bend catch basins with sumps, as approved by the City Engineer) constructed. Conveyance systems in the City of Bend shall be designed in accordance with COSM and the City standards, City standards taking precedence where in conflict.

When decommissioning a City UIC (drywell or drillhole), the Engineer and/or contractor are required to follow the DEQ steps for properly closing the storm facility. The process

with DEQ can take time, so the City encourages the Engineer/contractor to start the process early to avoid delays with right-of-way projects.

Step 1: Complete the DEQ UIC Pre-Closure Notification Form.

Step 2: Conduct a site inspection of the UIC; note any contaminants of potential concern.

Step 3: Determine Sampling Requirements. Samples will be collected only when the site inspection for the UIC determines:

a. Potential contamination source is identified within the UIC drainage area

b. The UIC contains free product

c. The UIC is located within 500 feet of a known domestic water well or within a 2-year time of travel of a delineated wellhead.

Step 4: Collect water and/or sediment samples as required and submit for laboratory analysis.

Step 5: Review the results of the laboratory analysis. If results are below applicable screening standards skip to Step 8. If results are above screening standards determine if there are likely impacts to the soil or groundwater quality as a result of UIC operation.

Step 6: Prepare follow-up site specific sampling plan if required based on the result of Step 5.

Step 7: Prepare Site-specific contaminated media management plan if required.

Step 8: Prior to UIC decommissioning, develop and implement a plan to manage the stormwater currently discharging to the UIC system.

Step 9: Prepare and Submit DEQ UIC Pre-closure Notification Form to DEQ at least 30 days prior to decommissioning the UIC.

Step 10: Decommission the UIC. This task may include scoping and bidding the work, and field work including performing required sampling, ensuring approved alternative facilities are in place, and rendering the UIC system completely inoperable including backfilling with materials appropriate for the site conditions that meet both DEQ and WRD requirements.

Step 11: Prepare a Submit the Closure and Decommission Report to DEQ and obtain final approvals.

6.4.1 Residential Conveyance to the Right-of-Way

Commercial and Industrial lots must not discharge to the right-of-way.

Residential subdivisions and lots have the ability to pipe private stormwater to the right way under the condition that:

1) The subdivision/lots were approved during land use for stormwater discharge to the right-of-way

2) The stormwater infrastructure was designed, constructed and tested to accommodate the additional storm capacity requirements

Stormwater conveyance shall be maintained within the subdivision tentative plan / masterplan area as approved during land use where private and public stormwater intermix. The stormwater for the development must be designed to be maintained within the development to a 100-year storm event – stormwater not flowing into adjacent, potentially undersized/under development, areas. Any agreements between the City and the development's Homeowners Associates, if applicable, and as required by land use, shall be recorded with Deschutes County prior to permitting storm discharge to the right-of-way.

Where permitted, stormwater from private property shall not discharge stormwater from overland flow to the right-of-way. Private yard drains and catch basins shall be directed to onsite private storm facilities and not into the right-of-way. Direct surface runoff from the private site must be contained on the private property, with exception of runoff from driveways where the right-of-way storm facilities must be sized to accommodate the additional storm flow. This is to deter discharge of sediments, yard debris and fertilizers and other contaminants into the City's systems.

At no time will the City permit a direct residential storm pipe connection to a public storm facility (drywell, sedimentation manhole, etc.) unless approved by the City Engineer. Where storm is being directed to the street by a weep hole, the sidewalk/shared-use path and pipe must be installed within the right-of-way per the standard drawings; the sidewalk/shared-use path cannot be bonded due to the requirements to maintain the pipe out of the concrete pour and installed the drain pipe to private property.

Stormwater systems may be constructed with service laterals to each lot to a stormwater main. This system must be design and constructed to sanitary sewer standards, utilizing manholes and service laterals. No cleanouts will be permitted on public systems. Public storm systems are not permitted within private property unless otherwise approved by the City Engineer and the public system being under a City Stormwater easement, 20 feet wide centered on the pipe.

Where a private storm system (collecting discharge from multiple sources/lots – single lot storm lateral) enters into a public storm system, a sedimentation manhole must be installed, with the sump depth designed to meet COSM requirement for the flow.

6.4.2 Pipe Material

Storm pipe under roadways or in areas that have traffic loads shall be constructed of AWWA C900 PVC pipe. Outside of the roadway, the Engineer has the option of using ASTM D3034 PVC sewer pipe. Storm pipe installed as part of a stormwater main and service pipe installation must be installed to sanitary sewer standards, following all depth of bury and water separation requirements, permitting the use of ASTM D3034 PVC pipe. All pipe installed shall conform to City of Bend specifications.

Where approved, residential storm pipe installed to curb weep holes shall be Schedule 40 PVC or approved equal.

6.4.3 Pipe Diameter and Length

The minimum pipe diameter shall be 8 inches. Pipe diameter shall be determined to ensure it is of proper size to convey a minimum 50-year storm event. When in the sag/low point, the pipe shall be sized to a 100-year storm event. The maximum length of pipe between junctions shall be no greater than 300 feet. Pipe diameters cannot be downsized for downstream runs.

Residential weep hole piping is to be minimum 3-inches. If it is determined that that the pipe running to the curb needs to be larger based on anticipate flows from the site, the City may require modifications to the curb exposure and height to accommodate the larger pipe size.

Where private water is being conveyed to a public storm sewer system to a swale or other storm facility within a subdivision, the storm sewer will be installed conforming to sanitary sewer design and construction standards, sizing the pipes to not less than a 50-year minimum storm basin size but not be less than 8-inch diameter.

6.4.4 Placement and Alignment

No storm drain pipe in a drainage easement shall have its centerline closer than 5 feet to a private rear or side property line or 10 feet from building foundations or other structures. For a storm drain located under the road, the storm drain shall be placed in accordance with the City of Bend standard detail. If it is anticipated that a storm drain system may be expanded in the future, provisions for the expansion shall be incorporated into the current design. Minimum depth of pipe is 12 inches below street base to top of pipe.

Drywell perforations shall be constructed in native soils, outside fill material. The drywell barrel foundation shall always be constructed on native ground. Any UIC installation, private or public, must not be within 70 feet of a hydrant.

Storm service pipes, considered sewer pipes because they convey non-potable water, shall meet the separation requirements of a sewer pipe, maintaining a minimum 10 feet from water services, but will be permitted within 2 feet of franchise services and sanitary sewer services. Storm pipe vertical separation shall maintain the same separation requirements as required for sanitary sewer installations.

When a storm sewer system main is installed, the street section shall be no less than 32-feet paved width. Storm systems shall be constructed to sanitary sewer construction standards, maintaining 10 feet from sanitary sewer mains and water mains. Sanitary sewer mains shall be in the middle of the road, with water and storm sewer mains on either side. Storm sewer mains are not to be installed within landscape strips to allow for franchise utility installation/maintenance and to avoid conflicts with water and sewer services to each lot.

Drywells and sedimentation manholes, when used as part of the drainage design, are to be placed in landscape strips per City Standard drawings, unless otherwise approved by the City Engineer. Drywells and sedimentation manholes must not be placed within sidewalks/shared-use paths or driveways.

6.4.5 Outfalls

New outfalls to the Deschutes River or other water bodies designated as waters of the United States require regulatory agency approval.

Pipe or curb cut outfalls into swales must have rip-rap installation to protect against scouring, with swale side slopes not exceeding 3H:1V at the outfall. Refer to the COSM for further design criteria requirements.

6.4.6 Storm Drain Debris and Safety

Debris protection shall be provided for storm drain systems. Debris may consist of soil deposits (that is, silt, sand, gravel and boulders), limbs, sticks, trash, or other landscaping materials.

Safety bars shall be provided for outfalls with a diameter of 18 inches or greater to protect from unauthorized individuals entering the storm drain system. Outfalls within a fenced area are not required to have safety bars. The clear space between bars shall be less than 4 inches.

6.4.7 Stormwater System Abandonment

No unused existing utility system elements may be abandoned in place within the City right of way or City controlled easements unless a waiver to allow abandonment is approved by the City Engineer.

When a system element is to be abandoned in place the following requirements must be followed;

- The City of Bend shall be notified whenever a system element is abandoned and shall be inspected to ensure conformance with the City of Bend Standards and Specifications.
- Submit full surveyed as-built plans in accordance with Part V of the City of Bend Standards and Specifications and comply with ORS dig law requirements for all abandoned underground, out of service and un-locatable facilities within the project limits.
- System elements with no approved future anticipated use, fill abandoned pipes completely with approved non-shrinking grout to prevent future loss of pipe integrity and roadway damage.
- Standard manhole structures will be removed to a minimum depth of six feet. Below a depth of six feet, the structures will be filled with approved road base rock material.
- Stormwater sedimentation manhole structures will be removed to a minimum depth of six feet. Below a depth of six feet, the structures will be filled with approved road base rock material.
- Catch basins will be required to be completely removed.
- All stormwater treatment facilities and UICs will be abandoned in accordance

with current DEQ rules and regulations.

6.5 Flow Control

Flow control facilities mitigate potential adverse impacts on downstream properties and natural resources resulting from the increase in stormwater runoff caused by land development.

Unless specifically approved by the City of Bend, stormwater runoff from any proposed land development to any natural or constructed point of discharge downstream shall not exceed the pre-development peak rate of runoff.

Flow control systems in the City of Bend shall be designed in accordance with COSM.

6.5.1 Sequential Implementation

In general, for any activity that creates, alters, or modifies a natural or man-made drainage system the following control measures are to be implemented sequentially:

1) Reduce runoff volumes and polluted runoff through Low Impact Development designs and source control measures
2) Address stormwater drainage with surface systems, such as above ground vegetated infiltration swales.
3) If surface control does not provide adequate capacity, treat the water quality storm in a surface facility and provide an overflow to an approved regional above ground retention facility or rule authorized UIC

6.5.2 Fencing

Fencing or other barriers shall be required to protect the health, welfare, and safety of the public under the following circumstances:

- Ponds with the first overflow at 3 or more feet above the pond bottom
- Ponds with side slopes in excess of 3H:1V
- Drainage facilities with retaining walls 2.5 feet high or taller. Walls within drainage facilities must be designed by a registered engineer for wall stability and hydraulic surcharge.

The City of Bend reserves the right to require a fence around any drainage facility should there be a concern for safety.

The minimum fencing requirements are as follows:

- The fencing shall be at least 4 feet tall unless otherwise specified by the City of Bend, and provide visual access per the City of Bend building code requirements for fence height and openings
- Gates are to be provided where drainage facilities are fenced. The gates shall be a minimum of 12 feet wide with provisions for locks. Separate gates may need to be

installed where the maintenance access drive connects to a public or private roadway.

- At the discretion of the City of Bend, marking fences (that is, vegetation, boulders, etc.), terraces, steeper side-slopes, egress bars, etc., may be allowed

6.5.3 Embankments

The height of an embankment is measured from the top of the bank to the catch point of the native soil at the lowest elevation. Embankments shall meet the following minimum requirements:

- Embankments, 4 feet in height or more, shall be constructed as directed by a Licensed Geotechnical Engineer

- Embankments shall be constructed on native consolidated soil, free of loose surface soil materials, roots, and other organic debris

- The embankment compaction shall be to 95 percent of the Modified Proctor Density, ASTM Procedure D698. Placement moisture content should lie within 1 percent dry to 3 percent wet of the optimum moisture content.

6.5.4 Access

Maintenance access roads shall be provided to control structures and other drainage structures associated with the stormwater facility (that is, inlet or bypass structures). Where storm infrastructure is away from paved right-of-way, a 14-foot wide, 2-inch thick paved all weather access road, with a 6-inch base, or as approved by the City Engineer, shall be installed centered over the sewer line with 6-foot square asphalt or concrete pad around manholes.

In ponds and swales, an access ramp is required.

6.6 Drainage Submittals

This section provides a framework for uniformity in Drainage Submittal preparation. Properly drafted construction plans and supporting documents should also facilitate the operation and maintenance of the proposed drainage system long after design and construction.

The City of Bend reviews the Drainage Submittal for compliance with these Design Standards and other applicable standards. The Drainage Submittal includes the Construction Plans, Full Drainage Report, and, other documentation to support the proposed stormwater management methods for the project. Depending on the complexity of the project, the City of Bend may request that a Concept Drainage Report (CDR) be submitted for review with the planning application or during the preliminary design process. The submittal and/or approval of the CDR does not replace the Drainage Submittal requirements. State law requires that all engineering work be performed by, or under the direction of, a qualified Engineer. The final Drainage report will be signed and stamped by a registered Engineer.

The Drainage submittal shall include the following components:

- Narrative
    - Project Description
    - Summary of Basin Requirements and other conditions/permits
    - Summary of Geotechnical Site Characterization
    - Downstream/Down-gradient Analysis
    - Upstream drainage basin analysis which are not project related but may generate runoff which may infiltrate proposed project area.
    - Hydrology Assumptions
    - Storm water Facility Description, existing and proposed
    - Conveyance System Description
    - Erosion and Sediment Control (ESC) Measures Description
    - Long Term Maintenance
        - Inspection plan / agreement – Provide calendar of required inspections
        - Spill Prevention and Control Plan
        - ESC Plan
    - Discussion on UICs being within a 2-year time of travel, or within 500 feet, of a domestic well head. Identify the location of the nearest domestic well – and include within the report the well log.
- Storm Basin Map
- Soils Map
- Phasing Map (if applicable)
- Site Photos
- Hydrology Calculations – including assumed or tested infiltration rates and other design assumptions
- Facility Sizing Calculations
- Conveyance Calculations
- UIC / swale testing criteria
- UIC rule authorization / registration documents, if available at time of report submittal
- 1200C permit plans and application, if applicable

- Grading, drainage facility, and erosion control plans (11x17).

The Long Term Maintenance section of the report shall be on a separate page as it will be attached to a Storm Water Maintenance Agreement (SWMA), if applicable for the site work. Storm Water Agreements are not required for public facilities

Drainage submittal requirements in the City of Bend shall be in accordance with COSM with the following modifications.

After any UIC is decommissioned, the City shall be provided all paperwork submitted and responses/approvals from DEQ. With the installation of any stormwater facility (swales, drywells, etc. as approved), testing, installation reports and an engineer of record certification shall be provided prior to approval and acceptance of the facility into the City's assets.

6.6.1 Concept Drainage Report

Acceptance of a CDR does not relieve the project proponent from a Geotechnical Site Condition Report, a Downstream/Down-Gradient Analysis, or changes to the design that may be necessary in order to meet the criteria and standards found in these Standards and the City of Bend's guidelines.

6.6.2 Concept Drainage Report Applicability

The City of Bend also reserves the right to require a CDR for projects when any unspecified drainage conditions or extenuating circumstances are present.

6.6.3 Road and Drainage Plans

Construction drawings shall be submitted for review by the City of Bend. The submittal and acceptance process shall be in accordance with the current City of Bend Standards and Specifications. Road and drainage plans shall include the City of Bend standard notes for construction.

6.6.4 Minimum Plan Elements

The road and drainage plans shall provide enough detail for a third party to be able to construct the proposed facilities per the Engineer's design. At a minimum, the plans shall meet the City of Bend's Design Standards, and the minimum plan elements described in the COSM.

6.6.5 Maintenance Agreements

All private commercial and industrial properties will be required to obtain a stormwater maintenance agreement at the construction conclusion of any new stormwater facility construction. Stormwater runoff from commercial and industrial sites must be maintained on private property, not permitted to flow into the right-of-way.

A typical subdivision does not require a stormwater maintenance agreement unless any of the following conditions exist:

1) Stormwater facilities are constructed within private streets, making the stormwater facility private (not maintained by the City or included within the City's DEQ permits). Any private UICs must be registered and rule authorized with DEQ.

2) Private stormwater runoff is permitted to flow into the public right-of-way stormwater facilities by land use. Stipulations on how private stormwater runoff is permitted to flow into public facilities are provided within these design standards.

    a. Stormwater runoff from private lots into the public right-of-way is not permitted unless the initial subdivision was design, constructed and tested by a registered engineer for the additional stormwater quantity

All stormwater maintenance agreements are to be prepared by the City and signed by the property owner. Refer to Bend Code Chapter 16.15.050.

Grading and Erosion Control

Table of Contents

7 Grading and Erosion Control

A comprehensive grading and clearing plan is required by the City of Bend Grading/Excavation/Stormwater Management Ordinance (Title XVI).

Soil conditions shall be addressed with the information gathered from the requirements of 11.2 - Geotechnical Recommendations Report where slopes greater than 2 horizontal to 1 vertical (2H:1V) exist, retaining walls greater than 48 inches in height or extensive areas of fill are proposed, where the wall is holding up City street or sidewalk/shared-use path, if unusual soil conditions are encountered or upon the request of the City Engineer.

Retaining walls or any other special structures shall be shown on the plans. Walls within 2 feet of a property line, having hydrologic, vehicular, or structural surcharge, or exceed 48 inches in height shall be designed by a registered Engineer and reviewed by the City of Bend for permitting.

Retaining walls are not permitted within the right-of-way without City Engineer approval. Where walls are approved on the right-of-way line, a slope easement shall be created on the adjacent private property being 1.5x the wall height, measured from finished grade at toe to top of wall cap. Where wall exceed or equals 4 feet tall, the slope easement shall be not less than 10 feet. To avoid undermining the wall, no structures, piping, or excavation shall be permitted within the slope easement unless approved by the City Engineer in writing.

If grading permit is required per Title XVI no work shall commence until a grading permit has been issued and a preconstruction meeting has been held.

All grading, erosion and drainage control plans submitted for review shall include the components required under the Central Oregon Stormwater Manual (COSM) and Bend Code Chapter 16.

Grading shall never exceed a 2H:1V cut/fill unless slope is verified by a geotechnical engineer and stabilized promptly after grading. 1.5H:1V cuts are permitted where excavation is within stable rock.

If a site exceeds 2 feet of fill, structural backfill shall be placed and tested in conformance to a geotechnical engineer's specifications. The City of Bend Building Department will require testing of this fill structure backfill before placement of structures on it.

When required for construction or road maintenance, the subdivision plan must establish an easement for a 2:1 slope along both sides of each public road right-of-way for public use. If a Public Utility Easement (PUE) is required along a road, that PUE is to be graded when the road is constructed on a side slope not to exceed 4:1; the 2:1 maximum side slope may commence outside the limit of the PUE. The Slope Easement must provide adequate room for proper transition grading at the toe or top of slope. The easement must be at the front setback line, or special setback line where applicable, per zoning, or as determined by a site-specific slope study in coordination with the road grade approved under this Chapter. A retaining wall instead of a slope easement may be allowed by the reviewing agency.

7.1 Erosion Control

Erosion control methods shall be shown on all construction documents and grading plan submittals. Every plan shall include methods for:

1) Temporary erosion control methods
2) A plan for final slope stabilization and mitigation for the disturbed ground
3) Erosion control maintenance.

Stormwater and sediments will be contained onsite, preventing the passage into right-of-way and/or adjacent private property.

All erosion control must be installed before mobilization, grubbing and/or grading begins. Water trucks or other means of controlling dust must be present on site and/or have a tackifier applied to disturbed soils.

7.1.1 Erosion Control Plans

The minimum requirements, if applicable, for an erosion control plan are as follows:

- Existing and proposed topographic contours shall be shown with adequate spacing of contour labels to easily discern direction of slope on a site.
- Clearing limits are defined. This includes site perimeter and areas to be protected (tree, utility, Areas of Special Interest, etc.)
- Construction Access Route. Every location where vehicles enter a site must have a construction entrance conforming to the minimum City standards.
- Sediment Controls (dust and water borne sediments)
- Soil stabilization
- Inlet Protection
- Runoff Control
- Concrete Washout
- Material Storage / Stockpiles
- Channel and outlet stabilization
- Dewatering
- Permanent Facilities
- Drywells, swales, other permanent detention/retention facilities
- Permanent erosion control for un-vegetated soils and slopes.

Inlet protection placed on grated inlets of street surfaces (bio-bags, gravel bags, bales, etc.) will not be permitted. All grated inlets are required to have pre-fabricated filter inserts with overflow installed per Standard Drawing E-2B. Field fabricated inserts (filter fabric, drain cloth, etc.) are not permitted.

Street surface inlet protection (bio-bags, gravel bags, bales, etc.) will only be permitted for ditch inlets and curb cut inlets per Standard Drawing E-2A.

7.1.2 Erosion Control Maintenance

Erosion control shall be maintained on all projects by the contractor under the guidance of the project EOR. The minimum maintenance of the Best Management Practices (BMPs) are as follows:

- Inspect on a regular basis (at a minimum weekly, and daily during/after a runoff producing storm event). All erosion and sediment control BMPs are to be fixed, replaced, or additional BMPs added immediately upon finding they are out of conformance or not functioning.

- Maintenance and repair:

    - Sediment must be removed from behind a sediment fence when it has reached a height of 1/3 of the fence height and also before fence removal

    - Sediment must be removed from behind bio bags, straw wattles, and other barriers when it has reached a height of 2 inches and also before BMP removal

    - Sediment must be removed from a sediment basin or catch basin when it has filled half (50 percent) of the facility storage capacity (sump area) and also at the completion of the project

- Remove temporary ESC BMPs within 30 days after the temporary BMPs are no longer needed.

- Permanently stabilize areas that are disturbed within 10 days of the project completion or when no work is being conducted

- When soils are tracked onto pavements, said pavements shall be immediately be swept and kept clean

- Contractors are expected to track weather conditions and forecasts and stabilize sites as needed to prevent erosion

7.1.3 Erosion Control Slope Mitigation

Prior to a site's final approval, all disturbed steep slopes (exceeding 2H:1V) must be treated for long-term erosion control. Disturbed ground of lesser slopes shall be treated for erosion control if sediments has the potential to leave the site.

Disturbed ground, especially steep slopes, shall be seeded. Seeding requirements are as follows:

- Seed shall be applied in a hydroseeding application, containing tackifier and fertilizers

    - Seed mix shall be free of noxious weed species, be native drought tolerant, and self-perpetuating. The following seed mixes, or approved equal, shall be used

        a. Grass seed mixture for areas “Disturbed by Construction”:

Species	Common Name	Percent by Seed Count
Festuca ovina	Creeping Red Fescue	30%
Pesudoregneria spicata	Blue Bunch Wheatgrass	25%
Festuca idahoensis	Idaho Fescue	15%
Achnatherum hymenoides	Indian Ricegrass	10%
Poa secunda ssp. Canbyi	Canby, OR Sandburg Bluegrass	10%
Elymus elymoides	Bottlebrush Squirreltail	5%
Linum lewisii	Blue Flax	5%

Application rate: 4 lbs. /1,000 square feet or approved equal.
* Oregon Certified Seed

        b. Seed Mix for Water Quality Swales:

Species	Common Name	Percent by Seed Count
Hordeum brachyantherum	Meadow Barley	25%
Danthonia callifornica	California Oatgrass	15%
Elymus glaucus	Blue Wildrye	10%
Bromus carinatus	California Brome	10%
Festuca roemeri	Roemer’s Fescue	10%
Deschampsia cespitosa	Tufted Hairgrass	10%
Agrostis exarata	Spike Bentgrass	10%
Alopecurus geniculatus	Water Foxtail	5%
Deschamsia elongate	Sender Hairgrass	5%

Application rate: 4 lbs. /1,000 square feet or approved equal.

        c. Lawn Seed (Turf Areas):

        Turf Type Tall Fescue, a minimum of three blends; 8 lb/1,000 sq. ft.

    - Seed shall be placed at a rate to provide 80-90 percent coverage over the disturbed surface

    - For immediate germination, application shall occur when the ground is not frozen, preferably when temperatures are between 75 and 85 degrees from daytime high. Hydroseeding should not occur on snow unless approved by the City Engineer.

    - Hydroseed shall be a Bonded Fiber Matrices (BFM) containing tackifier with seed and fertilizer. Install to manufacturer’s specifications or to a minimum 2,000 pounds per acre on slopes flatter than 2H:1V, 3,000 pounds per acre on 2H:1V slopes or steeper, whichever is most stringent.

- Prior to hydroseed placement, the contractor must

- Track-walk the full extent of the slope

- Install erosion control matting/blankets, fiber rolls/waddles, or other erosion control method per manufacturer's recommendations. The contractor and/or engineer shall determine the placement of these methods are based on the size of the disturbed slope and identification of any point discharge (channelized flows) onto the slope.

8 Franchise Utilities

8.1 Franchise Utilities in Public Rights-of-way

8.1.1 General

Utility companies that have a current franchise agreement with the City may construct facilities in City of Bend public rights-of-way or publicly controlled easements in strict conformance with the City of Bend Standards and Specifications and the requirements stipulated in the Franchise Agreement. Prior to starting any construction, franchise utility companies shall obtain a City Excavation / Right-of-Way permit in an existing roadway or easement. Utility companies and their designers and agents shall cooperate with the City of Bend to allow for City inspection of utilities and the street restoration during construction. The intent of this requirement is to protect the interests of all utilities within City of Bend rights-of-way.

The City of Bend requires that franchise utilities including, but not limited to, those required for electric, communication, lighting and cable television services and related facilities be installed underground, where possible. The developer shall make all necessary arrangements with the serving utility to provide the underground services. All above-ground equipment shall not obstruct clear vision areas and safe intersection sight distance for vehicular traffic.

Private utilities are not permitted within PUEs or right-of-way.

8.2 New Construction and Conduit Banks

When a private, underground utility is not completely installed by the time of road subgrade construction, appropriate utilities conduits (dry line) shall be placed in all areas to be paved to allow future completion of the utility. Conduit termini shall extend beyond the edge of pavement or curb a minimum of 5 feet. For wired utilities (cable, phone, electric, etc.), the ends of the conduit shall be sealed and marked in accordance with the requirements of the affected utility.

Franchise utilities shall be installed outside of the road pavement section, located within the road green strip / landscape strip or within a Public Utility Easement (PUE) on private property unless conducting perpendicular crossings. Only when approved by the City Engineer will franchise utilities be permitted within the road section of any new or existing development.

Private water utilities shall construct a dry line in an area to be improved with the line extending beyond the edge of pavement or curb a minimum of 5 feet. Any valves or thrust restraint for design conditions shall also be installed at the time the dry line is constructed.

All installations of private utilities shall be subject to the inspection of the affected utility and shall be acceptable to both the affected utility and the City of Bend.

8.3 Shared Trenches

Private underground utilities shall not be located within 10 feet horizontally of any water or sewer main line and shall be separated a minimum of 1-foot vertically. This requirement does not strictly apply to sewer service lines extending to individual properties.

All private utility crossings of public water or sewer mains shall be perpendicular to the roadway travel path.

Utilities may share the sewer service trench, 2-feet horizontally separated, in right-of-way areas in accordance with franchise utility agreements for shared trenches.

8.4 Trenching and Patching in Paved Right-of-Way Areas

Trench excavation and backfill shall conform to Standard Drawing R-10A and Specification Section 00405. Trench patching shall conform to Standard drawing R-11 and Specification Section 00495.

8.5 Small Wireless Facilities

Small Wireless Facility installations shall conform to the City of Bend Standards and Specifications, as well as the current version of additional references as specified and/or amended in the various subsections below. Small Wireless Facilities additional references include, but are not limited to:

- City of Bend Development Code and Ordinances of the City of Bend
- ORS 757.270 to 757.290
- Oregon Joint Use
- OPUC regulations
- NESC
- Applicable Building Codes
- Adopted joint use and co-locating requirements of all approved franchisees within the City of Bend
- All other referenced documents cited herein

8.5.1 Deviation from Small Wireless Facility Standards

The City of Bend provides for Small Wireless Facility installation designs that are flexible and reflective of their context while meeting current safety and operational standards. There may be times when compliance with the City of Bend Standards and Specifications is not desired or possible and the City's design standard deviation process shall be followed to receive approval from the City Engineer. The City Engineer may delegate review authority.

This standard deviation process shall not be used to override a requirement of a land use decision once finalized. The Bend Development Code has provisions for requesting modification to land use requirements. Except as provided elsewhere, in other City codes, resolutions, and land use actions; written requests for deviations from these Small Wireless Facilities design standards shall be reviewed and may be granted by the City Engineer according to the criteria outlined in Part I - Section 2 of this document.

8.5.2 Co-Location

The City of Bend prefers all Small Wireless Facilities be co-located per Bend Development Code Chapter 3.7. If the facilities cannot be co-located and a Franchisee wishes to install its facilities in the ROW, the Franchisee shall use the *City and County of Denver – Small Cell Infrastructure Guidelines (April 2018)* Chapters 1, Chapter 4, Chapter 5, Appendix A and Appendix B. All attachments to existing or new utility poles will be permitted through the approved Joint Use process of the utility pole owner. Attachments to City owned street luminaires shall comply with Chapter 3. Attachment to City of Bend Traffic Signal arms and structures is prohibited unless otherwise approved by the City Engineer and ODOT.

All references in the *City and County of Denver – Small Cell Infrastructure Design Guidelines* to "Xcel Energy" will mean the applicable utility pole owner, i.e. Pacific Corp or Central Electric COOP or other owner. All references to "City" and "County of Denver" will mean the "City of Bend." All inconsistencies, conflicting standards, and final interpretations of this or any additional references is at the discretion/ professional judgement of the City Engineer.

8.5.3 Location Guidelines

The following are guidelines for siting individual Small Wireless Facilities.

- Every effort should be made to install equipment in vaults underground or concealed as provided by the referenced design guidelines above

- Power connections to free standing facilities shall be buried underground in vaults unless otherwise approved

- All supporting equipment and connections to telecom facilities shall be installed in vaults underground, unless adequately shielded per the design guidelines or as approved otherwise

- New facilities linked together via fiber optics or other telecommunications infrastructure (other than wireless) will need to be designed as an Infrastructure/Tier Three ROW permit and shall be installed underground (connecting cables and power) unless they are co-located on existing power and telecom facilities

- Free standing facilities shall comply with Type 4 design specifications in Chapter 4 of the above referenced guidelines and shall be installed in all residential and business corridors as identified by the City during permitting

- An applicant wishing to attach to existing City of Bend facilities i.e., street luminaires, shall demonstrate that the pole(s) are appropriately sized, and have significant strength to support the additional equipment. Applicant shall provide an engineering

analysis of the structure by an engineer professionally registered in the State of Oregon.

- Refer to sections 3.4, 4.5, and 5.5 of the *City and County of Denver – Small Cell Infrastructure Guidelines (April 2018)* for additional placement requirements as applicable

- The City will review ROW permits concurrently with Joint Use applications for co-location requests with the applicable utility. Approval of all permits is conditional on approval of the Joint Use application from the franchise utility.

- See Standard Drawing R-2 for clear vision requirements. Large transformers and other above ground infrastructure, other than utilities poles, should be located outside the clear vision area unless otherwise approved by the City Engineer.

- The location of all co-located facilities shall be provided to the City in the form of a record drawing per 2.7 - Record Drawing Plan Submittal. All installations in the City's ROW shall be permitted per Bend Code Chapter 3.40.

8.5.4 Franchise Fees, License Fees and Permit Fees

Small Wireless Franchise Utilities shall pay all applicable franchise fees, license fees and permit fees in an amount established by the Fee Resolution or applicable Franchise Ordinance or Franchise Agreement, subject to any limit imposed by federal law. Utilities that do not have franchises shall pay the Utility License Fee plus applicable permit fees as outlined in the City's Fee Resolution, subject to any limit imposed by federal law.

8.6 Removal of Abandoned Facilities

Franchise Utilities shall remove any and all facilities not limited to conduit, structures, piping, wiring, poles, or other materials that are in, on, upon, over, under or beneath the public right of way that become unused. Restoration of the right of way shall be in accordance with the applicable City, state, and federal requirements and subject to the City of Bend Design Standards.

SECTION 2-10

Surveying

Table of Contents

10 Surveying

10.1 Datum Requirements

10.1.1 Horizontal Datum

Horizontal datum shall be based on the Deschutes County Coordinate System. The DCCS is a commonly used coordinate system, well-monumented within the City and available to all designers. It is also referred to as the "Central Oregon Coordinate System" and the "Deschutes County Grid". In any case, the basis for the coordinates is common to each. When converting to a Local Datum Plane (LDP), in which distances represent true ground distances, the project combined scale factor shall be stated for converting distances and coordinates between ground and grid. The combined scale factor shall be the product of the project elevation factor and the project grid factor.

10.1.2 Vertical Datum

Vertical Datum shall be NGVD 29.

10.2 Aerial Photography and Photogrammetry

Accuracy – Photo mapping for the purpose of creating a detail (base) map and Digital Terrain Model (DTM) shall be conducted so as to achieve at least 0.10-foot accuracy on hard surfaces.

10.2.1 Photo Targets

Aerial photo targets set within the project limits shall be surveyed for elevation by one or more closed differential or trigonometric level loops. The error of closure of each loop shall not exceed 0.02 foot. The elevations of aerial targets lying outside the project limits may be determined by GPS or other methods.

10.2.2 Supplemental Ground Surveying

Areas obscured or otherwise not detected by aerial photography shall be surveyed using ground methods that achieve at least 0.10-foot accuracy on hard surfaces.

10.2.3 Confidence Points

Random confidence points shall be measured in the field to verify the accuracy of the DTM. Confidence points shall NOT be included in DTM computation. There are four types of confidence points:

- **Surfaced** – hard surfaces (asphaltic concrete or concrete pavement, bridge decks, and walks)
- **Graded** – graded and possible compacted surfaces but not intended to be the traveled way
- **Natural** – surfaces in their natural state
- **Rugged** – extremely irregular surfaces (large rock outcroppings, rocky river bottoms, etc.)

The minimum number of confidence points required is 10 per instrument setup or 2 percent of the total number of contourable points used for the DTM. Two-thirds of all errors must fall within the error tolerances and 100 percent of all errors must fall within three times the error tolerances according to Table 12-1.

TABLE 12-1
Error Tolerances

Type	Imperial (feet)	Metric (millimeters)
Surfaced	+/- 0.1	+/- 30
Graded	+/- 0.3	+/- 100
Natural	+/- 0.6	+/- 200
Rugged	+/- 1.5	+/- 500

Confidence points shall represent all surface types contained in the DTM, shall be proportional to the four surface types depicted in the DTM, shall provide a good sampling of the overall model, and shall be placed randomly.

10.3 Requirements for a Licensed Surveyor

Land surveying activities, per ORS 672, including, but not limited to, boundary, right-of-way, easement determination, topographic mapping for design, horizontal and vertical control, legal description writing, construction staking, and any other surveying services necessary to prepare construction plans shall be performed under the direct supervision of an Oregon Registered Professional Surveyor.

10.4 Use of Benchmarks

Where practical, two or more benchmarks shall be surveyed and the elevation differences compared with the published data. If an unacceptable discrepancy between two or more benchmarks is discovered, measures shall be taken to determine which elevation(s) is wrong, and the bad elevations shall be corrected and brought to the attention of the proper jurisdiction.

10.5 Survey Data Required on Plans

In addition to the requirements of 2.3 - Information Required on Plans, the following survey data shall be shown.

10.5.1 Control

Project control points shall be shown graphically on the corresponding plan sheets. Tables listing Point Number, Northing, Easting, Elevation, and Point Description shall be shown on all plan sheets on which control points appear. A statement describing the project Basis of Bearings and the horizontal datum shall be placed on the Horizontal Control Sheet.

The benchmark used for project vertical control shall be described on the Horizontal Control Sheet. The description shall include the location, type, size, and origin of monument, if known, and the elevation and vertical datum.

10.5.2 Monuments of Record

Monuments of record shall be shown graphically on the corresponding plan sheets. Preserve survey monuments according to ORS 209.140, ORS 209.150 and ORS 209.155. If such monuments are to be disturbed or destroyed, comply with requirements of these ORS for replacement or necessary actions.

10.6 Construction Phase Surveying

10.6.1 Supplemental Control

Any additional survey control point(s) needed for construction staking shall be established by one of three methods:

- The point(s) shall be double-tied from existing adjusted control by measuring from a minimum of two different existing control points and averaging the xyz coordinates, or the point(s) shall be measured twice from an existing control point using a different existing, adjusted backsight point for each measurement, and averaging the xyz coordinates
- The point(s) shall be included in a closed, adjusted traverse that begins and closes on two existing adjusted control points
- The point(s) shall be included in a network survey that is adjusted by the Method of Least Squares

10.6.2 Construction Staking

Construction staking shall be provided per Specification Section 00305 for all water, sewer, storm, roadway, irrigation, franchise, or other facilities as required for City inspectors to verify position of facilities within the public right of way or public easements.

~~Construction staking shall be provided per Specification Section 00305. Stakes shall be provided prior to construction of facilities so that City inspectors may verify position of facilities.~~

10.6.3 Cutsheets

When requested, cut sheets for each phase of construction shall be prepared and forwarded to the Construction Inspector and to the Construction Supervisor on the next business day following the construction staking. A business day for purposes of this section is any day that construction work proceeds on a project. At minimum, cut sheet information shall include feature being staked, station, offset left or right, design elevation, offset hub elevation, and cut/fill.

10.7 Final Submittal of Electronic Files

10.7.1 CAD Files

All CAD files for final submittal to the City of Bend shall be prepared as specified in 2.4 - CAD Drafting Standards.

All electronic spreadsheet files for final submittal to the City of Bend shall be compatible with MS Excel.

10.7.2 Word Processing Documents

All electronic word processing documents for final submittal to the City of Bend shall be compatible with MS Word.

10.7.3 Image Files

All non-editable image files for final submittal to the City of Bend shall be submitted in PDF format.

Geotechnical Engineering

Table of Contents

11 Geotechnical Engineering

A geotechnical investigation is required by the City of Bend for all projects involving excavation within the public right-of-way unless a project-specific deviation request has been approved by the City Engineer. Because of the wide array of site conditions and project types within the public right-of-way, the Design Standards for geotechnical services contained herein are intended only to supplement the recognized design manuals and code documents listed in 11.8 - References, or the latest published edition of a reference as of the date of CIP contract execution or Initial Development Plan Submittal. The reference documents are listed in order of precedence, should a discrepancy be identified among the references. The City's Geotechnical Design Standards (presented below) and Construction Specifications shall take precedence over the reference documents.

The scope of the geotechnical investigation, typically including office studies, field and laboratory testing, engineering analyses, and recommendations for design and construction shall be developed by the Geotechnical Engineer based on engineering judgment and guidelines provided in applicable sections of the reference documents.

All public works and transportation infrastructure located within the public right-of-way shall be designed by a Professional Engineer registered in the State of Oregon. Copies of supporting design calculations shall be provided to the City Engineer upon request.

11.1 Geotechnical Data Report

Geotechnical Data Report (GDR). For development projects, a GDR is not required unless requested by the City following the Initial Submittal Plan. The purpose of this report is to summarize results of office studies and field and laboratory test results, as well as available information from previous projects. The GDR shall be submitted to the City prior to 30 percent completion of the design to allow the findings to be used in the design and for the development of the construction schedule and cost estimate. A report shall include:

- Description of the previous site uses, current site conditions, and proposed infrastructure
- Review of available subsurface information such as geology maps, seismic hazard maps, and geotechnical reports for previous nearby projects
- Reconnaissance of the surface conditions including topography, vegetation, exposed soils and/or rock outcrops, drainages, existing infrastructure, and any features that indicate geologic hazards such as subsidence, rapid erosion, or slope instability
- Results of subsurface explorations including geotechnical boreholes, test pits, and/or alternative methods approved by the City Engineer. Soil and rock shall be described according to the ODOT Soil and Rock Classification Manual (1987).
- Results of laboratory testing for soil and rock classification and the determination of engineering properties for design, including references to applicable testing standards
- Results of field instrumentation (for example, piezometers or slope inclinometers) or field testing (for example, infiltration testing)

11.2 Geotechnical Recommendations Report

For Capital Improvement Projects (CIPs), the responsible Engineer of Records shall be responsible for completing a Geotechnical Recommendations Report independent of the Geotechnical Data Report. A typical recommendations report shall include:

- Detailed descriptions of the proposed infrastructure and associated design criteria
- A brief summary of the subsurface condition and reference to the Geotechnical Data Report
- Discussion of analytical methods including technical references
- Summary and interpretation of analysis results
- Recommendations for design and construction

For new residential developments and fast-track CIPs, geotechnical data and recommendations may be provided in a single report with prior approval by the City Engineer.

11.3 Pipelines, Appurtenances, and Ancillary Structures

Potable water, stormwater, and sanitary sewer pipelines, and appurtenances, shall be designed according to the City's Construction Specifications and manufacturers' specifications. While it is recognized that these guidelines will provide adequate performance for typical projects, it remains the responsibility of the Design Engineer to ensure that the design satisfies the broader spectrum of criteria presented in the reference documents.

11.3.1 Excavation

All utility excavations shall satisfy the current requirements of the Oregon Administrative Rules (OAR), Division 3, Subdivision P, Excavations.

11.3.2 Thrust Restraint

Pipelines that convey fluid under pressure shall have thrust restraint measures at each bend and dead end run of pipe, designed according to Section M41 of the American Water Works Association (AWWA) 2009 Manual of Water Supply Practices. Joint restraints shall be used extending from the pipe bend to the point at which the friction along the pipe exceeds the thrust at that bend. Thrust blocks shall not be used without prior approval by the City Engineer.

11.3.3 Drywells

All drywells shall be designed in accordance with the current provisions of the Central Oregon Storm Water Manual, including completion of field and laboratory testing, where applicable.

11.3.4 Seismic Design

Buried pipelines shall be designed in accordance with the American Lifeline Alliance (ALA) 2005 publication "Seismic Guidelines for Water Pipelines," and above-grade piping shall be designed according to the 2002 ALA publication "Seismic Design and Retrofit of Piping Systems." The scope of the analysis will depend on the type and size of the utility, and its level of importance to the overall network. For example, even relatively small pipelines may

be deemed important if damage to those lines could threaten an adjacent mainline that serves lifeline facilities. Critical segments will require probabilistic seismic hazard analyses and a complete screening for seismic hazards including seismic wave propagation, seismic settlement, landslides, lateral spreading, liquefaction, and the presence of potentially active faults. For most residential applications, the design shall be completed according to the simplified design methods given in these publications.

11.3.5 Ancillary Structures

Public works structures such as pump stations, reservoirs, control buildings, and vaults shall be designed in accordance with Oregon Structural Specialty Code (2019), City of Bend Standard Construction Specifications, as well as applicable standards of the AWWA, and the American Concrete Institute (ACI). Seismic analysis of these structures shall include potential impacts to connections with buried and aboveground utilities and appurtenances.

11.4 Pavement Design

Pavements that will support a high volume of heavy vehicles and all streets included in the transit classifications (Expressways, Arterials, Major Collectors, Minor Collectors) shall be designed according to the ODOT Pavement Design Guide (2019), the American Association of State Highway and Transportation Officials (AASHTO) Guide for Design of Pavement Structures (1993), and the AASHTO supplement for Rigid Pavement Design & Rigid Pavement Joint Design (1998). Other recognized methods such as those developed by the Asphalt Institute, Portland Cement Association, Asphalt Pavement Association of Oregon, or the American Concrete Pavement Association may also be used with prior approval by the City Engineer. Local residential streets, including alleys, t-courts, and shared lanes, shall be designed using pavement sections equal to or greater than the minimum dimensions presented in 11.4.5 - Minimum AC Thickness and 11.4.6 - Minimum PCC Thickness and Joint Design.

11.4.1 Traffic Analysis

Pavement design will require an investigation of the traffic volumes, distribution of vehicle types, and traffic growth rates. The design traffic volume shall be calculated as the total number of equivalent, single, 18-kip axle load (ESAL) applications over the life of the pavement, based on the conversion factors for truck and non-truck traffic shown in Table 11-1.

TABLE 11-1
ESAL Annual Conversion Factors

Vehicle Type	ESAL Annual Conversion Factors			
	Flexible Pavement		Rigid Pavement	
	One-Way Traffic Data	Two-Way Traffic Data	One-Way Traffic Data	Two-Way Traffic Data
2-axle truck	100	50	100	50
3-axle-truck	220	110	270	135
4-axle truck	320	160	400	200
5-axle truck	650	325	950	475
6+ axle truck	650	325	950	475
Passenger cars	0.3	0.15	0.3	0.15
SUVs	1.9	0.95	1.9	0.95
Pickups	4.5	2.25	4.5	2.25

11.4.2 Subgrade Properties

Subgrade properties shall be determined for flexible pavements (resilient modulus) and rigid pavements (modulus of subgrade reaction) using methods appropriate to the proposed construction and design procedure. Back-calculation is the standard method for rehabilitation projects and may also be used for widening or the minor realignment of existing pavements. This method typically requires a condition survey, pavement cores, and falling weight deflectometer (FWD) testing to characterize the existing pavement section and subgrade.

For new pavement or full-depth reconstruction where back-calculation from FWD tests is not practical, the subgrade design parameters shall be determined using laboratory resilient modulus tests (flexible pavement), field plate load tests (rigid pavement), or correlations with the results of field dynamic cone penetrometer (DCP) tests. Subgrade parameters correlated from California Bearing Ratio (CBR) test results shall not be suitable for design. For roadways that will support less than 50,000 ESALs annually, the subgrade resilient modulus may be estimated based on the soils classification and prior experience with similar soils.

11.4.3 Inputs for 1993 AASHTO Pavement Design Procedure

Inputs for the 1993 AASHTO pavement design procedure shall be selected in accordance with the ODOT and AASHTO guidelines. For rehabilitation projects, selection of these design parameters shall be determined based on the condition of the existing pavement section and FWD test results. Structural coefficients used in the design of pervious pavements will need to be supported by field or laboratory test data, or recognized reference documents.

11.4.4 Minimum Design Life, and Life-cycle Cost Analysis

The minimum design life for new pavement sections shall be 20 years and 30 years for flexible and rigid pavements, respectively. Rehabilitated pavement sections shall have a design life of 15 years, or as determined by a life-cycle cost analysis (LCCA) according to AASHTO guidelines. LCCA shall be completed for new pavements and rehabilitation projects to evaluate the costs and benefits of the various pavement types or rehabilitation strategies.

11.4.5 Minimum AC Thickness

Refer to 3.8.5 - Pavement Sections for minimum AC thickness.

11.4.6 Minimum PCC Thickness and Joint Design

The minimum Portland cement concrete (PCC) thickness shall be determined according to the procedures of the AASHTO supplement for Rigid Pavement Design & Rigid Pavement Joint Design (1998), or approved equivalent, and rounded up to the nearest 0.5 inch. An increased PCC section may be required at bus stops or at other locations where heavy trucks regularly stop and start. In no case, shall the PCC thickness be less than 5 inches, and all PCC pavement sections should include a base rock section that will provide adequate drainage.

Proper joint design is critical to the performance of PCC pavements and the submitted pavement design shall include an explanation of the selected joint patterns, including applicable references and design criteria.

11.5 Sign, Luminaire, and Signal Pole Foundations in the Public Right-of-Way

For standard sign, luminaire, and signal poles, the ODOT standard foundation plans for standard sign, luminaire, and signal pole shall be used where the minimum geotechnical foundation requirements of the plans are met. Where nonstandard signs, luminaires, or signal poles are proposed, or where the geotechnical conditions do not meet the minimum requirements of the standard plans, foundations for the signs, luminaires, and signal poles within the public right-of-way shall be designed in accordance with the AASHTO (2001) Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

11.6 Other Transportation Design Elements

All other transportation design elements, including but not limited to bridges, culverts, embankments, retaining walls, and cut slopes, shall be designed in accordance with the ODOT (2018) Geotechnical Design Manual, the ODOT (2021) Bridge Design and Drafting Manual, and the AASHTO (2017) Load and Resistance Factor Design Bridge Design Specifications. Abbreviated design efforts may be acceptable for some applications if approved by the City Engineer.

11.7 Blasting

All transportation and utility design elements requiring blasting for the excavation of rock shall be designed to prevent damage to existing infrastructure, and avoid unnecessary overbreak of the rock. A precondition survey of nearby structures, private or public, shall be completed prior to the start of blasting, and the blasting program shall include provisions for monitoring of potential damage, or vibrations or noise in excess of permitted levels. Follow blasting requirements in OSS Section 00335.

11.8 References

Design of facilities for the City of Bend shall meet or exceed the requirements of the following references, or the latest published edition as of the date of CIP contract execution or Initial

Development Plan submittal unless otherwise directed in writing by the City Engineer. The documents are listed in order of precedence, should a discrepancy between cited references be identified.

11.8.1 Utility Systems; Pipelines, Appurtenances, and Ancillary Structures

- Oregon Occupational Safety and Health Department (OR-OSHA). Oregon Administrative Rules, Division 3, Subdivision P, Excavations.
- Oregon Department of Transportation/Oregon Chapter of the American Public Works Association (ODOT/APWA). 2021. *Oregon Standard Specifications for Construction.*
- AWWA 2009. Manual of Water Supply Practices –M41: Ductile-Iron Pipe and Fittings. Third Edition.
- ALA. 2005. Seismic Guidelines for Water Pipelines. March.
- ALA. 2002. Seismic Design and Retrofit of Piping Systems. July.
- Central Oregon Intergovernmental Council (COIC). 2010. *Central Oregon Stormwater Manual.*
- International Code Council (ICC). 2018. *International Building Code.*
- ICC. Oregon Structural Specialty Code. 2019.

11.8.2 Transportation Structural Elements; Pavements, Bridges, Culverts, Embankments, Retaining Walls, and Cut Slopes

- ODOT. 2018. Geotechnical Design Manual.
- ODOT. 1987. Soil and Rock Classification Manual.
- ODOT. 2019. Pavement Design Guide.
- ODOT. 2019. Bridge Design & Drafting Manual.
- AASHTO. 1993. Guide for Design of Pavement Structures.
- AASHTO 2001. Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, Fourth Edition.
- AASHTO. 2017. AASHTO Load and Resistance Factor Design Bridge Design Specifications, 8th Edition

IMPORTANT NOTICE:
Standards and Specifications 2023 Update

Provided below is a summary of the 2023 revisions to the **City of Bend Standards and Specifications**, adopted April 15, 2022. Text in red underline has been added. Text in red ~~strikethrough~~ has been removed.

Revised Sections include:

Section 00220 – Accommodations for Public Traffic

- 00220.60(a)(1) Contractor Responsibility
- 00220.90 Payment
- 00220.91 Payment Other Items

Section 00222 – Temporary Traffic Control Signs

- 00222.41 (e) Perforated Steel Square Tube Sign Supports

Section 00305 – Construction Survey Work

- 00305.00 Scope
- 0030.40 Construction Staking

Section 00405 – Trench Excavation, Bedding, and Backfill

- 00405.13 Pipe Zone Material
- 00405.15(b) Class B Backfill

Section 00440 – Commercial Grade Concrete

- 00440.11 Proportions
- 00440.12 Properties of Commercial Grade Concrete
- 00440.40(d) Weather

Section 00445 Sanitary, Storm, Culvert, Siphon, and Irrigation Pipe

- 00445.11 Materials
- 00445.40(b) Line and Grade
- 00445.40(h) Sewer Taps
- 00445.74 Video Inspection of Sanitary and Storm Sewers

Section 00470 – Manholes, Catch Basins, and Inlets

- 00470 Manholes (including drywells), Catch Basins, and Inlets
- 00470.90 Payment

Section 00641 – Aggregate Subbase, Base, and Shoulders

Section 00759- Miscellaneous Portland Cement Concrete Structures

- 00759.22 Smart Level

Section 01140 – Potable Water Pipe Fittings

- 01140.53 Filling, Flushing, Disinfection, and Hydrostatic Testing
- 01140.53 (b) Testing Procedures
- 01140.53 (e) Chlorination

Section 01170 – Potable Water Service Connections, 2 Inch and Smaller

- 01170.50 Flushing and Sampling

Section 00220 - Accommodations for Public Traffic

Comply with Section 00220 of the Standard Specifications modified as follows:

(Use the following subsection .02(a) when any of the following bullets are included in the project special provisions. Delete "(s)" or parentheses, as applicable.)

00220.02(a) General Requirements –

Replace the bullet that begins “Do not stop or hold vehicles…” with the following:

(The stop or hold duration may be increases up to 20 minutes with approval from the Engineer. 5 minutes is the default unless otherwise approved.)

- Do not stop or hold vehicles within the work zone for durations longer than allowed in the approved traffic control plan.

Add the following bullet*(*s*)* to the end of the bullet list:

- Notify the Engineer a minimum of 7 Calendar Days prior to activating any traffic control changes. Include contact information for the TCS and Site Manager in the notice.

- Temporary steel plating is not allowed between November 1st and March 1st. Removal all steel plates 24-hours prior to a forecasted snow event of greater than 1 inch.

(Use the following bullet when the pre-construction speed is greater than 35 mph and there is trench excavation or other excavation work to be performed.)

- When performing trench excavation or other excavation across or adjacent to a Traffic Lane on a roadway having a pre-construction posted speed greater than 35 mph, backfill the excavation, install surfacing, and open the roadway to traffic by the end of each work shift. Install a "BUMP" (W8-1-48) sign approximately 100 feet before the backfilled area and a "ROUGH ROAD" (W8-8-48) sign approximately 500 feet ahead of the "BUMP" sign. If this requirement is not met, maintain all necessary lane or shoulder closures and provide additional TCM, including flagging, at no additional cost to the Agency. Do not use temporary steel plating to reopen the roadway.

(Use the following bullet when any of the following apply:

- ***A new temporary or permanent STOP sign is installed at an intersection.***
- ***Modifications are made to lane configurations, lane assignments or roadway geometry that affects traffic patterns.***
- ***A permanent traffic signal is being installed or modified.***

- Before activating a modified traffic signal, revising lane usage, implementing new roadway geometry, or removing a "STOP" sign, protect traffic by installing "NEW

TRAFFIC PATTERN AHEAD" (W23-2) signing according to 00222.40. Keep the signs in place for 30 Calendar Days after completing the modifications.

(Use the following bullet when excavation or paving creates an abrupt edge.)

- When excavation or paving operations create an abrupt edge, protect traffic by installing "ABRUPT EDGE" (CW21-7) signs every 500 feet.

(Use the following bullet any time traffic queues are expected to develop within proximity of a railroad crossing. Include Standard Drawing TM850.)

- When flagging operations may extend traffic queues onto the railroad crossing, protect traffic at the intersection of _____ and _____ by providing an additional flagger. Position additional flagger signs according to the "Advance Flagger for Extended Traffic Queues" configuration shown on the Standard Drawings. Do not allow traffic to stop on the railroad crossing.

00220.02(b) Temporary Pedestrian Accessible Route Plan –

Delete the bullet that begins “For intersection Work…”

Replace the bullet that begins “Limit pedestrian detour…” with the following:

- Limit pedestrian detour lengths to the shortest available accessible route.

Add the following bullet:

- Limit closure of pedestrian facilities to the duration established in the pre con schedule.

(Use the following subsection .03(b) when public access(es) to a floatable natural waterway has been identified. Originated from HB2835 (2019). Delete "(s)" or parentheses, as applicable.)

00220.03(b) Closures - Add the following bullet*(*s*)* to the end of the bullet list:

- **Floatable Natural Waterway** - A minimum of 35 Calendar Days before restricting or closing the public access site(s), listed below:

(Fill in the blank with the appropriate public access location(s) information and include “as shown” if the access is shown on the Plans. Repeat the bullet as necessary to list all locations. Delete parentheses and the words in the parentheses as needed.)

  - **Public Access Location** - _____ *(*as shown*)*.

Submit to the Engineer, in writing, when the closure(s) or restriction(s) have ended.

00220.03(b) Closures –

Replace the bullet that begins "**Pedestrian Facilities –** A minimum of 14 Calendar Days…" with the following bullet:

- **Pedestrian Facilities** - A minimum of 72 hours before closing a sidewalk, Multi-Use Path, or other pedestrian facility. After receiving written approval, provide 48 hours' public notification before the closure.

Replace the bullet that begins "**Bicycle Facilities –** A minimum of 14 Calendar Days…" with the following bullet:

- **Bicycle Facilities** - A minimum of 72 hours before closing a bicycle lane. After receiving written approval, provide 48 hours' public notification before the closure.

Add the following paragraph to the end of the subsection:

Provide a minimum of 48 hours' notice to occupants of properties fronting a street where more than half the street will be closed to vehicular traffic. Coordinate street closure with all affected individuals and public agencies.

(Use the following subsection .40(e)(1) only when modifying closed lane restrictions. Fill in the blanks with the street name to be closed followed by the closure limits. Copy and paste the paragraph and bullet list as necessary for additional roads.)

00220.40(e)(1) Closed Lanes - Replace this subsection, except for the subsection number and title, with the following:

One or more Traffic Lanes may be closed on _____ between _____ and _____ when allowed, shown, or directed during the following periods of time except as specified in 00220.40(e)(2):

- _____

00220.40(e)(2) Opened Lanes – Replace the sentence that begins "Keep all Traffic…" with the following paragraph:

Maintain two-way traffic at all times unless otherwise allowed. Streets shall remain open for two-way traffic at all times when the Contractor is not performing work unless otherwise allowed. Maintain access to approaches to all properties except for short periods necessary for the progress of the construction. Keep all Traffic Lanes and pedestrian facilities open during the following periods:

(Use the following subsection .40(e)(2)(b) to list special events. List the names, times, and dates of the events.)

00220.40(e)(2)(b) Special Events - Add the following to the end of this subsection:

The following special events will occur during this Project:

- _____

(Use the following lead-in paragraph and subsection .40(f) when blasting, erecting bridge girders, erecting sign structures, or conducting other short duration work that can be done in periods not exceeding 20 minutes. Add applicable items and delete non-applicable items in the first sentence. Do not change the subsection alpha character (keep it "(f)".)

Add the following subsection:

00220.40(f) Limited Duration Road Closure - The Contractor will be permitted to close all Traffic Lanes for periods not to exceed 20 minutes in duration during blasting or erecting Bridge girders and sign structures over the Traffic Lanes or _____. This Work will only be permitted between the hours of _____ and _____ on ___(street name)___.

Succeeding roadway closures will not be allowed until traffic clears from a preceding closure.

(Use the following subsection .60(a)(1) when construction is anticipated in winter months)

00220.60(a)(1) Contractor Responsibility – Add the following paragraph and bullets to the end of the subsection:

Provide snow and ice removal for all streets with traffic control or channeling devices deployed within a travel lane and all streets where the existing pavement has been disturbed according to the following:

- Maintain a map showing snow removal boundaries and submit the map to the Engineer a minimum of 24-hours prior to a forecast showing snow accumulation exceeding 2 inches.
- When directed, provide snow and ice removal when accumulations exceed 2 inches on arterial and collector streets and 6 inches on local streets.
- Plow streets from curb to curb, or edge of pavement to edge of pavement where no curbs exist. Use equipment designed for such plowing including road graders, front end loaders, truck-mounted plows. Provide lights and beacons and appropriate signage for operating on public roads. Broadcast crushed basalt traction material on post-plowed surfaces in accordance with current City standards. Keep storm drains clear of snow and ice.
- Push the snow toward the side of the street. Minimize blocking of driveways and burying sidewalks. Do not push snow into natural surface bodies of water.
- Damage to public or private property caused by the Contractor's snow removal will be repaired at the Contractor's expense.

(Only use the following subsection 00220.90 modification and the added subsection 00220.91 below in conjunction with 00220.60(a)(1) above when construction is anticipated in winter months and the contractor will be responsible for clearing of snow. To clarify, if there is no responsibility of the contractor to remove snow, do not modify 00220.90 as shown below nor add the 00220.91 section.)

00220.90 Payment – Replace ~~this~~ the first sentence of this subsection, ~~except subsection number and title,~~ with the following:

No separate or additional payment will be made for Work performed under this Section, unless as identified in subsection 00220.91 or Pay Items are provided under other Sections.

Add the following subsection

00220.91 Payment Other Items

The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Snow Removal	Force Account

Item (a) will be paid on the Force Account basis in accordance with Section 00197 up to the contract allowance price and will include full compensation for furnishing all labor, materials, permits, tools and equipment required to complete the Work. Snow removal must be directed by the Engineer. Work performed without written authorization may not be subject to payment.

End of Section

Section 00222 – Temporary Traffic Control Signs

(Use the following lead-in paragraph when none of the following subsections are included in the project.)

Comply with Section 00222 of the Standard Specifications.

(Use the following lead-in paragraph when any of the following subsections are included in the project.)

Comply with Section 00222 of the Standard Specifications modified as follows:

(Use the following subsection .40(e) when adding any of the following temporary signs.)

00222.40(e) Temporary Sign Placement - Add the following to the end of the bullet list:

(Use the following bullet when it is necessary to reduce the overall roadway width between positive barriers [for example: concrete barrier, guardrail, and falsework] to less than 19 feet.)

- When the horizontal clearance for the Roadway is less than 19 feet, install horizontal clearance (CW21-12-48) signs, identifying the narrowest width of the Roadway. Locate these horizontal clearance signs as shown or as directed.

(Use the following bullet when it is necessary to reduce the overall vertical clearance to less than 15 feet 6 inches.)

- When the vertical clearance is less than 15 feet 6 inches, install low clearance (W12-2-48) and (OW12-2-36) signs. The clearance shown on the signs shall be 4 inches less than the shortest height of the opening. Locate these low clearance signs as shown or as directed.

(Use the following bullet on urban projects where there is an existing bike lane, designated "Bicycle Route", or when a significant volume of bicycle traffic can be expected and is required to use the travel lane.)

- When construction requires bicycles to use the Traffic Lanes, install a "Bicycle ON ROADWAY" (CW11-1) symbol sign on 1/2 mile spacing through the affected area. Keep the signs in place until completion of the Shoulder or bikeway final surface.

00222.41(e) Perforated Steel Square Tube Sign Supports – Replace the subsection except for the subsection number and title, with the following:

Perforated steel square tube sign supports may be used as a substitute for wood sign posts. Sign supports mounted on existing sidewalks, curbs, or other concrete surfaces are subject to approval by the engineer prior to installation. Surface mounted signs are not preferred. The engineer may evaluate surface mounted sign application on a location by

location basis. If approved, the contractor shall repair the mounting location at the time of sign removal to the satisfaction of the engineer.

End of Section

SP00300 (Special Provisions for the 2021 Book) (Last updated: 12-10-2021)

PART 00300 – ROADWORK

(Follow all instructions and make all edits with "Track Changes" turned on. If there are no instructions [orange text] above a subsection, paragraph, sentence, or bullet, then include it in the project. Delete all orange text before preparing the final document.)

Section 00305 - Construction Survey Work

Comply with Section 00305 of the Standard Specifications modified as follows:

00305.00 Scope – Replace this subsection, except for the subsection number and title, with the following:

Provide construction survey work according to the current edition on the date of Advertisement, of the ODOT *Construction Surveying Manual for Contractors* with the following exceptions:

(Review the ODOT Construction Surveying Manual for Contractors and modify the bullets below accordingly. Further, identify all survey monuments on the plans and indicate whether they are to be protected or if within in the construction area, who is responsible to replace)

1.5 Agency Responsibilities: delete the following bullets:

- Perform a Pre-Construction Survey in accordance with Chapter 7 of this manual.
- Perform measurements and calculations for pay quantities.
- Perform final "as constructed" measurements.

1.6 Contractor Responsibilities: add the following bullets:

- Perform a Pre-Construction Survey in accordance with Chapter 7 of this manual.
- Perform measurements and calculations for pay quantities.
- Perform final "as constructed" measurements.

Staking is required when using Automated Machine Guidance.

Add the following subsection:

00305.40 Construction Staking:

(a) General - All survey work shall be conducted by or under the supervision of a Registered Professional Land Surveyor, licensed in the State of Oregon. The Contractor will be responsible for providing all construction staking as required to complete the Work.

(b) Stakes – Conspicuously mark construction and reference point stakes for construction. Inform employees and subcontractors of the importance and the necessity to preserve and protect construction staking.

Provide the following information on construction stakes:

- Engineer's station (on back)
- Offset from line (underlined)
- Offset from control point (circled)
- Cut or fill to grade
- Distance right or left from centerline on curb stakes (on back)

(c) Flagging Code - A color code may be established during the course of the project indicating specific colors for the various kinds of stakes to be set.

(d) Staking Frequency:

(1) Street - Prior to commencing construction, clearing limits shall be established.

a. Provide staking for roadway centerline at 50-foot intervals on tangents and 25-foot intervals on curves.

b. Where a significant (greater than 3-foot) cut or fill is required for sub grade, provide slope stakes and construction staking for sub grade.

c. Stake curb line by means of an offset line no more than 6 feet from the face of curb, show the cut or fill to the finish grade. Protect and save curb stakes for a period of 5 working days after construction of curbs to allow Inspector to review alignment and grade. Provide additional stakes at catch basins, curb inlets, points of curvature and tangency, and ends of curb radii.

(Delete (d) for projects where grade verifications points will be provided by the Contractor and reviewed by the Engineer.)

d. Stake base rock by painting an appropriate target on the curb and providing construction stakes (blue tops). On streets of 48 feet or greater width, provide blue tops at the quarter points as well as centerline. At intersections, provide blue tops along the centerline and gutter lines of the intersecting road.

(2) Sewer – Provide offset staking for line and pipe invert for gravity and pressure sewer lines at 50-foot intervals.

a. Provide finish grade as required.

b. Stake manholes with two reference points (swing-ties) indicating the center of the manhole, flow invert elevation, and finish grade. Upon the completion of sub grade, stake the top of the manhole with the

finish grade and elevation by means of four offset stakes in a cross pattern so that the street slope and cross slope will be matched.

c. Stake services as required by the Engineer.

d. Agency reserves the right to increase staking to 25-foot intervals if grades sewer grades are not being met.

(3) Water – Provide offset staking for waterline line and grade at 50-foot intervals.

a. Stake two reference points (swing-ties) for fire hydrants indicating the center of the fire hydrants. Stake finish grade as required.

b. Stake services as required by the Engineer.

(4) Structures – Stake line and grade for all structures as shown on the plans or as directed by the Engineer.

(5) Franchise Utilities - Provide offset staking for franchise utility line installation at 50-foot intervals as shown on the plans.

Add the following subsection:

00305.41 Construction Stakes, Lines, and Grades:

(Use the following .41(a) for Private Development projects.)

(a) General – No work shall be performed until the Engineer inspects and approves stakes, lines, and grades. Work performed without field controls will be subject to removal at the contractor's expense.

(Use the following .41(a) for Capital Improvement projects.)

(a) General – No work shall be performed until stakes, lines, and grades have been established. Work performed without field controls will be subject to removal at the contractor's expense.

(b) Agency Responsibilities – The Engineer shall inspect Contractor's established lines, grades, Slopes, Cross Sections, and curve super-elevations for roadwork.

(c) Contractor Responsibilities – The Contractor shall:

- Lay out and set construction stakes and marks to establish the lines, grades, slopes, cross sections, and curve super-elevations for roadwork.
- Provide a set of construction stakes for line and grade for each phase of the Work.
- Set benchmarks and stakes for centerline of Bridges and bents.
- Calculate and provide finish deck grades.

- Inform the Engineer when stakes are available for inspection.
- Coordinate construction to provide sufficient area for performing surveying work efficiently and safely.
- Perform work in a manner as to preserve stakes and marks.
- Set any reference lines for automatic control from the control stakes.

End of Section

SP00400 (Special Provisions for the 2021 Book) (Last updated: 12-10-2021)

PART 00400 – DRAINAGE AND SEWERS

(Follow all instructions and make all edits with "Track Changes" turned on. If there are no instructions [orange text] above a subsection, paragraph, sentence, or bullet, then include it in the project. Delete all orange text before preparing the final document.)

Section 00405 - Trench Excavation, Bedding, and Backfill

(This Section requires SP00330 when Trench Foundation is required.)

Comply with Section 00405 of the Standard Specifications modified as follows:

00405.02 Definitions –

Common Excavation - Replace the definition with the following definition:

The removal of all material including excavation of rock that may require removal drilling and blasting, wedging, sledging, barring or breaking up with power tools.

Rock Excavation – Delete this definition

(The Agency does not differentiate between Common Excavation and Rock Excavation)

00405.12 Bedding - Replace this subsection, except for the subsection number and title, with the following:

For all pipes, unless otherwise directed, furnish ¾" – 0 base Aggregate conforming to 02630.10.

00405.13 Pipe Zone Material - Replace this subsection, except for the subsection number and title, with the following:

For all pipes, unless otherwise directed, ~~1" 0~~ furnish ~~of~~ ¾" – 0 base Aggregate conforming to 02630.10.

> ***(Use the following subsection .14(a) when additional material sources may be available outside of the project limits. Material must be density testable, and the contractor must prove the material is appropriate for the anticipated loading.)***

00405.14(a) Class A Backfill – Add the following sentence to the end of the paragraph:

Material must be moisture-density testable.

00405.15(b) Class B Backfill – Use crushed rock meeting the requirements for dense-graded base aggregate per section 02630.10. Designated size shall be ¾" minus.

00405.14(d) Class D Backfill – Replace this subsection, except for the subsection number and title, with the following:

Use native or common material that, in the opinion of the Engineer, meets the characteristics required for the specific loading or other criteria of the backfill zone. Material shall not exceed 3" in size with a minimum density of 90 pounds per cubic foot and must be moisture-density testable.

(Use the following subsection .41(a) when the open excavation method for installing pipes transversely is not permitted.)

00405.41(a) Within Paved Areas to be Preserved - Add the following to the end of this subsection:

Do not use the open excavation method for installing pipes transversely.

00405.42 Rock Excavation – Delete this subsection

(The Agency does not differentiate between Common Excavation and Rock Excavation)

00405.46(c)(2) Class A, B, C, or D Backfill – Add the following paragraphs to the end of the subsection:

Trench backfill shall be tested at one passing test for each 3 feet of fill and 100 LF of trench (e.g., 12-foot to 15-foot depth class shall require four to five tests per 100 LF or as directed by the Engineer. Passing test shall meet the requirements for trench compaction in that segment of trench backfill. Sampling locations shall be determined by the City of Bend. All results, including failing tests, shall be submitted to the City of Bend prior to any subgrade inspection.

All compaction testing shall be completed in the presence of a City of Bend representative. Where trench depths or conditions preclude density testing at deeper elevations because of worker safety concerns, the placement and compaction of backfill will be observed and documented on a full-time basis by contractor's qualified and approved personnel until backfill reaches an elevation at which density testing can commence. Establish compaction method and level of effort by compacting a test strip in an area that can be density tested.

Compaction testing shall remain current with the work being performed. Submit compaction reports within 7 Calendar Days of performing the test.

(The following paragraph may be deleted on projects that will have a full-time City of Bend Inspector)

All sampling and testing, including material certifying tests shall be performed by an independent testing laboratory.

00405.80 Measurement – Add the following paragraph to the end of the subsection:

No measurement will be made for rock or boulder excavation.

00405.81 Rock Excavation and Boulder Excavation – Delete this subsection

(The Agency does not differentiate between Common Excavation and Rock Excavation)

(Use the following subsection .90 when no Pay Items are included in the Schedule of Items for Section 00405.)

00405.90 Payment –

Delete pay items (a) and (b)

Add the following bullet to the list under the heading that begins “No separate or additional…”

- Rock or boulder excavation

Add the following paragraph to the end of this subsection:

When the Contract Schedule of Items does not indicate payment for Work performed under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this Work is required.

End of Section

Section 00440 - Commercial Grade Concrete

(This Section requires SP02030 and SP02050.)

Comply with Section 00440 of the Standard Specifications modified as follows:

00440.10 Materials – Add the following to the end of the material list:

Fiber …….02045

00440.11 Proportions – Add the following to the end of the bullet list:

- Fiber ~~- ½ bag per yard for curb and flat work~~

00440.12 Properties of Commercial Grade Concrete –

In the bullet that begins **"Entrained Air…"** replace "4.0 to 7.0 percent" with "4.5 to 7.5 percent".

In the bullet that begins "**Slump**…" delete "5 inches…" and add the following subsections:

- Slip form curb – 3 inches or less
- Flat work and handset curb – 5.5 inches or less

In the bullet that begins "**Compressive Strength…**" replace "3,000 psi" with "4,000 psi".

Add a bullet, **fiber** – ½ bag per yard not to exceed manufacturer's recommendations

(Use the following subsection .40(b) when 00759 is used for Commercial Grade Concrete curbs, concrete curb ramps with curbs, islands, traffic separators, driveways, sidewalks, monolithic curb and sidewalks, miscellaneous surfaces, and stairs)

00440.40(b) Placing - Add the following bullet to the end of the bullet list:

- When haul time or placement conditions warrant exceeding the time of discharge, submit a detailed breakdown of the estimated time needed from batching to discharge of a load along with the measures that will be taken to ensure slump, temperature and uniformity will be maintained. Submit in advance to establish a new time limit at the Engineer's discretion.

00440.40(d) Weather - Replace this subsection, except for the subsection number and title, with the following:

Do not place CGC when the air temperature is below 35°F or above 100°F without approval.

Protect CGC from freezing if the air temperature is expected to drop below 35°F during the first 5 Calendar Days after placement.

All concrete placed below 35°F shall be approved under the following prescribed cold weather concrete plan:

- Concrete may be placed when the ambient air temperature is 25°F and rising, and the projected day time temperature high will be above 35°F for 2 days (unless otherwise approved by the City Engineer)
- Concrete shall not be poured below 25°F

- Concrete may not be poured on frozen ground
- If subgrade is frozen, all frozen material must be removed and new compacted base must be placed before concrete is poured
- Concrete subgrade must be inspected by the City prior to placing concrete
- At a minimum, when ambient air temperatures are between 30°F and 40°F, hot water will be used to maintain concrete temperatures not less than 55°F at placement
- At a minimum, when ambient air temperatures are between 25°F and 30°F, hot water will be used to maintain concrete temperatures not less than 55°F at placement and 1% non-Chloride accelerator
- Provide batch tickets to the Inspector
- The City may require the use of a hi/low thermometer to record the temperature of the placed concrete for 7 calendar days. Concrete must be maintained at 40°F minimum during this time
- If concrete temperature falls below 40°F, the City may choose to have the concrete removed and replaced at the contractors/permittee expense
- Prevent concrete from freezing for 7 calendar days after concrete is placed
- At a minimum, cover all concrete at night if the 7 day forecast shows a potential for freezing. It is up to the contractor to determine the best practice for protecting the concrete.
- Alternate cold weather concrete plans may be submitted for review but approval is at the City's discretion. All costs for these alternative plans to be reviewed by the City of Bend Quality Assurance representative will be borne by the contractor.

When the air temperature exceeds 90°F, place concrete in accordance with ACI 305R-10.

End of Section

Section 00445 – Sanitary, Storm, Culvert, Siphon, and Irrigation Pipe

(This Section requires SP02415.)

Comply with Section 00445 of the Standard Specifications modified as follows:

00445.11 Materials –

Delete the reference to Polyvinyl Chloride Pipe in the material table

(e) Tracer Wire - Replace this subsection, except for the subsection number and title, with the following:

a. **Tracer Wire** - Furnish Copperhead Superflex 1045G-SF tracer wire, or approved equal.

b. **Connectors** - Furnish Copperhead SnakeBite LSC1030C locking connectors for terminals and connectors, or approved equal.

c. **Terminal Access Point** - Furnish Coperhead SnakePit LD14*2T-ADJ-SW for installations in unimproved surfaces or SnakePit RB14*2T-SW for installations in hard surfaces~~Furnish Copperhead SnakePit LD14 terminal access point, or approved equal.~~

Add the following to the end of the subsection:

(i) Marking Tape - Marking tape shall be non-detectible marking tape for sewer that is 2 inches wide APWA green, stretchable to a minimum of 7 times its original size. Provide marking tape with the label that matched the utility. Marking tape shall meet all requirements of the owning utility and as approved by the Engineer.

(j) Gravity Sanitary and Storm Sewer Pipe

a. Rigid PVC pipe compounds used in gravity sewer pipe shall conform to ASTM D-1784, Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (PVC) Compounds.

b. PVC pipe shall conform to ASTM D-3034 standards dimensions ratio not to exceed 35 or to ASTM F679, minimum pipe stiffness of 46 psi. Provide manufacturer's certification, including test results, for all materials supplied under this specification.

c. Where minimum cover cannot be maintained, or where directed by the Engineer, pipe shall be C-900 water pipe meeting the requirements of AWWA C-900 Specifications, Polyvinyl Chloride (PVC) Pressure Pipe

d. Polyethylene ADS N-12 Dual Wall Flexible Water Tight Pipe used in gravity storm sewer pipe shall conform to ASTM F 2648 and shall have a smooth interior and annular exterior corrugations.

e. Solid-wall HDPE used in gravity irrigation pipe shall conform to Section 02415.20.

(k) Pressure Sewer Pipe

a. Pipe shall be C900 and have a minimum DR of 18 unless specified otherwise for pressure sewer pipe 4 inches in diameter and larger. Pipes 4 inches in diameter and larger shall be gasketed and shall use mechanical joints with the exception of service tees, which shall use glued joints.

b. Pipe and fittings smaller than 4 inches in diameter shall be Schedule 40 PVC assembled using glued joints.

c. Vacuum mains shall be constructed of SDR 21 PVC.

(l) Jointing Materials – Polyvinyl Chloride Pipe

a. **Gravity Sewer Pipe** – Joints shall be rubber gasketed and watertight conforming to ASTM D3212 for gravity sewers. Gaskets shall conform to ASTM F477. Lubricant jointing shall be as approved by the pipe manufacturer.

b. **Pressure Sewer Pipe** – Joints shall be rubber gasket or solvent welded depending on pipe size. Solvent welded joints shall conform to the applicable requirements of ASTM D2466 and ASTM D2467.

c. **Gravity Storm Sewer** – Joints shall be watertight per requirements of ASTM D3212. Gaskets shall conform to ASTM F477. Gaskets to be installed by pipe manufacturer and covered with removable protective wrap. Joint lubricant as approved by manufacturer.

(m) Fittings – Polyvinyl Chloride Pipe

a. Gravity Fittings

i. PVC pipefittings shall conform to ASTM D3034, standard dimensions ratio not to exceed 35 or to ASTM F679, minimum pipe stiffness of 46 psi. Provide manufacturer's certification, including test results, for all materials supplied under this specification.

ii. All fittings shall be the same as the joints used on the sewer pipe. Caps or plugs shall be furnished with each tee outlet or stub with the same type gasket and joint as furnished with the service connection pipe specified for future service connections. The plug or cap shall be banded or otherwise secured to withstand all test pressures involved without leakage.

iii. Each tee for future service connection shall be marked with detection tape and a new 2-inch x 4-inch utility grade wooden stake painted green all around. The face of the curb shall be marked with an "S" locating the service crossing. Where no curbs are being installed, the

end of service tee shall be marked with a #4 rebar set adjacent to the 2 x 4 stake and set to within 6-inch of the finished grade.

b. Pressure Sewer Fittings

i. **Plug Valves** – Type V405 Eccentric (Isolation Valves)

Plug valves shall be a non-lubricated type and rated at 175psig CWP drip-tight shutoff, with pressure from either direction, and shall have a cast iron body with flanged ends. The valve-closing member shall rotate 90° degrees to a full open or closed position with the plug rotating out of the sewage flow. The lug shall be cast iron with round or rectangular port of no less than 80 percent of the connecting pipe area. The plug shall be coated with Buna-N or Hycar elastomers with seats Type of 316 stainless steel or nickel. The valve stem bearing shall be self-lubricating stainless steel or reinforced Teflon, with the stem seal multiple V-rings (Chevron), U-cups, or O-ring of nitrile rubber, and shall include grit seals on the valve stem. Valves shall be polymer coated inside and out, and have a non-rising stem. Unless otherwise specified, plug valves shall be supplied with a 2" operating nut. In vault service boxes or above ground plug valves shall be supplied with hand wheels.

Approved manufactures:
1. Keysone; Ballcentric
2. Dezurik; Series 100
3. Victaulic; vic-Plug

ii. **Check Valves** – Check valves on pressure sewer mains shall be external lever and weight actuated, iron-body, flanged-end, resilient seat check valves equivalent to Kennedy model 106 ALS. APCO model 104P3 with backflow device may be used in lieu of the Kennedy check valve in certain applications.

iii. **Pressure Sewer MH and C.O**. – Cleanouts shall be constructed as indicated on the Standard Drawings. MH shall be a 48-inch manhole as illustrated in the Standard Drawings.

iv. **Pressure Pipe Air-release Valves** – Air-release valves shall be constructed as indicated on the Drawings, complete with 2-inch shut-off valve, 1-inch blow-off valve, and back flushing apparatus, APCO Model 400, Valmatic 302, or equal. Valve shall provide for an operating pressure range of 0-50 psi.

v. **Hot Tap Specifications** – 2-inch and 3-inch saddles shall be epoxy coated ductile iron body saddles with double stainless steel straps equivalent to type 202S as manufactured by Romac.

All taps larger than 2 inch shall be stainless steel sleeves equivalent to type SST service saddles as manufactured by Romac.

vi. **Valve Boxes** – Valve boxes subject to traffic loading shall be a two-piece grade adjustable box. The valve box shall have 7-inch I.D. with a slip top section without a dirt flange on the bottom as shown in the Standard Drawing. Valve boxes shall be cast iron East Jordan Iron Works #363912 or equal. The bottom extension piece shall be a single piece of 6" 3034 pipe of the proper length for to allow for 6"-12" inches of overlap. The word "SEWER" or letter "S" shall be cast into the top of the lid. Valve boxes shall not be located in driveways.

vii. **Restraining Device** – Restraining devices used on pressure sewer shall be a full-circumference wedge-type device as manufactured by Romac Industries. Restraining device shall be Grip Ring™ or approved equal.

c. **Sewer Lateral fittings**

i. **Sewer Service Markers** – Service connection markers shall be new, one-piece Douglas Fir or cedar, 2x4, utility grade or better. Rebar shall be #4, Class 40 or better.

ii. **Service Saddles** – Gravity line service saddles shall be Romac "CB" type saddles or equivalent with stainless steel strap. No other type shall be permitted. Furnish Predco PE44 Exothermic Epoxy Kit, 4 oz Resin and 4 oz Hardener In on 8 oz Jar, or approved equal, for application around gasket seals.

iii. **Swing Check Valves** – Swing valves shall be APCO series 100, Legend Model T451, or equivalent U.S. Brands. The check valve shall be capable of passing a 2-inch diameter solid.

iv. **Plug Valves** – Non-lubricated 175 psig rated type CWP drip-tight shutoff with pressure from either direction cast iron body with flanged ends. The valve-closing member shall rotate 90° degrees to a full open or closed position with the plug rotating out of the sewage flow. The lug shall be cast iron with round or rectangular port of no less than 80 percent of the connecting pipe area. The plug shall be coated with Buna-N or Hycar elastomers with seats Type of 316 stainless steel or nickel. The valve stem bearing shall be self-lubricating stainless steel or reinforced Teflon, with the stem seal multiple V-rings (Chevron), U-cups, or O-ring of nitrile rubber, and shall include grit seals on the valve stem. Valves shall be polymer coated inside and out, and have a non-rising stem. Unless otherwise specified, plug valves shall be supplied with a 2" operating nut. In vault service boxes or above ground plug valves shall be supplied with hand wheels.

Approved manufactures:
1. Keysone; Ballcentric
2. Dezurik; Series 100
3. Victaulic; vic-Plug

00445.40(b) Line and Grade - PRESERVE the subsection title and DELETE the remaining paragraph beginning "Centerline and grade control…". REPLACE with the following:~~Replace this subsection, except for the subsection number and title, with the following:~~

Centerline and grade control shall be established by the contractor, per the contract documents, prior to start of construction.~~Centerline and grade control will be established prior to the start of construction~~.

Do not vary from established line and grade more than ½ inch for line and more than 1/32 inch per inch of pipe diameter. Variance shall not exceed 1 inch, subject to the following limitations:

00445.40(c) Pipe Distribution and Handling – Add the following paragraph to the end of the subsection:

Do not stage more pipe along an open trench, prior to installation, than can be installed in one work shift.

Add the following subsection:

00445.40(h) Sewer Taps – Sewer taps shall be performed only by competent personnel of companies' pre certified for sewer taps by the City of Bend. Tapping equipment shall be used only for sewer taps. A representative of the City Engineer must witness every sewer tap. Provide a minimum of 5 calendar days' notice prior to installing tap. Apply exothermic epoxy around gasket seals to adhere the gasket to the pipe.

Hot taps shall be scheduled only during the hours of 7:30 AM to 3:00 PM, Monday through Friday, including trench backfill.

00445.43(c) Polyvinyl Chloride Pipe – Add the following paragraphs to the end of the subsection:

For pressure sewer, wrap the pipe four (4) times per 20-foot section with detection tape to differentiate this pipe from the white or blue plastic pipe used in potable water applications.

Fittings, plugs, and caps shall be installed in pipe in the manner described within these specifications or by the approval of the City Engineer, or his/her representative. For dissimilar pipes, (e.g. AWWA C900 to ASTM D3034), a hard PVC transition type adapter coupling shall be used. Special conditions encountered for which suitable adapter couplings are not available, shall be referred to the City Engineer for consideration of an approved method. Fern-co and Calder Coupling type fitting will not be allowed.

(1) Solvent Welded Joints – After a length of Solvent Weld pipe is placed in the trench, both the spigot end and the receiving bell shall receive a thorough application of primer and glue as per the manufacturer's specifications. The pipe shall be centered, seated, and rotated at least 90°. The pipe shall be brought to correct line and grade and secured in place with approved backfill material. Pipe and fittings which do not allow a sufficient and uniform space for jointing shall be removed and replaced with pipe and fittings of proper dimensions to ensure such uniform space. Precaution shall be taken to prevent dirt from entering the joint space.

(2) Number of Pipes Laid Before Jointing – Solvent Weld and Rubber gasket joint pipe shall be connected as hereinafter specified as soon as they are placed in the trench.

(a) Pressure Sewer Thrust Blocking – Place thrust blocks at all angle points on pressure sewer. Where approved by the City Engineer, restrained joints may be used on pressure sewer lines in lieu of thrust blocks or deadmen.

00445.48 Tracer Wire - Replace this subsection, except for the subsection number and title, with the following:

(a) General – Place tracer wire directly over the pipe centerline. Make tracer wire splices using a solderless connection kit that effectively moisture-seals two or more conductors for direct burial and securely join the wires both mechanically and electrically. Insulate splices to be moisture-proof and waterproof. Splices wrapped with tape will not be accepted as waterproof. Have all splice kits approved prior to installation. Test all tracer wire with locating Equipment prior to acceptance.

(b) Storm Sewer – Install tracer wire on all storm sewer pipes that do not terminate on both end at a structure. Tracer wire is not required on storm sewer pipes between structures.

(c) Sanitary Sewer

(1) Gravity Sanitary Sewer – Install tracer wire on all gravity sanitary sewer laterals from main to clean out. Tracer wire is not required on gravity sewer main between structures.

(2) Pressure Sanitary Sewer – Install tracer wire on all pressure sanitary sewer pipes.

(d) Terminal Access Point – Where terminating tracer wire at a location that does not have a cleanout, or other surface element, terminate tracer wire in a terminal access point set to finish grade.

Add the following subsection:

00445.49 Marking Tape - Replace this subsection, except for the subsection number and title, with the following:

Install one layer of marking tape 1 foot above the pipe in all sanitary and storm sewers trench and as needed for relocated utilities or marking tape that is disturbed or damaged during construction.

00445.70(a) Storm Sewer and Culvert Installations – Add the following sentence to the end of the subsection:

Perform low-pressure air testing on storm sewer mains.

00445.70(b) Siphon, Irrigation, and Sanitary Sewer Installations – Add the following paragraph to the end of the subsection:

No sewer line will be televised until all inverts and channels in manholes are grouted and the manholes and pipes have been flushed with water.

00445.71(a) General – Add the following paragraph to the end of the subsection:

All pressure sewer and sewer force mains shall successfully pass a hydrostatic test prior to acceptance.

00445.72(a) General – Replace the sentence that begins “After completing installation…”, with the following:

After completing installation of the system, including all service connections, installation of other facilities requiring excavation through the trench backfill, backfilling and compaction, receipt and review of compaction reports, and prior to wearing surface paving, conduct a low-pressure air test or a hydrostatic test.

00445.72(c) Air Testing - Replace this subsection, except for the subsection number and title, with the following:

The pressure gauge used in air testing shall have minimum divisions of 0.1 psi and an accuracy of 0.0625 psi. All air testing shall be by the Time Pressure Drop Method. The test procedure is as follows:

(1) The Contractor may wet the lines prior to testing.

(2) Determine the average height of the groundwater over the line. The test pressures required shall be increased 0.433 psi for each foot of average water depth over the exterior crown of the pipe.

(3) Add air slowly to the section of system being tested until the internal air pressure is raised to 4 psi greater than the average back-pressure due to groundwater.

(4) After the test pressure is reached, allow at least 2 minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure.

(5) After the temperature stabilization period, disconnect the air supply.

(6) At any convenient observed pressure reading at 4.0 psig greater than the average external pressure of any groundwater above the pipe, begin timing the pressure loss. If the time shown in the table below for the designated pipe size and length elapses before the air pressure drops 0.5 psig, the section is considered to have passed the test. The test may be discontinued once the prescribed time has elapsed, even though the 0.5 psig loss has not occurred.

Pipe Dia. (in)	Min. Duration (min:sec)	Length for Min. Duration (ft)	Equation for Specific Length (sec)	Time (Minutes:Seconds)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	500 ft
4	1:53	597	0.19*L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.427*L	2:50	2:50	2:50	2:50	2:50	2:50	2:50	3:12	3:33
8	3:47	298	0.76*L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42	6:20
10	4:43	239	1.187*L	4:43	4:43	4:43	4:56	5:56	6:55	7:54	8:54	9:53
12	5:40	199	1.709*L	5:40	5:40	5:41	7:07	8:32	9:58	11:23	12:49	14:14
15	7:05	159	2.671*L	7:05	7:05	8:54	11:07	13:21	15:34	17:48	20:01	22:15
18	8:30	133	3.846*L	8:30	9:36	12:49	16:01	19:13	22:26	25:38	28:50	32:03
21	9:55	114	5.235*L	9:55	13:05	17:27	21:48	26:10	30:32	34:54	39:15	43:37
24	11:20	99	6.837*L	11:23	17:05	22:47	28:29	34:11	39:52	45:34	51:16	56:58
27	12:45	88	8.653*L	14:25	21:37	28:50	36:03	43:15	50:28	57:41	64:53	72:06
30	14:10	80	10.683*L	17:48	26:42	35:36	44:30	53:24	62:19	71:13	80:07	89:01
33	15:35	72	12.926*L	21:32	32:18	43:05	53:51	64:37	75:24	86:10	96:56	107:43
36	17:00	66	15.384*L	25:38	38:27	51:16	64:06	76:55	89:44	102:33	115:22	128:12

Technical Data:

a) Allowable Air Loss Rate (Q): The value for Q is 0.0015 cubic feet per minute per square foot of internal surface.

b) Testing Main Sewers with Services: If lateral sewers such as services are included in the test because of the difficulty in isolating such lateral sewer, their lengths may be ignored for computing test times. Ignoring the laterals results in a slightly more severe test.

c) Rounding Off Pipe Lengths: Rounding off pipe lengths shall always be to the next higher length value shown, i.e., the test time for 201 feet shall be the times shown for 250 feet. At the discretion of the Inspector, test times for a unique pipe length may be linearly interpolated from the next higher and lower times indicated.

Add the following subsection:

00445.72(e) Hydrostatic Pressure Testing of Pressure Sewer and Force Mains – Pressure sewer and force main shall be tested by hydrostatic methods. Furnish all necessary equipment and material and make all taps in the pipe as required for testing purposes. The test pressure shall be two times the calculated operating pressure, but not less than 50 psi for the low end of the pipe for a minimum duration of 2 hours. For high pressure lines, the test pressure shall not exceed the manufacturer's maximum operating pressure recommendation. Calculate allowable loss using the following:

Loss Formula - The quantity of water lost from the main must not exceed the number of gallons per hour determined by the formula:

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

L = allowable leakage in gallons per hour
S = length of pipeline tested in feet
D = nominal diameter of the pipe in inches
P = average test pressure during the leakage test in psi

Correct all visible leakage regardless of the allowable leakage specified. If the measured leakage exceeds the allowable amount specified, or if pressure cannot be maintained as specified, locate and repair the leaks and retest the pipeline until test requirements are met.

00445.74 Video Inspection of Sanitary and Storm Sewers - Replace this subsection, except for the subsection number and title, with the following:

After laying and joining sanitary and storm sewer pipe installations from 6 inches to 72 inches in diameter, including backfill and compaction of trenches, receipt and review of compaction reports, but before any finish surfacing or final paving, the Contractor shall coordinate with the City for the City to conduct a video inspection of all sanitary sewer pipes and storm sewer pipes.

Contractor shall introduce water flow of sufficient quantity at the upstream end of the pipe such that flow is observed to be exiting the downstream end of the pipe to be video inspected. Maximum allowable vertical pipe deflection shall not exceed the line and grade requirements of Section ~~00440.40~~00445.40(b) and will be determined by CCTV observation of standing water depth remaining in any section of the pipe after flow introduction.

Findings of the video inspection shall be recorded, provided to the Contractor, and the Contractor shall be required to correct all deficiencies at no expense to the City. Upon correction of deficiencies revealed by video inspection, the Contractor shall notify the City Engineer and a follow-up video inspection of the corrected areas will be done by the City. Costs for any follow-up video inspections will be borne by the Contractor.

The City will provide video inspection of all lines prior to completion of the one-year warranty and final acceptance of the work. This will be done at no cost to the Contractor.

Findings of the video inspection shall be recorded, provided to the Contractor, and the Contractor shall be required to correct all deficiencies at no expense to the City. Upon correction of deficiencies revealed by video inspection, the Contractor shall notify the City Engineer and a follow-up video inspection of the corrected areas will be done by the City. Costs for any follow-up video inspections will be borne by the Contractor.

If at any time during the one-year warranty period examination of the sewer line discloses a deficiency, that deficiency shall be corrected by the Contractor at no expense to the City.

Add the following subsection:

00445.80 Measurement – Delete the paragraph that begins “Video pipe inspection…”.

00445.80(k) Sewer Taps – The quantities for sewer taps will be measured on the unit basis.

00445.91 Payment –

Add the following Pay Items to the Pay Item list:

	Pay Item	**Unit of Measurement**
(m)	Sewer Service Pipe ____ Inch	Foot
(n)	Sewer Taps	Each

In item (m), the nominal pipe size will be inserted in the blank.

Delete the paragraph that begins “Video pipe inspection…”.

End of Section

Section 00470 - Manholes, Catch Basins, and Inlets

Comply with Section 00470 of the Standard Specifications modified as follows:

Change Section title to:

Section 00470 – Manholes (including drywells), Catch Basins, and Inlets

(Use the following subsection .10 when composite frames and covers will be used. Composite frames and covers are only permitted for use in non-traffic areas.)

000470.10 Materials – Add the following to the materials list:

Composite Frames and Covers……..... .....2450.31

000470.13 Inside Drop Manhole Connectors – Replace this subsection with the following:

000470.13 Inside Drop – Furnish Reliner inside drop bowl or approved equal. Size drop bowl per the manufacturer's recommendation based on the inlet pipe size. Furnish silicone to be used as a seal between the bowl and the manhole wall. Furnish stainless steel anchor bolts and anchor straps for inside drop pipe connections.

000470.14 Pipe and Fittings – Add the following to the end of the subsection:

Furnish BMP 24R oil/water separator snout, or approved equal. Anchor bolts shall be stainless steel.

(Use the following subsection .16 when corrosion resistant manholes are required.)

000470.16 Sanitary Sewer Manhole Carry-Through – Replace this subsection with the following:

000470.16 Corrosion Resistant Manholes – Furnish corrosion resistant manholes per the following:

(a) Polymer Concrete Manholes – Furnish polymer concrete manholes per Section 02451.

(b) Crystalline Waterproofing Additive – Furnish precast manholes with crystalline waterproofing additive per Section 02452.

Add the following subsection:

00470.18 Drywell

(a) Drain Rock – Furnish commercially available clean 2" – 3" crushed or river run drain rock.

(b) Drywell Liner – Furnish Seattle Textile PVC Coated Polyester Mesh (STC Item #: VM-1000-XXX-99) or approved equal.

Add the following subsection:

00470.19 Resilient Connector – Furnish flexible rubber connector conforming to the requirements of ASTM C923. Use Series 304 stainless steel pipe clamps to secure the pipe to the connector.

00470.41(c) Grates, Frames, Covers and Fittings Replace this subsection, except for the subsection number and title, with the following:

Set metal frames for manholes on full non-shrink grout beds to prevent infiltration of surface water or groundwater between the frame and the concrete of the manhole section. If concrete is to be poured around the frames, coat the portion of the frame that will contact the concrete with hot asphalt before placing the concrete. Set frames, covers and grates true to the locations and grades established. Clean bearing surfaces and provide uniform contact. The use of a bolt adjustment system for frames from the QPL is allowed. Secure all fastenings. Construct all mortared, sanitary sewer manhole necks and all riser ring joints made with non-shrink grout using an approved commercial concrete bonding agent applied to all cured concrete surfaces being grouted.

00470.42 Precast Concrete Catch Basins and Inlets - Add the following sentence to the end of this subsection:

Grade adjustments using a bolt system from the QPL is allowed.

00470.45 Steps – Delete this subsection

(The Agency does not allow steps or ladders in storm or sanitary structures)

Add the following subsection:

00470.48 Drywell Facility Construction – Install drywell structure per 00470.41. Place woven geofabric against undisturbed earth as shown in the standard drawing. Place drywell drain rock around the structure to the elevations of the concrete cap. Fold over the woven geofabric and place moisture barrier on top of the drain rock.

Pour the concrete cap directly on the moisture barrier – the concrete cap does not need to be formed. In earth or granular material, the outside two feet of the concrete cap shall be poured over undisturbed earth. In rock excavation, the cap may be poured directly to the rock wall, provided that the rock wall is stable.

The fabric liner specified for the inside of the drywell barrel shall have a smooth finish to promote cleaning by washing down. Felted materials are not acceptable. Fabric liner shall have sufficient tensile strength to be hung without undue sagging, and to resist tearing. It shall be resistant to raveling, and shall be anchored 18 inches back underneath the cone and at each dry well joint for the entire depth of the drywell.

The final elevation for each manhole shall conform exactly with the finished street. It is permissible to adjust the manhole frame to final grade after street paving provided the structure is low enough so as not to interfere with the street paving operation. Patching material shall be asphalt concrete with a maximum patch width of 6-inches.

Add the following subsection:

00470.72 Drywell Facility Testing – Prior to acceptance, all drywells shall pass a performance test under observation by a City representative. The test shall follow the following procedure:

1. Install the drywell per the approved plans, specifications, and applicable construction guidelines.

2. Inspect drywell prior to testing, making sure the drywell is clean and free of sediments.

3. Field check the accuracy of the flow meter by filling up a suitable container with known volume; for example a calibrated 55-gallon barrel.

4. Introduce clean water into the drywell and monitor using an in-line flow meter.

    a. If the drywell total inflow design volume is 10,000 gallons (1,336 CF) or less, place the design volume in the drywell within a 1 hour period and verify that the water either disappears immediately or document the standing water per the COSM Appendix 4B, Full Scale Drywell Test Method.

    b. If the drywell total inflow design volume is between 10,000-25,000 gallons (1,336-3,342 CF), place an initial 10,000 gallons (1,336 CF) into the drywell within 1 hour. If any standing water is present at the end of the 10,000-gallon test, then the City will require the full design inflow volume and/or a full-scale 2-hour drywell test per COSM Appendix 4B.

5. Infiltration Testing - Post-construction infiltration testing is required regardless of prior testing. Draw down measurements shall be performed to determine infiltration rate and recorded during the drywell testing, tested in 5-minute increments for 20 minutes (obtaining 4 recorded draw down measurements). An average infiltration will be determined from the draw down measurements and compared to the design infiltration used in the calculations.

Swale and drywell failure is determined if the facility cannot 1) contain volumes during the test, 2) if the facility is unable to infiltrate at the design infiltration rate (dictated in the construction documents or the storm water report) and 3) if the stormwater rises to the highest perforation in the drywell.

The standard testing form is provided on the next page.

UIC/Swale (Facility) Testing Report Form

Project: _____ Permit number: _____

Drywell ID: _____ Engineer of Record: _____

Date Tested: _____ Engineer Company:_____

Tester: _____ Testing Company:_____

Facility Dimensions:

Depth (*A*): _____feet Length:___ feet Width:_____feet

Testing (Based on approved plans and COSM requirements)

Required quantity:____gallons Required Testing time: ___ min

Assumed / Design Infiltration: _____ gal/min = ____ft/min

Test Time Start: _____

Depth of water at start: _____feet

Test Time End: _____

Depth of water at end: _____ feet (*B*)

Drawdown time – Infiltration Determination

Time (After test)	Depth, feet	Depth Change, feet, (*C*)	Infiltration (ft./min) I = *C* / 5
Test End	(*B*) =	0	
5 min			
10 min			
15 min			
20 min			
		Infiltration Average =	

Passed: ☐ Failed: ☐

Tester Signature: _____ EOR signature: _____

00470.90 Payment –

Add the following Pay Item to the Pay Item list:

Pay Item	Unit of Measurement
(l) Drywell Facility ____ Cubic Yard	~~Foot~~Each

In item (l), the drainage gallery size will be inserted in the blank.

End of Section

Section 00641 - Aggregate Subbase, Base, and Shoulders

(Use Section 00641 for road base for all classification of roadways in the City of Bend.)~~when any of the following apply, otherwise, use Section 00640:~~
~~Project includes any quantity aggregate base on collector or arterial roads~~
~~Project includes more than 3,500 tons of aggregate base~~)

Comply with Section 00641 of the Standard Specifications modified as follows:

00641.10(a) Base and Shoulder Aggregate - In the paragraph that begins "Aggregate for bases…", add the following sentence after the first sentence:

Base aggregate shall be either 1" - 0 or ¾" - 0 size.

00641.41 Mixing, Hauling, and Placing - In the paragraph that begins "Add water to the Aggregate …", add the following sentence after the first sentence:

Prior to the placement of base rock, completely install, grout, seat, backfill, set to finish grade, and compact test around all structures (e.g. manholes, utilities, catch basins).

00641.80(c) Area Basis - Replace the sentence that begins "The surface area will be…" with the following:

The surface area will be limited to the neat lines shown in the plans or as directed in the field.

End of Section

Section 00759 - Miscellaneous Portland Cement Concrete Structures

(This Section requires SP02001. This Section requires SP02510 if epoxy coated reinforcement is required.)

Comply with Section 00759 of the Standard Specifications modified as follows:

00759.03 Required Submittals – Replace this subsection with the following:

00759.03 Corrective Action Plan - Unless otherwise approved, notify the Engineer before performing corrective action. Include TPAR necessary to complete corrective action work.

At least 7 Calendar Days before concrete structures work is scheduled to begin, submit a corrective action plan. The corrective action plan shall address procedures to correct deficient structures through minor corrective action or replacement according to 00759.55(a), and include:

- List of minor corrective actions that will be used to correct deficiencies, according to 00759.50 and 00759.55.
- Procedures for performing corrective action.
- Proposed concrete grinding equipment and method of grinding.
- Proposed concrete repair material used for resurfacing ground concrete surfaces according to Section 02015.
- Construction activities, equipment and staging necessary to complete corrective action work.

The Engineer will review the corrective action plan(s) and provide a response to the Contractor within 5 Days after receiving the plan. Do not begin concrete structure work until the corrective action plan is approved by the Engineer.

Add the following subsection:

00759.13 High Strength Concrete – Furnish Class 5000 mix meeting the requirements of Section 02001 with fiber mesh meeting the requirements of Section 02045.

~~00756.22~~00759.22 **Smart Level -** Replace this subsection, except for the subsection number and title, with the following:

Furnish a 48-inch electronic smart level to measure grades and slopes. Calibrate smart level at the time of inspection.

Add the following subsection:

00759.23 Concrete Resurfacing Equipment - Furnish power-operated scarifying Equipment capable of uniformly removing and preparing the existing surface to depths required. For concrete grinding operations, furnish 12 segment grinders, fine-toothed scarifying Equipment, or other approved grinding Equipment.

00759.50 (a) General – Add the following paragraphs to the end of the subsection:

Construct ADA curb ramps, sidewalks, and other pedestrian facilities meeting the requirements of PROWAG. Verify compliance using smart levels meeting Section 00759.22.

Submit a corrective action plan for each non-compliant Structure after receiving notice of non-compliance from the Engineer. Perform correction of defects according to 00759.55.

00759.50 (b) Curbs, Islands, and Stairs – Add the following to the end of the subsection:

Stamp all sanitary sewer, storm sewer, and water locations centered on the curb exposure with the appropriate brand: “S” for sanitary sewer, “SW” for storm sewer, and “W” for water. Brand shall be a minimum of 4 inches in height and ¼ inch in depth.

00759.50(c) Driveways, Walks, and Surfacings - Replace this subsection, except for the subsection number and title, with the following:

Prevent segregation of the concrete during placement. Strike-off the concrete to the grade shown, and float the surface smooth. After the water sheen disappears, edge the joints and remove edging tool marks prior to final finishing. Lightly cross-broom the surface to a uniform texture. Do not trowel joints or edges after brooming surface.

00759.50(d) Curb Ramps - Replace this subsection, except for the subsection number and title, with the following:

Prevent segregation of the concrete during placement. Strike-off the concrete to the grade shown and float the surface smooth. After the water sheen disappears, edge the joints and remove edging tool marks prior to final finishing. Lightly cross-broom the surface to a uniform texture. Do not trowel joints or edges after brooming surface.

Add the following subsection:

00759.50 (f) Truncated Domes – Furnish truncated dome panels in standard sizes supplied by the manufacturer. Where cutting panels is necessary to provide custom sizes, follow manufacturer’s recommendations and use the following procedures:

- Do not install panels smaller than 2-feet by 2-feet. Provide standard panel sizes and plan cuts to minimize panel waste.
- Cut tiles to custom sizes using a continuous rim diamond blade in a circular saw or mini-grinder. Use a straightedge when cutting straight lines.
- When placing cut panels, butt clean uncut edges against each other. Orient cut edges to the outsides of the ramp.
- Furnish and place anchors for cut panels according to the manufacturer’s recommendations.

Leave factory installed protective cover on truncated domes during entire installation process to prevent concrete from splashing onto the finished surface of the tile.

While concrete is workable, use steel edging trowel with a minimum of 1/8" radius to edge the finished concrete around the panel. Use a steel trowel to finish the concrete around the perimeter of the truncated dome so it is flush with field level of the tile.

Immediately after concrete has cured, remove protective plastic wrap from the truncated dome by cutting the plastic wrap with a sharp knife held tight to the concrete/tile interface. If concrete bled under the plastic, use a soft brass wire brush to clean the residue without damage to the tile surface.
Add the following subsection:

00759.55 Correction of Deficient Structures - Unless otherwise approved, notify the Engineer before performing corrective action. Correct deficiencies at no additional cost to the Agency. Perform corrective actions as directed, according to the approved corrective action plan, and according to the following:

(a) Minor Corrective Action - Submit Equipment and procedure for minor corrective action to the Engineer for approval. Minor corrective action can be performed to correct a deficiency up to 1 square foot per panel. Limit minor corrective action to one area per panel. Perform minor corrective action according to the following:

(1) Concrete Grinding - Grinding to correct high area deficiencies is limited to 3/16 inch in driveway aprons, curb ramps, or refuge and up to 1 inch in other locations. Use equipment meeting the requirements of 00759.23. Resurface all ground concrete surfaces according to 00759.55(a)(2).

(2) Concrete Resurfacing - Resurfacing to correct low area deficiencies is limited to 3/16 inch depth. Existing concrete is to be at least 7 Days old prior to resurfacing. Resurface repair areas according to the following:

a. **Keyway** - Sawcut a keyway at the boundaries of repair areas that are not already defined by panel control joints. Sawcut is to be 1/8 inch wide by 1/4 inch deep. Bevel inside edge of keyway at a 45 degree angle.

b. **Surface Preparation** - Prepare limits of repair area by grinding using equipment from 00759.23. After grinding, sandblast the surface of the repair area. Clean the surface using a low pressure washer, less than 5,000 psi.

c. **Presoak** - Presoak the repair area for a minimum of 30 minutes to saturated surface dry. Prior to resurfacing, ensure there is no ponding water on the surface.

d. **Resurface** - Provide concrete resurfacer from the QPL according to 02015.60; refer to QPL remarks to select an appropriate material based on allowable installation depths. Furnish resurfacer in a color that closely matches the color of surrounding concrete surfaces. Mask boundaries of the repair area. Use hand tools to work resurfacer into keyways and match existing grade at boundaries. Apply a light broom-finish to achieve non-slip surface.

e. **Curing and Return to Traffic** - Wet cure for a minimum of 1 hour or per the manufacturer's recommendation, whichever is more restrictive. Follow manufacturer's recommendation for return to traffic time.

(3) Concrete Crack Repair - This section allows for repairs to minor concrete cracking typical during the curing process, not as a result of defective concrete. Repair cracks in concrete according to the following requirements:

a. **Up to 1/8" Wide** – If more than two cracks less than 1/8" wide occur within a sidewalk or driveway panel, remove and replace the panel. For all other cracks less than 1/8" wide, no corrective action is required.

b. **1/8" to 5/16" Wide** - If more than one crack, 1/8" to 5/16" wide, occurs within a sidewalk or driveway panel, remove and replace the panel. All other cracks, 1/8" to 5/16" wide, may be repaired or replaced. Submit a corrective action plan per 00759.03 to the Engineer for approval prior to beginning work.

c. **Greater than 5/16" Wide** - Remove and replace affected area of concrete.

(4) ACP Grinding - Taper grind to match existing pavement with a minimum grinding width of 1 foot for each 1/4 inch of ACP removed.

(b) Acceptance of Structures - Once the corrective work or replacement has been completed, acceptance will be based on the Engineer's inspection and approval of the Structure.

00759.90 Payment –

Add the following pay item to the end of the list:

Pay Item	Unit of Measurement
(o) Concrete Walks with Sawcut Joint	Square Foot

Replace the paragraph that begins " Item (k) includes the additional Work required …" with the following paragraph:

Item (k) includes the additional Work required to construct a curb ramp or replace an existing curb ramp. Payment for the area of the curb ramp will be made under the concrete walks Pay item.

Add the following paragraph to the end of the subsection:

Replace the paragraph that begins "No separate or additional payment will be…" with the following paragraph and bullet list:

No separate or additional payment will be made for:

- preplacement conference
- concrete form verification
- any necessary repair or removal and replacement of concrete structures
- providing supervisory personnel who have an active ODOT ADA Certification for Contractors to directly supervise the curb ramp Work

- developing corrective action plans

End of Section

Section 01140 - Potable Water Pipe and Fittings

Comply with Section 01140 of the Standard Specifications modified as follows:

01140.00 Scope – Replace this subsection, except for the subsection number and title, with the following:

The Contractor shall secure and comply with all applicable City, County, and State permits including Construction Safety and Health Standards. Prior to installing a water facility in an unimproved street, the street shall be brought to subgrade to ensure that adequate bury, depth of cover, and utility separation is provided.

This section covers the work necessary for furnishing and installing water pipe and fittings normally used for water distribution systems. Water line depth from finished grade to top of pipe shall be a minimum of 36 inches and a maximum of 72 inches.

Proposed corrosion protection measures shall be approved by the City Engineer prior to final design.

01140.10 Materials – Replace this subsection, except for the subsection number and title, with the following:

Furnish Materials meeting the following requirements:

- Unless otherwise specified, all materials shall be new of U.S.A. domestic manufacture with the certification of the country of origin. Materials shall meet all AWWA standards and applicable City, County, and State code requirements, for the specified materials.
- Piping materials used in pump station, meter vault, or control valve applications shall be approved by the City Engineer on a case-by-case basis.
- All fittings being purchased by suppliers shall be purchased directly from the Manufacturer.
- Mechanical joint C153 ductile iron fittings shall be marked with the Manufacturer's name.
- Mechanical joint water main fittings with accessories, 4-inch through 36-inch, shall be manufactured in accordance with and meet all applicable terms and provisions of standards ANSI A21.10 and AWWA C110 and ANSI A21.11 and AWWA C 111, current revisions. Mechanical joint fittings 4- through 24-inch shall be rated for 350 psi working pressure and fittings 30- and 36-inch shall be rated for 250 psi working pressure. Mechanical joint fittings with 14-inch or larger caps and plugs shall be rated for 250 psi working pressure, and 4- through 12-inch minimum size UL listed and marked for Fire Main Equipment. Cement-lined and seal-coated fittings shall meet ANSI A21.4 and AWWA C104 standards. All coated and lined fittings shall meet requirements of NSF-61.
- Approved Manufacturers: Tyler Pipe, Union, Clow, and American Iron Pipe Co.

(a) Ductile Iron Pipe – Ductile iron pipe shall be centrifugally cast in metal molds and cement-lined in accordance with AWWA specification C151-76. Push-on type joint pipe shall be used except where conditions require mechanical joints as shown and approved on plans. No material shall be shipped inside coated pipe. Pipe shall meet the following specifications:

(1) 4-inch through 12-inch I.D., Class 52 Ductile, AWWA Specification C151-76 DI pipe.

(2) 14-inch I.D. and larger, Class 50 Ductile, AWWA Specification C151-76 DI pipe.

Approved Manufacturers: U.S. Pipe, Pacific States Pipe, American Pipe and Griffin Pipe.

(b) Service Pipe – Service lines from the main to the meter stops and 6 feet beyond meter box shall be as follows:

I.D.	Type
1” and smaller	Type K soft annealed copper tubing (non-rigid)
1 1/4 ” and larger	Ductile iron or rigid copper (Type K-hard)

(c) Service Saddles – Service saddles for 2-inch water services shall be used on existing and new water lines. Where service saddles are allowed, they shall be Mueller double strap DR2S, or as approved by the City Engineer. The brass nipple between saddle and valve is to be installed horizontally; saddle bolts shall be torqued to manufacturer’s specifications. If a 1-1/2-inch service is desired by the customer, this reduction shall be made within the 2-inch meter setter.

(d) Saddle Tap – Bit size shall be as follows: ¾-inch tap – 11/16-inch bit, and for a 1-inch tap – 15/16-inch bit. All bits to be Mueller or equal, and approved for tapping cast iron, DI, galvanized and steel pipe.

The tapping machine shall be a Mueller #E-5, #D-5, or equal.

(e) Direct Tap – All bits to be Mueller AWWA tapered thread combined drills and taps or equal, and must be approved for tapping cast iron and DI water mains. All taps shall be made with a Mueller B-101 drilling and tapping machine or equal.

(f) Pipe Fittings

(1) Buried – Buried ductile iron fittings with mechanical joints shall meet ANSI 21.10, 250 PSI working pressure, with full body glands (AWWA C-110/C-153), bolts, and gaskets in accordance with ANSI 21.11. A non-toxic vegetable soap lubricant shall be supplied in sufficient quantities for installing the pipe. Lubricant must meet the appropriate AWWA Standards.

(2) Aboveground – Aboveground ductile fittings with threaded flanged joints or restrained joint meeting appropriate ANSI specifications, 250 PSI working pressure, bolts and gaskets in accordance with appropriate ANSI specification.

(3) Solid Sleeves – Solid sleeves 4- to 12-inch in diameter must be a minimum of 12 inches long; 14-inch-diameter or larger must be the long pattern. All solid sleeves must be standard Pacific States (Union /Tyler Foundry) or U.S. Pipe M.J. DI sleeve. Appurtenances shall be of same manufacturer.

(g) Plugs/Caps – Shall be mechanical joint DI and properly restrained.

(h) Special Coatings and Linings – Special coatings and linings shall be approved by the City Engineer prior to the time of purchase.

(i) Concrete for Thrust Blocking – Concrete for thrust blocking shall conform to ASTM C 94, Alternate 2, and shall be proportioned to obtain a 28-day compressive strength of 2500 pounds per square inch. “Sacrete” type products are not allowed.

(j) Marking Tape – Marking tape shall consist of inert polyethylene plastic impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the Soil. Marking tape must be minimum 2 inches wide, APWA blue, and stretchable to a minimum of seven times its original size. The tape shall be imprinted continuously over its entire length in permanent black ink with the words "Caution - Water".

01140.11 Handling Pipe and Fittings – Add the following to the end of the subsection:

No more pipe material shall be strung on job than can be installed in one shift. Material that is rejected at the point of delivery because of defects or damage shall be replaced by the Contractor. Material damage subsequent to acceptance by the Engineer or the City shall be replaced by the Contractor.

01140.41 Laying Pipe – Replace this subsection, except for the subsection number and title, with the following:

(a) General – Lay pipe to the lines and grades shown and established or as directed by the Engineer. Where field conditions require deflection or curves not shown, the Engineer will determine methods to be used. Fittings, valves, air release valves, and hydrants shall be installed at the designed locations with joints centered, spigots fully inserted, and valve and hydrant stems plumb.

(b) Push-on Joint Pipe – Ductile iron pipe with rubber gasket Tyton and/or Fastite type joints shall be laid and jointed in strict accordance with the manufacturer’s recommendations and in accordance with the requirements of these Specifications. Deflection limits shall conform with Figure 1. For pipe sizes not listed, maximum deflection shall be one-half the manufacturer’s maximum deflection.

Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer.

Once installed, rubber gaskets cannot be recovered and reused and must be discarded.

(1) Push-on Joint Restraints for Ductile Iron Pipe – Push-on joints shall be restrained using Field Lok gaskets for Tyton joint pipe and fast grip gaskets for Fastite joint pipe, using stainless steel locking segments vulcanized into the gaskets.

(2) Approved Manufacturers of Mechanical Restraints – EBBA Iron 1100 Series “Mega-Lug,” and Romac “Romagrip”.

Maximum Deflection of Tyton Gasket Joint Pipe (Based on 18-Foot Pipe Length)

Pipe Size	Bend in One Joint Angle	Deflection in Inches	Approx. Radius in Feet of Curve

	A	D	Produced by Succession Of Joints
6”	2° 00’	8”	450’
8” through 12”	2° 00’	8”	450’
14” through 24”	1° 30’	6”	650’

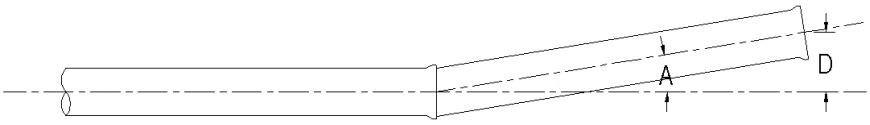


FIGURE 1
Pipe Deflection

(c) Screw Joint Pipe – Screw joint pipe threads shall be thoroughly cleaned by wire-brushing, swabbing, or other approved method. Approved joint compound shall be applied to the threads prior to making the joint. Joints shall be watertight at test pressures before acceptance.

(d) Installation of Mechanical and Flexible Couplings – Mechanical and flexible couplings shall be provided where indicated on the plans and shall be installed in accordance with the manufacturer’s recommendations. Before pipe lengths are joined, the ends of each pipe shall be thoroughly cleaned of oil, scale, rust, and dirt for a minimum distance of at least 8 inches from the end. Gaskets shall be wiped clean and lubricated with pipe lubricant for installation on the pipe ends. Coupling bolts shall be tightened progressively, drawing up bolts on opposite sides until all bolts have a uniform tightness. Workers tightening bolts shall be equipped with torque-limiting wrenches or other approved wrench type. Mechanical and flexible couplings shall be tested when the tests on the adjacent pipe are made. If the couplings do not pass the requirements of the leakage tests, the couplings shall be removed and reassembled on the pipe, and the leakage test shall be repeated. Deflection shall be in conformance with Figure 1. For pipe sizes not listed, maximum deflection shall be one-half the manufacturer’s maximum deflection.

Maximum Deflection of Mechanical Joint Pipe
Safe Deflection for 150 PSI[1] based on 18-Foot Pipe Length (see Figure 1)

Pipe Size	Maximum Joint Angle A	Deflection in Inches D	Approx. Curve Radius produced by maximum angle
8”-12”	2º 00’	8”	450’
14”-16”	1º 45’	7”	590’
18”-20”	1º 30’	5”	685’
24”	1º	4”	1000’

NOTES:
1. For test pressures above 150 psi, reduce the tabulated deflection by 10% for each additional 150 psi.

(e) Tapping – Tapping of City mains shall be done when the air temperature is at least 35°F and rising. When the air temperature is between 20°F and 35°F, taps may be permitted by the Engineer if the tapping bit is protected and heated to 35°F or above. If a heated tapping bit is used, the work must be backfilled immediately upon completion.

(f) Hot Taps – When appropriate and/or shown on the plans, branches and large services may be connected to existing City of Bend water lines by using a tapping sleeve and tapping valve. This procedure shall be performed only by a City-approved contractor and said approval shall be obtained from the City Engineer or their authorized representative at least 48 hours in advance of performing the hot tap. No pipe shall be exposed for tapping without a City representative onsite.

All hot tap sleeve and tee assemblies shall be air tested prior to start of tapping operation.

(Update paragraph below if there are specific hot taps that need to occur outside of the stated hours.)

Hot taps shall be scheduled only during the hours of 7:30 AM to 3:00 PM, Monday through Friday, including trench backfill.

(g) Tapping Sleeve Requirement – Match sleeve types as shown in the table with the type of main being tapped. Tapping sleeves shall be as manufactured by JCM, Mueller, Romac, or Smith Blair and as specified below:

(1) Epoxy-coated Fabricated Steel Sleeve; JCM 532 or equal.

(2) Stainless Steel Sleeve; JCM 432; Romac SST III (with stainless steel flanges); Mueller H-304; Smith Blair 665, or equal.

NOTE: Numbers in tables below correspond to accepted sleeve types.

For Taps Other Than Size-on-Size					
Type of Main Being Tapped	**Main 8" and Under**	**Main 10" or 12" Tap 8" and Under**	**Main 12" 10" Tap**	**Main 14" and Over Tap 8" and Under**	**Main 14" and Over Tap 10" and 12"**
C-900 Plastic	2	2	2	N/A	N/A
Steel Size Plastic	2	2	N/A	N/A	N/A
Ductile Iron	2	2	2	1	
Cast Iron (spun)	2	2	2	1	1
Cast Iron (pit cast)	2	2	2	1	1
Steel	2	2	2	1	1

01140.44 Thrust Restraint – Replace this subsection, except for the subsection number and title, with the following:

(a) Thrust Blocking – All additions and alterations to the City of Bend water system shall incorporate mechanical restraint systems into their design. Thrust blocking and the use

of a deadman to supplement mechanical restraints are only allowed with the approval of the City Engineer and must be designed by the Engineer of Record and detailed on plans.

(b) Thrust Blocking Materials – Refer to Section 01140.10(i) above.

(c) Anchorage – Reaction or thrust blocking shall be placed as shown on the plans. Blocking shall be placed between the undisturbed ground and the fitting to be anchored. Reaction blocking shall be placed so as to allow access to fitting joints unless specifically shown otherwise on the Plans. The pipe and joint fittings shall be wrapped with 6 mm plastic sheeting before placing concrete.

(d) Existing Thrust Blocks – No existing thrust blocks shall be removed by Contractor unless a City of Bend representative is on site for inspection and coordination.

01140.45 Marking Tape and Wire – Replace this subsection with the following subsection:

01140.45 Marking Tape – Install marking tape over all mains and services. Place marking tape 1 foot above the top of pipe for its full length, centered on the pipe.

01140.48 Maintaining Service – Add the following:

(c) Connections of new mains shall be made within 30 days of acceptable chlorination and pressure testing unless otherwise approved by the City Engineer.

01140.49 Backfilling – Replace this subsection, except for the subsection number and title, with the following:

(a) Pipe Bedding – The trench shall be excavated to a minimum depth of 6-inches below the pipe to provide minimum bedding. The pipe bedding shall be uniform, at grade, and compacted prior to placing pipe. Trench foundation shall meet the requirements of 00405.44.

(b) Compaction Testing – Refer to specification section 00405.46.

(c) Electrical Continuity – When so stated in the Specifications, the Contractor shall provide adequate means to permit an electric current to pass across all pipe joints. The electrical connection shall be made by driving silicon-bronze wedges between the barrel and the bell of joints using rubber gaskets. Two wedges shall be installed per joint on opposite sides of the pipe on the horizontal centerline. The wedges shall be approximately 1-inch square and shall be tapered from 1/8-inch to 1/16-inch, approximately. The wedges shall have serrated edges to provide good contact. The voltage drop at 500 amperes current flow shall not exceed 1.0 volt per joint.

01140.50 Filling and Flushing - Delete this subsection.

01140.51 Hydrostatic Testing - Delete this subsection.

01140.52 Disinfecting - Delete this subsection.

Add the following subsection:

01140.53 Filling, Flushing, Disinfection, and Hydrostatic Testing:

(a) Certification – The Contractor's employee responsible for conducting these tests shall be approved by the City of Bend. This person shall be present at and shall supervise all phases of these procedures.

Prior to testing, the Contractor shall be certified by the City of Bend Water Division. This Certification shall be contingent upon the Contractor passing a standard test prepared by the City. This test shall prove the Contractor's organizational ability of the steps required for chlorinating/flushing/testing; and a field demonstration of their techniques.

The metering device used in chlorination and/or pressure test procedures must have been certified by the City Water Division within 6 months of the test.

(b) Testing Procedures – Testing shall not occur until the following conditions have been met: 1) All excavation, installation, and backfill of structures, piping, and utilities has been completed, and 2) All compaction tests have been received and reviewed by the City. Testing procedures shall be conducted between 7:30 AM and 5~~3~~ PM, Monday through Friday. Pressure testing shall be scheduled so completion is within these normal working hours. Chlorine and pressure tests shall be performed between ~~10~~ 7:30 AM and 3~~5~~ PM when the temperature is, or is expected to be, no less than 33ºF. Chlorine tests require a minimum of 24 hours duration.

When testing cannot occur during the times noted above, submit a written request to the City at least 7 Calendar Days prior to the test noting the requested start and end time of and a description of why the test cannot be completed within the times noted above.

The Contractor shall not operate any valve connected to City water lines or take any action that would affect the operation of the existing system except with a City representative present, and only at that representative's express direction.

For flushing and testing of water service connections 2-inches and smaller, refer to Specification Section 01170.50 and 01170.51.

(c) Length of Test Section – Limit sections to be tested to 1,000 feet, unless otherwise approved.

(d) Flushing – The Contractor shall be responsible for all pipeline flushing, including but not limited to flushing air from service and main lines at time of chlorination, flushing chlorination water after all chlorination and rechlorination. System flushing procedures shall meet all State and Federal requirements for discharge and disposal.

Following removal of all air in the system, the Contractor shall thoroughly flush all lines with potable water. Flushing velocity shall not be less than 2 feet per second (fps). Flushing is considered completed when the system chlorine residual matches the background chlorine residual level of the City system at that point.

A portion of the flushing process for chlorinated systems may, after start-up with the Inspector, be completed by the Contractor without the Inspector being present. After chlorine residual testing on the City system and the chlorinated systems has been done and the inspector has operated the necessary valves, the Contractor may independently

complete the test. The Contractor will be furnished with appropriate forms to be completed as verification that the test results have been completed and the results are in compliance with City's Standards & Specifications.

(e) Chlorination – The Contractor shall be responsible for installation of chlorine taps at the terminal points of all lines, including all dead end lines. Taps may also be required on high points to vent trapped air. Tap location and placement shall be coordinated and observed by the City of Bend. With Inspector approval, fire hydrants may be used as a chlorination injection point.

At connections to existing mains, the maximum allowable distance for hand chlorination of the new main shall be 20-feet.

Chlorine Application – Apply sodium hypochlorite, commercial grade (12.5 percent Cl). This liquid chlorine compound may be used full strength or diluted with water.

Before chlorination, the City Representative shall witness all valves being opened in the system being chlorinated.

The City Representative shall collect all samples for chlorine residual testing as follows:

(1) After chlorination (beginning of test initial value).
(2) Prior to the chlorination solution being flushed at the end of the 24-hour test period (finish value).
(3) After the system has been thoroughly flushed and refilled.

A maximum of 60 parts per million (ppm) and a minimum of 25 ppm of free residual chlorine are the acceptable limits for the initial test. Any residual above or below acceptable initial limits shall be grounds for restarting the chlorination test. If the finished residual value varies by 60% or more than the starting value, the test shall be deemed to have failed and rechlorination shall be required after thoroughly flushing the line.

If after three chlorinations no passing level is obtained, the line shall be deemed contaminated, be removed, and replaced by the Contractor at their expense.

(f) Bacteriological Testing – Comply with AWWA C651.

(g) Pressure Testing – Comply with AWWA C600.

(h) Flow Testing – The Contractor shall flow test all services and hydrants for a minimum of 2 minutes prior to acceptance of the system by the City. Flow testing equipment shall be checked and approved by the City and the test conducted under direct supervision of the City. Test reports shall provide the following information:

- Hydrant flow in gallons per minute (gpm)
- Hydrant static pressure
- Station of hydrant
- Service line flow in gpm
- Lot and block of service

(i) Other Tests – The City Representative may require other tests, such as volatile organic compounds, inorganic chemicals, or synthetic organic chemicals, if there is

reason to believe the line has been contaminated by such compounds. The costs of these tests can be substantial and shall be borne by the Contractor. Failure to pass such other tests shall be grounds to reject the work and cause it to be replaced.

(j) Cleanup – Upon completion of the testing and acceptance of the tests by the City of Bend, the Contractor shall clean the area as directed by the City.

01140.80 Measurement – Replace this subsection, except for the subsection number and title, with the following:

(a) Pipe – Pipe length shall be measured horizontally from centerline to centerline of valves, fittings or to the end of the pipe, whichever is applicable. Measurement of the various depth classes as stated in the Bid Schedule shall be from the pipe invert as constructed to the design subgrade elevation or the finished ground surface at the point of measurement.

(b) Fittings Measurement – Measurement of fittings shall be made on a unit price basis for the type, kind, and size specified and installed. No separate or additional payment shall be made for couplings, joint lubricant, nuts, bolts, washers, and other fitting-related hardware or supplies.

(c) Thrust Blocks – Measurement for thrust blocks shall be made on a unit price basis for each thrust block installed.

(d) Testing and Disinfection – When neither specified nor listed in the proposal for separate payment, flushing, chlorination, and testing shall be considered incidental work for which no separate payment shall be made.

(e) Incidental Basis – Items not listed in the Bid Schedule shall be considered incidental work for which no separate payment shall be made.

End of Section

Section 01170 – Potable Water Service Connections, 2 Inch and Smaller

Comply with Section 01170 of the Standard Specifications modified as follows:

01170.10 Materials – Replace this subsection, except for the subsection number and title, with the following:

(a) Refer to Specification Section 01140.10 for service pipe and saddle material requirements. Any services larger than 1 inch shall be attached to the main line using a saddle connection. Service taps on C-900 shall be installed using a Ford S90 tapping saddle or equal.

(b) Fittings for copper pipe shall be CC 110 Compression type Mueller or approved equal.

(c) Meters – The meter will have no moving parts and constructed of a noncorrosive material. The meter will utilize an electromagnetic or ultrasonic measurement system. The meter must meet federal low lead requirements and be compliant with American water works Standard C-700, C-710, NSF/ANSI Standard 61 Annex F-G. The meter must be capable of measuring water flow in cubic feet and show reverse flow. The meter must operate with a maximum working pressure of 175 PSI without leakage, damage or effect on accuracy. A 1" meter will have an allowable pressure loss not to exceed 4 PSI at 30 GPM. The ¾" meter shall guarantee 1.5% accuracy rate at normal operating flows of 3 GPM for the service life of the meter. The 1" meter shall guarantee 1.5% accuracy rate at normal operating flows of 4 GPM for the service life of the meter. The meter will fit within the City of Bend Premises Isolation Program specification. The meter and register must be fully compatible with all ACLARA MTU firmware, factory constructed NICOR ends, Extended Range 2-way transmitting system and the newest available version of ACLARA MTU. The meter shall also be 9" lay length for ¾" meters and 11-inch lay for 1" meters.

When provided by the Contractor, water meters shall be brought to the City for identification stamping prior to installation.

(d) Meter Setters - All 1.5- to 2-inch meters shall use a meter setter series # B-2423-99000 with a 12-inch setter height as shown in Standard Drawing W-5A.

(e) Corporation Stop – Corporation stops shall be Mueller #B-25008 full port ball valve or approved equal. 2-inch corporation stops shall be Mueller #B-25028N 110CTS X MIP Ball Corp Stop (Low Lead) or approved equal

(f) Meter Stop – Meter stops shall be Mueller #B-24258 ball angle meter valve, or approved equal.

(g) Meter Boxes – All boxes shall include a CI reader lid. Meter vaults shall be traffic rated. Meter boxes approved by the City of Bend Water Division include:

- Armorcast:
  - Box: 17 x 30 x 18 Polymer Concrete (A6001640)
  - Lid: 17 x 30 Cover with Cast Iron Hinged Lid
- Quazite:
  - Box: 17 x 30 x 18, Flared, Polymer Concrete (PT1730BA18)

- Lid: 17 x 30 Cover with Hinged Cast Iron Reader Door

01170.40 General – Replace this subsection, except for the subsection number and title, with the following:

(a) All services shall have 3 feet of cover.

(b) Bedding and pipe zone material shall be placed at least 7 inches below and 12 inches above all pipes. The material shall be compacted with hand-held compaction equipment to 95% density as determined by AASHTO T-99, Standard Proctor.

(c) All services shall be flushed of all foreign objects before connecting double check valve.

(d) All services shall be flushed and checked for flow.

(e) Services installed during water line construction and prior to meter placement shall be constructed with temporary meter jumpers and supplied by the Contractor.

(f) Service runs between the corporation stop and the meter setting shall not contain fittings unless approved by the City Engineer.

(g) Electrical continuity shall be provided on all services as shown in the Standard Drawings.

(h) Existing water services to be abandoned must be cut at the corporation stop and removed from the right-of-way. Place a watertight cap on the existing corporation stop. Corporation stops on services larger than 1 inch shall be removed and replaced with a plug at the water main. Whenever possible the water service line including any fittings and valves shall be physically removed from the right-of-way.

(i) All property that is subject of a site plan, or any new construction that is being served by an inadequate water service, shall be required to upgrade the existing water service to City standards.

(j) Detection tape shall be installed on all services.

(k) Temporary water use during construction must be metered and shall be protected from backflow using an approved backflow protection device.

(l) Meter boxes shall be installed at each meter. Meter boxes shall be installed as shown on the Standard Drawings. The box shall be elevated to existing ground level or proposed finish grade. Water service meter boxes shall be set with a minimum distance of 18 inches between each water service box. Meter boxes shall be located in landscape areas where possible and shall only be installed within hardscape when approved by the City Engineer. All water services shall have a minimum of 10 feet horizontal separation from any sanitary sewer in the public right-of-way.

(m) Meter Installations – Meter installations shall be constructed as shown in the Standard Drawings. When a meter is not installed at time of completion, a jumper spacer

set to the dimension of the proposed meter and backflow prevention device shall be installed to provide service. This jumper shall be a galvanized nipple or Schedule 80 polyvinyl chloride (PVC).

All meter installations shall be constructed with an electric wire jumper of not less than 10 gauge. The material of the electric jumper shall be the same or galvanically compatible with the material of the water service; that is, galvanized wire on galvanized pipe and copper wire on copper pipe.

(n) In areas where new concrete curb is being installed over a water service, stamp all water service locations on the top of the curb with brand "W" for water per Specification Section 00759.50(b).

Add the following subsection:

01170.43 Fire Services – All fire line backflow prevention assemblies, whether Double Check or Reduced Pressure Principle Device, shall include a detector assembly complete with a bypass line with double check or reduced pressure principle device assembly inline and a meter that meets City of Bend specifications.

Backflow assemblies may be installed in the vertical position, provided that the assemblies are spring-loaded and meet the following criteria:

- 4-inch diameter or smaller, and/or specifically listed in the Oregon Health Division's Approved Backflow Prevention Assembly List.
- Recommended by the manufacturer for vertical installation.
- Has the normal flow upward.
- Fire lines shall require backflow protection commensurate with the degree of hazard (per UPC Chapter 6).

Add the following subsection:

01170.44 Backflow Requirements – All services shall have an approved backflow prevention assembly installed commensurate with the degree of hazard for the premises it serves. Backflow prevention shall be in accordance with OAR 333-061-070/UPC Chapter 6 and conditions set forth in the City of Bend Cross Connection Ordinance. Assembly shall be installed on the Owner's side of meter. If approved by the City of Bend Cross Connection Specialist, and the backflow assembly is a Reduced Pressure Principle Device Assembly, it may be installed immediately inside the building being served. In all cases, the device must be installed upstream of the first branch line leading off the service line. See examples from Standard Details W-15, W-15A, W-15B. Such backflow prevention device assembly(s) shall be installed and approved before water service shall be provided.

Double-check valves to be installed at the time the meter is installed.

All backflow prevention device assemblies, once installed, shall be inspected by the City of Bend Cross Connection Inspector or authorized agent. Prior to acceptance and initiation of service, the device shall be tested by an Oregon State Certified backflow tester with the results forwarded to and received by City of Bend Public Works Cross Connection Program.

(Designer to consider whether backflow prevention device assemblies [e.g. double check valves] should be paid for under Specification Section 01150, 01170, or be incidental to other work and include clarifying language in the appropriate specification measurement and payment sections. Consider application [e.g. residential, commercial, irrigation] and whether installation is new or a retrofit. Consider including a pay item (length basis) for the tail if the length may vary by location when connecting to existing services. May have multiple bid items by service and type of work being performed. Also consider noting which property is associated with a particular bid item.)

01170.50 Flushing and Disinfecting – Replace this subsection with the following:

01170.50 Flushing and Sampling– Before tapping the main for installation of service connections and sampling stations to existing water mains, flush the service connections and sample stations according to Section 01140. For installation of service connections and sampling stations concurrent with new water mains, flush service connections and sampling stations according to Section 01140. Sample all service connections according to Section 01140.53. Chlorinate all services according to Section 01140.53.~~Disinfection of 2-inch and smaller service lines is not required~~.

End of Section

Section 02630 – Base Aggregate

Comply with Section 02630 of the Standard Specifications.

End of Section

IMPORTANT NOTICE:
Standards and Specifications 2023 Update

Provided below is a summary of the draft revisions to the **City of Bend Standards and Specifications**, adopted April 15, 2022. Text in red is a revision to the standard drawing.

Revised Drawings include:

Roadway:

- R-1 Typical Street Cross-Sections – General Notes
- R-1H Typical Street Dead-End Turnaround
- R-1J Residential Alley Improvements
- R-3 Concrete Curb
- R-3A Concrete Curb Notes
- R-10A Franchise Utility Joint Trench
- R-35 Rectangular Rapid Flashing Beacon
- R-46 Pedestrian Refuge Island **(NEW)**
- R-50A Mobility Points – Small/Medium
- R-50B Mobility Points - Large

Sanitary

- S-2A Gravity Sewer/Storm Services on New Mains
- S-2B Gravity Sewer/Storm Service Connection to Existing Main
- S-2C Gravity Sewer/Storm Cleanout
- S-3C Standard Sewer/Storm Manhole
- S-9 Pressure Sewer Service – Non Traffic Area

Storm

- STRM-7A Stormwater Sedimentation Manhole – Alternate
- STRM-9 Standard Catch Basin Special Inlets
- STRM-10 Standard Pre-Cast Drywell
- STRM-12 Standard Catch Basin

Water

- W-7 Typical Hydrant
- W-8 Hydrant Location and Clear Zone
- W-10 1” & 2” Standard Air Release Valve – Traffic Area
- W-10B 2” Standard Air Release Valve
- W-13B Fire Sprinkler Line

ADDITION TO NOTE 3

GENERAL NOTES FOR STD DWGS R-1A THROUGH R-1H:

1. CENTER STREETS IN THE RIGHT-OF-WAY UNLESS OTHERWISE APPROVED BY CITY ENGINEER FOR UNIQUE TRANSITIONS OR SITE CONSTRAINTS.
2. THE LEVEL OF TRAFFIC STRESS PER THE ODOT APM CH. 14 IS SHOWN ON EACH STANDARD CROSS-SECTION. MODIFICATION OF THE CROSS-SECTIONS MUST PROVIDE THE APPROPRIATE LTS.
3. INSTALL SIDEWALKS/SHARED-USE PATHS PROPERTY TIGHT. SIDEWALKS/SHARE-USE PATHS MAY MEANDER AROUND UTILITIES, TREES, AND OTHER NON-MOVEABLE OBJECTS. METERS, MANHOLES, AND VALVES ARE NOT PERMITTED WITHIN THE SIDEWALK UNLESS OTHERWISE APPROVED BY THE CITY ENGINEER. EXCEPTIONS WILL ONLY BE PERMITTED IF SIDEWALK CANNOT MEANDER AROUND THE EXISTING CONSTRAINT, OR THE OBSTACLE CANNOT BE REMOVED/RELOCATED. EASEMENTS ARE REQUIRED WHERE SIDEWALK/SHARED-USE PATH MEANDERS OUT OF THE RIGHT-OF-WAY.
4. PAVEMENT SECTIONS FOR STREETS AND SIDEWALKS PER THE THICKNESSES NOTED IN TABLE BELOW OR AS SPECIFIED IN A STAMPED GEOTECHNICAL REPORT APPROVED BY THE CITY ENGINEER.
5. RETAINING WALLS AND STAIRS ARE NOT PERMITTED WITHIN THE RIGHT-OF-WAY UNLESS OTHERWISE APPROVED BY THE CITY ENGINEER.
6. STREET CROSS-SECTION/IMPROVEMENT STANDARDS ARE BASED ON STREET CLASSIFICATION. REFERENCE THE BEND DEVELOPMENT CODE SECTION 3.4 PUBLIC IMPROVEMENTS STANDARDS AND STANDARD CROSS-SECTIONS FOR ADDITIONAL DETAIL.
7. THE CROSS-SLOPE OF THE PLANTER STRIP BETWEEN THE CURB AND RIGHT-OF-WAY SHALL NOT BE STEEPER THAN 4H:1V TO PROVIDE A RECOVERABLE ROADSIDE SLOPE. 50H:1V (2%) IS TYPICAL/PREFERRED.
8. MAX 1.5H:1V CUT SLOPES PERMITTED IN ROCK CUTS WHEN APPROVED BY A GEOTECHNICAL ENGINEER.
9. MASTER PLAN DEVELOPMENTS PER BEND DEVELOPMENT CODE 4.5.100(E)(2)(C) MAY PROPOSE MODIFIED STREET SECTIONS THAT INCLUDE ADDITIONS TO OR ENHANCEMENTS OF THE BASIC MINIMUM STANDARD SECTIONS SHOWN HERE.
10. OFF STREET SHARED-USE PATHS (PATHS MEETING THE GENERAL ALIGNMENT OF THE TSP LOW STRESS NETWORK AND ARE MORE THAN 30 FT OUTSIDE OF THE RIGHT-OF-WAY) ARE ENCOURAGED, PARTICULARLY ALONG ARTERIAL STREET CORRIDORS. SIDEWALKS MAY BE REDUCED TO A MINIMUM 6 FT OR ELIMINATED WHEN THE SAME SIDE OF THE ROAD CORRIDOR IS SERVED BY A SHARED-USE PATH DEPENDING ON ADJACENT LAND USE AND PEDESTRIAN/BIKE ACCESS AND WITH CITY ENGINEER APPROVAL.
11. TWELVE-FOOT CENTER MEDIAN ON ARTERIAL AND COLLECTOR CROSS-SECTIONS INCLUDES EITHER A STRIPED MEDIAN (TWO-WAY LEFT TURN LANE, DOUBLE YELLOW, AND/OR TURN BAY) OR A NINE-FOOT RAISED REFUGE ISLAND WITH A ONE AND A HALF FOOT SHY LINE STRIPE EACH SIDE AS REQUIRED PER STANDARDS.
12. RAISED MEDIANS ARE AT THE CITY ENGINEER'S DISCRETION ON ARTERIALS & COLLECTORS. MEDIAN REFUGE ISLANDS FOR STREET CROSSINGS ON A LOW STRESS ROUTE OR AN ENHANCED CROSSING ON A CONNECTOR ROUTE DO NOT REQUIRE CITY ENGINEER APPROVAL.
13. ON-STREET PARKING SPACES ARE NOT STRIPED. IN HIGH PARKING DEMAND AREAS, A PARKING LINE MAY BE USED WITH CITY ENGINEER APPROVAL.
14. SEE BEND DEVELOPMENT CODE 3.4.200(F)(3) FOR STREETS AND INTERSECTIONS NOT IDENTIFIED FOR TRAVEL LANE EXPANSION WHERE ADDITIONAL RIGHT-OF-WAY IS NOT REQUIRED FOR VEHICLE TRAVEL LANES.
15. PLTS = PEDESTRIAN LEVEL OF TRAFFIC STRESS / BLTS = BICYCLISTS LEVEL OF TRAFFIC STRESS.
16. DEVIATIONS FROM THE PAVEMENT SECTIONS PROVIDED IN THE TABLE BELOW REQUIRE A STAMPED GEOTECHNICAL REPORT. PCC ROADWAYS REQUIRE A STAMPED GEOTECHNICAL REPORT.
17. SEE CITY SPEC 00744/00745 FOR MAXIMUM AC PAVEMENT LIFT THICKNESS.
18. WHERE EXISTING GROUND CROSS SLOPE EXCEEDS 12%, CURB-TIGHT SIDEWALK IS ALLOWED PER DESIGN STANDARD 3.4.7 - HILLSIDE.

CHANGED FROM LEVEL IV TO LEVEL III

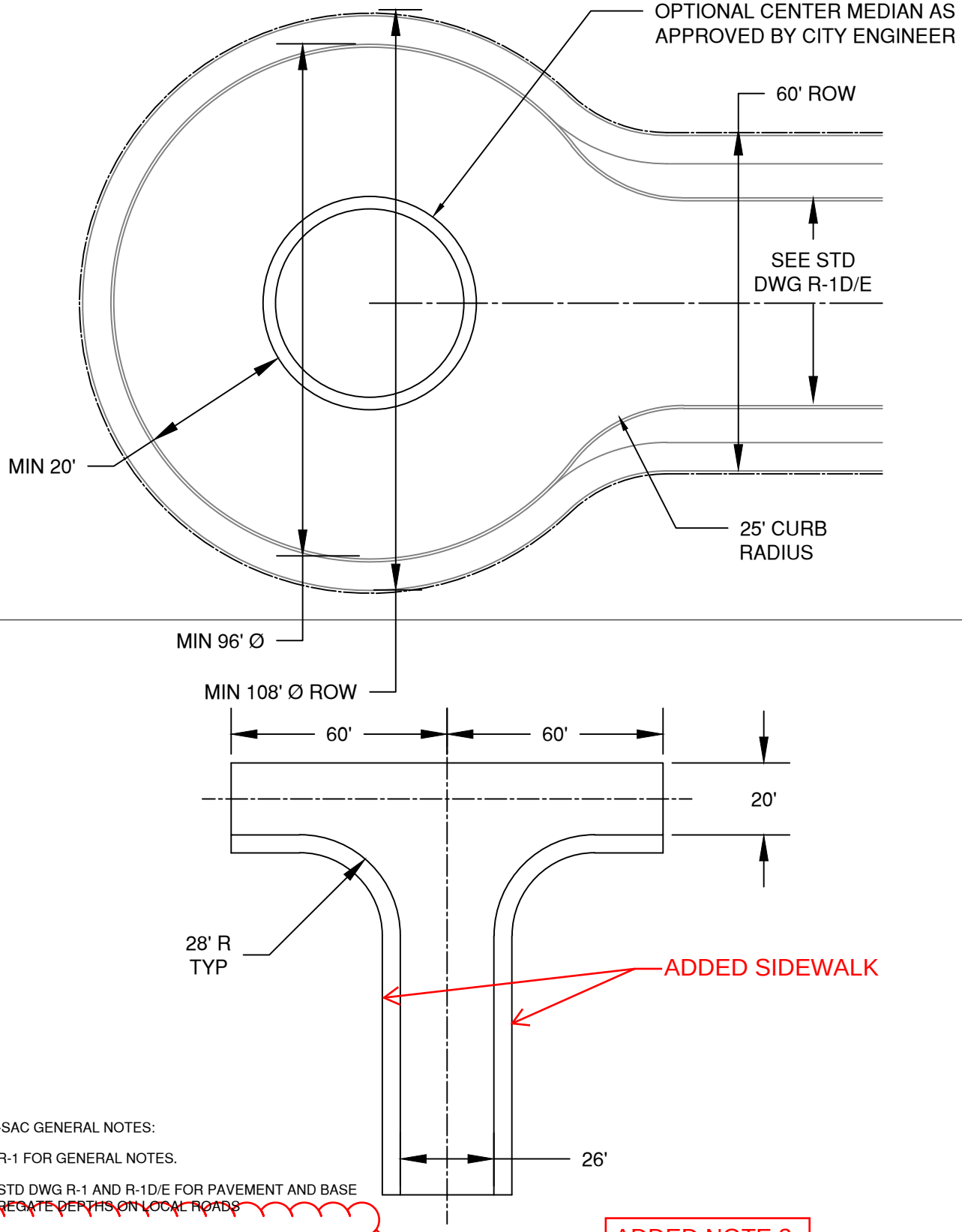
STREET TYPE	"A" ROW	"B" STREET	"C" SIDEWALK	"D" CURB	"E" ACP DEPTH/LEVEL	"F" BASE	"G" CUT/FILL
ARTERIAL	PER R-1A			7"/16"	8" - LEVEL III	10"	4H:1V
COLLECTOR	PER R-1B & R-1C			6"/14"	6" - LEVEL III	8"	4H:1V
LOCAL	PER R-1D & R-1E			6"/12"	4" - LEVEL III	6"	2H:1V
INDUSTRIAL LOCAL	PER R-1F			6"/12"	4" - LEVEL III	8"	2H:1V
ALLEY	PER R-1G			--	4" - LEVEL III	6"	2H:1V
ROUNDABOUT - ACP	VARIES	VARIES	VARIES	**	8" - LEVEL IV	10"	4H:1V
ROUDABOUT - PCC ***	VARIES	VARIES	VARIES	**	*	*	4H:1V

* THE STANDARD PAVEMENT SECTION FOR ARTERIAL STREETS IS ASPHALT. FOR RECONSTRUCTION, NEW STREETS MORE THAN 1/4 MILE LONG, AND FOR ROUNDABOUTS, A LIFE CYCLE COST ANALYSIS EVALUATING ASPHALT, PERPETUAL PAVEMENT, CONCRETE, AND OTHER SECTIONS SHALL BE SUBMITTED TO AND APPROVED BY THE CITY ENGINEER.

* CURBS AT ROUNDABOUTS AND ON SPLITTER ISLANDS SHALL BE HIGH-STRENGTH PER CITY SPEC 00759.13.

*** DOWELING REQUIRED AT ROUNDABOUT JOINTS

DRAWN AJD	CITY OF BEND	CITY OF BEND STANDARD DRAWING 710 NW WALL ST., BEND, OREGON 97701	SCALE NTS
DIV ROADWAY			DATE 01/31/2022
REV / DATE			APPR
		TYPICAL STREET CROSS-SECTIONS - GENERAL NOTES	STD DWG R-1

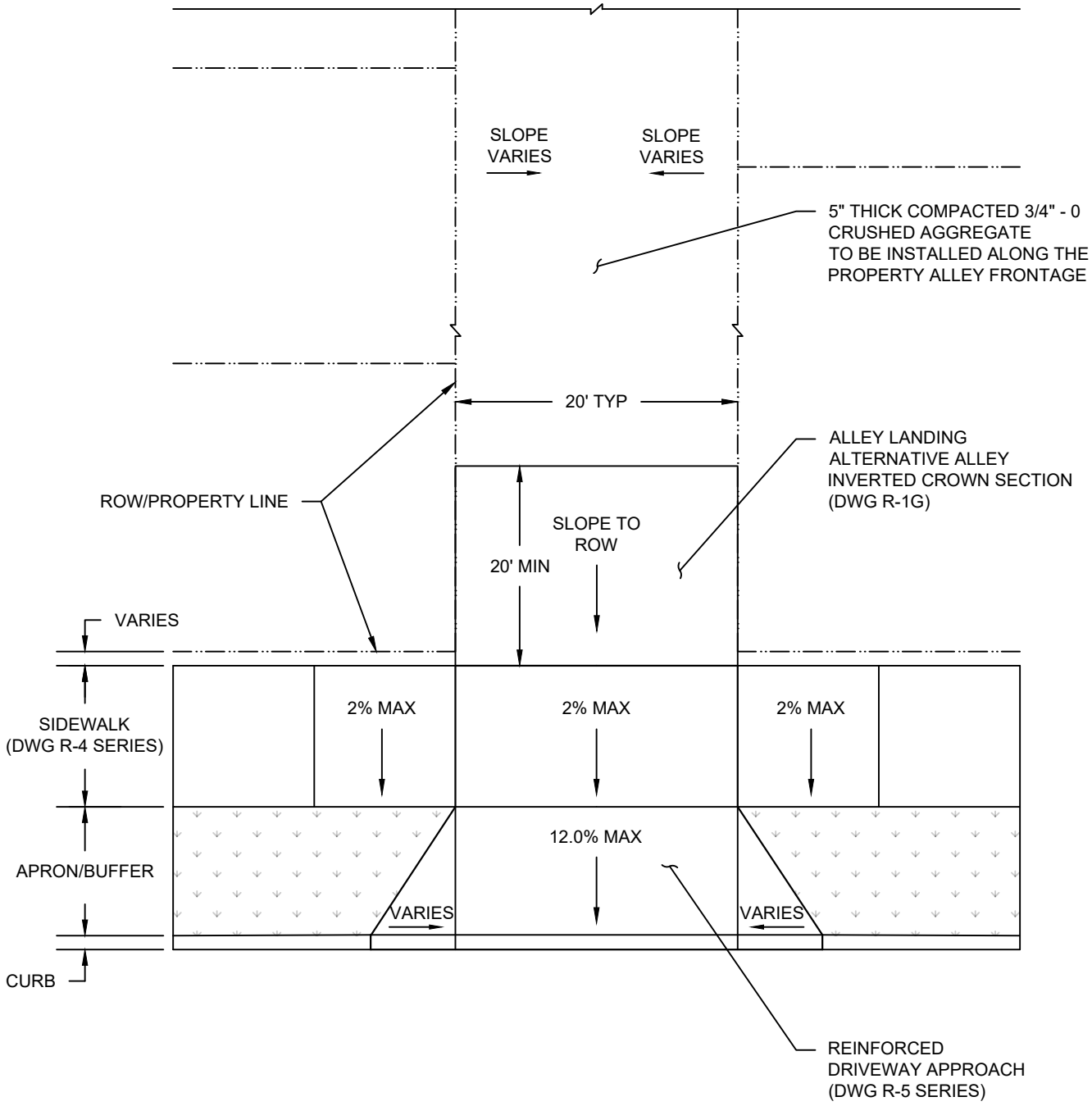


CUL-DE-SAC GENERAL NOTES:

1. SEE R-1 FOR GENERAL NOTES.
2. SEE STD DWG R-1 AND R-1D/E FOR PAVEMENT AND BASE AGGREGATE DEPTHS ON LOCAL ROADS.
3. 10' EASEMENT REQUIRED ON THE T-COURT FOR PEDESTRIAN PATH. SEE DEVELOPMENT CODE 3.8.400C3

ADDED NOTE 3

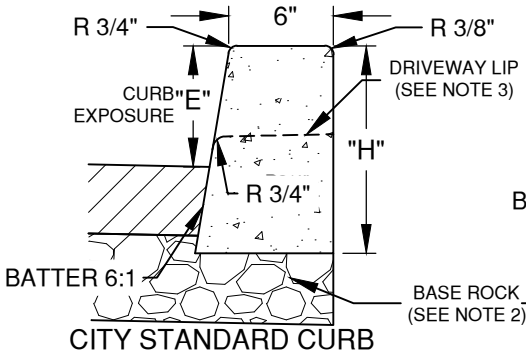
DRAWN AJD	CITY OF BEND	CITY OF BEND	SCALE NTS
DIV ROADWAY		STANDARD DRAWING	DATE 01/31/2022
REV / DATE		710 NW WALL ST., BEND, OREGON 97701	APPR
		TYPICAL STREET DEAD-END TURNAROUND	STD DWG R-1H



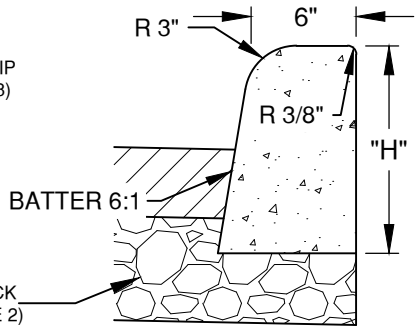
GENERAL NOTES:

1. IF THERE IS ALLEY ACCESS TO THE PROPERTY AND ONE OR MORE OF THE ALLEY DRIVEWAY APPROACHES ARE NOT IMPROVED TO CITY OF BEND STANDARDS AND SPECIFICATIONS, THEN AN ALLEY APPROACH MUST BE IMPROVED TO CITY OF BEND STANDARDS AND SPECIFICATIONS WITH THE PROPOSED DEVELOPMENT.
2. REFER TO THE BEND DEVELOPMENT CODE 4.2.400 FOR ADDITIONAL MINIMUM DEVELOPMENT STANDARDS REQUIREMENTS.

DRAWN DSE DIV ROADWAY REV DATE	CITY OF BEND	CITY OF BEND STANDARD DRAWING 710 NW WALL ST., BEND, OREGON 97701 RESIDENTIAL ALLEY IMPROVEMENTS	SCALE NTS DATE 04/21/2023 APPR STD DWG R-1J

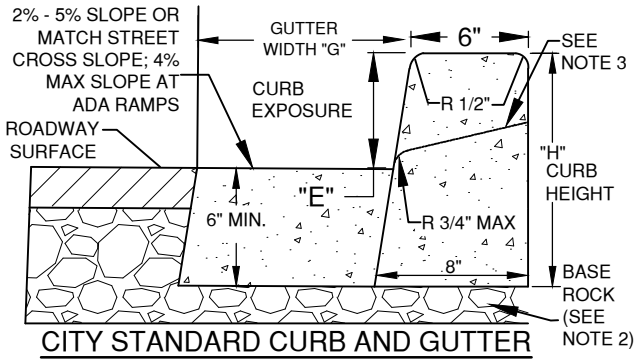


CITY STANDARD CURB

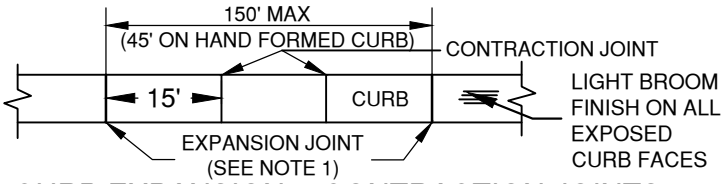


CITY ISLAND/MEDIAN MOUNTABLE CURB

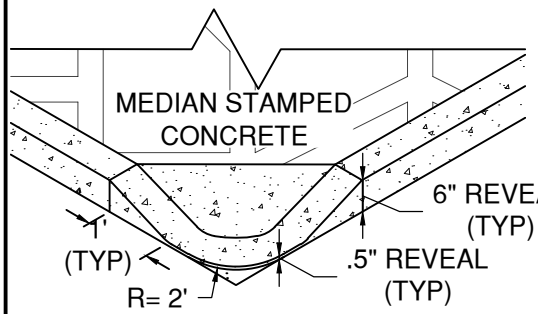
REMOVED STANDARD CURB WITH WEEP HOLE DETAIL

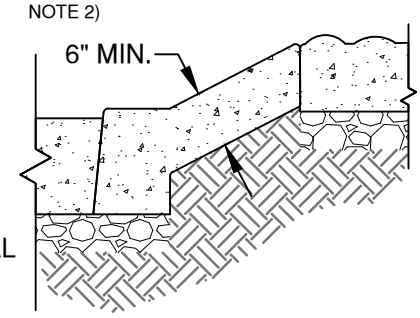


CITY STANDARD CURB AND GUTTER

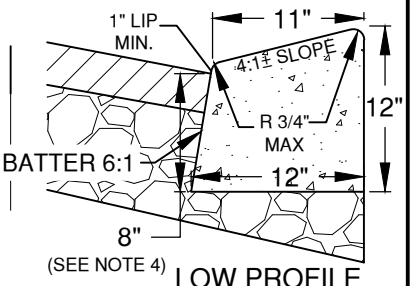


CURB EXPANSION & CONTRACTION JOINTS

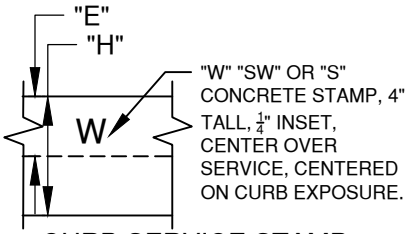




TAPERED CURB

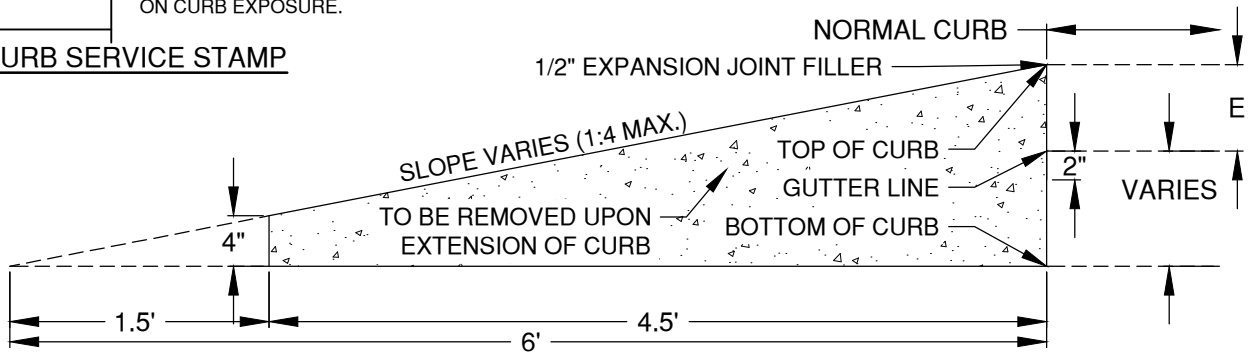


LOW PROFILE MOUNTABLE CURB



CURB SERVICE STAMP

ROAD CLASS	CURB HEIGHT - H	CURB EXPOSURE - E	GUTTER WIDTH - G
ARTERIAL	16"	7"	12"
COLLECTOR	14"	6"	18"
LOCAL	12"	6"	18"



CURB ENDING DETAIL

SEE NOTES ON STD DWG R-3A

DRAWN AJD	CITY OF BEND	CITY OF BEND STANDARD DRAWING 710 NW WALL ST., BEND, OREGON 97701	SCALE NTS
DIV ROADWAY			DATE 03/22/2023
REV DATE			APPR
		CONCRETE CURB	STD DWG R-3

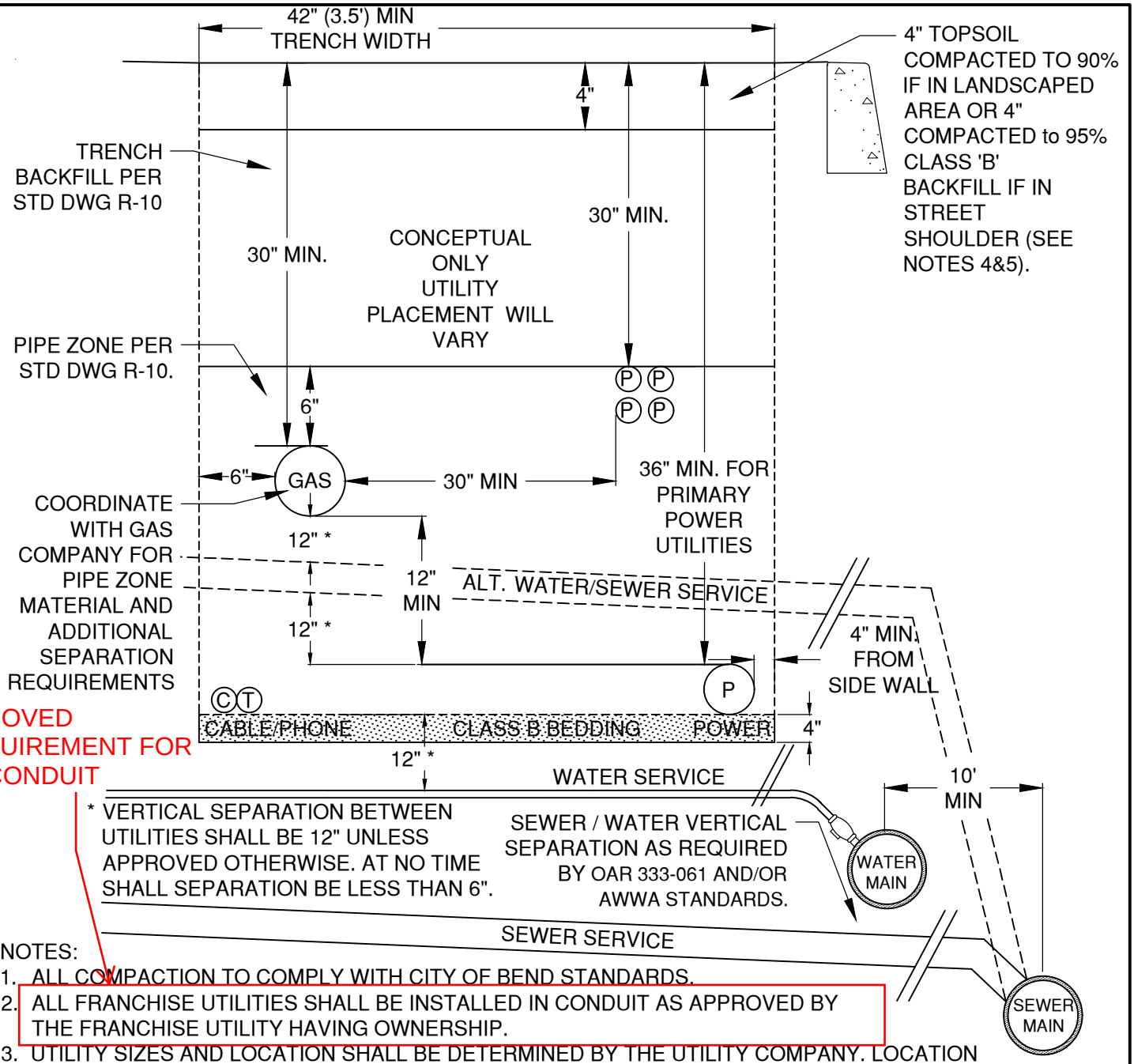
NOTES FOR STD DWG R-3:

1. EXPANSION JOINTS REQUIRED AT END OF RADII, DRIVEWAY APRONS, POINTS OF CURVATURE, AND NO GREATER THAN 150' MAXIMUM.
2. AGGREGATE BASE SHALL CONFORM TO SPECIFICATION SECTION 00640/00641. DEPTH AS REQUIRED TO MATCH BOTTOM OF STREET SECTION, 4" MIN.
3. SLOPE DRIVEWAY TOWARD STREET. 3/4" MAXIMUM LIP AT GUTTER, 1" ON COLLECTORS AND ARTERIALS.
4. MOUNTABLE CURB PERMITTED ON LOCAL STREET CUL-DE-SACS, ALLEYS, AND WHERE PERMITTED BY THE CITY ENGINEER. WHERE SIDEWALK ABUTS CURB, SIDEWALK SHALL BE MIN. 6" THICK
5. CURB AND GUTTER MAY BE REQUIRED WHEN GUTTER SLOPE IS BETWEEN 0.5% - 0.75%.
6. CONCRETE MATERIAL AND PLACEMENT SHALL CONFORM TO SPECIFICATION SECTION 00759.
7. LOCATE TAPERED CURB ON DOWNSTREAM SIDE OF PEDESTRIAN REFUGE IN CENTER MEDIAN CURB RAMPS TO PROTECT FROM SNOW PLOW DAMAGE.
8. TACK COAT IS TO BE APPLIED TO CURB FACE PRIOR TO PAVING.

ADDED

REMOVED NOTE "WEEP HOLE CURBS ON RESIDENTIAL STREETS ONLY WHERE APPROVED. SIDEWALK CANNOT BE PLACED CURB TIGHT WITH WEEP HOLES. SEE R-4A AND STRM 18"

DRAWN AJD		CITY OF BEND		SCALE NTS
DIV ROADWAY		STANDARD DRAWING		DATE 03/22/2023
REV	DATE	710 NW WALL ST., BEND, OREGON 97701		APPR
		CITY OF BEND	CONCRETE CURB NOTES	STD DWG R-3A

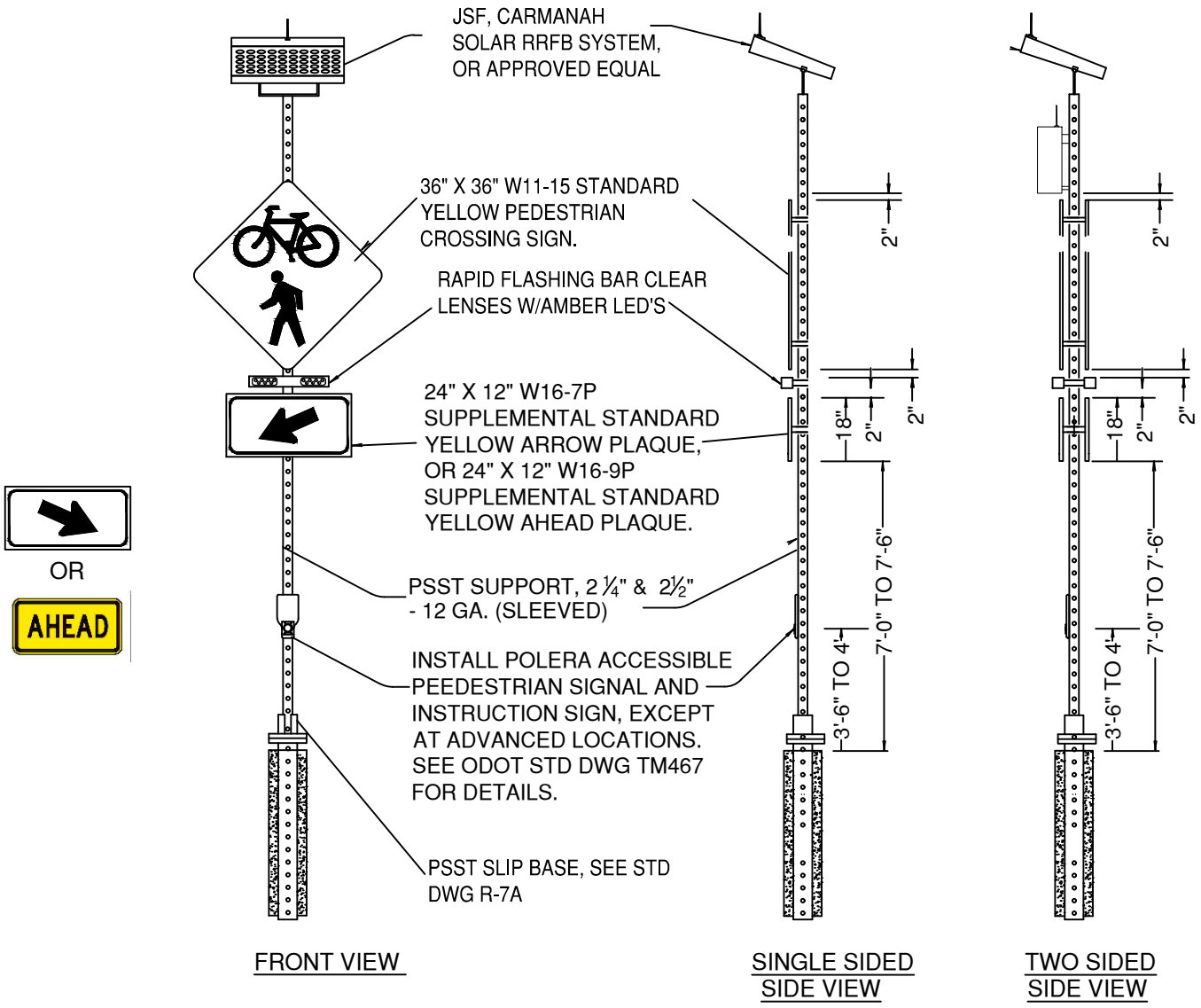


REMOVED REQUIREMENT FOR UL CONDUIT

NOTES:

1. ALL COMPACTION TO COMPLY WITH CITY OF BEND STANDARDS.
2. ALL FRANCHISE UTILITIES SHALL BE INSTALLED IN CONDUIT AS APPROVED BY THE FRANCHISE UTILITY HAVING OWNERSHIP.
3. UTILITY SIZES AND LOCATION SHALL BE DETERMINED BY THE UTILITY COMPANY. LOCATION TO BE SHOWN AND APPROVED BY CITY WITH A RIGHT OF WAY (ROW) PERMIT.
4. WHERE STORM SWALES ARE PROPOSED WITHIN THE LANDSCAPE STRIP, FRANCHISE UTILITIES SHALL BE INSTALLED OUTSIDE OF THE SWALE AREA.
5. TOP SOIL LAYER TO BE COMPACTED TO 90% MAX DENSITY. WHERE SIDEWALK IS PLACED OVER FRANCHISE UTILITY TRENCH, NO TOP SOIL SHALL BE PLACED AND SIDEWALK TO BE CONSTRUCTED TO COMPLY WITH CITY STANDARDS R-4A AND R-4B
6. STANDARD SHOWN FOR NEW CONSTRUCTION. MODIFICATIONS SHALL BE MADE WHEN WITHIN EXISTING DEVELOPMENTS WHERE APPROVED BY THE CITY ENGINEER.
7. UTILITIES OUTSIDE THE RIGHT OF WAY SHALL BE WITHIN A PUBLIC UTILITIES EASEMENT (PUE). BACKFILL AND INSTALLATION REQUIREMENTS STILL COMPLY WITH THE PUE.
8. NO SWALES OR SURFACE STORMWATER DRAINAGE FACILITIES ARE PERMITTED OVER FRANCHISE UTILITIES.

DRAWN AJD	CITY OF BEND	CITY OF BEND	SCALE NTS
DIV ROADWAY		STANDARD DRAWING	DATE 01/31/2022
REV DATE		710 NW WALL ST., BEND, OREGON 97701	APPR
		FRANCHISE UTILITY JOINT TRENCH	STD DWG R-10A



RECTANGULAR RAPID FLASHING BEACON SYSTEM
PSST INSTALLATION

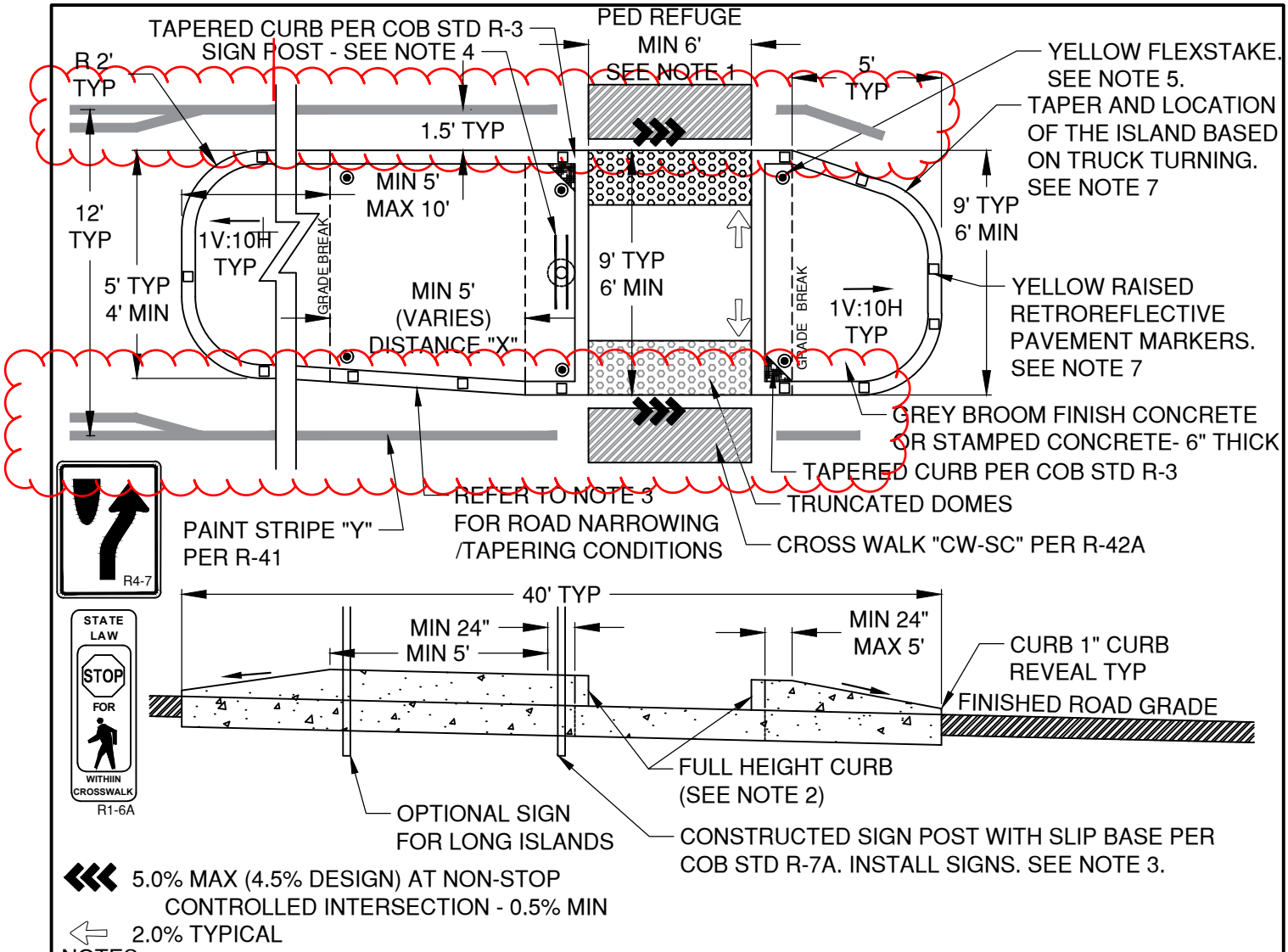
REPLACED "ADD RADIO NETWORK CONTROLLER FOR WIRELESS EQUIPMENT IF NEEDED"

NOTES:

1. ~~REMOVE SOLAR EQUIPMENT IF USING COMMERCIAL POWER~~
2. USE APPLIED INFORMATION AI-500-030 LOW POWER MONITORING DEVICE
3. ~~USE SCHOOL CROSSING (S1-1) FOR DESIGNATED SCHOOL CROSSING~~
4. USE DOUBLE SIDED SIGNS IN MEDIANS — ADDED #4

DRAWN AJD	CITY OF BEND	CITY OF BEND STANDARD DRAWING 710 NW WALL ST., BEND, OREGON 97701	SCALE NTS
DIV ROADWAY			DATE 01/31/2022
REV DATE			APPR
		RECTANGULAR RAPID FLASHING BEACON	STD DWG R-35

CONVERTED FROM NDY
TO Y ALONG MEDIAN



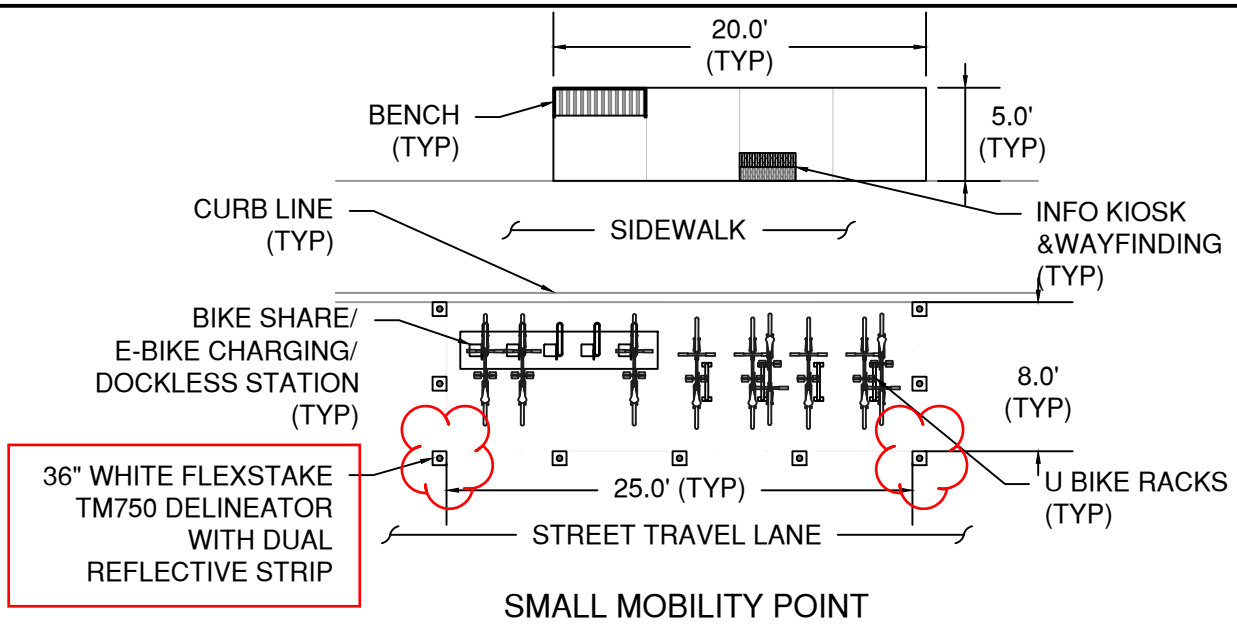
5.0% MAX (4.5% DESIGN) AT NON-STOP CONTROLLED INTERSECTION - 0.5% MIN

2.0% TYPICAL

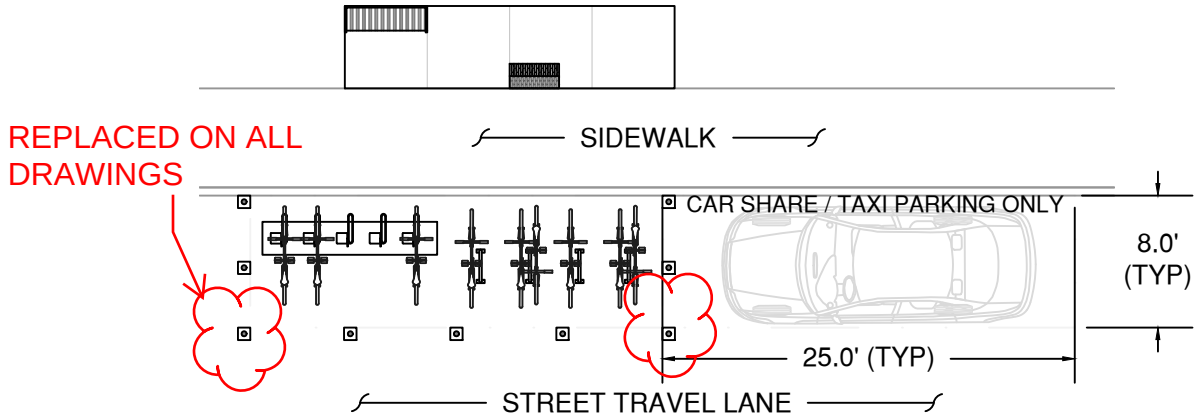
NOTES:

1. PEDESTRIAN REFUGE OPENING TO MATCH THE WIDTH OF THE CURB RAMPS, BUT NOT LESS THAN 6 FEET WIDE; IF SHARED USE PATH CROSSING, CURB RAMPS AND REFUGE WIDTH SHALL MATCH PATH WIDTH.
2. CURB TO BE INSTALLED PER CITY STANDARD R-3. FULL HEIGHT CURB (DEPENDENT ON THE STREET CLASSIFICATION) TO BE CONSTRUCTED OUTSIDE THE BULL NOSE / VERTICAL TAPER SECTIONS OF THE ISLAND.
3. TAPER TO BE $\frac{1}{2}$*X OR AS NEEDED TO TERMINATE THE ISLAND WITH A 4' MIN BULLNOSE.
4. INSTALL R1-6A AND R4-7 (R1-6A OR R1-6C SIGNS FOR SCHOOL ZONES) SIGNS BACK TO BACK ON SIGN POST ADJACENT TO THE PED REFUGE. INSTALL AN ADDITIONAL POST PER COB STANDARD R-7A FOR INSTALLATION OF A SECOND R4-7 SIGN IF THE ISLAND EXCEEDS 40 FEET IN TOTAL LENGTH, OR AS DIRECTED BY THE CITY ENGINEER.
5. ISLANDS ARE NOT TO BE DOWELED INTO ROADWAYS UNLESS APPROVED BY THE CITY ENGINEER.
6. INSTALL 36" YELLOW TUBULAR FLEXSTAKE TM 750, OR APPROVED EQUAL, WITH TWO REFLECTIVE STRIPS DELINEATOR ON THE END OF THE BULLNOSE. OFFSET TO AVOID BLOCKING THE R1-6A SIGN. USE CONCRETE ANCHORS (REDHEAD OR EQUIVALENT).
7. INSTALL RETROREFLECTIVE YELLOW CURB MARKINGS ON TOP OF CURB AT 3' MAX SPACING AROUND MEDIAN NOSE AND AT 15' SPACING TO AND BEYOND TAPER SECTION AS SHOWN.
8. PLACEMENT OF ISLAND WILL BE BASED ON A MINIMUM WB-50 TURNING TEMPLATE. LARGER TRUCK MANEUVERABILITY TO BE DETERMINED IN INDUSTRIAL/COMMERCIAL AREAS.

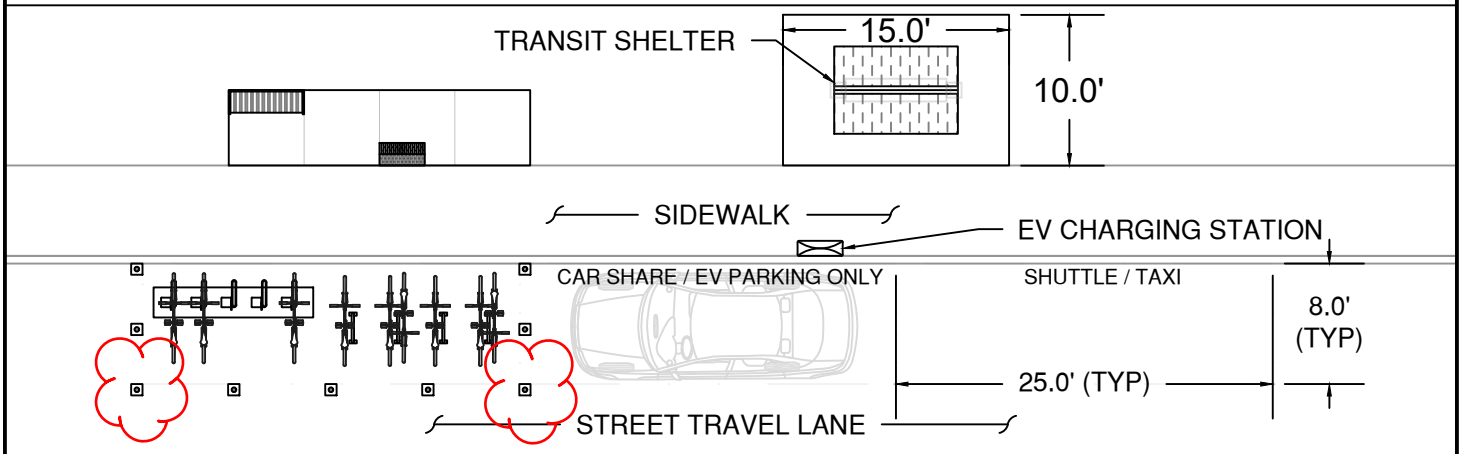
DRAWN CJH	CITY OF BEND	CITY OF BEND	SCALE NTS
DIV ROADWAY		STANDARD DRAWING	DATE 05/02/23
REV DATE		710 NW WALL ST., BEND, OREGON 97701	APPR
		PEDESTRIAN REFUGE ISLAND	STD DWG R-46



SMALL MOBILITY POINT



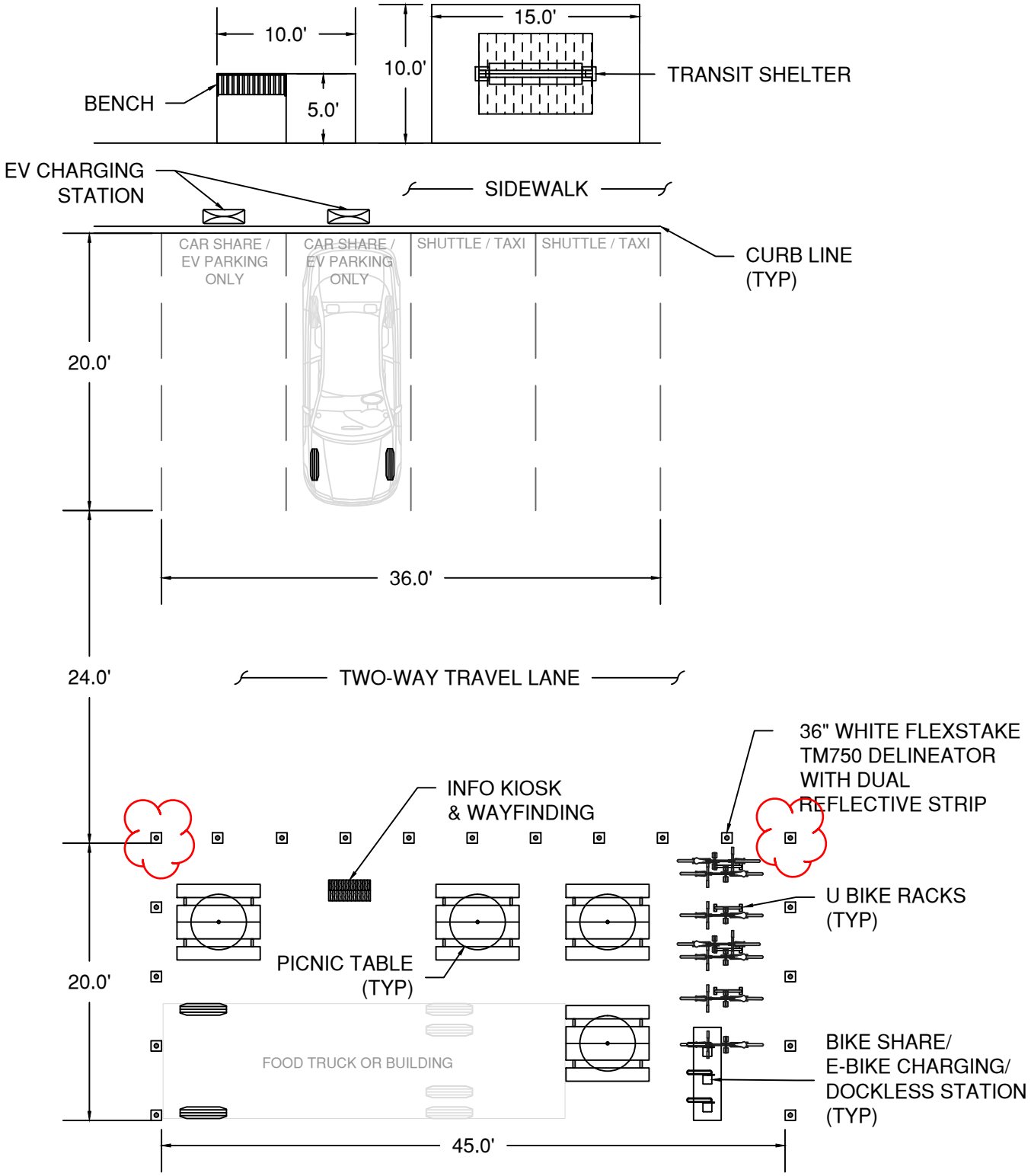
MEDIUM MOBILITY POINT



MEDIUM (+) MOBILITY POINT

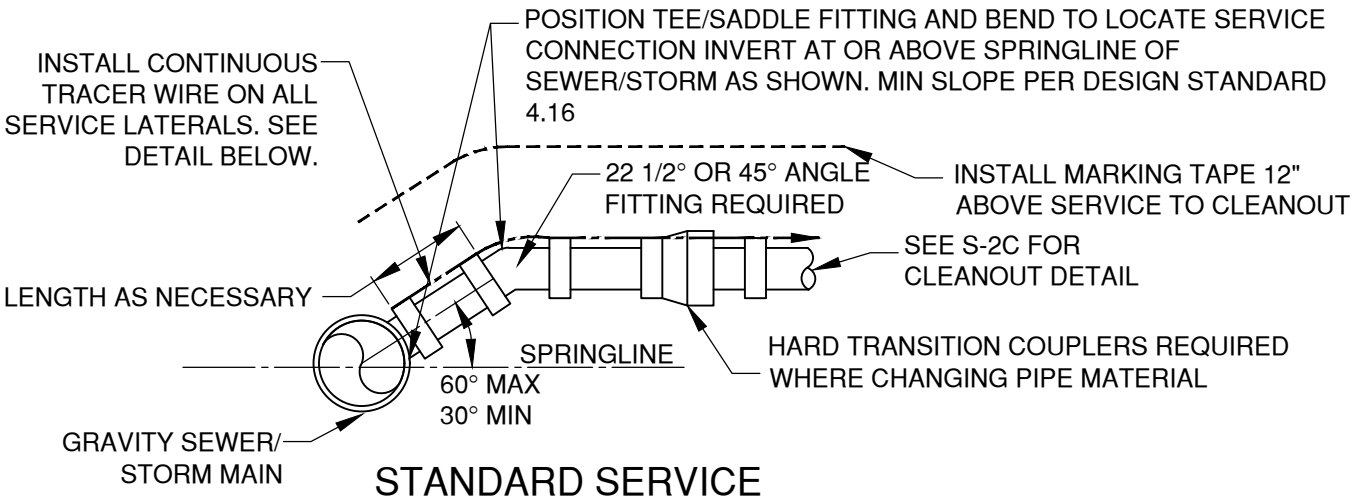
NOTES:
1. LOCATION & EXISTING CONDITIONS WILL DETERMINE LAYOUT
2. FINAL LAYOUT MUST MEET MINIMUM ADA STANDARDS FOR ACCESSIBLE DESIGN
3. ALL CONCEPTS SHOWN ARE FOR SPATIAL REPRESENTATION ONLY
4. BICYCLE PARKING STATIONS MAY BE PLACED WITH IN ON-STREET PARKING SPACES OR ON PRIVATE PROPERTY

DRAWN AJD	CITY OF BEND	CITY OF BEND STANDARD DRAWING 710 NW WALL ST., BEND, OREGON 97701	SCALE NTS
DIV ROADWAY			DATE 01/31/2022
REV / DATE			APPR
		MOBILITY POINTS - SMALL/MEDIUM	STD DWG R-50A

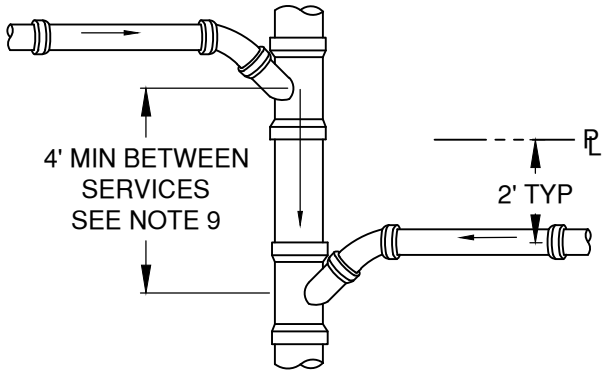


NOTES:
1. LOCATION & EXISTING CONDITIONS WILL DETERMINE LAYOUT
2. FINAL LAYOUT MUST MEET MINIMUM ADA STANDARDS FOR ACCESSIBLE DESIGN
3. ALL CONCEPTS SHOWN ARE FOR SPATIAL REPRESENTATION ONLY

DRAWN AJD	CITY OF BEND	CITY OF BEND	SCALE NTS
DIV ROADWAY		STANDARD DRAWING	DATE 01/31/2022
REV DATE		710 NW WALL ST., BEND, OREGON 97701	APPR
		MOBILITY POINTS - LARGE	STD DWG R-50B

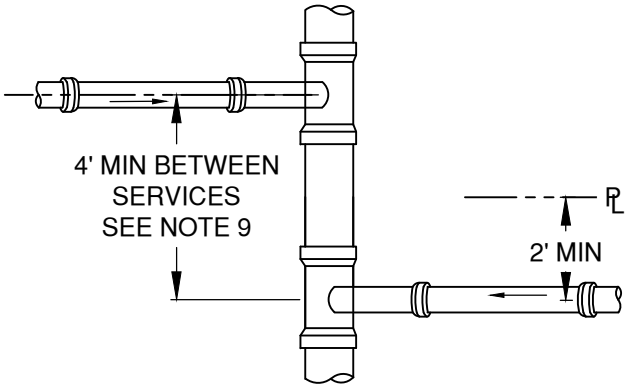


STANDARD SERVICE



WYE SERVICE CONNECTION

(FOR USE ON MAINS 12" AND SMALLER)



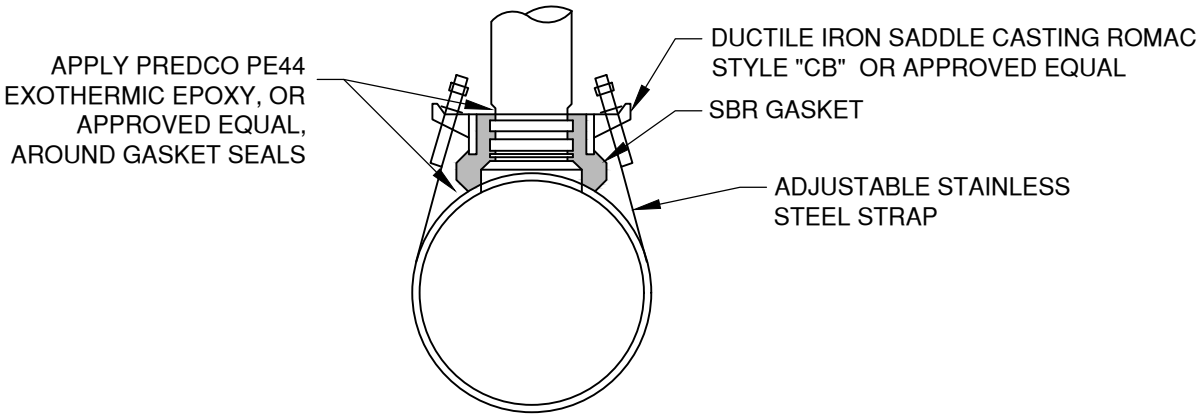
TEE SERVICE CONNECTION

(FOR USE ON MAINS LARGER THAN 12" OR ON EXISTING MAINS FOR INFILL SERVICE CONNECTIONS)

NOTES:

1. ALL TRENCHES TO CONFORM TO STD DWG R-10
2. SERVICES OFF NEW MAINS SHALL BE WYE OR TEE CONNECTIONS. SEE STD DWG S-2B FOR SERVICES OFF EXISTING MAINS
3. TRACER WIRE REQUIRED ON ALL SEWER / STORM SERVICES. MARKING TAPE SHALL BE INSTALLED AS SHOWN.
4. SEWER / STORM CONNECTION FROM THE PROPERTY LINE/ROW LINE TO THE CLEAN OUT NEAR THE BUILDING FOUNDATION REQUIRES A PLUMBING PERMIT.
5. WHEN A SEWER SERVICE IS LOCATED ABOVE OR WITHIN 18" BELOW A WATERLINE, THE SEWER SERVICE SHALL BE CONSTRUCTED WITH A MIN. 20 LF OF AWWA C900 OR AWWA C905 PIPE CENTERED AT THE WATERLINE PER OAR 333-061-0050(9).
6. STANDARD RESIDENTIAL SEWER SERVICES ARE 4"Ø. COMMERCIAL, INDUSTRIAL SEWER SERVICES ARE 6"Ø UNLESS OTHERWISE SIZED LARGER BY THE SITE'S ENGINEER.
7. WHERE A SERVICE CROSSES A NEW CURB, STAMP THE FACE OF CURB PER STD DWG R-3.
8. GRAVITY SEWER STANDARDS APPLY TO STORM SEWER MAINS.
9. MINIMUM 3' SECTIONS OF PIPE ARE REQUIRED BETWEEN FITTINGS.
10. ALL STORM SEWER LATERALS MUST COMPLY WITH CITY SEWER STANDARDS.

DRAWN AJD DIV SANITARY REV / DATE	CITY OF BEND	CITY OF BEND STANDARD DRAWING 710 NW WALL ST., BEND, OREGON 97701	SCALE NTS DATE 03/22/2023 APPR
		GRAVITY SEWER/STORM SERVICES ON NEW MAINS	STD DWG S-2A



SEWER SADDLE

FOR USE ON MAINS 12" AND SMALLER

REVISED LANGUAGE

ADDED NOTE

NOTES:

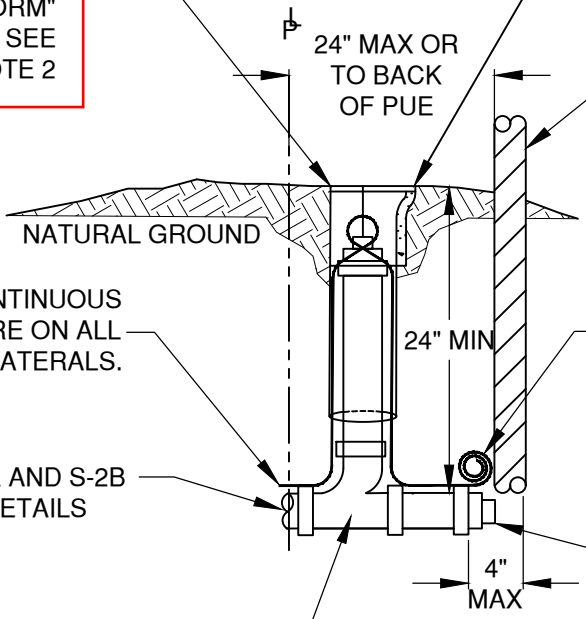
1. INSTALL SERVICE LATERAL PER STD DWG S-2A
2. CONNECTION TO EXISTING MAINS MAY BE CUT-IN FITTINGS PER STD DWG S-2A OR TAPS PER THIS DETAIL. PVC MAINS TO UTILIZE CUT IN FITTINGS.
3. SEWER SADDLE SHALL BE ROMAC STYLE "CB" OR APPROVED EQUAL.
4. INSTALL CONNECTION PER THE MANUFACTURER'S RECOMMENDATIONS.
5. GASKET SEAL EPOXY NOT TO BE INSTALLED ON PVC MAINS.

DRAWN AJD DIV SANITARY REV / DATE	CITY OF BEND	CITY OF BEND STANDARD DRAWING 710 NW WALL ST., BEND, OREGON 97701 GRAVITY SEWER/STORM SERVICE CONNECTION TO EXISTING MAIN	SCALE NTS DATE 03/22/2023 APPR STD DWG S-2B

CLARIFIED LANGUAGE AND ADDED MIN LENGTH, SEE NOTE 2, STAND PIPE

STORM: 4" CLEANOUT, USE 6" C900 VERTICAL STAND PIPE (MIN. 18" LENGTH) WITH CAST IRON LID WITH CAST LETTERING "STORM" OR APPROVED EQUAL. SEE NOTE 2

SEWER: 4" CLEANOUT, USE 6" C900 VERTICAL STAND PIPE (MIN. 18" LENGTH) AND CAST IRON LID WITH CAST LETTERING "SEWER" OR APPROVED EQUAL. SEE NOTE 2



MARK SERVICE STUB AT ROW WITH PRESSURE TREATED WOOD OR CAPPED PVC EXTENDING 2' ABOVE EXISTING GROUND. PAINT MARKER GREEN FOR SEWER OR PURPLE FOR STORM.

INSTALL CONTINUOUS TRACER WIRE ON ALL SERVICE LATERALS.

EXTEND 6" BEYOND CLEANOUT; COIL MIN 24" OF TRACER WIRE AT RIGHT OF WAY LINE. TRACER WIRE TO BE EXTENDED TO CLEANOUT AT STRUCTURE UNDER BUILDING PERMIT.

NOTE: SEE S-2A AND S-2B FOR SERVICE DETAILS

REMOVABLE PLUG OR CAP

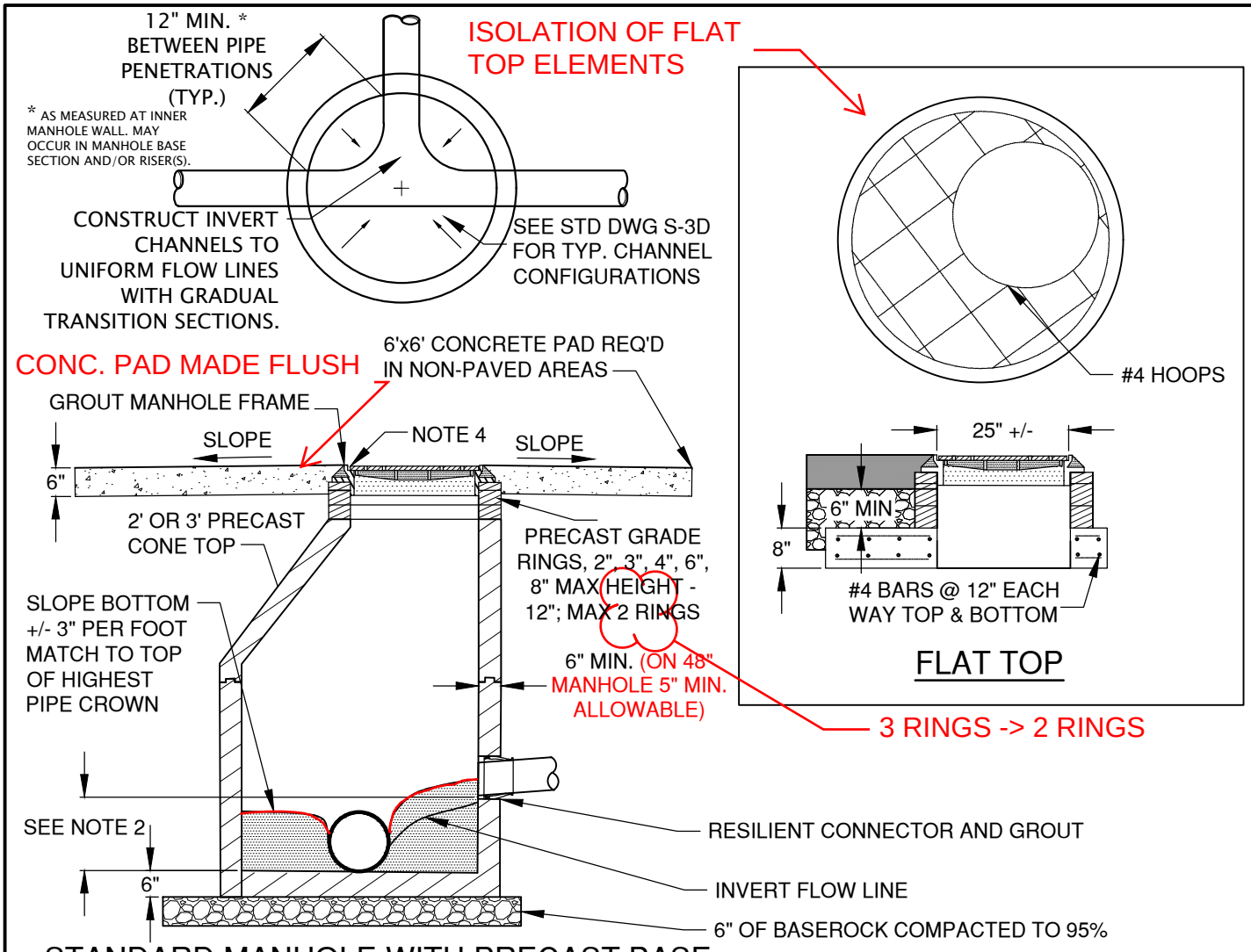
4"x4" WYE (RES TYP)
6"x4" WYE (IND/COMM TYP)

ADDED NOTE

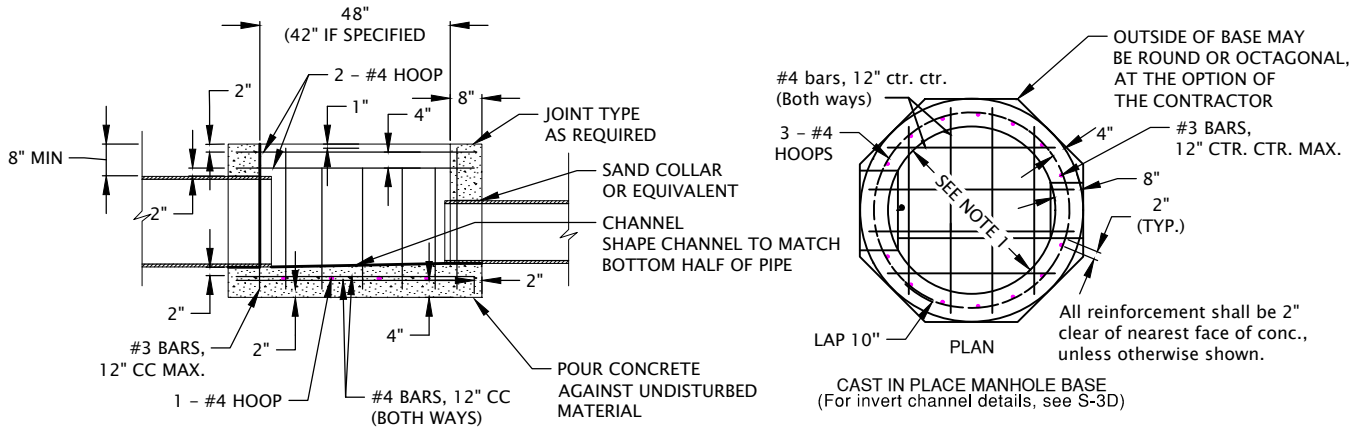
NOTES:

1. SEE STD DWG S-2A FOR GENERAL NOTES.
2. INSTALL CONCRETE BROOKS BOX WITH CAST IRON LID ON ALL CLEANOUTS WITHIN HARDSCAPE.

DRAWN AJD DIV SANITARY REV DATE	CITY OF BEND	CITY OF BEND STANDARD DRAWING 710 NW WALL ST., BEND, OREGON 97701 GRAVITY SEWER/STORM CLEANOUT	SCALE NTS DATE 03/22/2023 APPR STD DWG S-2C



STANDARD MANHOLE WITH PRECAST BASE

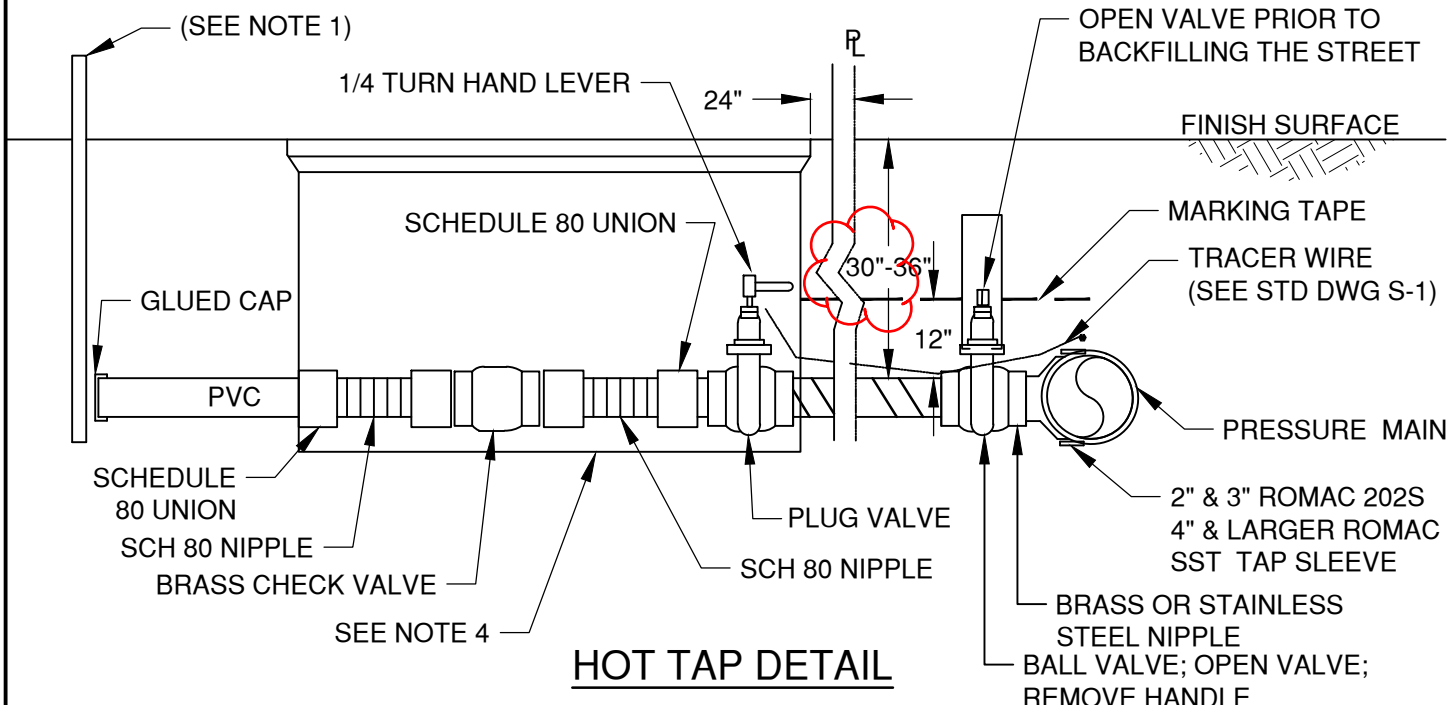


CAST IN PLACE MANHOLE BASE

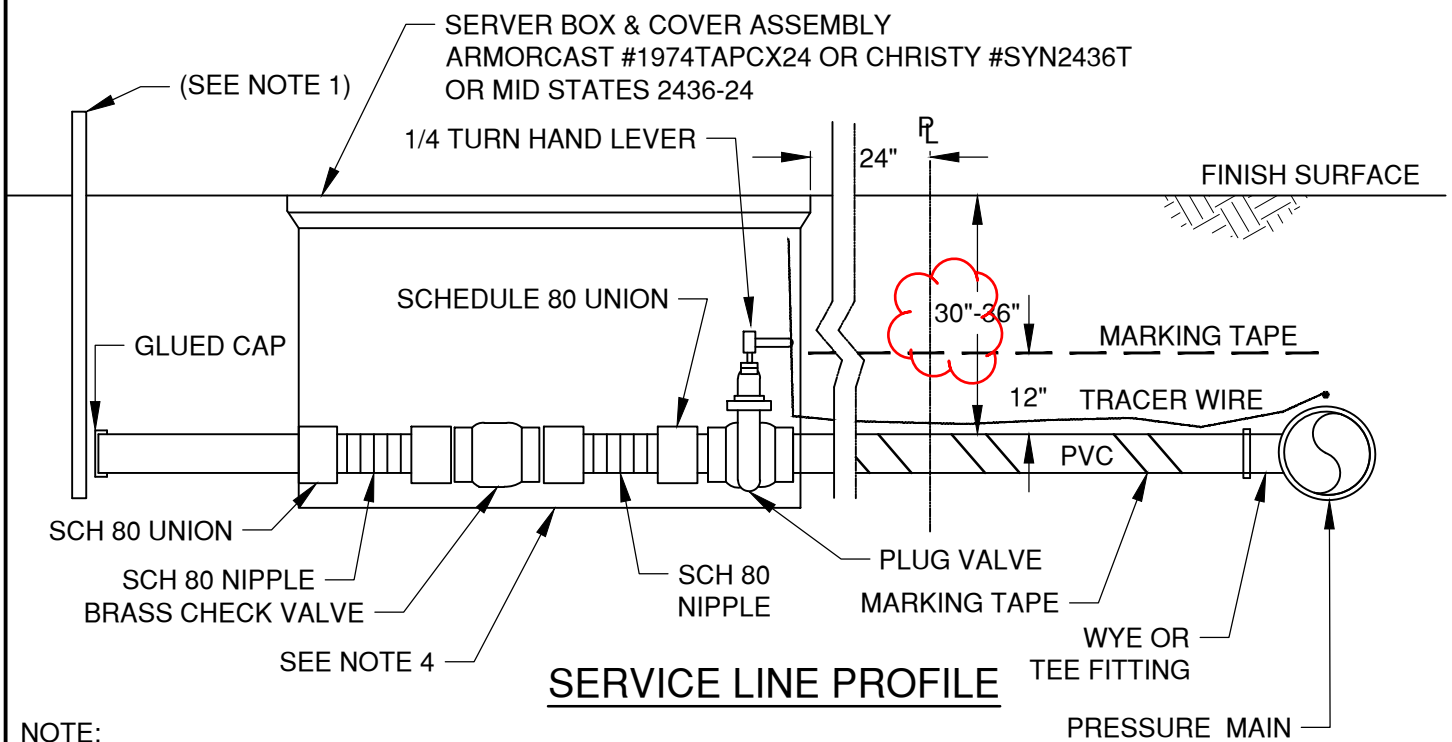
GENERAL NOTES:

1. MANHOLE DIAMETER PER CITY OF BEND DESIGN STANDARDS.
2. THE MAXIMUM INTERNAL DROP IS 1' FOR PIPES 8" IN DIAMETER OR LESS AND 2' FOR PIPES GREATER THAN 8" IN DIAMETER. SEE DWGS S-4 AND S-4A FOR LARGER DROPS.
3. ALL GROUT USED ON MANHOLES SHALL BE NON-SHRINK.
4. A SINGLE RISER RING IS ALLOWED ON INITIAL INSTALLATION.

DRAWN AJD	CITY OF BEND	CITY OF BEND	SCALE NTS
DIV SANITARY		STANDARD DRAWING	DATE 03/22/2023
REV DATE		710 NW WALL ST., BEND, OREGON 97701	APPR
		STANDARD SEWER/STORM MANHOLE	STD DWG S-3C



HOT TAP DETAIL

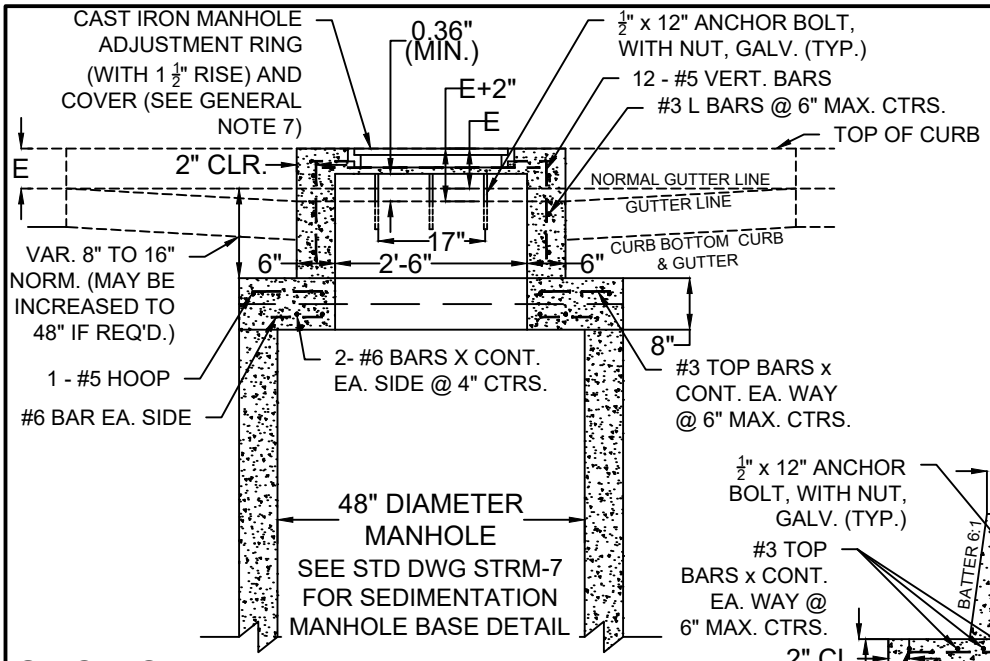


SERVICE LINE PROFILE

NOTE:

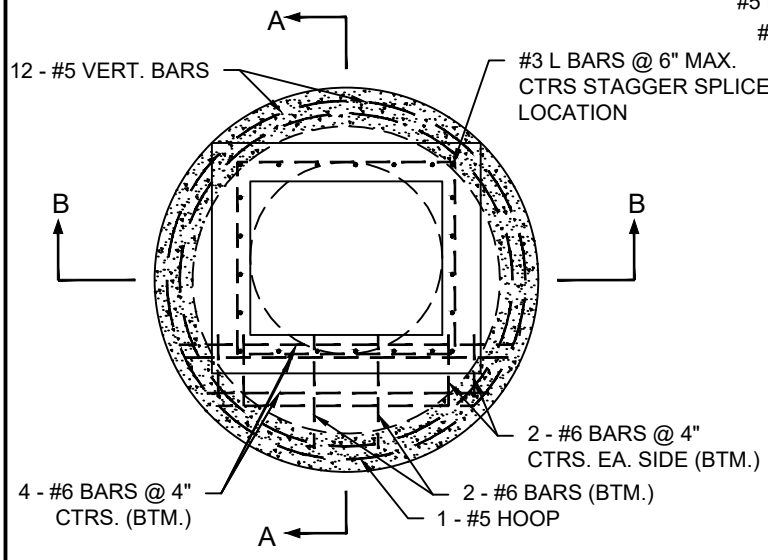
1. 2x4 SERVICE MARKER TO FULL DEPTH OF TRENCH. PROJECT END 2FT MINIMUM ABOVE FINISH GRADE & PAINT GREEN ALL AROUND
2. SERVICE BOX COVER MARKED "SEWER"
3. CHECK VALVES 3" & LARGER APCO 100. 2" LEGEND T451
4. SERVICE BOX AND ALL APPARATUSES WITHIN ARE PRIVATELY OWNED BUT REQUIRED TO BE INSTALLED WITH PRESSURE SEWER SERVICE

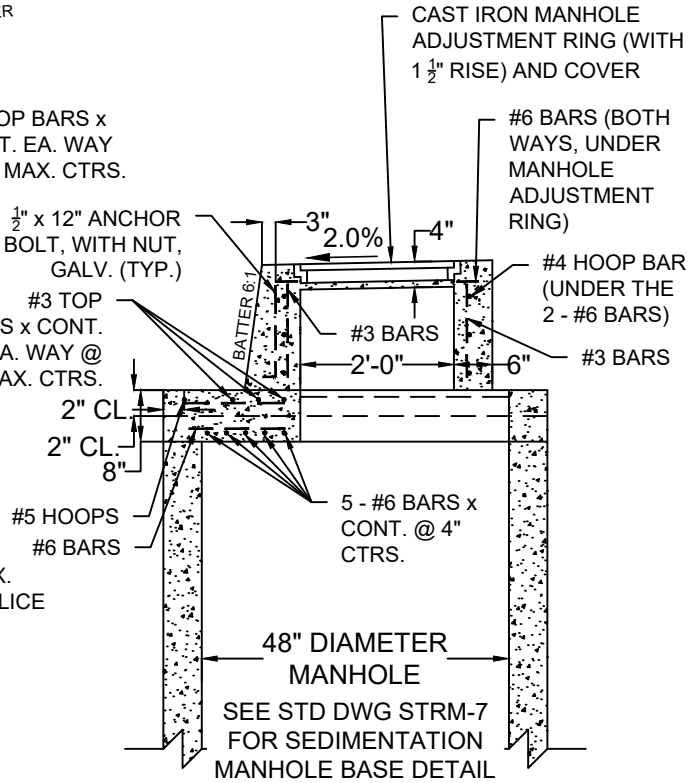
DRAWN AJD	CITY OF BEND	CITY OF BEND	SCALE NTS
DIV SANITARY		STANDARD DRAWING	DATE 01/31/2022
REV DATE		710 NW WALL ST., BEND, OREGON 97701	APPR
		PRESSURE SEWER SERVICE - NON TRAFFIC AREA	STD DWG S-9



SECTION A-A

NTS





SECTION B-B

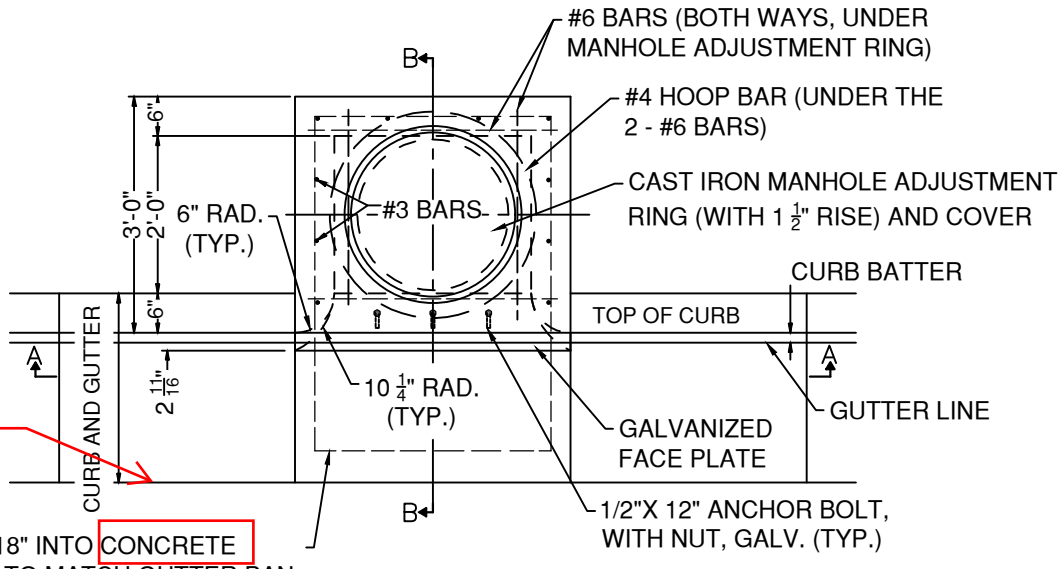
NTS

THIS SEDIMENTATION MANHOLE OPTION IS USED WHEN A CATCH BASIN OR INLET ARE PROPOSED AND A CONFLICT EXISTS PREVENTING INSTALLATION OF THE STANDARD SEDIMENTATION MANHOLE (STRM-7).

NOTES:

1. ALL REINFORCEMENT TO BE PLACED A MINIMUM OF 2" CLEAR OF NEAREST FACE OF CONCRETE UNLESS OTHERWISE SHOWN OR NOTED.
2. ALL PRECAST PRODUCTS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C478.
3. ALL CONCRETE SHALL BE COMMERCIAL GRADE CONCRETE.
4. INLET TOP MAY BE CAST-IN-PLACE OR PRECAST. ALL PRECAST INLETS SHALL CONFORM TO REQUIREMENTS OF ASTM C913.
5. VARY ANCHOR BOLT LENGTH AND REINFORCING BAR PLACEMENT AS REQUIRED BY CURB EXPOSURE E.
6. SEE COB STD DWG R-3 FOR CURB DETAILS.
7. SEE ODOT STD DWG RD356 FOR MANHOLE ADJUSTMENT RING. SEE COB STD DWG STRM-8 FOR CAST IRON MANHOLE ADJUSTMENT RING AND COVER.
8. SUMP SIZE TO BE DESIGNED IN ACCORDANCE WITH COSM - 20 CF OF SUMP VOLUME FOR EACH 1.0 CFS DESIGN FLOW - NOT LESS THAN 48" DEPTH.

DRAWN AJD	CITY OF BEND	CITY OF BEND	SCALE NTS
DIV STORM		STANDARD DRAWING	DATE 01/31/2022
REV DATE		710 NW WALL ST., BEND, OREGON 97701	APPR
		STORMWATER SEDIMENTATION MANHOLE - ALTERNATE	STD DWG STRM-7A

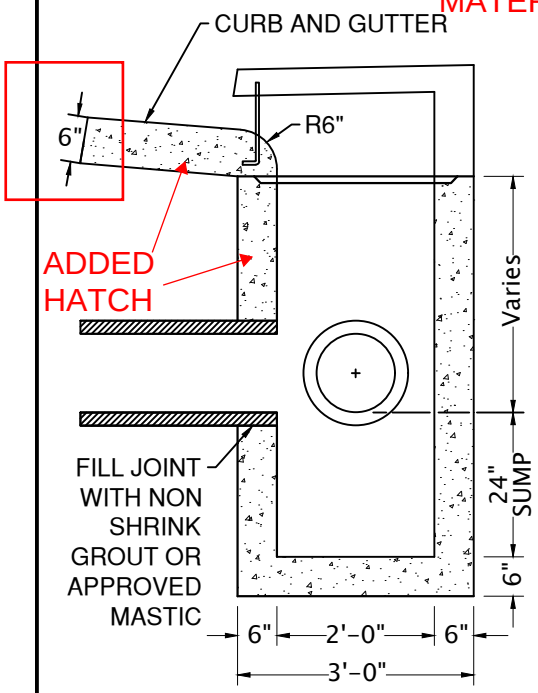


LINEWORK NOW BOLD

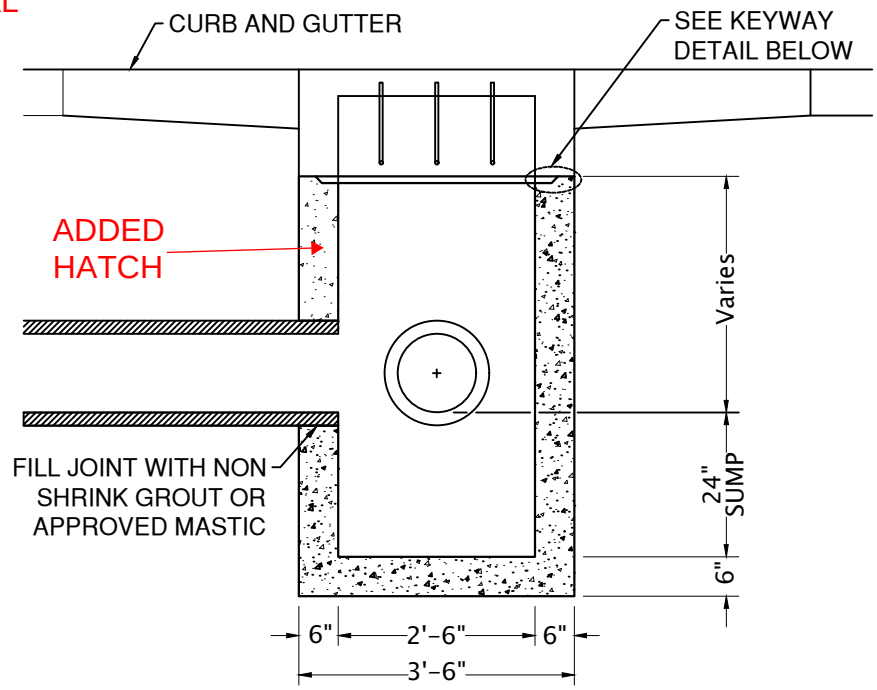
#3 BARS, PROJECT 18" INTO CONCRETE GUTTER PAN (BEND TO MATCH GUTTER PAN. SEE SECTION B-B)

SPECIFIED MATERIAL

PLAN VIEW

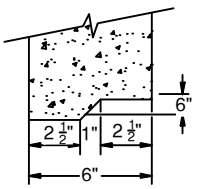


SECTION B - B



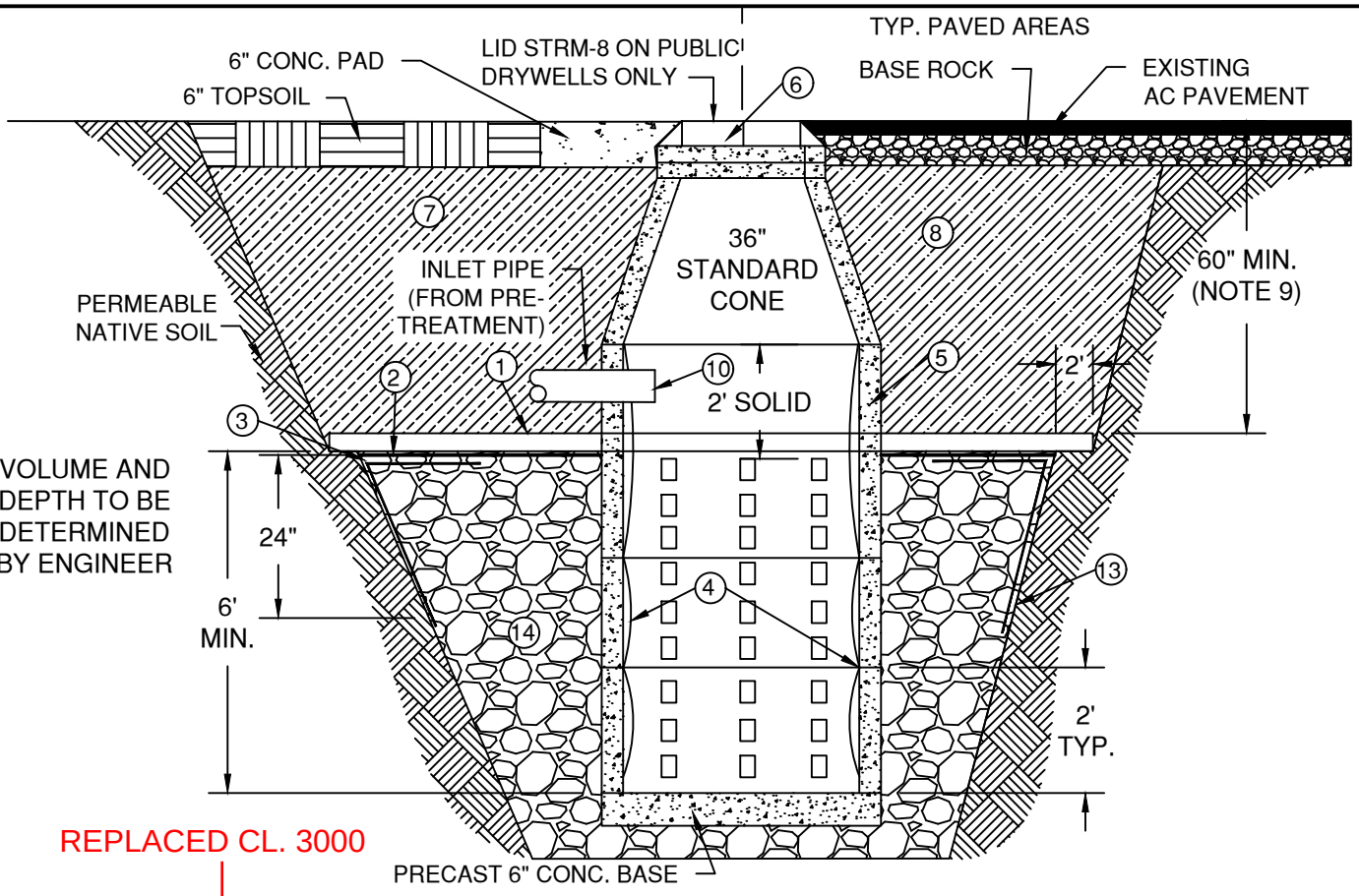
SECTION A - A

NOTES:
1. REMOVE SUFFICIENT CURB TO POUR BACK WALL. TOP SECTION MAY BE POURED MONOLITHIC WITH SIDEWALK.
2. CURB INLETS TO BE USED ON ARTERIAL AND COLLECTOR ROADWAYS.
3. "E" = CURB EXPOSURE.
4. SEE COB STD DWG STRM-8 FOR CAST IRON MANHOLE ADJUSTMENT RING AND COVER.



KEYWAY DETAIL

DRAWN AJD	CITY OF BEND	CITY OF BEND	SCALE NTS
DIV STORM		STANDARD DRAWING	DATE 03/22/2023
REV DATE		710 NW WALL ST., BEND, OREGON 97701	APPR
		STANDARD CATCH BASIN SPECIAL INLETS	STD DWG STRM-9



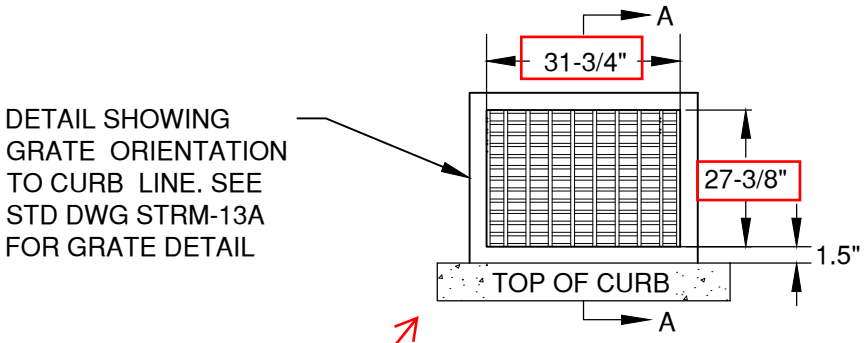
REPLACED CL. 3000

NOTES:

* SEE ALSO THE CITY OF BEND STANDARDS AND SPECIFICATIONS FOR DESIGN CRITERIA

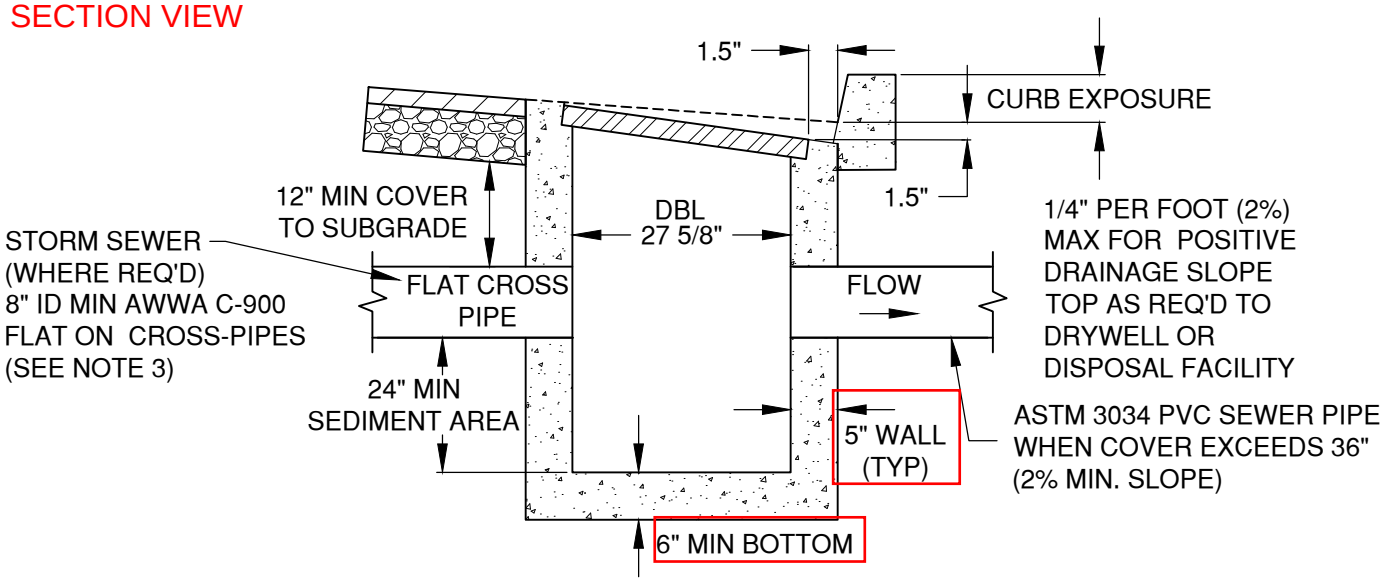
1. 6" CONCRETE CAP, SECTION 00440 COMMERCIAL GRADE CONCRETE, EXTEND TO UNDISTURBED MATERIAL 2' MIN. REQUIRED WITHIN ALL CITY OF BEND RIGHT OF WAY UNLESS NOTED OTHERWISE.
2. MOISTURE BARRIER-2 LAYERS OF 4 MIL POLY. ON ALL ROCK INSTALLATIONS.
3. NONWOVEN GEOFABRIC CONFORMING TO DRAINAGE GEOTEXTILE, OREGON TABLE 02320-1 REQUIRED ON ALL EARTH OR GRAVEL EXCAVATIONS TO 24" INTO ROCK. LAP 24" WITH MOISTURE BARRIER.
4. LINE INSIDE OF PERFORATED BARREL WITH HEAVY WEIGHT VINYL SCREEN, SUCH AS FULL FLOW VINYL SCREEN THAT MEETS THE REQUIREMENTS OF SPECIFICATION SECTION 00470. LINER SHALL BE FULLY AND CONTINUOUSLY ANCHORED, TOP AND BOTTOM OF EACH SECTION. ATTACH BY OVERLAPPING 12" MIN. BETWEEN JOINT OF MANHOLE CONE AND PERFORATED BARREL SECTION. INLET PIPE SHALL BE EXTENDED THROUGH THE SCREEN IF SCREEN IS ATTACHED ABOVE THE PIPE.
5. PRE-CAST SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-478. ALL CONCRETE SHALL BE COMMERCIAL GRADE CONCRETE
6. STANDARD RING AND COVER REQUIRED IN RIGHT-OF-WAY AREAS. NO SLOTTED COVERS WILL BE ALLOWED IN LIEU OF A CATCH BASIN.
7. CLASS "A" BACKFILL COMPACTED TO 95.0% OPTIMUM DRY DENSITY (AASHTO T-99).
8. CLASS "B" BACKFILL COMPACTED TO 95.0% OPTIMUM DRY DENSITY (AASHTO T-99).
9. PERFORATIONS TO BE 60" BELOW EXISTING UNDISTURBED GROUND.
10. INLET PIPE MUST BE DESIGNED SO IT CAN BE PLUGGED IN CASE OF SPILL. ALL PIPE PENETRATIONS ARE TO BE GROUTED OR WATER-TIGHT SEALED. PIPE INLETS NOT TO ENTER DRYWELL WITH PERFORATED BARREL.
11. DRYWELL RIMS TO BE PLACED OUTSIDE OF SIDEWALK, APRON & STREET SURFACES UNLESS APPROVED BY THE CITY ENGINEER.
12. PLANS SHALL PROVIDE VOLUME AND AREA OF ROCK PLACEMENT. ROCK PLACEMENT SHALL BE OUTSIDE WATER/SEWER TRENCHES. WHERE ROCK ENTERS PRIVATE PROPERTY, A DRAINAGE EASEMENT SHALL BE RECORDED.
13. GEOFABRIC TO BE EXTENDED FROM THE CONCRETE CAP TO BOTTOM OF DRYWELL STRUCTURE. WHERE THE EXCAVATION IS WITHIN SOLID ROCK (NO SIDEWALL SLOUGHING), GEOFABRIC CAN BE WAIVED AT ENGINEER'S DISCRETION
14. CLEAN 2"-3" CRUSHED OR RIVER RUN DRAIN ROCK PER SECTION 00470.18.

DRAWN AJD	CITY OF BEND	CITY OF BEND	SCALE NTS
DIV STORM		STANDARD DRAWING	DATE 03/22/2023
REV / DATE		710 NW WALL ST., BEND, OREGON 97701	APPR
		STANDARD PRE-CAST DRYWELL	STD DWG STRM-10



PLAN VIEW

PLAN VIEW MOVED TO ABOVE SECTION VIEW



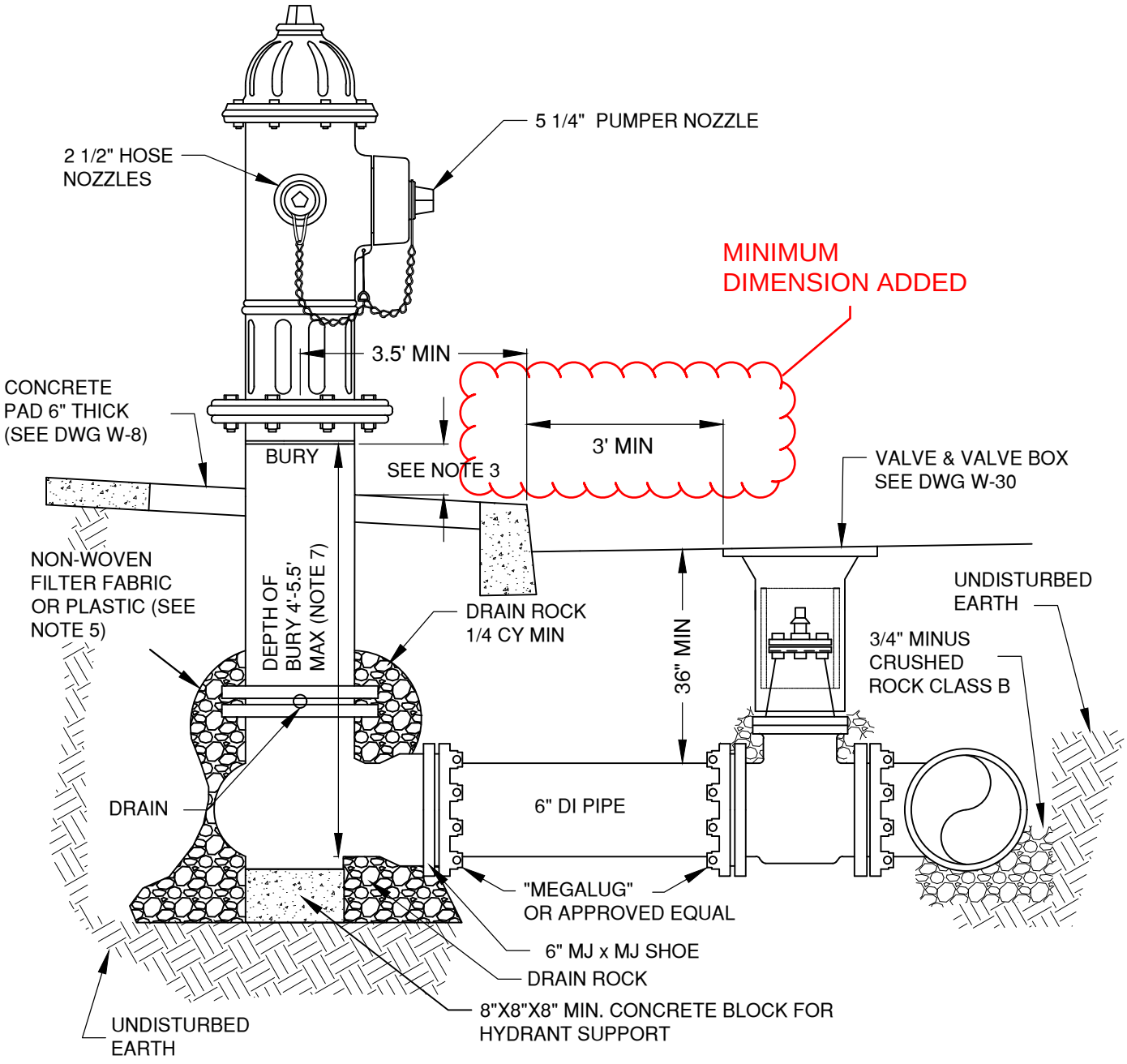
SECTION A-A

TEXT MODIFIED

NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL CATCH BASINS TO BE DOUBLE CATCH BASIN
2. BACKFILL TO BE COMPACTED TO 95% OF OPTIMUM PER SPECIFICATION SECTION 00330.43
3. CROSS PIPE ELEV MAY REQUIRE OTHER UTILITIES (SEWER, WATER, ETC) TO BE LOWERED TO PROVIDE MINIMUM SEPARATIONS
4. ALL PIPE CONNECTIONS TO BE GROUTED PER SPECIFICATION SECTION 00470.40
5. CONTRACTOR IS RESPONSIBLE TO KEEP CATCH BASIN CLEAN AND FREE OF SEDIMENT DURING CONSTRUCTION
6. CONTRACTOR IS RESPONSIBLE TO COVER AND BARRICADE ALL CATCH BASINS UNTIL GRATE IS INSTALLED
7. STANDARD CATCH BASINS ARE LIMITED TO LOCAL STREETS AND SHALL NOT BE USED ON ARTERIAL & COLLECTOR ROADWAYS. CURB INLETS ARE TO BE USED ON ARTERIAL & COLLECTOR ROADWAYS.
8. SEE DRG R-11 FOR PAVEMENT RESURFACING

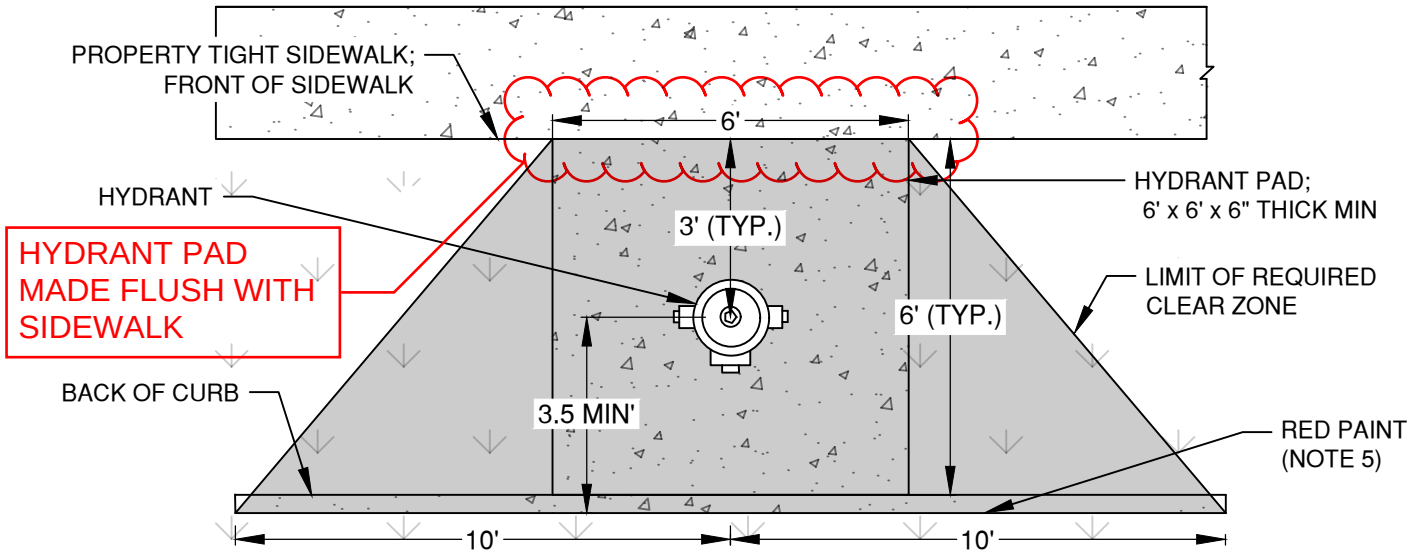
DRAWN AJD DIV STORM REV DATE	CITY OF BEND STANDARD DRAWING 710 NW WALL ST., BEND, OREGON 97701	SCALE NTS DATE 03/22/2023 APPR	
	STANDARD CATCH BASIN	STD DWG STRM-12	



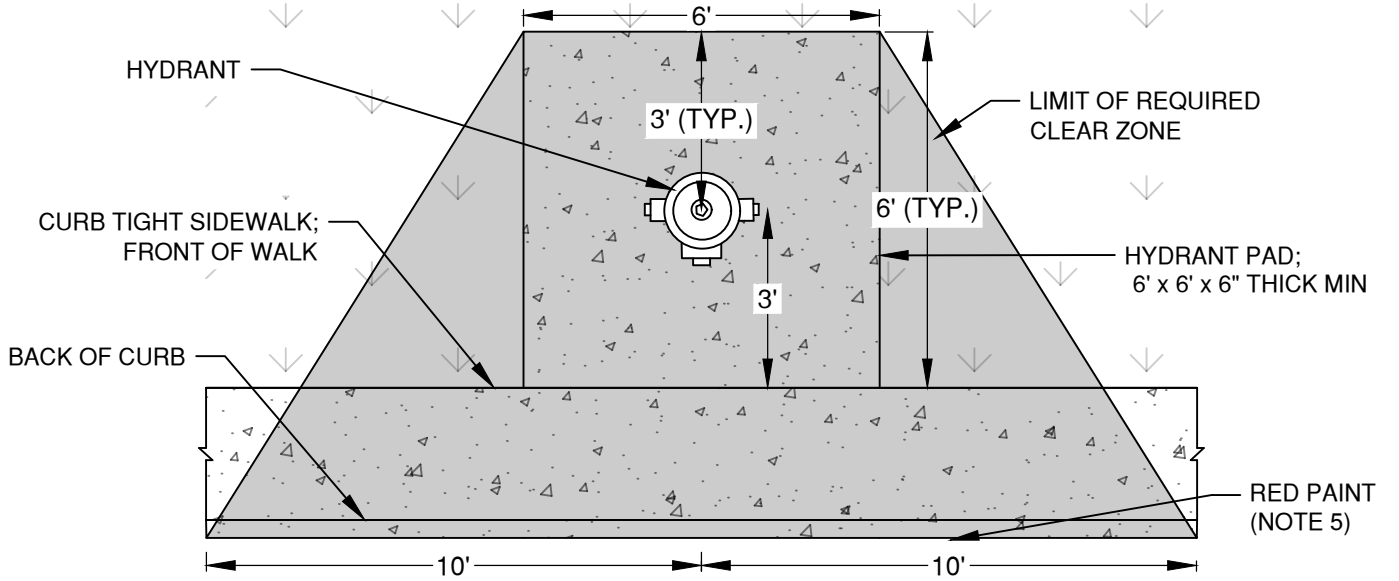
NOTES:

1. ALL PIPES SHALL HAVE RESTRAINED JOINTS.
2. MJ x MJ TEE OR MJxMJxSWIVEL (REQUIRES ENGINEER APPROVAL) WITH 6-INCH VALVE AT THE MAINLINE.
3. FINISH GRADE OF HYDRANT SHALL BE SET AT BURY LINE TO A MAXIMUM OF 3" BELOW BURY LINE FOR NEW INSTALLATION AND MAX OF 6" FOR RETROFITS. NO HYDRANT EXTENSIONS PERMITTED ON NEW INSTALLATIONS.
4. SET HYDRANT PLUMB. COMPACT ALL BACKFILL PER SPECIFICATIONS.
5. NON-WOVEN SEPARATION FILTER FABRIC OR PLASTIC (OSS TABLE 02320-4) INSTALLED BETWEEN UNDISTURBED EARTH AND DRAINROCK PRIOR TO BACKFILL.
6. HYDRANTS SHALL BE MANUFACTURER'S RED. NO OTHER COLOR IS PERMITTED.
7. BURY DEPTH IS MAX 6 FEET. USE 45 DEGREE OR 22.5 DEGREE BENDS TO ADJUST ACCORDINGLY.

DRAWN AJD	CITY OF BEND	CITY OF BEND	SCALE NTS
DIV WATER		STANDARD DRAWING	DATE 03/22/2023
REV DATE		710 NW WALL ST., BEND, OREGON 97701	APPR
		TYPICAL HYDRANT	STD DWG W-7



PROPERTY TIGHT SIDEWALK HYDRANT LOCATION AND CLEAR ZONE
PLAN VIEW

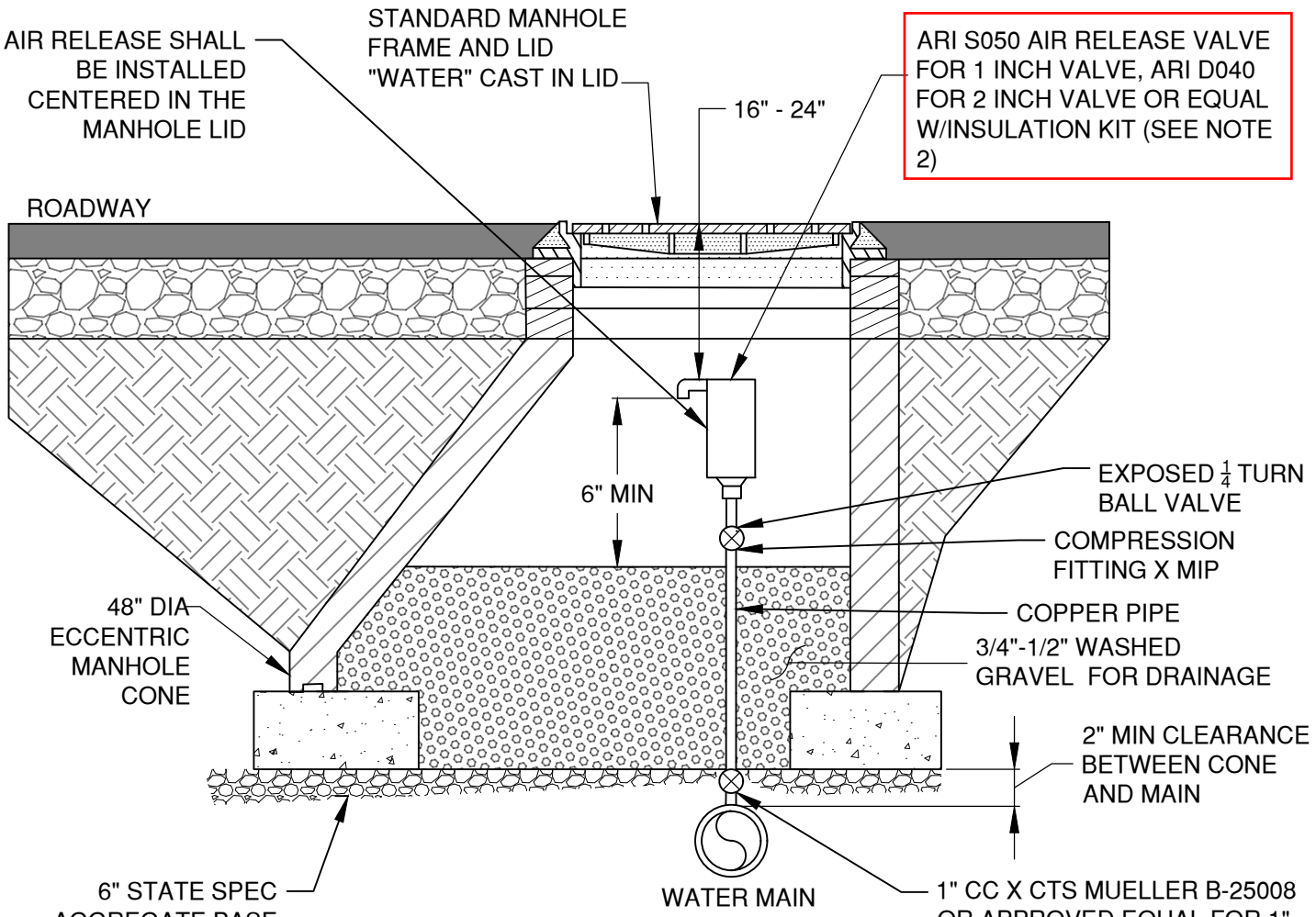


CURB TIGHT SIDEWALK HYDRANT LOCATION AND CLEAR ZONE
PLAN VIEW

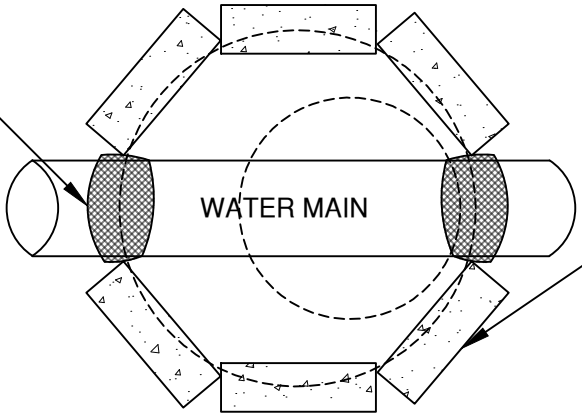
NOTES:

1. THE CLEAR ZONE PROHIBITS PARKING, FENCES, TREES, RETAINING WALLS, OR OTHER STRUCTURES THAT COULD INTERFERE WITH OPERATION OF HYDRANT. GRASS, MULCH, BARKDUST, AND GROUND COVER IS PERMITTED.
2. PROPERTY OWNERS SHOULD BE AWARE THAT GROUND COVER COULD BE DAMAGED WHEN THE HYDRANT IS USED OR WHEN HYDRANT MAINTENANCE IS PERFORMED.
3. CONCRETE PADS ARE TO BE A MINIMUM OF 6" THICK AND BE POURED AND PLACED ON 2" MIN. COMPACTED BASE ROCK PER SECTION OSS 00405.00
4. THERE SHALL BE A MINIMUM 4 FOOT CLEAR TRAVEL WIDTH ON SIDEWALKS ADJACENT TO HYDRANTS.
5. THE CURB SHALL BE PAINTED RED FOR A TOTAL OF 20 FEET, CENTERED ON THE HYDRANT.

DRAWN AJD DIV WATER REV / DATE	CITY OF BEND	CITY OF BEND STANDARD DRAWING 710 NW WALL ST., BEND, OREGON 97701 HYDRANT LOCATION AND CLEAR ZONE	SCALE NTS DATE 03/22/2023 APPR STD DWG W-8



PROFILE VIEW

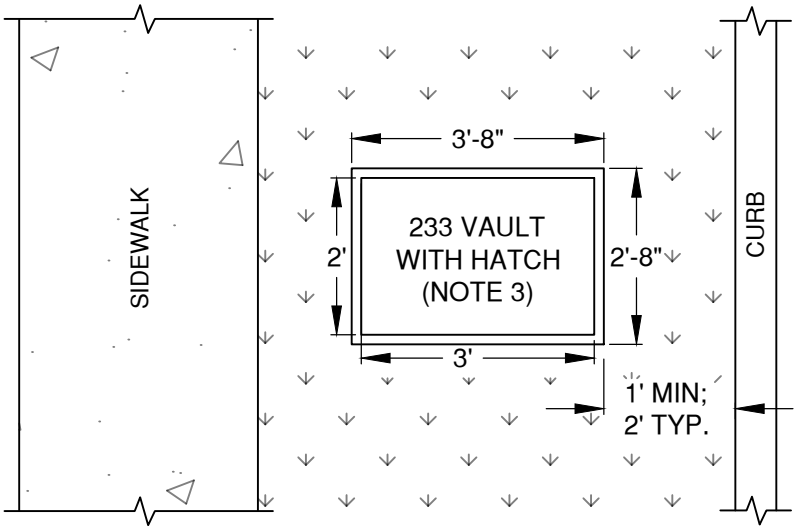


PLAN VIEW

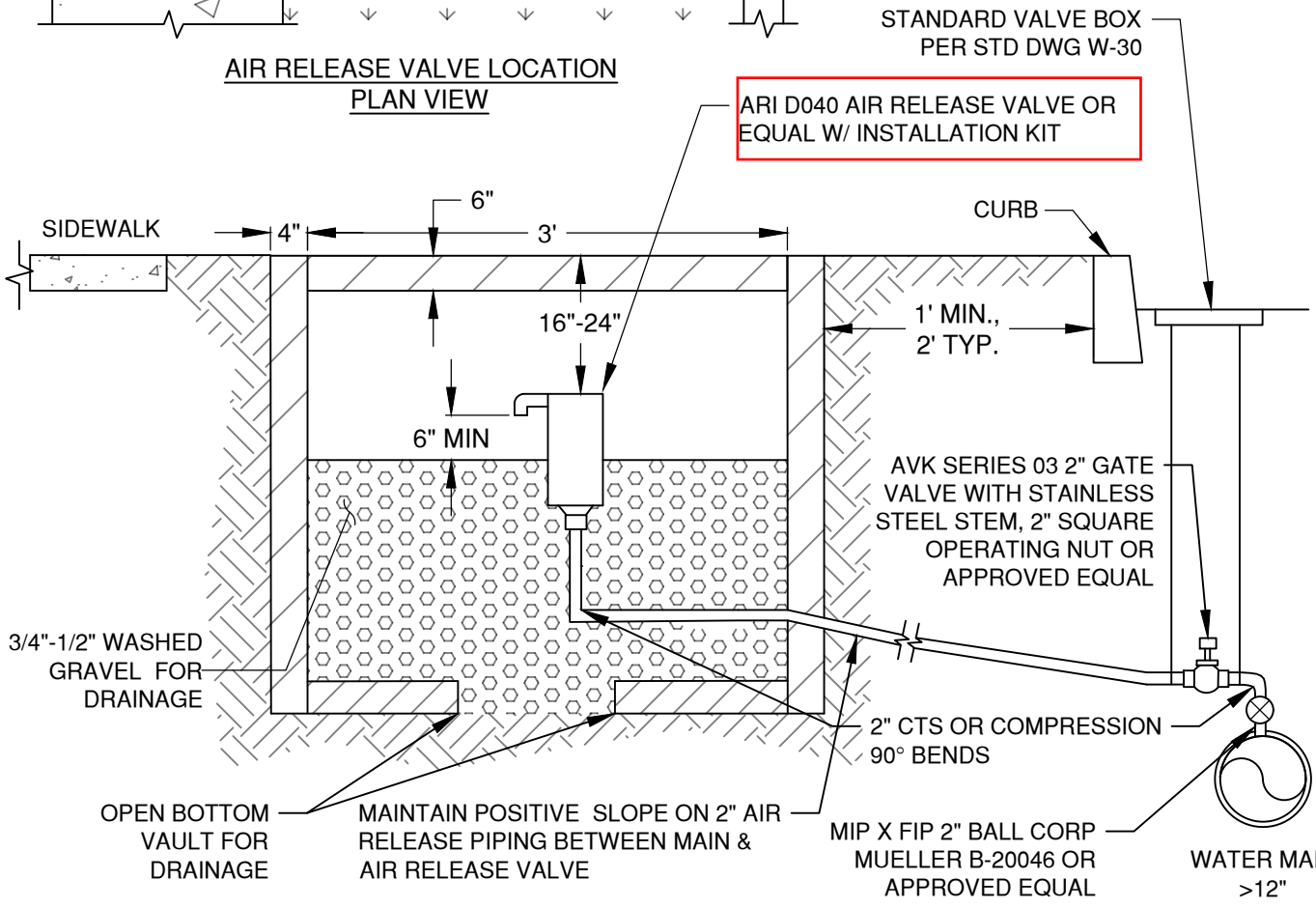
GENERAL NOTES:

1. AIR RELEASE OR COMBINATION VALVES SHALL BE INSTALL AT ALL HIGH POINTS. WHERE THE HIGH POINT IS AT THE TOP OF A LONG ASCENT (1,250 FEET+) A COMBINATION AIR/VACUUM VALVE SHALL BE INSTALLED.
2. 1" AIR RELEASE VALVE TO BE USED ON WATER MAINS LESS THAN 12" IN DIAMETER. 2" AIR RELEASE VALVE TO BE USED ON WATER MAINS GREATER THAN OR EQUAL TO 12" IN DIAMETER.

DRAWN AJD	CITY OF BEND	CITY OF BEND	SCALE NTS
DIV WATER		STANDARD DRAWING	DATE 03/22/2023
REV DATE		710 NW WALL ST., BEND, OREGON 97701	APPR
	CITY OF BEND	1" & 2" STANDARD AIR RELEASE VALVE - TRAFFIC AREA	STD DWG W-10



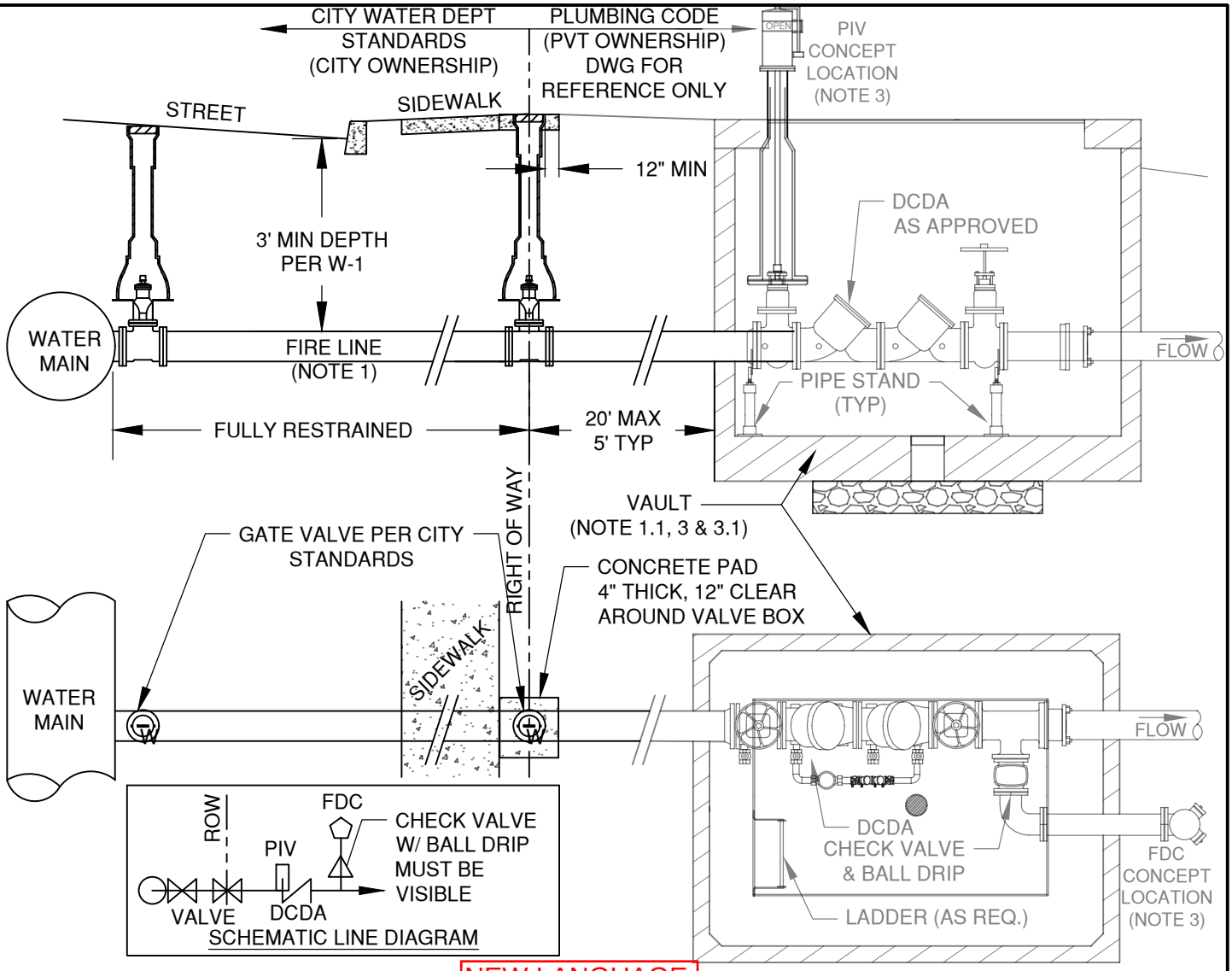
AIR RELEASE VALVE LOCATION
PLAN VIEW



GENERAL NOTES:

1. AIR RELEASE OR COMBINATION VALVES SHALL BE INSTALL AT ALL HIGH POINTS. WHERE THE HIGH POINT IS AT THE TOP OF A LONG ASCENT (1,250 FEET+) A COMBINATION AIR/VACUUM VALVE SHALL BE INSTALLED.
2. SEE STD DWG W-10 FOR 2" AIR RELEASE VALVES LOCATED IN TRAFFIC AREAS.
3. VAULT SHALL BE ADVANCED PRECAST PRODUCT 233 VAULT WITH 2'X3' HATCH AND OPEN BOTTOM, OR APPROVED EQUAL.

DRAWN AJD DIV WATER REV DATE	CITY OF BEND	CITY OF BEND STANDARD DRAWING 710 NW WALL ST., BEND, OREGON 97701 2" STANDARD AIR RELEASE VALVE	SCALE NTS DATE 03/22/2023 APPR STD DWG W-10B



NEW LANGUAGE

NOTES:

1. FIRE VAULT AND DCDA IS SHOWN FOR REFERENCE ONLY. VAULT AND PLUMBING BEYOND THE GATE VALVE SHALL BE INSTALLED PER PLUMBING CODE AND INSPECTED BY THE BUILDING DEPARTMENT.
   1.1. WHERE FIRE VAULT IS APPROVED BY CITY ENGINEER TO BE WITHIN THE ROW OR PUBLIC EASEMENT, VAULT SIZES ON STD DWG W-13A SHALL APPLY AND "FOR REFERENCE NOTES" ON THIS SHEET WOULD APPLY.
2. FIRE LINE TO BE 4" MIN DUCTILE IRON WATER MAIN PER CITY OF BEND SPECIFICATIONS. FIRE LINE TO BE SIZED BY ENGINEER UNDER A RIGHT OF WAY PERMIT.
3. VAULT TO BE SIZED BY ENGINEER IN CONFORMANCE TO BUILDING/FIRE/PLUMBING CODE, MEETING THE DOUBLE CHECK DETECTOR ASSEMBLY (DCDA) MANUFACTURER'S INSTALLATION SPECIFICATIONS. DESIGN SHALL ACCOUNT FOR ANY FREEZE PROTECTION REQUIRED TO MEET FIRE CODE.
   3.1. WHERE BUILDING IS WITHIN 20 FEET OF THE RIGHT OF WAY LINE, THE DCDA CAN BE WITHIN THE BUILDING'S MECHANICAL ROOM AS APPROVED BY THE CITY ENGINEER. THE DCDA MUST BE LOCATED FRONTING THE ROW AND LOCATED AT THE BUILDING PENETRATION. THE FDC MUST BE VISIBLE FROM ROW. ACCESS TO THE MECHANICAL ROOM TO BE PROVIDED BY AN EXTERIOR DOOR WITH KNOX BOX UNLESS OTHERWISE APPROVED.
   3.2. VAULTS ARE TO BE PLACED OUT OF HARD SURFACES (SIDEWALKS, DRIVEWAYS/ROADWAYS,ECT.)
4. POST INDICATOR VALVE (PIV) AND FIRE DEPARTMENT CONNECTION (FDC) TO BE LOCATED IN CLEAR VIEW OF THE FRONTAGE STREET, WITH THE FDC LOCATED WITHIN AN ALLOWABLE DISTANCE FROM A HYDRANT. PIV AND FDC MAY BE MOUNTED ON THE BUILDING IN CONFORMANCE WITH THE FIRE CODE AND AS APPROVED. PIV AND FDC CAN BE MOUNTED OUTSIDE THE VAULT OR THROUGH THE VAULT LID PROVIDED THEY DON'T INTERFERE WITH VAULT ACCESS AND THE PENETRATIONS ARE GROUTED AND DON'T NEGATE THE STRUCTURAL INTEGRITY OF THE VAULT. PIV NOT TO BE USED IN-LIEU OF ISOLATION GATE VALVE AT PROPERTY LINE.
5. ALL ELECTRICAL TO VAULT AND PIV TO BE INSTALLED PER BUILDING AND FIRE CODE AS REQUIRED.
6. PIPE SHALL MEET CITY ROW SPECIFICATIONS FROM MAIN TO DCDA.

DRAWN AJD	CITY OF BEND	CITY OF BEND	SCALE NTS
DIV WATER		STANDARD DRAWING	DATE 03/22/2023
REV / DATE		710 NW WALL ST., BEND, OREGON 97701	APPR
		FIRE SPRINKLER LINE	STD DWG W-13B