Hillsboro
OREGON

# Design and Construction Standards

# October 2018

## Public Works Department

## Water Department

150 East Main Street, Hillsboro, Oregon 97123-4028 • 503.681.6146 • www.Hillsboro-Oregon.gov/PublicWorks

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## PREFACE

This document sets forth the City's public improvement requirements. It is published under the authority of the City of Hillsboro. Copies of this document are available through the Public Works (Engineering Division) and Water Departments, and on the City of Hillsboro website. Under the authority of the City of Hillsboro *Municipal Code*, the Public Works and Water Department Directors may officially interpret the provisions of this manual.

These standards are to be used in conjunction with the following documents, which are hereby adopted by reference:

References

- *AASHTO LRFD Bridge Design Specifications, 7th Edition* (AASHTO)
- *American National Standard for Arboricultural Operations – Safety Requirements, 2012* (ANSI)
- *American National Standard for Tree Care Operations – Tree, Shrub, and Other Woody Plant Management – Standard Practices (Pruning)* (ANSI)
- *A Policy on Geometric Design of Highways and Streets, 6th Edition, 2011* (AASHTO)
- *American Water Works Association Standards* (AWWA)
- *Bridge Design and Drafting Manual, 2015* (ODOT)
- *Construction Surveying Manual for Contractors, February 2016* (ODOT)
- *Design and Construction Standards for Sanitary Sewer and Surface Water Management, April 2017* (CWS)
- *ePlans Applicant User Guide v13.*7 (City of Hillsboro)
- *Erosion Prevention and Sediment Control Planning and Design Manual* (CWS)
- *Fire Department Apparatus Access* (City of Hillsboro)
- *Flood Insurance Rate Map* (FEMA)
- *Flood Insurance Study* (FEMA)
- *Guide for Design of Pavement Structures* (with 1998 supplement)*, 4th Edition* (AASHTO)
- *Low Impact Development Approaches Handbook, June 2016* (CWS)
- *Manual of Field Test Procedures* (ODOT)
- *Manual on Uniform Traffic Control Devices for Streets and Highways* (with Oregon Supplement*, 2009 Edition* (FHA)
- *ODOT Geotechnical Design Manual, November 2015*
- *ODOT Pavement Design Guide, August 2011* (ODOT)
- *Oregon Standard Specifications for Construction, 2018* (ODOT)
- *Oregon Structural Specialty Code, 2014* (International Code Council)
- *Oregon Temporary Traffic Control Handbook, 2011 Edition* (ODOT)
- *Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way* (US Access Board)
- *Roadside Design Guide, 4th Edition* (AASHTO)
- *Roundabouts: An Informational Guide, 2nd Edition* (published as NCHRP Report 672)
- *Transportation System Plan Update, 2004* (City of Hillsboro)

Abbreviations

| | |
|---|---|
| A | ampere |
| AASHTO | American Association of State Highway and Transportation Officials |
| AC | alternating current or asphalt concrete |
| ACI | American Concrete Institute |
| ACP | asphalt concrete pavement |
| ACPA | American Concrete Pavement Association |
| ADA | American with Disabilities Act |
| ADT | Average Daily traffic |
| AG | air gap |
| AMR | automated meter reading |
| ANSI | American National Standards Institute |
| ANSI A-300 | *American National Standard for Tree Care Operations – Tree, Shrub, and Other Woody Plant Management – Standard Practices (Pruning)* |
| *ANSI Z-133.1* | *American National Standard for Arboricultural Operations – Safety Requirements* |
| APWA | American Public Works Association |
| ARV | air release valve |
| ASTM | American Society for Testing and Materials |
| ATB | asphalt treated base |
| AVB | atmospheric vacuum breaker |
| AWG | American Wire Gauge |
| AWWA | American Water Works Association |
| BFV | butterfly valve |
| BHN | Brinell Hardness Number |
| BO | blow-off |
| CARV | combination air release and vacuum valve |
| CB | catch basin |
| CBR | California bearing ratio |
| CC&R | Codes, Covenants, and Restrictions |
| CDA | Copper Development Association |
| CF | cubic feet |
| CI | cast iron |
| CL | centerline |
| CLSM | controlled low-strength material |
| COB | City of Beaverton |
| COH | City of Hillsboro |
| CP | concrete pipe |
| CPU | central processing unit |
| CTB | cement treated base |
| CTS | copper tube size |
| CWS | Clean Water Services |
| CY | cubic yards |
| dB | decibel |
| DBH | diameter at breast height |
| dBm | decibel-milliwatt |
| DC | double check valve assembly |
| DCDA | double check detector assembly |
| DCP | dynamic cone penetrometer |
| DI | ductile iron |
| DIN | Deutsches Institut für Normung |
| Drg | drawing |
| DSL | Department of State Lands |

| | |
|---|---|
| ESAL | equivalent single axle load |
| ESC | erosion and sediment control |
| ETA | Electronics Technicians Association |
| FDU | fibre distribution unit |
| FEMA | Federal Emergency Management Agency |
| FHA | Federal Highway Administration |
| FHWA | Federal Highway Administration |
| FIPT | Female Iron Pipe Thread |
| FIRM | National Flood Insurance Rate Maps |
| FLG | flange |
| FOG | fats, oils, and grease |
| FPS | feet per second |
| FWD | falling weight deflectomiter |
| GAL | gallon |
| Galv. | galvanized pipe |
| GIS | geographic information system |
| GPM | gallons per minute |
| GPS | global positioning system |
| GRD | grease removal devices |
| GV | gate valve |
| GVRP | GARP VLAN registration protocol |
| HDPE | high density polyethylene |
| HMAC | hot mix asphalt concrete |
| HP | horsepower |
| Hz | hertz |
| ID | inside diameter |
| IE | invert elevation |
| IMSA | International Municipal Signal Association |
| ITS | Intelligent Transportation Systems |
| Km | kilometers |
| LED | Light Emitting Diode |
| LIDA | low impact development approaches |
| LRFD | load and resistance factor design |
| MAMD | moving average maximum density |
| Max. | maximum |
| MFTP | *Manual of Field Test Procedures* |
| MH | manhole |
| MIPT | Male Iron Pipe Thread |
| Min. | minimum |
| MJ | mechanical joint |
| mm | millimeter |
| MPH | miles per hour |
| MSS | Manufacturer's Standardization Society |
| MUTCD | *Manual on Uniform Traffic Control Devices* |
| NAD | North America Datum |
| NASSCO | National Association of Sewer Service Companies |
| NCHRP | National Cooperative Highway Research Program |
| NEC | National Electric Code |
| NEMA | National Manufacturers Association |
| NESC | National Electric Safety Code |
| NFPA | National Fire Protection Association |
| NGVD | National Geodetic Vertical Datum |
| NIST | National Institute of Standards and Technology |

| | |
|---|---|
| nm | nanometer |
| no. | number |
| NPDES | National Pollutant Discharge Elimination System |
| NPT | National Pipe Thread |
| NSF | National Sanitation Foundation |
| NTS | not to scale |
| OAR | Oregon Administrative Rules |
| OD | outside diameter |
| ODOT | Oregon Department of Transportation |
| OPSC | Oregon Plumbing Specialty Code |
| ORS | Oregon Revised Statutes |
| OSHA | Oregon Occupational Safety & Health Administration |
| OSSC | The Oregon Structural Specialty Code |
| OUCC | Oregon Utilities Coordinating Council |
| PC | point of curvature |
| PCC | Portland cement concrete |
| PCMS | portable changeable message sign |
| PDF | portable document format |
| PE | pipe end or Professional Engineer |
| PGE | Portland General Electric |
| PMA | Private Maintenance Agreement |
| PPM | parts per million |
| PROWAG | *Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way* |
| PRV | pressure reducing valve |
| PSF | pounds per square foot |
| PSI | pounds per square inch |
| PT | point of tangency |
| PUE | public utility easement |
| PVB | pressure vacuum breaker assembly |
| PVC | polyvinyl chloride |
| Pvmt. | pavement |
| QPL | ODOT Qualified Products List |
| ROW | right-of-way |
| RP | reduced pressure principle backflow assembly |
| RPDA | reduced pressure principle detector assembly |
| RRFB | rectangular rapid flashing beacon |
| S | slope |
| SD | Storm Drain |
| S.I. | The International System of Units |
| SDC | Systems Development Charges |
| Sec. | seconds |
| SF | square feet |
| SFP | small form-factor pluggable |
| SHRP | Strategic Highway Research Program |
| Std. | standard |
| SVBA | spill resistant vacuum breaker assembly |
| SWM | Surface Water Management |
| SY | square yard |
| THWN | thermoplastic heat and water-resistant nylon-coated |
| TSP | The City of Hillsboro Transportation System Plan, as amended |
| TVWD | Tualatin Valley Water District |
| UL | Underwriters Laboratories |
| UNS | Unified Numbering System |

| | |
|---|---|
| USACE | United States Army Corps of Engineers |
| USGS | United States Geological Survey |
| UV | ultraviolet |
| V | volts |
| WaCo | Washington County |
| WMAC | warm mix asphalt concrete |
| WMP | The City of Hillsboro Water System Master Plan, as amended |
| WQMH | water quality manhole |
| WTR | water |
| XHHW | XLPE high heat-resistant water-resistant |

Definitions

**Abutting:** To be contiguous to; having a property line, zoning boundary, or wall in common.

**Access:** The place, means, or way by which pedestrians, bicyclists, and/or vehicles have ingress and egress to a property or use. A private access is an access not in public ownership or control by means of deed, dedication, or public easement.

**Active Treatment:** Erosion Control treatment method that relies on chemical additives creating coagulation and flocculation along with settlement and filtration methods to separate sediment and water in order to discharge non-sediment laden water.

**Alley:** A very low-capacity road intended for secondary vehicular access to the rear or side of private properties.

**Appurtenance:** An accessory or other item associated with a particular activity.

**Arterial:** A high-capacity urban road. The primary function of an arterial road is to deliver traffic from collectors to freeways, and between urban centers, at the highest level of service possible.

**Auxiliary Water Supply:** Any water supply on or available to the premises other than the primary potable water supply.

**Backflow:** The undesirable reversal of flow in a potable water distribution system as a result of a cross-connection. Backflow may occur due to either backsiphonage or backpressure.

**Backflow Device:** An approved piping arrangement such as an *Air Gap (AG) or an Atmospheric Vacuum Breaker (AVB)* that prevents the reverse flow of water; but, it is not testable, which distinguishes it from a *Backflow Prevention Assembly.*

**Backflow Prevention Assembly:** An approved and testable assembly provided from the manufacturer as a complete unit with its shut off valves and test cocks.

**Backpressure:** A pressure, higher than the supply pressure, caused by a pump, elevated tank, boiler, or any other means that may cause backflow. Backpressure can cause backflow to occur when the supply piping is connected to a system, equipment or fixture that exceeds the operating pressure of the supply piping. If these connections are not properly protected, backflow can occur.

**Backsiphonage:** Backflow caused by negative or reduced pressure in the supply piping. Backsiphonage is caused by a negative pressure in the supply piping. Common causes of backsiphonage are high

velocities in the pipes, a line repair or break that is lower than a service point, lower main pressure due to a high water withdrawal rate such as firefighting or main flushing, or reduced supply pressure on the suction side of a booster pump.

**Building:** A structure having a roof supported by columns or walls, which is built for the support, shelter, or enclosure of persons, animals, vehicles, or property of any kind.

**Cistern:** An artificial reservoir for storing liquids; especially a tank for storing rainwater.

**City Engineer:** A City employee delegated by the City Manager to have the superintendence, direction, and control of the engineering matters of the City.

**City-Owned Utility:** A utility owned and operated by the City or its agents. Includes, but is not limited to water, sanitary sewer, storm drainage, storm water treatment, street lighting power, traffic signal controls, and City-owned telecommunications systems.

**City-Owned Utility Easement:** An easement granted to the City and dedicated to specific City-owned utility purposes.

**Collector:** A low-to-moderate-capacity road which serves to move traffic from local roads to arterials. Unlike arterials, collector roads are designed to provide access to residential properties

**Contiguous:** Having a property line, zoning boundary, or walls in common; see also *abutting.*

**Cross-connection:** A connection or a potential connection between any part of a potable water system and any other environment containing other substances in a manner that, under any circumstances, would allow such substances to enter the potable water system. Other substances may be gases, liquids, or solids, such as chemicals, water products, steam, water from other sources (potable or non-potable), or any matter that may change the color or add odor to the water. Bypass arrangements, jumper connections, removable sections, swivel or changeover assemblies, or any other temporary or permanent connecting arrangement through which backflow may occur are considered to be cross-connections.

**Developer:** A person, company, corporation, or business who constructs a building, group of buildings, or residential units on a parcel that requires land-use action, public improvement permits, and/or a building permit to proceed with the development.

**Development:** Any man-made change to real property in the City, including but not limited to construction or installation of a building or other structure, or major site alterations such as grading or paving.

**Disturb or Disturbance of a Right-of-Way or Existing Improvements:** Any activity that physically alters, or disrupts the intended use of, a public right-of-way or an existing improvement therein. May also refer to the occupation of a public right-of-way for the purpose of construction.

**Easement:** A right to the use of certain real property for specified purposes, granted by the property owner to specific persons, firms, corporations, City, or the public.

**Emergency:** Construction work that responds to an unforeseen combination of circumstances or the resulting condition(s) that call for immediate action to restore service to utility customers, restore pedestrian and vehicular traffic flow, mitigate a safety hazard, or restore emergency access.

**Engineer:** The owner's or developer's project engineer, design engineer, stamping engineer, or engineer of record.

**Geotechnical Engineer:** Owner's or developer's project consulting geotechnical engineer, engineering geologist, or their assigned representative.

**Health Hazard:** A cross-connection or potential cross-connection involving any substance that could, if introduced into the potable water supply, cause death or illness, spread disease, or have a high probability of causing such effects.

**Improved street or improved right-of-way:** An existing public street or right-of-way that has been improved with curb and gutters, pavement, sidewalks, utility facilities, or other improvements.

**Inspecting Engineer:** The engineer or qualified individual designated by the owner or developer to inspect the construction materials and quality of public improvements.

**Land-Use Approvals:** Approvals issued by the Planning Department for new development, expansions of existing development, or land divisions, under the provisions of the Zoning Ordinance or the Subdivision Ordinance.

**Local Road:** A low-capacity road primarily providing land access with little or no through movement.

**Low Impact Development Approach (LIDA):** See CWS 1.03.36

**Neighborhood Route:** A low-capacity road providing connectivity between Local Roads and Collectors or Arterials. Neighborhood Routes are generally longer and carry more traffic than Local Roads.

**Non-health Hazard:** Impairment to the quality of the water to a degree that does not create a hazard to the public health, but does adversely affect the aesthetic qualities of such water for potable use.

**Passive Treatment:** Erosion Control treatment method that separates sediment and water using chitosan lactate, gravity settling techniques, or filtration methods in order to discharge non-sediment laden water.

**Permittee:** Any person performing or causing to be performed work within the right-of-way with the city's oral or written permission.

**Point of Delivery:** The point or location where the connection between the public water system and the owner's water system exists.

**Pothole:** An exploratory excavation to uncover an existing utility facility for the purpose of determining its precise location and elevation.

**Premises Isolation:** The practice of protecting the public water supply from contamination or pollution from the premises by installing a backflow preventer at or near the point of delivery (meter) in order to effectively isolate the public water supply from any backflow occurring within the premises. (Premises Isolation does not protect the water user within the premises.)

**Public Infrastructure:** All streets, street trees, street lights, bikeways, paths, sidewalks, curbs, signing and striping, traffic signal systems, storm sewer systems, sanitary sewer systems, and water systems that are within the public rights-of-way, public easements, and/or are owned and maintained by the public agency.

**Public Right-of-Way:** Public streets, alleys, or highways under the jurisdiction of the City. This definition excludes City-owned real property. The City reserves the right to regulate and approve the placement of utilities within a public right-of-way, including below the surface and into the air space above the right-of-way.

**Public Utility Company:** A utility company as defined in ORS 775.005, which provides water, power, heat, and telecommunications to the public. Also referred to as a "franchise utility", if subject to a franchise agreement with the City of Hillsboro.

**Public Utility Easement:** An easement conveyed, granted, or dedicated to the City or the public established, dedicated, or devoted to public utility purposes. See ORS 92.010 (19).

**Public Utility Facility:** Any physical structure or improvement necessary or desirable to deliver service to a Franchise Utility Company's customer, and which is located in a Public Utility Easement, public right-of-way, or a private utility easement.

**Public Works Director:** A City employee delegated by the City Manager to manage the Public Works Department.

**Record Drawing:** Final set of construction drawings showing the constructed location of boundaries, utilities, connections, public and private infrastructure. Record drawings incorporate all field changes made to the approved construction drawings.

**Roundabout:** A circular intersection with yield control of all entering traffic, channelized approaches, counter-clockwise circulation, and appropriate geometric curvature to ensure that travel speeds on the circulatory roadway are typically less than 30 MPH.

**Street Trees:** Trees, both new and existing, planted in the public right-of-way as part of an improvement project. Trees that were located in the public right-of-way prior to development are not considered "street trees" and are subject to the City of Hillsboro *Municipal Code*.

**Surface Water Management (SWM) Facility:** Any feature or approach designed or protected to provide stormwater management. SWM facilities consist of water quality and quantity facilities and may include water quality swales, constructed wetlands, landscaped retention areas, detention ponds, proprietary systems, or other natural or engineered features that are maintained as stormwater quality or quantity control facilities.

**Utility:** Overhead or underground wires, pipelines, conduits, ducts, or other structures required for supplying the community with electricity, gas, water, sewerage, or similar services. May also refer to a public or private utility agency.

**Water Director:** A City employee delegated by the City Manager to manage the Water Department.

**Working Days:** Calendar days, excluding state or federal holidays and weekends.

## SECTION 100

## 100. GENERAL DESIGN REQUIREMENTS

### 110. General Public Improvements Requirements

#### 110.1. General

A. The purpose of this manual is to set standards for the construction of public and private improvements to serve new and future developments and for the reconstruction of existing facilities to upgrade existing infrastructure. These standards shall apply to all public improvements within the existing public rights-of-way, to all improvements from new developments required within the proposed public rights-of-way or public easements, to all improvements intended for maintenance by the City, and to all other improvements which require approval of the City Public Works and/or Water Departments.

B. The standards contained in this manual are established by the City as rules governing materials and the quality of workmanship to which design engineers, developers, contractors, and others shall adhere in preparing plans and specifications, and in constructing improvements and facilities. These standards also establish the rules to which City staff will adhere in reviewing plans and inspecting construction.

C. City design and construction standards are primarily based upon AASHTO's *A Policy on Geometric Design of Highways and Streets* and *Roadside Design Guide*, *AWWA Standards*, CWS's *Design and Construction Standards for Sanitary Sewer and Surface Water Management,* FHWA's *Manual on Uniform Traffic Control Devices for Streets and Highways* (with Oregon Supplement), ODOT's *Oregon Standard Specifications for Construction,* Chapter 333 *Oregon Administrative Rules,* and the *Oregon Fire Code.* Where the standards contained in this manual do not address a particular situation, the standards contained in the above referenced documents shall be applied.

D. The City may make the following changes or corrections to the provisions of this manual periodically, as needed, when the changes or corrections do not alter the sense or meaning of its provision. Changes shall be posted on the City's website with the manual for easy access to the updates:

1. Misspellings: Misspelled words may be corrected.

2. Histories: Erroneous legislative histories may be corrected.

3. Cross-references: Cross-references may be changed to agree with newly enacted, amended, reenacted, renumbered, relettered, reallocated, or corrected ordinances or resolutions.

4. Capitalization: Improper capitalization may be corrected.

5. Headings: Descriptive headings of titles, chapters, sections, or subsections may be edited or added to briefly and clearly indicate the subject matter of the title, chapter, section or subsection.

6. Renumbering and relettering: The numbering or lettering of sections of ordinances and resolutions, including duplicative numbering or lettering created by conflicting enactments, may be corrected or properly arranged.

7. Changed job titles and agency names: References in design standards to specific job titles or agency names that are changed without substantial effect on job or agency responsibilities may be changed to refer to the new job title or agency name.

8. Punctuation: Punctuation, including hyphenation, may be corrected.

9. Clerical Errors: Typographical or grammatical errors may be corrected.

10. Gender: Gender-specific terms that occur in an ordinance or order may be changed to gender-neutral terms and necessary grammatical changes to properly use the gender-neutral terms may be made.

11. Reference Documents: Any document referenced in this manual that undergoes a periodic reprinting update may have the reprinting date revised in this manual.

E. The City may make the following changes to the provisions of this manual, as needed, when the changes do not alter existing City policy or have significant cost impacts.

1. Implement new products, technical requirements, or construction practices that improve the quality of the improvement and reduce maintenance costs.

2. Revisions that rectify construction and maintenance issues that are resulting from the use of the current requirements in this manual.

3. Mandated changes: Additions, deletions, or revisions to City design standards may be made when required for City compliance with mandatory regional, state, or federal regulations.

4. Any changes approved by the Utilities Commission.

F. Any changes the City proposes to this manual that affect existing City policy or will result in a significant cost increase will be posted on the City's website for a 30-day review period. After review of the comments, City staff will revise the proposed changes and present a recommendation to the Transportation Committee. Subject to the Transportation Committee's recommendation, the changes will then be presented to City Council by means of ordinance or resolution for approval. Any changes approved by the City Council will be enforceable on the effective date of the ordinance or resolution.

G. Upon approval of changes to this manual, a technical memorandum explaining the changes will be posted on the City website along with the current edition of the manual for easy access to updates. Periodic reprinting of this manual will incorporate all changes approved prior to the date of the reprinting and the new edition will be approved by City Council with a new edition date and will be enforceable on the effective date of the ordinance resolution.

H. Any change or correction made under the authority of this section does not affect the substantive meaning of any enactment of the City. Any erroneous or inadvertent substantive change must be construed as a clerical error and given no effect.

110.2. Required Approvals and Permits

A. Property owners, developers, and others proposing to construct new public infrastructure, including streets, storm system, sanitary sewer, water, public sidewalks, and/or other frontage improvements within the public right-of-way, or significant changes to any of these public infrastructure types, as defined by the City and CWS, will be required to obtain all applicable land-use approvals, obtain a site development permit and/or right-of-way permit as appropriate, pay all applicable fees, and secure applicable performance assurances before commencing any work.

110.3. Commencement of Work

A. No work regulated by the City's codes shall commence prior to the approval of construction plans and issuance of the appropriate approval(s). A fully-executed compliance agreement and public improvement permit will be issued at the pre-construction conference only if the following steps have been completed satisfactorily:

1. Submittal of a CWS Service Provider Letter and/or City of Hillsboro Sensitive Area Pre-Screen, and Stormwater Connection Permit Authorization from CWS.
2. Completion of all land-use approvals, including appeal periods if applicable.
3. Performance of all applicable Conditions of Approval that must be met prior to issuance of the permit.
4. Approval of the public improvement construction plans by the City and CWS.
5. Submittal of acceptable calculations and other supporting documents to the City when such documents are requested.
6. Approval by the City of the detailed construction cost estimate.
7. Completion and submittal of the signed developer agreement.
8. Provision of certification of liability insurance for general contractor, which shall meet or exceed minimum City requirements for policy limits.
9. Approval of the performance assurance required in the developer agreement by the City.
10. Approval of all legal documents, easements, and other documents in addition to showing improvements on construction plans as required by a decision-making authority's conditions of approval.
11. Payment of all fees necessary for the public improvement permits per the current adopted fee schedules.
12. Submittal of copies of permits from all other affected governmental jurisdictions.
13. Issuance of a Grading and Erosion Control Permit.
14. Product submittals for all water related infrastructure.

110.4. Performance and Maintenance Assurance Requirements

A. Performance Assurance standard: 100 percent of the cost to construct all public streets, street lights, traffic signals, sidewalks, signage, street trees, and striping. The Performance Assurance may be in the form of either a cash deposit, letter of credit, or performance bond.

B. Maintenance Assurance standard: Prior to release of Performance Assurance, a 1-year Maintenance Assurance will be required at 10 percent of the cost to construct all public streets, street lights, traffic signals, sidewalks, signage, striping, and released 1 year after acceptance following the correction of any identified defects.

110.5. Precedence of Documents

A. If there is a conflict between approval documents, the document highest in precedence shall control. The order of precedence is:

**First:** City of Hillsboro *Municipal Code*

**Second:** Building code and issued building permits

**Third:** CWS *Design and Construction Standards for Sanitary Sewer and Surface Water Management* for design and construction requirements related to storm sewer, sanitary sewer, surface water management, and erosion control.

**Fourth:** City of Hillsboro *Design and Construction Standards*

**Fifth:** Permits issued by other county, state, or federal agencies, or regional jurisdictions

**Sixth:** Conditions of any land-use approval

**Seventh:** *Oregon Standard Specifications for Construction*

**Eighth:** *ODOT Pavement Design Guide*

**Ninth:** Approved design plans

B. The City of Hillsboro has adopted the Clean Water Services Design and Construction Standards (CWS Standards). All sanitary sewer, closed storm conveyance, treatment, and surface water management facilities must at a minimum meet the CWS Standards.

C. Supplemental written agreements, franchise agreements, and approved revisions to plans and specifications by the appropriate jurisdictions and conforming to local, state, and federal law will take precedence over documents listed above. Detailed plans shall have precedence over general plans.

110.6. Violations

A. Any act or omission which violates these standards is deemed a civil infraction and a public nuisance and is subject to all the legal provisions and remedies available to the City.

## 120. Permit Application Submittal Requirements

### 120.1. General

A. Permit application submittals must include all materials required according to the permit type. Required submittals may include design plans, completed checklists, stormwater drainage calculations, geotechnical reports, or other pertinent information.

B. Based upon project-specific characteristics, supplementary design analysis exhibits, though not included in the plans, may be required to demonstrate constructability, emergency vehicle accessibility, or compliance with other applicable design standards. Such exhibits may include sight distance diagrams, photometric analyses, vehicle turning simulations, driveway profiles, and the like.

1. The required design vehicle for turning simulations will be determined by the City.

2. See Subsection 350.1. for street lighting plan requirements.

C. All plan review applications must be submitted through the ProjectDox system for electronic plan review. Visit the Electronic Plan Review page at http://www.hillsboro-oregon.gov/services/electronic-plan-review for instructions on submitting plans for electronic review

Upon completion of the initial City plan review, comments will be returned to the applicant through ProjectDox. After all review comments have been addressed, the applicant may resubmit the revised documents and/or drawings through ProjectDox. After the submittals for all related permit types have been approved, the City will forward them to CWS for final approval and issuance of a Storm Water Connection Permit Authorization. The contractor will not be issued permits to begin construction until all plans are approved, stamped, and all fees are paid.

**Plan approval does not relieve the Engineer from responsibility for errors, omissions, or deficiencies in the plans.**

D. Projects may be submitted as a whole or in phases. Whole projects will be reviewed in their entirety. Phased projects will be reviewed only for the specific phase submitted and special requirements may be necessary to develop an acceptable utility system. Phased project submittals shall include a master layout showing the connectivity of the entire project.

Projects that have been previously reviewed and approved as a whole project, and then later divided into phases, shall be required to have each phase resubmitted for review and approval. Projects that have been previously reviewed and approved as a phased project, and then later divided into smaller sub-phases, shall be required to have each sub-phase resubmitted for review and approval. Approval of previously submitted plans (whole or phased) does not imply or guarantee the new phases or sub-phases will be approved without comment or alteration.

E. The City is not responsible for coordination between public and private plans that are submitted for the same Developer project. The Engineer shall be responsible to make revisions and update both sets of plans if improvements or the location of improvements change within the project. All revisions shall be resubmitted for approval.

The Developer shall be responsible for coordination between Public and Private Plans and designs when more than one Engineer is involved.

120.2. Design Plans Formatting Requirements

A. All plans must be submitted in one of the following file formats:

1. Portable Document Format (PDF)

2. Design Web Format (DWF)

B. All plans must be drawn to scale. The vertical scale shall be 1 inch = 2 feet, 4 feet, 5 feet, or 10 feet and the horizontal scale shall be 1 inch = 20 feet, 40 feet, or 50 feet for all drawings. Metric or architectural scales shall not be used. Each sheet must have the scale identified with a scalebar or notation adjacent to the north arrow. When more than one scale is used on a sheet, an independent scalebar must accompany each applicable detail. No scale is required if the drawing is schematic, but the City may require it be redrawn to scale if needed for clarity. Schematics drawings shall be labeled “Not to Scale”.

C. All text shall be at least 0.075” high.

D. Permanent and temporary survey control points, existing survey monuments, vertical benchmarks, and related data shall be shown on the plans in accordance with Subsection 150.

E. A titleblock shall appear on each sheet and shall be placed in the lower right-hand corner of the sheet, across the bottom edge of the sheet, or across the right-hand edge of the sheet. The titleblock shall include the name of the project, the name and contact information for the engineering firm and owner, the sheet title, the sheet number, and the City of Hillsboro land use approval file number.

F. The seal of the responsible Engineer or Landscape Architect shall appear on each sheet. Plans for public improvements shall be stamped by a registered Professional Engineer licensed to practice in the appropriate engineering discipline in the State of Oregon. Plans for landscaping and water quality features shall be stamped by either a registered Landscape Architect or Professional Engineer licensed in the State of Oregon.

G. The description and date of all revisions to the plans shall be shown on each affected sheet, and shall be approved and dated by the Engineer as evidenced by original signature(s) or initials.

H. Indicate the location and direction of view for all sections.

I. All plan views shall contain the following:

1. Existing and proposed right-of-way, property, tract, and easement lines with labels.

2. Subdivision name, lot numbers, street names, and other identifying labels.

3. Existing aboveground and underground utility facilities and vegetation within the construction limits.

4. All other affected areas and features that are on-site or within a distance of 100 feet outside the site boundary, including but not limited to:

   a) Features that will be within the zone where grading, excavations, fills trenching, stockpiling, pile driving, blasting, ground shaking from construction vehicles or equipment, structural loading, or invasive construction activities may potentially compromise their structural stability or condition. Such features include, but are not limited to, cultivated vegetation, landscaping and trees, buildings, fences, decks, walks, slabs, and pavements.

   b) Trees of any type that are 6-inches DBH or more and whose root zones extend into the site (using the trees' dripline as the delineator of the root zone) or are off-site and within 10-feet or less of the site boundary.

   c) Other areas and features impacting the design and designated by the City for evaluation.

   d) Tax lot information including Washington County Tax Assessor's Map and Tax Lot Number.

5. Match lines with stationing and sheet number references.

6. FEMA designated 100-year flood plains and flood ways, or areas of flooding during a 100-year storm event.

7. Wetland areas, wetland mitigation areas, and storm water quality undisturbed corridors (Vegetated Corridors), drainage ways, and significant natural resource areas.

8. Legend showing all symbols and line types used on the drawing.

9. A north arrow shall be placed adjacent to all plan views.

J. All profile views shall adhere to the following:

1. Profiles shall designate structures using alpha or numeric labels corresponding to plan view notation. For existing sanitary and storm sewer manholes, designations shall conform to CWS system identification requirements.

2. All existing and proposed storm, sanitary, water, and other utilities crossing the profile shall be shown, with elevations noted or labeled 'field verify elevation' if elevation is not known.

120.3. Organization of Plans

A. Plans shall be arranged in specific order. The normal arrangement for development plans is shown in Table 120.1. Not all of these sheet types may be present in a given project. For small or linear (roadway) projects it may be acceptable to combine sheet types. See the Capital Improvement Program *Project Development Guide* for more information on the City-preferred format for linear (roadway) project plans.

120.3.1. Title Sheet

A. All projects shall have a title sheet containing the following elements.

1. Project name in large letters across the top of the page
2. The name, phone number, mailing address of owner, developer, and developer's engineering firm (including contacts)
3. The City land-use approval file number clearly noted.
4. Vicinity map showing the location of the project in respect to the nearest major street intersection
5. General notes
6. Notice to excavators (one call utility locates)
7. Sheet legend
8. Information on site impervious surface area for both existing and post-developed conditions. This calculation shall be separated into the square footage:
   a) Within public right-of-way
   b) Within private property
9. State the basis for horizontal and vertical control. See Subsection 150.
10. A note shall be placed on the title sheet that states: "This design complies with ORS 92.044(7) in that no utility infrastructure is designed to be within 1 foot of a survey monument location shown on a subdivision or partition plat. No design modification or final field location change shall be permitted if it would cause any utility infrastructure to be placed within a prohibited area."
11. A description that includes township, range, quarter section and tax lot numbers of the areas impacted by the development.
12. Index of sheets.
13. For multi-phase projects, an overall map showing the limits of each phase.
14. USACE and/or DSL permit application number (if permit is required) and the project or permit application number(s) for any other federal, state, or local entity, or wetland delineation. Copies of the permit applications shall be included with the submittal.

**Table 120.1 – Sheet Order**

| Sheet Order |
|---|
| 1. Title Sheet |
| 2. Existing Conditions and Demolition |
| 3. Tree Removal |
| 4. Preliminary Plat |
| 5. Typical Sections |
| 6. Details |
| 7. Traffic Control |
| 8. Roadway Plan and Profiles |
| 9. Utility Plan and Profiles |
| 10. Water Quality/Quantity |
| 11. Site Grading and Erosion Control |
| 12. Landscaping |
| 13. Retaining Walls |
| 14. Signing and Striping |
| 15. Illumination |
| 16. Traffic Signals |

120.3.2. Existing Conditions and Demolition

A. Identify the location of existing buildings, wells, septic tanks, drain fields, fuel tanks, and any other buried structures. Historical buildings identified on the City's Cultural Resource Inventory shall be identified as such on the drawings. Significant and/or historic trees shall be identified as such on the drawings.

B. The Engineer shall not rely solely on aerial photography, USGS Quadrangle Maps or other public topographic maps, or any combination thereof, for the topographic information used to prepare the design plans. They shall make an on-site evaluation and survey and shall use the survey data as the primary source of topographic information.

C. Include existing contours at a maximum interval of 2 feet.

120.3.3. Tree Removal

A. Include all plan elements required by the land-use application approval and/or zoning ordinance. Show trees to be removed with an "X" over them. Show tree protection fencing on trees to remain.

120.3.4. Preliminary Plat

A. Include a scaled copy of the approved preliminary plat. Include all existing and proposed easements, right of way widths and dedications, and tract descriptions.

120.3.5. Typical Sections

A. Roadway projects shall have at least one typical sections sheet containing the following elements.

1. Typical section(s) of roadway improvements identifying wearing, base, and subbase materials and depths.

2. Labels specifying grade control points, slopes, grades, and longitudinal features such as curbs, sidewalks, and fences.

3. Dimensions of horizontal features such as travel lanes, bike lanes, shoulders, cycle tracks, planters, and sidewalks.

120.3.6. Details

A. One or more detail sheets shall be provided as part of the plans submittal. The detail sheet(s) shall show all the details necessary for the project. The City reserves the right to require additional details to be submitted as needed to fully convey the design intent.

B. Standard drawings published by the City, Washington County, ODOT, CWS, AWWA, and other agencies may be used. They shall be reproduced in full and included with the construction plans, not merely referenced. They shall be full size or 95 percent of the original size.

C. If a standard drawing needs to be modified, remove the standard drawing titleblock and include it as a project-specific detail.

120.3.7. Traffic Control

A. Projects with staged construction or temporary traffic control measures require traffic control sheets, broken out by stage, containing the following elements.

1. Plan view identifying areas “under construction” and “under traffic” for the stage shown as well as taper lengths.

2. Sections at critical areas showing the existing, temporary, and/or finish grades for the stage shown as well as dimensions for travel lane widths, work zone widths, shy distances, and clearances.

3. Traffic control devices including temporary construction signs, PCMS, barricades, barriers, drums, flaggers, tubular markers, temporary striping, temporary signals, etc. are shown, noted, and dimensioned on both the plan and the relevant section views.

4. General notes containing information related to closure limitations, local access, and staging areas.

B. Detour plans may be required for projects including road closures. They include advance warning sign locations and the proposed detour route. They are placed within the traffic control series at the appropriate location based on the construction stage sequencing.

120.3.8. Roadway Plan and Profiles

A. All roadway projects shall include roadway plan and profile sheets containing the following elements. Some of the required information may be shown as separate details for clarity.

1. Plan View

a) Roadway centerline alignment(s) including curve data and stationing at minimum 100-foot intervals and “tic” marks at minimum 50-foot intervals.

b) Roadway crown alignment if different than roadway centerline.

c) Location and horizontal geometry for all sidewalks, curbs (including curb returns), cycle-tracks, driveways, and all other proposed features.

d) Intersection grading information, including spot elevations, contours, and drainage patterns.

e) Location of all roadway low points and locations of all catch basins and inlets.

f) Sidewalk ramp information including; spot elevations at all break points; all ramp and surrounding sidewalk panel lengths; designed grades between each spot elevation; distance from each landing to pedestrian push button; distance between pedestrian push buttons; and roadway counter slope at each ramp. Please use ODOT standard drawing DET1720 as a guide.

g) Curb elevations along all cul-de-sacs, eyebrow corners, curb returns, and any other location where the curb location and grade is not typical relative to the roadway alignment and profile grade. Include spot grades at all curb return quarter-deltas, at

all low and high points, and as necessary to define the desired vertical geometry along the curbline. Provide such elevations a minimum of 50 feet beyond the point at which the curb again becomes typical relative to the roadway alignment and profile grade.

h) Location, stationing, and size of all proposed mains and service lines for storm drainage. Stationing shall be located in relationship to the roadway stationing at manholes and at all other key locations.

i) Location and description of existing survey monuments. See Subsection 150.3.

j) Location of proposed street intersection monument cases and other required survey monuments. See Subsection 150.3.

2. Profile View

a) Stationing, elevations, vertical curve data (including curve K values), and slopes for all vertical alignments (design grade profiles).

b) Existing ground along the alignment and at the edges of the right-of-way if grade differences are significant.

c) Show profile grades for at least 100 feet beyond the limits of the proposed construction. For stub streets that may be extended in the future, the vertical alignment shall be designed for at least 200 feet beyond the limits of the proposed construction.

d) All proposed drainage facilities, including invert and top elevations, slopes, materials, bedding, and backfill.

e) Existing drainage facilities, including off-site facilities, upstream and downstream, that affect the design (i.e., downstream restrictions that back water on to project site). Base flood elevations shall be shown on the profile, if applicable.

f) Profiles for ditch and creek flow lines shall extend a minimum of 200 feet beyond the project limits, both upstream and downstream. Typical cross sections at 50-foot intervals shall also be submitted.

120.3.9. Utility Plan and Profiles

A. Include existing public and private utilities, proposed public utility improvements, and existing and proposed easements. All existing easements shall be clearly labeled with easement type and recording information.

B. Show all piping, structures, and appurtenances.

C. Provisions for cross-connection control must be clearly shown on the plans, including any retro-fitting of existing water service connections and existing auxiliary water supplies, conversions to the Water Department water services that are required as a condition of development approval, upgrading of existing services connections by replacement of same and any other cross connection control required by state and local rules and codes.

D. Location, street stationing, and size of all proposed mains and service lines for sanitary sewer and water.

120.3.10. Water Quality/Quantity

A. Include a site plan for all existing and proposed public and private water quality facilities showing elevations, grade, connections, structures, easements, and tracts.

B. Plans shall contain a detail for all headwalls, outfalls, spillways, and by-pass lines.

C. Plans shall contain a cross section showing the channel, mid-slope, and upland slope of the facility. The cross section shall show the location and depth of all amended soils, drain rock, and underdrains.

D. A planting plan specific to each water quality/quantity facility shall be included with a separate table for all plantings specific to the treatment, mid-slope, and upland slope areas.

120.3.11. Site Grading and Erosion Control

A. A site grading plan is required for any development involving excavation or fill in the public right-of-way or on private property.

B. All soil disturbing construction activity must adhere to the requirements of the most recent approved CWS *Design and Construction Standards*, CWS *Erosion Prevention and Sediment Control Planning and Design Manual,* and all associated land-use approvals. A detailed erosion control plan conforming to the current CWS plan template shall be shown in conjunction with the site grading plan.

C. All grading plans for areas where the grading will be within 5 feet of the property line, shall include cross sections cut along the property line at 50 foot intervals (a minimum of three are required). The cross sections shall extend a minimum of 50 feet into each property and shall show the existing and proposed grades, structures, and utility facilities.

D. See Subsection 180 for City policy and guidance concerning environmental protection during construction.

E. Include existing and proposed contours at a typical interval of 2 feet.

F. Include retaining walls.

120.3.12. Landscaping

A. Include PUE's, other easements, sight vision zones, sidewalks, bikeways, entry monuments or signage, mail boxes, sound walls, retaining walls, irrigation, all underground utilities, street trees, and street lighting in the project and along all existing and proposed street frontage.

120.3.13. Signing and Striping

A. Projects involving new signing or roadway striping and projects impacting existing signing or roadway striping require signing and striping sheets including the following elements.

1. Lane dimensions, taper rates for transitions, and radii for striped curves.

2. Existing and proposed striping and pavement markings.

3. Existing and proposed signs.

B. Use ODOT formatting and legends.

120.3.14. Street Lighting

A. See Subsection 350 for street lighting plans requirements.

120.3.15. Traffic Signal Plans

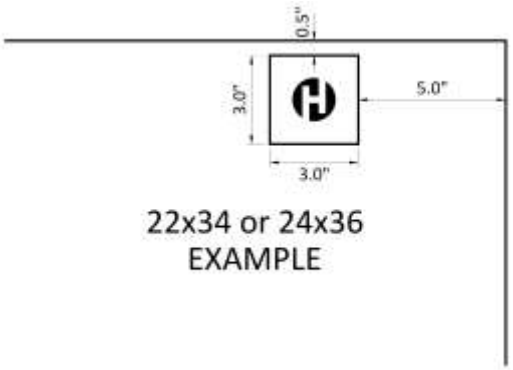
A. See Subsections 340 and 360 for traffic signal and communications plans requirements.

120.4. Electronic Stamp Requirements

A. An area located in the top right corner of all drawings shall be reserved for the City electronic plan review approval stamp. The stamp location will allow for a 1/2 inch border.

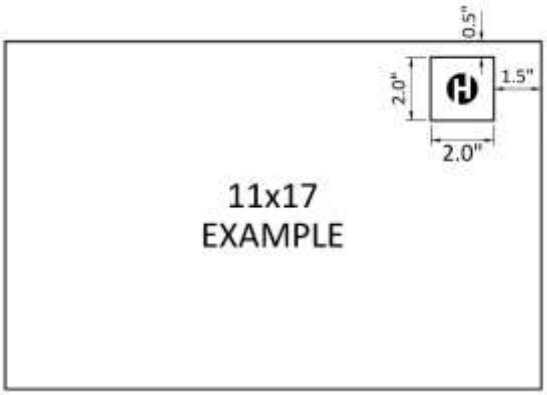
1. 22x34 inch and 24x36 plans require a blank (3x3 inch) space 5 inches from the upper right edge of page as shown in the figure below.

**Figure 120.1 – D Size Electronic Stamp Placement**




2. 11x17 inch plans require a blank (2x2 inch) space in the upper right of each page as shown in Figure 120.2.

**Figure 120.2 – B Size Electronic Stamp Placement**



3. All files must be electronically stamped and signed per *Oregon Revised Statutes* and *Oregon Administrative Rules*. Architects and Engineers are responsible to meet the specific provisions for electronic signatures within the rules and statutes.

120.5. Record Drawings

A. Following completion of construction and prior to final acceptance of a completed project, the Engineer shall electronically submit one complete set of record drawings for City review through the ProjectDox system. There are no additional fees for the record drawing review.

B. Record drawings shall contain and reflect any and all design modifications incorporated into the completed project, and any and all revisions to the previously approved construction plans. Include typical sections, street lights, conduits, everything installed underground, etc. Engineer shall verify all changes and provide a clean record drawing plan set.

C. Record drawings shall be accompanied by a completion certification letter from the Engineer. The completion certification letter shall include a statement that the site and adjacent properties (as affected by work performed under the City permit) are stable with respect to settlement, subsidence, and sloughing of cut and fills slopes.

D. See Subsection 360.4.C.2. for communications record drawing requirements.

**A residential building permit release will not be issued until the record drawings have been submitted to the City and approved.**

E. If specialists (geotechnical engineer, surveyor, arborist, wetland scientist, engineering hydrologist, etc.) were required in the design of the project, a completion certification from those individuals shall be required related to their specialty.

F. To receive acceptance by the City, the site must either have all vegetation/landscaping established or all required erosion control measures installed per CWS *Design and Construction Standards.*

G. Each sheet of the record drawings shall be stamped “Record Drawing” and dated.

H. Each record drawing shall be signed by the Engineer. This signature constitutes a certification that the public improvements, grading, and other elements of the engineering drawings have been completed in accordance with the City and CWS approved plans and to the standards of the City and CWS.

I. Every sheet included in the construction plan set showing permanent features shall be included. Record Drawings shall be of archival quality, using black ink on mylar or polypropylene. Additionally, electronic submittal of the scanned and signed record drawings and the record CAD base files is required. Furthermore, the following requirements apply:

1. All public right-of-way, including easements, must be shown. Easement type and recording information shall be noted if applicable.

2. Distances between utility mainlines in shared trenches must be shown.

3. Mainline type, size, and material must be shown

4. Manhole stations and invert elevations must be shown.

5. All laterals must be shown with descriptions of their lengths, plan stationing, sizes, materials, and invert elevation at the right of way line.

6. If one or more sidewalks are constructed, the appropriate City standard drawing for each type of public sidewalk must be included.

7. Clear vision zones shall be shown for each intersection.

8. Permanent and temporary survey control points and related data must be shown in accordance with Subsection 150.3.

## 130. Easements

A. Public Utility Easement (PUE)

The minimum width for a PUE shall be 8 feet. The PUE shall be located along all property lines adjacent to public rights-of-way. The City may require a larger PUE in commercial and industrial areas and where right-of-way widths are sub-standard. See Subsection 230.11 for easement grading requirements.

B. City-Owned Easements

**Table 130.1 – Minimum Easement Widths**

| Easement Type | Width |
|---|---|
| Public Utility Easement (PUE) | 8' |
| Public Water Easement (paved surface) | 15' |
| Public Water Easement (un-paved surface) | 20' |
| Public Sewer Easement | 15' |
| Shared (Parallel) Public Sewer Easement | 25' |
| Access and Maintenance Easement | 20' |

1. Public water lines shall be located in the public right-of-way. A public water line may only be located on private property upon approval and at the sole discretion of the Water Department. A public water line on private property shall be centered within a permanent water facilities easement granted to the City. The easement shall have a minimum width of 15 feet along its entire length when placed in a roadway, parking area, or other hardscaped surface. The easement shall have a minimum width of 20 feet in unimproved or landscaped areas where vehicular access is not normally available.

2. Public storm and sanitary sewer located on private property shall be located within a permanent public storm and/or sanitary sewer easement granted to the City, with a minimum width of 15 feet along its entire length. Parallel public storm and sanitary sewer sharing an easement require the easement width to be increased to a minimum of 25 feet. Shared easements require approval of the City.

3. The required width of an easement may be greater than the minimum requirement, based on the surrounding conditions and property line configurations. There may be additional restrictions on the setback of structures near an easement to comply with building codes.

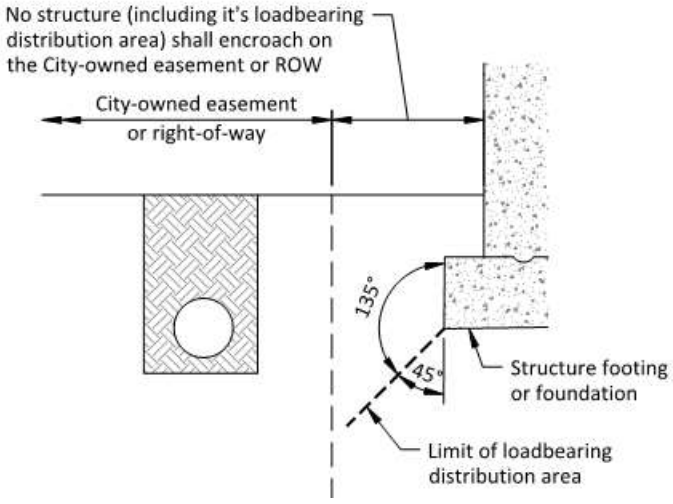
4. A twenty-foot wide permanent access and maintenance easement to benefit the City may be required in instances where City-owned infrastructure is inaccessible by way of the

permanent easement. The access and maintenance easement shall be along a route accessible by the City's maintenance vehicles.

5. Encroachments

a) There shall be no encroachment within a City-owned easement by a privately owned structure, building, building overhang, retaining wall, monument sign, or any other object, including a structure's loadbearing distribution area as defined in Figure 130.1, which would adversely affect the ability of the City to maintain public utilities.

**Figure 130.1 – Loadbearing Distribution Area**




b) There shall be no parallel encroachment within a City-owned right-of-way or easement, including a PUE, by a private utility facility or structure, including a structure's loadbearing distribution area as defined in Figure 130.1, without prior written approval by the City. Private utilities shall cross City-owned easements at right angles. Private utility facilities and structures shall not be placed within the pipe zone. The City will not approve any encroachment which would adversely affect the ability of the City to maintain public utilities.

6. The City will not approve any certificate of occupancy or approve any land partition, partition plat, lot line adjustment, or subdivision plat for any development that has not dedicated and/or granted all rights-of-way and easements as required by the land-use conditions of approval.

C. Easement forms are subject to the approval of the City prior to recording.

D. All recording costs for easements created by private development shall be borne by the developer.

E. All existing and proposed easements shall be shown on the construction plans. Include the easement type and recorded document information on the construction plans. All proposed easements shall have a blank space provided for final recording numbers to be added to the record drawings.

## 140. Accuracy of City Maps and Plans Not Guaranteed

A. The City may provide property owners, engineers, contractors, and other members of the public with information from the City's archives. The City can't guarantee and makes no representation that it has verified the accuracy of the measurements, locations, or other information on such maps and plans.

## 150. Surveying

A. All land surveying work performed for the City shall conform to all applicable *Oregon Revised Statutes*, Washington County Surveyors Office requirements, and these standards.

### 150.1. Requirements Regarding Registered Oregon Land Surveyors

A. All land surveying work performed for the City shall be done by a Professional Land Surveyor currently registered by the State of Oregon. All maps, surveys, reports, and final documents shall bear the seal of the Registered Land Surveyor responsible for their creation. All actions and work performed by a Registered Professional Land Surveyor shall comply with all applicable *Oregon Revised Statutes*, including but not limited to Chapters 92, 93, 209 and 672.

B. It is the responsibility of the Registered Professional Land Surveyor performing the survey work to acquire the right-of-entry for each required property. Notification shall be made in accordance with ORS 672.047. **All contact with property owners and the public shall be professional, polite, and respectful.**

### 150.2. Survey Safety

A. Safety related policy for surveying operations in public rights-of-way within the City shall conform to the *Manual on Uniform Traffic Control Devices* (MUTCD) regarding temporary traffic control. Safety related policy shall conform to the *Oregon Temporary Traffic Control Handbook*.

### 150.3. Survey Monuments

A. Existing Monuments

1. All existing Public Land Survey Corners including Section, One-Quarter Section, Donation Land Claim, and other Public Land Survey Corners affected by the project shall be referenced and protected. Additionally, all Washington County Benchmarks, GPS Control Points, or other significant survey control points shall be referenced and protected. If disturbance can't be avoided, the person or agency causing the disturbance shall notify the Washington County Surveyors Office, prior to such disturbance, to coordinate referencing and replacement of the monument. The party responsible for the disturbance shall pay all costs of the replacement.

2. All existing City Vertical Benchmarks and City Control Points affected by the project shall be referenced and protected. If disturbance can't be avoided, the person or agency causing the disturbance shall notify the City Surveyor, prior to such disturbance, to coordinate referencing and replacement of the monument. The party responsible for the disturbance shall pay all costs of the replacement.

3. Survey Monuments Affected by City-Developed Projects.

   a) General Construction. All Survey Monuments of Record, including Public Land Survey Corners, City and County Benchmarks, and City Control Monuments affected by a City-developed construction project shall be referenced in a pre-construction monument survey. At the conclusion of construction, any monuments of record which were disturbed by construction activities shall be either replaced or

referenced. A record of survey showing the monument replacement shall be filed with the Washington County Surveyors Office.

b) Road Construction Projects. All Survey Monuments of Record, including Public Land Survey Corners, City and County Benchmarks, and City Control Monuments affected by a City-developed road construction project shall be referenced in a pre-construction monument survey as required by ORS 209.155. When the construction project is complete, the disturbed monuments shall be either replaced or referenced by the post-construction monument survey as required by ORS 209.155.

B. New Survey Monuments

1. All new centerline and right-of-way monuments shall be installed per City standard drawings, ORS 209.155(2)(a), and Washington County Surveyors Office requirements.

2. All monuments shall be set by a Professional Land Surveyor currently registered by the State of Oregon. A record of survey shall be filed for all monuments set. The record of survey shall conform to ORS 209.250 and any additional requirements set forth by the County or City.

150.4. Units, Datum, and Coordinate Systems

A. Units

1. All coordinates utilized in the Oregon Coordinate System of 1983 and the Oregon Coordinate Reference System of 2011 shall be expressed in International Feet units.

2. All local plane coordinates shall be expressed in Feet units.

3. All elevations shall be expressed in Feet units.

B. Datum

1. All elevations shall be referenced to the City of Hillsboro Vertical Datum. City Datum is based on sea level and is roughly equivalent to NGVD 29 Datum.

C. Coordinate Systems and Control

1. Primary Horizontal control for City projects shall be referenced to one of the three coordinate systems listed below.

a) Oregon Coordinate System of 1983, North Zone, (NAD 83);

b) The Oregon Coordinate Reference System of 2011, Portland Zone (NAD 83);

c) Local Datum Plane. For construction and land surveying projects, it is preferable to utilize a local coordinate system. When a local datum plane is used, a conversion must be specified utilizing a projection point with coordinates in both the Local Datum Plane and at least one of the other coordinate systems listed above, a combined scale factor, and rotation to grid north. Notes shall be submitted containing all information required to transform, rotate, and scale the project to NAD 83 coordinates.

2. Primary Horizontal control Surveys for City projects constrained to the Washington County Primary Control Network Points.

3. Project Control shall be durable in nature and able to remain intact for the duration of the project. It shall be located outside the limits of construction to ensure its longevity.

150.5. Base Mapping and Record Drawings

A. All engineering plans, record drawings, and other mapping submitted in CAD or GIS formats shall be provided using the following control:

1. Horizontal control shall be referenced to Oregon Coordinate System of 1983, North Zone, (NAD 83) or Oregon Coordinate Reference System of 2011, Portland Zone (NAD 83). All digital maps and data files shall be on the same coordinate system.

2. If a local datum plane is used for the project, a conversion must be specified utilizing a projection point with coordinates in both the Local Datum Plane and at least one of the other coordinate system listed in Subsection 150.4.C.1, a combined scale factor, and rotation to grid north. Notes shall be submitted containing all information required to transform, rotate, and scale the project to NAD 83 coordinates.

150.6. Types of Surveys and Tolerances

A. Horizontal Control Survey. Tolerances for newly established Project Control shall meet the Acceptance Tolerances and Standards, based upon survey method, as defined in Chapter 5 of the *Construction Surveying Manual for Contractors*.

B. Right-of-Way/Property Survey. Includes Monument surveys as detailed in Subsection 150.3. In addition to the requirements in the *Oregon Revised Statutes*, tolerances for right-of-way or property lines shall meet the Acceptance Tolerances and Standards, based upon survey method, as defined in Chapter 5 of the *Construction Surveying Manual for Contractors*.

C. Construction Staking: Staking Tolerances shall meet the Construction Staking Tolerances as defined in Chapter 4 of the *Construction Surveying Manual for Contractors*.

1. See Subsection 510.4.5 for Water Department staking requirements.

## 160. Design Standard Exception

160.1. Design Standard Exception Request

A. The Engineer may request that the City approve a one-time exception to a City standard by submitting a completed *Design Standard Exception Request* form available on the City website. If approved, the exception is for project-specific use and shall not constitute a precedent or general modification of the City standard.

## 170. Construction

170.1. Lane Restrictions, Staging and Stockpiling Areas, and Disposal of Spoils

A. Lane Restrictions

1. Arterials shall have no lane restrictions from 6:30 am to 9:00 am and from 3:30 pm to 6:30 pm.

2. Collectors and Neighborhood Routes with an Average Daily Traffic (ADT) of over 1,000 shall have no lane restrictions from 7:00 am to 8:30 am and from 4:00 pm to 6:00 pm.

3. No lane restrictions shall occur on weekends or holidays.

B. Staging and Stockpiling Areas: Stockpiling and staging of equipment and materials within the public right-of-way is prohibited without the approval of the City. Stockpiling on private property may require that the contractor gain approval through the City Planning Department's land-use process. The land-use process may require significant time to complete.

C. Disposal of spoils: The contractor shall obtain all necessary land-use approvals and disposal or fill permits for the off-site disposal of spoils from the construction site.

170.2. Inspections

A. All public improvements shall be inspected by the Engineer.

B. The City's inspection services do not relieve the owner, developer, Engineer, or contractor of the responsibility for proper construction and compliance with these standards. City inspection services do not constitute approval of any modification to the approved construction plans.

C. Privately funded inspection services, required by the City as the primary inspection services on a project, are more comprehensive and intensive than City inspection services and are the responsibility of the owner, developer, and designated inspecting engineer.

D. All public water line improvements shall be inspected by the City of Hillsboro Water Department.

170.2.1. City Inspection Services

A. Inspection services provided by the City include:

1. Acting as a liaison between the designated inspecting Engineers, their inspectors, and the City.

2. Monitoring both work progress and performance testing results.

3. The performance of administrative and coordination activities as required for supporting the processing and completion of the project.

4. The issuance of a Stop-Work Order by notice to the designated inspecting Engineer, or that Engineer's inspector.

170.2.2. Responsibilities of Inspecting Engineer

A. Obtain and use a copy of City-approved construction plans and specifications and a copy of these standards.

B. Review and approve all pipe, aggregate, Portland cement concrete, asphaltic concrete, and other materials to ensure compliance with City standards.

C. Approve all plan or specification changes in writing and obtain City approval (see City Inspection Services above). All changes to the approved plans or specifications must be with the approval of the City prior to the commencement of work affected by the revision.

D. Monitor construction activities to ensure work meets City specifications.

E. Perform (or have performed) material, composition, and other tests required to ensure City specifications are met.

F. For street construction, in coordination with City's inspector, perform the following inspections and record date of each:

1. Curbs, curb-and-gutter, catch basins, street inlets, and sidewalk ramps are built to line and grade and meet all ADA requirements;

2. Subgrade meets grade and compaction specifications;

3. Base course meets depth/thickness, gradation, grade, and compaction specifications;

4. Leveling course meets depth/thickness, gradation, grade, surface condition, and compaction specifications;

5. Wearing course meets material, depth/thickness, gradation, grade, surface condition, compaction, and strength specifications.

G. Submit daily inspection reports to City's inspector at the end of each week.

H. Prior to requesting building occupancy on commercial, multi-family, and/or other projects with concurrent site development and building permits, the Engineer shall certify that all necessary public improvements have been installed and accepted in compliance with the City-approved site development permit construction plans. This certification shall also indicate that all items required through the land-use process, including but not limited to payment of all fees, recording of all public utility easements, and obtaining maintenance bonds, have been completed at or before occupancy of the first building.

170.3. Safety Requirements

A. The contractor is responsible for observing the safety of the work and of all persons and property coming into contact with the work. The contractor shall conduct his work in compliance with all the requirements prescribed by OSHA. Traffic control in work zones shall conform to the MUTCD and the ODOT supplements to the MUTCD. A traffic control plan shall be submitted and approved by the City prior to construction.

B. The City will issue a Stop-Work Order if a serious safety issue is not addressed or corrected.

170.4. Inspection Scheduling

A. The contractor shall notify the City at least 48 hours (two full working days) prior to any required City inspection. Connections between existing work and new work shall not be made

until necessary inspection and tests have been completed on the new work and it is found to conform in all respects to the requirements of the plans and specifications.

170.5. Preservation, Restoration, and Cleanup

A. All construction projects shall include restoration. Restoration shall return all public infrastructure affected by the construction activities, including haul routes, to original or better condition.

B. Restoration of surfaces may require extensive rehabilitation, including, but not limited to slurry seal, overlay, grind and inlay, and full depth reconstruction.

170.6. Materials

A. To ensure the proper, safe operation and required service life of all public improvements, all construction materials and components used in the construction of public improvements shall be of new manufacture. No rebuilt, reconditioned, refurbished, or used materials and components will be allowed. All new construction materials and components shall be installed as designed by the manufacturer. No alteration of materials and components shall be made.

B. Whenever these standards reference a specific product, manufacturer's name, or brand, it shall be understood that the words "or approved equal" follow. Determination of quality in reference to the project design requirement will be made by the City. A contractor shall not use an alternative product without prior written approval of the City. A request to designate an alternative product as an "approved equal" shall be processed as if the alternative product were an exception under Subsection 160.

## 180. Environmental Protection during Construction

180.1. General Policy and Requirements

A. The contractor shall comply with all laws, regulations, and standards of all federal, state, and local authorities, including:

- Clean Water Services
- US Army Corps of Engineers
- Oregon Dept. of Fish and Wildlife
- Environmental Protection Agency
- Oregon Dept. of Environmental Quality
- Oregon Dept. of State Lands
- National Marine Fisheries Service
- Oregon State Historic Preservation Office

B. The contractor shall properly install, operate, and maintain both temporary and permanent measures, as shown in the approved plan, to protect the environment during the entire duration of the project.

C. The City requires construction projects to be scheduled so as to minimize potential erosion or other environmental harm.

D. All materials delivered to the job site shall be covered and protected from the weather. None of the materials shall be exposed during storage. Waste material, rinsing fluids, and other such material shall be disposed of in such a manner that pollution of groundwater, surface water, or the air does not occur.

## 190. Fee In Lieu of Improvement Construction

A. A developer or property owner may be allowed or required to pay a fee in lieu of construction for a conditioned development improvement.

B. The fee, for all types of improvements except potable water systems and surface water quality facilities, shall be determined as follows:

1. The applicant shall submit an itemized construction cost estimate to the City for approval. The estimate shall include all items necessary for the construction of the improvement in accordance with the development condition, these standards, and the City of Hillsboro *Community Development Code*. The construction cost estimate should not include additional costs for permitting, surveying, engineering, and the like. If the applicant is not able to prepare the construction cost estimate, City staff will prepare it on their behalf.

2. If applicable, the City will subtract from the estimate any items that would otherwise be eligible for SDC credits.

3. The fee will be 150% of the approved construction cost estimate before the SDC credit eligible components are removed.

4. The applicant shall send the fee to the appropriate City department prior to obtaining City permits.

C. For surface water quality facilities, the fee shall be determined by Clean Water Services.

D. The Water Department only allows fee-in-lieu in unique circumstances for potable water improvements. A fee-in-lieu waiver must be approved by the Water Department Engineering Manager and Director. Contact the Water Department for further information. The Water Department does not allow SDC credits.

## SECTION 200

## 200. ROADWAYS

### 210. General Roadway Requirements

A. The standards contained in this section may be superseded for projects within Plan Districts. For such projects, refer to the relevant Plan District within the Community Development Code. Plan District boundary information is available on the City website.

B. All roadways shall meet the requirements of the Oregon Fire Code with City of Hillsboro Amendments and are subject to the approval of the fire code official.

### 210.1. Functional Classification

A. The functional classification for roads are established by the City of Hillsboro *Transportation System Plan* (TSP) and are as shown in Table 210.1.

**Table 210.1 – Functional Classifications**

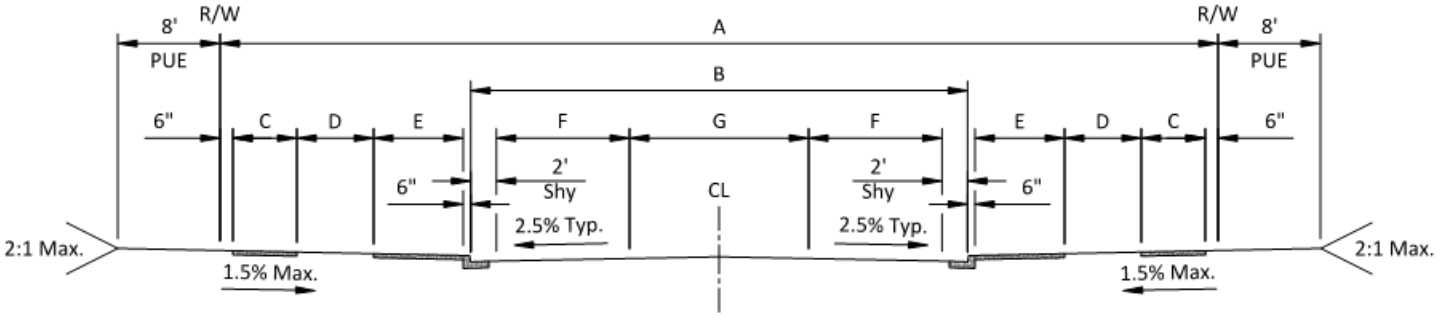
| Functional Classification | Subcategory |
|---|---|
| Arterial | - |
| Collector | Commercial & Industrial |
| | Residential |
| Neighborhood Route | Commercial & Industrial |
| | Residential |
| Local Road | Commercial & Industrial |
| | Residential |
| Alley | - |

### 210.2. Typical Sections

A. Standard roadway typical sections are shown by functional classification in Figures 210.1 through 210.5.

B. When required as a condition of development, half-street improvements shall include all the area between centerline and the edge of right-of-way, including the reconstruction of any existing street section not meeting the required pavement design life. See Subsection 220 for pavement design-life requirements.

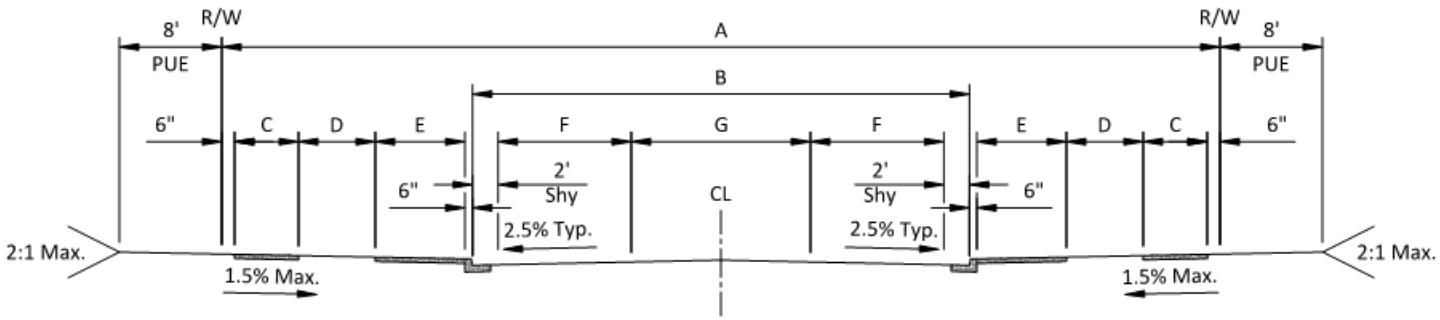
**Figure 210.1 - Arterial Road Section**




| Number of Lanes | Right-of-Way (A) | Paved Width (B) | Sidewalk Width (C) | Landscape Strip Width (D) | Raised Cycle Track Width (E)* | Travel Lane Width (F) | Center Turn Lane (G) |
|---|---|---|---|---|---|---|---|
| 2 | 66’ | 28’ | 5’ | 6’ | 7’ | 12’ | - |
| 3 | 80’ | 42’ | 5’ | 6’ | 7’ | 12’ | 14’ |
| 5 | 104’ | 66’ | 5’ | 6’ | 7’ | 12’ | 14’ |
| 7 | 130’ | 90’ | 6’ | 6’ | 7’ | 12’ | 14’ |

*For raised cycle track standards and criteria, see Subsection 230.10.C.

**Figure 210.2 - Collector Road Section**

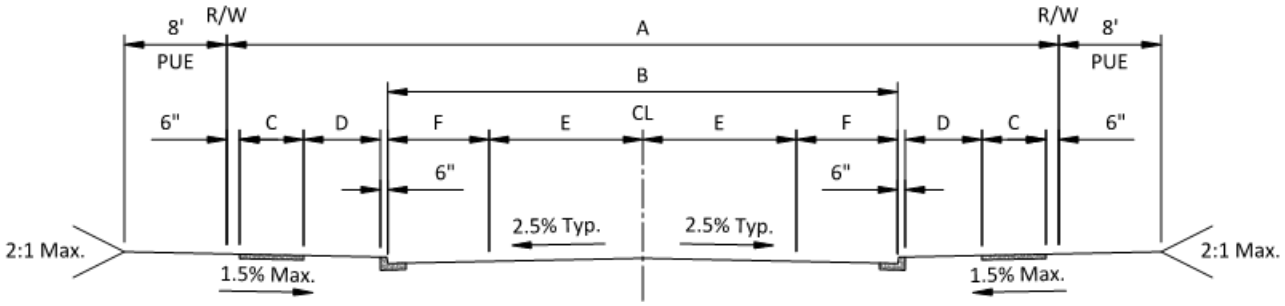



| Subcategory | Number of Lanes | Right-of-Way (A) | Paved Width (B) | Sidewalk Width (C) | Landscape Strip Width (D) | Raised Cycle Track Width (E)* | Travel Lane Width (F) | Center Turn Lane (G) |
|---|---|---|---|---|---|---|---|---|
| Residential | 2 | 64’ | 28’ | 5’ | 5’ | 7’ | 12’ | - |
| | 3 | 74’ | 38’ | 5’ | 5’ | 7’ | 11’ | 12’ |
| | 5 | 96’ | 60’ | 5’ | 5’ | 7’ | 11’ | 12’ |
| Commercial & Industrial | 2 | 66’ | 28’ | 5’ | 6’ | 7’ | 12’ | - |
| | 3 | 80’ | 42’ | 5’ | 6’ | 7’ | 12’ | 14’ |
| | 5 | 104’ | 66’ | 5’ | 6’ | 7’ | 12’ | 14’ |

*For raised cycle track standards and criteria, see Subsection 230.10.C.

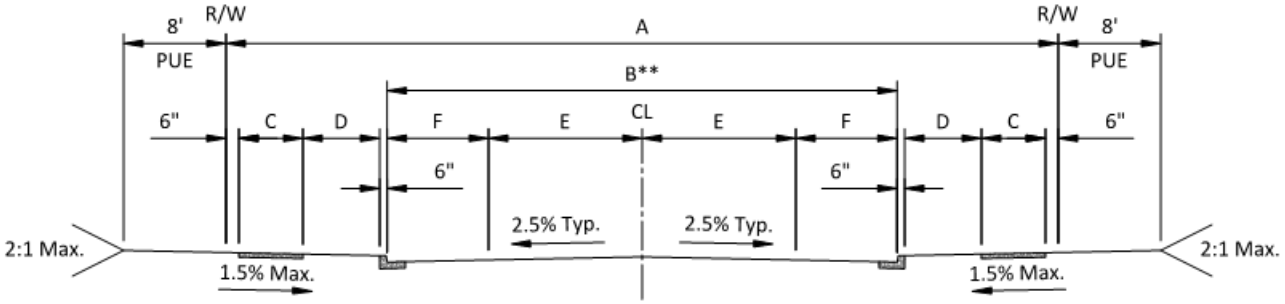
NOTE: Parking may be added if approved by City. If approved, the location of the cycle track and landscape strip shall be reversed to prevent car doors opening into the cycle track and additional R/W shall be provided.

**Figure 210.3 – Neighborhood Route Section**




| Subcategory | Right-of-Way (A) | Paved Width (B) | Sidewalk Width (C) | Landscape Strip Width (D) | Travel Lane Width (E) | Parking Lane (F) | Parking |
|---|---|---|---|---|---|---|---|
| Commercial & Industrial | 62’ | 40’ | 5’ | 5’ | 12’ | 8’ | Both Sides |
| Residential | 60’ | 36’ | 5’ | 6’ | 12’ | 6’ | Both Sides |

**Figure 210.4 - Local Road Section**




| Subcategory | Right-of-Way (A) | Paved Width (B) | Sidewalk Width (C) | Landscape Strip Width (D) | Travel Lane Width (E) | Parking Lane (F) | Parking |
|---|---|---|---|---|---|---|---|
| Commercial & Industrial | 62’ | 40’ | 5’ | 5’ | 12’ | 8’ | Both sides |
| Residential | 54’ | 32’ | 5’ | 5’ | 10’ | 6’ | Both sides |
| Residential | 50’ | 28’ | 5’ | 5’ | 11’ | 6’ | One side |
| Residential | 46’ | 24’ | 5’ | 5’ | 12’ | - | None |

**All roadways must meet minimum fire access requirements.

**Figure 210.5 - Alley Section for Lots that Front a Public Street**

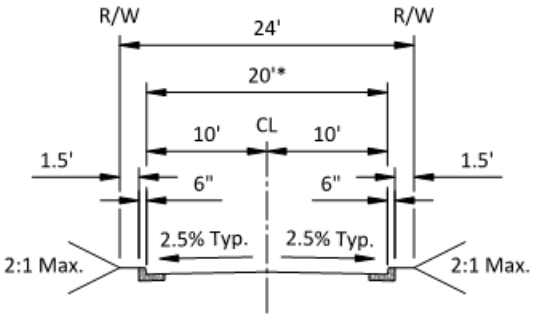
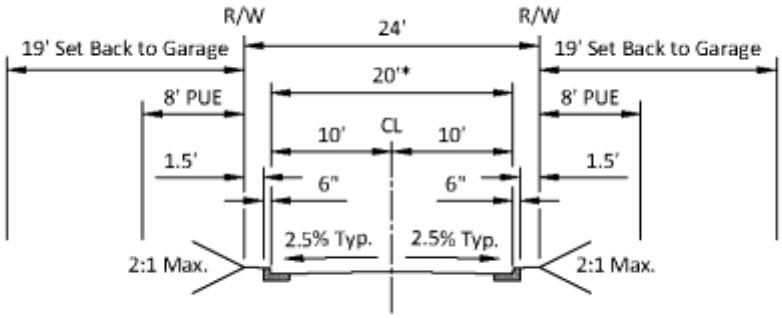


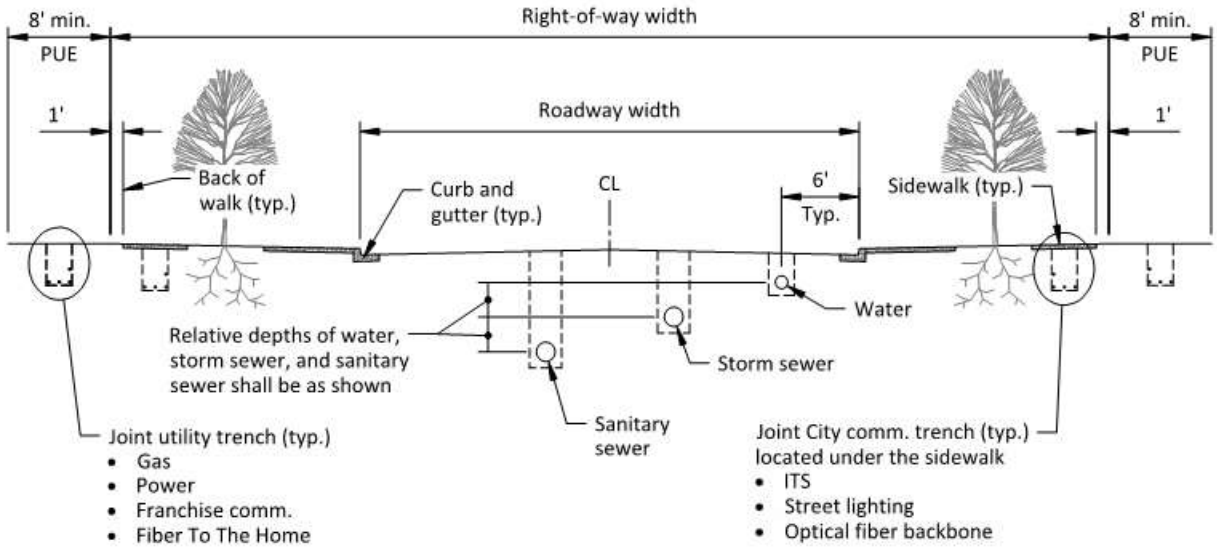

**Figure 210.6 - Alley Section for Lots that Front a Green Space**




*All roadways must meet minimum fire access requirements.

C. Standard utility locations are shown in Figure 210.7.

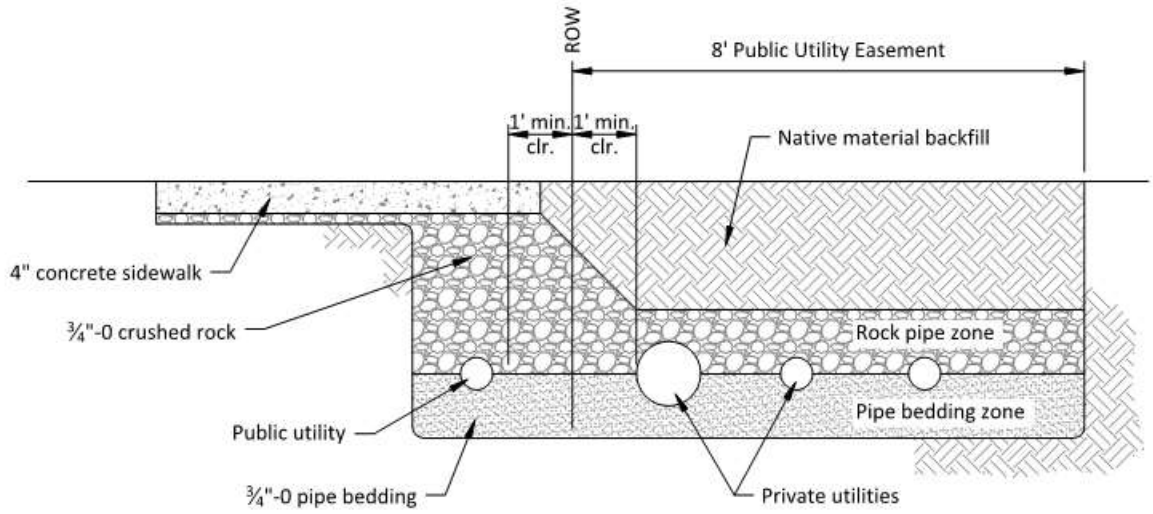
**Figure 210.7 – Standard Utility Locations**




## Notes

1. Sanitary sewer and storm sewer shall be located per Clean Water Services (CWS) standards.
2. Manholes shall not be placed in the vehicle wheel-path. See Subsection 410.D.
3. Maintain minimum required separations between sanitary sewer and water per CWS regulations and OAR 333-061-0050.
4. The placement and depths of gas, power, cable, and other dry utilities located within the Public Utility Easement (PUE) shall be per Oregon Utilities Coordinating Council (OUCC) standards.
5. See CWS Std. Drg. No. 590 for trench backfill details. For all trenches with paved areas, use Class "B" backfill. For all trenches within unpaved areas, use Class "A" backfill.
6. Water lines shall be placed on the South and East sides of the roadway. Gas and electric lines shall be placed on the North and West sides.
7. All above ground utilities shall meet roadway clear zone requirements.
8. Optical fiber conduit and cable shall be placed in the joint utility trench (in the PUE) in Fiber To The Home (FTTH) applications. It shall be placed in the joint communications and street lighting trench (in the ROW) within corridors specified in the City's Transportation Communications Plan. See Subsection 360.1.
9. See Subsection 230.10.A.3 and Std. Drg. No. 350-2 for requirements concerning utility placement within sidewalks.
10. See Subsection 130 for easement requirements.
11. See COH Std. Drg. No. 250-2 for pavement restoration details.

**Figure 210.8 – Shared Utility Trench Option**




D. The joint utility trench (containing gas, power, and franchise communications) may be combined with the joint City communications trench (containing ITS, street lighting, and optical fiber backbone) as shown in Figure 210.8.

210.3. Channelization/Intersections

A. The TSP identifies the required number of lanes for each street. Additional lanes may be required at intersections in excess of the minimum street standards shown in the TSP and the typical sections shown herein. Additional right-of-way may be required to accommodate the increased number of lanes at intersections.

B. Where traffic signals exist or are anticipated for installation within five years, additional right-of-way shall be provided to accommodate signal poles and equipment clear of the sidewalk.

C. See Subsection 230.5 for intersection design standards.

210.4. Design Speed

A. Design speeds are as shown in Table 210.2.

**Table 210.2 – Design Speeds**

| Functional Classification | Design Speed |
|---|---|
| Arterial | 45 mph |
| Collector | 35 mph |
| Neighborhood Route | 25 mph |
| Local Road | 25 mph |
| Alley | 15 mph |

210.5. Roundabouts

A. Roundabouts shall be designed according to the guidelines presented in *Roundabouts: An Informational Guide*.

220. Pavement Design and Construction

A. Pavement materials and construction work must comply with the current *Oregon Standard Specifications for Construction*. Abbreviations and terms used within this section are as defined or used in the ODOT standard specifications unless otherwise defined.

B. Pavement materials for each new roadway classification shall be as shown in Table 220.1.

**Table 220.1 – Pavement Materials**

| Functional Classification | Subcategory | Pavement Material |
|---|---|---|
| Arterial | - | Concrete |
| Collector | Commercial & Industrial | Concrete |
| | Residential | Asphalt |
| Neighborhood Route | Commercial & Industrial | Concrete |
| | Residential | Asphalt |
| Local Road | Commercial & Industrial | Asphalt |
| | Residential | Asphalt |
| Alley | - | Asphalt |

220.1. Designed Pavement Sections

A. Pavement design period

1. **New pavement**: 40 years.
2. **Rehabilitation**: 20 years.
3. **Widening**: 20 years, plus 20 year rehabilitation of existing pavement.
4. **Reconstruction**: 40 years.
5. Design period may be conditioned in the land use decision. If unsure, contact transportation planning.

B. Pavement designs shall be developed using the following:

1. **Asphalt concrete**: AASHTO *Guide for Design of Pavement Structures* (AASHTO Guide) and the design guidelines of the latest ODOT *Pavement Design Guide* (ODOT Guide).
2. **Portland cement concrete**: 1998 *Supplement for Rigid Pavement Design* (AASHTO Supplement) or the StreetPave™ design software by the American Concrete Pavement Association (ACPA).

C. Pavement designs shall be developed and documented by an engineering report prepared and stamped by an Oregon registered Professional Engineer experienced in pavement design. The report must include specific pavement design recommendations for materials and construction. Additionally, the report must include sufficient design documentation regarding site conditions, design assumptions and design parameters to allow for independent peer review of the design recommendations. The engineering report shall address considerations for year round construction. Recommendations for both summer and winter construction shall be included.

D. Field testing of pavement construction work shall follow the procedures and testing schedule listed in the latest edition of the *ODOT Manual of Field Test Procedures* (MFTP) for the applicable type of work.

220.2. Subgrade Evaluation

A. Conduct sufficient soil explorations (at least one per 500-feet of roadway and at least two total) to visually classify the soils within three feet below the planned subgrade surface. Conduct laboratory testing on samples of the subgrade soils including determination of moisture content, Atterberg Limits as necessary for soil classification, moisture-density relationship by standard Proctor compaction and subgrade support values for the in situ subgrade and compacted subgrade.

B. Subgrade support values for design of flexible pavement (resilient modulus) and rigid pavement (modulus of subgrade reaction or k-value) shall be estimated by one or more of the following methods:

1. Estimate in situ subgrade support values by back calculation of Falling Weight Deflectometer (FWD) deflections measured on paved or aggregate surfaced areas within the project limits. FWD testing shall be conducted in accordance with ASTM D 4694 and D 4695. The FWD must have been reference calibrated at a FHWA/SHRP Regional Calibration Center within twelve (12) months preceding the testing. Back calculate the elastic modulus of the subgrade soil for flexible pavement design in accordance with the back calculation procedures described in the AASHTO Guide or other procedures meeting the guidelines of ASTM D 5858. Use the modulus correction factors given in the ODOT Guide to convert back calculated elastic moduli into equivalent saturated laboratory resilient moduli. Back calculate the dynamic k-value of the subgrade for rigid pavement design in accordance with the back calculation procedures described in the AASHTO Supplement and correct the dynamic k-value to static k-value using a factor of 0.5.

2. Estimate in situ subgrade support values by measuring subgrade soil penetration resistance using the dynamic cone penetrometer (DCP) in accordance with ASTM D 6951. Estimate the subgrade resilient modulus for flexible pavement design from DCP Index (mm/blow) using the correlation given in the ODOT Guide. Use the modulus correction factors given in the ODOT Guide to convert DCP determined resilient moduli into equivalent saturated laboratory resilient moduli. Estimate subgrade static k-value for rigid pavement design from DCP Penetration Rate (inches/blow) using the correlation given in the AASHTO Supplement.

3. Determine in situ resilient modulus by laboratory testing of push tube samples of subgrade soil. Conduct the resilient modulus testing using the ODOT testing protocol. Evaluate resilient modulus at a deviator stress of 6 psi without confining pressure.

4. Determine the resilient modulus of compacted subgrade by testing laboratory compacted subgrade soil. Compact the subgrade sample to 95% of standard Proctor maximum dry density at moisture content of 1 to 2 percentage points above standard Proctor optimum moisture content. Conduct the resilient modulus testing using the ODOT testing protocol. Evaluate resilient modulus at a deviator stress of 6 psi without confining pressure.

5. Estimate the k-value of compacted subgrade by CBR testing of a laboratory compacted subgrade soil. Compact the subgrade sample to 95% of standard Proctor maximum dry density at moisture content of 1 to 2 percentage points above standard Proctor optimum moisture content. Conduct the CBR testing in accordance with ASTM D 1883 using surcharge weight equivalent to the proposed pavement section. Estimate the static k-value from the CBR value using the correlation given in the AASHTO Supplement.

   In lieu of testing to establish subgrade support values, presumptive design values of 3,000 psi for resilient modulus and 50 pci for k-value may be used.

220.3. Traffic Loading Analysis

A. The pavement design traffic loading is the total number of Equivalent 18-kip Single Axle Load (ESAL) repetitions that the pavement is expected to experience during the design period. Traffic engineering analysis shall be conducted to estimate existing and/or projected average daily traffic volumes, percentage of heavy vehicles, distribution of heavy vehicle volumes according to the Federal Highway Administration (FHWA) axle classifications and projected growth rate in heavy vehicle volumes during the design period.

B. Daily heavy vehicle volumes shall be multiplied by the conversion factors shown below in Table 220.2 to calculate annual ESAL repetitions for each heavy vehicle. The cumulative ESAL repetitions from all heavy vehicles during the design period shall be calculated taking into account the expected annual growth in heavy vehicle volumes. The minimum traffic loading for pavement design shall be 50,000 ESAL repetitions.

**Table 220.2 – Annual ESAL Conversion Factors**

| FHWA Classification | Daily Vehicle Volume to Annual ESAL Repetitions Conversion Factors | |
|---|---|---|
| | Flexible Pavement | Rigid Pavement |
| Weight restricted buses, school buses | 246 | 269 |
| 2-axle Transit Buses | 780 | 1170 |
| Articulated Transit Buses | 1550 | 2320 |
| 5 | 104 | 99 |
| 6 | 284 | 417 |
| 7 | 757 | 1199 |
| 8 | 253 | 277 |
| 9 | 466 | 715 |
| 10 | 561 | 912 |
| 11 | 603 | 606 |
| 12 | 546 | 663 |
| 13 | 1037 | 1660 |

C. The presumptive traffic loadings shown below in Table 220.3 may be used as design values in lieu of a detailed traffic analysis.

**Table 220.3 – Presumptive Traffic Loadings**

| Functional Classification | Flexible Pavement 40-yr ESAL Repetitions | Rigid Pavement 40-yr ESAL Repetitions |
|---|---|---|
| Local Residential & Neighborhood Route (note 1) | 50,000 | 70,000 |
| Commercial/Industrial | 1,000,000 | 1,600,000 |
| Collector | 4,000,000 | 6,000,000 |
| Arterial | 8,000,000 | 13,000,000 |

Note: Use Commercial/Industrial Functional Classification traffic loadings if street will be used by a Tri-Met bus line or similar shuttle buses.

D. The traffic loading for circulatory lanes within roundabouts should be 1.5 to 2 times the highest traffic loading on the approach lanes to account for the combined loading from the approaches.

E. If using StreetPave™ load spectrum traffic analysis is required. Use site specific total truck traffic with the default typical traffic category corresponding to the road type. For transit bus routes, default to major arterial traffic category.

220.4. Flexible Pavement Thickness Design Criteria

A. Use the design parameter values shown below in Table 220.4 for flexible pavement design.

**Table 220.4 – Flexible Pavement Design Parameter Values**

| Parameter | Design Value |
|---|---|
| Design Reliability Level: | 90% arterial, collector, commercial, and bus routes<br>80% Local residential and neighborhood routes |
| Initial Serviceability, Po: | 4.2 |
| Terminal Serviceability, Pt: | 2.5 |
| Standard Deviation: | 0.50 |
| New Asphalt Concrete Layer Coefficient: | 0.42 |
| New Aggregate Base Layer Coefficient: | 0.10 |
| New Aggregate Base Resilient Modulus, psi: | 20,000 |
| New Aggregate Base Drainage Coefficient: | 1.0 |
| New Aggregate Subbase Layer Coefficient: | 0.08 |
| New Aggregate Subbase Resilient Modulus, psi: | 11,200 |
| New Aggregate Subbase Drainage Coefficient: | 1.0 |

B. The pavement section shall be designed using the Layered Design Analysis method described in Section 3.1.5 of Part II of the 1993 AASHTO Guide. The calculated pavement thickness should be rounded to the nearest 0.5-inch.

C. The minimum roadway AC section thickness shall be 5 inches consisting of a 3-inch thick base lift and 2-inch thick wearing course. Multi-use pathways shall have a minimum AC section thickness of 3-inches placed in a single lift.

D. The minimum thickness of aggregate base shall be 8-inches. Geotechnical Engineer to provide analysis of rock section's suitability to support construction traffic. Analysis should take into account construction time of year. Plant mixing is required for all aggregate.

E. Full depth reclamation with cement can be included provided laboratory testing and design is provided in the engineering report. Layer coefficient shall be 0.16 where at least 50 percent, by weight, of existing material to be treated is granular, otherwise layer coefficient shall be considered equal to aggregate subbase (0.08).

F. The asphalt concrete should be ½- or ¾- inch dense ACP according to ODOT 00744. A request can be made for low nominal maximum aggregate size for thin lift paving.

G. Minimum and maxium lift thicknesses are 2.0 and 3.0 inches, respectively for ½- and ¾- inch dense ACP.

H. Compact asphalt concrete to a minimum of 91% of MAMD for the base lift and 92% of MAMD for all subsequent lifts.

I. For typical ACP, binder should be PG 64-22. However the binder grade should be adjusted depending on aggregate gradation, traffic levels, and the amount of recycled asphalt material. Binder grade discussion and reasoning must be submitted in the engineering report.

220.5. Rigid Pavement Thickness Design Criteria

A. AASHTO Supplement Design requirements

1. Use the design parameter values shown below in Table 220.5 for rigid pavement design by the AASHTO Supplement procedures and Table 220.6 for rigid pavement design with the StreetPave™ system.

2. The minimum PCC slab thickness shall be six (6) inches. Streets with transit or shuttle bus traffic shall have minimum PCC slab thickness of eight (8) inches.

3. The minimum thickness of aggregate base shall be four (4) inches. Geotechnical Engineer to provide analysis of rock section's suitability to support construction traffic. Analysis should take into account construction time of year. Plant mixing is required for all aggregate.

4. The slab thickness design shall take into account the slab edge support condition as defined within the AASHTO Supplement and/or StreetPave™.

5. For AASHTO Supplement design, if the transverse joints are un-dowelled, the tensile stress at the top of the slab needs to be checked for axle loading near the transverse joint (joint loading). Dowels are required if the tensile stress for joint loading exceeds the tensile stress calculated at the bottom of the slab for the mid-slab loading case (as used for the slab thickness design).

6. For AASHTO supplement design, estimate the magnitude of joint faulting at the end of the design period for dowelled or un-dowelled joints using the predicative models. Adjustment to the design is required if the predicted faulting magnitude exceeds the critical values given in Table 28 of the 1998 Supplement. Potential adjustments include use of dowels or increase in dowel diameter, use of treated base material and use of subsurface drains to improve drainage conditions.

7. For StreetPave™ design, default setting should be "No" under macro fibers. If macro fibers are proposed, project specific test results must be provided using the ASTM C1609 test method with an analysis showing a maximum residual strength of 15 percent.

8. Requirements under ODOT 00756.60 must be met prior to opening to traffic.

**Table 220.5 – Rigid Pavement Design Parameter Values (AASHTO supplement)**

| Parameter | Design Value |
|---|---|
| Design Reliability Level: | 90% arterial, collector, commercial, and bus routes<br>80% Local residential and neighborhood routes |
| Initial Serviceability, Po: | 4.5 |
| Terminal Serviceability, Pt: | 2.5 |
| Standard Deviation: | 0.40 |
| 28-day Flexural Strength, psi: | 600 |
| Modulus of Elasticity of Concrete, psi: | 3,600,000 |
| Modulus of Elasticity of Base Material, psi | Median value from Table 14 of AASHTO Supplement for the base type |
| Drainage coefficient for faulting analysis: | 0.80 |
| Poisson's Ratio of PCC: | 0.15 |
| Edge Support Adjustment Factor: | As recommended in AASHTO Supplement for type of edge support |
| Friction Coefficient between Slab and Base | Median value from Table 14 of AASHTO Supplement for the base type |
| Mean Annual Wind Speed, mph: | 7.9 |
| Mean Annual Temperature °F: | 53.6 |
| Mean Annual Precipitation, inches: | 36.3 |
| Moisture Gradient & Construction Temperature Differential in Slab: | 1 °F per inch of slab thickness |
| Mean Annual Freezing Index: | 33 degree (F) days |
| Annual Temperature Range °F: | 46.6 |
| Number of Days with Maximum Temperature above 90 °F: | 10.8 |

**Table 220.6 – Rigid Pavement Design Parameter Values (StreetPave™)**

| Parameter | Design Value |
|---|---|
| Design Reliability Level | 90% arterial, collector, commercial, and bus routes<br>80% Local residential and neighborhood routes |
| Terminal Serviceability | 2.5 |
| 28-day Flexural Strength, psi | 600 |
| Modulus of Elasticity of Concrete, psi | 3,600,000 |
| Slabs Cracked | 10% |
| Drainage coefficient for faulting analysis | 0.80 |
| Poisson's Ratio of PCC | 0.15 |
| Edge Support | Design dependent. Exception required for untied support |
| Macro fibers in concrete | Default to No. Maximum of 15% residual if approved by City |

220.6. Rigid Pavement Jointing Design Criteria

A. The Design Engineer shall provide a jointing plan in the project plans showing the construction joints and transverse and longitudinal joints in the concrete pavement to control cracking. The jointing plan shall show to scale at a minimum: manholes, valve boxes, inlets, joint layouts, dowels, tie bars and other required reinforcement and joint details including sawing depths.

B. Joint layout shall be designed in accordance with American Concrete Pavement Association (ACPA) recommendations and the criteria described herein. The Design Engineer shall avoid or minimize: joints that intersect another joint or the pavement edge at an angle of less than 60-degrees, interior corners (L-shaped slabs), slabs less than 1-foot wide, odd shapes (keep slabs rectangular, trapezoidal or triangular). Utility fixtures shall be isolated from the slab by box-outs with isolation joints in accordance with Std. Drg. No. 220-2. Coordinate the joint layout with fixture locations so that the joints are centered on the box-outs or coincide with the isolation joints around the box-outs.

C. Gutter joints shall be aligned with the transverse joints on the adjoining slab unless an isolation joint is placed between the gutter and the slab. Note that if the gutter is isolated from the slab by a butt type joint, then an edge support factor of 1.0 shall be used in the slab thickness design.

D. Longitudinal joints shall coincide with lane lanes. Note that on streets with an odd number of lanes this will require an offset crown. Spacing between longitudinal joints shall not exceed 15 feet or 24x slab thickness on unbound base or 21x slab thickness on stabilized base

E. Transverse contraction joints shall be spaced at relatively equal intervals and shall be close to the same spacing as the longitudinal joints so that the panels are relatively square. The ratio of the maximum to minimum slab dimensions (aspect ratio) formed by joints shall not exceed

1.25. Spacing between transverse joints shall not exceed 15-feet or 24x slab thickness on unbound base or 21x slab thickness on stabilized base. If the aspect ratio cannot be met, a reinforcement grid shall be installed as shown on Std. Drg. Nos. 220-1 and 250-3.

F. Joint construction, dowel bar installation and tie bar installation shall conform to the details shown on Std. Drg. Nos. 220-1 and 250-3.

1. Transverse joints (sawed or construction) in plain concrete pavement slabs 7 inch thick or greater shall be dowelled. All joints within intersections shall be dowelled when dowels are needed on the transverse joints in one of the approach lanes. Plate dowels will not be allowed. Dowel installation shall be per ODOT 00756.43(a).

2. All joints shall be sealed with joint sealant listed on the ODOT QPL placed in a joint reservoir sized in accordance with the recommendations of the joint sealant manufacturer (typically the reservoir width should be twice the sealant depth for silicone sealant). The sealant shall be supported by a backer rod of the size and material recommended by the joint sealant manufacturer. The top of the sealant shall be recessed below the slab surface by 1/8 to 3/8-inch.

220.7. Structural Rehabilitation Design

A. Pavement coring shall be performed at representative locations to determine the thickness and composition of the pavement materials and evaluate cracking depth, investigate cracking mode (top-down or bottom-up) and investigate for moisture induced damage (asphalt stripping damage). Investigation shall also include a visual survey of pavement distress.

B. Field investigation shall include falling weight deflectometer (FWD) testing of existing pavement to determine structural condition and remaining structural life for Commercial/Industrial, Collector, and Arterial street sections.

1. FWD testing conducted in accordance with ASTM D 4694 and D 4695. The FWD must have been calibrated within twelve (12) months preceding the testing. Investigation shall also include a visual survey of pavement distress.

2. The FWD test data shall be analyzed to delineate analysis units representing segments having distinctly different structural characteristics.

3. The in situ resilient modulus of the subgrade and the effective structural number of the existing pavement structure shall be estimated from back-calculation analysis of the FWD test data using the back-calculation analysis procedure described in the AASHTO Guide or other procedures meeting the guidelines of ASTM D 5858.

C. Resilient modulus analysis for residential street sections should be one of the options listed under 220.2B. Additionally, residential effective structural analysis should be layered based on the suggested coefficients listed in Table 5.2 of the AASHTO guide.

D. Design for structural rehabilitation of existing pavement shall be accomplished using the procedures described in Part III of the AASHTO Guide and the rehabilitation design guidelines in the ODOT Guide. The rehabilitation recommendations shall include consideration to measures for mitigation of reflective cracking.

220.8. Subgrade Evaluation

A. The Design Engineer shall evaluate the laboratory soils test data to determine if subgrade compaction is feasible including consideration of moisture conditions during construction and whether the compacted subgrade will support construction activities and traffic.

B. If subgrade compaction is deemed feasible, the pavement section shall be designed based on the subgrade support values determined from the laboratory tests of compacted subgrade. Compaction of the subgrade shall be accomplished in accordance with the procedures and compaction criteria given in ODOT 00330.43 including deflection testing according to ODOT TM 158. Subgrade separation geotextile shall be placed over the compacted subgrade prior to placing aggregate base.

C. If subgrade compaction is not deemed feasible, the subgrade shall be stabilized by one of the following methods:

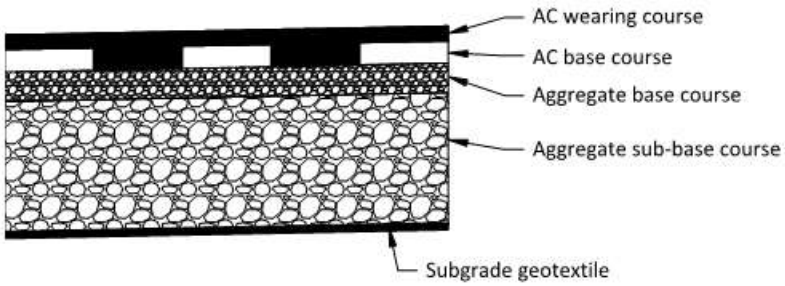
1. Conduct subgrade stabilization in accordance with ODOT 00331. Use aggregate bases conforming to section 2630. Use of geosynthetic reinforced aggregate backfill is allowed. Include subgrade separation geotextile placed directly over the subgrade to prevent infiltration of subgrade fines into the aggregate backfill.

2. Treat the subgrade with portland cement in accordance with ODOT 00344 including the compaction criteria given in ODOT 00344.45. Determine the cement treatment rate to achieve a seven (7) day compressive strength of at least 200 psi as determined by ASTM D 1633 Method A on specimens compacted to 95% of maximum dry density at optimum water content as determined by ASTM D 558. Portland cement content greater than 8 percent requires City approval.

220.9. Standard Pavement Sections

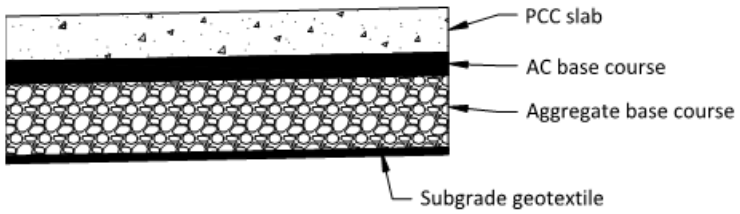
A. The pavement designs shown in Figures 220.1 and 220.2 may be used as alternatives to preparing a project-specific design.

**Figure 220.1 - Standard Asphalt Concrete (AC) Pavement Section**




| Functional Classification | Subcategory | Thickness (inches) | | | | AC Mix Design Level |
|---|---|---|---|---|---|---|
| | | AC Wearing Course (Note 3) | AC Base Course (Note 3) | Aggregate Base Course (Note 4) | Aggregate Sub Base Course (Note 5) | |
| Collector | Residential | 2.0 | 8.0 | 8.0 | 12.0 | 3 |
| Neighborhood Route | Residential | 2.0 | 3.0 | 4.0 | 12.0 | 2 |
| Local Road | Commercial & Industrial | 2.0 | 6.0 | 6.0 | 12.0 | 2 |
| | Residential | 2.0 | 3.0 | 4.0 | 12.0 | 2 |
| Alley | - | 2.0 | 2.0 | 4.0 | 10.0 | 2 |
| Multi-Use Path | - | 2.0 | 2.0 | 4.0 | 10.0 | 2 |

**Figure 220.2 - Standard Portland Cement Concrete (PCC) Pavement Section**




| Functional Classification | Subcategory | Thickness (inches) | | |
|---|---|---|---|---|
| | | PCC Slab (Note 6, 7) | AC Base Course (Note 3) | Aggregate Base Course (Note 4) |
| Arterial | - | 10.0 | 4.0 | 10.0 |
| Collector | Commercial & Industrial | 9.0 | 4.0 | 10.0 |
| Neighborhood Route | Commercial & Industrial | 9.0 | 4.0 | 10.0 |

NOTES TO FIGURES 220.1 AND 220.2:

1. These standard pavement sections are based on conservative design criteria including anticipated traffic and construction vehicle loading under poor soil conditions. These assumptions may not be representative of typical conditions for many locations.

2. For Local Roads, use the Commercial & Industrial pavement section if a transit bus line or similar shuttle buses will use the street.

3. Use Level 2, ½ inch dense ACP PG 64-22. Place in two 2-inch lifts.

4. Use ¾”-0 or 1”-0 dense graded base aggregate meeting the requirements of 00641. Thickness may need to be increased to 12 inches or more for constructability in areas of soft or wet subgrade.

5. Use 1½”-0 dense graded aggregate meeting the requirements of 00331.

6. Use Class 4000, 1½” paving concrete.

7. Use epoxy coated, 1.25-inch diameter by 18-inch long smooth circular steel dowel bars at 12-inch spacing along all transverse joints. Bars should be coated with a bond breaker to be approved by the Engineer.

## 230. Roadway Design

A. All roadways shall be designed in accordance with the guidance provided in the current edition of *A Policy on Geometric Design of Highways and Streets*, except as modified by this section.

### 230.1. Horizontal Alignment

A. Centerline alignment of improvements should be parallel to the centerline of right-of-way.

B. Horizontal curves shall meet the minimum radius requirements shown in Table 230.1.

C. Reversing horizontal curves shall be separated by at least 50 feet of tangent (100 feet on Arterials).

D. Horizontal curves shall be designed using a maximum superelevation rate of 4 percent ($e_{max}$=4%). See Subsection 230.4 for superelevation standards.

**Table 230.1 – Minimum Curve Radii**

| Design Speed (MPH) | Friction Factor (F) | Minimum Curve Radius (ft.) for Various Cross Slopes | | | |
|---|---|---|---|---|---|
| | | (e) – 2.5% | (e) 0%* | (e) 2.5%* | (e) 4%* |
| 15 | 0.330 | 50 | 45 | 45 | 40 |
| 20 | 0.300 | 100 | 90 | 85 | 80 |
| 25 | 0.252 | 185 | 165 | 150 | 145 |
| 30 | 0.221 | 305 | 275 | 245 | 230 |
| 35 | 0.197 | 475 | 415 | 370 | 345 |
| 40 | 0.178 | 700 | 600 | 525 | 490 |
| 45 | 0.163 | 980 | 830 | 720 | 665 |

*Use of superelevation requires City approval.

### 230.2. Horizontal Transitions

A. Street width transitions shall be designed according to Figure 230.1.

B. For street width transitions from a wider width to a narrower width, the length of transition taper shall be determined as follows:

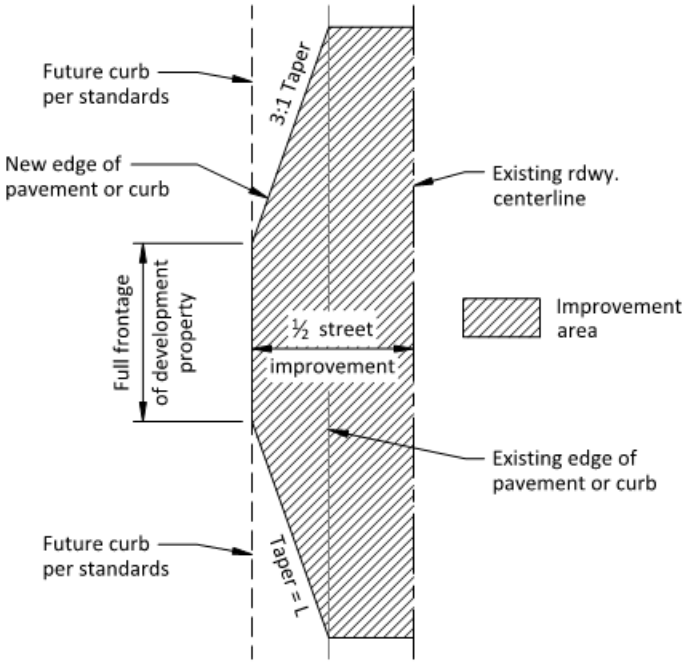
$$L = S \times W \qquad (\text{if } S \geq 45)$$

$$L = \frac{W \times (S)^2}{60} \qquad (\text{if } S < 45)$$

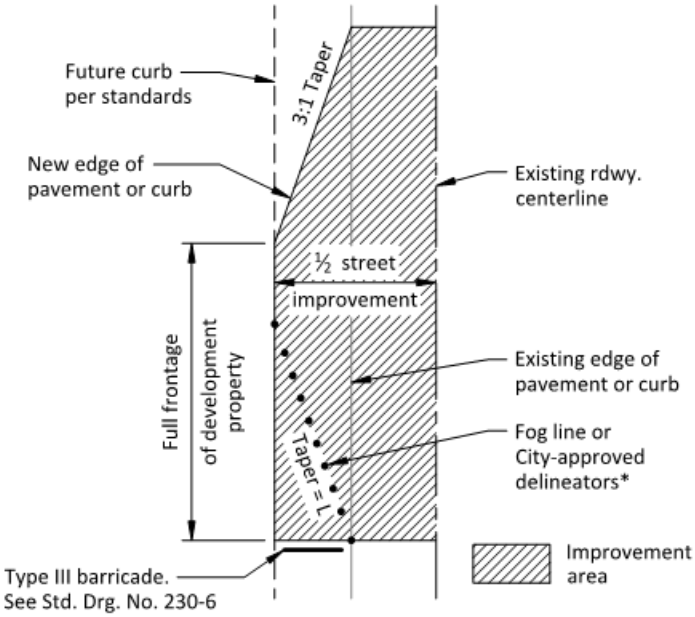
L = minimum length of taper (feet)
S = design speed (MPH)
W = shift distance (feet)

C. Street width transitions from a narrower width to a wider width shall be designed with a 3:1 minimum taper.

**Figure 230.1 – Street Width Transitions**




**Standard ½ Street Improvement Taper**




**Barricaded ½ Street Improvement Taper**

*Maximum spacing of delineators shall be the numerical value of the design speed (for example 35' spacing for 35 mph)

230.3. Vertical Alignment (Profiles)

A. Vertical alignments shall meet the following requirements:

1. Minimum street grades shall be 0.5 percent.
2. Grade changes of 1 percent or more shall be accomplished with vertical curves.
3. Minimum vertical curve length is 25 feet.
4. Grade breaks shall be separated by a minimum of 50 feet.

B. When new streets are built adjacent to or crossing drainage ways, the finish grade shall be designed a minimum of 1 foot above the 100-year flood plain as identified in the most current National Flood Insurance Rate Maps (FIRM) and the Flood Insurance Study.

D. Vertical curves shall conform to the values found in Table 230.2.

**Table 230.2 – Design Control for Crest and Sag Vertical Curves**

| Design Speed (MPH) | Minimum Rate of Vertical Curvature (K) | |
|---|---|---|
| | Crest | Sag* |
| 15 | 3 | 10 |
| 20 | 7 | 17 |
| 25 | 12 | 26 |
| 30 | 19 | 37 |
| 35 | 29 | 49 |
| 40 | 44 | 64 |
| 45 | 61 | 79 |

*Values are for roadways where street lighting is not present. The City may accept a lower K value for sag vertical curves if the roadway design includes lighting. The Engineer shall provide calculations for sag curve K values based on lighting.

D. Drainage affects the design of vertical curves on curbed roadways, as a level point may occur at the crest or sag. All vertical curves shall be sharp enough so that a minimum grade of 0.30 percent is provided within 50 feet of the level point.

230.4. Cross-slope and Superelevation

A. Roadway cross-slope shall be no less than 2 percent and no greater than 4 percent.

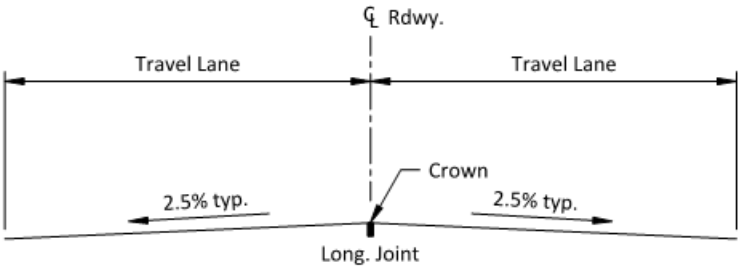
B. The use of superelevations is subject to approval by the City.

C. Stormwater runoff from outside the right-of-way shall be controlled to prevent concentrated crossflow in superelevated roadway sections.

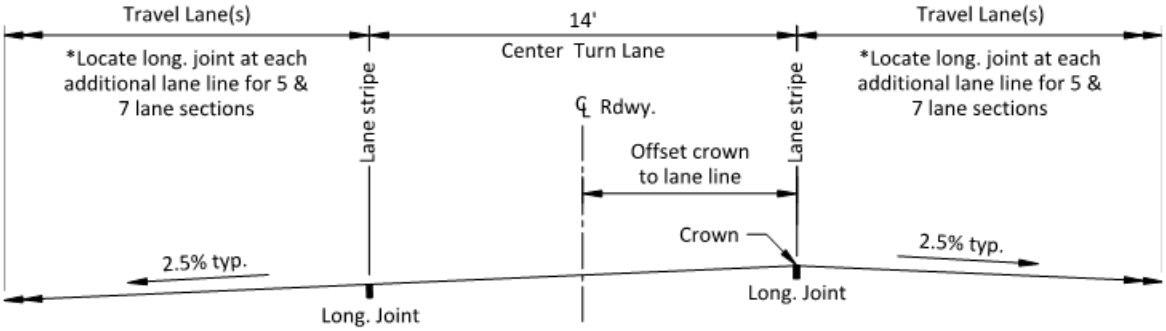
D. Street grades, intersections, and superelevation transitions shall be designed to prevent concentrations of storm water from flowing across the travel lanes.

E. On PCC roadways with an odd number of lanes, the crown shall be offset to a lane line to prevent locating a joint in the middle of a traffic lane. See Figure 230.2.

**Figure 230.2 – Offset Crown on Concrete Roadways**




**2 Lane Roadways**




**3, 5 and 7 Lane Roadways**

230.5. Intersections

A. The interior angle at intersecting streets shall be as near to 90 degrees as possible and shall be no less than 75 degrees. A straight horizontal alignment (no curves, no angle points) shall be used through the intersection and for a minimum of 25 feet on each side of the intersecting right-of-way centerlines.

B. At stop-controlled intersections, the crown of the major (higher classification) street shall continue through the intersection. The cross-slope of the minor street shall flatten to match the longitudinal grade of the major street. A grade break of 5 percent or less may be allowed in the profile of the minor street as it crosses the crown of the major street. At intersections where both streets have the same functional classification, the City will either determine the controlling roadway or require the intersection be designed according to Subsection 230.5.C.

C. At signalized intersections, and at intersections which may be signalized in the future, the cross-slope of the major roadway shall be such that the profiles of both roadways meet all the requirements of Subsection 230.3 through the intersection.

D. Roadways intersected by streets not constructed to full standards shall be designed to match both the present and future vertical alignments of the intersecting street. The requirements of this manual shall be met for both present and future conditions.

E. Minimum curb radii at intersections are shown in Table 230.3. The right-of-way radii at intersections shall be sufficient to maintain at least the same right-of-way to curb distance as the lower classified street.

F. Sidewalk ramps shall be provided for all directions at each corner of every intersection. See Subsection 230.10 for sidewalk ramp standards.

G. Maximum intersection spacing (block length) shall be 1,000 feet for Arterials and 400 feet for Collectors.

**Table 230.3 – Minimum Curb Radii at Intersections**

| Functional Classification | Minimum Curb Radius (ft.) | |
|---|---|---|
| | Residential | Commercial & Industrial |
| Arterial | 40 | 40 |
| Collector | 30 | 40 |
| Neighborhood Route | 25 | 40 |
| Local Road | 25 | 40 |
| Alley | 25 | - |

NOTES TO TABLE 230.3:

1. If streets with different functional classifications intersect, use the larger radius.
2. If an on-road parking or bike lane exists, the radius shown may be reduced by five feet.
3. Based on project-specific factors, the City may require a truck turning analysis to determine the curb radius. In such cases, the required radius may be larger than what is shown.

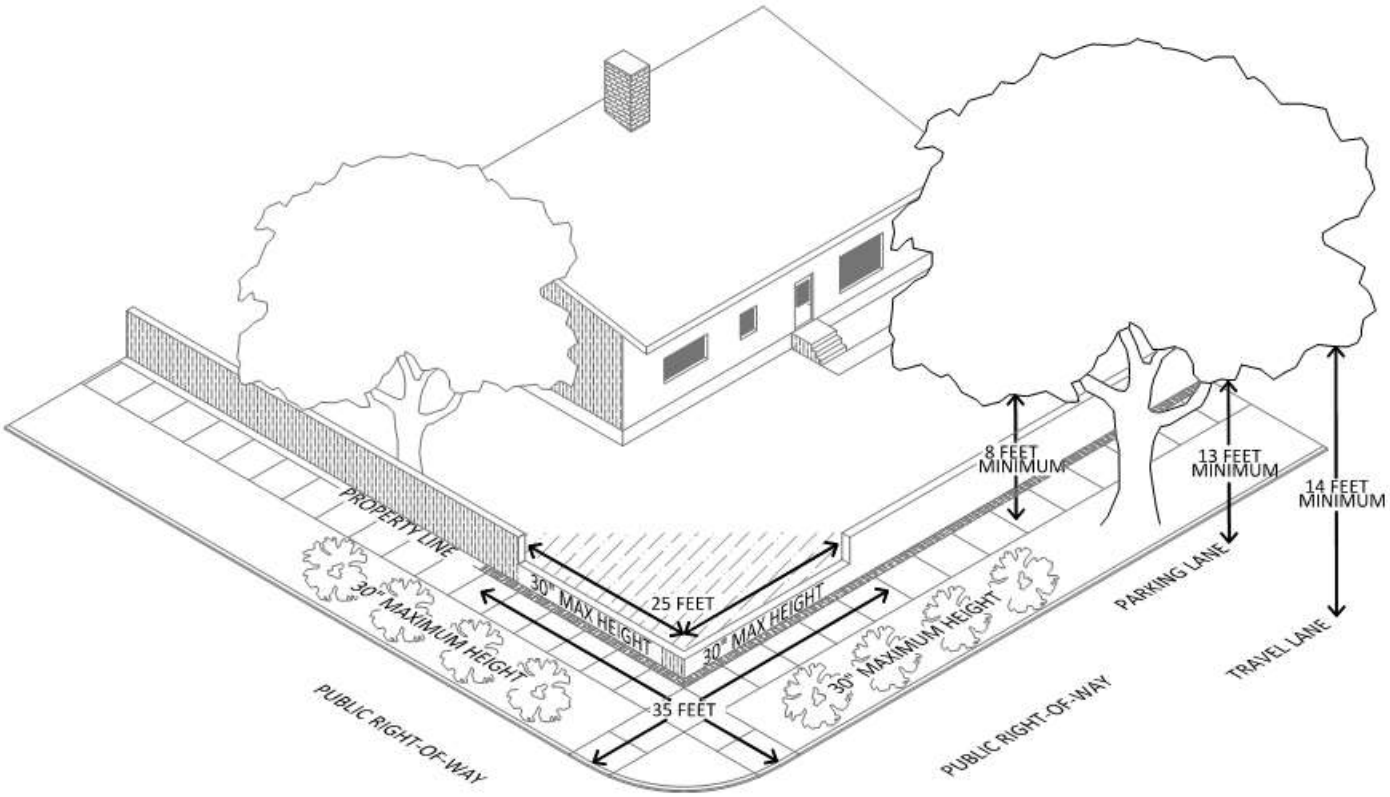
230.5.1. Visibility at Intersections (Sight Distance)

A. The Engineer shall evaluate safe intersection sight distance using the principles and methods recommended by AASHTO. This policy shall apply to the design of new streets and driveways, and to the placement of any object located within or behind the public right-of-way.

B. No object taller than 30 inches, or plant capable of growing taller than 30 inches, shall be placed within a sight clearance area. Poles, tree trunks, and similar objects less than 12 inches in diameter may be allowed in the sight clearance area if it can be shown that such obstructions do not prevent the continuous view of the vehicle approaching on the intersecting street.

C. Where new development occurs, sight distance requirement areas shall be shown on the plat and construction plans as Permanent Vision Clearance Easements.

**Figure 230.3 Intersection Sight Clearance Area**




NOTES TO FIGURE 230.3:

1. 8’ minimum vertical clear zone over entire width of sidewalk.
2. 13’ minimum vertical clear zone over entire parking lane (when applicable).
3. 14’ minimum vertical clear zone over entire travel lane.
4. 10’ minimum clear zone triangle at intersections for alleys.

230.5.2. Curb Extensions (Bulb-outs)

A. Curb extensions (bulb-outs) shall meet the requirements shown in Figure 230.4.

230.5.3. Raised Cycle Track Transitions

A. Raised cycle track transitions shall meet the requirements shown in Figure 230.5.

B. For raised cycle track standards and criteria, see Subsection 230.10.C.

**Figure 230.4 - Curb Extensions (Bulb-outs)**

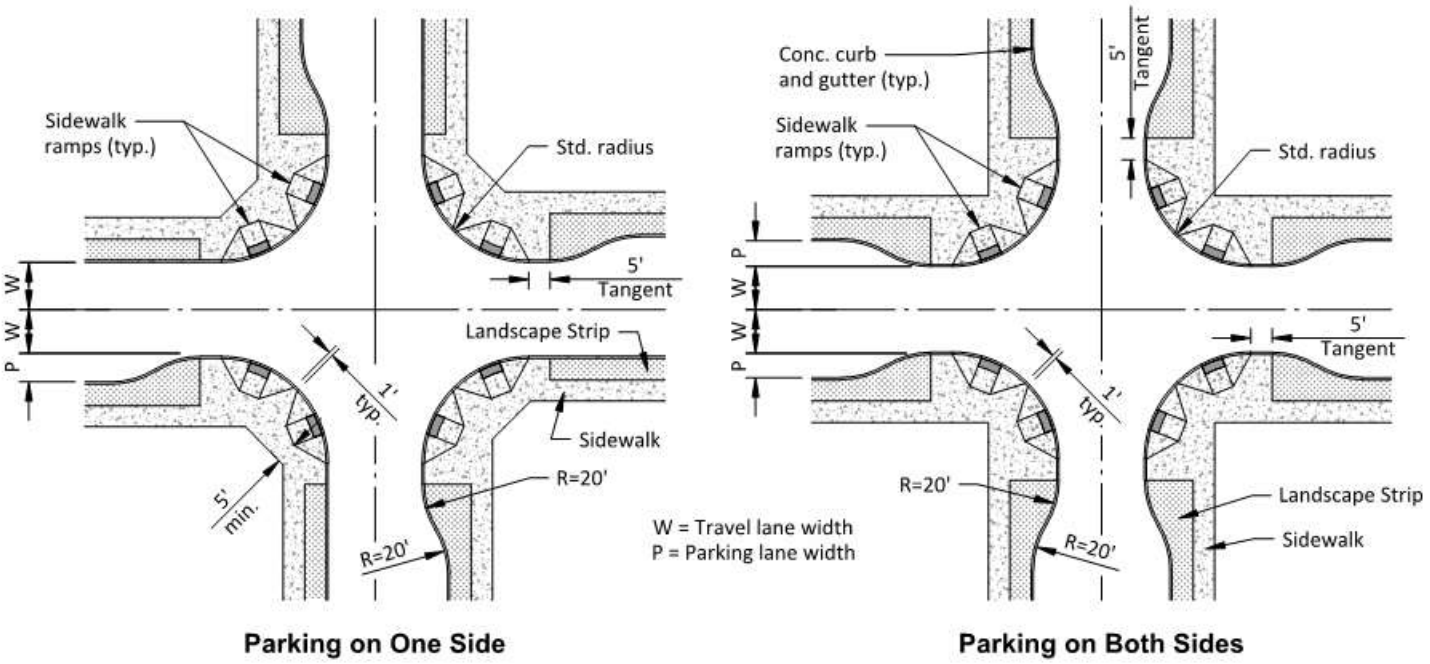
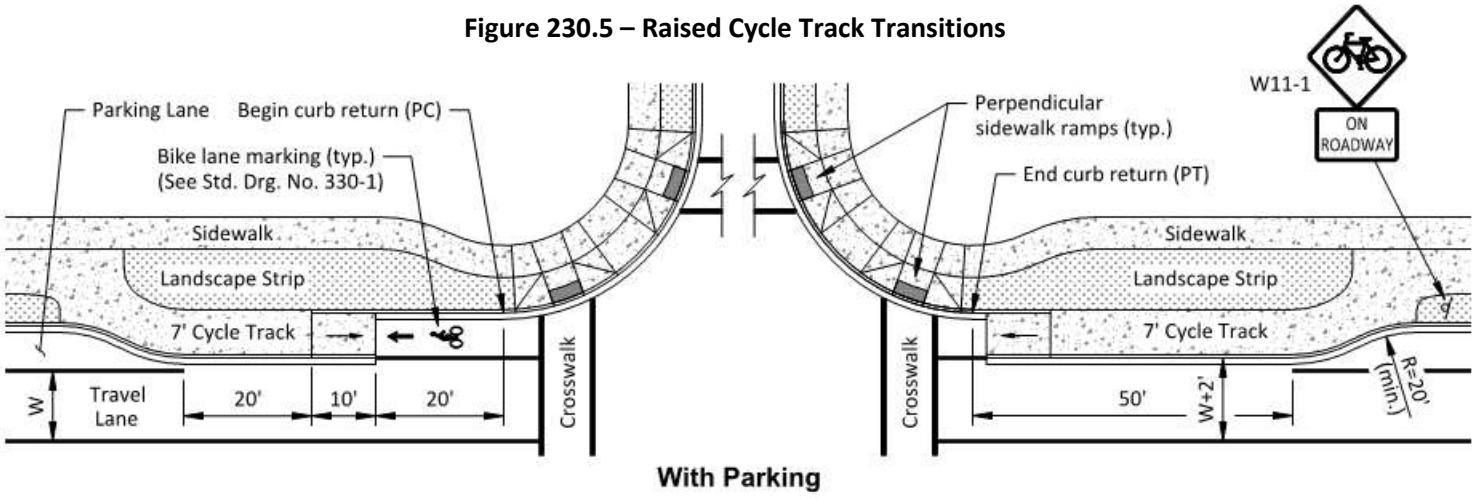
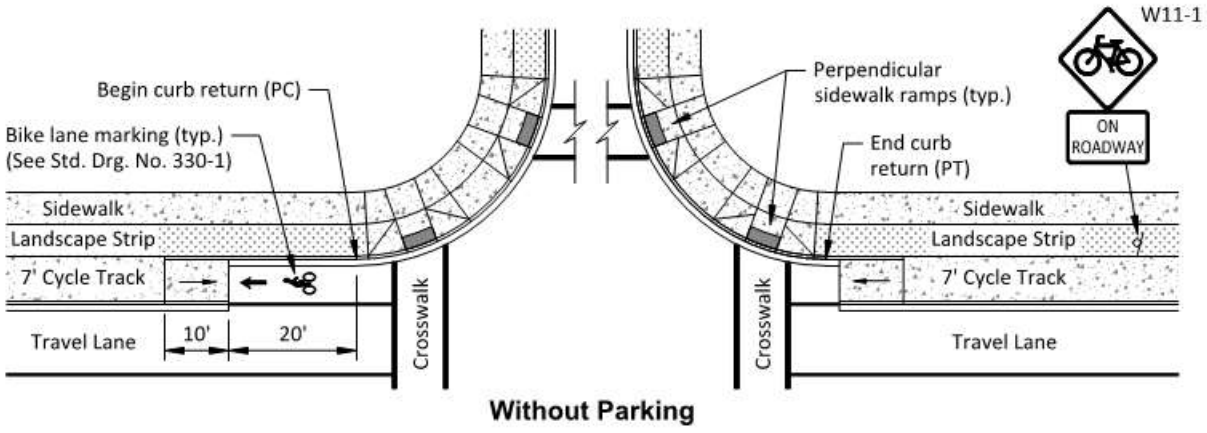



**Figure 230.5 – Raised Cycle Track Transitions**



230.6. Driveways

A. Driveways are not permitted on streets with an existing or proposed non-access reserve strip.

B. All driveways shall have a minimum width of 9 feet. The maximum width of driveways shall be 30 feet for residential, and 50 feet for commercial and industrial.

C. There shall be a minimum 25 feet long full-height curb between driveways on the same lot and a minimum 2 feet long full-height curb between adjacent driveways on separate lots.

D. Concentrated surface runoff from industrial or commercial sites is not allowed to flow over sidewalks onto a public roadway.

E. Driveways shall meet intersection sight distance requirements. See Subsection 230.5.1.

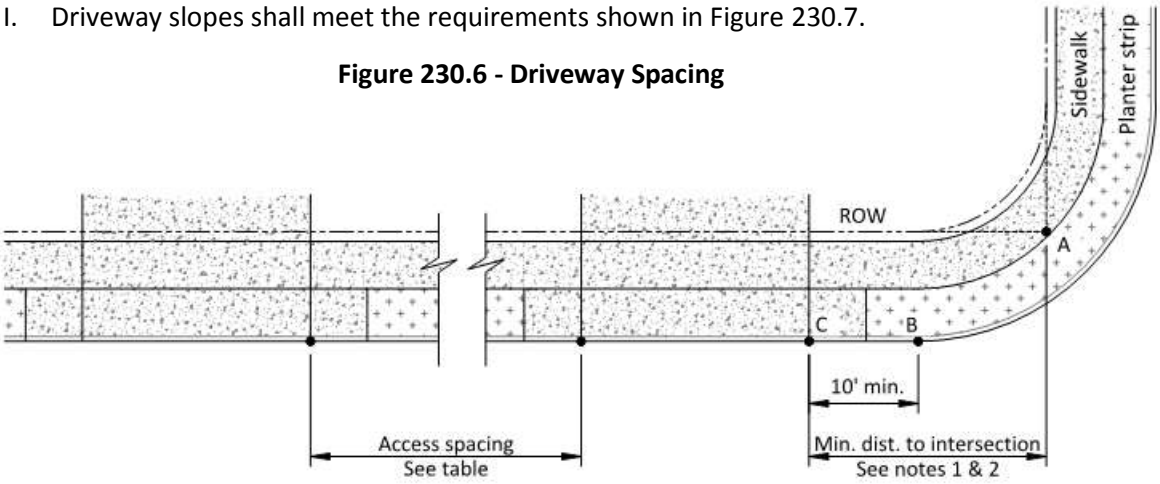
F. New single-family residential driveway shall have no direct access to a Collector or Arterial unless there is no other alternative.

G. On Collectors and Arterials, limit the number of access points by using shared driveways where possible.

H. Driveway spacing shall meet the requirements shown in Figure 230.6.

I. Driveway slopes shall meet the requirements shown in Figure 230.7.

**Figure 230.6 - Driveway Spacing**




| Functional Classification | Min. Spacing |
|---|---|
| Arterial | 600 ft |
| Collector | 300 ft |
| Neighborhood Route | See Subsection 230.6.C. |
| Local Road | See Subsection 230.6.C. |
| Alley | See Subsection 230.6.C. |

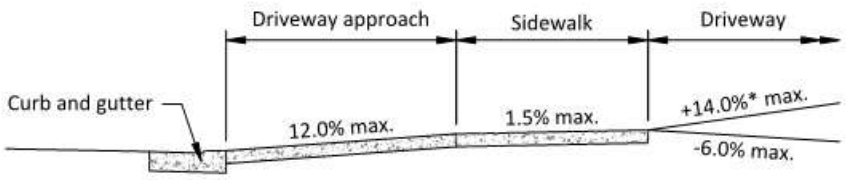
NOTES TO FIGURE 230.6:

1. The edge of driveway (Point C) shall be located no less than 100’ from the point of intersection (Point A) of right-of-way lines at intersection with Collector or Arterial.

2. The edge of driveway (Point C) shall be located no less than 25’ from the point of intersection (Point A) of right-of-way lines at intersection with Local Road.

3. The edge of driveway (Point C) shall be located no less than 10’ from the point of curvature of the curb (Point B) adjacent to any intersection.

**Figure 230.7 - Driveway Slopes**



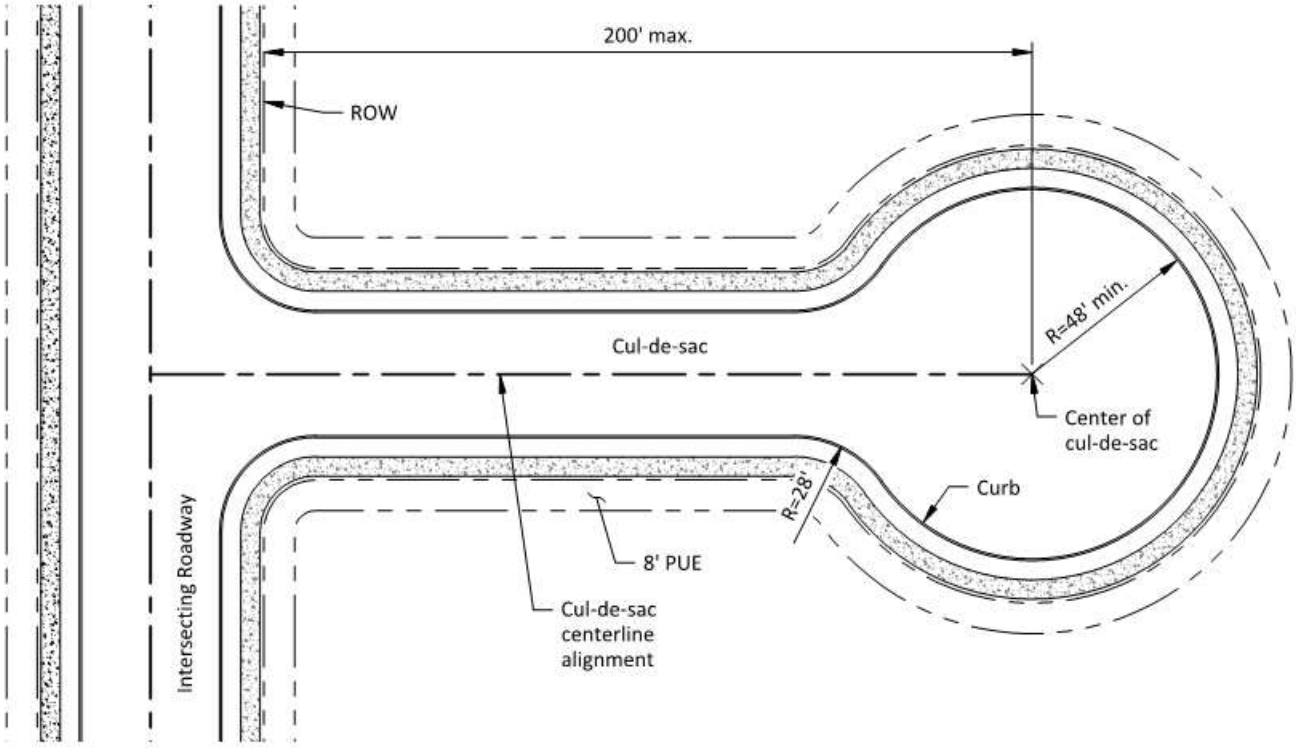

*10% max. where required for fire access.

230.7. Cul-de-sacs, Eyebrow Corners, and Turnarounds

A. Cul-de-sacs shall meet the requirements shown in Figure 230.8.

B. Eyebrow corners shall meet the requirements shown in Figure 230.9.

**Figure 230.8 - Standard Cul-de-sac**

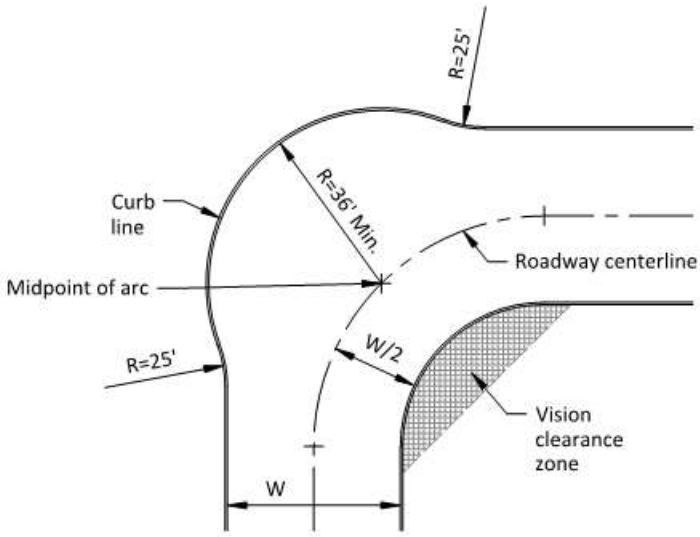



NOTES TO FIGURE 230.8:

1. Cul-de-sacs are only allowed on Local Roads.

2. Sidewalk, landscape strip, ROW, and easement widths shall remain consistent around the full perimeter of the cul-de-sac and shall be in accordance with Subsection 210.2.

**Figure 230.9 - Standard Eyebrow Corner**




NOTES TO FIGURE 230.9:

1. Eyebrow corners may be used only on Local Roads where expected ADT will not exceed 500 vehicles per day.
2. Eyebrow corner geometry shall be evaluated on the basis of turning requirements for the Fire Department vehicles.
3. Eyebrow corners shall meet AASHTO requirements for minimum stopping sight distance.

C. Turnaround geometry shall be evaluated on the basis of turning requirements for the Fire Department vehicles. Turnaround geometry details must be in accordance with *Oregon Fire Code* with City of Hillsboro amendments. Turnarounds are only allowed on Local Roads.

230.8. Raised Medians

A. The style and design of the raised median shall be site-specific and is subject to City approval.

B. The raised median shall be safe for the design speed.

C. Raised medians shall be set back at least 2 feet from the travel way on both sides for roadways with speeds of 35 MPH or higher. For speeds less than 35 MPH, a 1 foot set back shall be used.

D. Street lighting shall be sufficient to provide illumination of the raised median.

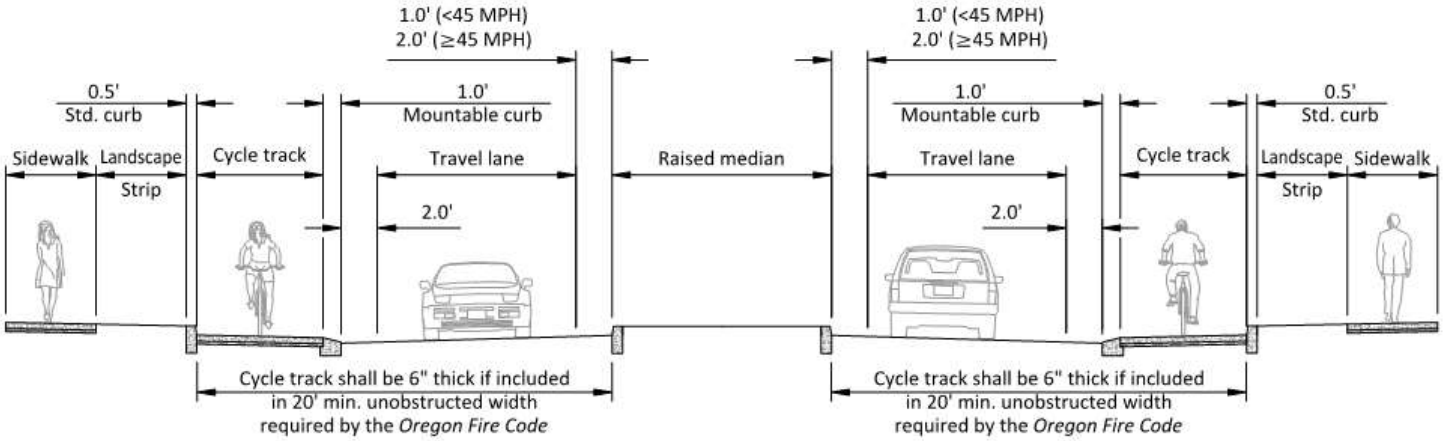
E. Objects in the median, such as trees, shrubs, signs, and light poles, shall not physically or visually interfere with vehicle or pedestrian traffic.

F. Concrete raised medians on concrete streets shall be constructed in accordance with ODOT standard drawing RD705. The pavement panel shall extend under the median and the median shall be placed on top of the pavement panel.

G. Raised medians containing vegetation require a private maintenance agreement between the City and the Developer/Owner.

H. An unobstructed width of not less than 20’ (26’ where the adjacent property requires the Fire Department to use an aerial apparatus) is required per the *Oregon Fire Code*. Street design shall include mountable curbs and 6” thick concrete cycle tracks when the cycle track is included in the unobstructed width.

**Figure 230.10 - Typical Roadway Section with Cycle Track and Raised Median**




230.9. Curbs

A. All streets shall include standard curb and gutter on both sides.

B. Mountable curbs may be allowed under the following conditions, and as approved by the City.

1. The street is a residential Local Road; and

2. The frontages of the lots are 45 feet or less; and

3. A storm sewer lateral is provided to each lot in lieu of a curb drain; and

4. The mountable curb is proposed at the time of land-use application and is approved as part of the process.

C. When new curb is being constructed, a stamp shall be impressed on the top of the curb to mark where each water, sanitary, storm, or private irrigation line crosses. Impressions shall be 2 inches high and shall accurately locate the service directly below the stamp. The impression for a water line shall be the letter “W”, for a sanitary line it shall be the letter “S”, for a storm line it shall be the letter “D”, and for an irrigation line it shall be the letters “IR”. A note shall be placed on the approved construction plans indicating this requirement.

230.10. Sidewalks, Sidewalk Ramps, and Cycle Tracks

A. Sidewalks

1. Sidewalks shall be at least 5 feet wide and separated from the curb by a landscape strip as indicated in Subsection 210.2 and Std. Drg. No. 230-4.

2. Where clustered mailboxes, transit shelters, benches, or any other objects are within a sidewalk, the walk shall be widened to provide clearance equal to ADA minimum requirements. See Std. Drg. No. 230-5.

3. Sidewalks should be kept free of utility structures and other encroachments by locating such structures behind the sidewalk, in the landscape strip, or in the PUE. If a utility structure must be located in the sidewalk, it shall be installed flush with the sidewalk and have a non-skid walking surface rated for pedestrian traffic.

4. Maximum designed cross-slope shall be 1.5 percent.

B. Sidewalk Ramps

1. Sidewalk ramps shall be a minimum of 5 feet in width andbe designed and constructed in accordance with Title III of the Americans with Disabilities Act of 1990 (ADA) and the *Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way* (PROWAG).

2. All existing sidewalk ramps abutting a street overlay or pavement reconstruction project shall be brought into compliance with ADA requirements for sidewalk ramps.

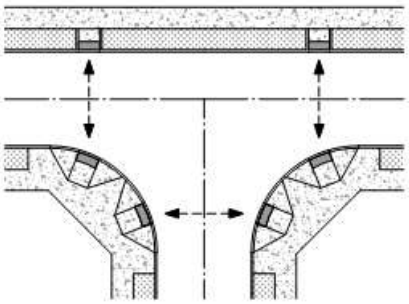
3. Marked crosswalks shall be provided at crossings that are protected by a traffic signal. Marked crosswalks may be provided at other locations only when approved by the City.

4. Ramps located within marked (striped) crossings shall be wholly within the crossing, excluding the flared wings.

5. Two directional ramps shall be provided at each street corner.

6. At Tee intersections, the "cross-bar" of the tee shall have two crossings equipped with ramps. All Tee intersections shall have at least six ramps, with two ramps on each corner of the intersection. See Figure 230.11.

**Figure 230.11 – Sidewalk Ramps at Tee Intersections**



7. See ODOT standard drawings RD756, RD757, RD759, and RD788 for ramp details.

8. All truncated domes shall be black.

9. Maximum designed ramp slope shall be 7.5 percent. All ramps shall be graded to drain toward the roadway.

10. For sidewalk ramp plan requirements, see Subsection 120.4.8.

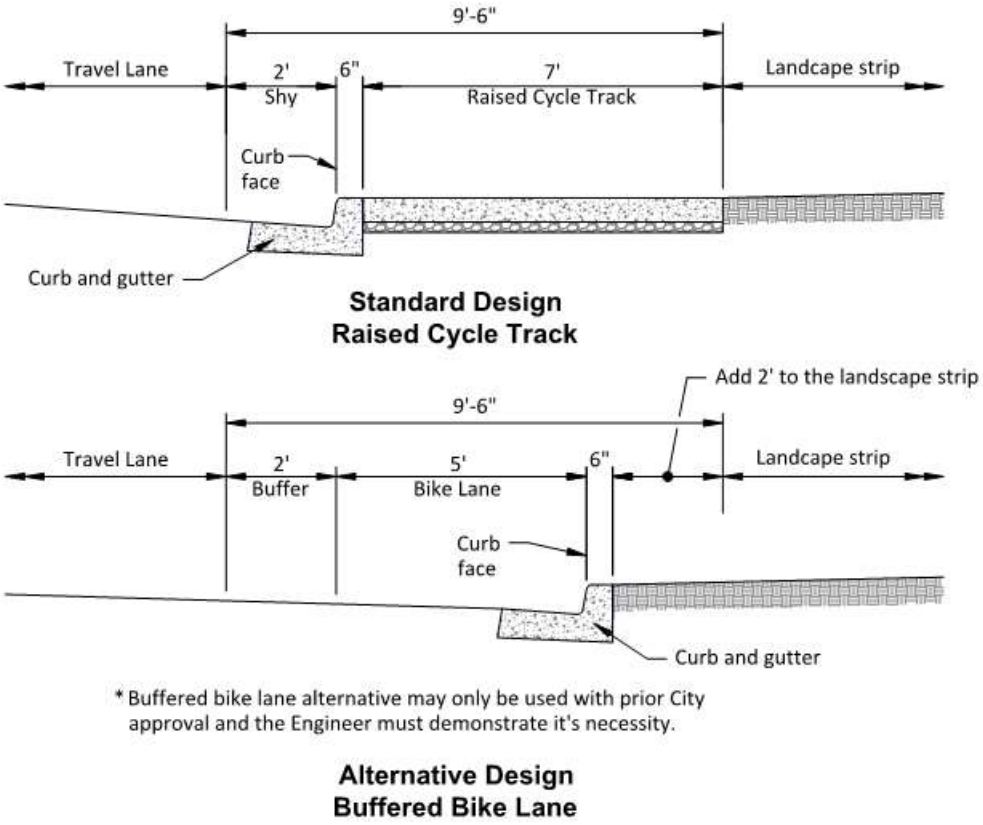
C. Raised Cycle Tracks

1. Raised cycle tracks shall be 7.0 feet wide (not including curb) and have a designed cross-slope of no more than 1.5 percent. See Std. Drg. No. 230-4.

2. Minimum spacing between potential conflict points, such as driveways, alleys, and at grade street crossings, shall be 200'.

3. Subject to City approval, a buffered bike lane alternative design may be used in place of the standard raised cycle track when warranted by site-specific constraints. See Figure 230.12.

**Figure 230.12 – Buffered Bike Lane Alternative Design**




230.11. Grading

A. Collectors and Arterials shall have a maximum 2 percent upward grading to 1 foot behind the sidewalk, and no slope steeper than 6:1 beyond. All public utility easements outside right-of-way shall have maximum slope of 5:1.

B. If side-slope grading is needed beyond the right-of-way and public utility easements to catch the existing grade, a slope easement is required.

C. Retaining walls may be used if side-slopes are greater than the 2:1 requirement in the subsections above or where slope stability is a problem. If side-slopes are to be maintained (mowed) by the City, a maximum of 3:1 slope will be required. Retaining walls shall be constructed to a height where the side-slope is no more than 2:1. Retaining walls must meet vision clearance requirements as identified in Subsection 230.5 and meet all State of Oregon Building Code requirements. A permit will be required from the City's Building Department for retaining and landscape walls 4 feet or higher.

230.12. Stub Streets and Stub Alleys

A. Stub streets and stub alleys (stubs) should only be used where future extensions are planned. An interim turnaround shall be constructed when stubs exceed 50’ in length and require maintenance access for utilities and street sweepers. Stubs requiring fire, garbage, or local delivery access may be subject to additional requirements. Stubs shall be barricaded and signed per Std. Drg. Nos. 230-6 and 230-7.

## 240. Transit Stops and Shelters

### 240.1. General

A. All transit stops, shelters, and associated appurtenances shall be designed and constructed in accordance with the *Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way* (PROWAG).

B. Placement of waste receptacles, signs, seating, or any other appurtenance shall not infringe upon an ADA area or the pedestrian access route as defined by R302 of PROWAG. It must not compromise direct access between the ADA waiting area and the ADA Landing area or access between either ADA area and the sidewalk.

C. Any installation of transit stops, shelters, or associated appurtenances requires issuance of a ROW permit through Public Works.

D. Prior to installation, transit stops, shelters, and associated appurtenances must be evaluated for adequate sight distance by an Engineer.

### 240.2. ADA Landing Area

A. ADA landing areas shall provide a minimum clear length of 8.0 feet, measured perpendicular to the curb, and a minimum clear width of 5.0 feet, measured parallel to the roadway.

B. Where transit stops serve vehicles with more than one car, ADA landing areas serving each car shall comply with this section.

C. Where rear door ADA landing areas are provided, they shall comply with this section.

D. Parallel to the roadway, the grade of ADA landing areas shall be the same as the roadway. Perpendicular to the roadway, the designed grade of ADA landing areas shall be 1.5 percent or less.

E. ADA landing areas shall be connected to streets, sidewalks, or pedestrian circulation paths by ADA accessible pedestrian access routes.

### 240.3. Clearances

A. All transit stops shall met the standard clearance requirements shown in Table 240.1

**Table 240.1 – Transit Stop Standard Clearance Requirements**

| Description | Requirement |
|---|---|
| Sidewalk Clearance | Minimum of 5.0’ of sidewalk clearance. |
| Accessible Pathway | Minimum 5.0’ wide paths between shelter and any utility object. |
| Road Clearance | 2.5’ minimum clearance between shelter and edge of curb. |
| ADA Landing Area | See Subsection 240.2 |

240.4. Transit Shelters

A. Transit shelter placement and orientation shall provide the following:

1. 5 feet of pedestrian pass-by, including clearance between poles, hydrants and other obstacles.

2. ADA landing area adjacent to bus stop sign and outside of shelter.

3. Clear pathway from the ADA waiting area inside the shelter to the ADA landing area.

4. Clear pathway from the rear door landing area to the pedestrian access route.

5. Interior lighting at the shelter for passenger visibility and security.

B. Transit shelters shall meet the clearance requirements shown in Table 240.2.

**Table 240.2 – Transit Shelter Clearance Requirements**

| Description | Requirement |
|---|---|
| ADA Waiting Areas in Shelters | A minimum of 2.5’ x 4.0’ space must be kept clear for mandatory waiting area to accommodate mobility devices. |
| Visibility | Shelter must not block motorist’s or pedestrian’s line of sight. |
| Building Clearance | Minimum 12 inches from buildings, fences, and other structures to the bus shelter in order to allow room for maintenance. |
| Relation to Bus Stop | Shelter shall be within 25 feet of the ADA landing Area. |
| Sight Distance | The shelter shall be placed so that the passengers waiting in the shelter can see approaching vehicles. |

240.5. Seating

A. Benches or seats shall not be placed closer than 3.5 feet from the curb, or 6.0 feet from the curb when a travel lane exists immediately adjacent to the curb.

B. Clearance requirements for shelters apply to seating.

C. Orient seating towards the roadway or in the direction of approaching traffic.

D. Furniture shall be bolted to the sidewalk using stainless steel drop-in anchors sized according to the furniture manufacturer's recommendations.

240.6. Pavement Requirements

A. Any damage to the sidewalk surface resulting from transit stop related furniture (even in the event of an automobile collision) is the responsibility of the transit authority to repair.

B. Sidewalk repairs must be completed according to Subsection 230.10.

C. In roadway areas where buses start, stop, or turn, or along roadways with high bus volumes, the following requirements shall be met:

1. On roads carrying more than 150 buses per day, concrete pavement shall be used.

2. A reinforced concrete pad shall be provided at high-volume bus stops and bus pullouts.

240.7. Standard Transit Stop Configurations

A. Standard transit stop configurations are shown in Figures 240.1 through 240.3.

**Figure 240.1 - Curb-tight Sidewalk with Bus Shelter**

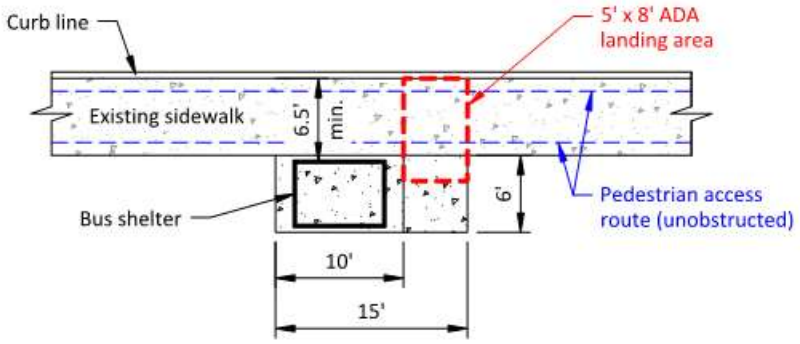



**Figure 240.2 - Separated Sidewalk with Rear Door Landing Area**

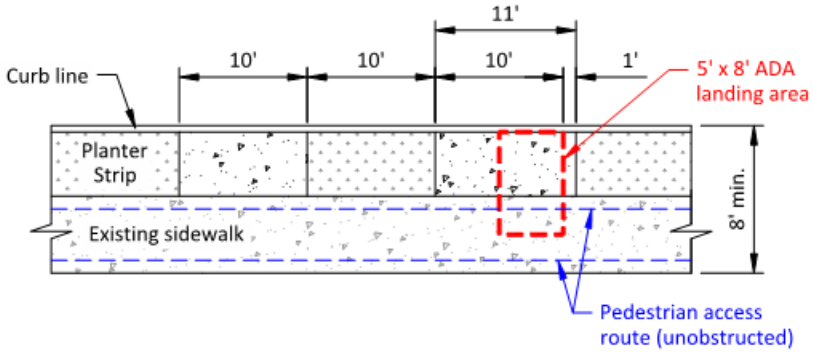
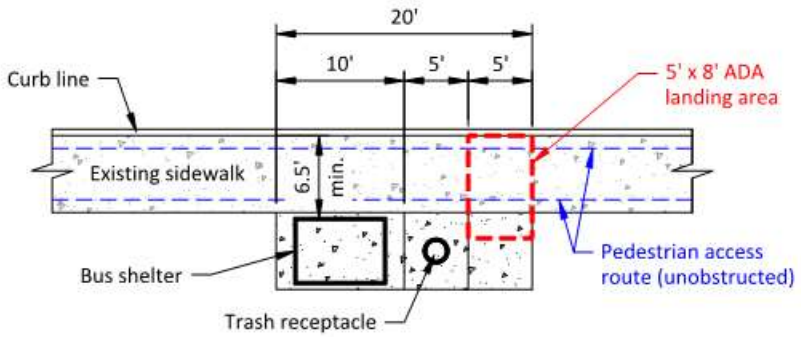


**Figure 240.3 - Curb-Tight Sidewalk with Shelter and Waste Receptacle**




250. Roadway Repairs

A. Street cuts are not allowed on new streets or streets overlaid within the last 5 (five) years. See Std. Drg. No. 250-1.

B. Asphalt street cuts and pavement restoration shall comply with Std. Drg. No. 250-2.

C. Portland cement concrete (PCC) repair shall comply with Std. Drg. No. 250-3.

D. Temporary steel plating shall comply with Std. Drg. No. 250-4.

E. Temporary pavement patching shall meet the following requirements:

1. Pavement restoration shall be as required by this section and the approved plans. After the trench has been backfilled, the pavement may be patched temporarily. Pavement repairs made in emergency situations will be considered temporary and must be restored in accordance with the requirements for permanent pavement restoration. AC pavement shall conform to the standards outlined in Subsection 220.

2. Permanent replacement of pavement, curb-and-gutter, sidewalk and driveway cuts shall be completed within five (5) working days from the completion of the utility work.

3. Hot mix temporary trench patching shall be in place at the end of every workday.

4. Cold mix asphalt shall only be used when hot mix is not available. The compacted thickness of cold mix asphalt shall be at least 2 inches. The contractor shall monitor the patch and maintain a smooth driving surface by promptly correcting any irregularities in the pavement surface that deviate from the proper street grade or cross-section by plus or minus ¼ inch or more. If the temporary patch is not monitored and maintained, or if the temporary patch creates unsafe driving conditions, the City may complete a permanent repair at the contractor's expense.

## SECTION 300

# 300. SIGNING, PAVEMENT MARKINGS, TRAFFIC SIGNALS, STREET LIGHTING, AND COMMUNICATIONS

## 310. General Requirements

A. Signing, pavement markings, traffic signals, communication systems, and street lighting shall be furnished and installed in conformance with the current editions of the MUTCD, the Oregon supplements to the MUTCD, ODOT Standard Drawings, and the *Oregon Standard Specifications for Construction*.

## 320. Signing

A. Street signage shall comply with the requirements shown on Std. Drg. No. 320-1.

## 330. Pavement Markings

A. Striping materials and layout plan, prepared by the Engineer, shall be approved by the City prior to installation. The Engineer is also responsible for field layout subject to approval of the City.

B. Permanent pavement markings shall comply with the requirements shown on Std. Drg. No. 330-1.

C. Temporary pavement markings

1. Foil-back tape and flexible pavement markers (stick-and-stomps) may only be used, for a time period not exceeding one (1) month, in areas where traffic will not subject them to heavy wear.

2. Painted pavement markings may be used for a time period not exceeding one (1) year.

## 340. Traffic Signals

A. Signal poles shall be located at the back of the sidewalk. If right of way is not available at back of sidewalk, alternative locations may be submitted for City approval.

B. All new signals, signal modifications, and signal retrofits shall use video or radar detection. Detection type subject to operational needs and shall be at the discretion of the City.

C. New signals shall include underground infrastructure required for installation of loop detection. Infrastructure to include conduit, pull string, locate wire, and junction boxes at stop bar and advanced detection locations.

D. New signals, signal modifications, and signal retrofits shall include one pan-tilt-zoom (PTZ) camera, or as determined by the City.

E. The Engineer shall conduct appropriate geotechnical investigations and design signal pole foundations in accordance with ODOT Standard Drawings TM650 through TM653.

F. Pedestrian signal head indications shall include a countdown display in order to inform pedestrians of the number of seconds remaining in the pedestrian change (or “don’t walk”) interval.

G. New, modified, and retrofitted traffic signals shall include an audible pedestrian signal (APS) system and ADA compliant ramps.

1. APS push buttons shall be installed on a standalone pole. Do not install push buttons on signal pole.

2. Locate push buttons within 10 inches of ADA sidewalk ramp landings, when measured horizontally.

3. Pedestrian push button poles shall be separated by at lease 10 feet.

4. Provide push button pole location and button orientation on all sidewalk ramp design plan sheets.

H. New traffic signals shall be equipped with an Advance Transportation Controller (ATC) compliant signal controller built to ODOT specifications, and be of the make and model bench tested and approved by ODOT.

I. For all traffic signal modifications and retrofits, supply new ATC signal controller built, tested, and approved by ODOT.

J. New signals shall be designed for and include a 332 Stretch signal controller cabinet.

K. Signal indicator lights shall be installed at all new, modified, and retrofitted traffic signals. One signal indicator light shall be provided for the through movement at each approach.

L. The pedestrian clearance intervals shall be in accordance with a walk speed of 3.5 feet/second.

M. Red and yellow times will be reviewed by the City or the applicable road authority. The table below provides the minimum standards for red and yellow time operation.

**Table 340.1 – Red and Yellow Signal Times**

| Phase | Posted Speed (MPH) | Yellow Time Operation (sec.) | All Red Operation (sec.) |
|---|---|---|---|
| Thru | 20 | 3.0 | 1 |
| Thru | 25 | 3.0 | 1 |
| Thru | 30 | 3.5 | 1 |
| Thru | 35 | 4.0 | 1 |
| Thru | 40 | 4.0 | 1 |
| Thru | 45 | 4.5 | 1 |
| LT | LT | 3.0 | 1 |

## 350. Street Lighting

### 350.1. General Requirements

A. All street lighting shall be designed by an Oregon licensed engineer using the provisions in this manual, and where applicable, ANSI/IES RP-8 American National Standard Practice for Roadway Lighting.

B. The following codes and references shall be used in designing all street light systems:

1. National Electrical Code (NEC).

2. Portland General Electric (PGE).

3. National Fire Protection Association (NFPA 70E)

C. The proposed light fixtures shall be 3000K color temperature and have B-U-G values no greater than 2-0-2 respectively. Figure 350.1 contains a list of all preapproved materials.

1. Fixture type shall be selected per the Ornamental Lighting Districts map available on the City of Hillsboro website.

a) Areas outside of ornamental lighting districts shall use Autobahn fixtures. See Figure 350.1, Page 10 of 10.

D. All electrical components shall be UL approved and testing lab approved from labs accepted by the State of Oregon.

E. All street light plans shall include pole, foundation, conduit, junction box, cabinets and service, lighting controls, and transformer/controller locations along with any other pertinent information.

F. The lighting plans shall include general installation notes, including the type, manufacturer, catalog number, number of LEDs, wattage, mounting height, arm length, and specification of proposed equipment. Plans shall also include the wiring and circuit diagrams. For general plan requirements see Subsection 120.

G. The lighting plans shall include photometric data such as average foot-candles, average to minimum ratio, maximum to minimum levels, and lamp lumen depreciation factor. Photometric calculations shall be provided using separate calculation zones for roadway, intersection, and pedestrian facilities. The plans shall indicate the roadway and intersection functional classifications and pedestrian conflict assumed for calculations. An electronic file of the photometric calculations shall be provided in both PDF and original lighting software format (.AGI) and the IES file(s) used in the calculations.

H. Circuits and cable runs shall be designed to provide separate and independent circuits for street lights. Wire size shall be determined by the loading and distance of each circuit. Loading calculations shall be based on the maximum loading possible for the circuit assuming all fixtures are operating at the maximum output for the highest drive current for the fixture. Wire shall be sized to limit voltage drops to a maximum of 2 percent between the utility service connection and the control panel and a maximum of 3 percent from the control panel to the most distant fixture served. Submit an electronic file of the voltage drop / line loss calculations for City approval.

I. Photometric analysis shall include only light fixtures which are within the right-of-way. Light sources on private property cannot be included in the street lighting analysis.

J. Photometric analysis shall include only light fixtures installed as part of the project for which the analysis pertains and existing light fixtures within the right-of-way. Street lighting analysis shall not include future light fixtures.

K. Lighting design shall account for a modified photometric distribution when glare shields are used.

L. The Engineer shall be responsible to provide all required traffic control during system installation.

M. The Engineer shall be responsible for making arrangements with PGE connecting the street lighting system to the local distribution system and for locating the service cabinet.

N. Street lights and poles shall be designed to be PGE Schedule 32 or Schedule 95 (by City direction only) Option C (City owned and maintained) LED lights. All Option C lights must be connected to a city owned service and meter. The City shall have final approval authority on which luminaire to be utilized based on the specific lighting application.

O. A 10-day burn-in period shall be completed prior to final acceptance of street lights by the City.

P. Engineer shall submit to the City items for materials review prior to ordering any street lighting equipment (poles, light fixtures, lighting controls, control nodes, junction boxes, foundations, services, cabinets, etc.) and pass along to the City applicable manufacturer warranties.

Q. In systems with existing lights on both sides of the street, the circuitry shall be configured such that the lights on one side of the street can be “de-energized” without affecting the operation of the lights on the opposite side of the street. A maximum of 72 hours (3 days) of outage is permissible for existing street lighting. Where work would result in an outage for all existing lights, temporary lighting in a manner acceptable to the City shall be provided. Temporary lighting of up to 1 month (30 days) shall be allowed and the Engineer shall strive to complete all street lighting work and energize lights within that timeframe.

R. A minimum of 2-inch conduit shall run between junction boxes. Between each light pole and the adjacent junction box provide two 1-inch conduits. All conduit runs shall be marked with an underground marking tape per 00960.42(e) of the *Oregon Standard Specifications for Construction*. All conduits shall be Schedule 40 PVC and all elbows shall be fiberglass. Install bushings on all conduit ends and seal the ends with an approved conduit plug. See City Standard Details.

S. Engineer shall be responsible for locating street light poles such that no portion of the pole, mast arm, or luminaire is within 10 feet of any energized line. Installation shall conform to OAR 437-002-0047 and 437-002-2316.

T. Street lighting conduit shall be placed in the joint City communications trench located under the sidewalk.

350.2. Design Standards

A. Junction Boxes

1. Junction boxes shall be no more than 3 feet from each pole served and there shall be 1 junction box for each street light pole. Install 1 junction box for each lighting controller and include 1 spare 2-inch conduit installed to the controller with a pull string. See City Standard Details.

2. All junction boxes and lids shall be open bottom polymer concrete or polymer fiberglass, with skid resistant cover marked “Street Lighting”.

3. Do not install junction boxes in sidewalk ramp or ramp wings. Junction boxes shall be placed in the following locations in order of preference, or as approved by the City:

    - Landscape strip
    - Back of sidewalk (apron required, see Std. Drg. No. 350-1)
    - Sidewalk (outside of primary walking route)

B. Cable and Wire

1. A single phase, 3 wire, 240 volt, dedicated metered service shall be provided for street lighting.

2. All wire shall be stranded copper, single conductor, type XHHW, with a 600 volt insulation (unless no insulation is provided as noted below). Solid wiring shall not be used. The minimum wire size for the lighting circuit shall be #10 AWG wire and the maximum wire size shall be #1 AWG wire. All wire splices shall occur in junction boxes.

3. Street lighting circuits shall be designed to ensure that no section of roadway shall end up completely unlit with the loss of a single circuit. The following circuit configurations apply:

    a) When lighting is provided on one side of the street, no 2 adjacent lights shall be on the same circuit.

    b) When lighting is provided on both sides of the street, each side of the street shall be on a different circuit.

    c) At unsignalized intersections with more than 1 light, the intersection lights shall be connected to a minimum of 2 circuits.

4. Wire insulation color shall conform to the following:

    a) 120 volt photo electric circuit wires: A black wire from the controller to the photo cell, red wire for the return to the cabinet shall be used.

    b) 240 volt line distribution wires: Install circuit wire pairs as shown below, with each pair of wires sharing the same insulation color. If additional circuits are required insulation color shall be approved by the City of Hillsboro.

        - 1st circuit pair = black
        - 2nd circuit pair = red
        - 3rd circuit pair = blue

- 4th circuit pair = brown
- 5th circuit pair = yellow
- 6th circuit pair = orange

c) Grounded (neutral) conductors, if needed, shall be white or natural gray.

d) Grounding electrode conductors from the light pole to the adjacent junction box shall be green insulated or bare stranded wire.

e) Equipment ground conductors in the conduit raceways shall be green insulated.

5. Color coding of each conductor shall remain consistent throughout the entire system. Factory supplied striping of conductors will be accepted when the required color insulation is not available. Color tape will not be accepted as an alternate for insulation color coding.

C. Poles and Foundations

1. All poles shall be grounded. Install a ground rod in the junction box located at each pole. Install a 1" schedule 40 PVC conduit with a #6 green insulated or bare wire from the pole to the ground rod located in each junction box. See City Standard Details.

2. All light poles shall be constructed with a nominal 2-1/2-inch by 5-inch hand hole placed approximately 2-4 feet above the ground line. In plan view, the hand hole shall be at 90 degrees from the mast arm or curb side of the pole. The hand hole shall be secured with cast aluminum or galvanized steel cover painted to match the pole and held in place with a stainless steel tamper resistant set screw.

3. Breakaway designs shall be used for light poles located along roadways with posted speeds greater than 35 mph and within the clear-zone as defined by Table 3-1 of the *Roadside Design Guide* except for those located in drainage ditches, or near bus shelters or areas of extensive pedestrian concentrations.

4. Light poles shall be set on a pre-cast concrete light foundation. Foundations shall be one of the following, or as approved by the City:

- 20R-LB-PGE
- 5CL-LB-PGE
- 4-LB-PGE
- 7-LB-PGE

D. Lighting Controller

1. The controller cabinets shall be installed away from intersections and other locations where an errant vehicle could damage the cabinet. The cabinet location should be near a side property line and should not detract aesthetically from the adjacent properties. In residential areas, locations along side yard frontages are preferred to front yard frontages. Cabinet locations should also take into consideration future system growth. Engineer should consult with City and PGE regarding cabinet location at the beginning of design.

2. The cabinet shall have a service panel that has a "Service Equipment" rated UL label attached to the panel. A 100 amp, single phase, 3 wire, 240 volt, dedicated metered service is to be provided by the developer. Each street lighting circuit shall be wired 240 volts. The street light base mounted controller shall be installed per ODOT's standard drawing TM485 and shall be on ODOT's blue sheets. The controller shall be made of stainless steel and include circuit breakers, test switch, neutral and ground bars. When only one illumination breaker is being installed, leave space for 3 additional illumination breakers. Follow NFPA 70E standards for arc flash and provide the required labeling for the controller cabinet. Attach available fault current to inside of door with a permanent label.

E. An Inline fuse shall be installed between the circuit and each light fixture on that circuit per subsections 00970.42 & 02920.26 of the *Oregon Standard Specifications for Construction*. The circuit protector shall be accessible through the hand hole.

F. All street lights shall operate at 240 volts and shall be grounded. All lighting fixtures shall be capable of varying lighting output via a dimmable LED driver connected to a 7-prong photocell socket. Field test the completed lighting system as outlined in subsection 00970.70 of the *Oregon Standard Specification for Construction*.

G. All street lights shall be controlled by the City's street light control system. Each fixture shall have a GE LightGrid control node installed in the photocell socket. The City will provide the Engineer with the applicable street lighting dimming schedule for programming and the Engineer is responsible for programming the control node information needed to add the new fixtures into the City's system. In the event that a system is brought online prior to the nodes being programmed or where no street lighting dimming schedule is required, the Engineer shall operate the lights under the control node's photocell control at designed lighting levels.

H. A gateway serves as a device to allow a group of wireless controllers to communicate with the central server using a backhaul communication mesh network. Engineer is responsible to ensure compatibility among all components of the system.

**Table 350.1 – Street and Parallel On-Street Bicycle Facilities Lighting Levels**

| Average Maintained Illuminance on the Horizontal | | | | |
|---|---|---|---|---|
| Roadway Classification | Pedestrian Conflict Area | Minimum Average Maintained in Foot Candles [1 2 3] | | |
| | | Concrete Street | Asphalt Street | Uniformity Ratio Avg. to Min. |
| Arterial | High | > 1.2 | > 1.7 | < 3:1 |
| | Medium | > 0.9 | > 1.3 | < 3:1 |
| | Low | > 0.6 | > 0.9 | < 3:1 |
| Collector | High | > 0.8 | > 1.2 | < 4:1 |
| | Medium | > 0.6 | > 0.9 | < 4:1 |
| | Low | > 0.4 | > 0.6 | < 4:1 |
| Local Road | High | > 0.6 | > 0.9 | < 6:1 |
| | Medium | > 0.5 | > 0.7 | < 6:1 |
| | Low | > 0.3 | > 0.4 | < 6:1 |

[1] Do not design roadways more than 1.3x above the minimum average foot candle light levels.
[2] Values reflect design light levels under peak conditions outside dimming thresholds.
[3] Includes parallel bicycle facilities that are not separated by a landscape strip.

**Table 350.2 – Parallel Separated Bicycle and Pedestrian Facilities Target Lighting Levels**

| Average Maintained Illuminance on the Horizontal | | | |
|---|---|---|---|
| Location | Minimum Average Maintained in Foot Candles [1 2 3] | | |
| | Concrete Facility | Asphalt Facility | Uniformity Ratio Avg. to Min. |
| > 2 dwelling units per acre | > 0.4 | > 0.4 | < 4:1 |
| < 2 dwelling units per acre | > 0.3 | > 0.3 | < 6:1 |
| Rural/Semi-Rural | > 0.2 | > 0.2 | < 10:1 |

[1] Do not design facilities more than 1.3x above the minimum average foot candle light levels.
[2] Values reflect design light levels under peak conditions outside dimming thresholds.
[3] For parallel bicycle facilities separated by a landscape strip and sidewalks.

**Table 350.3 – Intersection Lighting Standards**

| Average Maintained Illuminance on the Horizontal | | | | |
|---|---|---|---|---|
| Intersection Classification | Pedestrian Conflict Area | Minimum Average Maintained in Foot Candles [1 2 3] | | |
| | | Concrete Intersection | Asphalt Intersection | Uniformity Ratio Avg. to Min. |
| Arterial/ Arterial | High | ≥ 2.4 | ≥ 3.4 | ≤ 3:1 |
| | Medium | ≥ 1.8 | ≥ 2.6 | ≤ 3:1 |
| | Low | ≥ 1.2 | ≥ 1.8 | ≤ 3:1 |
| Arterial/ Collector | High | ≥ 2.0 | ≥ 2.9 | ≤ 3:1 |
| | Medium | ≥ 1.5 | ≥ 2.2 | ≤ 3:1 |
| | Low | ≥ 1.0 | ≥ 1.5 | ≤ 3:1 |
| Arterial/ Local Road | High | ≥ 1.8 | ≥ 2.6 | ≤ 3:1 |
| | Medium | ≥ 1.4 | ≥ 2.0 | ≤ 3:1 |
| | Low | ≥ 0.9 | ≥ 1.3 | ≤ 3:1 |
| Collector/ Collector | High | ≥ 1.6 | ≥ 2.4 | ≤ 4:1 |
| | Medium | ≥ 1.2 | ≥ 1.8 | ≤ 4:1 |
| | Low | ≥ 0.8 | ≥ 1.2 | ≤ 4:1 |
| Collector/ Local Road | High | ≥ 1.4 | ≥ 2.1 | ≤ 4:1 |
| | Medium | ≥ 1.1 | ≥ 1.6 | ≤ 4:1 |
| | Low | ≥ 0.7 | ≥ 1.0 | ≤ 4:1 |
| Local Road/ Local Road | High | ≥ 1.2 | ≥ 1.8 | ≤ 6:1 |
| | Medium | ≥ 1.0 | ≥ 1.4 | ≤ 6:1 |
| | Low | ≥ 0.6 | ≥ 0.8 | ≤ 6:1 |

[1] Do not design intersections more than 1.3x above the minimum average foot candle light levels.
[2] Values reflect design light levels under peak conditions outside dimming thresholds.
[3] Intersection analysis area includes curb ramps and crosswalks.

**Table 350.4 – Roundabout Lighting Standards**

| Average Maintained Illuminance on the Horizontal and Vertical [3] | | | | |
|---|---|---|---|---|
| Intersection Classification | Pedestrian Conflict Area | Minimum Average Maintained in Foot Candles [1 2] | | |
| | | Concrete Intersection | Asphalt Intersection | Uniformity Ratio Avg. to Min. |
| Arterial/ Arterial | High | ≥ 2.4 | ≥ 3.4 | ≤ 3:1 |
| | Medium | ≥ 1.8 | ≥ 2.6 | ≤ 3:1 |
| | Low | ≥ 1.2 | ≥ 1.8 | ≤ 3:1 |
| Arterial/ Collector | High | ≥ 2.0 | ≥ 2.9 | ≤ 3:1 |
| | Medium | ≥ 1.5 | ≥ 2.2 | ≤ 3:1 |
| | Low | ≥ 1.0 | ≥ 1.5 | ≤ 3:1 |
| Arterial/ Local Road | High | ≥ 1.8 | ≥ 2.6 | ≤ 3:1 |
| | Medium | ≥ 1.4 | ≥ 2.0 | ≤ 3:1 |
| | Low | ≥ 0.9 | ≥ 1.3 | ≤ 3:1 |
| Collector/ Collector | High | ≥ 1.6 | ≥ 2.4 | ≤ 4:1 |
| | Medium | ≥ 1.2 | ≥ 1.8 | ≤ 4:1 |
| | Low | ≥ 0.8 | ≥ 1.2 | ≤ 4:1 |
| Collector/ Local Road | High | ≥ 1.4 | ≥ 2.1 | ≤ 4:1 |
| | Medium | ≥ 1.1 | ≥ 1.6 | ≤ 4:1 |
| | Low | ≥ 0.7 | ≥ 1.0 | ≤ 4:1 |
| Local Road/ Local Road | High | ≥ 1.2 | ≥ 1.8 | ≤ 6:1 |
| | Medium | ≥ 1.0 | ≥ 1.4 | ≤ 6:1 |
| | Low | ≥ 0.6 | ≥ 0.8 | ≤ 6:1 |

[1] Do not design intersections more than 1.3x above the minimum average foot candle light levels.

[2] Values reflect design light levels under peak conditions outside dimming thresholds.

[3] Vertical illuminance is measured at a height of 5 feet in each driving direction and perpendicular to the main pedestrian flow.

**Table 350.5 – Unsignalized Pedestrian/Bicycle Crossing Target Lighting Values[8]**

| **Average Maintained Illuminance on the Horizontal and Vertical [7]** | | | |
|---|---|---|---|
| Maintained Illuminance Values for Walkways in Foot Candles<br>High Pedestrian Conflict Areas [1 2 6] | | | |
| Location | **$E_{avg}$** [3] | **$EV_{min}$** [4] | Uniformity Ratio [5] |
| Mixed Vehicle and Pedestrian | ≥ 2.0 | ≥ 1.0 | ≤ 4:1 |
| Pedestrian Only | ≥ 1.0 | ≥ 0.5 | ≤ 4:1 |
| Maintained Illuminance Values for Walkways in Foot Candles<br>Medium Pedestrian Conflict Areas [1 2 6] | | | |
| Location | **$E_{avg}$** [3] | **$EV_{min}$** [4] | Uniformity Ratio [5] |
| Pedestrian Areas | ≥ 0.5 | ≥ 0.2 | ≤ 4:1 |
| Maintained Illuminance Values for Walkways in Foot Candles<br>Low Pedestrian Conflict Areas [1 2 6] | | | |
| Location | **$E_{avg}$** [3] | **$EV_{min}$** [4] | Uniformity Ratio [5] |
| Rural/Semi-Rural Areas | ≥ 0.2 | ≥ 0.06 | ≤ 10:1 |
| Low Density Residential<br>(≤ 2 dwelling units per acre) | ≥ 0.3 | ≥ 0.08 | ≤ 6:1 |
| Medium Density Residential<br>(2.1 – 6.0 dwelling units per acre) | ≥ 0.4 | ≥ 0.1 | ≤ 4:1 |

[1] Do not design areas more than 1.3x above the minimum average foot candle light levels.

[2] Values reflect design light levels under peak conditions outside dimming thresholds.

[3] **$E_{avg}$** – Minimum maintained average horizontal illuminance at the pavement surface.

[4] **$EV_{min}$** – Minimum vertical illuminance at 5 feet above the pavement.

[5] Ratio of **$E_{avg}$** to the minimum horizontal illuminance at the pavement surface.

[6] Refer to IES RP-8-14 for additional guidance regarding these tables.

[7] Vertical illuminance is measured at a height of 5 feet in both directions and parallel to the main pedestrian flow.

[8] Target values for mid-block and RRFB enhanced crossings.

**Figure 350.1 – Preapproved Equipment (Page 1 of 10)**

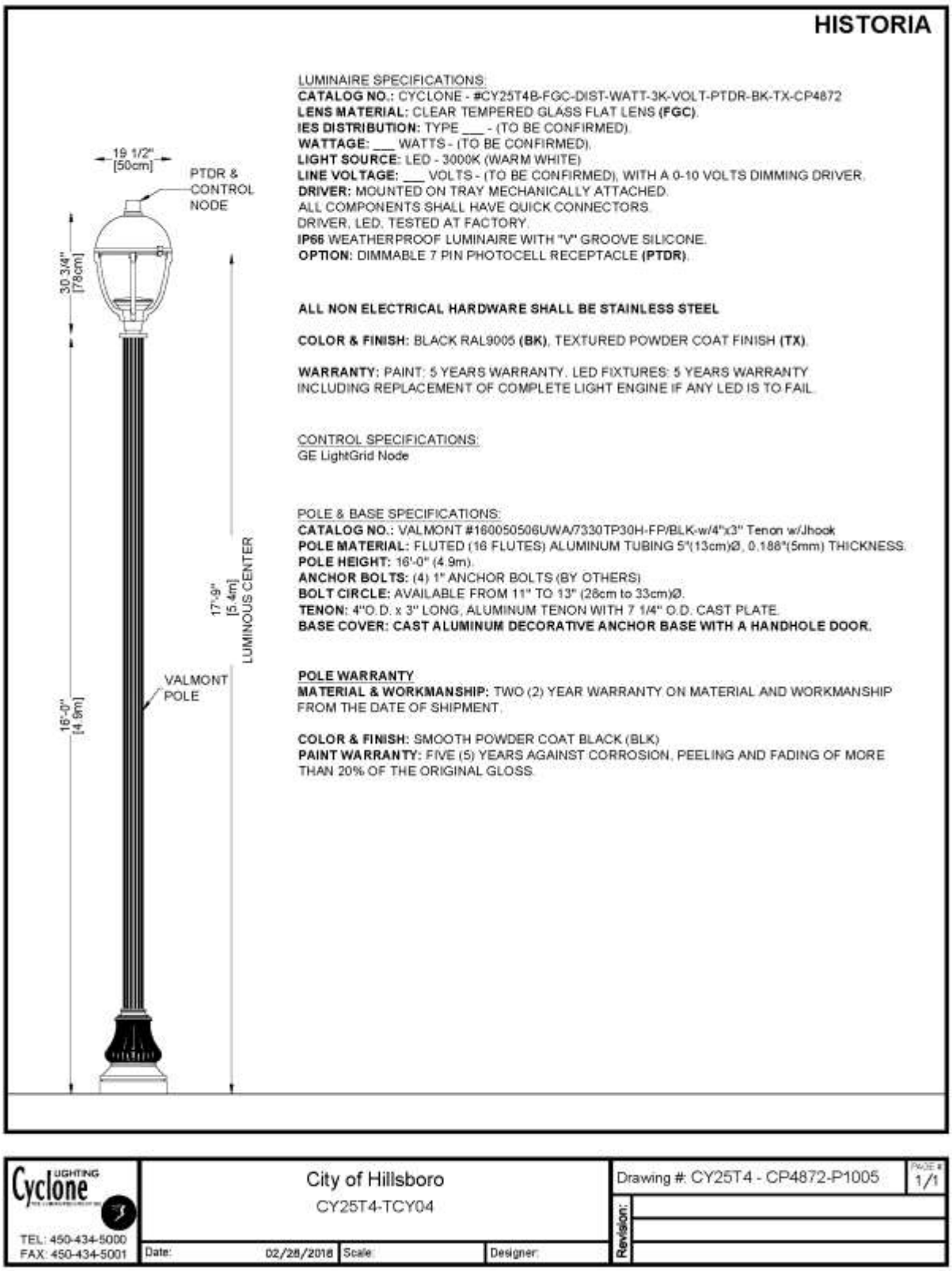


**Figure 350.1 – Preapproved Equipment (Page 2 of 10)**

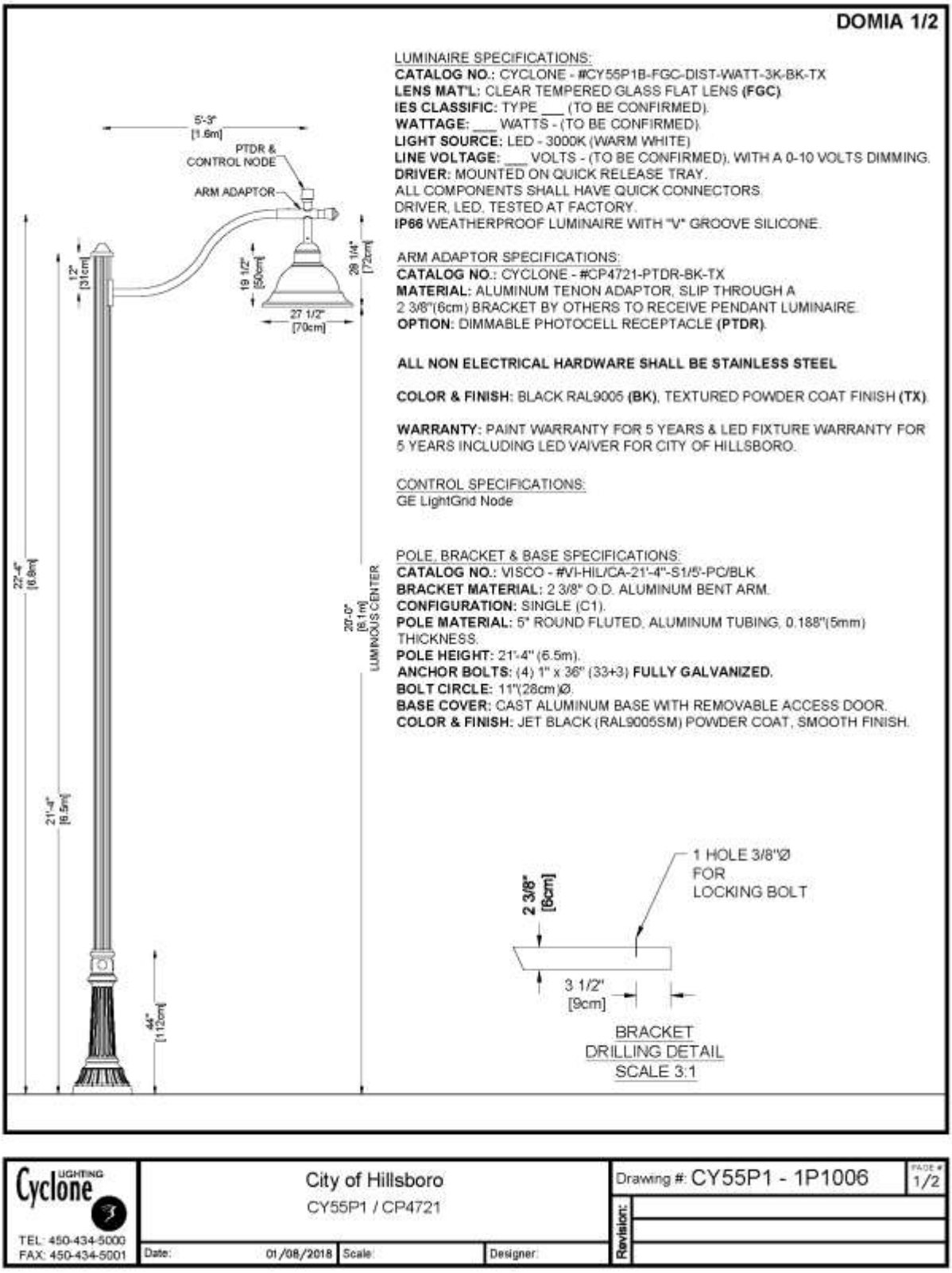


**Figure 350.1 – Preapproved Equipment (Page 3 of 10)**

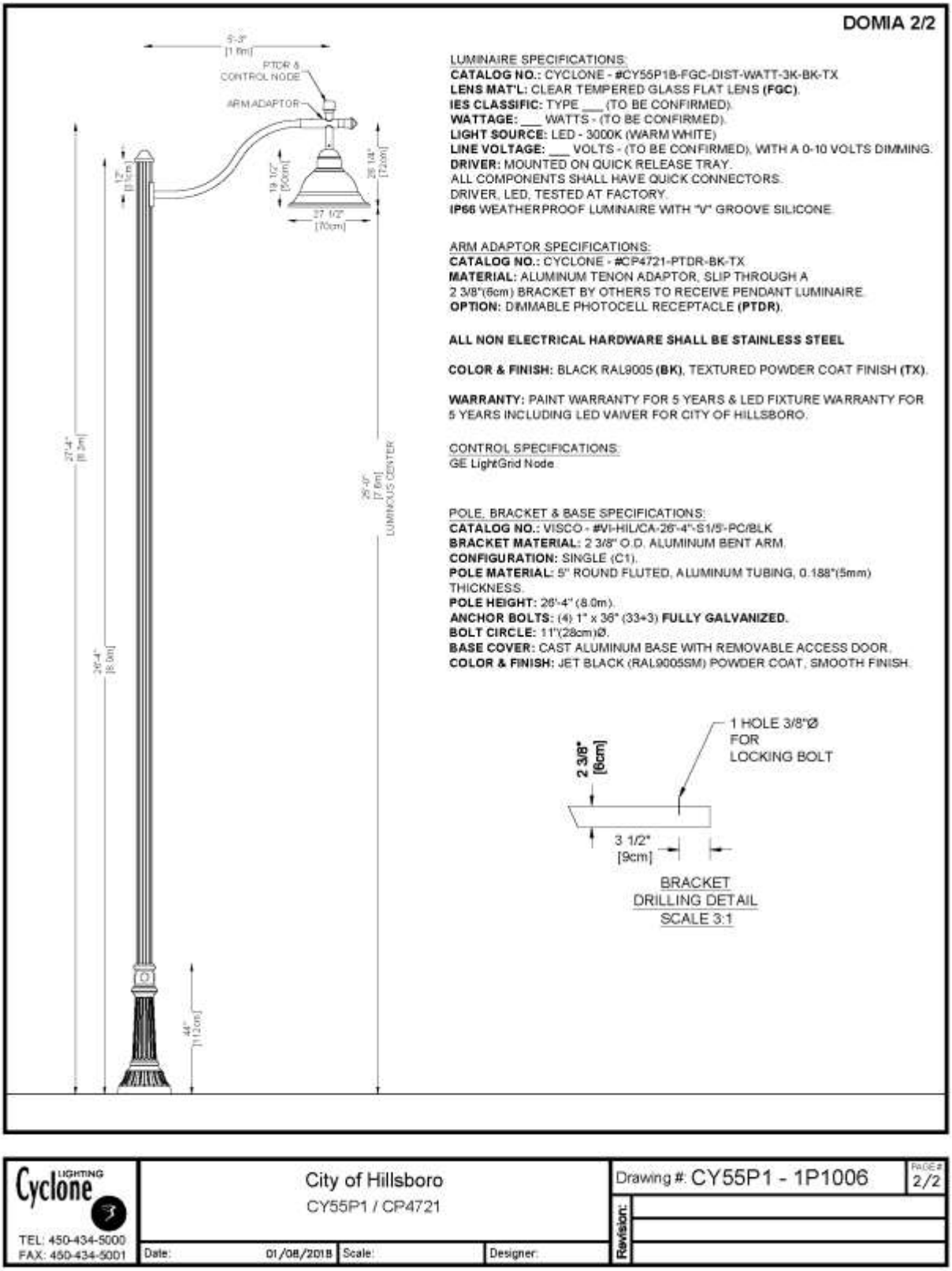
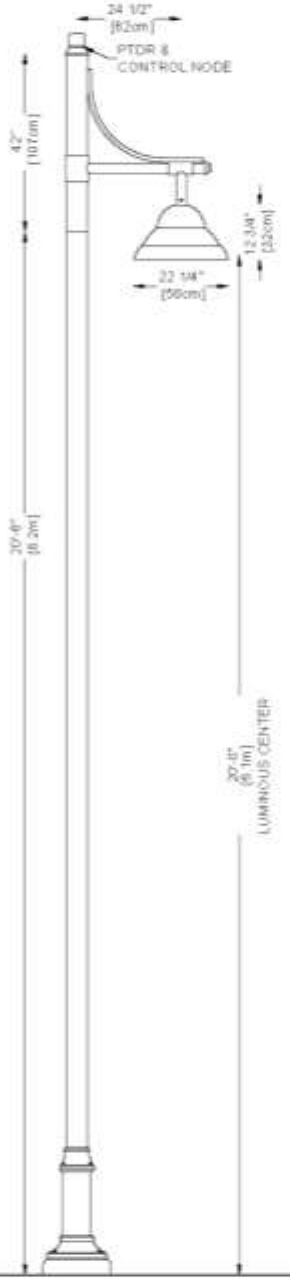


**Figure 350.1 – Preapproved Equipment (Page 4 of 10)**

**NEW ERA SHORT 1/2**




LUMINAIRE SPECIFICATIONS:
**CATALOG NO.:** CYCLONE - #NEL3001P1-FGC-DIST-WATT-3K-VOLT-BK-TX-CP5121
**LENS MAT'L:** CLEAR TEMPERED GLASS FLAT LENS **(FGC)**.
**IES CLASSIFIC:** TYPE ____ - (TO BE CONFIRMED).
**WATTAGE:** ___ WATTS - (TO BE CONFIRMED).
**LIGHT SOURCE:** LED - 3000K (WARM WHITE)
**LINE VOLTAGE:** ___ VOLTS - (TO BE CONFIRMED), WITH A 0-10 VOLTS DIMMING.
**DRIVER:** MOUNTED ON QUICK RELEASE TRAY.
ALL COMPONENTS SHALL HAVE QUICK CONNECTORS.
DRIVER, LED, TESTED AT FACTORY.
**IP66** WEATHERPROOF LUMINAIRE WITH "V" GROOVE SILICONE.

BRACKET SPECIFICATIONS:
**CATALOG NO.:** CYCLONE - #M204-C1-T50-PTDR-BK-TX
**MATERIAL:** CENTRAL TUBING 5"(13cm)Ø MADE OF ALUMINUM WITH ONE ARM 2 3/8"(6cm)Ø A DECORATIVE ELEMENT AND TENON FOR LUMINAIRE, WELDED TOGETHER.
**CONFIGURATION:** SINGLE (C1).
**OPTION:** DIMMABLE PHOTOCELL RECEPTACLE **(PTDR)**.

CONTROL SPECIFICATIONS:
GE LightGrid Node

**POLE SPECIFICATIONS:**
**CATALOG NO.:** CYCLONE - #PS50-20'-6"-SA-T50-BK-TX.
**MATERIAL:** 5" ROUND, STEEL TUBING, 0.125"(3mm) THICKNESS.
**POLE HEIGHT:** 20'-6" (6.2m).
**ANCHOR BOLTS:** (4) 1" x 36" (33+3) **FULLY GALVANIZED.**
**BOLT CIRCLE:** 11 1/2" (29cm)Ø. AVAILABLE FROM 8" TO 12" (20cm to 30cm)Ø.

**BASE COVER SPECIFICATIONS:**
**CATALOG NO.:** CYCLONE - #BD57-BK-TX
**MATERIAL:** TWO-PIECE COVER MADE OF CAST ALUMINUM.

**ALL NON ELECTRICAL HARDWARE SHALL BE STAINLESS STEEL**

**COLOR & FINISH:** BLACK RAL9005 **(BK)**, TEXTURED POWDER COAT FINISH **(TX)**.

**WARRANTY:** PAINT WARRANTY FOR 5 YEARS & LED FIXTURE WARRANTY FOR 5 YEARS INCLUDING LED VAIVER FOR CITY OF HILLSBORO.

Cyclone LIGHTING
TEL: 450-434-5000
FAX: 450-434-5001

City of Hillsboro
NEL3001P1 / M204-C1 / PS50-BD57

Drawing #: NEL3001P1 - 1P1001 PAGE # 1/2

Revision:

Date: 01/08/2018 Scale: Designer:

**Figure 350.1 – Preapproved Equipment (Page 5 of 10)**

**NEW ERA SHORT 2/2**


LUMINAIRE SPECIFICATIONS:
**CATALOG NO.**: CYCLONE - #NEL3001P1-FGC-DIST-WATT-3K-VOLT-BK-TX-CP5121
**LENS MAT'L**: CLEAR TEMPERED GLASS FLAT LENS **(FGC)**.
**IES CLASSIFIC**: TYPE ____ - (TO BE CONFIRMED).
**WATTAGE**: ___ WATTS - (TO BE CONFIRMED).
**LIGHT SOURCE**: LED - 3000K (WARM WHITE)
**LINE VOLTAGE**: ___ VOLTS - (TO BE CONFIRMED), WITH A 0-10 VOLTS DIMMING.
**DRIVER**: MOUNTED ON QUICK RELEASE TRAY.
ALL COMPONENTS SHALL HAVE QUICK CONNECTORS.
DRIVER, LED, TESTED AT FACTORY.
**IP66** WEATHERPROOF LUMINAIRE WITH "V" GROOVE SILICONE.

BRACKET SPECIFICATIONS:
**CATALOG NO.**: CYCLONE - #M204-C1-T50-PTDR-BK-TX.
**MATERIAL**: CENTRAL TUBING 5"(13cm)Ø MADE OF ALUMINUM WITH ONE ARM 2 3/8"(6cm)Ø A DECORATIVE ELEMENT AND TENON FOR LUMINAIRE, WELDED TOGETHER.
**CONFIGURATION**: SINGLE (C1).
**OPTION**: DIMMABLE PHOTOCELL RECEPTACLE **(PTDR)**.

CONTROL SPECIFICATIONS:
GE LightGrid Node

**POLE SPECIFICATIONS:**
**CATALOG NO.**: CYCLONE - #PS50-25'-6"-SA-T50-BK-TX.
**MATERIAL**: 5" ROUND, STEEL TUBING, 0.125"(3mm) THICKNESS.
**POLE HEIGHT**: 25'-6" (7.8m).
**ANCHOR BOLTS**: (4) 1" x 36" (33+3) **FULLY GALVANIZED.**
**BOLT CIRCLE**: 11 1/2" (29cm)Ø. AVAILABLE FROM 8" TO 12" (20cm to 30cm)Ø.

**BASE COVER SPECIFICATIONS:**
**CATALOG NO.**: CYCLONE - #BD57-BK-TX.
**MATERIAL**: TWO-PIECE COVER MADE OF CAST ALUMINUM.

**ALL NON ELECTRICAL HARDWARE SHALL BE STAINLESS STEEL.**

**COLOR & FINISH**: BLACK RAL9005 **(BK)**, TEXTURED POWDER COAT FINISH **(TX)**.

**WARRANTY**: PAINT WARRANTY FOR 5 YEARS & LED FIXTURE WARRANTY FOR 5 YEARS INCLUDING LED VAIVER FOR CITY OF HILLSBORO.

| | | |
|---|---|---|
| Cyclone LIGHTING<br>TEL: 450-434-5000<br>FAX: 450-434-5001 | City of Hillsboro<br>NEL3001P1 / M204-C1 / PS50-BD57<br>Date: 01/08/2018 Scale: Designer: | Drawing #: NEL3001P1 - 1P1001 PAGE # 2/2<br>Revision: |

**Figure 350.1 – Preapproved Equipment (Page 6 of 10)**

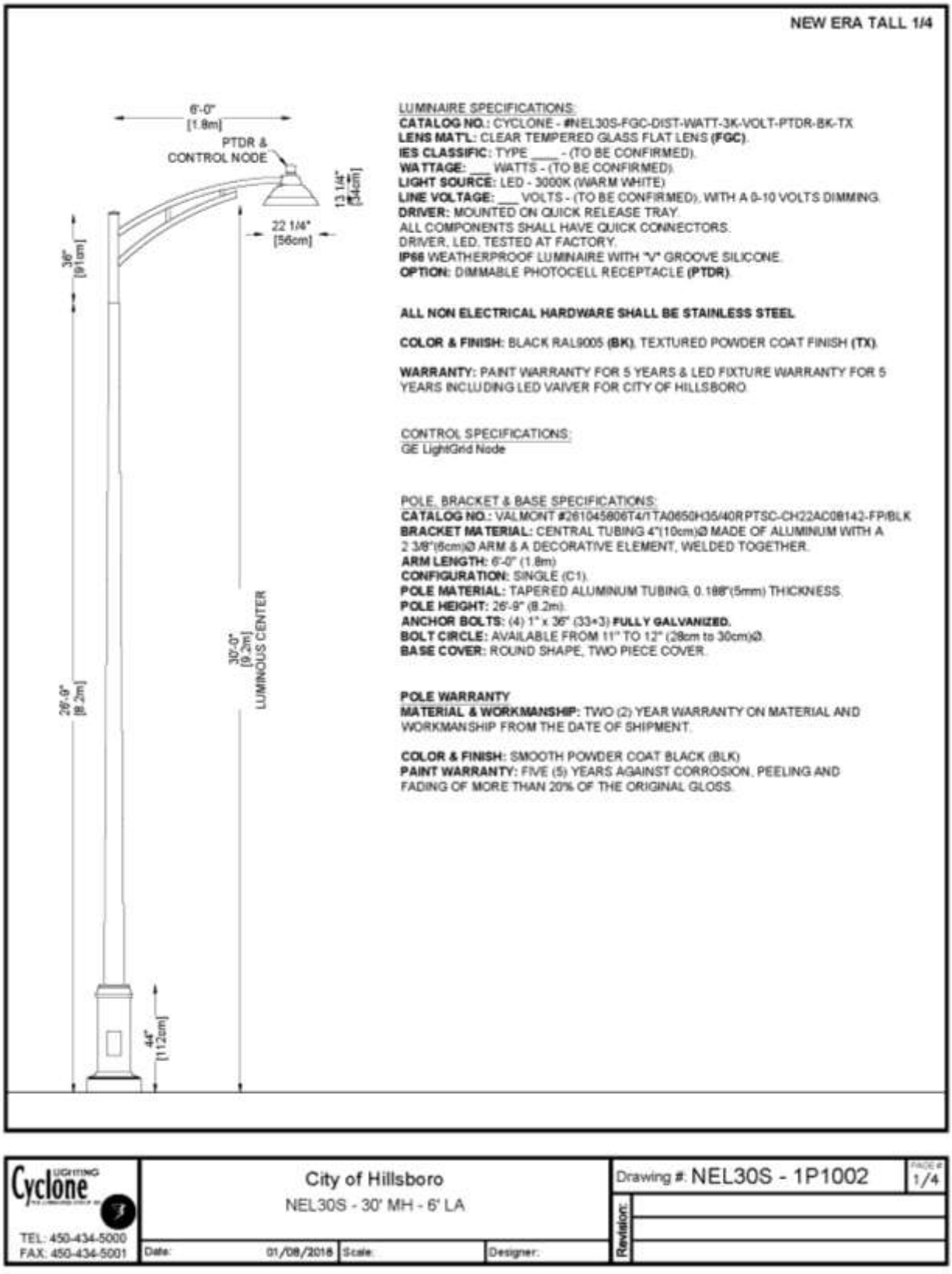


**Figure 350.1 – Preapproved Equipment (Page 7 of 10)**

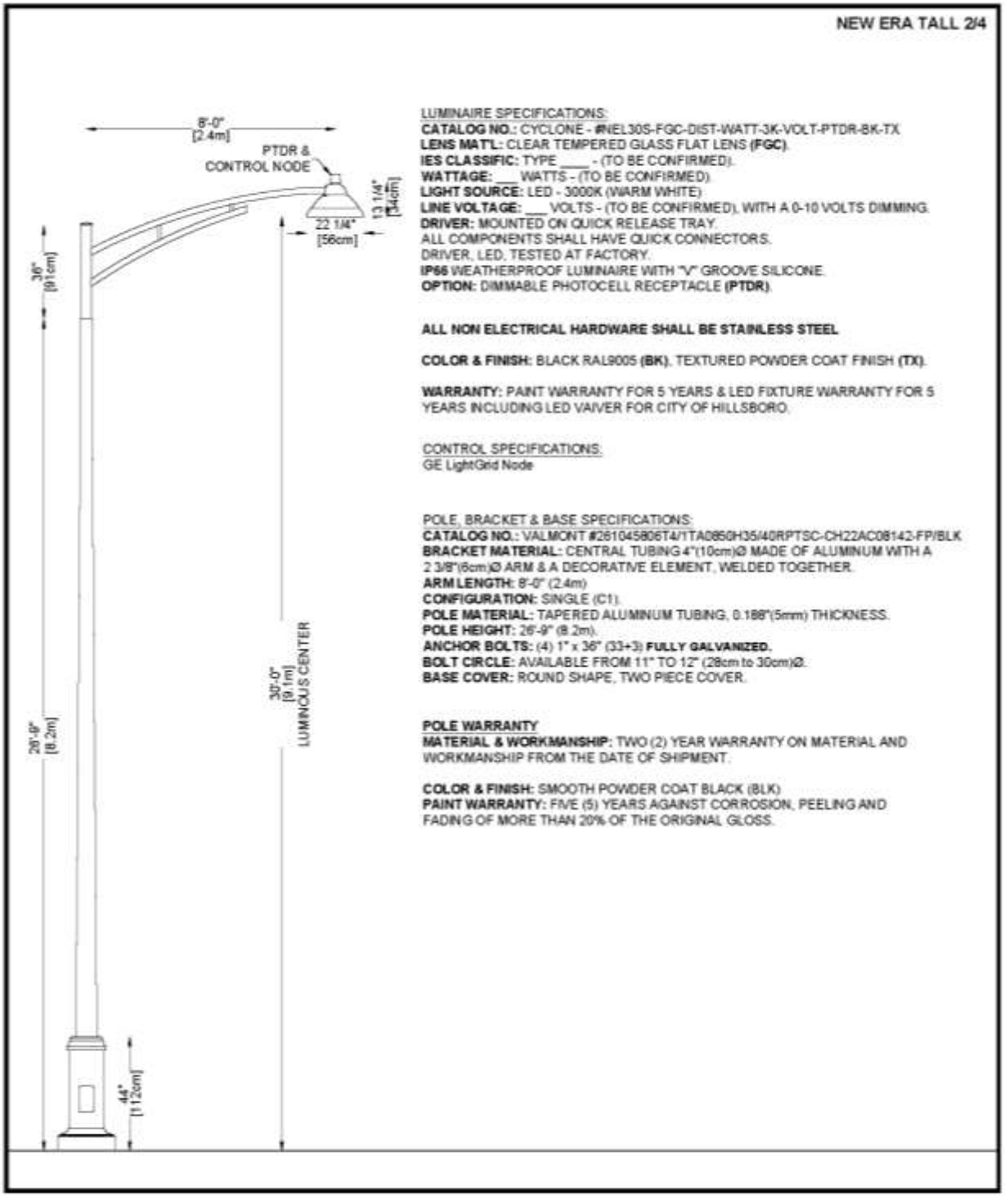


**Figure 350.1 – Preapproved Equipment (Page 8 of 10)**

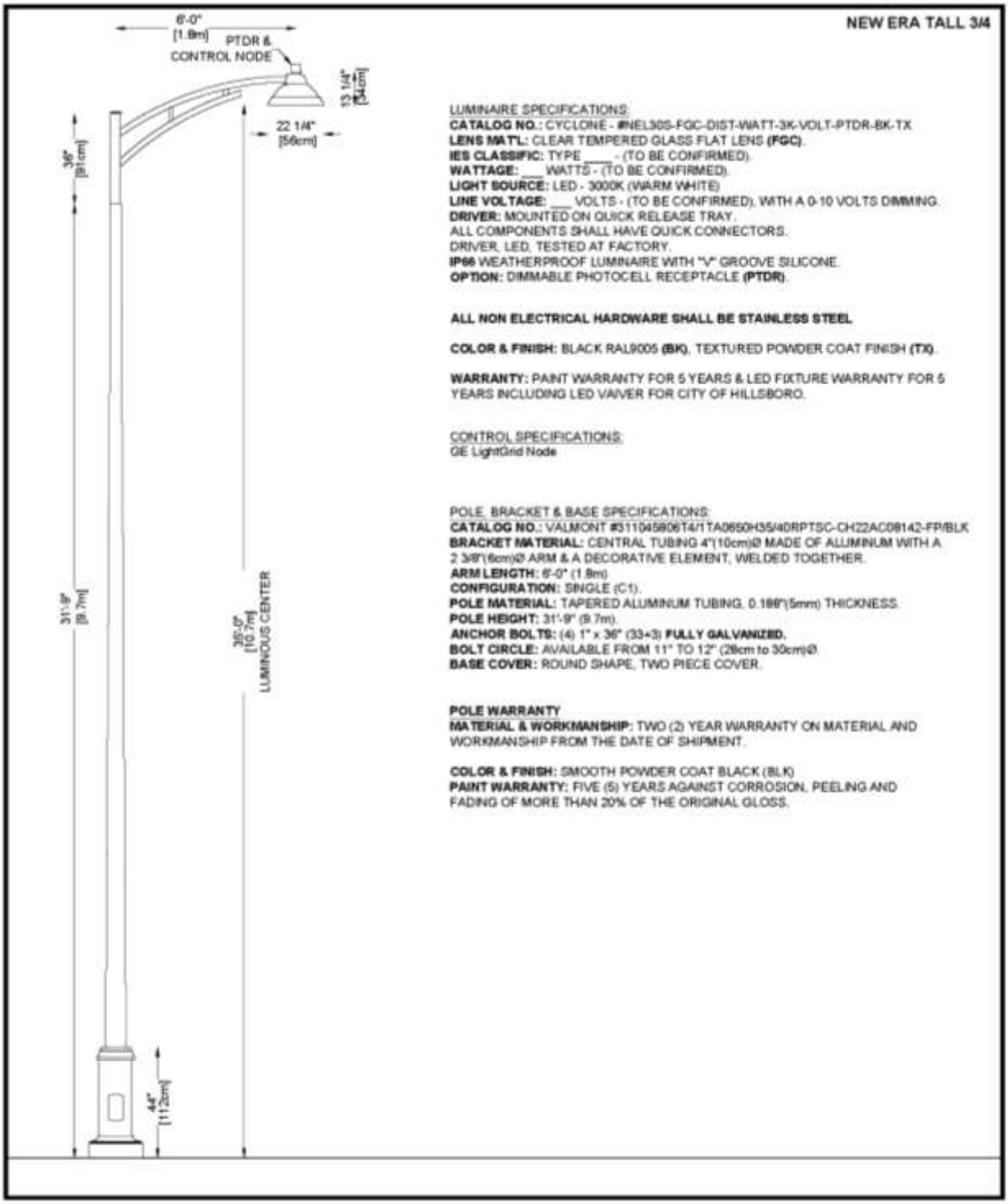


**Figure 350.1 – Preapproved Equipment (Page 9 of 10)**

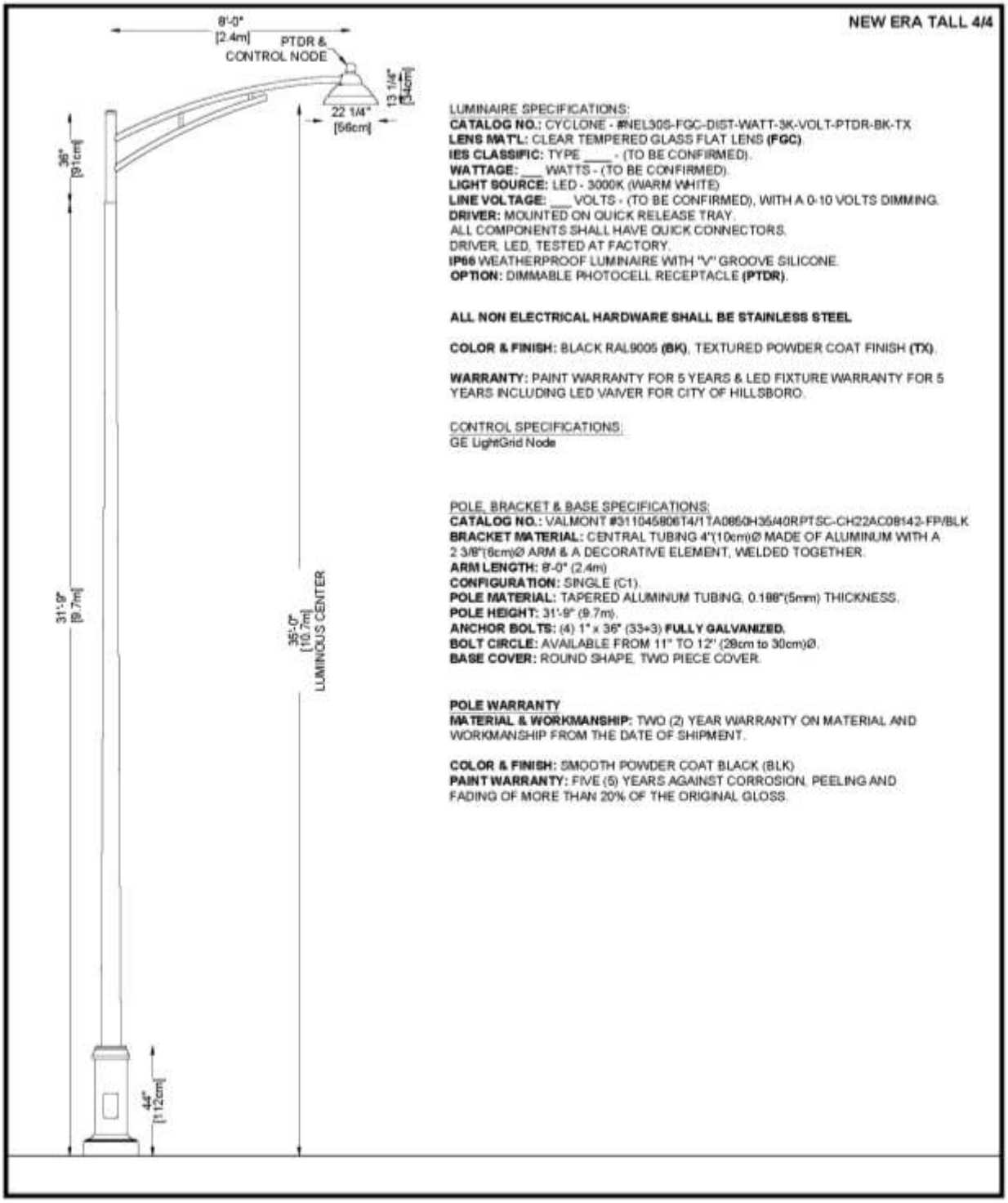
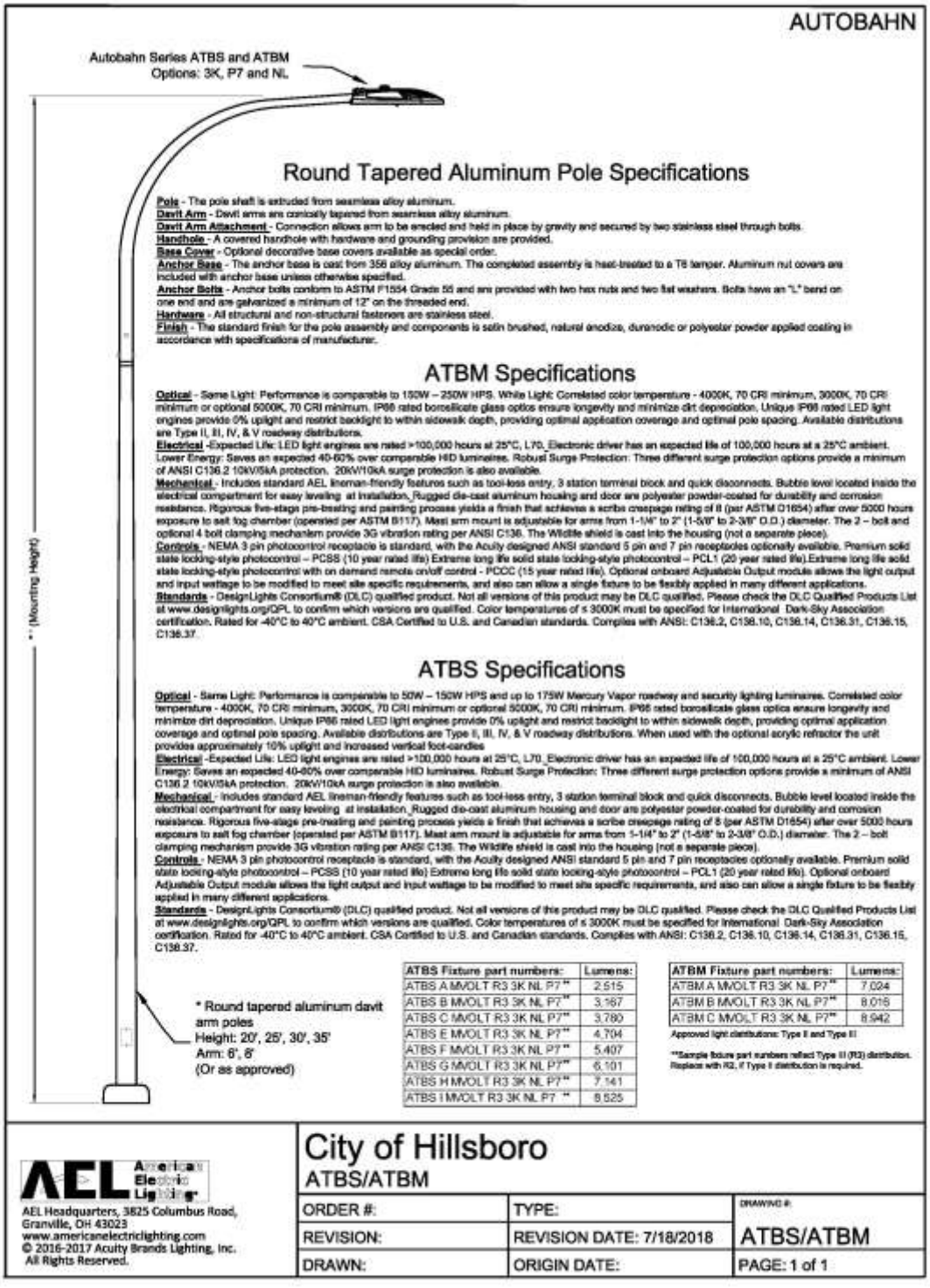


**Figure 350.1 – Preapproved Equipment (Page 10 of 10)**



## 360. Communications

### 360.1. General Design Requirements

A. Install conduit and communications junction boxes to create a complete raceway system. Install fiber optic cables and related equipment on corridors specified in the City's Transportation Communications Plan. Test the fiber optic system and document the results.

B. Install conduit and communications junction boxes on both sides of roadway within City right of way or utility easement. If project work is only on one side of roadway, conduit and junction boxes may only be needed on that side depending on plan review by the City.

C. All conduit and junction box raceway networks must form a single connected system. Ensure conduit system connects to existing traffic signal controller cabinets, traffic signal interconnect, and communications conduit.

D. Install three 2-inch conduits along roadway and two 2-inch conduits into traffic signal controller cabinets. Install poly pull line and tracer wire in each conduit.

1. Conduit shall be located per Figure 210.7. See Subsection 210.2.C.

E. Install communications junction boxes at the corners of intersections and within 25 feet of traffic signal controller cabinets.

F. Install conduit and junction boxes only on roadways classified by the Transportation System Plan as Collector or Arterial.

G. For roadways identified in the Transportation Communications Plan:

1. Install one 144 strand single mode fiber optic cable on one side of the roadway as directed by City staff.

2. At traffic signal controller cabinets install a splice closure in the adjacent communications junction box, one 12 strand single mode fiber optic cable to cabinet, and fiber optic termination equipment. Fusion splice and terminate fiber optic cable in the cabinet. Perform 4 additional fusion splices in splice closure as directed by City staff.

3. Install fiber optic cable slack storage loops equal to 10% of the total cable length, distributed throughout the cable length. Include minimum 25 feet cable slack with each cable at fiber optic distribution units and splice closures.

### 360.2. Materials

A. Conduit

1. General

a) Conduits shall be sized according to the requirements of the National Electric Code (NEC) current edition.

b) Separate conduits shall be used for low voltage and high voltage circuits, such as: signal circuits, detector circuits, service wires, communications wires, and 240 volt or greater illumination circuits.

2. Conduit material shall be polyvinyl chloride (PVC) schedule 40 or high density polyethylene (HDPE) schedule 40. Rigid non-metallic fiberglass schedule 40 conduit shall be used for all conduit bends or sweeps.

3. Sweeps

   a) Conduit sweeps shall be minimum 36 inch radius.

   b) Conduit shall have no more than 360 total degrees of bend.

4. Conduit shall be installed at a depth of 30 inches below finished ground surface.

5. Install an electrical poly pull rope with minimum 1,200 pound break strength in all conduits.

6. Install a 16 AWG THWN locate wire with orange jacket and blue tracer in all conduit. Extend the wire 2 feet beyond the conduit end and install wire nut.

7. A single locatable pull line meeting the requirements of the poly pull line and locate wire may be used in place of individual poly pull line and locate wire.

8. Install push-on bell style bushings on ends of conduit.

9. Provide underground marking tape that is red polyethylene film, 6 inches wide, 4 mils thick minimum, and imprinted with the following or similar legend: "CAUTION CAUTION CAUTION BURIED ELECTRIC LINE".

B. Communication Junction Box

1. Communication junction boxes are large style polymer concrete for use in underground systems. The communication junction boxes are used to accommodate the large bending radius of fiber optic cabling and to provide room for cable storage. Install in non-deliberate vehicular traffic areas only.

2. Communications junction boxes at intersections shall be 3 feet by 3 feet with a depth of 3 feet. Junction boxes along the communication path used for pulling and storage shall be 3 feet by 2 feet with a depth of 2 feet.

3. Materials shall consist of aggregate bonded with a polyester resin and reinforced with fiberglass strands. The communication junction box and cover shall be gray in color. Covers shall meet AASHTO H-20/HS-20 specifications for loads. Covers shall have a skid resistant surface and bolt to the box with stainless steel hex head bolts. The size of the communication junction box shall be as shown.

4. Communication junction boxes shall be installed with a 12 inch concrete apron if located outside a paved or concrete area.

5. Junction box covers shall have the legend “COMMUNICATION” or “FIBER” stamped or embossed on the cover as appropriate. Letter size shall be no smaller than 1/16 of the box width. City will install metal asset tags on all junction boxes.

C. Fiber optic cable – See Subsection 370.

D. Network cable

1. Industrial Ethernet cables shall be Waterblock/direct burial rated, shielded enhanced, Category-6 cable with 24 AWG solid bare copper conductors, PE inner jacket, overall shield, and sunlight and oil resistant PE jacket. Terminate cable with RJ-45 connectors. The cable must be rated for minimum 300 V or UL 444 listed.

2. Patch cables shall be unshielded Category-6 cable with 24 AWG stranded, bare copper conductors and factory terminated with RJ-45 connectors and strain relief boots. The outer jacket shall be pink in color.

E. Network equipment

1. The Fiber Edge Switch must meet the following requirements:

- Two Gigabit Ethernet SFP ports with paired SFP transceivers
- Eight 10/100Base-TX Ethernet ports
- 35mm DIN rail mount
- Operating voltage: 120 V AC
- Include power cable
- Support Rapid Spanning Tree Protocol (IEEE 802.1w)
- Support Quality of Service (IEEE 802.1p)
- Support VLAN (IEEE 802.1Q) with double tagging and GVRP support
- Support Link Aggregation (IEEE 802.3ad)
- Operating temperature range: -29°F to 165°F

2. The Fiber Aggregate Switch must meet the following requirements:

- Eight Gigabit Ethernet SFP ports with paired SFP transceivers
- One 10/100/1000Base-TX Ethernet port
- 19 inch rack mount
- Operating voltage: 120 V AC
- Include power cable
- Support Rapid Spanning Tree Protocol (IEEE 802.1w)
- Support Quality of Service (IEEE 802.1p)
- Support VLAN (IEEE 802.1Q) with double tagging and GVRP support

- Support Link Aggregation (IEEE 802.3ad)
- Operating temperature range: -29°F to 165°F

3. Single strand bi-directional SFP transceiver for Gigabit Ethernet switches must be provided in matched pairs and meet the following requirements:

- One LC single mode fiber connector
- Nominal transmission distance 10 km
- Hot swappable
- Support 1000Base-BX
- Transmit power: -9.0 to -3.0 dBm
- Receiver sensitivity: -19.5 to -3.0 dBm
- Wavelengths: 1310 nm and 1490 nm
- Operating temperature range: -29°F to 165°F

F. Fiber optic communications bracket for powering and mounting DIN rail equipment in traffic signal controller or ITS cabinets. The communications bracket must meet the requirements defined in ODOT's standard specification for Microcomputer Signal Controller Appendix B.

G. ITS Cabinet

1. Ground mounted traffic style (332) cabinet with 8 inch riser frame and foundation. The cabinet must be UL 50 Type 3R listed. The cabinet must consist of Housing #1 and Mounting #1 cage assemblies as defined in ODOT's standard specification for Microcomputer Signal Controller. Provide the housing requirements listed in Chapter 6 Section 2 with the exception of the police panel. The cabinet assembly must be assembled and listed by a certified UL 508A panel shop or have the final assembly certified by an approved National Recognized Testing Laboratory.

2. The cabinet must come equipped with a filtered, forced air ventilation system and light. Light must automatically turn on when cabinet doors are opened.

3. All incoming 120 V circuits must terminate on terminal blocks. All terminal blocks must be UL 1059 listed. For No. 10 AWG conductors or smaller, use sectional, double terminal, barrier type terminal blocks with binder screw terminals. Terminal ampacities must be equal to or greater than conductor ampacities. For No. 8 AWG conductors or larger, use one-piece for factory assembled, sectional, barrier type terminal blocks with box lug terminals having a pressure plate between screw and conductor. Use terminals of the correct size for the conductor to be connected.

4. Bus bars must be sized to accommodate required connections and must be amperage rated for use.

5. Source power circuit must be protected by a main circuit breaker. All branch circuits must be protected by branch circuit breakers. All circuit breakers must be UL 489 listed.

6. Receptacles must be general purpose, NEMA 5-15R, duplex, white, specification grade, rated 15A, 125 V, 3 wire, grounding type, with screw terminals. Mount within receptacle box and install cover plate. All receptacles must be UL 498 listed.

7. Provide a rack mounted line conditioner in the cabinet that automatically regulates the incoming voltage from brownouts, overvoltages, and transient surges for the protection of electrical equipment. The line conditioner must use a transformer based voltage correction circuit for maintaining nominal 120 V AC +/- 5%, 60 Hz output with 90 V to 139 V AC, 60 Hz input; support minimum 1440 watt load; provide minimum 1,440 joules surge suppression; and be UL 1012 listed. Line conditioner must provide minimum 10 receptacles.

360.3. Installation, Setup, and Finishing Requirements

A. Conduit Installation

1. All conduit runs shall be as direct as possible from point to point, shall remain within right-of-way, shall connect with adjacent existing conduits as appropriate to form communications network, and maintain as straight an alignment as possible. Make conduit runs continuous between any pole, junction box, or cabinet. Use the same size conduit for the entire length, outlet to outlet.

   a) Communications conduit shall be placed in the join City communications trench located under the sidewalk.

2. Ream the ends of all conduits to remove burrs and rough edges. Plug or cap all conduit ends until wiring is installed. After wiring is installed install duct seal compound or precut closed cell polyethylene foam that will prevent debris from entering the conduit system.

3. Install all conduits at a minimum 30-inch depth under roadways and shoulders, and minimum 18 inch depth in all other areas.

4. In areas to be paved or landscaped, place all conduit before paving or landscaping.

5. Install underground marking tape above all buried conduit, 6 inches below surface.

B. Communication Junction Box Installation

1. For communication junction box installation location requirements, see Subsection 350.2.3.

2. Install communications junction boxes no more than 500 feet apart.

3. Install the tops of junction boxes flush with the surrounding grade, sidewalk, or top of curb. If installed outside roadways or shoulders, install a 12-inch Portland cement concrete apron around the junction box. In boxes having an open bottom, construct a sump of well graded 3/4-inch - 0 crushed gravel, 12 inches deep covering the approximate area of the box. Do not install conductors until the sump has been constructed.

C. Fusion splicing requirements
   1. Use individual fusion type splices to join fibers in fiber optic cables and pigtails.
   2. Apply appropriate protective coating to all splices, protect with a thermal shrink sleeve, and place in a splice tray. Loop individual fibers one full turn within splice tray to avoid micro-bending. Maintain two-inch minimum bend radius during installation and after placing in optical fiber splice tray. Individually restrain each fiber in splice tray. Place optical fibers in the splice tray so that there is no discernible tensile force on optical fiber.
   3. Perform all splice work in a controlled, weatherproof, dust-proof environment.
   4. Splicing equipment must be in good working order, have been properly calibrated within the past six months, and meet all industry standards. Prepare cables, install closures and splice fibers in accordance with accepted and approved industry standards.
   5. Individuals performing fiber optic terminations and splices must have a minimum of two years' experience terminating, splicing, and testing fiber optic cable, and possess either a Fiber Optics Installer or Fiber Optics Technician Certification recognized by the Electronics Technicians Association (ETA) or a Fiber Optics for ITS certificate from the International Municipal Signal Association (IMSA).

D. Furnish and deliver all network equipment to the City. City staff will configure and install network equipment.

E. Furnish, stow, and protect all patch cords and jumpers at network equipment locations. Unless otherwise specified, City staff will connect patch cords and jumpers.

F. Install FDUs with sufficient quantity and type of port capacities, cassettes, splice trays, and coupler plates.

G. Attach splice closure to the inside wall of communications junction boxes. Maintain sufficient clearance for routing of the fiber optic cables without exceeding the minimum bending radius of any cable. Flash-test the closure after completion of splicing work to manufacturer's recommended pressure.

H. Installed fiber optic system shall meet the following limits:
   1. Cable attenuation at 1310nm: < 0.40 dB/km
   2. Cable attenuation at 1550nm: < 0.30 dB/km
   3. Connector insertion loss: < 0.75 dB (bi-directional average)
   4. Connector return reflection: < -40 dB
   5. Fusion splice: < 0.10 dB (bi-directional average)

360.4. Documentation

A. Labels

1. Install labels to identify cables and jumpers at all termination points, communications junction boxes, and cabinets. Install labels to identify all communications components and devices in cabinets.

2. Use yellow or white colored labels with permanent black lettering. Labels must be mechanically imprinted. Do not use handwritten labels. Use tubular plastic labels on cables and jumpers.

3. Include the following information on labels:

    - Owner
    - Number of fibers
    - Purpose (e.g. intersection served)
    - Cable or connection origin
    - Cable or connection destination

B. Warning Tags

1. All warning tags must be of a long life material, orange in color, and marked in a permanent and consistent manner with black lettering. Include the text “CAUTION FIBER OPTIC CABLE” on all warning tags and show the cable fiber count.

2. Attach warning tags to fiber optic cables using UV-resistant zip ties according to the manufacturer’s recommendations. Do not affix in a manner that will cause damage to the fiber optic cables. Attach warning tags to the cables in at least two locations in communications junction boxes and at least one location in cabinets.

C. Design Drawing Requirements

1. Provide communication system plans sheets with traffic signal plans. Communication plans must consist of at least the following. For general plan requirements see Subsection 120.

    - Raceway and Cable Installation Plan
    - Fiber Optic Splicing Diagram
    - Network Equipment Connection Diagram
    - Communications Equipment Schedule

2. Mark record drawings with each installed cable’s length sequential marking at each cable entry to communications junction box, cabinet, and at each splice closure and fiber optic distribution unit. For general record drawing requirements see Subsection 120.6.

**Table 360.1 – Approved Communications Materials**

| Section | Item Name | Approved Make/Model |
|---|---|---|
| 360.2.A | Conduit | See ODOT Blue Sheets |
| 360.2.A | Conduit Fittings | See ODOT Blue Sheets |
| 360.2.A | Locatable Pull Line | |
| 360.2.A | Underground Marking Tape | See ODOT Blue Sheets |
| 360.2.B | Communications Junction Box | Synertech Underground Products,<br>Strongwell,<br>Quazite |
| 360.2.D | Industrial Ethernet Cable | |
| 360.2.D | Network Patch Cable | |
| 360.2.E | Fiber Edge Switch | Siemens Ruggedcom 6GK6090-0GS23-0BA0-Z A01 |
| 360.2.E | Fiber Aggregate Switch | Siemens Ruggedcom 6GK6022-0AS23-0DC0-Z A07+B07+C07+D07+E01 |
| 360.2.E | SFP Transceivers (pair) | Siemens Ruggedcom SFP1132-1BX10R and SFP1132-1BX10T |
| 360.2.F | Communications Bracket | See ODOT Green Sheets |
| 360.2.G | ITS Cabinet | |

**Figure 360.1 – Communications Plans Standard Callouts**

## POLES

- EX / 1 — Retain and protect existing power pole (Power source)
- EX / 2 — Retain and protect existing utility pole
- EX / SP — Retain and protect existing signal pole
- EX / MP — Retain and protect existing traffic signal mast arm pole
- EX / LP — Retain and protect existing luminaire pole
- EX / WP — Retain and protect existing wood pole
- RIS — Install conduit riser on pole. Coordinate size and location with utility

## WIRES & CABLES

- EX / W — Retain and protect existing wiring
- EX / 39 — Retain and protect existing messenger cable
- EX N/P — Retain and protect existing (N=number) twisted pair interconnect cable
- EX FO N/X — Retain and protect existing (N=number) single mode fiber optic cable owned by (X=jurisdiction)
- EX / NET — Retain and protect existing network cable
- EX / LW — Retain and protect existing locate wire
- EX / PL — Retain and protect existing pull line
- FO N/X — Install (N=number) single mode fiber optic cable for ownership by (X=jurisdiction)
- NET — Install network cable
- LW — Install locate wire
- PL — Install poly pull line
- RX / W — Remove existing wiring
- RX N/P — Remove (N=number) twisted pair interconnect cable
- RX FO N/X — Remove existing (N=number) single mode fiber optic cable owned by (X=jurisdiction)
- RX / LW — Remove existing pull line
- RX / PL — Remove existing locate wire
- RR / W — Remove and relocate existing wiring
- RI / W — Reinstall existing wiring

## CABINETS

- EX / C — Retain and protect existing cabinet
- EX / SC — Retain and protect existing service cabinet
- EX / ITS — Retain and protect existing ITS cabinet
- ITS / C — Install model 332 ITS cabinet
- DIN / F — Install Fiber Optic Interconnect Communications Bracket
- COM — See communication component schedule for cabinet communications equipment

## JUNCTION BOXES

- EX / JB — Retain and protect existing junction box
- JB / C — Install communications junction box
- SPC — Install fiber optic splice closure.
- RX / JB — Remove existing junction box
- RX / SPC — Remove existing fiber optic splice closure
- RR / SPC — Remove and relocate existing fiber optic splice closure
- RI / SPC — Reinstall existing fiber optic splice closure

## CONDUITS

- S EX / CC — Retain and protect existing (S=size when shown) inch communications conduit
- S — Install (S=size) inch electrical conduit
- CJ — Splice new conduit to existing conduit
- CS — Cap conduit stub (for future use)
- HDD — Install conduit by horizontal directional drilling
- S RX / CC — Remove existing (S=size when shown) inch communications conduit
- S AX / CC — Abandon existing (S=size when shown) inch communications conduit

## JURISDICTIONS

CoH = City of Hillsboro
CoB = City of Beaverton
WaCo = Washington County
ODOT = Oregon Depertment of Transportation

## 370. Optical Fiber Backbone Cabling

### 370.1. General

A. Scope

1. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of horizontal optical fiber infrastructure as described on the drawings and/or required by these specifications.

    a) Installation, splicing, termination, testing, labeling and documentation of new fiber optic communication cable as specified and on the drawings.

    b) The installation environment could include tie in and coordination with existing and new optical fiber and copper facilities, underground duct banks, and direct-buried conduit.

    c) The Contractor shall be responsible for: placement of cable, installation and attachment of cable to support devices within the underground structures and pole lines, the placement of conduit, the installation of pull-boxes, the furnishings of fiber optic splice closures, and installation of termination hardware, and other as specified by the City.

    d) Contractor shall be responsible for providing and installing grounding and bonding materials, duct plugs, and fire stopping materials as required completing the installation.

    e) Other incidental hardware and appliances, necessary for the proper performance and operation of the communication cable system, which are consistent with the practices of cable installation, are to be provided by the Contractor as required to complete the installation.

    f) Contractor is responsible to ensure that utility locating has been performed as per the requirements of Oregon One Call. The Contractor is responsible for any damages to any utility caused during construction. In any area where a utility has been located, work activity must be verified through pot holing.

2. The Contractor shall complete all work and turn over a completed and standards compliant optical fiber cabling system to meet the City network installation system needs. The scheduled date for completion of optical fiber cabling and associated copper and wireless systems shall incorporate the activation dates for services need to activate all networked services including voice, data, special systems needed for a Certificate of Occupancy, the testing and operation of Building Monitoring Systems, and Electronic Safety and Security Systems.

B. Related Sections & References

1. Design, install and test data distribution systems per manufacturer's requirements and in accordance with NESC, NFPA 70 (National Electric Code), state codes, local codes, and requirements of authorities having jurisdiction.

    a) ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises

    b) ANSI/TIA/568-C.1, Commercial Building Telecommunications Cabling Standard

    c) ANSI/TIA/568-C.2, Copper Cabling Components Standard

    d) ANSI/TIA/568-C.3, Optical Fiber Cabling Components Standard

    e) ANSI/TIA/EIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces

    f) TIA-590-A, Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant

    g) ANSI/TIA/EIA-606-A, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

    h) ANSI/J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

    i) ANSI/TIA/758-A, Customer-owned Outside Plant Telecommunications Infrastructure Standard

    j) ANSI/TIA-942, Telecommunications Infrastructure Standard for Data Centers

2. The Contractor is responsible to determine and adhere to the most recent edition of these standards when developing their responses and completing the project installation.

C. Quality Assurance

1. The City will inspect installation in progress. It is the responsibility of the Contractor to schedule regular and milestone inspection times with the City. It is incumbent upon the Contractor to verify that the installation and material used has been inspected before it is enclosed within building features, buried, or otherwise hidden from view. The Contractor shall bear costs associated with uncovering or exposing installations or features that have not been inspected.

2. The Contractor will provide electronic test results and a 20 year manufacturer's warranty with a copy of the warranty to be submitted to the City at the completion of work.

D. Optical Fiber Backbone System Description

1. The main Entrance Facility (EF) and each Telecommunications Room (TR) shall house both voice and data backbone cabling and active equipment to support networking requirements. The EF in most cases shall be the main point of entry for outside services as well as main distribution point for all backbone cabling. Fiber optic backbone cable shall be employed between the EF and each TR for voice, data and special systems connectivity.

2. Optical fiber cabling systems vary depending upon system design, but a 144 fiber SMF cable is typical.

3. Optical Fibers in the backbone shall be terminated using a pigtailed assembly that have incorporated into those assemblies a LC connector that is fusion spliced to the backbone optical fibers, unless otherwise specified and approved by the City; housed in rack-mount fiber optic enclosures with cable supports.

4. All cables and termination hardware shall be 100% tested for defects in installation and to verify cable performance under installed conditions. All conductors and fibers of each installed cable shall be verified useable prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed-through couplers, patch panels, and connector blocks shall be repaired or replaced at the provider's expense in order to ensure 100% useable conductors in all installed cables.

370.2. Products

A. General

1. The materials and products specified herein reflect the minimum acceptable standards of fabrication and manufacture.

2. All materials and products supplied by the Contractor and specified herein are to be new, unused, of first quality and in original packaging or shipping containers.

3. Provide materials as specified or as approved equivalent by the City.

4. Match optical fiber glass for tie in to existing optical fibers.

5. The following manufacturer's warranted systems are approved unless otherwise specified:

a) AMP

b) Belden

c) Berk-Tek

d) CommScope

e) Corning

f) Ortronics

g) Siemons

A. Substitutions

1. Product substitutions shall be managed according to the following guidelines.

a) All substitutions shall be submitted to and approved by the City.

b) Acceptance of substitutions is at the City's discretion. The City reserves the right to determine suitability of the substitute product and reject any and all materials submitted for substitution. Submit requests for substitutions in writing to the City for approval within 10 days of contract award, or sooner if required to maintain the construction schedule.

c) Products rejected or otherwise judged unsatisfactory by the City will not be authorized for use in completing the work. Any unapproved products discovered as part of the installation will be removed and replaced with the City specified and approved products at the Contractor's expense.

d) Project Drawings may be based on equipment configuration of a particular manufacturer. If a substitution is approved, the Contractor shall make changes needed to accommodate the substitution at no expense to the City, including work under other divisions.

B. Outside Plant Fiber Optic Cable

1. General

a) Single mode fiber is the standard optical fiber media for backbone installations and optical fibers shall be low water-peak, laser optimized, suitable for CWDM use and complies with the ITU G.562.d. standard.

b) The cable types listed herein have been selected based on the typical environments and applications. It is the Contractor's responsibility to verify and submit an RFI on cables specified within that do not meet code or the environmental requirements of the project, environmental or code requirements of the installation before purchasing or providing.

c) When splicing into existing optical fibers the Contractor is to ensure the matching of optical fiber glass to the new and existing fibers and install the same glass type and manufacturer to prevent optical fiber mismatch.

2. Single Mode Optical Fiber Specification

a) Optical Characteristics – Single-mode fiber optic cable 8.3µm/125µm single-mode low water peak optical fibers.

b) Attenuation: 0.35dB/km @ 1310 nm; 0.25dB/km @ 1550 nm.

3. Multi-Mode Optical Fiber – When Specified by the City only.

a) Install Multi Mode optical fiber when approved and specified by the City.

b) Optical Characteristics – OM3 50µm/125µm laser optimized fibers, for new installations.

c) Optical Characteristics – OM1 62.5µm/125µm multimode optical fibers as specified for additions and modifications to existing of the same optical fiber.

4. Mechanical Construction – Armored fiber optic cable for direct-buried and conduit installation. Construction shall include: locatable central strength member or an IT approved equivalent, water swell-able yarn, buffer tubes/fibers, water swell-able tape, ripcord, polyethylene inner jacket, high tensile strength, corrugated steel tape armor (for direct buried applications), Polyethylene outer jacket, UV-stabilized jacket or equivalent.

a) Provide optical fiber color codes in compliance with Color TIA/EIA 527-7 and 14.

b) Cable shall be assembled to ensure that no more than 12 fiber strands occupy each buffer tube of like fiber strands.

c) Uni-tube Cable Construction: Fiber optic cables with 12 strands or less must include the following components:

i. Central Buffer Tube - Single loose buffer tube must provide sufficient clearance to allow for expansion without constraining the fiber. The fibers

must be loose or suspended within the tube. The fibers must not adhere to the inside of the buffer tube. Provide the number of fibers per cable as shown on the plans.

The loose buffer tube must have a coefficient of friction sufficiently low to allow free movement of the fibers. The material must be tough and abrasion resistant to provide mechanical and environmental protection of the fibers, yet designed to permit safe intentional "scoring" and breakout, without damaging or degrading the internal fibers.

Buffer tube filling compound must be a homogenous hydrocarbon based gel with anti-oxidant additives used to prevent water intrusion and migration. The filling compound must be non-toxic and dermatologically safe to exposed skin. It must be chemically and mechanically compatible with all cable components, non-nutritive to fungus, non-hygroscopic and electrically non-conductive. The filling compound must be free from dirt and foreign matter and must be readily removable with conventional nontoxic solvents.

Water blocking tape may be used as an acceptable substitute for buffer tube filling compound.

Central buffer tube must be surrounded by peripheral strength members that will prevent stress on the fibers when the cable jacket is placed under strain.

ii. Core and Cable Flooding - The cable core interstices must contain a water blocking material, to prevent water ingress and migration. The water blocking material must be either a polyolefin based compound, which fills the cable core interstices, or an absorbent polymer, which fills voids and swells to block the ingress of water. The flooding compound or material must be homogeneous, non-hygroscopic, non-conductive, and non-nutritive to fungus. The compound or material must also be nontoxic, dermatologically safe and compatible with other cable components.

iii. Peripheral Strength Members - Tensile strength must be provided by high tensile strength aramid yarns, which must be stranded evenly around the central buffer tube and must not adhere to other cable components. The cable must have a short-term tensile strength of at least 300 lbf.

iv. Outerjacket - The jacket must be free of holes, splits, and blisters and must be medium or high density polyethylene, or medium density cross linked polyethylene with minimum nominal jacket thickness of 1 mm to 0.076 mm. Apply jacketing material directly over the peripheral strength members and water blocking materials. Jacketing material must not adhere to the aramid strength material. The polyethylene must contain carbon black to provide

ultraviolet light protection and must not promote the growth of fungus. Armored jackets shall not be used.

Mark the jacket or sheath with the manufacturer's name, the words "Optical Cable", the number of fibers, "SM", year of manufacture, and sequential measurement markings in feet. Make the marking in a contrasting color to the cable jacket.

d) Stranded Cable Construction: Fiber optic cables with more than 12 strands must consist of the following components:

i. Buffer tubes - Loose buffer tubes must provide sufficient clearance to allow for expansion without constraining the fiber. The fibers must be loose or suspended within the tubes. The fibers must not adhere to the inside of the buffer tube. Each buffer tube must not exceed a maximum of 12 fibers. Provide the number of fibers per cable as shown on the plans.

The loose buffer tubes must have a coefficient of friction sufficiently low to allow free movement of the fibers. The material must be tough and abrasion resistant to provide mechanical and environmental protection of the fibers, yet designed to permit safe intentional "scoring" and breakout, without damaging or degrading the internal fibers.
If used, buffer tube filling compound must be a homogenous hydrocarbon based gel with anti-oxidant additives used to prevent water intrusion and migration. The filling compound must be non-toxic and dermatologically safe to exposed skin. It must be chemically and mechanically compatible with all cable components, non-nutritive to fungus, non-hygroscopic and electrically non-conductive. The filling compound must be free from dirt and foreign matter and must be readily removable with conventional nontoxic solvents.

Water blocking tape may be used as an acceptable substitute for buffer tube filling compound.

Buffer tubes must be stranded around a central member by a method, such as reverse oscillation stranding process, which will prevent stress on the fibers when the cable jacket is placed under strain.

ii. Central Member - The central member which functions as an anti-buckling element must be a glass reinforced plastic rod with a similar expansion and contraction characteristic as the optical fibers and buffer tubes. To ensure the proper spacing between buffer tubes during stranding, a symmetrical linear overcoat of polyethylene may be applied to the central member to achieve the optimum diameter.

iii. Filler Rods - Fillers may be included in the cable to maintain the symmetry of the cable cross section. Filler rods must be solid medium or high-density

polyethylene. The diameter of filler rods must be the same as the outer diameter of the buffer tubes.

iv. Stranding - Completed buffer tubes must be stranded around the overcoated central member using stranding methods, lay lengths and positioning such that the cable meets mechanical, environmental and performance specifications. A polyester binding must be applied over the stranded buffer tubes to hold them in place. Binders must be applied with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes. The binders must be non-hygroscopic, non-wicking, and dielectric with low shrinkage.

v. Core and cable flooding - The cable core interstices must contain a water blocking material, to prevent water ingress and migration. The water blocking material must be either a polyolefin based compound, which fills the cable core interstices, or an absorbent polymer, which fills voids and swells to block the ingress of water. The flooding compound or material must be homogeneous, non-hygroscopic, non-conductive, and non-nutritive to fungus. The compound or material must also be nontoxic, dermatologically safe and compatible with other cable components.

vi. Tensile strength member - Tensile strength must be provided by high tensile strength aramid yarns or fiberglass, which must be helically stranded evenly around the cable core and must not adhere to other cable components. The cable must have a short-term tensile strength of at least 600 lbf.

vii. Ripcord - The cable must contain at least one ripcord under the jacket for easy sheath removal.

viii. Outerjacket - The jacket must be free of holes, splits, and blisters and must be medium or high density polyethylene, or medium density cross linked polyethylene with minimum nominal jacket thickness of 1 mm +/- 0.076 mm. Jacketing material must be applied directly over the tensile strength members and water blocking materials and must not adhere to the aramid strength material. The polyethylene must contain carbon black to provide ultraviolet light protection and must not promote the growth of fungus. Armored jackets shall not be used.

Mark the jacket or sheath with the manufacturer's name, the words "Optical Cable", the number of fibers, "SM", year of manufacture, and sequential measurement markings in feet. Make the marking in a contrasting color to the cable jacket.

5. Approved Brands: Fiber optic cable shall be of the following brand and model or approved equal:

**Table 370.1 – Approved Fiber Optic Cable**

| Uni-tube cable (12 or less strands) | Stranded cable (more than 12 strands) |
|---|---|
| Corning FREEDM series | Corning ALTOS EU4 series |
| Superior Essex Series 51 | Superior Essex Series 11D |
| | Prysmian Draka ezPREP EDH series |

C. Jumpers and Pigtails

1. Pigtails: Pigtails shall be of simplex (one fiber) construction, 900 μm PVC jacket. Minimum bend radius shall be 1.2 inches. Pigtail jackets shall be color coded to match the strand of connected cable. All pigtails shall be factory terminated and tested and at least six feet in length.

2. Jumpers: Jumpers may be of simplex or duplex design. Duplex jumpers shall be indicate polarity of connectors using unique colors or tags. All jumpers shall be at least three feet in length, sufficient to avoid stress and allow orderly routing. Provide strain relief for jumpers at both ends and elsewhere as needed. Minimum bend radius shall be at least 6 inches during installation and 3 inches following installation. The outer jacket shall be 2mm PVC and be yellow in color.

D. Fiber Optic Connectors

1. Provide for all new fiber optic installations with fusion spliced LC/APC pig tail connectors. The connectors shall be manufactured by the cabling system manufacturer and composed of the same optical fiber glass as used in the optical fiber cable specified by the project.

2. When adding to or modifying existing work coordinate connector type with the City.

3. The connector operating temperature range shall be -40°C to +70°C. Connection durability shall be less than a 0.2 dB change per 500 mating cycles per TIA-455-21A (FOTP-21).

4. Field terminations shall be limited to splicing of adjoining cable ends and/or cables to pigtails.

5. Multimode connectors, when specified shall be LC pigtailed connectors. They shall all be fusion spliced unless otherwise specified by the City.

6. Use the City approved color code (no exceptions) for coupler panels as follows:

a) 62.5um couplers – Beige

b) 50um couplers – Aqua

c) SM APC couplers – Green

E. Fiber Optic Enclosures

1. Wall mounted enclosures shall be approved by the City prior to system design and installation. The enclosure shall be equipped for a fusion spliced pigtail connector installation.

2. Provide wire management approved by the City to equipment and interconnection enclosures.

3. Rack Mount enclosures shall be approved by the City prior to system design and installation. The enclosure shall be equipped for pigtail connector splicing and installation.

4. Provide one 2RU wire manager, installed per rack at the top and one 2RU wire manager installed in the middle of the rack coordinated with the FDU installation to provide a crossover pathway for optical fiber jumpers.

5. Provide blank 2RU panel install below the top wire manager.

F. Optical Fiber Splice Closures

1. Enclose fiber optic field splices (other than within an FDU) in complete splice closures, with outer closure, splice organizer trays, brackets, clips, cable ties, seals and sealant as needed. The splice closure must be watertight, chemical and UV resistant, and rated for the environment in which they are to be installed.

2. The fiber optic splice closure must be suitable for a temperature range of 0°C to 40°C.

3. All splice closures shall be approved by the City prior to installation.

4. All closures shall be pressure tested. No encapsulate shall be used on fiber enclosures.

5. Provide Preformed Coyote Fiber Optic Splice Closures Kits or other approved by the City that are sized as required for the maximum fiber count within the splice case including distribution fibers.

6. Install only the splice enclosure manufacturer's specified splice trays. Splice only 12 fibers per splice tray (no exceptions, unless with written approval prior to installation

from the City project manager).

7. Splice trays shall be labeled with a permanent label on the front face of each splice tray indicating fiber count.

8. Support all closures with manufacturers approved brackets.

9. When placed in a junction box or vault, there must be sufficient space for routing of the fiber optic cables, without exceeding the minimum bending radius of any cable.

10. The closures must be designed to accommodate butt splicing.

11. The splice closure must meet the following requirements:

    a) Non-filled thermoplastic case

    b) Rodent proof, water proof, re-enterable and moisture proof

    c) Expandable from 4 cables per end to 8 cables by using adapter plates if necessary

    d) Cable entry ports must accommodate 0.25” to 1.0” diameter cables

    e) Multiple grounding straps

    f) Place no stress on finished splices within the splice trays

12. Include sufficient splice trays for minimum specified splice capacity in the splice closure. Individually mount and mechanically protect each splice in the splice tray.

13. Each closure must include at least 50’ of additional fiber length.

G. Innerduct

1. Aluminum threaded innerduct couplers shall be used to join two segments of corrugated innerduct together. Non-metallic couplers are not acceptable.

2. All innerduct shall have a measured pull tape rated for 400 lb. pulling tensile.

3. Each inner duct run shall be of the same manufacturer, model and size.

4. All runs with cables leaving the building shall be water and gas proof sealed using a method approved by the City.

5. Innerduct sealing plugs shall be used to seal used and unused innerducts. Use in conjunction with triplex duct sealing plugs.

H. Labels

1. Plastic cable labels shall be mechanically printed and shall be attached to all fiber optic cables using black UV rated cable ties or stainless steel cable ties within six inches of the splice closure and 6“ from all ducts and sleeves.

2. Provide electronically printed, waterproof, self-adhesive, laminated labels installable on the external surface of the outside panel of all FDU’s and closures.

370.3 Execution

A. Optical Fiber Backbone Installation

1. General

a) This Section describes the installation for the products and materials, as well as methods and the City Standards associated with the optical fiber backbone installation. These Specifications, along with the Drawings and other City supplied specifications shall be provided during the course of the installation.

b) The Contractor is instructed to coordinate his efforts with other trades who may be working within the same vicinity to avoid conflicts, lost time, cleaned environment for splicing and termination and potential injury. The City will assist in contractor coordination as requested or as required.

c) The Contractor shall install all materials plumb, square and in a workman-like manner.

d) The Contractor shall supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.

e) The Contractor shall verify space requirements and locations with the project team and the City before starting cable installations and terminations proceed.

f) The Contractor shall verify the cable type and jacket rating required for use with the City before starting the fiber installation.

g) The Contractor shall verify existing cable fill in conduit, raceway or cable tray system prior to quote or bid and before installation of additional cables so as not to exceed 40% cable fill. Contractor will be responsible for installation of additional conduit, raceway or cable tray where additional cables to be added will exceed the 40% cable fill.

h) The Contractor shall comply with all National, State of Oregon and local codes and City Policies, Procedures, Standards AND Design Guidelines during the course of installation.

i) Should any portion of these Specifications conflict with applicable Codes, the Contractor shall cease work on that particular aspect of the Project and notify the City immediately.

j) All equipment shall be installed in a neat and professional manner, arranged for convenient operation, testing and future maintenance.

k) All fiber cables shall be installed and terminated / fusion spliced by technicians trained and experienced in the installation and termination of fiber cables.

l) The Contractor shall employ certified system installation technicians and have at least 5 years experience in the installation of similar and equivalent systems.

m) The Contractor shall supply verification of experience, for this type of work, to the City for approval before performing any work.

2. Field Conditions

a) Fixed facility locations shown on the Drawings are based upon the latest design information available at the time this Specification was prepared.

b) The Contractor shall conduct field inspections to coordinate, verify and/or determine the actual as-built locations of conduits, manholes, handholes and all other special facilities that affect the installation, prior to commencing the installation in any area.

c) All EF/TR's and underground structures including utility tunnels, conduit and manhole systems, handholes and related fixtures shall be kept as clean as possible during installation. Labor required for any cleaning work shall be included in the quote or bid and provided by the Contractor.

3. Pre Cable Installation

a) Ensure the correct product(s) for the project have been received by the Contractor, are compliant to the project's product specification and have been approved for installation by the City. The Contractor should verify part numbers and footages on cable reel shipping labels, bills of lading, invoices, etc., shall be compared to the original order upon receipt and before installation.

b) The Contractor shall inspect fiber optic cable reels for damage upon receipt from the shipper and verify the receipt of the specified product before installation.

c) The contractor should verify the length of the cable both visually and by the results of the OTDR test to verify the project requirements prior to installation.

d) The Contractor will retain the manufacturer's test data and provide it, along with all other specified test documentation to the City at the completion of the Project.

e) All cable that does not meet the project or required City specification or approved by the City shall be removed and replaced at the contractor's expense.

4. Optical Fiber Installation Within Ductbanks & Innerducts

a) If field conditions prohibit the use of the designated duct, inner duct or multi-cell/sub duct, the Contractor is to contact the City for instructions prior to installation.

b) If existing multi-cell or innerduct duct specified is available, install one fiber cable in each sub-duct.

c) If cable is already installed within a duct without innerduct the Contractor is to contact the City for direction.

d) Install cables in accordance to the manufacturer's approved installation methods, procedures and instructions to ensure warranty compliance.

e) Install measured pull tapes with a minimum of 400 lb pulling tensile in conduits when installing cables or innerduct into occupied conduits.

5. Fiber Optic Cable Installation

a) Use mechanical aids to install cable.

b) Place tension measuring device or breakaway swivel between ends of cable grip and pull rope to ensure tension does not exceed 80
percent of recommended tension or 500 lbs., whichever is less.

c) Use cable grips with a ball bearing swivel for installing fiber optic cable to prevent cable from twisting during installation.

d) Adhere to cable manufacturer's specifications and recommended procedures, including:

- Installation
- Proper attachment to cable strength elements for pulling
- Bi-directional pulling
- Cable tensile limits and tension monitoring procedure
- Cable bending radius limits

e) Protect the loops from tangling or kinking. Do not exceed bending radius specifications.

f) Install fiber optic cable using cable-pulling lubricant as recommended by manufacturer.

g) Use a non-abrasive pull-tape. Station personnel at each junction box, vault, or cabinet to lubricate cable and prevent kinking or other damage.

h) Install pull line and locate wire, even if not shown.

i) Following installation of cable in conduit, seal all conduit entrances with conduit plug or duct-sealing compound to keep out moisture, foreign materials and rodents.

6. Installation of Optical Fiber within the EF/TR

a) Upon entering the EF/TR the backbone fiber optic cable shall be routed on cable tray to the designated rack location.

b) At least 25 feet of slack cable shall be included and stored as specified and approved by the City. A minimum of 2 times the diameter of the cable minimum bend radius shall be maintained. Cable slack in the TRs shall be contained and routed in the cable tray. Do not coil the cable to achieve the service loop. Store slack as approved by the City.

7. Splicing and Termination

a) The contractor is responsible to ensure that all outages associated with active cable and equipment is coordinated and approved by the City.

b) Fusion spice optical fibers in accordance to the approved fusion splicer, optical fiber and enclosure manufacturer's methods, procedures and instructions to ensure warranty compliance.

c) Perform all splice work in a controlled, weatherproof, dust-proof environment.

d) All optical fiber shall be neatly and efficiently dressed into splice tray management and the contractor is to ensure that splices are accessible without damage to the

optical fibers or splices.

e) The contractor is to ensure that all splice trays are labeled and optical fibers and trays properly secured.

f) The contractor shall test and call for splice inspections of all optical fiber splices before closing cable splice enclosures.

g) Individuals performing fiber optic terminations and splices must have a minimum of two years' experience terminating, splicing, and testing fiber optic cable, and possess either a Fiber Optics Installer or Fiber Optics Technician Certification recognized by the Electronics Technicians Association (ETA) or a Fiber Optics for ITS certificate from the International Municipal Signal Association (IMSA).

B. Fiber Optic Cable Testing

1. Scope of Work

a) Work covered by this Paragraph shall consist of furnishing labor, equipment and supplies unless otherwise specified, and in performing the following operations recognized as necessary for the successful testing and verification of the installation of the Fiber Optic cable plant described on the Drawings and required by these specifications.

b) Notify the City 48 hours in advance when work, technicians and equipment are prepared for acceptance tests and inspections. Coordinate a meeting with the City personnel to discuss the required testing procedures, required performance, test equipment, documentation, etc. to verify to the City a complete understanding of project requirements.

c) Provide technicians that are trained and certified in the use of the test equipment used for the testing operations associated with the specified work.

d) Maintain test equipment to manufacturers' requirements, and ensure that all equipment is calibrated according to the manufacturer's requirements. Provide a copy of the current calibration certificate associated with all test equipment associated with the contracted work.

2. Testing

a) Verify through visual inspection using an optical fiber test scope all fiber optic cable terminations, splices and connecting cables for defects and cleanness.

b) The fiber optic cables shall be tested utilizing a power meter and stabilized light source capable of testing at 850 nm and 1300 nm for multimode and 1310nm and 1550nm for single-mode. Contractor shall complete a fiber optic post installation report at the time of testing containing meter readings at both 850 nm and 1300 nm for multimode and 1310nm and 1550nm for single-mode in one direction (TR to outlet) on each fiber, actual loss and other pertinent data regarding the cables tested, including model and serial number of test equipment, cable part #, installed fiber length, building span loss at 850 nm and 1300 nm for multimode and 1310nm and 1550nm for single-mode and date tested. Testing required is 100%.

c) Place a printed copy and provide and electronic copy on a CD of the test results from the tester in a 3-ring binder, proceeded by a tabbed divider and label as "Backbone Fiber": To_____ From_____.

d) Span loss calculations are required on the final test sheet for loss at 850 nm and 1300 nm for multimode and 1310nm and 1550nm for Single-mode.

(D = Length x L = Fiber Loss) + (C x # connectors Loss) + (# Splices Loss)

e) Maximum Acceptable Connector Loss Values

**Table 370.2 – Maximum Acceptable Connector Loss**

| Fiber Type | Test Wavelength | Mated Pair Connector Loss (each including fusion splice) |
|---|---|---|
| 50/125 Multimode | 850nm | 0.5 dB |
| 50/125 Multimode | 1300nm | 0.5 dB |
| 62.5/125Multimode | 850nm | 0.5 dB |
| 62.5/125Multimode | 1300nm | 0.5 dB |
| Single-mode | 1310nm | 0.5 dB |
| Single-mode | 1550nm | 0.5 dB |

f) Acceptable Fiber Type Test Wavelength Fusion Splice Loss (each)

**Table 370.3 – Acceptable Fiber Type Test Wavelength Fusion Splice Loss**

| Fiber Type | Test Wavelength | Splice Loss (each) |
|---|---|---|
| 50/125 Multimode | 850nm | 0.10 dB |
| 50/125 Multimode | 1300nm | 0.10 dB |
| 62.5/125Multimode | 850nm | 0.10 dB |
| 62.5/125Multimode | 1300nm | 0.10 dB |
| Single-mode | 1310nm | 0.10 dB |
| Single-mode | 1550nm | 0.25 dB |

g) Testing requirements for Attenuation and Reflection

   i. Acceptable attenuation shall be calculated based upon on connector, type, number of splices and optical fiber length and shall comply with TIA/EIA 526. Attenuation shall not exceed the specified perimeters established by the manufacturer and the requirements of this section

   ii. Reflection test perimeter shall not exceed > - 40 db per connector or splice.

h) The total optical fiber segment performance shall not exceed the summation of all the manufacturers components specified performance parameters (Loss Budget) and/ or the combined loss values of components in Section 2.04 of this document.

i) Verify through bi-directional dual frequency power meter testing the attenuation and power loss of each point to point fiber optic strand and connectors. Test method (B) TIA/EIA 526 (7 and 14) is required.

j) Test all inter/intra building optical fiber segments using an OTDR with launch and receiving cables on each end during each test operation.

k) All optical fiber testing shall utilize the manufacturers specified and approved test jumpers and adapters.

l) Optical fiber cable that is left un-terminated at both ends shall be tested using a launch cable and bare fiber adapter.

m) Fiber optic cable that is left un-terminated at one end shall be tested at the connector end using an OTDR.

n) Submit electronic copy of test results within two calendar days of each test to the Engineer, including results of failed tests or re-tests for approval. Include the following information in test results submittals:

- Contract name and number
- Contractor name and address
- Testing technician name
- Date and time of test
- Dates of cable manufacture, installation, and testing
- Cable identification with traceability from factory to installation
- Fiber numbers and/or ports tested
- Locations of test origin and end points
- Termination and port identification
- Fiber segment length

- Test wavelength
- Test results
- One licensed copy of applicable OTDR reader program

o) If the test results are unsatisfactory, the fiber is unacceptable. Repair the unacceptable fiber at no additional cost to the City and then retest to demonstrate acceptability.

C. Labeling

1. Fiber Color Code approved for sequencing follows:

**Table 370.4 – Fiber Color Code**

| Number | Color |
|---|---|
| 1 | Blue |
| 2 | Orange |
| 3 | Green |
| 4 | Brown |
| 5 | Slate |
| 6 | White |
| 7 | Red |
| 8 | Black |
| 9 | Yellow |
| 10 | Violet |
| 11 | Rose |
| 12 | Aqua |

D. Record Drawing Information

1. Contractor shall provide record drawing information to the City to accompany all test result information.

2. Record drawing information shall be in electronic format as a PDF/A. Indicate location of all outlets, distribution cable trays, junction boxes, FDU with configuration, optical fiber cable equipment rack layout with cable designators and counts and all additions and deletions pertaining to the backbone optical fiber cabling system.

3. Contractor shall provide one set of preliminary as-build information, splice diagrams and test results including all test result information 30 days prior to occupancy to ensure the scheduled installation and activation of the City equipment and services.

4. Failure of the contractor to provide the required record drawing information in a timely manner for the City to prepare cutover information may cause an installation delay for the project due to the contractors not meeting these requirements. The delivery of the record drawing documentation needs to be coordinated with the City as a project milestone.

5. The Contractor shall provide at substantial completion a list of all uncompleted work and a punch list of open items to the City Project Manager and prior to City scheduled activations.

6. If construction drawings are not utilized, contractor shall provide all telecommunications location information on an accurate and electronic formatted scaled floor plan preapproved by the City.

7. Partial as-builds shall be submitted as additional cabling is completed to meet installation schedules. The Contractor shall provide one set of preliminary as-build information, equipment layouts including elevations and test results to meet the schedule requirements of the City equipment installation and activation.

8. As final submission, provide a CD with 2 copies of the IBNS in Excel format one copy shall be locked and the second shall be in an open, searchable format. Provide floor plans with outlet locations and ID's in Auto Cad and Complete Test results (not just summary sheet) in LinkWare.

9. The final record drawing shall be submitted with all corrections made no later than 30 days after cabling installation is completed.

10. For general record drawing requirements see Subsection 120.6.

E. System Warranty

1. Contractor shall provide a 20-year extended manufacturer’s warranty in addition to the contractor’s warranty provided to the project. The warranty shall be titled to the City. The warranty shall begin at the system acceptance date and remain in effect for a period of 20 years from that date.

2. The umbrella warranty provided for the optical fiber backbone cabling system shall be issued by the manufacture of the cabling system. The contractor shall provide to the City any additional warranties from partners in addition to the cabling system warranty, i.e. cable manufacturer, contractor warranties. Acceptable manufacturer warrantees include:

    - AMP
    - Belden
    - CommScope/Systimax/Uniprise
    - Ortronics
    - Siemons

- Corning

a) All installed systems must conform to the manufacturer's official published specifications. Any exceptions agreed to by the contractor and the manufacturer shall be approved by the City. The contractor shall submit in writing and obtain approval from the City for all exceptions pertaining to the cabling system's warranty prior to the request being submitted to the manufacturer.

b) The warranty shall include a warranty of the applications published by the manufacturer at the time of the warranty application. The contractor is to provide to the City a list of these applications.

c) The contractor will provide the City with a copy of the warranty application at the time of submittal to the manufacturer.

d) Contractor shall perform all labeling requirements and provide testing documentation for verification and submittal to the manufacturer and the City. A copy of the warranty application and all documentation and test results shall be submitted simultaneously to the City and the manufacturer.

e) Contractor shall provide complete record drawing copies intra and inter building cable and infrastructure plans sent to the manufacture showing final locations of all FDU's and splice enclosures prior to submission of the warranty application. The contractor is to ensure that the warranty submittals match the submitted record drawing.

f) Contractor shall submit for the warranty all cable records to reflect moves, adds, and changes as-built.

g) The contractor shall include and schedule the City in all site surveys and inspections that relate to the warranty application or processes.

## 380. Fiber to the Premises

For design and construction standards applicable to the City of Hillsboro Fiber to the Premises system, refer to Standard Drawings 380-1 through 380-5.

## SECTION 400

## 400. SURFACE WATER MANAGEMENT (SWM) AND SANITARY SEWER

### 410. General

A. The City of Hillsboro has adopted the Clean Water Services Design and Construction Standards (CWS Standards). All sanitary sewer, closed storm conveyance, treatment, and surface water management (SWM) facilities must at a minimum meet the CWS Standards, and when the City standard is higher, the requirements of this section.

B. Public sewer facilities shall be designed to allow the logical service of all parcels or tracts of land within the basin. Sewer lines shall be extended, at owner's or developer's expense, to adjacent parcels to facilitate future development. Sewer facilities shall be designed to accommodate all future (full build-out) flows from upstream development.

C. Manufactured tees shall be utilized during the construction of new public storm and sanitary sewer lines with a diameter of 18 inches or less.

D. Permanent compression style (Cherne) plugs are not allowed. Compression plugs may be used for testing purposes only. Permanent plugs for the ends of mainlines and laterals shall be rigid pipe plugs or caps. Cleanouts shall end with a threaded cap fitting. All fittings shall be water tight and conform to the specifications of the host pipe material. The pipe trench shall be properly compacted to ensure that the plug or cap is sufficiently restrained. This requirement applies to sewer lines proposed to be extended with later phases of development as well.

E. Manhole components shall conform to the following requirements:

1. Standard manholes require a minimum of one 2-inch concrete grade ring. Flat top manholes require a minimum of 4 inches of concrete grade rings.

2. No metal grade rings shall be used on new manholes. A maximum of one metal grade ring may be allowed on existing manholes for pavement overlays.

3. Up to 12 inches of concrete grade rings may be used for adjusting the elevation of manhole castings. Elevation adjustments greater than 12 inches require an additional section of manhole be installed.

4. All manholes shall use standard 7-inch castings.

5. To prevent manhole lids from rocking and clanging, the contractor shall ensure the following requirements are met prior to inspection and acceptance by the City:

   a) The lid sits flat within the frame and attain a true bearing all around.

   b) Bearing surfaces have been machine planed or ground by the manufacturer prior to delivery to the jobsite.

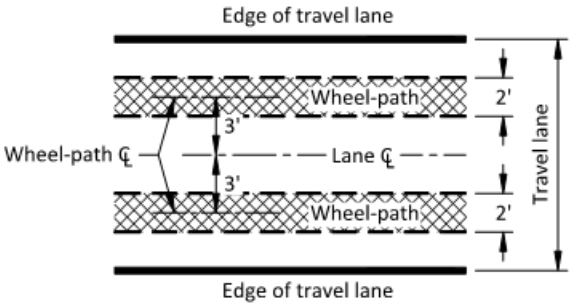
   c) All lids shall be test fit to frame prior to installation.

6. Manholes lids shall not encroach into the wheel-path, as defined in Figure 410.1.

7. Manholes in roadways having a speed limit of 35 MPH or higher require a bolt-down lid. See Std. Drg. No. 410-1.

8. Defective manhole channels shall be corrected by removing and replacing the defective channel in its entirety.

**Figure 410.1 – Wheel-path**




9. All new inside drop manholes must be at least 60 inches in diameter, or be an equivalently sized rectangular structure approved by the City.

10. Inside drop manholes shall use drop bowls. The maximum slope of the pipe entering the drop bowl is 2 percent.

F. Prior to acceptance, all new public sewer lines shall be thoroughly cleaned, tested, and then inspected by the contractor in accordance with CWS standards. Work shall be completed by the contractor and approved by the City prior to paving. An electronic and paper copy of the video inspection report in NASSCO PACP format, produced by a certified NASSCO operator, shall be submitted to the City.

1. SWM facilities associated with the development shall have all accumulated sediment deposited during construction removed.

G. Prior to acceptance of new infrastructure at the conclusion of the maintenance warranty period the following will be performed by the owner, developer, builder or responsible party:

1. All public stormwater and sanitary sewer infrastructure created and used by the associated development shall be thoroughly cleaned, then video inspected. An electronic and paper copy of the video inspection report in NASSCO PACP format, produced by a certified NASSCO operator, shall be submitted to the City for review and approval prior to release of the maintenance assurance.

2. All City streets used and associated with the development shall be cleaned and all accumulated debris shall be removed.

3. SWM facilities associated with the development shall have all accumulated sediment deposits removed.

H. Prior to final approval of any building associated with new subdivisions the following shall be performed by the owner, developer, builder or responsible party:

1. All City streets used and associated with the development shall be cleaned and accumulated debris shall be removed.

2. SWM facilities associated with the development shall have all accumulated sediment deposits removed.

I. See Subsection 210.2.C for standard storm and sanitary sewer locations.

J. Type CG-2 inlets shall not be used on public, curbed streets.

## 420. Surface Water Management (SWM)

A. SWM Facility Order of Precedence

1. The following table lists the various types of SWM facilities by order of precedence. Prior to receiving City approval, the Engineer must demonstrate that the preceding facility types aren't feasible.

**Table 420.1 – SWM Facility Order of Precedence**

| Order | Facility Type | Remarks |
|---|---|---|
| 1st | Enhancement and/or Expansion of an Existing Public Vegetated SWM Facility | See Subsection 420.B |
| 2nd | New Public Vegetated SWM Facility Serving Multiple Tax Lots and/or Public Streets | Requires recorded storm and access easements if located on private property. |
| 3rd | Private Vegetated SWM Facility Serving a Single Tax Lot | Located on private property. Privately owned and maintained by property owner. |
| 4th | Street-side Infiltration Planter in the Public ROW | See Subsection 420.1.A.4 |
| 5th | Public/Private Proprietary Treatment Facility | Requires a recorded access easement if located on private property. The selection of proprietary treatment facility types must be in accordance with CWS 4.05.8. |
| 6th | Fee-in-lieu | See Subsection 190 |

B. Use of Existing SWM Facilities

1. Use of an existing SWM facility to meet treatment and/or detention requirements is allowed subject to the following conditions:

a) A mandatory pre-design meeting with City staff shall be held to determine the requirements related to the specific existing facility. Any or all of the following conditions may be applied if use of the existing facility is permitted;

i. The existing facility must meet current standards and be functioning correctly. Existing facility deficiencies or deferred maintenance may need to be corrected by the developer proposing to use the existing facility.

ii. Expansion of existing facilities for treatment of new development may require additional enhancement to the remainder of the facility, in addition to the expansion.

b) Enhancement of facilities may qualify for a partial or full SDC and fee-in-lieu reduction of charges.

c) Existing facilities shall not be removed until a new facility has been constructed and accepted by the City. The new facility shall have a minimum treatment capacity equal to the facility being removed.

420.1. SWM Facilities

A. General Requirements

1. SWM facilities, including side slopes, retaining walls, perimeter fencing and all associated structures, shall not be installed within a PUE, sanitary sewer, water, or other incompatible public or private easement.

2. LIDA swales and infiltration planters shall be constructed with a perforated drain pipe underdrain system connected to a downstream public or private storm system unless the following is shown:

a) A geotechnical or drainage report concludes that infiltration at the proposed location is a minimum of 2 inches per hour during all times of year.

b) The drain rock of the facility can be installed above the elevation of the water table.

3. No utility lines shall be located under any type of facility with the exception that service lines may be installed under facilities within the ROW.

4. Private facilities constructed on individual single-family residential lots shall only be located within the front yard or street-side of the property and have a gravity connection to the public storm system, surface water body, or other approved point of discharge.

a) Private facilities located on single-family residential lots shall be accessible and maintainable by the property owner.

b) Private facilities located on single-family residential lots can be deferred by the developer to the builder to construct during the time of the single family residential construction. To defer construction, the developer shall show an outline of where to construct each facility on each individual lot including all upstream and downstream gravity connections on the Public Infrastructure Permit Plans. Plans shall include a note identifying that the builder is responsible to construct each facility during the time of construction on each residential lot.

c) The Builder shall obtain individual Building Department permits for each residential lot.

d) A Private Maintenance Agreement for each lot shall be signed and recorded prior to final approval for each facility.

e) Small improvements creating and/or modifying 1,000 square feet or more of new impervious surface which do not create the requirement for Public Infrastructure Plans/Site Development Plans shall provide the following to obtain a Building Permit:

i. LIDA facility sizing calculations based on CWS treatment requirements;

ii. Site plan showing an outline of where to construct each SWM facility including all upstream and downstream gravity connections

iii. Approved planting plan, maintenance plan, and detail for each facility created.

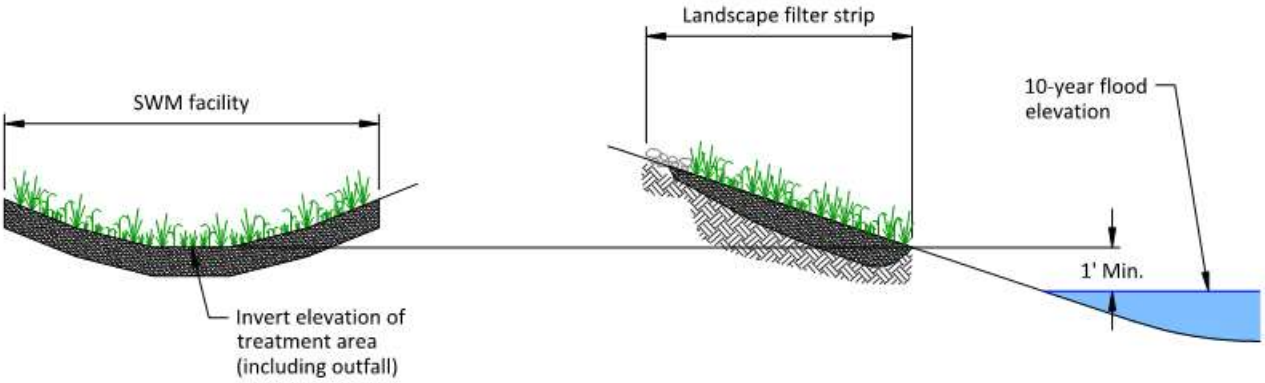
iv. A Private Maintenance Agreement with each lot shall be signed and recorded in order to sign off and final each facility at the completion of construction.

5. SWM facilities shall be designed to prevent backwatering into the facility during storm events.

   a) The invert elevation and the permanent pool elevation of the facility's treatment and detention area and all associated conveyance structures, excluding the outfall, must be constructed at least 1 foot in elevation above the 10-year storm event water surface elevation at the point of discharge. The outfall invert must be constructed no lower than the 10-year storm event water surface elevation at the point of discharge. This requirement applies to all types of facilities, including underground detention systems. Facilities designed at or below the 100-year flood elevation shall include additional analysis of backwater effects during the 10, 25, and 100 year storms, as applicable, and include a maintenance plan with more frequent routine maintenance by the owner.

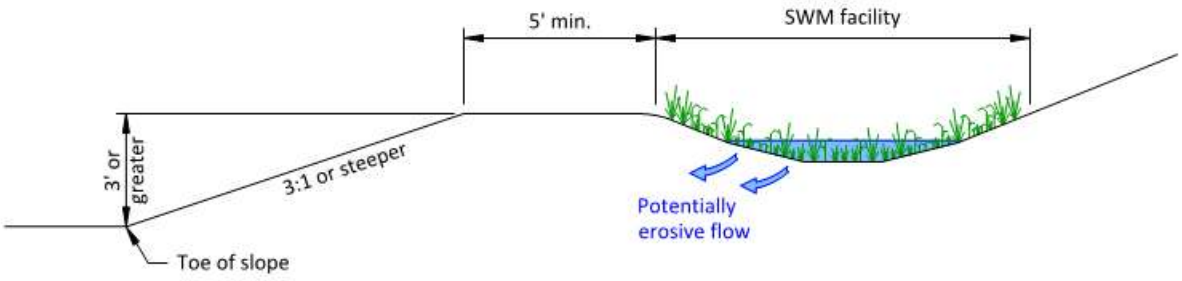
   b) Landscape filter strips must be constructed at least 1 foot above the 10-year flood elevation.

**Figure 420.1 – Minimum Elevations for SWM Facilities**




6. Any SWM facility designed into a slope steeper than 3:1 and exceeding 3 feet in height shall be designed with a 5 foot minimum setback as shown in Figure 420.2.

**Figure 420.2 – Minimum Setback on Slopes**




B. Requirements for SWM facilities constructed within the ROW.

1. When private development creates new, or alters existing, impervious surface within the ROW and no other treatment options are available, construction of new public SWM facilities within the ROW will be allowed. The facilities shall be designed to the City public standards and the City will own and maintain each public facility.

2. No trees may be planted within the defined facility boundary.

3. Utility service lines must be installed below the facility's drain rock.

4. Franchise utilities such as conduit, pedestals, vaults, or junction boxes shall not be allowed within the defined facility boundary.

5. Water meters, fire hydrants, street signs, street lights, and other City utility infrastructure shall only be installed in the upland slope opposite the curb (if present) and not within the defined treatment area of the facility. Installation of such equipment shall not damage subgrade components of the facility.

6. Street-side Infiltration Planters:

   a) Require adjacent maintenance vehicle access, without closing a travel lane, on streets with a posted speed of 35 mph or higher. Maintenance vehicle access shall be a minimum of 10 feet in width and 30 feet in length.

   b) Require a 3-foot or wider step-out zone for access to parked car doors when adjacent to on-street parking.

C. Pretreatment

1. Water quality manholes (WQMH's) shall be installed in locations that require minimal traffic control to access.

D. High-Flow Bypass

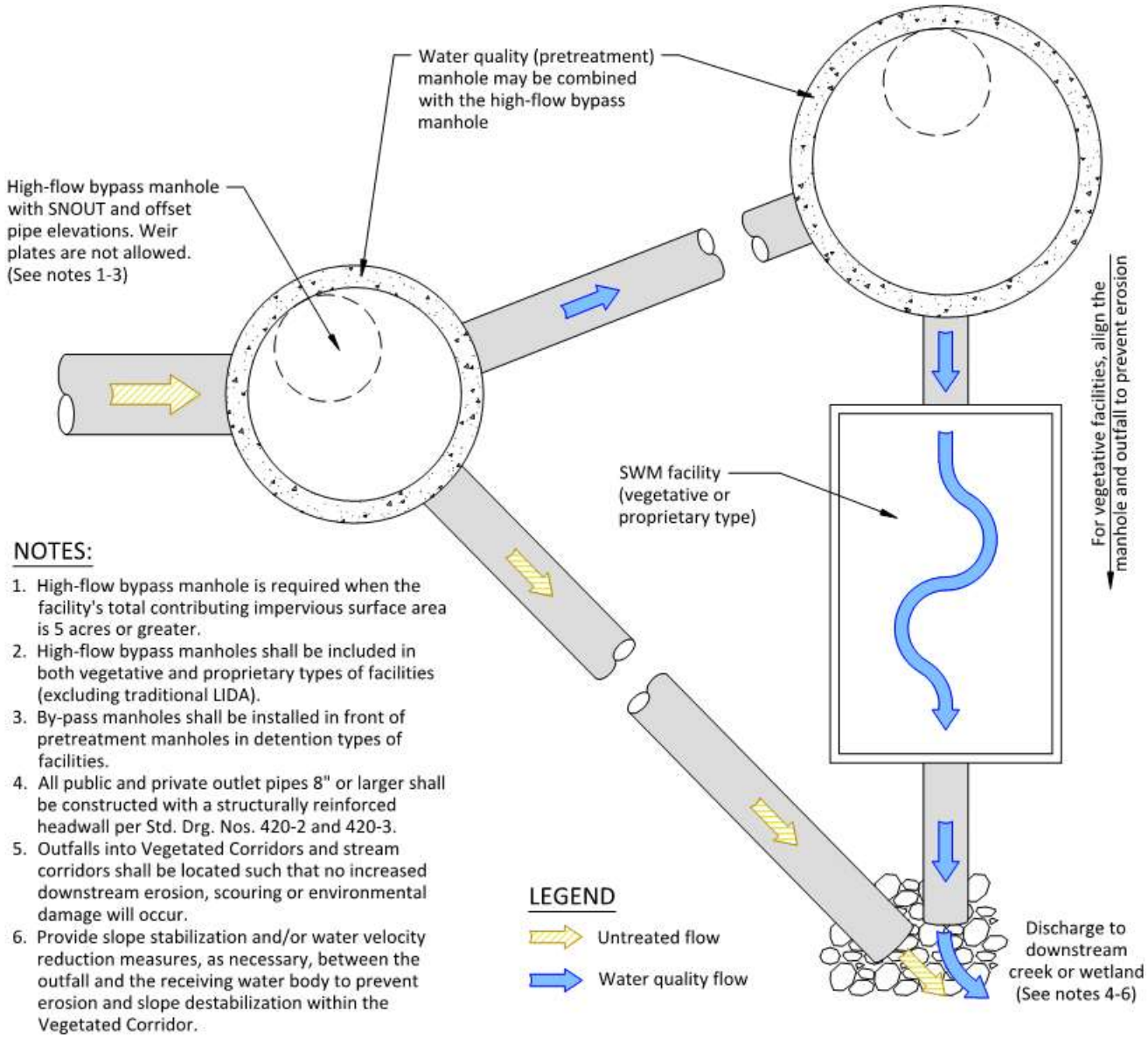
1. Treatment facilities shall include a system to bypass flows larger than the water quality flow if the facility's total contributing impervious surface area is 5 acres or larger.

2. High-flow bypass systems shall be installed for all end of pipe type of facilities. Facilities that directly receive sheet flow do not require a bypass system.

3. High flows shall be diverted upstream of pretreatment manholes.

4. The bypass shall be constructed with a stilling basin at the outfall.

**Figure 420.3 – SWM Facility Diagram**



E. Outfalls

1. When required, headwalls shall be constructed per Std. Drg. No. 420-2 or 420-3.

2. SWM Outfalls into Vegetated Corridors and stream corridors shall be located such flows are evenly dispersed using appropriate velocity reduction methods and are not concentrated prior to discharge into the vegetated corridor.

3. Outfall inverts in detention facilities shall be located above the 2-year storm water surface elevation.

4. Outfalls into SWM facilities shall be aligned and orientated according to the following:

   a) Linear facilities: Outfall should direct flows parallel to the centerline of the treatment channel.

   b) Pond facilities: Outfall should direct flows to the center of the pond.

   c) Outfalls shall not be located in close proximity to a facility's outlet which may reduce retention time and treatment efficiency. The storm drainage report must demonstrate that flow from each outfall location will receive the required treatment and detention time within the facility prior to discharge.

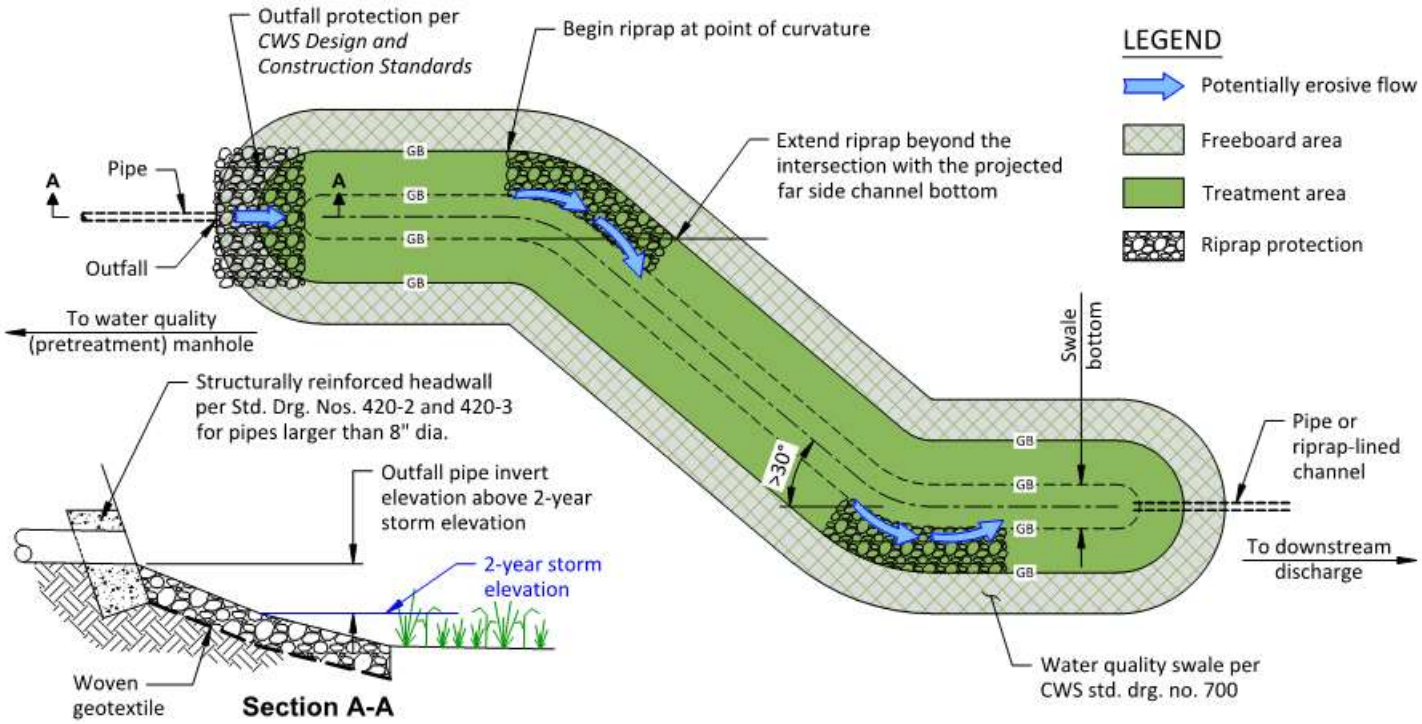
5. Provide slope stabilization and/or water velocity reduction measures, as necessary, between the outfall and the receiving water body to prevent erosion and slope destabilization within the Vegetated Corridor.

F. Riprap

1. For facilities with no high-flow bypass manhole, riprap armoring is required on the outside corners within the treatment channel anywhere the channel changes direction more than 30 degrees as shown in Figure 420.4.

2. Outfall riprap pads must be constructed above the permanent pool elevation of all proposed or repaired outfalls to provide energy dissipation.

**Figure 420.4 – Riprap Protection at Vegetative SWM Facilities**




G. Underdrains

1. All SWM facilities with a permanent pool shall include a gravity drain system for the permanent pool. See Std. Drg. No. 420-4.

H. Facility Elevation Details

1. Plans shall include Standard Details Nos. 1 through 3, as applicable for each facility type, in order to identify the design elevations of the facility. The information shown on the detail must match the design shown in the plans and the stormwater report.

I. Vegetation

1. All trees planted within any vegetative SWM facility shall be located within the freeboard area and not within the treatment or mid-slope areas.

2. Public SWM facilities shall not be planted with fruit bearing vegetation or vegetation types that contain thorns. Vegetation deemed by the City that becomes excessively large when mature will not be allowed within the limits of the facility.

3. Planting plans shall include Standard Detail No. 4, listing all plants in the facility. Plant size, quantity, and species shall meet CWS requirements.

4. All facility vegetation must meet sizing requirements at final inspection. 100 percent of all required plant stock must be correctly planted and alive to receive a final approval and move the facility into the warranty period.

5. A minimum of 80 percent survival of each plant community is required in order to release the 2-year maintenance assurance (warranty bond).

    a) If 80 percent survival has not been achieved by the end of the warranty period, replant and add the necessary vegetation to meet the survival requirement. Replanting will extend the maintenance assurance period up to an additional 2 years.

J. Filter Vaults

1. Filter vaults should be located in non-traffic or light traffic locations and require maintenance vehicle access without closing a travel lane. Vault location needs to include sufficient access for the City's vacuum cleaning truck.

2. Filter vault access hatches need to provide sufficient maintenance access. Standard manhole lids do not provide sufficient access. Vault access hatches should be rated for the appropriate traffic loading. Large hatches should be equipped with a spring assist system for easy opening. Hatches located within sidewalks require a non-skid walking surface.

3. A water quality manhole is required for pretreatment upstream of all filter vaults per Section 420.1.6.C and 420.1.6.D.

420.2. SWM Facility Access and Maintenance

A. All SWM facilities shall provide vehicle access to within 10 feet of all outfalls and stilling basins within the facility.

B. All SWM facilities shall be maintained in accordance with CWS standards and Table 420.2. until accepted by the City.

**Table 420.2 – Required SWM Facility Maintenance Actions**

| Category | Required Maintenance Action |
|---|---|
| Pretreatment | All upstream sumped structures shall be cleaned annually. |
| Vegetation | All weeds, invasive and volunteer vegetation shall be removed annually. All required vegetation quantities shall be maintained and replanted when necessary to maintain the original vegetation quantities identified within the approved plans. |
| Structures | All structures placed within the facility shall be inspected and maintained by the property owner annually. Structures shall remain functional, not blocked or impaired by vegetation, debris, or animal activity. Structures should be cleaned annually to remove all deposits and accumulated material. |
| Sedimentation | The original design elevation of the treatment area shall be monitored and maintained by the property owner through the removal of all excess sedimentation deposits. All inlet and outlet pipes, structures, and riprap shall not be buried or partially buried by sedimentation deposits. |
| Perimeter Boundaries | All fences, retaining walls, and adjacent existing topography shall be monitored and maintained to their original design and condition. All walls shall be maintained such that the integrity of the wall does not negatively impact the facility. |

420.3. Erosion Control Requirements

A. Visible sediment and sediment laden water is prohibited from being discharged, conveyed, tracked or otherwise placed beyond the limits of all construction sites and shall not be discharged into any part of the existing public or private storm sewer system, wetlands, waters of the state or any other natural drainage within, adjacent or outside the limits of the construction site.

1. With approval from the City, all sediment and sediment laden water hauled beyond the limits of the construction site to an approved disposal location shall utilize an appropriate transport method to adequately prevent prohibited spills, leaks and deposits during transport as identified in Section 420.3.A.

B. Additional inlet protection measures may be required if any one measure of inlet protection begins to fail.

C. A concrete washout location and detail shall be included in all projects involving concrete work, including single-family residential.

1. Proposed concrete washout locations will not be placed within the existing or proposed right-of-way for linear projects and are required to be located behind the curb.

D. A dewatering plan is required for all construction projects performing construction activities during the defined wet weather period where dewatering is anticipated by the Project Engineer or City and at any time during the year when mass grading and cut activities are below the calculated water table elevation. All construction projects meeting this requirement shall submit plans during the time of the initial grading and erosion control plan review and include a design using either passive or active treatment methods for approval.

1. When passive treatment method designs are initially used the design shall support a potential upgrade to an active treatment method with minimal site plan changes.

2. Projects with unanticipated dewatering must submit revised grading and erosion control plans with a dewatering plan and receive approval prior to any work requiring the dewatering activity.

3. Dewatering systems may be required to be installed and ready for operational use prior to beginning mass grading and trenching activities during site development.

E. Vegetative SWM facilities shall not be planted until the completion of all mass grading, cut and fill work.

1. Once a SWM facility has been planted, it may not be used as a temporary sediment basin, stilling basin or holding pond.

2. Future SWM facilities that are used as sediment or stilling basins and holding ponds shall have all excess material removed and returned to the final grade shown on the approved plans prior to the addition of topsoil and vegetation.

F. If a site is known to have existing underground drainage systems (field tiles), they shall be shown on the Grading and Erosion Control Plan and submitted to the City for approval. If they are unexpectedly encountered during construction, the systems shall be added to the Grading and Erosion Control Plan and resubmitted to the City for approval. Impacts to the drainage patterns of adjacent properties shall be addressed according to Subsection 420.4. The systems shall either be:

1. Removed; or

2. Left in place and connected to the storm system.

a) If left in place, the design documents, including the drainage report, shall be amended to account for the additional flow that the downstream SWM facility will receive while continuing to demonstrate compliance with all applicable design standards. Record drawings shall depict all field tile connections to the public storm system.

G. Department of State Lands (DSL) and US Army Corps of Engineers (USACE) environmental permit requirements shall be integrated into the local grading and erosion control plans at the time of review. This includes the following:

1. All associated in-water work as approved by DSL & USACE

2. Required stream dewatering and by-pass systems

3. Wetland removal, expansion and offsite mitigation

H. Disturbance within a Vegetated Corridor, including plant removal, enhancement, and/or any other ground disturbing activity over 500 square feet, shall be shown in the erosion control plans with sediment control BMP's as required.

420.4. Grading Requirements

A. Within a proposed development creating multiple tax lots, grading shall direct storm water towards a public conveyance system or an existing natural drainage. Grading shall not direct storm water onto, or across, a series of adjacent tax lots thereby inundating the lot at the lowest point.

B. See the *ODOT Hydraulics Manual* for more information regarding Oregon drainage law.

420.4.1. Oregon Drainage Law

A. Oregon drainage law, which originates from common law or case law, has developed without legislative action, and it is embodied in the decisions of the courts. Therefore, there are no Oregon Revised Statues to cite pertaining to Oregon drainage law.

B. Oregon has adopted the civil law doctrine of drainage. Under this doctrine, adjoining landowners are entitled to have the normal course of natural drainage maintained. The lower owner must accept water that naturally comes to his land from above, but he is entitled to not have the normal drainage changed or substantially increased. The lower landowner may not obstruct the runoff from the upper land if the upper landowner is properly discharging the water.

C. For a landowner to drain water onto lands of another in the State of Oregon, one of two conditions must be satisfied initially: (1) the lands must contain a natural drainage course; or, (2) the landowner must have acquired the right of drainage supported by valuable consideration (i.e. a purchased drainage easement). In addition, because Oregon has adopted the civil law doctrine of drainage, the following three basic elements must be followed.

1. A landowner may not divert water onto adjoining land that would not otherwise have flowed there. "Divert water" includes but is not necessarily limited to:

    a) water diverted from one drainage area to another, and,

    b) water collected and discharged which normally would infiltrate into the ground, pond, and/or evaporate.

2. The upper landowner may not change the place where the water flows onto the lower owner's land. (Most of the diversions not in compliance with this element result from grading and paving work and/or improvements to water collection systems.)

3. The upper landowner may not accumulate a large quantity of water, then release it, greatly accelerating the flow onto the lower owner’s land. This does not mean that the upper landowner cannot accelerate the water at all; experience has found the drainage to be improper only when the acceleration and concentration were substantially increased.

D. Subsurface waters which percolate to the surface can be intercepted and diverted for the protection of the highway without regard for the loss of these waters to the adjacent landowners. In those cases where wells and springs are involved, the right-of-way agent should contact the affected owner(s) to prevent any misunderstanding over damage that could be claimed.

E. Drainage designs should satisfy Oregon drainage law to avoid claims or litigation resulting from improper drainage design. When it is apparent that the drainage design will not satisfy the law, then drainage easements should be obtained from the affected property owners. The legal staff should be consulted in those situations that appear to be unique and could result in litigation.

F. Where certain drainage patterns have been established over long periods of time (i.e. in excess of at least 10 years), that are not the original natural drainage, there may be legal rights acquired which allow the continuance of the altered drainage pattern. Again, legal staff should be consulted in such situations.

## 430. Sanitary Sewer

A. Manholes constructed outside of roadways and developed areas shall be constructed with a finished rim elevation 1 foot above the surrounding elevation.

B. Lateral connections within 15 feet of the top of the system shall be made using an approved factory wye fitting. Other angled fittings shall be used as necessary to establish the required perpendicular angle at the mainline and at the right-of-way or property line. The pipe distance between fittings shall be minimized to establish the required *straight* line from the mainline to the ROW or easement boundary. Any wye connections shall be approved at the discretion of the City.

C. Pipes buried to a depth of 20 feet or greater, as measured from ground surface to the pipe invert elevation, shall use pipe material type C900 or C905.

D. At locations where a new manhole is constructed over an existing mainline for the purpose of connecting a new mainline or lateral, the manhole channel shall be constructed to smoothly transition the direction of incoming flows towards the pipe exiting the manhole.

## SECTION 500

## 500. WATER SYSTEM

### 510. General Requirements

#### 510.1. Scope

The following guidelines and specifications are set forth as minimum standards for the planning, design, and construction of public water system improvements. In the event these guidelines and specifications do not address a specific situation, the Water Department shall, at its discretion, determine the appropriate course of action to be followed. The Water Department may revise these requirements at any time without prior notification.

As a part of the design process for public water systems, it is highly recommended that the Engineer meet with a Water Department representative to review criteria and lay out the water system prior to plan submittal (www.hillsboro-oregon.gov/departments/water/contact-us). It is also recommended that the Engineer meet with the City of Hillsboro fire code official to ensure compliance with any applicable provisions of the Oregon Fire Code.

#### 510.2. General Design Requirements

When designing public water system improvements, system hydraulics are to be analyzed using projections and data from the current City *Water System Master Plan* (WMP). The water system analysis shall include the fire demand and a simultaneous demand for the maximum (peak) day demand or peak hour non-fire demand, whichever is greater.

Data used to calculate available water supply for fire or non-fire demand shall be obtained from hydrant flow tests conducted by Water Department. The flow test information will provide a "snap shot" of the flow and pressure measured in the water system at a given location and time. The Engineer shall recognize the actual flow and pressure available will vary depending on the time of day, water system demands, and future development. The Water Department recommends the Engineer include in their water system design all the safety factors identified in the flow test report. This recommendation does not relieve the Engineer of the responsibility to ensure the adequate long-term viability of any development.

The fire flow demand shall be as specified by the Fire Marshal as applicable for the location, land use type, proposed buildings, and occupancy hazard.

Required fire flow shall be determined based on the proposed building size, construction type and occupancy hazards and shall be approved by the fire code official in accordance with the 2014 Oregon Fire Code [2012 ICC International Fire Code] or current version adopted by the State of Oregon and any local amendments adopted by the City of Hillsboro.

If a water system flow test and analysis is required as a condition of approval, the hydrant flow test is to be conducted by the City of Hillsboro Water Department and analyzed by the developer's

Engineer. The following steps are to be performed by the Engineer in order to obtain the flow test data and produce the water system analysis:

1. A written request for a hydrant flow test must be submitted by the applicant/engineer to the City of Hillsboro Water Engineering staff (phone 503-615-6702) (www.hillsboro-oregon.gov/Water). Allow seven (7) to ten (10) working days for flow test results, unless an extended 7-day Static Hydrant Pressure Logging (ESHPL) is requested. Allow an additional seven (7) calendar days for results if the ESHPL is requested.

2. Two stamped copies of the design calculations and other relevant documentation, including all assumptions and hydrant flow test results, are to be provided by a registered professional engineer to the City Building and Fire Departments for review and evaluation.

510.2.1. Public Water Easement

All water infrastructures are to be located within a dedicated public right-of-way. When it is not practical or possible, or a situation exists where the Water Department requires the improvements to be placed outside of site right-of-way, an easement shall be provided. The minimum water main easement shall be 15 feet wide (when placed in a roadway or parking area) and a minimum 20 feet wide if vehicular access is not normally available.

The easement shall be exclusive for water mains and appurtenances and not shared with other utilities or structures (unless otherwise approved by the Water Department). The easement shall allow the City to construct, inspect, operate, maintain, replace, reconstruct, or remove the water distribution system. Water services or facilities located on private property shall be in a recorded easement measuring 5 feet to 10 feet from each outside wall of the meter vault or box, depending on water service size. Easement shall be titled “PERMANENT WATER SYSTEM FACILITIES EASEMENT”.

Private water service lines (downstream from the water meter) which cross another private property or which may be located within and running parallel to the Public Utility Easement (PUE), must be placed in an easement identified as “Private Water Easement”.

Meter boxes or other public water infrastructure shall not be located in a Public Utility Easement (PUE).

All easements shall be recorded prior to City acceptance.

See Subsection 130 “Easements” for additional information and requirements.

510.3. General Material Requirements

All materials shall be new and undamaged. No rebuilt, reconditioned, or used material will be allowed. Any internal or external imperfections found with the product must be returned to the manufacture and replaced.

The same manufacturer of each item shall be used throughout the project.

All materials not specifically referenced shall comply with applicable sections of ASNI, ASTM, or the AWWA Standard Specifications with review approval from the Water Department.

See City of Hillsboro Water Department Approved Product List, located on the City of Hillsboro website.

### 510.4. General Construction Requirements

Improvements shall be constructed as shown on the plans and in accordance with these Standards and Standard Drawings. Equipment and materials shall be installed in compliance with the manufacturer's recommendations, except where a higher quality of workmanship is required by the Plan Specifications and these Standards.

All materials and work shall be in strict accordance with any applicable regulations and requirements of Federal, State, and local authorities. The Contractor may be required to arrange for inspection by these agencies and submit evidence of their approval, when required or requested by the Water Department.

Take care to prevent damage to pipe, fittings, and other materials and equipment during transportation, unloading, and final placement for installation. Manufacturer recommended product handling shall be followed to protect coatings, linings, and structural integrity of materials used in public water system construction. Under no circumstances shall materials be dropped or dumped into the trench.

All damaged materials and equipment during construction shall be replaced or repaired to the satisfaction of the Water Department.

The Contractor shall maintain safe working conditions for employees, City staff, and the general public in and around trench excavations. Precautions shall be taken to avoid damage to franchise utilities, adjacent properties, existing water infrastructure, and public or private landscapes/hardscapes. If any underground utilities are damaged, report damage to Water Department Operations.

#### 510.4.1. Maintaining Existing Service

It is required to maintain continuous water service to existing water users at all times. The Contractor shall schedule construction work accordingly. When it becomes necessary to shut down service to make required inter-ties or repairs, the Contractor shall notify and get shut-off date approval from the Water Department so affected customers can be timely notified in advance.

If a fire system is affected, the Contractor is required to contact the approved fire code official for alternate fire protection requirements.

#### 510.4.2. Non-Emergency Water Shut-off Notification

Water main and service shut-offs are to be coordinated through a Water Department representative. Customers are required to be notified a minimum of 48-hours prior for residential

properties and 72-hours for commercial or industrial properties. Weekends and holidays are not to be counted as part of notification time.

510.4.3. Bulk Water

Water will be available for the Contractor's use from approved fire hydrants upon purchase of a Bulk Water Permit from the Water Department. Site specific hydrants for Bulk Water usage may be allowed on a case-by-case basis, at the sole discretion of the Water Department. The Contractor or developer shall submit a written request to the Water Department, including: project name, location, and reason for request.

All bulk water usage shall be metered and include an approved backflow assembly when required. Bulk Water meters are supplied by the Water Department with the permit.

Bulk Water Permits and tanker vehicle inspections shall be administered at the Water Departments Operations Building at 390 West Main Street or by an approved Water Department representative.

Bulk water tank filling is also available at the above location, at regular business hours, for a fixed fee.

**Related Standard Drawing: 640-1**

510.4.4. Valve Operation

No Hillsboro water system valves within the City's water service area shall be operated without authorization by the City of Hillsboro Water Department.

510.4.5. Staking Requirements

Construction staking is required for all water system improvements. Staking shall be performed by or under the supervision of an Oregon Registered Professional Land Surveyor or Registered Professional Engineer.

Staking shall be in place prior to installation of water system improvements. Staking shall be preserved and shall not be disturbed until the Construction Inspector authorizes it to be removed. If staking is disturbed or removed prior to the Inspector's approval, it shall be promptly replaced.

Line and grade stakes for water mains shall be provided on an offset line at intervals not exceeding 50 feet. Offset distances shall not be greater than 20 feet. Stakes shall be marked with stationing as well as Hub elevations and elevation references (cut/fill) to finished grade, i.e., and/or to top of pipe.

Locations of taps, valves, fittings, hydrants, water meters, and other appurtenances shall be stake with offset stakes. Hydrant and meter stakes shall be marked with elevation references (cut/fill) to top of curb or to finished grade if no curb will be installed. Meter stakes shall be marked with lot numbers.

At the end of each project all survey staking material must be removed from site before being declared complete.

## 520. Trenching, Backfill, and Surface Restoration

### 520.1. Design Requirements

#### 520.1.1 Erosion/Sediment Control

An erosion control plan shall be designed and approved for all water related projects. Requirements for design of the plan shall conform to Subsection 115.4.11 “Site Grading and Erosion Control” of this manual.

### 520.2. Materials

#### 520.2.1. Foundation Stabilization Materials

2” to 3” dense graded crushed rock meeting ODOT Standard Specifications Section 00641, Section 02630, and is approved by the Water Department.

Geotextile fabric is to meet ODOT Standard Specification Table 02320-1 (Drainage) for Type 2 geotextiles.

#### 520.2.2. Bedding and Pipe Zone Materials

Class “B”
¾”-0” dense graded crushed rock, with no more than 5% passing the No.200 sieve (wet test) and meeting ODOT Standard Specification Section 00641 and Section 02630.

Class “E”
Controlled Low-Strength Material (CLSM) conforming to ODOT Standard Specifications Section 00442. All CLSM mix designs are to be submitted for approval and must include 28 day cylinder break report from test batch as evidence of compressive strength, not exceeding 150 psi.

#### 520.2.3. Backfill Materials

Class “B”
¾”-0” dense graded crushed rock, with no more than 5% passing the No.200 sieve (wet test) and meeting ODOT Standard Specifications Section 00641 and Section 02630.

Class “A”
Clean native or imported earth material free of organics, rock, stones, wood, and other debris.

### 520.3. Construction

#### 520.3.1. Excavation

The Contractor is to provide all materials, labor, and equipment necessary to protect trench excavations at all times.

Excavations within the public right-of-way are required to be backfilled by the end of the work shifts, unless another method for safely covering the excavation is approved by the Water Department.

Disposal of all excavated materials shall be at an approved permitted dumpsite meeting all State and local requirements.

520.3.2. Trenching Requirements

The allowable open trench length is typically 300 feet. This distance may be reduced within public right-of-way areas based on safety concerns, work conditions, vehicle access, or lack of Contractor resources for trench area management.

The minimum trench width allowed is 24 inches and increases based on the pipe diameter. Consideration shall be taken to ensure trench is wide enough to accommodate shoring, protective structures, pipe installation, backfilling and compaction.

The Contractor shall provide means and equipment for trench dewatering during all construction. Water shall be disposed of in an approved manner to reduce impact and prevent all facility and property damage. Water discharge shall meet the requirements of the Clean Water Services (CWS) “Erosion Prevention and Sediment Control Planning and Design Manual”.

**Related Standard Drawings: 520-1**

520.3.3. Pipe Bedding and Trench Backfill

Compaction of trench backfill materials shall be according to Oregon Standard Specifications for Construction Section 00330.43a, b, and c.

Foundation Stabilization Material Placement

If the material at the bottom of an excavation is deemed by the Water Department as unsuitable for support, the Contractor shall over excavate as directed and replace with foundation drain rock with gradation as requested by the Engineer. Foundation stabilization material shall be placed in 6-inch lifts and compacted up to the required grade.

Geotextile fabric may be approved for use in place of or in addition to over excavation and stabilization rock. A registered Geotechnical Engineer must be consulted if deemed necessary by the Water Department.

Pipe Bedding Placement

Place pipe bedding material to a minimum thickness of 4 inches below the outside bottom of the pipe barrel then spread smoothly to the proper grade so that the pipe is uniformly supported

along the entire barrel length. Pipe bedding material shall be compacted to a minimum 95% maximum density, in accordance with AASHTO T-99.

Excavate bell holes for each joint to permit proper assembly and inspection.

Pipe Zone Material

Place material in loose lifts, not exceeding 6 inches, compacting by hand under the haunches of the pipe and in areas not accessible to mechanical tampers. Bring lifts up evenly to a minimum of 8 inches above the top of pipe. Pipe zone material shall be compacted to a minimum 95% maximum density, in accordant with AASHTO T-99.

Trench Backfill

Backfill the trench in loose lifts of 12 inches to 24 inches depending on compaction method. Compact material to a minimum 95% of maximum density as determined by AASHTO T-99.

Water settling methods are not allowed.

CLSM Backfill

Discharge CLSM material from the mixing truck into the trench in a way that prevents dislodging or the shifting of water mains or other infrastructure from intended elevation and alignment. This may require multiple pours to accomplish, especially if buoyancy is a factor. The flowability (slump) shall be adjusted, as needed, to guarantee all voids within the trench are filled as required.

CLSM is not to be placed in temperatures 38° F or less, or poured on frozen ground.

Use sandbags, wood forms, or other barriers to contain CLSM mix as needed. Such barriers may require removal before burial. Properly seal and protect culverts, pipelines and other effected utilities from CLSM infiltration.

All ground and surface water in the trench shall be controlled during placement of CLSM. At no time will CLSM be allowed to be poured in submerged conditions.

Allow CLSM to firmly set prior to placement of additional lifts. To prevent rutting and displacement CLSM shall set a minimum of 24 hours before traffic or construction equipment come into contact with the material. In roadway areas where traffic will need to be restored at the end of the work shift, steel sheeting shall be used until CLSM has hardened and road surface has been rebuilt.

Test cylinders shall be prepared according to ASTM D-4832. Field testing of CLSM shall include one (1) set of four (4) 3” x 6” cylinders. Two (2) cylinders are for break at 7 day and two (2) for break at 28 day.

**Related Standard Drawings: 520-1**

520.3.4. Compaction Testing

For quality control, a third party ODOT certified testing company shall be contracted to perform nuclear density testing and any other applicable testing. Compaction test requirements shall be in accordance with ASTM D698.

A standard proctor is to be obtained through an approved certified testing laboratory for all materials used by the Contractor.
Generally, tests are to be performed one (1) every 100 feet of linear trench for pipeline trenches, and minimum one (1) test for each water service or other lateral appurtenance trench. Trenches 5 feet and greater will require compaction testing every 2 feet of depth. Frequency of in field testing will be determined by excavation type, depth of excavation, and the Contractor's compaction methods and equipment.

If trench backfill does not pass compaction testing it shall be evaluated for deficiencies, such as inadequate moisture, material inconsistencies, and contamination. The Contractor shall discuss a plan for correcting these deficiencies by means of increased compaction effort, addition of water, or the removal and replacement of backfill material. Plan must be approved by the Water Department.

Trench backfill within an existing roadway is to be visually tested for soft spots at finish grade of the rock subgrade, according to ODOT TM 158 in ODOT Manual of Field Test Procedures.

## 530. Water Main Piping

### 530.1. Design Requirements

#### 530.1.1. Pipe Sizes

All hydraulic calculations to determine pipeline sizing are to be made using Hazen-Williams "C" coefficient of 100 and velocity not exceeding 5 fps. The following pipe sizes are accepted for use in the Hillsboro water system: 4, 6, 8, 12, 18, and 24-inch. Distribution water mains typically have a minimum 8-inch diameter.

Water piping serving dead-end streets may be reduced in size below 8 inches if all of the following conditions apply to the waterline:

1. It is under 300 feet in length.
2. It has no more than eight (8) service connections.
3. There is no possibility for future extension.
4. Design is accompanied by hydraulic calculations validating that the minimum fire flow required by the fire code official can be met.

The Engineer is encouraged to meet with a Water Department representative prior to design to discuss the size of water mains and any other matters particular to the project (www.hillsboro-oregon.gov/departments/water/contact-us). Pipeline size shall be determined based on service area and system requirements, or as established in the current City WMP.

530.1.2. Pipe Location

Water mains shall be located in the roadway, typically 6 feet from the South or East curb face. If the roadway does not currently have a curb, the Engineer is to use the proposed future location of the curb. Future curb locations can be found in the City's *Transportation System Plan* which is available from the Planning Department. Water mains along looped or curved streets shall not switch sides and be located on either the inside or outside of the loop.

**Related Standard Drawings: 530-1**

530.1.3. Pipe Depth

Minimum required cover over water main piping is 36 inches in improved areas and 48 inches in unimproved areas.

Care shall be taken to maintain the required cover depth over water system piping and appurtenances in all easement areas.

530.1.4. Pipe Deflection

Location and degree of deflection at joints shall be shown on plans for all vertical and/or horizontal pipe deflection. See Subsection 530.3.2. "Pipe Joining".

530.1.5. Clearances from Other Utilities

All clearances listed below are measured from the edge of each pipe and/or utility.

Water services and sewer laterals shall have a 5 foot minimum horizontal separation.

Maintain minimum vertical and horizontal clearances. Avoid crossing at highly acute angles.

Horizontal clearances from water piping and appurtenances:

| | |
|---|---|
| Cable TV | 5' |
| Natural Gas | 5' |
| Electrical | 5' |
| Storm Sewer | 5' |
| Sanitary Sewer | 10' or as allowed by OAR 333-061-0050 |
| Telephone, Fiber Optics | 5' |
| Other (not specified) | 5' or as required by the Water Department |

Vertical clearances from water piping and appurtenances (for crossing only):

| | |
|---|---|
| Cable TV | 12” |
| Natural Gas | 12” |
| Electrical | 12” |
| Storm Sewer | 12” |
| Sanitary Sewer | 18” or as allowed by OAR 33-061-0050 |
| Telephone Fiber Optics | 12” |
| Other (not specified) | 12” or as required by the Water Department |

All utilities shall cross under water piping and appurtenances unless otherwise authorized by the Water Department Engineering Manager.

Where a water pipe crosses below a sanitary sewer line, one full length of water pipe shall be used with the pipe centered for maximum joint separation. Spacing and separation may be modified as allowed by OAR 333-061-0050 and approved by the Water Department Engineering Manager.

530.1.6. Pipeline Extensions

If the need for an extension of public water system results from property development, the extension shall be at the expense of the owner(s) of the parcel(s) for which the extension is necessary. The condition is applicable to the full length of all street frontages.

Water systems shall be installed through new development or improvements to existing infrastructure. Water system improvements shall take into consideration future development and effects to adjacent and downstream properties.

530.1.7. Dead-End Mains

Dead-end waterlines shall be avoided whenever possible. Considerations for allowances of dead-end water mains are: future development, cul-de-sacs, or when the looping of the water system or banking of water meters is not practical.

A line size valve shall be installed on all dead-end water mains where future extensions are probable. Dead-end water mains shall terminate prior to property boundary and be equipped with a blow-off assembly.

530.1.8. Blow-off Assemblies

Blow-off assemblies shall be required on all dead-end water mains for flushing, disinfection, and operational flushing necessary for maintaining water quality. For blow-off sizing requirements refer to the flow chart in Subsection 530.4.1. “Filling and Flushing”.

530.1.9. Auto-Flushers

An auto-flusher may be required for maintaining water quality on dead-end water mains and large water mains designed for future water supply needs. The projected usage necessary for meeting the Oregon Health Division’s minimum standards for safe drinking water will be evaluated in determining auto-flusher requirements.

Proper drainage shall be considered when planning installation of an auto-flusher. If installed within 1000 feet of a waterway or designated wetland, water shall discharge into a public sanitary or storm sewer, unless otherwise approved by the Water Department.

530.2. Materials

530.2.1. Ductile Iron Pipes

Ductile iron pipe shall be Class 52 thickness, conforming to the latest revision of ANSI/AWWA C151/A21.51.

An Affidavit shall be provided with each shipment stating the ductile iron pipe was cast from a domestic raw material source consisting of at least 75% recycled ferrous metals. The Affidavit shall be signed by a Professional Engineer registered in the state of the source manufacturing facility.

All ductile iron pipes shall be factory cement-lined and seal-coated conforming to ANSI/AWWA C104/A21.4.

The exterior of the ductile iron pipe shall be coated with a layer of arc-applied or paint-applied zinc coating per ISO 8179. The mass of of the zinc shall be 200 $g/m^2$ of the pipe surface area. The outside coating of the pipe shall consist of an asphaltic seal coat approximately 1 mil thick conforming to ANSI/AWWA C151/A21.51. Pipe markings shall include he word “Zinc” in the pipe markings or label required by AWWA C-151 and/or other markings as deemed appropriate by the manufacturer.

Pipe shall be furnished in 18-foot or 20-foot lengths.

All ductile iron pipe shall be sourced and manufactured in the United States of America. No exceptions will be allowed.

530.2.2. Push-on Joints

All push-on gaskets shall be restraining gaskets designed for use in either Fastite or Tyton joint manufactured pipe. Push-on gaskets shall conform to ANSI/AWWA C11/A21.11. Gaskets for pipe

sizes 4-inch to 12-inch shall be rated for 350 psi. Gaskets for 18-inch to 24-inch pipes shall be rated for 250 psi.

530.2.3. Ductile Iron Fittings

All ductile iron fittings shall be manufactured in the United States of America. Any exceptions shall require prior written approval from the Water Department Engineering Manager.

All fittings shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C153/A21.53. Fittings shall have cast upon them the manufacturer's identification, pressure rating, nominal diameters of openings, and the number of degrees or fractions of a circle for all bends.

Fittings shall be coated inside with an approved epoxy or cement mortar with an asphaltic seal coat conforming to AWWA C104. Fittings shall be coated outside with an approved epoxy or a bituminous coating at least 1 mil thick, as specified in Section 4.4 of AWWA C110.

Fittings shall be ductile iron mechanical joint (MJ) or flange joint (FLG) conforming to AWWA C153 and C110.

Specialized fittings may be required by the Water Department when involving bridge infrastructure, casing pipe or pipes with high vibration exposure.

530.2.4. Mechanical Joint Fittings and Restraints

All mechanical joint fittings shall include mechanical restraints. All mechanical restraints shall be manufactured in the United States of America. Any exceptions shall require prior written approval from the Water Department Engineering Manager.

Ductile iron mechanical joint fittings and accessories shall conform to ANSI/AWWA C11/A21.11, ANSI/AWWA C110/21.20, and ANSI/AWWA C153/A21.53. Fittings for pipe sizes 4-inch to 24-inch shall be rated for 350 psi working pressure.

Tee-head bolts and nuts shall be "Cor-Ten" or ductile iron conforming to ANSI B18.2 and ASTM A307.

Mechanical joint restraints shall be an integral part of the follower gland. Restraint shall be provided by individually activated wedges that increase resistance to pullout as the force of pressure is increased. Joint restraint ring and wedge components shall be constructed of grade 60-42-10 ductile iron, conforming at ASTM A536. Wedges shall be heat-treated to a minimum hardness of 370 BHM. The dimensions of the follower gland shall be compatible with joint bells conforming to ANSI/AWWA A21.10/C110 and ANSI/AWWA A21.52/C153. Mechanical restraint systems shall be pressure rated to a minimum 350 psi for sizes up to 16-inch and 250 psi for pipe sizes 18-inch and larger.

530.2.5. Flange Joints

Flange fittings are allowed only where shown on the Standard Drawings, or as approved by the Water Department.

Flange bolt holes and pattern shall conform to ANSI B16.1 for class 125 flanges or ANSI B16.5 for class 150 flanges. Class 250 flanges are not compatible with classes 135 and 150 bolt pattern. Gaskets for flanged joints shall be full face, 1/8-inch thick rubber or synthetic rubber, with holes for passing bolts through and conforming to ANSI/AWWA C110/A21.10 and ANSI/AWWA C153/A21.53.

Bolts for flanged joints shall be the size and quantity shown on Table 14 of AWWA C110. Bolts and nuts shall conform to ANSI B18.2 and ASTM A307, with threads conforming to ASME B1.1.

Flange joints are to have a minimum pressure rating of 250 psi.

530.2.6. Restrained Flange Coupling Adaptors/Dismantling Joints

Gland and flange body shall be ductile iron per ASTM A536, grade 65-45-12, and compatible with ANSI class 125 and 150 bolt circles.

Restraining bolts and lugs shall be ductile iron per ASTM A536.

T-Bolts and nuts shall be high strength low alloy steel which meets AWWA C111.

Gasket materials shall conform to ASTM D20.

Steel bolts shall meet or exceed the requirements of ASTM A307 or ASTM F568M for carbon steel or ASTM F593 or ASTM F738M for stainless steel.

530.2.7. Tapping Sleeves

Tapping sleeves shall conform to ANSI/AWWA C223 unless otherwise specified.

The tapping sleeve body and flange shall be stainless steel Type 304, conforming to ASTM A240. Flange class shall conform to Subsection 530.2.5 “Flanged Joints” and accommodate tapping flanges per MSS SP-60.

Gaskets shall seal the full circumference of the pipe conforming to ASTM D2000.

Bolts and hardware shall be stainless steel Type 304 and be coated to reduce galling.

Tapping sleeves shall be equipped with a ¾-inch NPT brass or stainless steel test plug for seal testing prior to tapping.

**Related Standard Drawings: 530-2**

530.2.8. Casing Pipe, Spacers, and Seals

Casing pipe shall be smooth steel conforming to ASTM A36. The minimum wall thickness shall be as required by the jurisdiction governing the highway, railway, or waterway crossed. Casing pipe shall not have a wall thickness less than ¼-inch.

Casing spacers shall be used to support the carrier pipe within the casing and help resist movement of the pipeline. Casing spacers and hardware shall be manufactured from stainless steel, be of 2-piece construction, and a minimum 12 inches wide.
Skids are to be manufactured out of polyethylene for insulation and abrasion resistance.

The spacer shall have a minimum of four (4) runners for carrier pipe sizes up to 12-inch, and six (6) runners for carrier pipe sizes through 24-inch.

Casing seals are to be either a slip-on boot style or split wrap-around style. Slip-on boot style seals are to be manufactured out of 1/8-inch synthetic neoprene rubber and be secured by two (2) stainless steel bands and clamps. Split wrap-around style seals are to be manufactured from 1/8-inch flexible coal tar, reinforced with fiberglass and include two (2) stainless steel bands and clamps.

530.2.9. Blow-off Assemblies

2-inch Blow-off Assembly (Permanent)
The blow-off assembly shall be self-draining, non-freeze type.

Design of the blow-off shall allow for repair and maintenance work to be performed without excavation. The size of the device shall allow for installation within a “Portland” style valve box. See Subsection 540.3.7 “Valve Boxes”.

The inlet and outlet connections and all internal working parts of the assembly shall be constructed of brass. Inlet shall be a vertical 2-inch female iron pipe thread connection. The outlet shall be a male iron pipe thread connection.

Pipe and fittings between the ductile main and the self-draining blow-off assembly shall be 2-inch brass. An independent curb valve is to be installed just downstream of the ductile iron pipe to aid in maintenance of the blow-off assembly. All piping, fittings, and meter stops shall meet requirements of Section 560 “Water Service Connections”.

4-inch Blow-off Assembly (Temporary)
All pipe and fittings are to meet requirements of this Subsection. The 4-inch gate valve must meet requirements of Subsection 540.2.1. “Gate Valves”.

**Related Standard Drawings: 530-3, 530-4, 530-5**

530.2.10. Auto-Flushers

Auto-flusher assembly inlets shall be either FIPT or MIPT connection manufacture from brass or stainless steel.

Piping and electronics are to be rated at 150 psi or greater.

Piping for auto-flushers is to be 2-inch type K rigid copper with an isolation valve located at the water main.

Device controller is to be stand-alone 9 volt DC powered, programmable for up to 12 flushing cycles per day.

**Related Standard Drawings: 530-6**

530.3. Construction

If a project contains multiple connection points to the City's existing water system, only one connection will be allowed until all testing, disinfection, and acceptance of water improvements has been completed to the satisfaction of the Water Department. The Contractor is to install a temporary blow-off at the end of each leg prior to the tie-in point to allow for flushing of the system.

Proper equipment, tools, and facilities shall be provided and used by the Contractor for the safe and convenient execution of the work.

530.3.1. Pipe Installation

All pipe and appurtenances shall be installed at the location, elevation, and grade shown on the plans, or as directed by the Water Department. At no time shall the water line deviate more than 1-inch vertically or horizontally from the approved design, without prior approval from the Water Department.

Pipe configuration shall be with the bell pointed in direction of installation whenever practical.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed. During installation no debris, tools, clothing, or other materials shall be placed in the pipe. When pipe installation is not in progress, the ends of the pipe shall be closed by a watertight plug or equivalent mechanical means.

Full lengths of pipe shall be used whenever possible to limit the number of joints. Pipe lengths less than 2 feet shall not be used unless approved by the Water Department.

The cutting of pipe must be executed in a neat manner without damage to the pipe or the lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the pipe ends shall be dressed with a file or power grinder to remove all rough and sharp edges. Cut ends of push-on joint pipe shall be suitably beveled. Approved cutting equipment includes abrasive cut-off saw, rotary wheel cutter, a guillotine pipe saw, or milling wheel saw.

530.3.2. Pipe Joining

<u>Cleaning</u>
Before joining, all pipe contact surfaces are to be thoroughly cleaned, wire brushed if necessary, and kept clean until joining is completed. Remove all lumps, blisters, and excess coal tar coating from the bell and spigot ends of each pipe and fitting.

<u>Mechanical Joints</u>
All mechanical joints shall be installed with joint restraints.

Installation of mechanical joints shall be as recommended by the manufacturer and in accordance with ANSI/AWWA C111/A21.11 Appendix A. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled.

Bolts shall be uniformly tightened to the torque valves listed below or according to manufacturer's instructions, whichever is greater.

**Table 530.1 – Mechanical Joint Bolt Torque**

| Joint Size (in.) | Bolt Size (in.) | Range of Torque (ft-lbs) |
|---|---|---|
| 3 | 5/8 | 45-60 |
| 4-24 | ¾ | 75-90 |
| 30-36 | 1 | 100-120 |
| 42-48 | 1¼ | 120-150 |

The above torque loads may be applied with torque measuring or indicating wrenches.

If effective sealing is not attained by the maximum torque indicated above, disassemble the joint and reassemble after thorough cleaning. Overstressing of bolts to compensate for poor installation is not permitted.

Push-on Joints

All push-on joints shall be restrained.

Installation of push-on joints shall be according to manufacturer's recommendations and AWWA C600.

All joint surfaces shall be lubricated immediately before joining of pipe with an NSF approved joint lubricant, as recommended by the gasket manufacturer.

The Contractor shall take precaution not to damage the pipe, gasket, or fittings when pushing pipe together. Pipe spigot is to be squared with pipe bell prior to the joining process. If deflection is needed at a push-on joint, deflection shall take place after pipe is shoved home in the bell.

Deflection

Pipe deflection shall not exceed the values listed in the table below, or the manufacture's maximum allowable pipe joint deflection, whichever is less.

**Table 530.2 – Maximum Allowable Deflection for D.I. Pipe Restrained Joints**

| (18-foot pipe length) | | |
|---|---|---|
| Pipe Diameter (inches) | Push-On Joint Maximum Deflection | |
| | Angle (degrees) | Offset per 18-foot pipe length (in.) |
| 4 | 5 | 18 |
| 6 | 5 | 18 |
| 8 | 5 | 18 |
| 12 | 5 | 18 |
| 18 | 3 | 15 |
| 24 | 2.5 | 9.5 |

Flange Joints

Installation of flange joints shall be according to manufacturer's recommendations and ANSI/AWWA C111/A21.11 Appendix C.

Flange faces shall be flat and perpendicular to the pipe center line. Flange faces must be cleaned with a wire wheel prior to installation of the valve. Flange bolts shall be tightened in a progressively crisscross pattern, such as by first tightening the bottom bolt; then the top bolt; next the bolts on either side; finally, the remaining bolts. This process should be repeated until all bolts are sufficiently tightened. Bolts for flange fittings shall be long enough to tighten through the nut and have three threads exposed beyond the nut.

530.3.3. Thrust and Straddle Blocks

The Water Department will only accept concrete thrust blocking where shown on Standard Drawings or for applications where joint restraints are not feasible. Cost is not a determining factor in feasibility.

When permitted, install thrust blocking according to the Standard Drawings. Concrete shall have a slump of 2 to 4 inches and shall comply with ODOT Standard Specifications Section 2001.29 (Class 3000 – ¾-inch) "Commercial Grade Concrete". Any field mixing of concrete must be approved by the Water Department staff.

Concrete blocking shall extend from the fitting to solid undisturbed earth and installed so that all joints are accessible for repair. Prior to using high-early concrete for thrust blocking, the Contractor shall submit a mix design from the supplying concrete plant for Water Department approval.

Concrete thrust restraint for vertical bends shall include embedded steel rebar hooks as shown in the Standard Drawings.

All pipe and fittings in contact with concrete shall be completely wrapped in two (2) layers of 4-mil polyethylene sheets or one (1) layer of 8-mil polyethylene prior to the placement of the concrete.

Straddle blocks installed on existing waterlines 8-inch and smaller require U.G. clamps or mid span restraint glands. Straddle blocks on waterlines 10 inches and larger require designed rebar reinforcement stamped by a registered professional engineer and approved by the Water Department.

**Related Standard Drawings: 530-7, 530-8**

530.3.4. Connection to Existing Water System

Connections to the existing water system shall be made at a time and under conditions which minimize service interruption to customers, as authorized by the Water Department. See Subsection 510.4.2. “Non-Emergency Water Shut-off Notification”.

Facilities shall be provided for the proper dewatering and disposal of all water removed from water mains and excavations to avoid damage to adjacent property.

Connection to an existing water system shall only take place after the new improvements are leak tested, flushed, disinfected, and satisfactory bacteriological test results are obtained. All connections to the existing water system shall be authorized by and executed in the presence of a Water Department representative.

Special care shall be taken to prevent contamination while dewatering, cutting into, and making connections with existing water pipe. Trench water, mud, or other contaminating substances shall not be permitted to enter the water pipes. The interior of all pipe, fittings, and valves installed in water connections shall be thoroughly cleaned and then swabbed, sprayed, or dipped in a 1% hypochlorite solution prior to assembly.

Wet Tapping

Connection to existing water pipe may be made by means of a wet tap. The cutting in of tees will not be permitted unless approved and signed off by the Water Department Engineering Manager.

All wet taps shall be installed by a contractor approved by the Water Department and installed under the direction of Water Department representative. Contact the Water Department for a list of approved tapping contractors.

Wet taps 10 inches and larger require a horizontally installed gate valve with bevel gear actuator, unless bury depth allows for a minimum 24 inches of cover over valve nut.

Connection to Existing Valves

Water improvements that include connection to the City water system by means of an older existing valve may require the replacement of said valve if the valve’s condition is determined by the Water Department to be questionable in performing the necessary pressure testing and disinfection.

530.3.5. Abandoning Facilities

The Contactor shall seal the open ends of all pipes, fittings, etc. that are to be abandoned with an end cap, coupling, or a concrete plug with a thickness equal to the diameter of the pipe. The Water Department requires that all abandoned piping be severed as close to active piping as practical.

All service lines are required to be severed at the main and for the corporation stops to be capped if not required to be removed. A 4" diameter by 4" long piece of PVC pipe is to be installed over all capped corporation stops that remain as part of abandonment. All other parts of the service lines and other appurtenances are to be cut off and removed at 24 inches minimum below finish grade.

Structures (vaults, meter boxes, etc.) shall be removed completely to eliminate conflict with any future utility improvements. Abandonment of structures shall be completed only after piped systems have been properly abandoned.

Abandoned valve boxes in pavement areas shall be cut off 24 inches below grade, removed, gravel filled, and plugged with compacted asphalt. Valve boxes outside of pavement areas shall be cut off 24 inches below grade, removed, and filled with native backfill.

The Water Department has first claim to any removed or abandoned water materials (valves, hydrants, fittings, etc.). The Contractor shall dispose of all unwanted materials in an approved manner.

530.4. Flushing, Hydrostatic Testing, and Disinfection

530.4.1. Filling and Flushing

Filling

At the completion of water improvements, the water main shall be slowly filled while removing air through air release valves, hydrants, blow-offs, and water services.

Flushing

Prior to disinfection of water improvements, all water mains, services, and appurtenances shall be flushed to remove all trapped air and any foreign material or debris which may remain in the pipelines following installation.

The Contractor shall provide hoses and temporary pipes as required to dispose of flushed water into a storm sewer system. The Contractor shall make provisions to dechlorinate the flushed water as required.

Flushing velocities shall be a minimum 3-fps for water mains 12-inch and smaller. For water mains larger than 12-inch, where it is impractical or impossible to flush the pipe at a velocity of 3 fps, the flushing procedure shall be reviewed by Water Department staff.

Water for Filling and Flushing

The Water Department will furnish all water necessary for initial testing, flushing, and disinfection. If additional water is needed due to unsatisfactory tests, the Contractor will be billed for the water used.

Water needed for other construction activities shall be obtained as described in Subsection 510.4.3. "Bulk Water".

**Table 530.3 – Required Flow and Openings to Flush Pipelines**
**40 psi Residual Pressure in Water Main**

| Pipe Diameter | Flow Required to Produce 3 ft/s (approx.) Velocity in Main | Size of Tap, in.(blow-off) | | | | Number of Hydrant Outlets | |
|---|---|---|---|---|---|---|---|
| | | 1" | 1 ½" | 2" | 4" | | |
| Inches: | GPM: | Number of Taps in Pipe | | | | 2½" | 4½" |
| 4 | 120 | 1 | - | - | - | 1 | 1 |
| 6 | 260 | - | 1 | - | - | 1 | 1 |
| 8 | 470 | - | 2 | - | - | 1 | 1 |
| 12 | 1060 | - | - | 3 | - | 2 | 1 |

With 40-psi pressure in the main with the hydrant flowing to atmosphere, a 2½-inch hydrant outlet will discharge approximately 1,000 gpm; and a 4½-inch hydrant outlet will discharge approximately 2,500 gpm. Number of taps on pipe based on discharge through 5 feet of galvanized iron (GI) pipe with one 90° elbow. Data conforming with ANSI/AWWA C651 Table 3.

530.4.2. Hydrostatic Testing

Prior to hydrostatic testing, all water improvements shall be completed including water mains, services, blow-offs, and any other appurtenances.

The Contractor shall perform hydrostatic (pressure) and leakage tests on all newly laid pipes and valves in accordance with OAR 333-061-0050, the latest methods outlined in AWWA C600, and these Standards.

The Water Department Engineer or Inspector shall be notified a minimum of 24 hours prior to testing, and shall be present to monitor all tests.

The Contractor shall furnish all necessary equipment, material, and labor required to conduct the testing.

Provide the following equipment and materials for hydrostatic testing:

i. A clean 55-gallon barrel and 5-gallon bucket.

ii. One injection pump approved by the Water Department.

iii. Suitable hose and any additional equipment necessary to perform the testing correctly.*

*The Water Department will provide a NIST calibrated pressure gauge for hydrostatic testing.

The test shall be conducted after the trench has been partially backfilled with the joints left exposed for inspection, or completely backfilled and compacted. Where a section of pipe is to be tested with newly poured concrete thrust blocking, the Contractor shall not apply test pressure until a minimum of **seventy-two (72) hours** have elapsed after the concrete was installed. Any deviation shall be reviewed by the Water Department staff.

The following procedure shall be used to conduct a pressure test, unless otherwise approved by the Water Department.

**Note: The Water Department does not guarantee existing water system valves against leakage. The Contractor is advised to test new improvements independent of the existing water system:**

i. The pipe shall be filled with water using an approved method that protects the existing distribution system from contamination. The new piping being tested shall remain isolated from the existing water system.
ii. After the trench has been backfilled or partially backfilled, slowly fill the pipe with water, expelling all air during the filling.
iii. The test pressure shall be a minimum of 150 psi for the 2-hour test.
iv. Apply the specified test pressure by pumping additional water into the new piping system with a hydrostatic pump.
v. Valve off the pump and hold the pressure in the line for the 2-hour test period. If the pressure falls below 145 psi, the line shall be pumped back up to 150 psi. The amount of water used to re-obtain 150 psi shall be measured and counted against the allowable leakage.
vi. At the end of the test period, again operate the pump until the test pressure of 150 psi is obtained, measuring the water used.
vii. The pump suction shall be in a barrel or similar container, or metered so that the amount of water required to restore the test pressure may be measured accurately.
viii. Leakage shall be defined as the quantity of water necessary to restore the specified test pressure at the end of the test period. No pipe installation will be accepted if the leakage is greater than the number of ounces lost in a 2-hour period as determined by the following formula:

$$L = \frac{256 * S * D * \sqrt{P}}{148{,}000}$$

Where L = Allowable leakage (ounces/2 hours)

S= Length of pipe tested (feet)

D = Nominal diameter of pipe (inches)

P = Average pressure during the leakage test (static pressure times 2) (psi)

Should any section of pipe being tested account for leakage greater than that allowed, the Contractor shall locate and repair the defective joints, pipe, or appurtenances and retest that section of pipe. Leakage must be within the specified allowance and approved prior to disinfection.

At the satisfactory completion of Hydrostatic testing, all line valves are to be tested to assure effective seal and proper operation. While under full test pressure, start with the furthest valve from the test gauge and test each valve in succession up to, and including, the closest valve. The testing procedure is to close the valve being tested and release pressure beyond. Valves are considered acceptable when no loss is observed on the test gauge.

530.4.3. Disinfection of Pipes

Disinfection of water improvements shall be done in accordance with all Oregon Health Authority regulations and AWWA C651 Standards.

Methods

Hypochlorite Solution
Disinfection shall be accomplished using the continuous feed method with a mixture of hypochlorite (calcium or sodium) and water resulting in a free chlorine residual of 25-50 MG/L in the pipeline.

Bleach
Use only 12.5% commercial food grade bleach, NSF-certified for potable water use. Liquid bleach shall be applied by means of an approved chlorination pump device. Bleach shall be fed through proper devices for regulating the rate of flow and providing effective diffusion of disinfectant to obtain a free chlorine residual of 25-50 MG/L.

Spraying, Swabbing, or Dipping
If the calcium hypochlorite procedure is used, first mix the dry powder with water to make a thick paste, and then thin to approximately a one-percent solution (10,000 MG/L chlorine). If the sodium hypochlorite procedure is used, dilute the liquid with water to obtain a one-percent solution.

The following chart outlines the amount of sodium or calcium hypochlorite required to obtain a 50 MG/L disinfection mixture for various pipe diameters.

**Table 530.4 – Requirements for Pipe Disinfection**

| Pipe Diameter (inches) | Volume in Pipe per 100-foot segment (gallons) | Calcium Hypochlorite (Granular form) 65% Available Chlorine (cups) | Commercial Food Grade Bleach 12½% Cl² (gallons) |
|---|---|---|---|
| 4 | 65 | 0.10 | .013 |
| 6 | 147 | 0.23 | .03 |
| 8 | 261 | 0.40 | .053 |
| 12 | 588 | 0.90 | .12 |
| 18 | 1321 | 2.03 | .32 |
| 24 | 2349 | 3.60 | .47 |

Procedure

The Contractor shall schedule disinfection no later in the week than Wednesday, to allow for completion of bacteriological sampling on Friday.

The Contractor shall mix the hypochlorite granules or liquid in large plastic containers with sufficient water to obtain the required dilution. The containers must have sufficient capacity to ensure that the solution will mix thoroughly with the water when injected into the pipeline.

Inject the disinfectant into the pipeline to be treated through a corporation stop or other suitable appurtenance, at a point close to the feed source. Maintain the required flow of fresh water by manipulating water main and blow-off valves to mix and pull the disinfectant throughout the system at a maximum pressure of 20 psi. **Under no circumstances will the Contractor be allowed to operate the isolation valve unless instructed in person by a Water Department Representative.** The rate the disinfectant is injected into the piping shall be in such proportion to the rate of water entering the pipe that the combined mixture shall contain 25-50 MG/L of free available chlorine. Operate all newly installed valves, hydrants, and other appurtenances during disinfection to ensure that the disinfection mixture is dispersed into all parts of the system including dead-ends, new services, and similar areas that otherwise may not receive the treated water.

At the completion of chlorine injection, close all valves and remove the pump. The pressure in a chlorinated pipeline shall not be more than 10 psi.

Water improvements that are one (1) pipe length or less may, at the Water Department's discretion, be swabbed or sprayed with a 1% hypochlorite solution as an approved disinfection method.

Contact Time

The chlorine-water mixture shall remain in the pipeline for a minimum period of 24-hours (or as directed by the Water Department) in order to destroy all non-spore-forming bacteria. The disinfection mixture contact time shall not exceed a 36-hour time period in order to minimize

damage to ductile iron pipe and fittings. At the end of the 24-hour period, the disinfection mixture must have a chlorine residual of 10 MG/L or greater. If the chlorine residual is less than the required minimum, the Contractor shall repeat the disinfection procedure.

Disposal of Disinfection Water

Dispose of the chlorine water mixture in an approved manner. Methods of disposal shall be as follows:

a. Discharge water into a sanitary sewer system: The Contractor shall provide all hoses, fittings, and temporary pipes required to discharge into an approved public sanitary system. All hoses and piping shall be tied off and secured, and include an acceptable air gap between the discharge point and sanitary flow line. Check with the local sewer department for required conditions of disposal to the sanitary sewer system.

b. Discharge water into a storm sewer system: If the Contractor desires to dispose of water in a public storm system, the water is to be dechlorinated prior to discharge. The Contractor shall provide hoses, temporary pipes and an approved air gap, as required, for discharge. See AWWA C652 Appendix C for chemicals required to neutralize the chlorine residual. Ascorbic acid is included as an acceptable chemical for dechlorinating.

c. Discharge water to ground surface or ditches**:** If the Contractor desires to dispose of water to the environment, and the Water Department approves the request, the water shall be dechlorinated prior to discharge. The Contractor shall provide hoses and temporary pipes as required. See AWWA C652 Appendix C for chemicals required to neutralize the chlorine residual. Ascorbic acid is included as an acceptable chemical for dechlorinating.

530.4.4. Bacteriological Testing

After flushing and disposal of the disinfection mixture, two (2) bacteriological samples will be drawn by the Water Department. The first sample will be drawn following a 16-hour retention period. The second sample will be drawn at a minimum of 15 minutes later. Both water samples must pass the bacteriological tests before the water line(s) will be accepted. The Contractor shall provide a representative to assist the Water Department when samples are taken.

All corporation stops used for testing and chlorination shall be removed at the completion of work and replaced with brass plugs prior to final backfilling and surface restoration.

## 540. Valves and Valve Boxes

### 540.1. Design Requirements

#### 540.1.1. Isolation Valve Size, Spacing, and Location

A sufficient number of valves shall be provided to facilitate water system isolation and minimize impact to surrounding customers. All system appurtenances shall include a valve for isolation during general maintenance and repair operations.

Generally, valves shall be installed at water main intersections in groups of three (3) for tee applications and four (4) for cross applications. Valves shall be MJ style and include restraints.

The maximum distance between main line valves shall be 800 feet.

All valves 8-inch and smaller shall be gate valves.

All valves 10-inch and larger shall be butterfly valves, with the exception of wet taps.

All valves shall be full size. No reduced port valves will be allowed.

Valves shall be installed in areas adequate to allow for a 3-foot clear zone maintained around all water system valve boxes. Fencing, trees, large bushes, retaining walls, and anything else that may interfere with the operation of a water valve is prohibited within the clear zone.

Valves shall not be located within a curb, gutter, driveway, sidewalk surfaced area or ADA ramp.

Valve operator extensions are required on all valves with operating nuts more than 6 feet below finish grade. Oversized valve cans and risers are to be included with all operator extension installations.

Valve box lids located in roadways with high-volume traffic or speed limits 35 mph and greater shall have locking lids, to prevent lid from being dislodged.

**Related Standard Drawings: 540-1, 540-2, 540-3**

540.1.2. Combination Air Release Valves (CARV)

CARV valves are required at all high points on all transmission and distribution piping where elevation changes are equal to or greater than the diameter of the pipe being installed.

540.1.3. Insertable Valve

At the discretion of the Water Department Engineering Manager, an approved insertable valve may be used on a case-by-case basis.

540.2. Materials

All valves shall be marked with valves size, class, manufacturer, and year of manufacture. Markings shall be cast in raised letters on the valve body.

All valves located inside vaults require a handwheel.

540.2.1 Gate Valves

Gate valves shall be resilient-wedge type conforming to AWWA C509 and/or C515, and shall be UL listed and FM approved.

All gate valves shall be hydrostatically tested at the factory and have a minimum rated working pressure of 200 psi.

The wedge shall be ductile iron or cast iron completely encapsulated with resilient material. The sealing material shall be permanently bonded to the wedge with a rubber tearing bond which meets ASTM D429.

Direct Bury
All direct bury gate valves shall be furnished with a 2-inch square operating nut and open counter clockwise when viewed from above. All buried valves shall have non-rising stems made of solid bronze and include integral or non-integral collars in compliance with AWWA.
Non-Direct Bury
Gate valves installed in backflow vaults or above-ground backflow assemblies shall be outside screw-and-yoke type valves, equipped with a bronze stem, and supplied with a hand wheel.

540.2.2. Butterfly Valves

Butterfly valves shall be rubber-seated type conforming to AWWA C504. Valves shall be bubble tight at rated pressures with flow in either direction, and shall be designed for applications involving valve operation after long periods of inactivity. Valves employing a complete rubber liner or with sprayed or plated seating surfaces are not acceptable.

The valves shall be Class 150B as shown in AWWA C504, Table 2. All butterfly valves shall be hydrostatically tested at the factory and have a minimum rated working pressure of 150 psi.

Butterfly valves shall be furnished with a 2-inch square operating nut and shall open counter clockwise when viewed from above. All manual operators shall be approved for direct bury applications. Valve actuators shall be totally enclosed worm gear or the traveling nut self-locking type, and shall be designed to hold the valve in any intermediate position between fully open or fully closed without creeping or fluttering. All valve actuators shall be capable of withstanding an overload input torque of 450 ft-lbs at full-open or full-closed position without damage to the valve or valve operator.

540.2.3. Valve Operator Extensions

Valve operator extensions can be fabricated using 2-inch by 2-inch by .120-inch square steel tubing or 1-inch schedule 80 steel pipe and ¼-inch steel plate, with 2-inch socket made from ¼-inch thick steel plate or 2½-inch by 2½-inch by .180-inch square steel tubing, then hot dip galvanized.

Valve operator extensions can also be fabricated using fiberglass valve stem extensions. The cantering ring is adjustable for 8, 6, or 4½-inch valve can risers. Attach with a 2-inch lower operating nut and a 2-inch upper operating nut with a versatile size centering ring. Fiberglass adhesive shall remain out of the sun at all times until installation.

**Related Standard Drawings: 540-4**

540.2.4. Valve Boxes

Standard
Valve box tops shall be 18-inch tall "Vancouver" style constructed of cast iron and shall be factory cast with the word "Water." Valve box castings shall be a smooth and uniform cylinder and top rim. Valve boxes of uneven thickness, pitted, or otherwise flawed in the casting will not be accepted. Debris caps are required in all valve boxes unless otherwise stated by the Water Department.

Oversized
Valve box tops shall be 12 inches in height with an inside diameter of 9 5/8 inches. Lids are to be inset and have a 10 5/8-inch outside diameter and include a pick notch in top surface for removal. Valve box castings shall be a smooth and uniform cylinder and top rim. Valve boxes of uneven thickness, pitted, or otherwise flawed in the casting will not be accepted. Debris caps are required in all valve boxes unless otherwise stated by the Water Department.

Locking Traffic Lid
Valve box tops shall be 18-inch tall "Vancouver" style (same casting as the Standard valve box) with two (2) 3/8-inch diameter, 16 thread, 1¼-inch long stainless steel slotted screws for securing lid to main casting. "City of Hillsboro" shall be cast into the lid in ½-inch lettering.

Valve Box Riser
The riser, or bottom section of the valve box, shall be 6-inch or 8-inch diameter SDR 35 PVC pipe (ASTM D3034) as required for valve box size.

**Related Standard Drawing: 540-2, 540-3**

540.2.5. CARV

¾-inch, 1-inch, and 2-inch CARV's shall have a minimum working pressure rating of 230 psi.

CARV body shall be made of high strength plastic.

The inlet connection shall be male NPT. The vent outlet shall be 3/8-inch female NPT (for ¾-inch and 1-inch valves) and 1½-inch (for 2-inch valves).

All valves, copper tubing, fittings, saddles, and vaults shall meet the material requirements of Section 560 "Water Service Connections".

**Related Standard Drawings: 540-5, 540-6**

540.3. Construction

540.3.1. Handling

The Contractor shall follow the manufacturer's instructions and protect valves from damage while transporting, unloading, and during installation. The valve operating shaft shall not be used for lifting. Care shall be taken not to damage the interior and exterior coating on valves. Valves that have chipped or damaged coating shall be repaired or replaced, at the sole discretion of the Water Department.

540.3.2. Storage

Store valves inside if possible. Valves stored outside shall be protected from the weather and accumulation of dirt, rocks, and other debris. Do not expose rubber seats to sunlight.

540.3.3. Valve Installation

Valves are to be installed in accordance with the manufacturer's instructions and comply with applicable AWWA requirements.
Thoroughly clean valves, including flange faces of all foreign matter of debris. Prior to installation, the Contractor shall inspect each valve for proper opening and closing operation, and verify that the valve seats properly.

The joining of valves with pipes or fittings shall comply with Subsection 530.3.2. "Pipe Joining".

Valves shall be installed so the stem is plumb with finish grade.

Center the PVC riser pipe on the axis of the operating nut, set plumb and adjust the top of the valve box to finish grade. Any valve boxes found to be off center, out of plumb or not flush with finish grade shall be removed and reinstalled in the proper position.

540.3.4. CARV Installation

CARV's are to be installed in accordance with these Standards and the manufacturer's recommendations. CARV's shall be located as shown on plans or as directed by the Water Department.

Install CARV's at the required elevation to maintain a minimum 1% positive grade for the copper tubing from the water main to the CARV.

540.3.5. Valve Operator Extensions

Where depth of the operating nut is more than 6 feet below finish grade, a valve operator extension shall be provided to bring the operating nut to within 18 to 24 inches of the surface. Each valve shall have no more than one continuous-piece valve operator extension. (Multiple piece extensions are not allowed.)

540.3.6. Valve Boxes

Where the valve is located outside of asphalt or concrete finished surfaces, the Contractor shall install a 24-inch by 24-inch by 5½-inch concrete pad around the valve box with No.4 rebar.

All valve box lids shall be tightly fitted and approved by the Water Department.

Valve boxes for valves requiring an operator extension and permanent blow-off assemblies, shall be 8-inch diameter "Portland" style constructed of cast iron with the word "Water" factory cast and the words "Portland OR" removed from the casting. The related bottom section shall be cut from a single piece of 8-inch riser material.

**Related Standard Drawings: 540-2, 530-3, 530-4, 530-5**

## 550. Fire Hydrants

### 550.1. Design Requirements

Obtain permit approval from the designated fire code official for proposed hydrant locations prior to submitting design plans.

Generally, fire hydrants shall be located such that no part of any one- or two-family residential building is more than 600-feet from a hydrant, and no part of a commercial, industrial, or multi-family building is more than 400-feet from a hydrant (when measured along an accessible route).

When new water mains are extended along streets where hydrants are not required for the protection of surrounding structures or other fire concerns, fire hydrants shall be provided at a spacing not exceeding 1,000 feet, for transportation hazards. When streets are provided with median dividers which cannot be crossed by fire fighters pulling hose lines, or where arterial streets are provided with four or more traffic lanes and have a traffic count of more than 30,000 vehicles per day, hydrant spacing shall average 500 feet on each side of the street and be arranged on an alternating basis up to a fire-flow requirement of 1,500 gallons per minute and 400 feet for higher fire-flow requirements.

On-site fire hydrants and systems shall be provided where required by the fire code officials when a portion of the facility or building hereafter constructed or moved into or within the jurisdiction, is more than 400 feet from a hydrant on a fire apparatus access road (as measured by an approved route around the exterior of the facility or building).

Fire hydrants shall not be connected to a water main with less than an 8-inch diameter. However, a 6-inch water main may be approved if the design hydraulic calculations validate the ability to provide for the minimum fire flow regulated by the fire code official.

Each hydrant must be equipped with an independent gate valve for isolation during replacement or repair.

When placed at mid-block locations, fire hydrants are to be installed at a common property line. For ease of operation, fire hydrants shall also be located in areas that allow for the required clear zone.

All efforts shall be made to place fire hydrants outside of new or existing sidewalk and out of proximity to driveways or other vehicle accesses.

**Related Standard Drawing: 530-1, 550-1**

550.2. Materials

All fire hydrants shall be a dry barrel, traffic breakaway type, and be UL listed and FM approved conforming to AWWA C502.

The main opening valve shall be 5¼ inches compression type, opening against pressure and closing with pressure. The main valve shall open when turned counter clockwise. The valve operating nut shall be a 1½-inch National Standard pentagon nut.
Fire hydrants are to have a minimum pressure rating of 200 psi and be factory tested at twice the rated pressure.

The hydrant shoe must have two (2) positive acting bronze drain valves that completely drain the hydrant by opening when the main valve is closed.

The nozzle section shall consist of two (2) 2½ inch hose connections and one (1) 4½ inch pumper connection. All nozzles shall be field replaceable. The thread type are to be National Standard Fire Hose Coupling Screw Threads.

The ground line connection, between the nozzle section and the barrel, shall incorporate the use of breakable lugs and be designed such that the nozzle section can be rotated to any increment of 360°.

The inside of all hydrants, except for bronze and machined surfaces, shall be coated in accordance with AWWA C502 standards. The exterior coating on the hydrant nozzle is to be painted yellow. The following paint products are approved for use in the City of Hillsboro water system: Rust-Oleum Corporation (Strust QT 4PK Gloss Sunburst Yellow, #V7747504 and Acrylic 1-GL 2PK 3700 Safety Yellow, #3744402); Sherwin-Williams Company (Controls Rust Spray Enamel Safety Yellow, #140-0571 and DTM ACRYLIC Gloss Acrylic Coating, #B66Y37) or an approved equal.

Fire hydrants shall be permanently marked with the manufacturer's name, size of valve opening, and year of manufacture.

Granular drain backfill material shall conform to ODOT Standard Specifications, Section 00430.11 for 1¼ to ¾-inch material.

550.3. Construction

550.3.1. Handling

The Contractor shall take care not to damage interior or exterior hydrant coatings. A strap or approved lifting device shall be used for lifting and setting hydrants, chains and cables are not allowed. Any repair of damaged surfaces below ground level shall be executed as required by the Water Department.

Surface damage repairs to coatings of nozzle area (above ground) shall include applying two (2) coats of yellow enamel hydrant paint or as required by the Water Department.

550.3.2. Installation

Hydrants are to be installed in accordance with AWWA C600, AWWA Manual M17 and the manufacturer's recommendations. Hydrants shall be located as shown on the approved plans or as directed by the fire code official.

Backfill of hydrants shall comply with Subsection 520 "Trench Backfill and Surface Restoration".

Any hydrant removed from service will require an "Out of Service" rings installed on the pumper hose connection or be covered with a labeled plastic bag. Out of service hydrants are to be reported to the City of Hillsboro Fire Department by the end of the business day.

Hydrant bury depth shall be no more than 6 feet and no less than 30 inches below finished grade.

Hydrants installed in planter strips are to be located in the center of the planter strip, with a minimum distance of 24 inches (from center of hydrant barrel) from all sidewalks, wheelchair ramps or curb lines. At the sole discretion of the Water Department, hydrants may be allowed to be closer if conflicts or limitations are present.

Set hydrant elevation so that the traffic breakaway flange is between 3 and 6 inches above finish grade. Fire hydrant extension kits are not allowed for field height adjustments unless approved by the Water Department.

All hydrants are to stand plumb with ports parallel or at right angles to the curb, with the pumper connection facing the curb. The Water Department shall determine final position of port orientation.

**Related Standard Drawing: 550-1, 550-2, 550-3, 550-4**

550.3.3. Joints

Joint restraints shall be installed on all joints between the water main and the hydrant.

550.3.4. Base Blocks

Hydrants shall be placed on a 12-inch by 12-inch by 8-inch H solid concrete pier block set on 6 inches of compacted Class B backfill per Subsection 520 "Trench Backfill and Surface Restoration".

550.3.5. Drainage

For hydrant drainage, place clean granular drain backfill material around the base block, under the hydrant, and to a minimum elevation of 6 inches above hydrant drain openings (4 CF minimum).

550.3.6. Reflectorized Buttons

The Contractor is required to place a blue reflectorized button for each hydrant installed. Buttons are to be adhered to the roadway surface by thermoplastic pads, at the completion of final street surfacing.

**Related Standard Drawings: 550-4**

## 560. Water Service Connections

### 560.1. Design Requirements

#### 560.1.1. Water Services

The City of Hillsboro Water Department is responsible for serving and maintaining water pipes from the water main to the customer's side of the water meter. Maintaining the piping between the water meter and the property being served is the customer's responsibility.

Developers requesting credit for existing water services that are to be removed as part of development, shall contact the Water Department prior to abandonment for information and eligibility. The Developer is responsible for removal of the existing meter box or vault, termination of the connection at the water main, and all necessary street repair and restoration of disturbed areas.

Water Department policy is to provide one water service per single tax lot for residential properties. Duplex structures on a single tax lot may be served by two water services. If a structure contains more than two dwelling units or customers on a single tax lot, a master meter must be installed. Subject to Water Department approval, commercial, industrial, and multi-family tax lots may be allowed additional services.

Standard water meter sizes available from the Water Department are 5/8x3/4-inch, 1-inch, 1½-inch, 2-inch, 3-inch, 4-inch, 6-inch, and 8-inch. The Engineer is responsible to properly size water meters for adequate service for the development, as required by the Oregon Plumbing Specialty Code (OPSC).

Single 5/8x3/4-inch, double 5/8x3/4-inch, and double 1-inch meters shall be served by a 1-inch copper service line. For flag lots and private tracts, no more than four (4) 5/8x3/4-inch meters are allowed to be grouped together, unless approved by the Water Department. A manifold assembly is required to reduce the number of water main taps and help minimize congestion within the public right-of-way for other infrastructure.

Water meters are to generally be located in the public right-of-way adjacent to the street curb (6 inches off back of curb). Depending on the water service size and location, meters located on private property are to be in a recorded easement measuring 5 to 10 feet from each outside wall of the meter vault or box. The Water Department has final authority regarding the location of meters to best serve the City's requirements.

Water meters shall not be placed in driveways without prior approval from the Water Department. If approved, a traffic rated box and lid will be required.

All water meters 2-inch and smaller must be installed by the Water Department; 3-inch and larger meters are the responsibility of the Contractor.

All meters 1½-inch and larger will require a meter bypass (with the exception of irrigation services).

Minimum required cover for service lines between the water main and meter is 30 inches in improved areas and 42 inches in unimproved areas.

**Note:** The numerical dimensional value describing the water service is the size of the water meter and may or may not correspond with the size of the required pipe or copper tubing.

560.1.2. Fire Services

Commercial and industrial properties where multiple water services are required as part of development (fire, domestic, irrigation) are to be supplied by a common pipe designed to meet maximum water demands for all services. Valves are required to be installed at each service branch for isolation. Fire services are to be designed with an inline valve at the property line to separate public piping from the private fire system.

**Related Standard Drawing: 560-1**

560.1.3. Fire Flushing

A controlled flush is required on all commercial/industrial fire sprinkler systems per the current adopted edition of NFPA-24. Contact and arrange for a Water Department representative to be on-site during the flushing process. A portable flow meter will be installed by the Water Department to monitor water flow rate and water usage of all flushed water.

A cleared area shall be left accessible on the fire system riser pipe for installation of the flow meter sensor. The necessary clear area distances between the flow meter sensor and miscellaneous fire system valves and fittings are shown in the table below.

**Table 560.1 – Required Fire Service Flow Meter Clearance Distances**

| Subject | Distance Away (Diameter) |
|---|---|
| Valves | ≥20 x D |
| Pumps | ≥20 x D |
| 90° Bend | ≥15 x D |
| Inlet Run | ≥15 x D |
| Outlet Run | ≥3 x D |

If adequate space is unavailable on the fire system riser pipe an alternate sensor location will need to be determined, requiring Water Department approval.

560.2. Materials

All materials for water services with 5/8x3/4-inch through 2-inch meters shall conform to AWWA C800 and be new and undamaged.

Brass products furnished under this specification, which are not in contact with potable water shall have an alloy composition of copper, tin, lead and zinc in accordance with ASTM B62. The material is to be copper alloy UNS C83600, commonly referred to as 85-5-5-5.

All brass components that are designed to be in contact with potable water must be made from either CDA/UNS Brass Alloys C89520 or C89833 with a maximum lead content of 0.25% by weight and comply with ANSI/AWWA C800 and ANSI/NSF Standard 61 Annex G.

Brass fittings shall comply with the Safe Drinking Water Act, as amended, and the U.S. Environmental Protection Agency (EPA).

Unless otherwise noted, all fittings and valves shall have a minimum working pressure of 150 psi.

All fittings shall either be stamped or embossed with the manufacturer's name or trademark.

560.2.1. Water Meters

Water meters must be ANSI/NSF 61 (Annex G) certified.

Water meters shall have straight-read, permanently sealed registers reading only in cubic feet increments. The water meter size shall be permanently marked on the register dial face.
Water meter housings shall be permanently cast or stamped identifying the size, model, serial number, and arrow showing direction of flow. The Water Department will designate serial numbers for meters.

All water meters shall be pressure tested at 300 psi. To be acceptable for installation meter registers must be accuracy tested between 98.55% and 101.5%.

All water meters are to be equipped with automated meter reading (AMR) capability. The meter reading system shall conform to AWWA C707.

Contact the Water Department for specific AMR model numbers and installation requirements.

<u>Small Water Meters (5/8 x 3/4 through 2-inch)</u>
Water meters 5/8 x 3/4-inch through 2-inch shall be the positive displacement nutating disc or oscillating piston type meters and conform to AWWA C700. The Water Department will supply all meters 2-inch and smaller.

All 5/8 x 3/4-inch and 1-inch water meters shall be designed with freeze protection. Breakable covers shall be made of cast iron, stainless steel, copper alloy, or engineering plastic per AWWA C700.

Connections for 5/8 x 3/4-inch and 1-inch meters shall be external straight threads conforming to ANSI/ASME B1.20.1. Connections for 1-1/2-inch and 2-inch meters shall be oval flange per Table 3 of AWWA C700.

Large Water Meters (3 through 8-inch)

All water meters 3-inch and larger shall be purchased and installed by the Contractor.

Water meters 3-inch to 6-inch shall be the compound type meters and conform to AWWA C702. Subject to Water Department approval, 8-inch water meters may be compounded type or turbine type, depending on customer flow requirements and meter accuracy parameters. Turbine water meters shall conform to AWWA C701.

Connections for 3-inch through 8-inch water meters shall be round flange type, conforming to ANSI/ASME B16.1 for cast iron pipe flange (class 125) and ANSI/ASME B16.24 for copper alloy flange (class 150).

Combination fire flow and domestic water meters shall be UL listed or FM approved and conform to AWWA C703/C702. The use and type of combination fire flow and domestic water meters can only be approved by the Water Department on a case-by-case basis.

560.2.2. Copper Tubing

All 3/4-inch and 1-inch tubing shall be annealed, seamless, type K soft copper tubing conforming to ASTM B88. All copper for 1½-inch and 2-inch meter water services shall be hard drawn temper (rigid), type K copper tubing, in 20-foot lengths conforming to ASTM B88.

The tubing shall be coupled using compression fittings having a positive gripping feature to prevent tubing pull-out.

560.2.3. Corporation Stops

All corporation stops shall be full port opening, ball-valve design and have a flow passage area equivalent to the fitting outlet flow area.

Corporation stops for ¾-inch and 1-inch direct taps shall be manufactured with AWWA CC tapered inlet threads and CTS compression type outlets with positive gripping feature.

1-inch corporation stops requiring tapping saddles shall be manufactured with external CC thread inlet and TLS compression type outlet.

560.2.4. Copper Meter Setters

2 inch copper meter setters are required on all water services with 1½-inch and 2-inch meters. These shall be designed for vertical inlet and horizontal outlet FIPT connections.

The vertical height of a copper meter setter shall be 15 inches for all water services with 1½-inch and 2-inch meters, and include a high or elevated by-pass assembly.

Copper meter setters shall include two (2) angle ball valves, one (1) at the inlet to the meter, and one (1) at the outlet of the meter. Angle ball valves are to be full port and include drilled wings for padlock installation.

All solder used in the manufacturing of copper meter setters shall be lead free.

560.2.5. Tapping Saddles

Tapping saddle bodies shall be cast from ductile iron, meeting or exceeding ASTM A536, and have a minimum pressure rating of 150 psi.

Tapping saddles shall have double straps. Each strap shall have a minimum width of 1½ inches. Straps, bolts, nuts and washers shall be heavy duty type 304 stainless steel. Pipe sizes 4 inches and greater are to have 5/8-inch diameter bolts. Pipe sizes 3 inches and less may use 1/2-inch diameter bolts.

Tapping saddle outlet shall be internal CC thread to match the corporation stop threads. Tapping saddle thread much always match corps.

Tapping saddle gaskets shall be rubber or approved synthetic rubber. Saddles shall have a minimum pressure rating of 150 psi.

Tapping saddles are required to have an epoxy coating.

Tapping saddles are required for all 1-inch taps on a 4-inch pipe, taps on a 2-inch pipe and all 2-inch taps. For taps 3-inch and larger see Subsection 530.2.7. “Tapping Sleeves”.

560.2.6. Coupling and Elbows

Joints shall be CTS compression type with positive gripping feature or iron pipe thread (NPT).

Copper sweat fittings may be allowed on 1½-inch and 2-inch services on a case-by-case basis only. The Contractor shall contact the Water Department for approval.

560.2.7. Repair Bands

Repair bands shall be manufactured from Type 304 Stainless Steel and include ductile iron lugs per ASTM A536.

Bolts shall be made of high strength, low alloy, corrosion resistant steel conforming to AWWA C111/A21.11.

Gasket shall be Nitrile or virgin styrene-butadiene (SBR) rubber.

560.2.8. Sample Stations

Sample stations shall be above-ground freeze-proof type with a locking aluminum cover. Sample station exteriors shall be painted with OSHA Safety Blue and include City of Hillsboro logo, when required by the Water Department.

The inlet connection shall be female iron pipe thread (NPT).

All interior parts shall be extractable for maintenance without excavation.

**Related Standard Drawing: 560-2**

560.2.9. Meter Box and Covers

Meter boxes and lids shall be made of Polymer concrete only.
All meter box lids shall have the word “Water Meter” cast into the exterior surface.

Meter box lids shall be equipped with a cast iron reader lid, unless H-20 load rated.

5/8-3/4-inch and 1-inch Meter
Boxes shall be 12 inches wide by 20 inches long by 12 inches deep.

Meter box lids for installation in traffic areas are to be H-20 load rated concrete or cast iron traffic lids.

1½-inch and 2-inch Meter
Meter boxes and lids shall be 17 inches wide by 30 inches long by 18 inches deep.

Meter boxes and lids for installation in traffic areas shall be H-20 load rated.

3-inch to 8-inch Meter
Meter vault required see Subsection 570 “Precast Concrete Vaults”.

560.2.10. Water Service Valves (3/4-inch through 2-inch)

All angled or straight meter valves shall be full port opening, ball valve design, and have a flow passage area equivalent to the fitting outlet flow area. Both angle and straight meter valves shall have drilled wings for padlock installation.
Straight meter valves (curb stops) are to be either CTS compression or FIPT on both the inlet and outlet sides of the valve.

All angled meter valve inlet connections shall be CTS compression type with positive gripping feature.

560.3. Construction

Meter boxes and vaults for water services shall remain at finish grade and accessible at all times. Customers are responsible for maintaining a minimum 3-foot clear zone around these facilities, including landscape, fencing, retaining walls, signs etc.

The methods employed for handling and placing materials and equipment for construction of water service installation shall ensure that all piping and appurtenances are in good condition after installation and testing. Should damage occur to pipe, tubing, fittings, or other equipment, repairs and/or replacement will be required to the satisfaction of the Water Department.

Backfilling of water services shall comply with Subsection 520 “Trench Backfill and Surface Restoration”.

Water services may be installed using trenchless installation methods such as boring or "Hole-Hawgs". Trenchless installation may be required for new or replacement services within existing roadways.

560.3.1. Installation of Water Meters

The Water Department will furnish and set all water meters 2-inch and smaller. The Contractor is to furnish and install all water meters 3 inches and larger. Water services shall be activated by a Water Department representative, not the Contractor. Service activation will take place following approval of plumbing inspection, testing and approval of any required backflow prevention assemblies, and confirmation of all fees paid in full to the Water Department.
AMR shall be installed according to the meter manufacturer's recommendations.

560.3.2. Service Placement

Water meter boxes shall be located in the public right-of-way adjacent to the street curb (6 inches from back of curb). Meter vaults shall be installed in the public right-of-way and per Section 570 "Precast Concrete Vaults".

Meters located on private property shall be in a recorded public water easement measuring 5 to 10 feet from each outside wall of the meter vault or box. The Water Department has final authority regarding the location of meters to best serve the City.

Water services shall be installed perpendicular to the street centerline or curb line and located where shown on plans.

Meter boxes are to be placed outside of traffic areas (such as driveways, sidewalks and roadways) whenever possible. When a meter box is approved to be installed in a traffic area, the box and lid shall be H-20 load rated. See Subsection 560.2.9. "Meter Box and Covers".

560.3.3. Service Taps

Service taps shall be a minimum of 18-inches from water main joints and fittings and minimum 12 inches from another tap. Multiple direct taps in sizes ¾-inch or 1-inch shall be staggered if installed closer than 2 feet apart.

All service wet taps must be installed by an approved tapping contractor and under the direction of a Water Department representative. Contact the Water Department for a list of approved contractors.

Service taps on 4-inch and smaller water main pipe shall be tapped through a tapping saddle, with the exception of ¾-inch taps on 4-inch pipe which may be direct tapped. Service taps on 6-inch and larger ductile or cast iron water main pipe can be directly tapped for ¾-inch or 1-inch copper tubing, and tapped with a tapping saddle or sleeve for 1½-inch and larger meter water services.

560.3.4. Small Water Services (5/8-3/4-inch through 2-inch meters)

Service lines for 5/8x3/4-inch meters shall be 1-inch type K soft copper tubing with compression fittings. Service lines for double 5/8x3/4-inch meters or single 1-inch meters shall be 1-inch type K soft copper tubing with compression fittings. Service lines shall consist of one continuous piece of copper. No splices will be allowed unless the service is over 60 feet in length and/or is approved by the Water Department.

Service lines for both 1½-inch and 2-inch meters shall be 2-inch type K rigid copper tubing with compression fittings, and shall have a 2-inch curb stop valve installed at the water main connection. Curb stop valves for 2-inch service lines shall be supported by an 8-inch by 8-inch by 8-inch concrete pier block placed on undisturbed earth or compacted pipe zone material.

See Subsection 520 "Trench Backfill and Surface Restoration".
The Contractor shall follow the manufacturer's recommended tightening method for brass compression fittings. Do not exceed the manufacturer's recommended torque specifications for each specified fitting type.

The Contractor shall prepare all iron pipe (NPT) and CC threads (AWWA) with Teflon tape or pipe thread compound prior to installation.

The cutting of copper tubing shall be done in a neat and precise manner. Cuts shall be smooth, straight, and at right angles. After cutting, the tubing shall be reamed with a copper reaming tool to remove all roughness and sharp edges.

All services with meters 2 inches and less shall be marked on the adjacent top of curb. New curb shall be stamped with a minimum 1-inch tall, ¼-inch deep, "W" mark, directly on top of the curb. Existing curb shall be etched with a minimum 1-inch tall "W", minimum 1/8-inch deep.

**Related Standard Drawings: 560-3, 560-4, 560-5, 560-6, 560-7, 560-8, 560-9,**

560.3.5. Large Water Services (3-inch through 8-inch meters)

For meters 3 inches and larger, service lines shall be minimum 4-inch class 52 ductile iron pipe. (3-inch meters shall be installed using 4-inch by 3-inch flanged reducers.) Ductile iron pipe must extend a minimum of 5 feet beyond the downstream exterior wall of all domestic or fire service backflow vaults.

3-inch water services shall include a 2-inch diameter bypass pipe inside the meter vault with a curb stop valve inside. All other large water services are to be installed with a bypass pipe outside the meter vault with a gate valve inside. The bypass pipe for 4-inch and larger meters shall match the service size.

All large water services shall include either a 1½-inch or 2-inch meter test port installed on the customer side of the meter and a 1-inch sampling port on the meter bypass.

All large water services shall include adjustable pipe supports in the meter vault. Pipe supports shall be anchored into the floor of the vault using stainless steel anchors.

For large water service vaults, see Subsection 570 "Precast Concrete Vaults".

560.3.6. Service Testing and Disinfection

Water services that are installed along with water main improvements must be hydrostatic tested and disinfected prior to use, in accordance with Subsection 530.4 “Flushing, Hydrostatic Testing, and Disinfection”.

If the water services are 20 feet long or less and not installed with other water system improvements they may, at the Water Department’s discretion, be treated with 1% hypochlorite solution prior to assembly. The interior of all pipe, fittings, and valves shall be thoroughly cleaned and then swabbed, sprayed, or dipped in 1% hypochlorite solution.

All corporation stops used for testing and chlorination shall be removed prior to service availability, after testing, and later replaced with brass plugs.

560.3.7. Fire Service Installation

When installing private fire mains, the underground piping from the water supply to the system riser, lead-in connections to the system riser, and all hydrants shall be completely flushed before a connection is made to downstream fire protection system piping.

Coordinate with the Building and Water Department for underground piping inspection and fire riser installation. The Water Department will install a temporary flow meter on the system for the duration of the flushing procedure. When flow rates utilizing a temporary flow meter are unattainable, an alternate solution may be approved by the Water Department.

## 570. Precast Concrete Vaults

### 570.1. Design Requirements

Vaults are required with all 3-inch and larger water meter and backflow assemblies. All vault assemblies shall be equipped with an approved gravity drain line to a storm sewer or drained to daylight. When adequate gravity drainage is not available, a plumbed sump pump assembly may be approved by the Water Department.
Vaults shall be equipped with electrical power and adequate lighting when required by the Water Department.

Vault assemblies are not be placed in sidewalks or other pedestrian walkways, unless absolutely necessary. At the sole discretion of the Water Department, installation in these restricted zones may be approved on a case-by-case basis. All vaults in walkways shall include a non-slip coating on the access hatch and the hatch drain plumbed to a storm system or other approved location. Contact the Water Department for vault lid/hatch requirements in and around vehicle access areas.

All vaults in high ground water levels shall be designed against floating with a safety factor of 1.50. The Engineer shall contact the Water Department regarding vault installation in high groundwater areas. Approval of these vaults is on a case-by-case basis only.

### 570.2. Materials

570.2.1. Precast Concrete Vaults

Vault structural design shall conform to ASTM C-857 and be constructed to withstand an H-20 load rating with a 30% impact factor.

Concrete for the manufacturing of vaults shall conform to ACI-318 and have a minimum compressive strength of 4500 psi after twenty-eight (28) days.

Vault rebar shall conform to ASTM A615 Grade 60 and wire mesh shall conform to ASTM A185 Grade 65.

Horizontal vault joints shall be sealed using a butyl resin sealant.

Where shown on the Standard Drawings, pipe blockouts shall be provided in vault walls.

Vaults shall be manufactured with a minimum 12-inch diameter by 3-inch depth sump, in the location shown on the applicable Standard Drawing.

Exterior walls and base of the vault must be waterproofed. Asphalt compounds of brush or spray consistency conforming to ASTM D449 may be used with the City's approval. Vaults waterproofed using clear compounds shall be marked in black paint or permanent marker which indicates the type of waterproofing material used.

Precast concrete vaults shall be furnished to the dimensions shown and as specified on the Standard Drawings.

570.2.2. Ladders

Vaults shall be equipped with fabricated steel ladders meeting the applicable OSHA requirements and drawings. Steel ladders and accessories are to be hot-dipped galvanized after fabrication.

Aluminum ladder extensions are required and must extend at least 3 ½ feet above vault lid, see Approved Products List.

Mounting bolts for ladders shall be ½-inch stainless steel provided by the manufacturer or product vendor.

All required hardware for vault ladders and other vault accessories shall be supplied or approved by the vault manufacturer.

**Related Standard Drawing: 570-1**

570.2.3. Sump Pumps

All sump pumps must be 115-volt plug-in type, not hard wire installed.

Sump pumps shall be furnished with an oil-filled, 0.3 hp energy efficient, 115 volt, 8-10 amp motor. Motor windings are to contain automatic thermal overload protection.

All sump pumps must be UL listed.
The pump shall be controlled by a wide angle float switch incorporating a three pronged piggyback plug arrangement.

Pump casing shall be watertight with a 1½-inch NPT discharge that is able to pass up to ½-inch solids.

Sump pumps shall include a 1½ -inch PVC check valve/ball valve/union combination unit on the discharge pipe.

If there is no electrical power accessible or there is a safety hazard in trying to get power, a high and dry water powered pump may be installed, at the discretion of the Water Department.

**Related Standard Drawing: 570-2**

570.2.4. Vault Access Hatches

Pedestrian rated access hatches shall be manufactured from type 6061-T6 aluminum for bars, angles, and extrusions and type 5086 aluminum for diamond plate exterior surface. Provide a recessed lift handle with lock latch assembly. The slam lock keyway shall be protected by a threaded removable plug that sits flush with the exterior surface. All aluminum in contact with concrete shall be coated with a bituminous coating.
Vault lids that are approved for installation in pedestrian walkways shall treated with an approved non-slip surface having a static coefficient of friction between 0.80 and 1.00 as specified by ASTM C1028.
For pipe connection, the access hatch channel drain shall be supplied with a 1½-inch PVC coupler on the underside of the channel frame for drain pipe connection.

Backflow Assembly vaults shall be furnished with heavy duty, hot-dipped galvanized diamond plate steel access hatches (doors) with spring assist and locking latches.

All hatch doors for areas with potential vehicle impacts, including pedestrian walkways, are to be H-20 rated.

570.2.5. Access Manholes

A manhole-style access lid will be required for applications where vaults are installed within public streets and roadways or high density traffic areas. Provide a 30-inch frame and lid together with any required concrete riser rings. Riser rings shall be H-20 load rated with a max height of 12”. The manhole lid shall have the letter “W” cast in the exterior surface.

To provide a water tight seal, joint sealant shall be applied between the manhole casting/riser ring joints and riser ring/vault joints.

570.2.6. Pipe Supports

Pipe supports shall be manufactured from corrosion resistant galvanized steel and be bolted directly to a class 125 pipe flange.

Pipe supports shall be tested to a minimum compressive strength of 10,000 pounds.

All pipe supports are to be adjustable and include stainless steel hardware for anchoring the base to the vault floor.

570.3. Construction

Install all vaults according to the applicable Standard Drawings.

Carefully inspect all precast vault sections prior to installation. Do not use vault sections with chips or cracks in the tongue. Install gasket material in accordance with manufacturer's instructions and only use primer furnished by the gasket manufacturer.

Vaults are to be placed on a minimum 6-inch layer of compacted Class "B" backfill material per applicable Standard Drawing. Where poor ground conditions unsuitable for vault support are encountered, over-excavate and add foundation stabilization material, per Subsection 520.3.2 "Pipe Bedding and Trench Backfill".

Vault lid elevation shall be 3 to 5-inches above the finished ground surface, with the exception of a vault approved by the Water Department for installation within a sidewalk or other pedestrian walkway. Vault hatches within walkways are to have hatch drains plumbed to an approved storm system, or as required by the Water Department.

Installation of sump pumps shall include a line sized check valve, ball valve, union fitting and a Schedule 40 PVC pipe and fittings. Sump pumps shall not discharge water into the public right-of-way.

If approved, provide electrical service to the vault with a voltage compatible with the sump pump motor, any vault lighting, and in accordance with applicable electrical codes. Conduit for power shall maintain minimum two feet separate from all other pipe penetration.

Pipe inlet and outlet penetrations shall be made through manufactured pipe block-outs. Holes shall be made by core drilling or by drilling a series of small diameter drill holes no more than 2 inches apart along the circumference of the opening. Openings shall be no larger than 2 inches greater than the flange diameter of the pipe being installed. All wall penetrations for pipe or conduit shall be sealed with non-shrink grout, a mechanical pipe seal, or approved equal.

All pick holes created during manufacturing are to be filled with grout prior to completion.

Vaults shall be watertight throughout the full depth, including pipe inlets and outlets.

**Related Standard Drawings: 570-1, 570-2, 570-3 Series, 570-4 Series**

## 580. Corrosion Protection

580.1. Design Requirements

Corrosion protection may be required where water systems are in close proximity to utility infrastructure carrying electrical current or where the natural soil has aggressive corrosive elements. Protection measures may include: minimum separation requirements, application of protective coverings and coatings, pipe joint bonding, and installation of dielectric isolation and galvanic anodes. Cathodic protection (CP) test stations will typically be required in combination with corrosive soil and stray current mitigation methods to evaluate and monitor corrosion protection effectiveness.

Franchise utility installations that are in close proximity and considered a corrosion risk by the Water Department, will require the utility to submit a mitigation plan addressing liability and means and methods for reducing stray current impact to the Water Department's water system infrastructure. Utilities that are of primary concern for stray current include: NW Natural Gas piping (infrastructure utilizing an induced current cathode protection system), high voltage power lines such as BPA and PGE (overhead and underground transmission installations), and TriMet MAX Light Rail electrical system (area within 100-feet either side of tracks).

All corrosion protection equipment, materials and workmanship shall conform to the National Electrical Code, National Association of Corrosion Engineers, and manufacturer's installation recommendations.

580.2. Materials

580.2.1. CP Test Stations

Wire and Cable

Wire for test stations shall be insulated with high molecular weight polyethylene (HMWPE), thermoplastic heat and water resistant nylon coated (THWN), cross-linked high heat water resistant insulated wire (XHHW), or rubber insulated building wire (RHW) and be American wire gage (AWG) stranded copper with a 600-volt service rating. Wire size and color requirements can be found on the applicable Standard Drawing or as directed by the Water Department.

Post Mount (Type A)

Test Box: Cast aluminum suitable for slip-fit mounting to 3-inch rigid galvanized conduit.

Terminal Block: Plastic or glass-reinforced laminate, 1/4-inch thick with five terminals.

Terminals shall have special heads to prohibit movement and be easily accessible from both sides without requiring removal. Terminal studs, washers, and nuts shall be nickel-plated brass.

Post Mount (Type B)

Test Stations shall include nickel plated or stainless steel hardware. Cap, terminal board and collect nut shall be manufactured from Makrolon polycarbonate plastic with three (3) wire terminals accessible from both sides of the board. Support posts shall be 1¼-inch in diameter with a 5 feet length. Color shall be blue.

Flush Mount (Type C)

Test stations are to be installed in a polymer concrete utility box with dimensions of 10-inch x15-inch x12-inch and include a 20K load rated polymer concrete traffic lid.

A phenolic terminal board, ¼-inch thick, shall be waterproof and sufficiently sized to accommodate termination of all required wire and connectors. Terminals shall be provided with studs, fasteners, stand-offs, and other hardware and shall be brass or copper, UL 486. Terminal labeling shall be engraved in the panel board, 1/4-inch high letters, 1/32 to 1/16-inch deep.

Flush Mount (Type D)
Test station base is to be constructed of 4" ABS with a height of 18" and designed for a drop in lid. The lid and rim shall be heavy duty cast iron with "CP Test" cast in the exterior lid surface. The terminal block shall be secured beneath the lid and manufactured from a polyester laminate with brass terminals. Machine screws and nuts shall be 1/4-inch, 20 thread, nickel plated with lock washers.

All CP test stations installed in combination with an anode shall be equipped with a .01 OHM shunt where wires terminate on terminal board.

580.2.2. Exothermic Welding

Cable and wire connections to pipe and fitting shall be made with an exothermic weld kit specifically designed by the manufacturer for welding the material type. Supply all necessary molds, cartridges, tools and supplies for performing exothermic welding as required. Manufacturer's equipment and supplies are not to be interchanged with another manufacturer's products.

Welder molds shall be graphite, ceramic molds will not be allowed. Cartridge load size recommendations from the manufacturer shall be followed closely with regard to pipe size, pipe material type, and wire or cable size Welding charges for use on cast and ductile iron are different from those used on steel.

Portable pin brazing equipment is an approved method for bonding cable and wire to pipe and fittings. Follow manufacturer's recommended procedure and use appropriate equipment for the size of wire being attached and type of pipe material being bonded.

All exothermic welding and pin brazing equipment and supplies are to be submitted to and approved by the Water Department prior to performing work.

580.2.3. Exothermic Caps

Exothermic caps shall be electrically insulated elastomeric mastic caps that are soft and pliable for molding around exothermic welds. Exothermic caps shall include all manufacturer's recommended primers and coatings for cap bonding on pipe surfaces.

580.2.4. Wire and Cable

Joint Bonds
Wire/Cable for joint bonds shall be HMWPE insulated, AWG stranded copper rated for 600 volts. Wire/Cable size and color requirements can be found on the applicable standard drawing or as directed by the Water Department.

580.2.5. Reference Electrodes

Zinc reference electrodes shall be 1.4-inches by 1.4-inches by 9-inches long and cast of high purity zinc in accordance with ASTM B418.

Copper-Sulfate reference cells shall be "permanent" type, designed for direct burial with a minimum thirty (30) year life.

a) Reference cells shall be pre-packaged in a permeable cloth bag with a proprietary backfill mix to retain moisture and minimize migration of contaminants from surrounding soil.

b) Reference cells for transmission piping shall measure 10 inches diameter by 16 inches long minimum and weigh approximately 25 pounds. Reference cells for distribution piping shall measure 6 inches in diameter by 14 inches long and weigh 15 pounds.

c) Reference cells are to be equipped with No. 12 AWG stranded copper lead wire with yellow HMWPE insulation of suitable length to reach test station for proper installation without splicing (10 feet minimum length).

580.2.6. Galvanic Anodes

Supply magnesium anodes meeting the requirements of ASTM AZ 63A, Type II or high potential magnesium anodes meeting the requirements of ASTM B843.

Transmission Pipeline System Anodes:
Sizing of anodes for transmission system piping shall be based on the corrosion potential of the affected area. Sizing required shall be approved on a case-by-case basis by the Water Department.

Distribution System Anodes:
Size of anodes for distribution system piping shall be as required by the project design.

Lead Wire:
Anode shall be furnished with stranded copper wire with HMWPE insulation, minimum 10 feet long. Lead wire shall be unspliced and be attached by the manufacturer's connection, which shall be more durable than the wire itself. No. 10 AWG wire shall be furnished for transmission piping anodes and No. 12 AWG wire for distribution piping anodes.

Anodes shall be prepackaged in a permeable cloth bag containing the manufacturer's prescribed backfill. The backfill shall be a minimum of 2.5 times the bare weight of the anode.

580.2.7. Flange Insulating Kits

Gaskets shall be full faced, 1/8-inch, Type E with elastomeric sealing element and rated for maximum operating and test pressures of the water system. Sealing element shall be retained in a groove within the retainer portion of the gasket.
Insulating sleeves shall be full length fiberglass reinforced epoxy National Electrical Manufacturers Association (NEMA) G-10 grade.

Washers shall be NEMA G-10 insulating style, 1/8-inch thick. All accessories shall be as recommended by the manufacturer.

Flexible Coupling with Insulated Boot
The coupling body and end rings shall be manufactured from ductile iron per ASTM A536, grade 65-45-12. Gasket and insulating boot shall be manufactured of styrene-butadiene rubber (SBR) compound for water service. Bolts and nuts shall be 5/8-inch high strength, low alloy corrosion-resistant steel meeting AWWA C111-80. Couplings shall meet AWWA C219 standards.

580.2.8. Wire Connectors and Splice Connections

Wire Connectors (Test station terminals):
One-piece, tin-plated crimp-on lug ring connectors.

Splice Connectors (AWG 10 and larger wire):
Splice connections shall be made using copper or bronze split bolt connectors.

Splice Connectors (AWG 12 and smaller wire):
One-piece, tin-plated crimp-on connectors.

580.2.9 Tapes and Coatings

Electrical Tape:
Vinyl electrical tape shall be 7 or 8.5 mil, minimum thickness, and be designed for primary insulation and jacketing for splices/repairs rated up to 600V.

Insulating Putty:
Insulating putty is to be 125 mil self-fusing tape for connections rated up to 600V.

Corrosion Prevention Tape:
Tape shall be designed for use in underground applications with a minimum 50 mil thickness. Product is to be designed for cold application, incorporate an integrated primer and meet all applicable requirements of AWWA C209.

Mastic Coatings:
Approved bitumastic coatings can be found on the Approved Products List.

Rubber Splicing Tape:
30-mil Ethylene Propylene self-bonding tape.

Corrosion Protection Tape:
10 and 20 mil all-weather corrosion protection PVC tape, including quick-drying, non-sag rubber based primer.

580.2.10 Conduit and Fittings

PVC:
Conduit shall be Schedule 40 PVC, NEMA type II, UL listed for concrete encasement and underground direct burial. Fittings shall be Schedule 40 PVC, NEMA type II, solvent-weld conduit connections as recommended by conduit manufacturer.

Rigid Steel:
Conduit shall meet requirements of and be installed in accordance with NFPA Code 70. Fittings shall meet requirements of UL 514B. Connections shall be thread type, with the exception of the slip fit test station connection. Both conduit and fittings shall be hot-dip galvanized with chromate protective layer, conforming to UL 6.

Cable Warning Tape:
Cable warning tape shall be 3-inch wide, yellow with black letters to say "CATHODIC PROTECTION CABLE BURIED BELOW".

580.2.11 Pipe and Fittings Encasement Materials

Polyethylene (pipe bagging):
Encasement sleeves are to be minimum 8-mil thickness, low density (LLD), V-Bio enhanced polyethylene conforming to AWWA C105, Method A. The use of polyethylene sheets will not be allowed.

**Related Standard Drawing: 580-1**

Geomembrane:
Material shall be constructed of PVC, be single ply construction, with a minimum 50 mil thickness. All materials shall meet or exceed ASTM D7176.

**Related Standard Drawing: 580-2**

Pipe Encasement:
Corrugated HDPE, single wall, non-perforated pipe or Schedule 40 PVC pipe.

**Related Standard Drawing: 580-3**

Service Tubing Encasement:
Polyethylene flexible roll tubing, minimum .060-inch wall thickness; or Schedule 40 PVC.

580.3. Construction

580.3.1. CP Test Stations

Installation of CP test stations may be required on any water infrastructure with the potential for being impacted by corrosion activity. This can include stray current mitigation sites, transmission pipelines and appurtenances, isolation points separating cathodically protected systems from unprotected infrastructure, and any other water infrastructure which may be highly impacted by corrosion activity.

Place test stations within a permanent waterline easement or dedicated public right-of-way. Only by approval are test stations to be placed in vehicular traffic and roadway areas. When pipelines and appurtenances are under paved surfaces, test stations shall be extended and placed in planter strips or sidewalks adjacent to the curb or edge of pavement. Test stations outside of traffic areas are to be placed immediately adjacent to the pipeline or appurtenance.

Post Mount Type:

Type A
Conduit shall be 2-inch in diameter and installed as shown on the applicable Standard Drawing. Install insulated bushings and throat connectors on ends of all rigid steel conduits. Install vertical steel conduit plumb and to the proper design elevation.

All horizontal conduit runs shall have a minimum cover of 24 inches. The vertical conduit runs shall be offset from over top of the pipeline but installed directly adjacent to the wire connection with pipe.

Type B
Wire shall be direct buried from the top of the pipeline to the test station with a minimum cover of 24 inches.

Install test station anchor into vertical support post and backfill, keeping station plumb.

Flush Mount Stations:

Type C
The foundation for the test station box shall be a minimum of 6-inches of class “B” backfill.

The terminal board, complete with hardware, shall be laid in the box along with 24 inches coil of slack wire.

Type D
The foundation for base of test station shall be minimum 6 inches of class “B” backfill.

Conduit shall extend into the base of the box and be trimmed smooth and flat.

Take care to install test station so that lid sets flush with finish surface.

Leave an adequate length of slack wire to allow the terminal board to be extended 24 inches from the test station base.

Reference Electrodes
Remove plastic shipping bag and install reference electrode 6 inches below spring line of pipe, and no more than 18 inches from outside edge of pipe.

Route wire through conduit and terminate in test station.

Place native soil free of rocks, clods and other debris around the reference electrode, backfilling in 6-inch lifts.

**Related Standard Drawings: 580-4 Series**

580.3.2. Exothermic Welding and Pin Brazing

Exothermic Welding

All connections of copper wire and/or cable to steel, ductile, and cast iron surfaces shall be made by exothermic (thermite) weld method or pin brazing.

1. Take precaution to ensure that pipe and fitting wall thickness is sufficient so that the thermite weld method will not damage the integrity of the pipe or fitting. Only the manufacturer's recommended equipment and supplies for each specific thermite weld application will be allowed. Note: Welding charges for use on cast and ductile iron are different from those used on steel.

2. Prior to making the weld connection, a 3-inch by 3-inch window shall be prepared by removing the outside surface coating down to bare metal. File or grind surface to a bright metal finish. Only vitrified type grinding wheels are acceptable for use; resin wheels will not be allowed.

3. Trim insulation to sufficient length and then install copper sleeves on the ends of the cables or wires. Proceed with thermite welding in strict accordance with the manufacturer's written instructions. Surface shall be completely dry prior to attempting a thermite weld.

4. After the connection has cooled, clean slag, and then strike weld with a hammer to test for defects. Remove and replace any defective connections.*

5. Lead wires shall have no less than 4 to 6 inches (depending on the weld) of separation between welds. A separate weld shall be made for each wire connection.

6. Install prefabricated thermite weld cap over each completed connection or specified insulating materials, as shown on the applicable Standard Drawing.

7. All thermite weld connections shall be inspected and approved by a Water Department representative prior to backfill.

**Related Standard Drawings: 580-7A**

Pin Brazing

1. Make wire connections to the pipeline or other structure with pin braze process per manufacturer's recommendations.

2. Remove a minimum amount of the existing coating required for placement of the pin braze mold on the steel structure. The steel surface must be completely clean and dry (near white metal surface preparation).

3. To prevent the steel surface from re-oxidizing, brazing must take place as soon as possible after grinding; no more than a 5 minutes delay.

4. Test the weld integrity by striking it from the side with a two pound hammer. If the weld comes off or cracks, move away a minimum of 6 inches and repeat welding process. Do not re-weld in the same location.

5. Apply primer and weld cap per manufacturer's recommendation.

6. Apply generous coat of bitumen over the weld cap and weld area, overlapping the pipe coating by 3 inches. Allow bitumen to cure per manufacturer's recommendation prior to repair of pipe coating.

7. Wet or damp exothermic weld molds will produce porous welds. The mold shall be completely dry before attempting to weld.

8. All connections shall be placed at distances specified in the Detail Drawing.

**Related Standard Drawings: 580-7B**

580.3.3. Wire and Cables

Test Station Installation

1. The bottom of the trench shall be free from stones, roots, or other materials. Use care to avoid abrasions, cuts, punctures, or any other damage to wire or cable during installation.

2. Each wire and/or cable shall be continuous in length and free of joints or splices unless otherwise specified or shown on the drawings.

3. Place wire in a rigid PVC conduit as required. Allow a minimum 2 foot slack loop in each cable/wire between the pipe connection and the conduit. Any conduit extending above finish grade shall be rigid steel for the full vertical length.

4. All buried wire, with the exception of joint bond cables, shall have cable warning tape placed 12 inches directly above the entire length of run during backfill operations.

5. Wire shall be color coded as shown on the Standard Drawing. Each color is to be impregnated into the insulation material. Colored tape or paint will not be accepted.

6. Joint bonds shall be bonded as shown on the Drawings and shall be installed with the detail noted cable.

7. Wire connectors for test stations are to be crimp-type and sized for connecting ring terminals.

8. At least 24 inches of slack shall be left for each terminal at each test station. Slack shall be made available for wire extension beyond the test station enclosure.

9. Continuity testing shall be performed by the Contractor on all CP test stations following completion of backfilling and hydrostatic testing of the water system. The Water Department is required to be present during all continuity testing.

**Related Standard Drawings: 580-8**

Splicing and Insulation Repair
Wire/Cable splices will generally not be permitted, except with Water Department approval. When a splice is approved by the Water Department, use the following method:

Splicing Method "A" (#12 and smaller wire)

1. Splices shall be made using a suitable sized copper alloy compression connector. All splice connections are to be inspected by the Water Department, prior to being wrapped.

2. Spiral wrap, in both directions, a minimum of 4 inches beyond the splice connection with two layers of rubber splicing tape. Tape shall be applied using a 50% overlap application method.

3. Spiral wrap the area covered by rubber splicing tape with two layers of electrical tape, using a 50% overlap application method.

Splicing Method "B" (#10 and larger wire/cable)

1. Splices shall be made using a suitable sized split bolt connector. All splice connections shall be inspected by the Water Department, prior to being wrapped.

2. Apply insulating putty to the entire splice connection, molding edges to a smooth surface.

3. Spiral wrap the connection area with two layers of electrical tape, using a 50% overlap application method.

Insulation Repair
Damage to wire/cable insulation shall be inspected by the Water Department to determine whether a repair can be made or replacement is required. To repair insulation, follow steps 2 and 3 of Splice Method "A" listed above.

580.3.4. Galvanic Anodes

1. Follow manufacturer's recommendations for preparation and installation of anode.

2. Install galvanic anodes 12 inches below pipe invert, with a 5-foot offset from edge of pipe, and at the location shown on drawings. Anode may be installed horizontally or vertically.

3. Minimum distance for anode placement from other unprotected pipelines shall be 2 feet.

4. Place native soil free of rocks, clods and other debris around the anode, backfilling in 6-inch lifts.

5. Bury anode wires a minimum of 24 inches below finish grade.

580.3.5. Dielectric Insulation

Electrical isolation is required at all connections between galvanically dissimilar pipe materials, new and existing pipe sections, protected and unprotected metallic structures, or any other locations deemed necessary by the Water Department.

Flange Isolation

All insulating flange components are to be clean and free of grease and oil prior to assembly. Bolt holes in mating flanges shall be properly aligned at the time bolts and insulating sleeves are inserted to prevent damage. After flange bolts have been tightened, each insulating washer and bolt sleeve shall be inspected for cracks or other damage. Damaged washers and sleeves shall be replaced as required.

Insulating Couplings

Clean each pipe end for a distance of 2 inches greater than length of insulating boot. Check area where gaskets will seat to make sure there are no dents, projections, gouges, or other defects that will interfere with the gasket seal. Grind welds flush with pipe surface.

Take extra care to follow the manufacturer's bolt tightening procedures and torque recommendations.

Cover all bare metal with two coats of mastic protective coating.

**Related Standard Drawing: 580-9**

580.3.6. Utility Crossing Pipe Encasement

Pipe Encasement

When required by the Water Department, install a sleeve of corrugated HDPE or Schedule 40 PVC pipe around the barrel of the pipe for a distance of 20-feet. Center the sleeve on the crossing utility and seal the ends with casing seals. If the pipe configuration will not allow the above installation, completely wrap the piping in 50-mil geomembrane material for a distance of 20-feet centered on the pipe crossing.

The Water Department may require alternate encasement lengths and materials on a case-by-case basis.

**Related Standard Drawings: 580-2, 580-3**

Water Service Encasement

When required by the Water Department, install a sleeve of polyethylene flexible roll tubing or Schedule 40 PVC over the service line tubing and seal the ends with corrosion protection tape. If the service line configuration will not permit sleeve installation, completely wrap with two (2) layers of corrosion prevention tape using 50% overlap method. Width of encasement will vary and be determined by the Water Department on a case-by-case basis.

**Related Standard Drawings: 580-1**

## SECTION 600

## 600. CROSS CONNECTION CONTROL AND BACKFLOW PREVENTION

### 610. General

This Chapter provides an overview of the City of Hillsboro *Cross Connection Control Program.* The purpose of the Program is to protect public health by maintaining the quality of Hillsboro's drinking water. Rules governing the Program are contained in the Hillsboro Utilities Commission Resolution #222 as codified under Subchapter 2.28, Chapter 2 of the City of Hillsboro *Municipal Code*, and OAR 333-061-0070.

The application of the *Cross Connection Control Program* involves the installation of backflow assemblies for *premises isolation*. The Water Department's responsibility for cross connection control is up to the *point of delivery*; therefore, when backflow protection is required by the Water Department, it shall be installed at the *point of delivery* or as directed by the Water Department. Backflow assemblies shall be placed within the property line as close to the water meter as possible, with no connections or tee fittings between the meter and backflow assembly.

*Premises isolation* backflow protection is specifically for protection of the public water system. It differs in scope from backflow protection required by the *Oregon Plumbing Specialty Code (OPSC*). The protection prescribed in Chapter 6 of the OPSC is primarily for the safety of the water users within a facility. *Premises isolation* backflow protection safeguards the public drinking water supply by effectively isolating it from any contamination originating within the *premises* water distribution system.

### 620. Installation Requirements:

A plumbing permit is required prior to installing *premises isolation* backflow protection on domestic and irrigation service lines. Backflow protection for fire systems is reviewed and permitted through both the Water Department and the Fire Department Inspector.

Backflow assemblies and devices shall be installed according to the requirements set forth in OAR 333-061-0071, the OPSC and Water Department Standard Drawings (located in the Appendix of this Standard).

The *backflow prevention assembly* for premises isolation is to be located immediately after the water meter on the private property side of the public right-of-way boundary. If installed underground, it shall be placed in a properly sized valve box or vault (see Standard Drawings in the Appendix). Aboveground installations shall be placed in a properly sized enclosure provided with *freeze protection* and according to the Standard Drawings in the Appendix. Fire service connections 3-inch or larger shall have a line size valve installed at the property line of the premises and shall be ductile iron pipe construction to a point which is a minimum of 5-feet beyond the downstream exterior wall of the backflow vault.

The type of *backflow prevention assembly* to be used for *premises isolation* shall be based on the actual or potential hazard within the *premises*. For example: If the *premises* contains fixtures or

equipment that require a reduced pressure principle backflow assembly (RP), the City will require a RP immediately after the water meter.

620.1. Typical Conditions Requiring Backflow Protection

An approved, customer owned and maintained *backflow prevention assembly* shall be installed on domestic, irrigation or fire service line(s) to *premises* when any of the following conditions exist:

1. Premises with activities included in Table 42 of OAR 333-061-0070.
2. There is an *auxiliary water supply,* such as a well, *cistern,* or body of water on the property.
3. There is intricate or inaccessible piping, which makes it impractical to ascertain whether or not a *cross-connection* exists.
4. There is an elevation difference between the service connection at the public water main and the highest water outlet on the property that exceeds 30-feet.
5. There is a risk of *backsiphonage* or *backpressure* due to practices or equipment.
6. There is an actual or potential *cross-connection* that presents a health hazard.
7. There is an irrigation system.
8. There is a water storage tank or bulk water filling station for vehicles and/or equipment.
9. There is a temporary water supply provided for construction use.
10. There is a fire line, fire sprinkler system, or private fire hydrant on the premises.
11. There are materials or chemicals on site which present a potential hazard to the water supply.

630. Auxiliary Water Supply:

Water customers having an *auxiliary water supply* such as a well, cistern, or body of water on site are required to have *premises isolation backflow protection.* A Double Check Valve Assembly (DC) is required even if the auxiliary source is used only for irrigation purposes and no connection to the potable line exists. If the *auxiliary water supply* has a chemical injection capability, the protection shall be a Reduced Pressure Backflow Assembly (RP).

Existing connections from a well or other source to the premises water piping system must be fully removed prior to turning on a newly provided service meter to new customers.

If a premises receiving City of Hillsboro water has an abandoned well, a copy of the certificate of abandonment from the appropriate State or County Agency shall be provided to the City of Hillsboro. Once the City of Hillsboro verifies the abandonment, no backflow prevention assembly will be required at the meter unless other hazards warrant it.

640. Approved Backflow Prevention Assemblies and Devices, and Sizes:

A list of *backflow prevention assemblies* approved for use in Oregon is available from the Drinking Water Section of the Oregon Health Authority.

The type of *backflow prevention assembly* required is determined by the hazard level, and the potential for *backsiphonage, backpressure* or both. (See Table 49 in OAR 333-061-0070.)

Assembly size shall be determined by the Building Department or Fire Department Inspector.

640.1. Types of Assemblies and Devices

A. Air Gap (AG):

An Air Gap is the unobstructed vertical distance through free atmosphere between the lowest effective opening from any pipe or faucet conveying water to the receptacle. These vertical, physical separations must be at least twice the effective opening of the water supply outlet, never less than 1-inch above the receiving vessel flood rim.

An approved AG is required on water tank trucks that fill from Bulk Water Hydrants.

**Related Standard Drawing: 640-1**

B. Double Check Valve Assembly (DC):

A DC is a complete assembly consisting of two internally loaded, independently operating check valves, located between two tightly closing resilient-seated shutoff valves with four properly placed resilient-seated test cocks. This assembly shall only be used to protect against a *non-health hazard* (i.e., a pollutant).

Application examples for DCs:

- Any premises that has an auxiliary water supply such as a private well, cistern, or other body of water.
- Commercial and multi-tenant buildings that do not present a health hazard
- Multi-story buildings in which the highest portion of the water piping is in excess of 30-feet above the water main at the service connection
- Restaurants or other food service establishments (caterers, kitchens, coffee shops, etc.)
- Mobile and manufactured home parks
- Premises with fire service lines, fire sprinkler systems, or private hydrants
- Premises with numerous backflow incidents as evidenced by *Automatic Meter Reading* (*AMR)* reports.

**Related Standard Drawings: 640-2B, 640-3 Series, 640-4 Series**

C. Double check Detector Assembly (DCDA):

A DCDA is a specially designed backflow assembly consisting of a line-size-approved double check valve assembly with a bypass containing a water meter (Neptune T-10 AMR with E-Coder)R900i) and an approved double check valve assembly. The meter shall register accurately for only very low rates of flow up to 3 GPM and shall show a registration for all rates of flow. This assembly shall only be used to protect against a *non-health hazard* (i.e., pollutant).

**Related Standard Drawings: 640-5 Series**

D. Reduced Pressure Backflow Assembly (RP):

Also known as a "Reduced Pressure Principle Backflow Assembly," an RP is a complete assembly consisting of a mechanical, independently acting, hydraulically dependent relief valve, located between two independently operating, internally loaded check valves that are located between two tightly closing resilient-seated shutoff valves with four properly placed resilient-seated test cocks. If either check valve leaks, the pressure relief valve maintains a differential pressure of at least 2-psi between the two check valves, by discharging water to the atmosphere. The reduced pressure backflow assembly is designed to prevent backflow caused by backpressure and backsiphonage from low to high *health hazards*.

Application examples for the RP:

- Commercial, industrial and multi-tenant buildings that present a health hazard
- Food processing and beverage bottling including ice manufacturing plants and bottled water industries.
- Chemical plants, manufacturing plants, metal plating industries
- Industries that use heat exchangers
- Spas and pedicure salons
- Premises with boilers
- Hospitals, medical offices, dental clinics, veterinary offices, plasma centers, convalescent facilities, and other health care facilities
- Laboratories (chemical, medical, biological, environmental testing, etc.)
- Mortuaries
- Fueling (gas) stations
- Automotive service facilities
- Sewage treatment plants and sewage pump stations
- Dry cleaners and commercial laundries
- Car wash facilities
- Any water system with pumps to supplement pressure
- Premises with chemically treated fire sprinkler systems.
- Irrigation systems that contain injectors for the addition of chemicals or fertilizer
- Irrigation systems that use pumps
- Water tanker trucks or other water storage systems without a permanent air gap assembly.
- Farms, including hobby farms that use water for other than household purposes.
- Premises where both reclaimed and potable water are used
- Premises with piping under pressure for conveying liquids other than potable water and the piping is installed in proximity to potable water piping

- Premises where City staff is denied access or restricted access for survey
- Any premises or other water using activity that presents a health hazard to the public water supply.

**Related Standard Drawings: 640-6, 640-7, 640-8, 640-9, 640-10**

E. Reduced Pressure Detector Assembly (RPDA):

Also known as a "Reduced Pressure Principle Detector Assembly," an RPDA is a specially designed backflow assembly consisting of a line-size approved reduced-pressure principle backflow prevention assembly with a bypass containing a water meter (Neptune T-10 AMR with E-Coder)R900i) and an approved reduced-pressure principle backflow prevention assembly. This assembly shall be used to protect against a non-health hazard (i.e., pollutant) or a health hazard (i.e., contaminant). The RPDA is primarily used on fire sprinkler systems.

An RPDA will be required on the fire service line of premises that use foamite, antifreeze, or other chemicals within their fire protection system. Also, if the fire protection system has an unapproved auxiliary water supply that is connected or intended to be connected to the fire system an RPDA will be required by the Water Department.

**Related Standard Drawings: 640-8, 640-9**

F. Pressure Vacuum Breaker Assembly (PVB) for Irrigation:

A PVB is a backflow assembly consisting of an independently operating, loaded air-inlet valve located on the discharge side of the check valve, with properly located resilient-seated test cocks and tightly closing resilient-seated shutoff valves attached at each end of the assembly designed to be operated under pressure for prolonged periods of time to prevent backsiphonage. The pressure vacuum breaker may not be subjected to any backpressure.

PVB's are to be used only when the danger of backflow is from backsiphonage. An advantage of this assembly is that only one PVB is required per irrigation system. The system cannot have pumps or possibility of backpressure after the PVB. Control valves for the irrigation system must be installed on the downstream side or after the PVB. The PVB must be installed a minimum of 12-inches above the highest point of the irrigation system that it serves and must not be placed in an area subject to flooding. Per the Oregon Plumbing Specialty Code (OPSC), the PVB is approved for high hazards.

**Related Standard Drawing: 640-2A**

G. Atmospheric Vacuum Breaker (AVB) for Irrigation:

An AVB consists of a float check, a check seat, and an air-inlet port. A shutoff valve immediately upstream may or may not be an integral part of the device. The AVB is designed to allow air to enter the downstream water line to prevent backsiphonage. This unit may never be subjected to a backpressure condition or have a downstream shutoff valve, or be installed where it will be in continuous operation for more than twelve (12) hours AVBs are approved by the OPSC for high hazards when only subjected to backsiphonage conditions.

If used on an irrigation system, one AVB is required for each irrigation zone. Chemicals or fertilizer may not be introduced into the irrigation system that contains AVB's. The AVB shall not be installed in a corrosive or dusty environment, or in areas that are subject to flooding. The AVB must be installed at least 6-inches above the highest point of the downstream piping or outlets. It must be used intermittently and shall not be pressurized for more than twelve (12) hours during a 24-hour period.

**Related Standard Drawing: 640-2A**

650. Testing of Backflow Prevention Assemblies:

State of Oregon Administrative Rules requires *backflow prevention assemblies* to be tested at the time of installation, when repaired or moved, and at least annually thereafter. All testing must be performed by a State-certified Backflow Tester. Test reports for DCDA's and RPDA's must include the detector meter reading. Results of the test must be provided to the Water Department within ten (10) working days* of the test.

*The 10-day requirement is based on the State of Oregon Rules and not on financial conditions or payment arrangements between the Tester and the customer.

## SECTION 700

## 700. LANDSCAPING

### 700. General

A. The standards contained in this section apply to all landscaping placed within the public ROW. Replacement trees shall also adhere to these standards.

B. The standards contained in this section may be superseded for projects within Plan Districts. For such projects, refer to the relevant Plan District within the Community Development Code. Plan District boundary information is available on the City website.

C. A Public Works Right-of-Way Permit or Public Infrastructure Permit is required prior to planting in the public ROW. Within a development, the property owner or their landscape contractor shall schedule a pre-planting inspection of the holes and trees with the City Inspector. Upon completion of the tree planting, they shall notify the City Inspector in order to schedule a final inspection.

D. No person shall remove or replace a street tree without first obtaining a permit from the City, specifically authorizing the removal or replacement.

E. Any tree that was planted within the ROW prior to December 2011 may remain, unless identified as a hazard tree.

F. Except under overhead utility lines where more extensive pruning may be necessary to protect the utility lines and crews, any pruning of trees growing within the ROW shall adhere to Subsection 750.

G. Unless superseded by a Plan District requirement, tree grates shall not be used unless they are needed to make a narrow sidewalk meet ADA regulations. The installation of tree grates requires City approval. Tree grates shall be “Urban Accessories OT Title-24” or approved equal.

H. Tree species shall be selected in accordance with Tables 700.1 through 700.3. Non-approved trees may be removed and replaced at the owner’s expense.

**Table 700.1 – Approved Street Tree Species for Areas 3' Wide or Less**

| Common Name | Scientific Name | Shape | Min. Power Offset | Height | Spread | Color | Fall Color |
|---|---|---|---|---|---|---|---|
| Pyramidal European Hornbeam | Carpinus betulus var. Fastigiata | Dense compact, narrow when young, becoming oval | 10 | 30' | 25' | Dark green | Yellow |
| Eastern Redbud | Cercis canadensis | Low branching, somewhat flat topped | None | 30' | 30' | Medium green | Yellow |
| Glorybower Tree | Clerodendrum trichotomum | Oval, rounded umbrella | None | 20' | 20' | Dark green | Gold |
| Chinese Dogwood | Cornus kousa chinensis | Widely vase shaped to rounded layered branches | None | 30' | 20' | Medium green | Reddish |
| Dogwood (Hybrid) | Cornus kousa x nuttallii Var. Starlight or Venus | Upright, oval | 10' | 30' | 20' | Dark green | Red to purple-red |
| Columnar Beech | Fagus sylvatica var. DaWyck Purple | Columnar, fastigiate | 10' | 50' | 10' | Purple | Coppery-bronze |
| Mayfield Ginkgo | Ginkgo biloba var. Mayfield (MALE ONLY) | Narrow, columnar | 10' | 30' | 12' | Light green | Golden-yellow |
| Sunburst Honeylocust | Gleditsia triacanthos | Irregular, somewhat rectangular outline | 10' | 30' | 35' | Bright yellow tip growth | Yellow Brown |
| Crape Myrtle | Lagerstroemia indica | Varies | 10' | 20' | 20' | Dark green | Yellow to red |
| Prairifire Crabapple | Malus var. Prairifire | Upright spreading, rounded | None | 20' | 20' | Purple becoming reddish green | Bronze |
| Tschonoskii Crabapple | Malus tschonoskii | Upright, narrowly oval | None | 28' | 14' | Silvery green to green | Orange, red, and purple |
| Canada Red Chokecherry | Prunus virginiana var. Shubert | Upright spreading, rounded | 10' | 30' | 20' | Green purple | Red to reddish purple |
| Skyrocket English Oak | Quercus robur var. Fastigiata | Narrow, fastigiate | 10' | 45' | 15' | Dark green | Yellow brown |
| Japanese Stewartia | Stewartia pseudocamelia | Pryamidal to oval | None | 30' | 20' | Medium to dark green | Orange, red, and purple |
| Big Leaf Snowbell | Styrax obassia | Oval | None | 25' | 20' | Dark green | Yellowish |

**Table 700.2 – Approved Street Tree Species for Areas 3’ – 6’ Wide**

| Common Name | Scientific Name | Shape | Min. Power Offset | Height | Spread | Color | Fall Color |
|---|---|---|---|---|---|---|---|
| Hedge Maple | Acer campestre | Dense and rounded | 10’ | 30' | 30' | Dark green, glossy | Yellowish |
| Armstrong Maple | Acer freemanii | Narrow | 10’ | 45' | 15' | Green | Yellow-orange |
| Amur Maple | Acer ginnala | Upright, oval | None | 55' | 45' | Medium green | Orange to orange-red |
| Crimson Sentry Maple | Acer platanoides var. Crimson Sentry | Compact, dense, pyramidal to oval | 10’ | 25' | 15' | Deep purple | Maroon to reddish bronze |
| Bowhall Red Maple | Acer rubrum var. Bowhall | Broad oval, round | 10’ | 40' | 40' | Green | Yellowish orange to red |
| Pacific Sunset Maple | Acer truncating | Upright spreading, rounded crown | 10’ | 30' | 25' | Dark green, smooth, very glossy | Yellow orange to bright red |
| Katsura | Cercidiphyllum japonicum | Oval, pyramidal | 10’ | 60' | 60' | Green | Yellow |
| Tricolor Beech | Fagus sylvatica var. Purpurea Tricolor | Broad, rounded pyramid | 10’ | 40’ | 30’ | Purple | Copper |
| Summit Green Ash | Fraxinus pennsylvanica var. Summit | Upright branching, narrow oval | 10’ | 45' | 25' | Medium green | Yellow |
| Princeton Sentry Ginkgo | Ginkgo biloba var. Princeton Sentry | Narrowly pyramidal | 10’ | 40' | 15' | Green | Bright yellow |
| Saratoga Ginkgo | Ginkgo biloba var. Saratoga | Dense, pyramidal | 10’ | 40’ | 20’ | Emerald green | Gold |
| Sunburst Honeylocust | Gleditsia triacanthos | Irregular, somewhat rectangular | 10’ | 40' | 35' | Bright yellow tip growth | Yellow-brown |
| Crimson Spire Oak | Quercus alba x Q. robur var. Crimschmidt | Columnar, tightly fastigiate | 10’ | 45' | 15' | Dark green to bluish-green | Rusty red |
| Emerald Sunshine Elm | Ulmus propinqua | Vase | 10’ | 35’ | 25’ | Green | Yellow |
| Green Vase Zelkova | Zelkova serrata var. Green Vase | Vase, rounded | 10’ | 40' | 40' | Deep green | Rusty red |

**Table 700.3 – Approved Street Tree Species for Areas 6' Wide or Greater**

| Common Name | Scientific Name | Shape | Min. Power Offset | Height | Spread | Color | Fall Color |
|---|---|---|---|---|---|---|---|
| European Beech | Fagus sylvatica | Broadly pyramidal to oval | 25' | 50' | 40' | Dark green, glossy | Bronze |
| Autumn Purple Ash | Fraxinus americana var. Purple Autumn | Rounded | 25' | 45' | 40' | Green, textured | Reddish Purple |
| Patmore Ash | Fraxinus pennsylvanica | Symmetrical upright branches, oval head | 25' | 45' | 35' | Dark green, glossy | Yellow |
| American Hophornbeam | Ostrya virginiana | Upright oval | 25' | 40' | 25' | Dark green | Yellow |
| Persian Parrotia | Parrotia persica | Broadly pyramidal to rounded | 25' | 30' | 20' | Green, textured | Yellow, orange, and red |
| Scarlet Oak | Quercus coccinea | Upright spreading, open, broadly oval | 25' | 50' | 40' | Dark green, glossy | Red |
| Northern Red Oak | Quercus rubra | Rounded | 25' | 50' | 45' | Dark green | Red |

710. Street Tree Quality and Condition Standards

A. A street tree shall have a straight and upright trunk perpendicular to the ground with the lowest scaffold branches a minimum height of 5 feet above the ground. (Scaffold branches are the primary limbs radiating from the trunk of a tree from which all subordinate branches grow.) Any structural pruning of the scaffold branches to obtain the above clearance or required appearance must have been performed the year prior to digging the tree.

B. Street trees shall be grown to the standards and specifications of the American Standard for Nursery Stock (ANSI Z-60.1-1996), published by the American Association of Nurserymen.

C. Street trees shall be provided reasonably free from insects and disease, decay, major structural defects, and damage to the bark, the trunk, all branches, and the root system. The term "reasonably free" is as defined by nursery industry standards for street trees.

D. Street tree scaffold branches shall be well proportioned and pointing upward where they attach to the main trunk, with an average spacing of at least six inches. Trees with a main trunk branch "Y" are not acceptable.

E. Street trees shall be a minimum of 1.5 inches in caliper and shall be a minimum of 10 feet tall at the time the trees are dug.

F. Trees shall be transported and provided in the following condition at time of planting.

1. Balled and burlapped or in wire baskets, providing:

a) The trees have a tight, sound root ball with firm attachment of the trunk. Trees with trunks loosely attached to the root ball will not be accepted.

b) The root ball size and condition conform to the standards and specifications of the American Standard for Nursery Stock (ANSI Z-60.1-1996), published by the American Association of Nurserymen.

c) The root balls have not been allowed to dry out at any time. Any trees stressed from lack of sufficient water will not be accepted.

d) The trees have a well-developed root system and are not root-bound or have circling/girdling roots.

2. In a container, providing:

a) The trees are free of circling, girdling roots, i.e. root-bound.

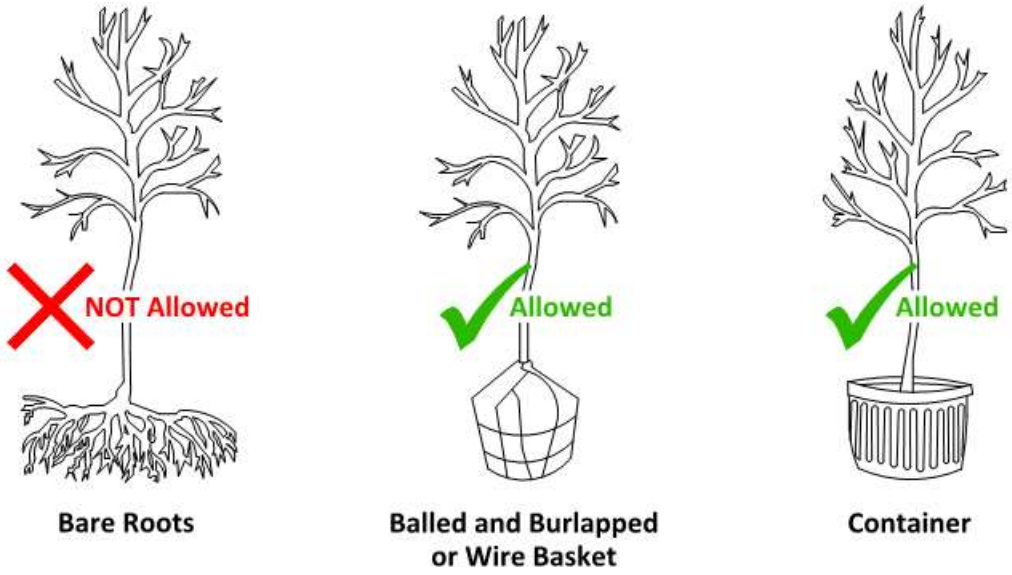
b) The trees have roots extending to the inside edges of the container.

c) The trees have been grown in the container for a maximum of one year.

G. Bare root trees are not allowed.

H. Trees that need pruning of dead, broken, or split branches to meet the requirements in this standard shall not be planted.

**Figure 710.1 – Street Tree Condition**



## 720. Planting Location, Spacing, and Clearances

### 720.1. Location

A. On streets without sidewalks, tree locations shall accommodate future sidewalks.

B. Trees locations shall accommodate current and future utility line corridors.

C. No tree shall be planted within a landscape strip or median planter less than 2.5 feet wide.

D. Trees shall be centered in landscape strips between the sidewalk and the street curb.

E. Trees shall not be planted over existing or future underground utility lines.

### 720.2. Spacing

A. Tree spacing shall equal the *Spread* dimension shown in Tables 700.1 through 700.3.

### 720.3. Clearances

A. All landscaping (trees and shrubs) shall be maintained to meet the requirements for vision clear zones at intersections and along streets and sidewalks. See Subsection 230.5.1 and the *Roadside Vegetation Management Program* page on the City website.

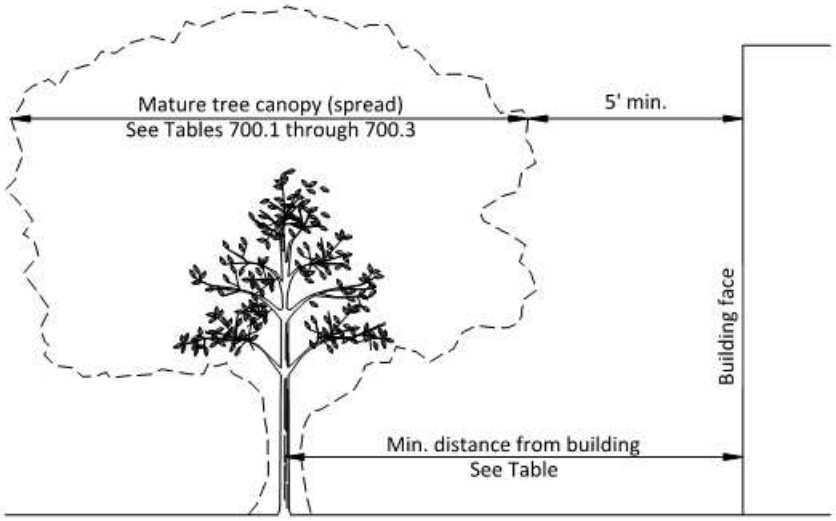
B. Street trees shall meet the clearance requirements shown in Table 720.1.

C. Trees and shrubs shall meet the minimum clearances from buildings shown in Figure 720-1.

**Table 720.1 - Minimum Street Tree Planting Clearances**

| Feature | Minimum Distance From Feature | | |
|---|---|---|---|
| | Small tree (up to 35’ ht.) | Medium tree (up to 60’ ht.) | Large tree (over 60’ ht.) |
| Public intersections | 35 feet | 35 feet | 35 feet |
| Alley and Private intersections | 15 feet | 15 feet | 15 feet |
| Courtesy walks/sidewalks | 2 feet | 3 feet | 4 feet |
| Driveways | 5 feet | 5 feet | 10 feet |
| Fire hydrants | 5 feet | 5 feet | 5 feet |
| Manholes and catch basins | 5 feet | 10 feet | 10 feet |
| Water meters | 5 feet | 5 feet | 5 feet |
| Utility boxes | 5 feet | 5 feet | 5 feet |
| Utility poles | 5 feet | 10 feet | 10 feet |
| Street lights | 15 feet | 20 feet | 25 feet |
| Stop signs | At least 35 feet. Shall not visually block sign | | |
| Regulatory signs | Shall not visually block sign. | | |

**Figure 720.1 - Minimum Building Clearances**




| Tree Size | Minimum Distance from Building* |
|---|---|
| Small trees (potential growth of up to 35’ ht.) | 5 feet |
| Medium trees (potential growth of up to 60’ ht.) | 10 feet |
| Large trees (potential growth of over 60’ ht.) | 15 feet |
| Shrubs | 3 feet |

*Trees planted 10 feet or closer to a building shall have an impenetrable root barrier installed near the building. The root barrier shall run the length of the planting area or the structure, and reach a depth of at least twenty-four (24) inches.

730. Planting Requirements

A. Trees shall be planted in accordance with Std. Drg. No. 730-1.

740. Establishment Period Maintenance and Care Requirements

A. The Establishment Period is the period of time a developer, contractor, builder, and or property owner is obligated to provide 1) maintenance meeting the requirements of this subsection and 2) maintenance assurance by means of a maintenance bond. The abutting property owner is responsible for street tree maintenance after the Establishment Period. The Establishment Period shall begin on the date of final acceptance of the trees by the City and shall extend for two years from that date.

B. Each tree shall receive regular weekly watering as needed to ensure the trees are not stressed during the hotter portions of the growing season (from April 15th through October

15th). Water shall be provided in a manner that allows penetration into the soil around the tree.

C. Stakes and ties shall be maintained and repaired as needed. Stakes and ties shall be removed at the end of the Establishment Period if the trees are well rooted into the native soil and are able to withstand local wind conditions.

D. A minimum 3 foot diameter planting area around each tree shall be maintained with a layer of medium or medium-fine bark mulch 2-4 inches deep. The bark mulch shall be kept at least 2 inches away from the trunk of the tree and be kept free of weeds.

E. Additional structural pruning shall be performed at the end of the Establishment Period. A strong scaffold branch structure shall be developed by pruning to select the primary scaffold branches. In addition to the requirements of Section 750, the structural pruning shall also adhere to the following:

1. Trees shall be pruned to remove subordinate branches that are crossing, damaged, diseased, broken, or have included bark.

2. Trees shall not be topped or reduced in height.

3. Trees shall be pruned to meet all the clearance requirements of Subsection 720.3.

4. Pruning shall be performed according to the ANSI A-300 pruning standards and specifications established for trees at planting (5.4.1) and for trees during the first three years after planting (5.4.2).

5. Trees shall be pruned so at least 2/3 of the tree's height is foliage and canopy with the remaining 1/3 being the trunk.

F. Any tree falling into one of the following conditions shall be replaced. The new tree shall have a new establishment period of two years starting on the date it is accepted by the City.

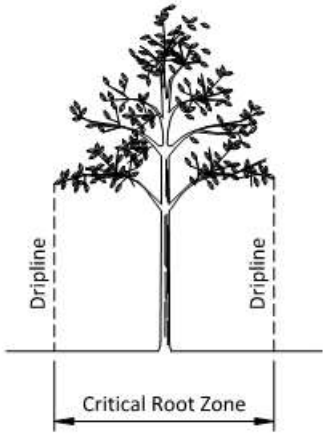
1. Dead Tree. Any tree that has no live growth originating in all or a portion of the scaffolding branches.

2. Stressed Tree. Any tree that has lost 50 percent or more of its total foliage or has a reduction of 50 percent of normal leaf size for that species.

3. Non-Approved Trees. Any tree variety not listed in Table 700.1 through 700.3.

G. No activity detrimental to the tree's roots is allowed within the tree's Critical Root Zone, as defined in Figure 740.1.

**Figure 740.1 – Critical Root Zone**



## 750. Tree Pruning Standards

A. Tree pruning shall meet the ANSI A-300 pruning standards.

B. All work shall be performed following Oregon Safety and Health Administration (OSHA) regulations and following the ANSI Z-133.1 and the ANSI A-300.

C. Pruning shall be deemed necessary when such action is to:

1. Correct structural problems, remove deadwood, and decayed parts.

2. Comply with the City of Hillsboro *Municipal Code*.

3. Correct a safety or health problem.

4. Maintain required clearances.

D. All tree work performed near electrical lines shall conform to the National Electrical Safety Code, ANSI Z-133.1, and OAR 437-002-0301 through 0311.

E. Trees shall be pruned in a manner that retains well-spaced, inner lateral branches so as to allow the trunk taper to be developed as needed for the strength of the branch attachment.

F. No tree shall have more than 20 percent of its canopy removed in any one pruning or in any one year.

G. No hooks, spikes, or climbing gear, which pierces the trunk of a tree, shall be used.

## 760. Private Irrigation System Crossings

A. This Subsection applies to all private irrigation systems crossing the public ROW. Such crossings shall be avoided wherever possible.

B. Crossings shall be show in the permit review plans submitted to the City.

C. The crossing shall be included in the project's record drawings (see Section 120.6). If the crossing is relocated after acceptance of the record drawings, the Developer/Owner shall obtain a ROW permit prior to commencing work. Prior to final inspection of the ROW permit, the Developer/Owner shall update the record drawings at their own expense.

D. The Owner/Developer (or Homeowner's Association if applicable) shall be responsible for repairing, at their own expense, any damage to the public infrastructure that is associated with the repair, replacement, or maintenance of the private irrigation crossing.

E. All irrigation piping, and associated communication wire, shall be placed in a pipe sleeve. Sleeves shall be minimum of 4 inch ductile iron or C900 PVC.

F. A gate valve, enclosed by a box marked "Irrigation" and having a green lid, shall be provided at both ends of the crossing.

G. Minimum depth of cover to the top of the pipe shall be 36 inches.

H. Backfill the pipe zone with imported riverbank sand and the rest of the trench with crushed ¾-inch minus rock, compacted in 6-inch lifts.

I. The letters “IR” shall be stamped into the top surface of the curbs on each side of the roadway where the crossing is installed. See Subsection 230.9.C.

J. Place a 14 gauge blue trace wire above the entire length of the sleeve.

## SECTION 800

## 800. STRUCTURES

### 810. General

A. The term "structures" as used in this section applies to bridges, retaining walls, reinforced concrete box culverts, and pipes greater than 72" in diameter constructed in the public right-of-way or within public easements.

B. Structures shall be designed and constructed in accordance with the *Oregon Standard Specifications for Construction, Manual of Field Test Procedures, Bridge Design and Drafting Manual, Roadside Design Guide, AASHTO LRFD Bridge Design Specifications*, and *The Oregon Structural Specialty Code (OSSC)* (as adopted by the City's Building Department).

### 820. Design Criteria

A. The project drawings and specifications shall state the ODOT requirements and design criteria for structures that apply to the project.

B. Concrete for structures shall be a minimum of Class 5000, 3/4 inch concrete.

### 830. Retaining Walls

A. The term "retaining wall" as used in this section includes the wall face, structural backfill, geogrids and other tie back systems, wall drainage systems, drainage backfill, and all other wall components required by the wall system manufacturer or Engineer to ensure the stability of the wall.

B. Retaining walls exceeding 4 feet in height (measured from the base of the foundation to the top of the wall) shall be designed by a registered Professional Engineer licensed to practice structural engineering in the State of Oregon. Walls less than 4 feet in height but supporting a surcharge load must also be designed by a registered Professional Engineer.

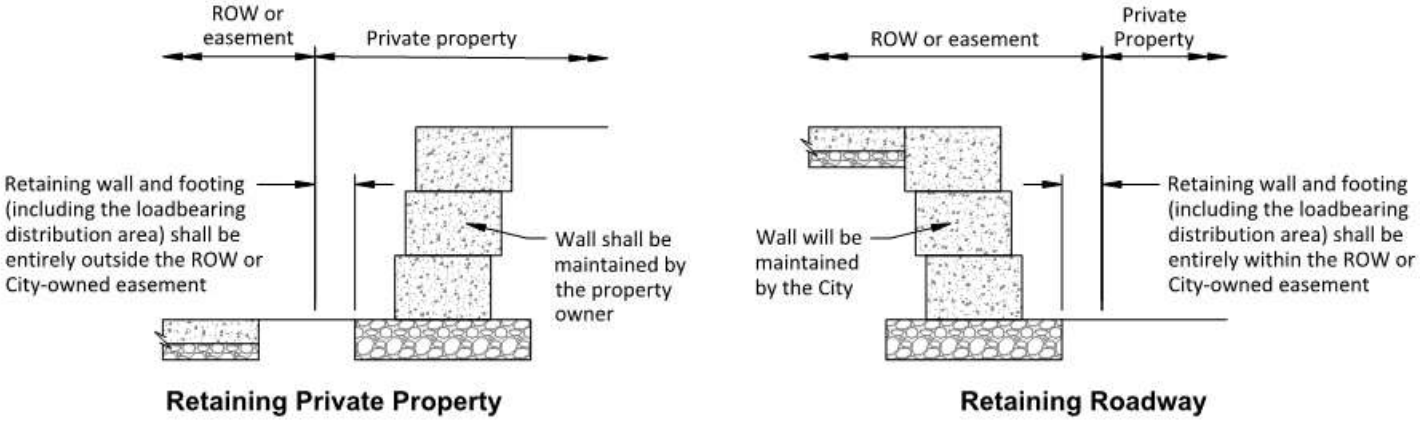
C. Retaining walls shall be designed to avoid conflicts with the maintenance of utilities.

D. Retaining walls shall be designed for maintenance traffic loads when applicable.

E. If a retaining wall is located outside a public right-of-way, a building permit may be required by the City depending upon the height and loading of the wall. Visit the City of Hillsboro Building Department website for building permit requirements.

F. Walls constructed to retain a roadway or other public infrastructure shall be located entirely within the ROW or City-owned easement. Walls constructed to retain private property shall be located entirely on the private property and shall be maintained by the property owner. See Figure 830.1 for wall location and ownership.

**Figure 830.1 – Wall Location and Ownership**

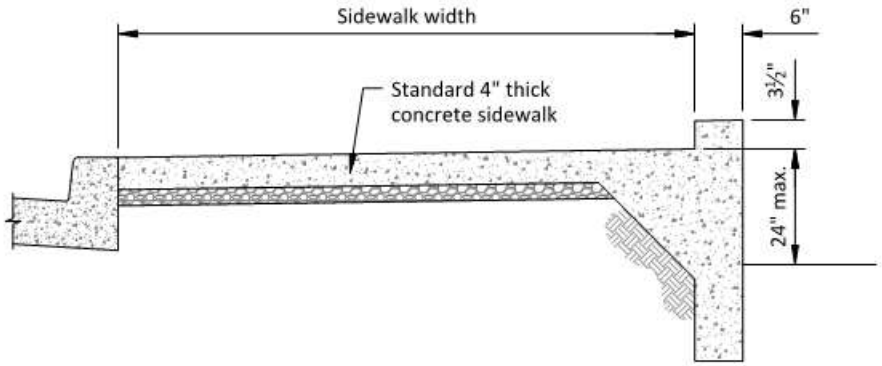



G. Retaining walls located near street intersections shall conform to the sight distance requirements specified in Subsection 230.5.1.

H. All walls taller than 24" require a handrail or fence.

I. Retaining walls less than 24" in height located at the back of a proposed sidewalk shall include a 3½ inch tall "kicker" as shown in Figure 830.2.

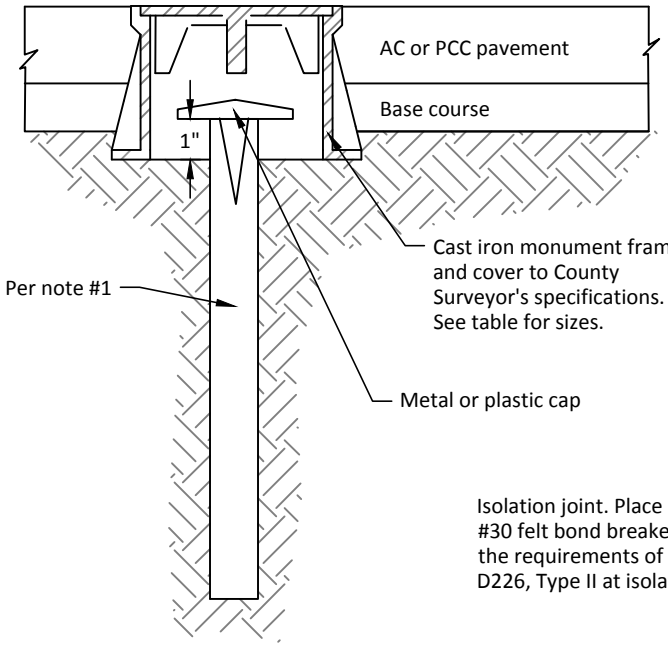
**Figure 830.2 – Short Wall at Back of Sidewalk**

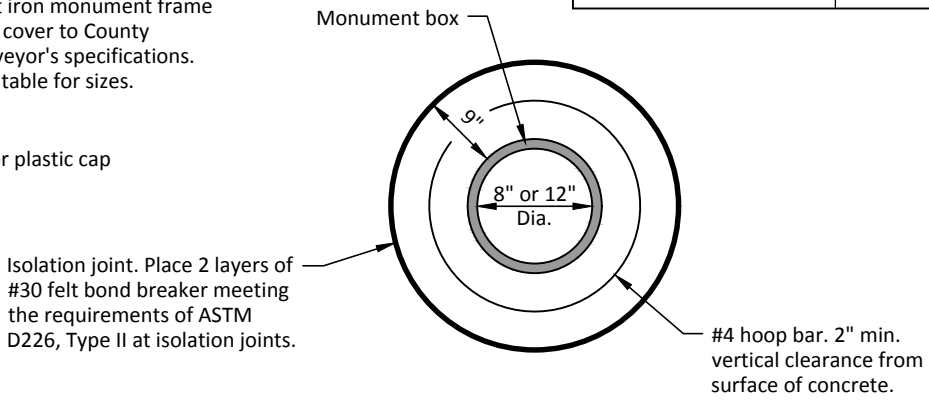


# Appendix A
# Standard Drawings

# INDEX TO CITY OF HILLSBORO STANDARD DRAWINGS

| Box Sizes | |
|---|---|
| Functional Classification | Dia. |
| Arterial | 12" |
| Collector | 12" |
| Neighborhood Route | 8" or 12" |
| Local Road | 8" or 12" |
| Alley | 8" or 12" |



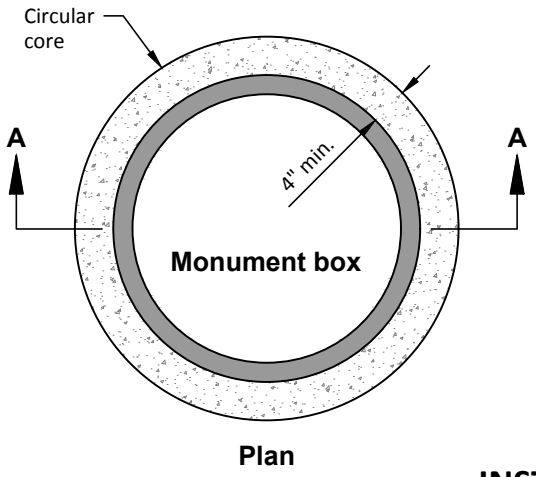




## STANDARD MONUMENT BOX

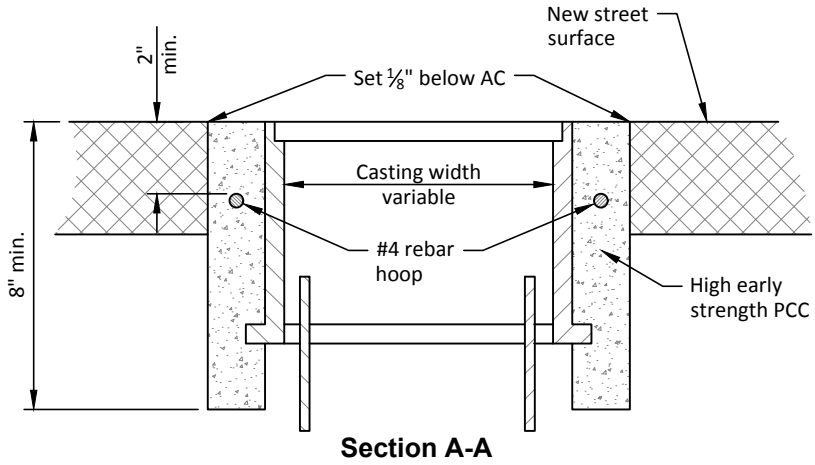
SCALE: NTS

## INSTALLATION IN PCC ROADWAY

SCALE: NTS




Plan




Section A-A

## INSTALLATION IN AC ROADWAY

SCALE: NTS

NOTES:

1. All monuments shall use either ⅝" dia. X 30" long iron rod or ¾" inside dia. X 30" long gavanized iron pipe.

2. Any monuments that may be subject to destruction or disturbance shall be protected in accordance with ORS 209.140-155.

| Models Approved for Use in Washington County | |
|---|---|
| **East Jordan Iron Works, Inc.**<br>8" Monument Box:<br>00361411 #3614Z 8-1/4" x 8" Monument Body<br>00361421 #3614A "Monument" Cover<br>12" Monument Box:<br>00367311 #3673Z 12" x 7-7/8" Monument Body<br>00367323 #3673A "WC" Monument Cover w/ Drop Handle | **Olympic Foundary**<br>8" Monument Box:<br>Model No. M1014 8" Frame<br>Model No. M1014 8" Cover<br>12" Monument Box:<br>Model No. M1035 12" Frame 14-6330<br>Model No. M1035 12" Cover 15-14 6331<br>Model No. M1036 12" Frame 14-6329<br>Model No. M1036 12" Cover 14-638 |

Hillsboro Public Works

MONUMENT BOXES

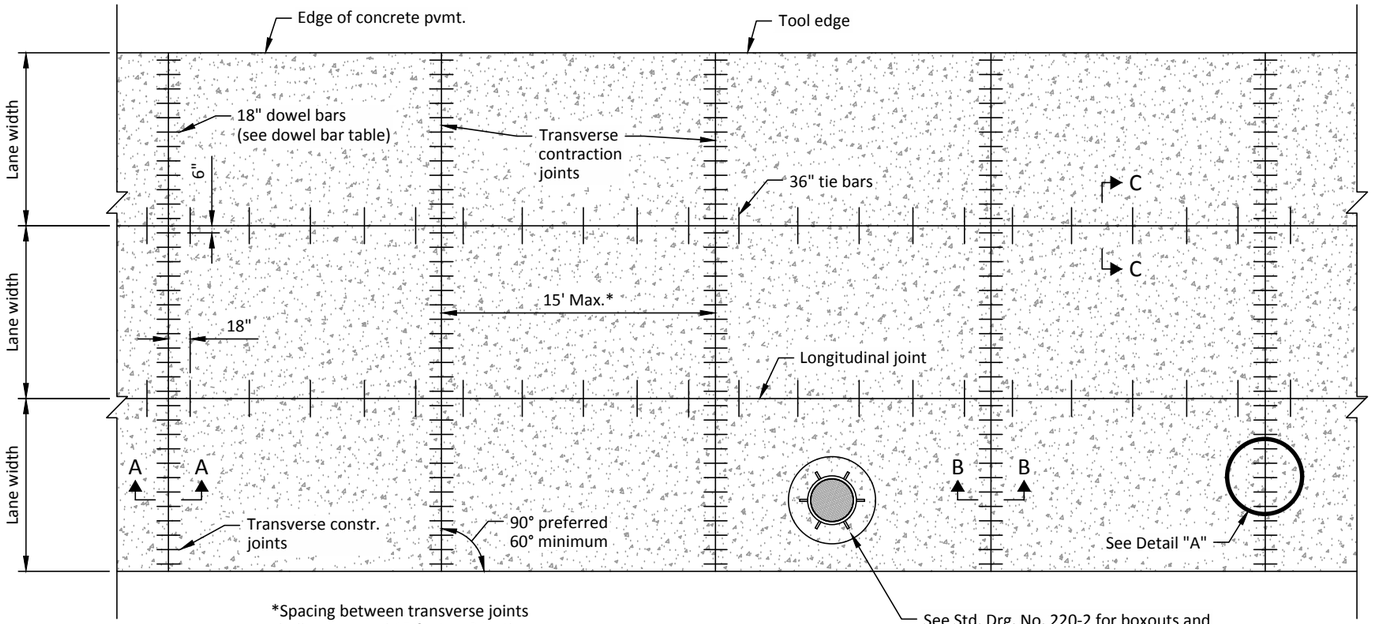
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 150-1

SCALE NTS

FILE NAME: COH-150-1.DWG

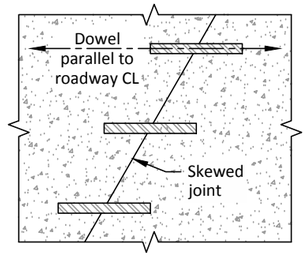
PLOT DATE: 7/13/2017 4:18 PM




*Spacing between transverse joints shall not exceed 15 feet or 24 x the slab thickness on unbound base or 21 x slab thickness on stabilized base.

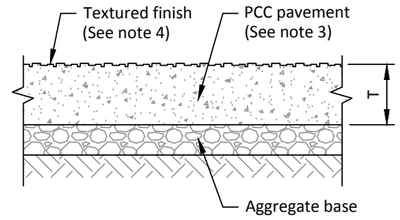
## PLAN

SCALE: NTS



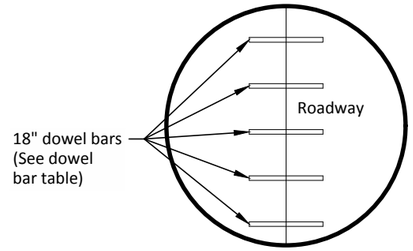

## DOWEL AT SKEWED JOINT

SCALE: NTS




## TYPICAL PAVEMENT SECTION

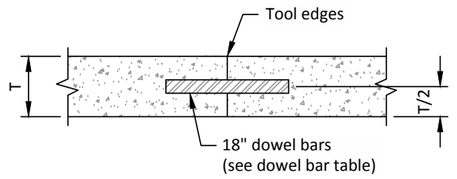
SCALE: NTS



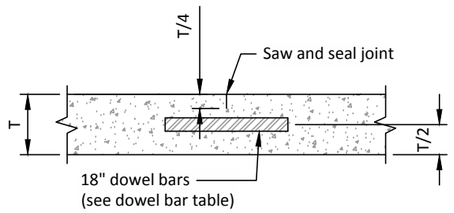

## DETAIL "A"

SCALE: NTS

| DOWEL BAR TABLE | | |
|---|---|---|
| Pvmt. Thkn. (T) | Dowel Dia. | C/C Dowel Spacing |
| 7" - 8" | 1" | 12" |
| 8½" - 10" | 1¼" | 12" |
| 10½" & up | 1½" | 12" |



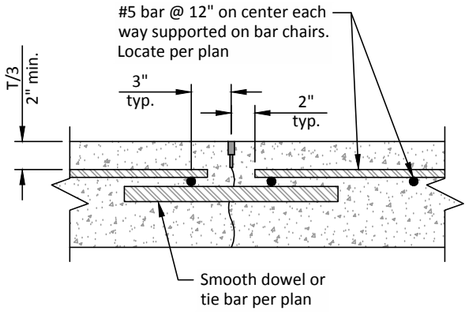

**Section A-A**
**Construction Joint**




**Section B-B**
**Contraction Joint**

## TRANSVERSE JOINT

SCALE: NTS




## REINFORCEMENT GRID PLACEMENT NEAR JOINTS

SCALE: NTS

NOTES:

1. Install tie bars along longitudinal joints between concrete panels. Tie bars are not installed between concrete pavement and ACP pavement.

2. Center tie bars and dowel bars on joint.

3. If the time frame designated for opening traffic is less than 72 hours after concrete placement, provide Class HES4000 - 1½ concrete designed to attain a minimum average compressive strength of 3,000 psi prior to allowing traffic on the concrete. Otherwise furnish Class 4000 - 1½ paving concrete.

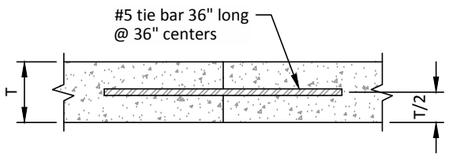
4. The surface of the concrete shall have a textured finish using a steel-tine tool with ⅛ inch tines that will mark the finished concrete to a depth of 1/16 inch to ⅛ inch. Randomly space the markings from ½ inch to 1¼ inches as approved. Avoid overlaps of the texturing. Markings shall be transverse to the roadway centerline and full roadway width.

5. New interior longitudinal and transverse joints shall be sawcut as soon as the concrete has set enough to allow sawing without tearing or raveling.

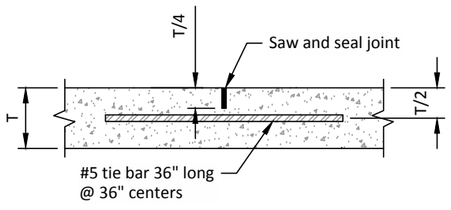
6. The new saw cut transverse and longitudinal joints shall be filled with poured rubber-asphalt joint filler. The saw cut joint shall be flushed with water, vacuumed to remove cement slurry and dried before installing the joint filler.

7. Irregularly shaped panels, rectangular panels with an aspect ratio exceeding 1:1.25, and panels containing more than one utility structure (such as manholes, valves, etc.) shall be reinforced. See reinforcement grid details this sheet.

8. All tie bars and dowel bars shall be Grade 60 steel and shall be smooth, epoxy coated, circular, and greased.



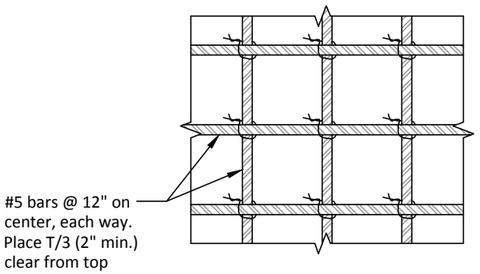

**Contact Joint**




**Weakened Plane Joint**

## SECTION C-C
## LONGITUDINAL JOINT

SCALE: NTS




## REINFORCEMENT GRID

SCALE: NTS

SCALE: PLAN AS SHOWN | HORIZ. | VERT. | DRAWN: XXX | CHECKED: XXX

| # | DATE | REVISION | BY | APP'D |
|---|---|---|---|---|

Hillsboro Public Works

STANDARD DRAWING

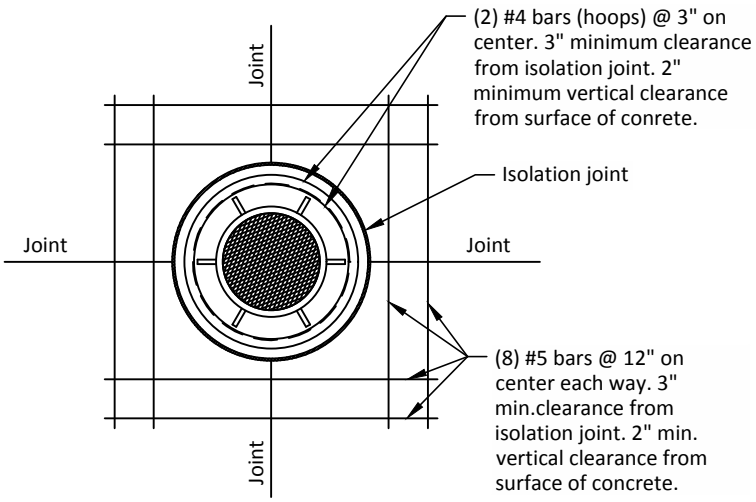
CONCRETE ROADWAYS

PROJECT NO.
STANDARD

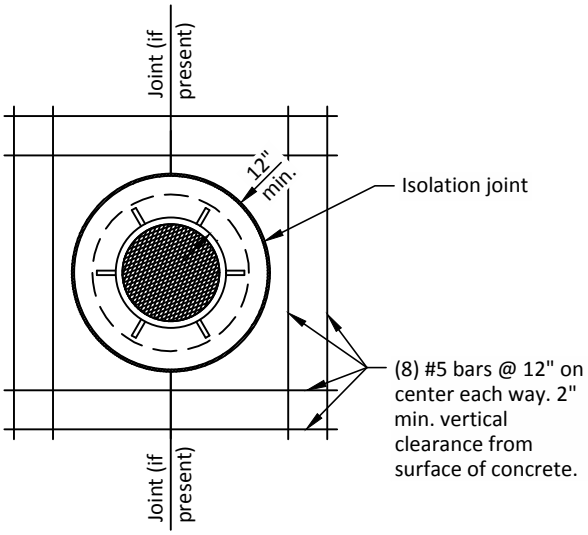
STD. DRG. NO.
220-1

PLOT DATE: 5/17/2017

FILE NAME: COH-220-1.DWG



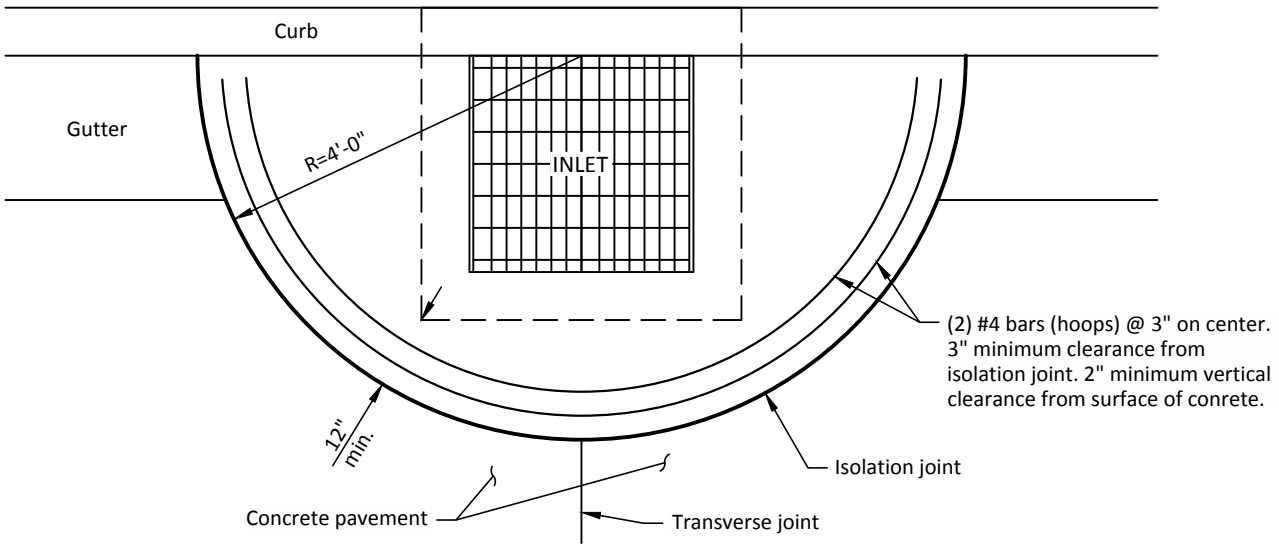

**Boxout on Joint Intersection**




**Boxout on Joint or Wholly Within Panel**

## MANHOLE BOXOUT

SCALE: NTS




## GUTTER & CURB INLET CATCH BASIN (CG-2) BOXOUT

SCALE: NTS

NOTES:

1. Place 2 layers of #30 felt bond breaker meeting the requirements of ASTM D226, Type II at isolation joints.

2. Locate joint on center of manhole rim when possible.

Hillsboro Public Works

MANHOLE AND INLET CONCRETE BOXOUTS

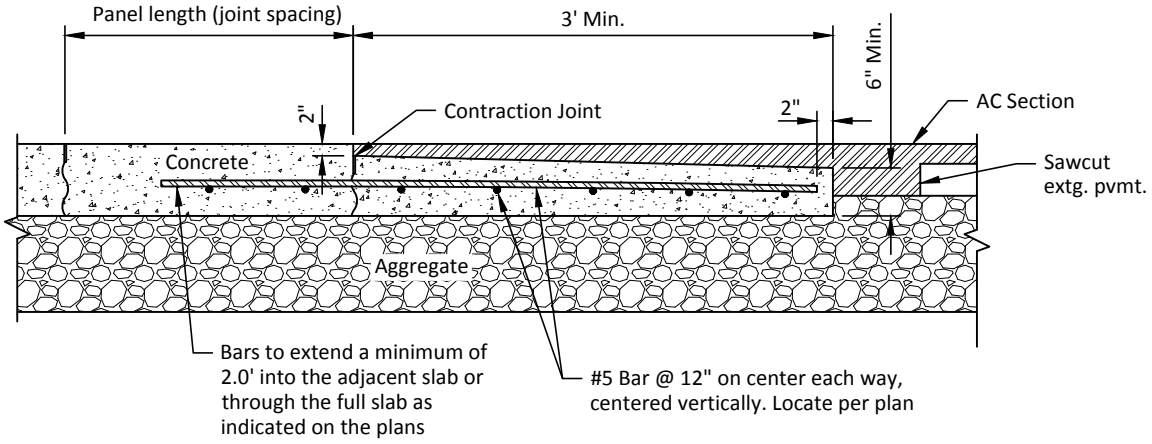
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 220-2

SCALE NTS

FILE NAME: COH-220-2.DWG

PLOT DATE: 7/13/2017 4:00 PM




## CONCRETE IMPACT PANEL

SCALE: NTS

Hillsboro Public Works

CONCRETE IMPACT PANEL

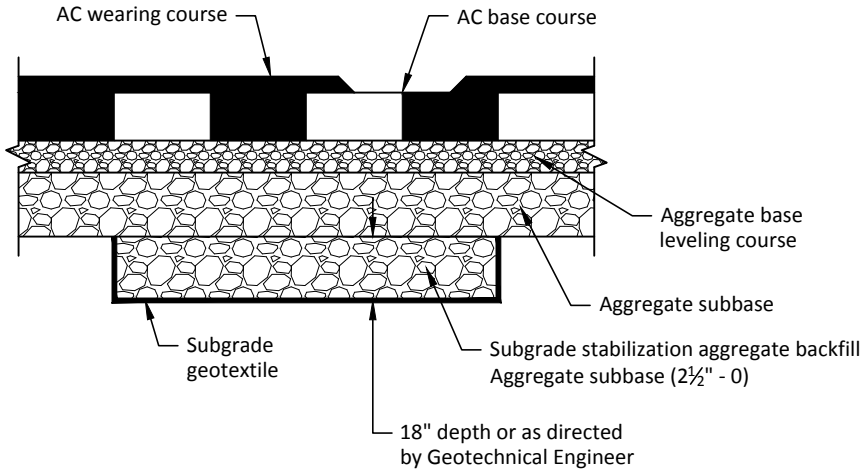
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 220-3

SCALE NTS

FILE NAME: COH-220-3.DWG

PLOT DATE: 3/7/2017 3:46 PM




## SUBGRADE STABILIZATION

SCALE: NTS

NOTES:

1. For surfacing details not shown, see typical sections.
2. Locations as directed

Hillsboro Public Works

SUBGRADE STABILIZATION

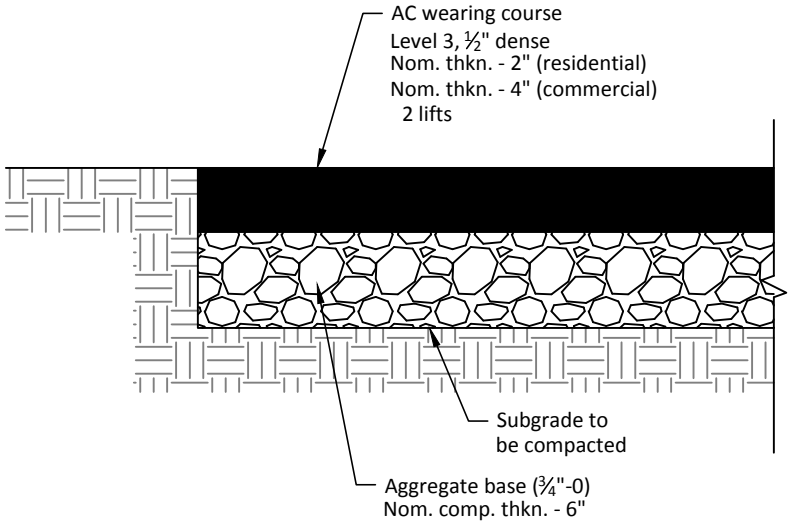
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 220-4

SCALE NTS

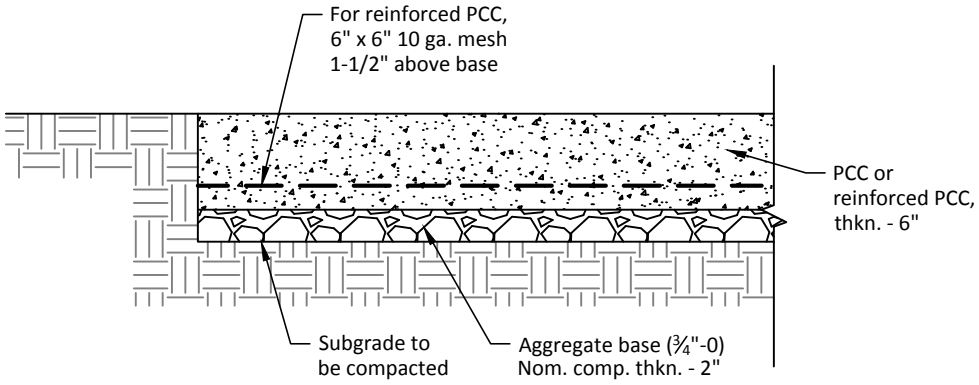
FILE NAME: COH-220-4.DWG

PLOT DATE: 3/7/2017 3:47 PM




## ASPHALT CONCRETE (AC) DRIVEWAY

SCALE: NTS




## PORTLAND CEMENT CONCRETE (PCC) DRIVEWAY

SCALE: NTS

Hillsboro Public Works

DRIVEWAY PAVEMENT SECTIONS

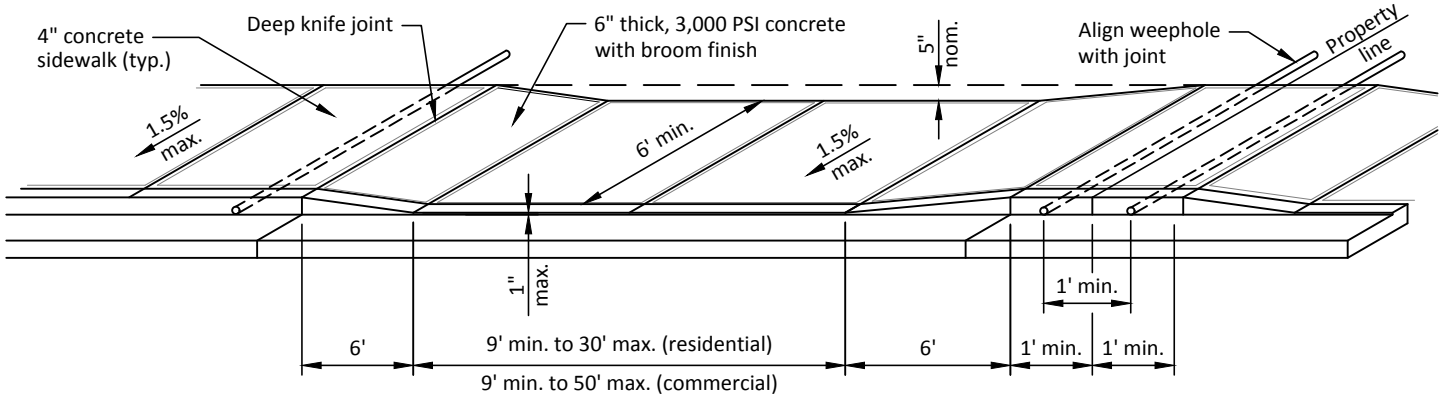
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 220-5

SCALE NTS

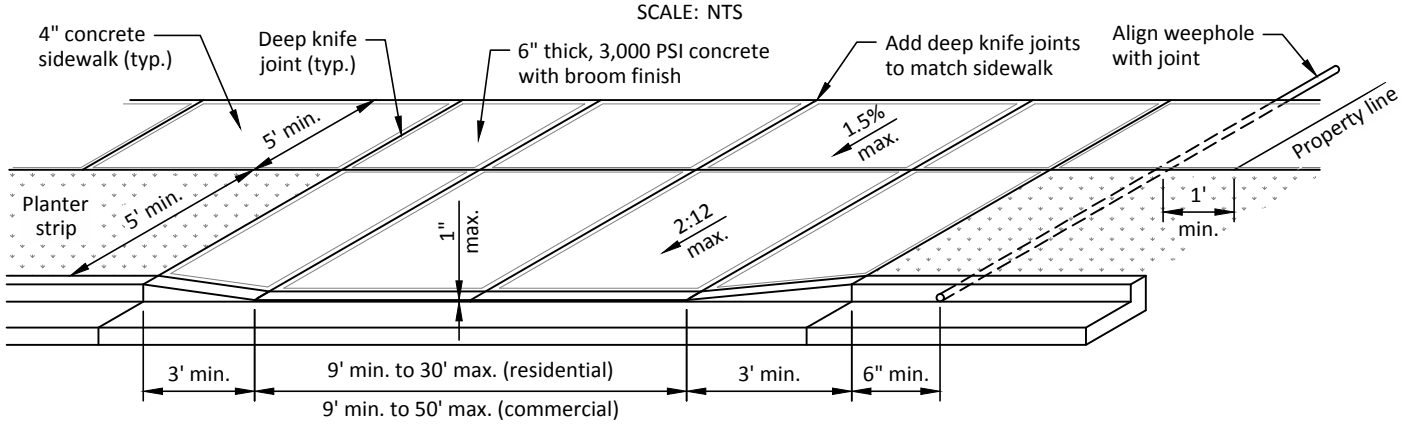
FILE NAME: COH-220-5.DWG

PLOT DATE: 3/7/2017 3:47 PM



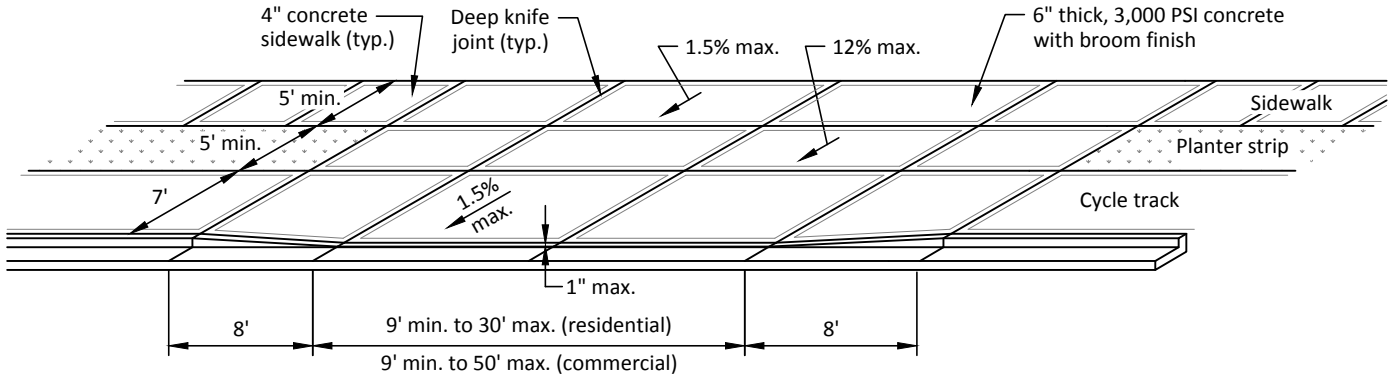

## DRIVEWAY APPROACH AT CURB

SCALE: NTS




## DRIVEWAY APPROACH WITH PLANTER STRIP

SCALE: NTS




## DRIVEWAY APPROACH WITH CYCLE TRACK

SCALE: NTS

NOTES:

1. Use concrete mix with minimum 3,000 PSI compressive strength at 28 days.
2. Compact subgrade until firm and unyielding and install a minimum of 2" of compacted 3/4"-0 aggregate base rock.
3. Sawcut all concrete and asphalt. Remove entire curb or curb and gutter for new driveway approaches on existing streets.
4. Install 24" truncated dome panel across entire width of sidewalk on both sides of signalized driveways. See ODOT Std. Drg. RD759 for additional truncated dome requirements.
5. Driveway approaches shall comply with all ADA requirements.
6. Construct knife joint at driveway centerline and at 10' OC max. spacing.
7. Commercial driveway approaches may require additional reinforcement.
8. Provide at least one weephole for each lot/parcel. Align knife joint over weephole.
9. Minimum spacing between potential conflict points on raised cycle tracks, such as driveways, alleys, and at grade street crossings, shall be 200'.

Hillsboro Public Works

DRIVEWAY APPROACHES

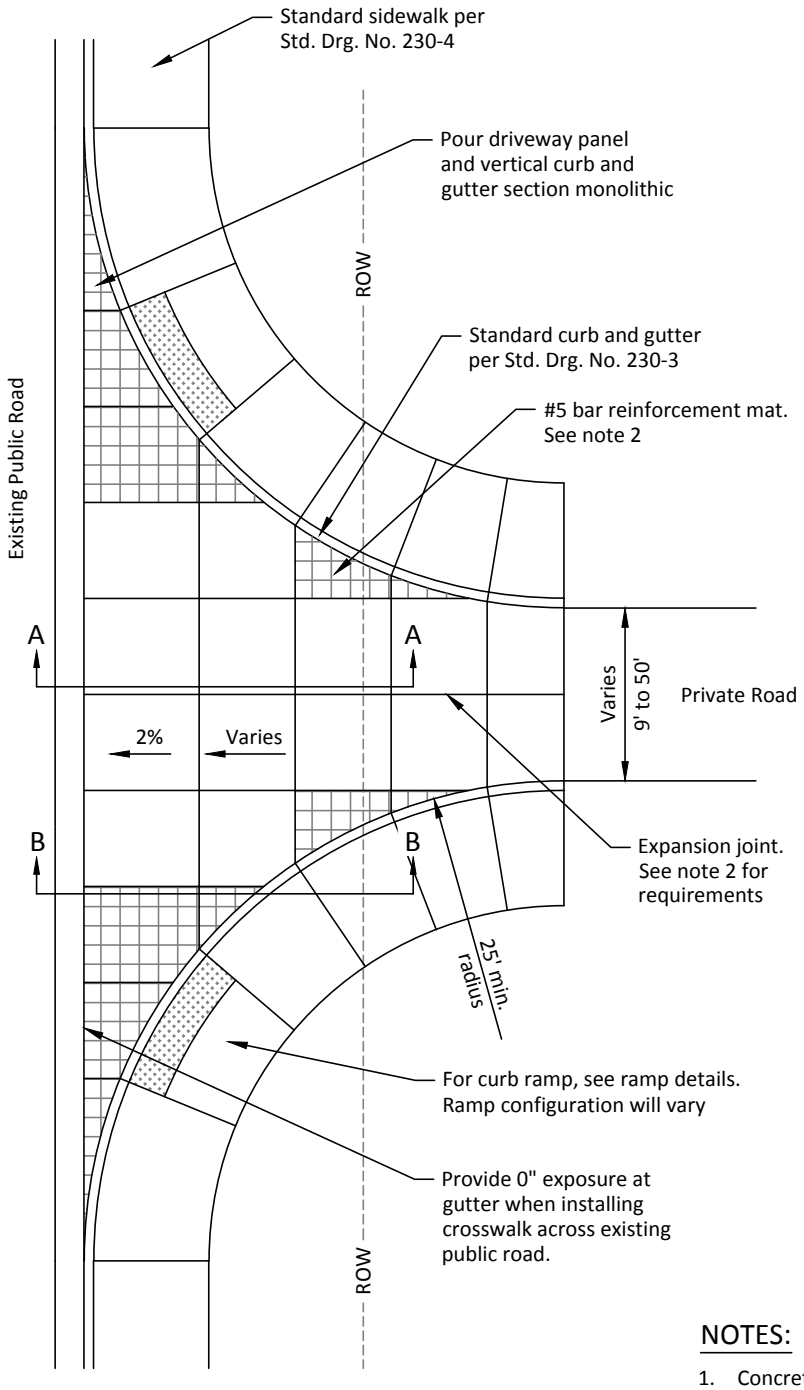
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 230-1

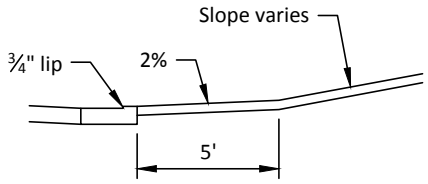
SCALE NTS

FILE NAME: COH-230-1.DWG

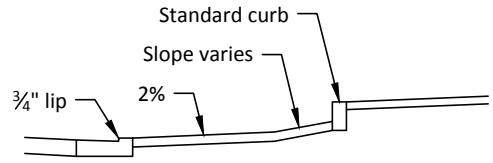
PLOT DATE: 6/20/2017 9:09 AM




**Plan View**




**Section A-A**




**Section B-B**

NOTES:

1. Concrete shall be 6" thick with 3,000 PSI min. compressive strength.
2. Panel jointing dimensions shall be square or conform to maximum 1:1.25 ratio of length:width. If panel does not meet 1:1.25 ratio, or is not rectangular, #5 bar mat shall be placed at 12" OC, mid-height in slab.
3. Private road approaches shall be used only for business accesses and for private roads located in a single tract. Standard driveway approaches, as shown in Std. Drg. No. 230-1, shall be used to serve residential flag lots.

Hillsboro Public Works

PRIVATE ROAD APPROACH

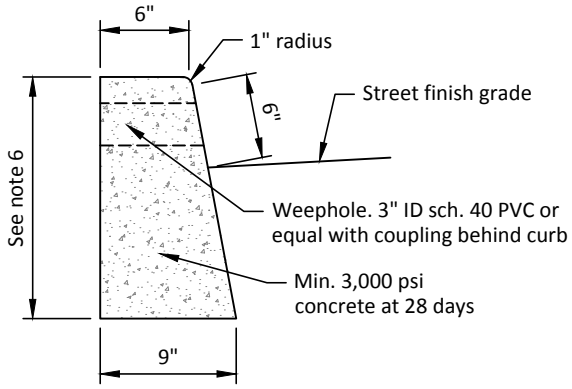
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 230-2

SCALE NTS

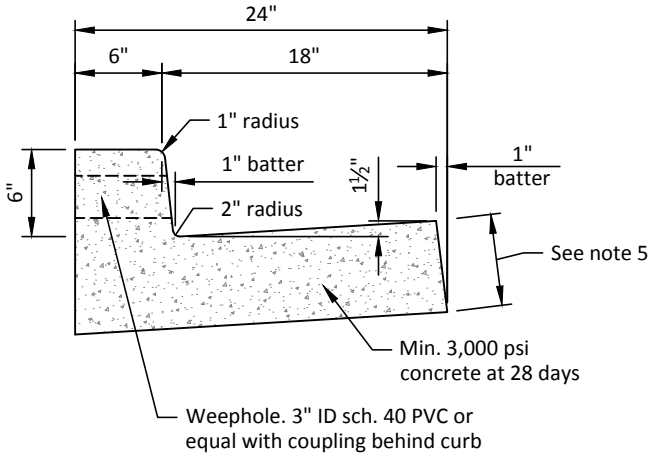
FILE NAME: COH-230-2.DWG

PLOT DATE: 4/6/2017 4:45 PM



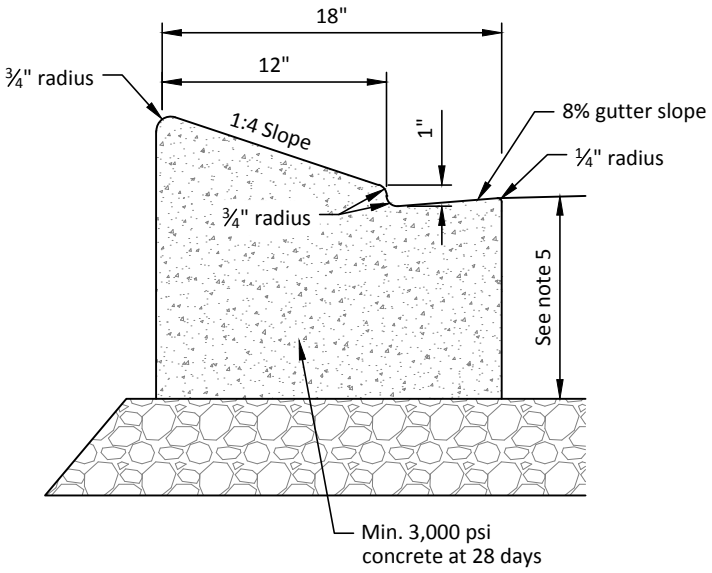

## STANDARD CURB

SCALE: NTS




## CURB AND GUTTER

SCALE: NTS




## MOUNTABLE CURB

SCALE: NTS

NOTES:

1. Expansion joints shall be provided at each point of tangency of the curb material. Joints shall be pre-molded, non-extruding, with a min. thickness of ½".
2. Contraction joints shall be a minimum of 2" deep, spaced a maximum of 15 feet apart, and match PCC street slab joints.
3. Base rock 1½" minus, compacted to 95% AASHTO T-180, shall be to subgrade of street structure or 4" in depth, whichever is greater, extending 1' behind curb.
4. Slope of gutter shall not exceed 5% at sidewalk ramp.
5. Gutter thickness shall match the pavement thickness, where thickness exceeds six inches.
6. The height of the standard curb shall match the pavement thickness plus the curb exposure when greater than 16".

Hillsboro Public Works

CURBS

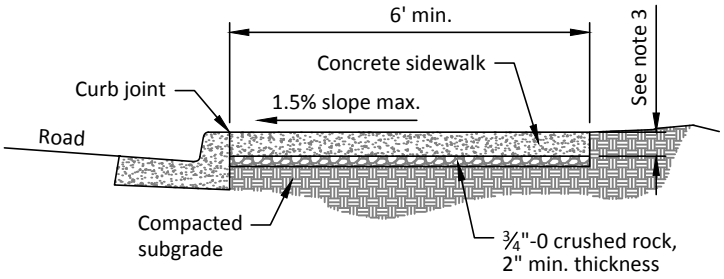
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 230-3

SCALE NTS

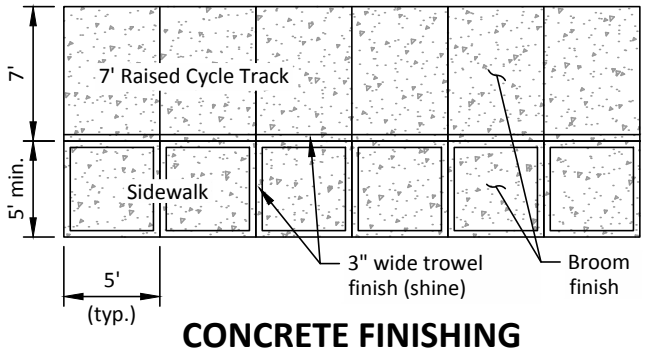
FILE NAME: COH-230-3.DWG

PLOT DATE: 3/14/2017 10:31 AM



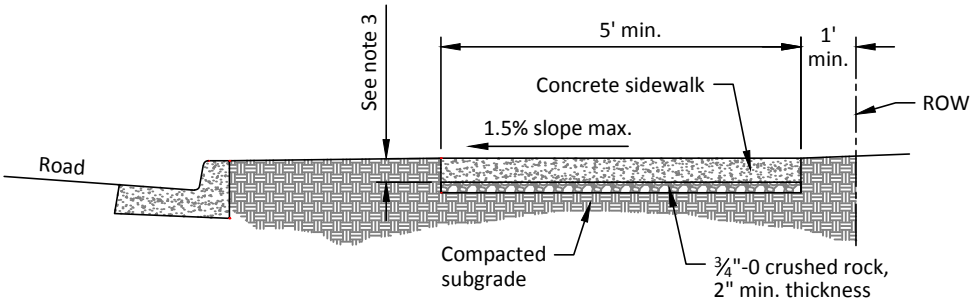

## CURB-TIGHT SIDEWALK

SCALE: NTS



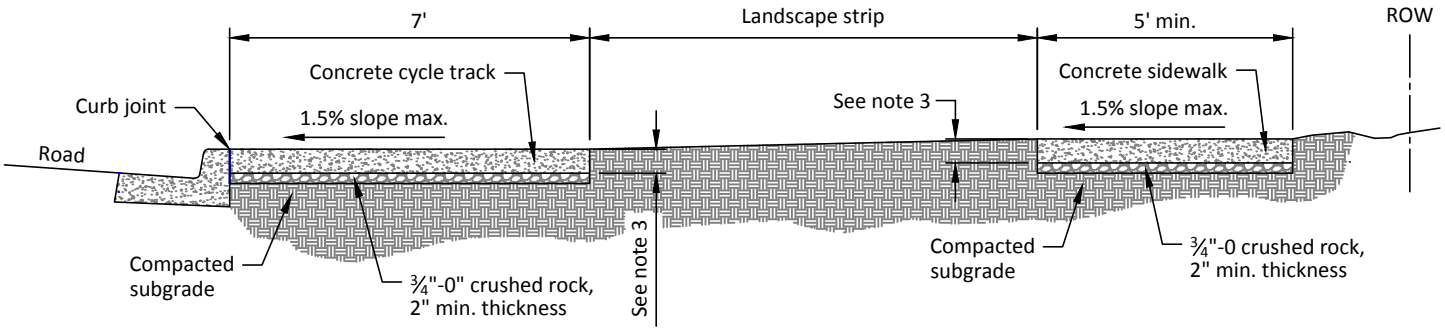

## CONCRETE FINISHING

SCALE: NTS




## SIDEWALK AT PROPERTY LINE

SCALE: NTS




## SIDEWALK WITH CYCLE TRACK

SCALE: NTS

## NOTES:

1. Concrete shall be 3,000 PSI at 28 days. Batch mix tickets shall be made available at Inspector's request.
2. Cycle track and sidewalk panels shall be 5 feet long. Trowel finish (shine) perimeters of each sidewalk panel and both sides of the longitudinal joint between the sidewalk and cycle track when adjacent. Broom finish all panels.
3. Sidewalk thickness shall be a minimum of 6" through driveway sections and 4" elsewhere.
4. Weepholes in curbs shall be extended to the back of sidewalk with 3" ID sch. 40 pipe and coupler at ±1.5% slopes. Align knife joints over weepholes.
5. Trowel surfaces at curb joints with a minimum ½" radius.
6. When parking is provided, the location of the cycle track and landscape strip shall be reversed, or additional width added to cycle track, to prevent car doors opening into the cycle track.

Hillsboro Public Works

SIDEWALKS AND CYCLE TRACKS

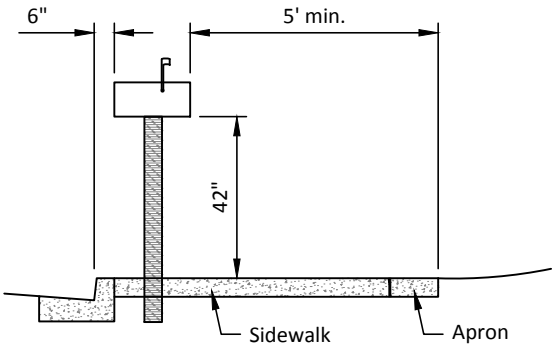
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 230-4

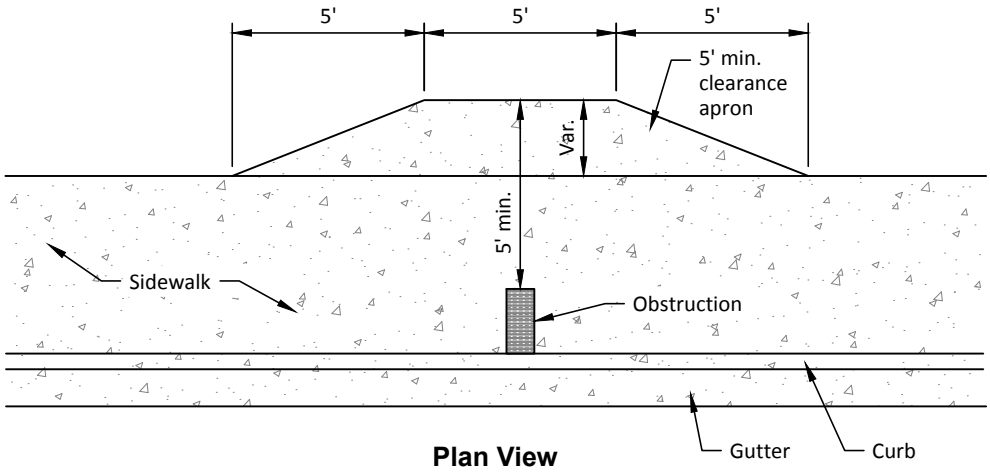
SCALE NTS

FILE NAME: COH-230-4.DWG

PLOT DATE: 6/28/2017 8:45 AM




**Section View**




**Plan View**

NOTES:

1. Use this detail for all sidewalk obstructions including mailboxes, light poles, utility poles, etc.
2. Maintain minimum 5' clear zone around all obstacles.
3. Install mailboxes in accordance with ODOT standard drawings.
4. Permanent location of mailboxes to be determined by the US Postal Service.
5. Face of mailboxes to be mounted flush with the back of curb.
6. Sidewalk easement or right-of-way dedication may be required if apron extends onto private property.

Hillsboro Public Works

SIDEWALK WIDENING AT OBSTRUCTION

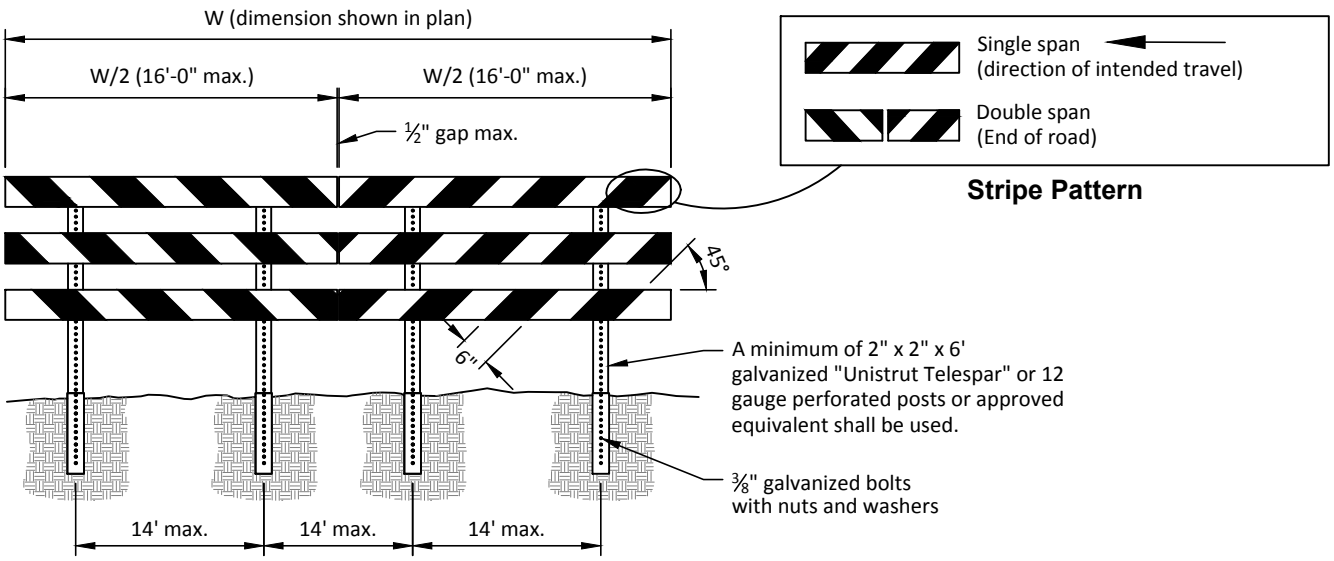
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 230-5

SCALE NTS

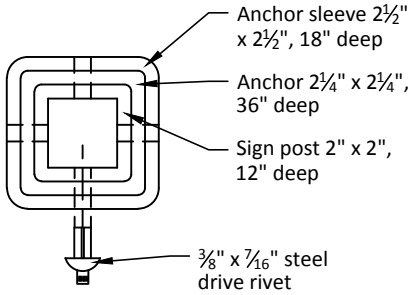
FILE NAME: COH-230-5.DWG

PLOT DATE: 3/7/2017 3:50 PM

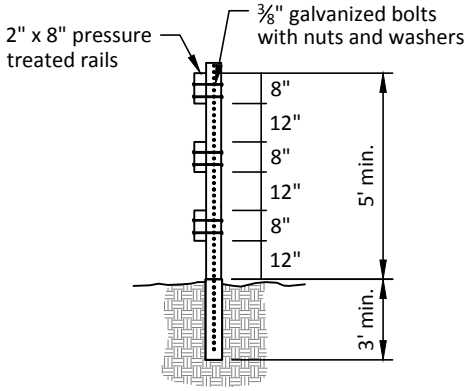



**Stripe Pattern**

**Elevation**




**Typical Post Installation**




**End View**

NOTES:

1. Rails to have alternating red and white stripes. All stripes shall be Type III reflective sheeting.
2. See MUTCD and the corresponding Oregon supplement.
3. 1" pan head sheet metal screws shall be used if sheet panels are to be fastened to the face of the cross boards.
4. All materials and workmanship shall be in accordance with the current *Oregon Standard Specifications for Construction*.

Hillsboro Public Works

BARRICADE - TYPE III, STEEL

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 230-6

SCALE NTS

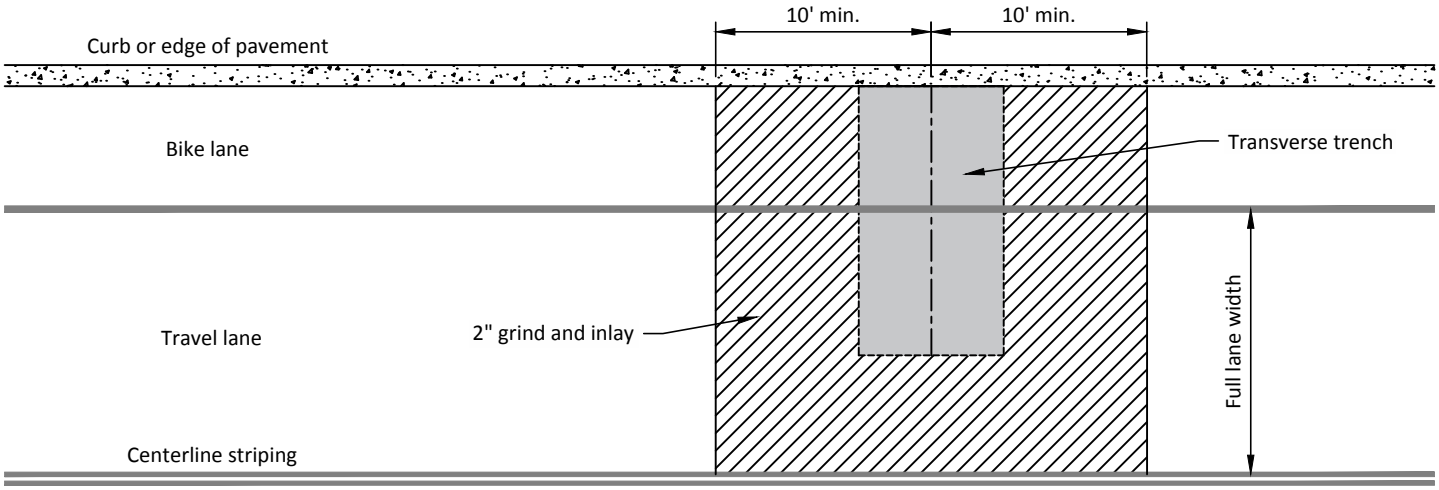
FILE NAME: COH-230-6.DWG

PLOT DATE: 3/7/2017 3:51 PM

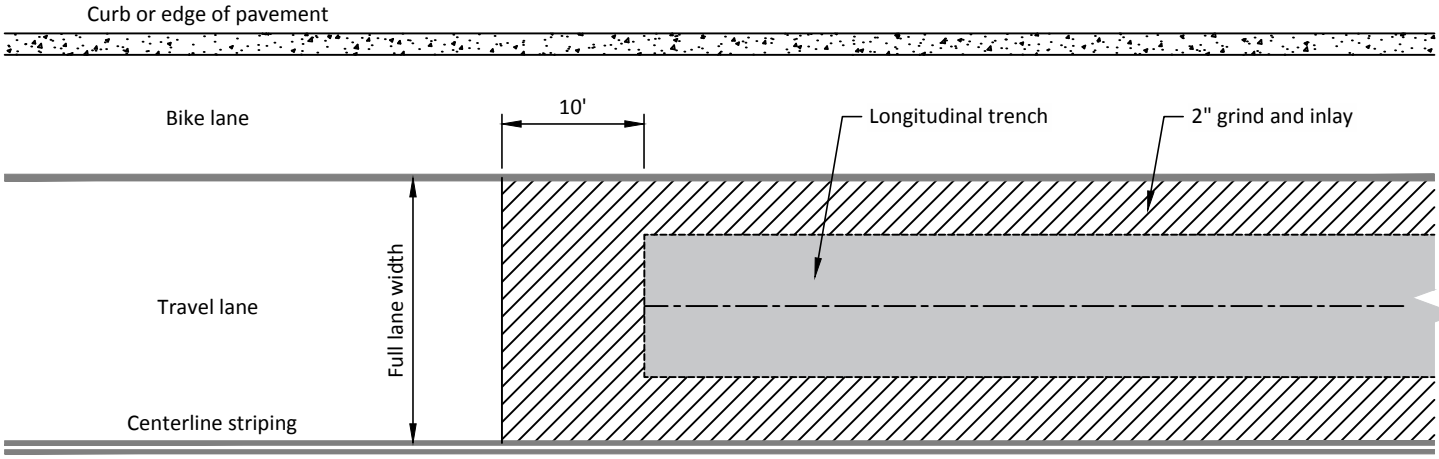

NOTES:

1. All letters to be black on a white Type III reflective background.

| | | | |
|---|---|---|---|
| Hillsboro Public Works | STREET STUB | VERIFY SCALES<br>BAR IS ONE INCH ON ORIGINAL DRAWING<br>0 1"<br>IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY | STD. DRG. NO. 230-7<br>PROJECT NO. NTS |
| | FILE NAME: COH-230-7.DWG | PLOT DATE: 3/7/2017 3:52 PM | |




**Transverse Trench**




**Longitudinal Trench**

NOTES:

1. Call for inspection prior to paving trench to discuss prep-work with Inspector.
2. Asphalt within trench area is to be replaced in 2" lifts back to previous grade.
3. Limits of grind described above must be at least 2" deep for entire area. Once this is complete, the final lift may be applied after inspection.
4. Any transverse cut into a lane requires a full lane width, 2" grind and inlay replacement (example: if the bike lane is cut into but not the travel lane, only the bike lane will require a full width 2" grind and inlay as shown).

Hillsboro Public Works

UTILITY CUTS
MORATORIUM STREETS

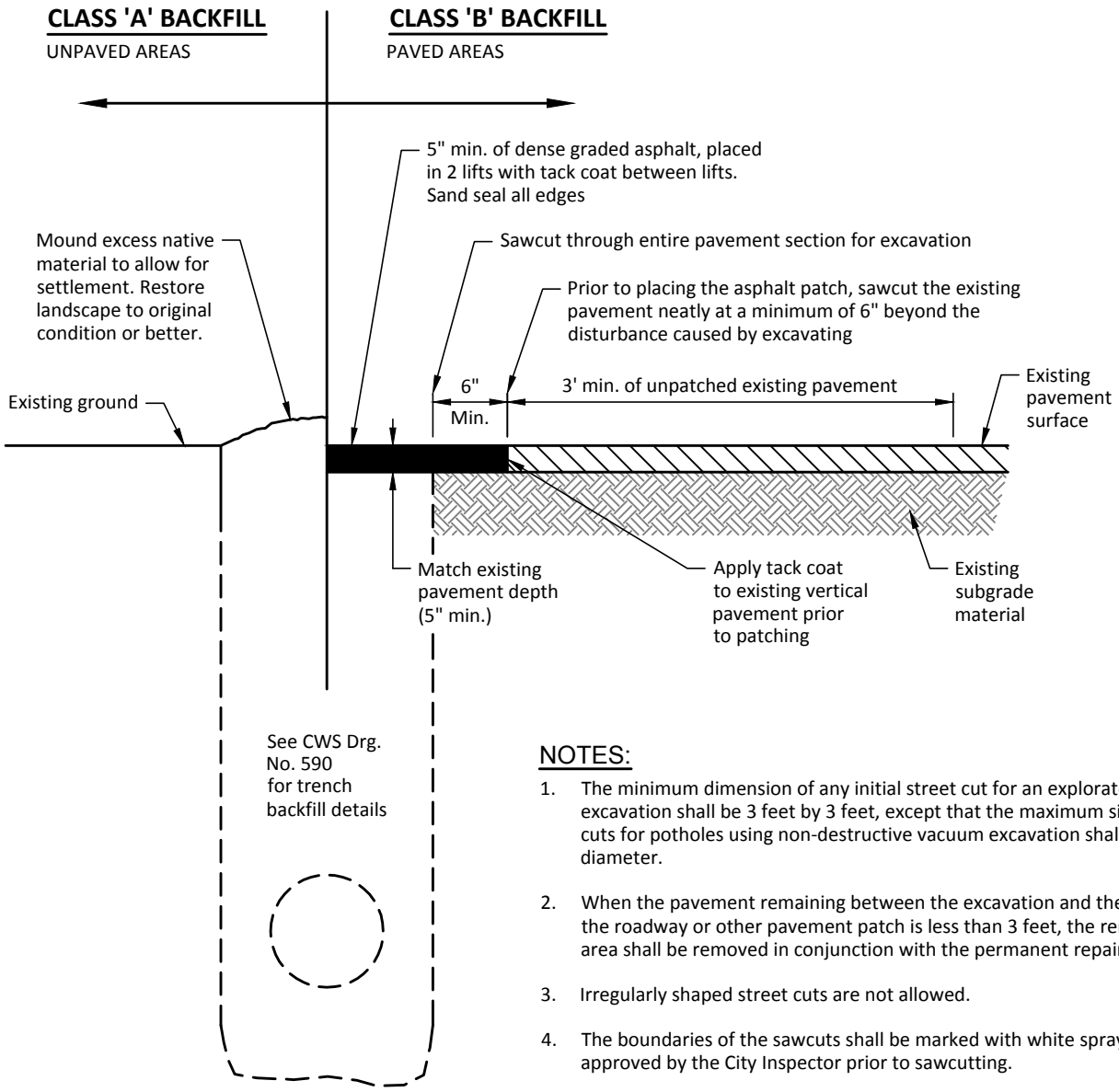
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 250-1

SCALE NTS

FILE NAME: COH-250-1.DWG

PLOT DATE: 3/7/2017 3:52 PM




NOTES:

1. The minimum dimension of any initial street cut for an exploratory excavation shall be 3 feet by 3 feet, except that the maximum size for street cuts for potholes using non-destructive vacuum excavation shall be 1' in diameter.
2. When the pavement remaining between the excavation and the edge of the roadway or other pavement patch is less than 3 feet, the remaining area shall be removed in conjunction with the permanent repair.
3. Irregularly shaped street cuts are not allowed.
4. The boundaries of the sawcuts shall be marked with white spray paint and approved by the City Inspector prior to sawcutting.
5. All existing pavement surfaces shall be swept clean of dirt, dust, and debris prior to patching.
6. All disturbed pavement markings shall be restored to match adjacent striping.
7. Spoil piles must be removed and the area must be cleaned and restored to like kind or better condition.

## TYPICAL TRENCH AND SURFACE RESTORATION

SCALE: NTS

Hillsboro Public Works

TYPICAL TRENCH AND SURFACE RESTORATION

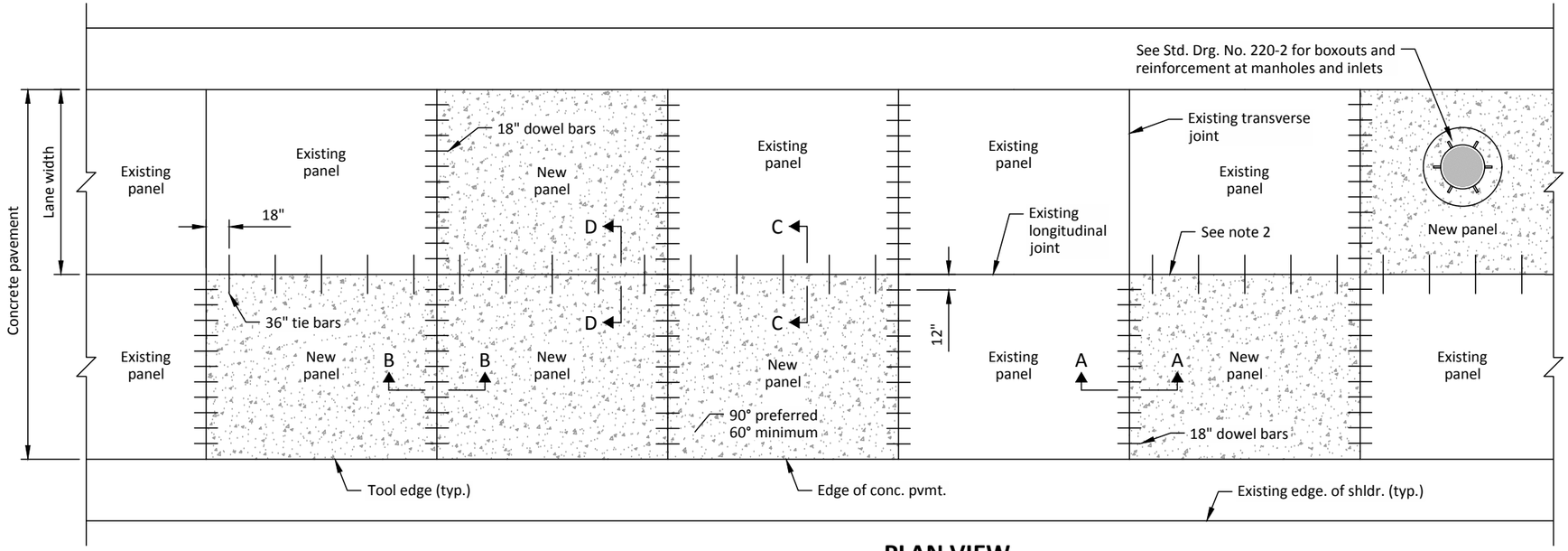
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 250-2

SCALE NTS

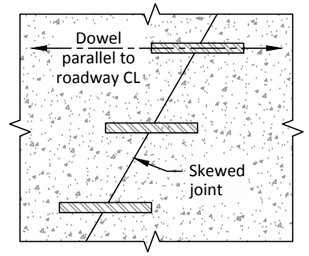
FILE NAME: COH-250-2.DWG

PLOT DATE: 3/7/2017 3:53 PM



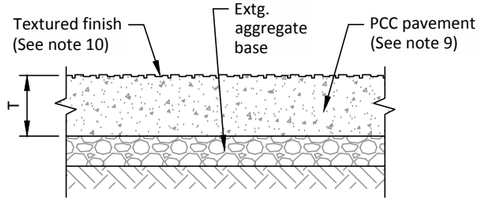

## PLAN VIEW

SCALE: NTS




## DOWEL AT SKEWED JOINT

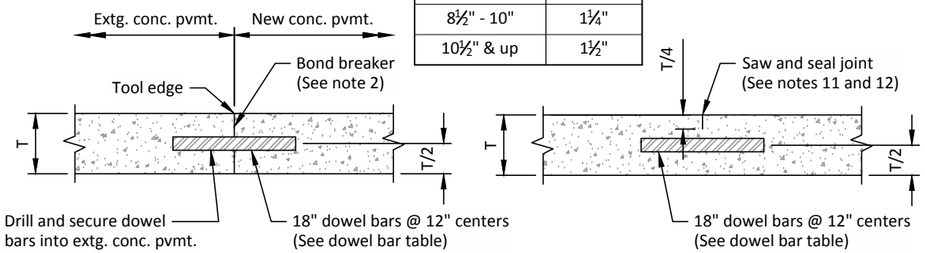
SCALE: NTS




## TYPICAL PAVEMENT SECTION

SCALE: NTS

| Dowel Bar Table | |
|---|---|
| Pvmt. Thkn. (T) | Dowel Dia. |
| 7" - 8" | 1" |
| 8½" - 10" | 1¼" |
| 10½" & up | 1½" |



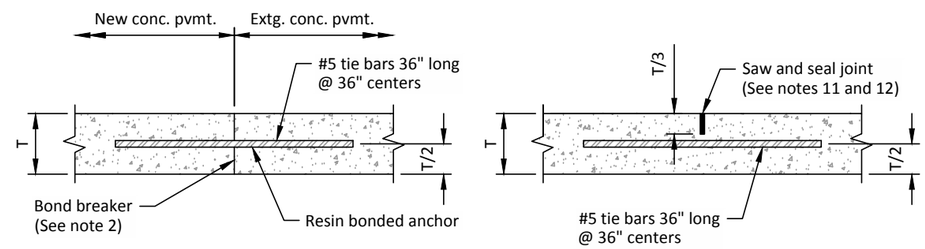

**Section A-A**
**Construction Joint**




**Section B-B**
**Contraction Joint**

## TRANSVERSE JOINT

SCALE: NTS



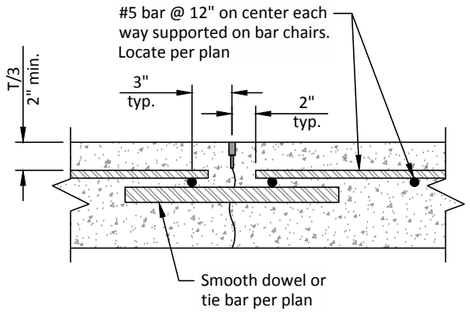

**Section C-C**
**Contact Joint**




**Section D-D**
**Weakened Plane Joint**

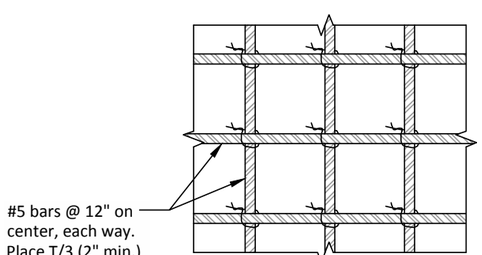
## LONGITUDINAL JOINT

SCALE: NTS




## REINFORCEMENT GRID PLACEMENT NEAR JOINTS

SCALE: NTS




## REINFORCEMENT GRID

SCALE: NTS

## NOTES:

1. Install tie bars along longitudinal joints between full panel replacement and existing concrete pavement. Tie bars are not installed between concrete pavement and ACP pavement.

2. Place 2 layers of #30 felt bond breaker meeting the requirements of ASTM D226, Type II at joints between panel replacement and existing panel.

3. Place new dowel bars between any existing (cut) dowel bars.

4. Center tie bars and dowel bars on joint.

5. Any repair of PCC pavement must be a full panel replacement.

6. Dowel holes should be 1/16 inch oversize in diameter and 9 inches to 9.5 inches deep for 18 inch long smooth dowels and 18 inches to 18.5 inches deep for 36 inch long tie bars. A hand held drill is not allowed.

7. Fill clean dowel hole with quick-set epoxy grout complying with ASTM C 881 Types IV or V, Grade 3, Classes B & C, suitable for anchoring smooth dowel bars in hardened concrete and on the ODOT QPL. Insert smooth fully greased dowels with grout retention ring into hole.

8. If the time frame designated for opening traffic is less than 72 hours after concrete placement, provide Class HES4000 - 1½ concrete designed to attain a minimum average compressive strength of 3,000 psi prior to allowing traffic on the concrete. Otherwise furnish Class 4000 - 1½ paving concrete.

9. The surface of the concrete shall have a textured finish using a steel-tine tool with 1/8 inch tines that will mark the finished concrete to a depth of 1/16 inch to 1/8 inch. Randomly space the markings from ½ inch to 1¼ inches as approved. Avoid overlaps of the texturing. Markings shall be transverse to the roadway centerline and full roadway width.

10. New interior longitudinal and transverse joints shall be sawcut as soon as the concrete has set enough to allow sawing without tearing or raveling.

11. The new saw cut transverse and longitudinal joints shall be filled with poured rubber-asphalt joint filler. The saw cut joint shall be flushed with water, vacuumed to remove cement slurry and dried before installing the joint filler.

12. Irregularly shaped panels, rectangular panels with an aspect ratio exceeding 1:1.25, and panels containing more than one utility structure (such as manholes, valves, etc.) shall be reinforced. See reinforcement grid details this sheet.

13. All tie bars and dowel bars shall be Grade 60 steel and shall be smooth, epoxy coated, circular, and greased.

SCALE: PLAN AS SHOWN | HORIZ. | VERT. | DRAWN: XXX | CHECKED: XXX

| # | DATE | REVISION | BY | APP'D |
|---|---|---|---|---|

Hillsboro Public Works

**STANDARD DRAWING**

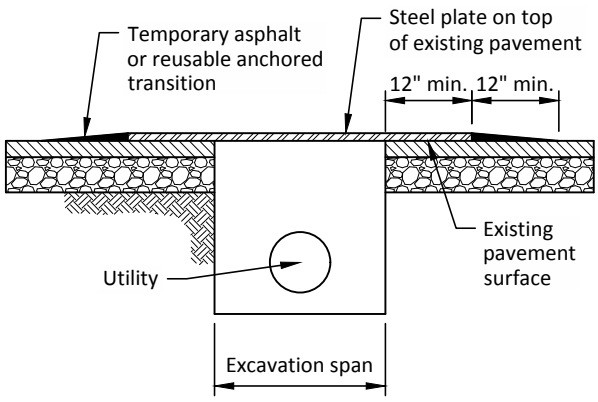
**CONCRETE ROADWAY REPAIR**

PLOT DATE: 5/17/2017

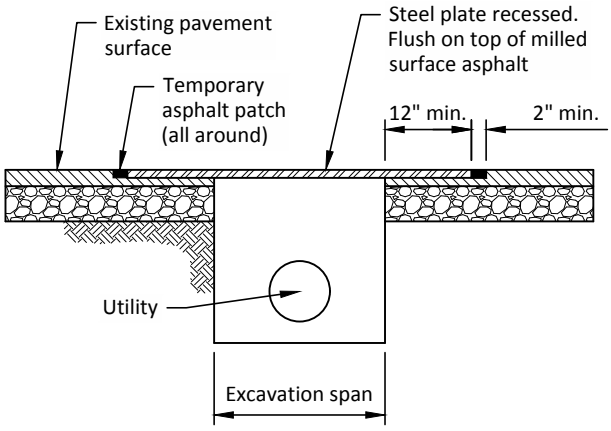
PROJECT NO. **STANDARD**

STD. DRG. NO. **250-3**

FILE NAME: COH-250-3.DWG



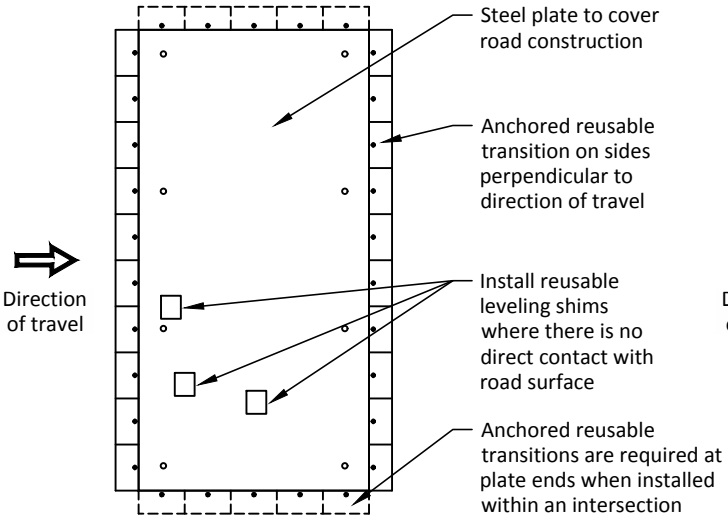

**Type 1**



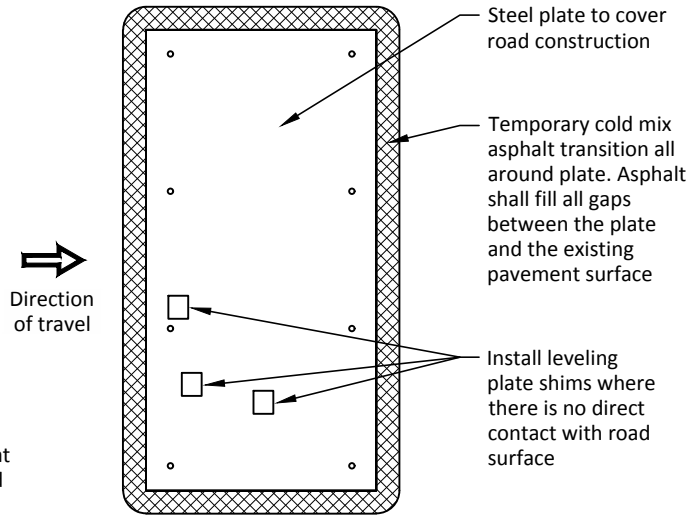

**Type 2**

## STEEL PLATE INSTALLATION

SCALE: NTS




**Reusable Anchored Transitions**




**Asphalt Transitions**

## TRANSITIONS

SCALE: NTS

NOTES:

1. Steel plates must be able to withstand H-20 traffic loading without any movement.
2. Steel plates shall be fabricated to meet ASTM A36 steel requirements.
3. When two or more plates are used, the plates shall be tack welded together at each corner to reduce or eliminate vertical movement.
4. Steel plates shall be installed to resist bending, vibrations, etc., under traffic loads and shall be anchored securely to prevent movement.
5. All steel plates shall be without deformation. The plates surface shall not deviate more than ¼ inch when measured with a 10-foot straight edge along the length of the plate.
6. Before steel plates are installed, the excavation shall be adequately shored to support the bridging and traffic loads.
7. Anchored reusable transitions to be "Plate Locks Road Plate Securing System" or equivalent.
8. Reusable leveling shims to be "Plate Shims" or equivalent.
9. Reusable leveling shims and transitions to be anchored using THD ¾" x 4" anchor and washer or equivalent.
10. Place W8-24 "STEEL PLATE AHEAD" warning sign 100 feet in advance of the steel plate location.
11. Local Roads with an ADT greater than 5,000 shall use Type 2 installation.
12. On all concrete roads, Type 1 installation shall be used with 1¼" min. thick plate.


**W8-24**

| Steel Plate Installation | Road Classification | Posted Speed | Min. Plate Thickness |
|---|---|---|---|
| Type 1 | Local Road & Alley | Less than 35 mph | 1 inch |
| Type 2 | Collector & Arterial | 35 mph and greater | 1¼ inch |

Hillsboro Public Works

TEMPORARY STEEL PLATES

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 250-4

PROJECT NO. NTS

FILE NAME: COH-250-4.DWG

PLOT DATE: 3/7/2017 3:57 PM

## GENERAL SIGNING NOTES:

1. Contractor shall supply and install all signs, and is responsible for staking sign locations and obtaining utility locates for staked sign locations. Signs shall be located per typical sign location or as shown on the plans. It is the contractor's responsibility to verify the final street names with the County Survey Office at 503-846-8723 before ordering and installing street name signs.

2. All signing shall conform to the *Manual on Uniform Traffic Control Devices* and the City's permanent signing legend. Spacing between letters, words, numbers, and/or symbols shall be in conformance with the *Standard Alphabets for Highway Signs* in the MUTCD.

   A. FOR LOCAL STREET INTERSECTIONS:
   Eight (8) inch 0.100 inch flat blade aluminum blanks.

   LETTERING: Four (4) inch initial uppercase with (3) inch lowercase Series D
   PREFIXES: Three (3) inch uppercase Series D
   SUFFIXES: Three (3) inch initial uppercase with (2.25) inch lowercase Series D
   SUPERSCRIPT FOR NUMERICAL STREET NAMES: Two (2) inch uppercase Series D

   B. FOR COLLECTOR AND ARTERIAL STREET INTERSECTIONS (<40 mph):
   Twelve (12) inch 0.100 inch flat blade aluminum blanks.

   LETTERING: Six (6) inch initial uppercase with (4.5) inch lowercase Series D
   PREFIXES: Four (4) inch uppercase Series D
   SUFFIXES: Four (4) inch initial uppercase with (3) inch lowercase Series D
   SUPERSCRIPT FOR NUMERICAL STREET NAMES: Three (3) inch uppercase Series D

   C. FOR MULTI-LANE COLLECTOR AND ARTERIAL STREET INTERSECTIONS (>40 mph):
   Eighteen (18) inch 0.125 inch flat blade aluminum blanks.

   LETTERING: Eight (8) inch initial uppercase with (6) inch lowercase Series D
   PREFIXES: Six (6) inch uppercase Series D
   SUFFIXES: Six (6) inch initial uppercase with (4) inch lowercase Series D
   SUPERSCRIPT FOR NUMERICAL STREET NAMES: Four (4) inch uppercase Series D

   D. FOR SIGNALIZED INTERSECTIONS:
   Twenty one (21) inch 0.125 inch flat blade aluminum blanks, mounted to mast arm or strain pole for span wire signal systems.

   LETTERING: Twelve (12) inch initial uppercase with (9) inch lowercase Series D
   PREFIXES : Eight (8) inch uppercase Series D
   SUFFIXES: Eight (8) inch initial uppercase with six (6) inch lowercase Series D
   SUPERSCRIPT FOR NUMERICAL STREET NAMES: Six (6) inch uppercase Series D

3. Use ODOT standards for mast arm street name sign spacing.

4. COMMON ABBREVIATIONS:

| | | |
|---|---|---|
| Ave = Avenue | Ln = Lane | Rd = Road |
| Blvd = Boulevard | Lp = Loop | St = Street |
| Cir = Circle | Pkwy = Parkway | Ter = Terrace |
| Ct = Court | Pl = Place | Way = Way |
| Dr = Drive | | |

5. POSTS:

   A. A 2 X 2 inch X 10 foot (min.) galvanized "Unistrut Telespar" 12 gauge perforated posts or approved equivalent shall be used.

   B. A 2 inch X 2 inch X 12 foot (min.) galvanized "Unistrut Telespar" 12 gauge perforated posts or approved equivalent shall be used when a combination of signs is more than 36 inches in height. Sign combinations and minimum sign mounting height shall determine post length.

   C. Large signs may require larger posts than the minimums shown above. See ODOT Std. Drg. TM681 for additional post sizing requirements. (3 second gust wind speed = 95 MPH)

   D. No wood, round metal, or other type of post shall be used.

6. All signs shall be aluminum. Plywood and polyplate are not allowed.

7. Contractor is required to submit shop drawings for City approval prior to fabrication of all non-standard drawings.

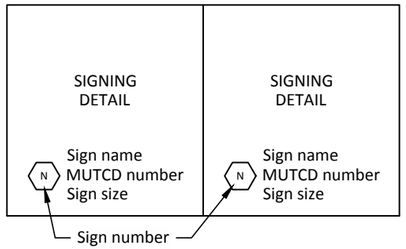
8. Minimum size for speed limit signs shall be 30 inch x 36 inch.

## SIGNING CALLOUT NOTES

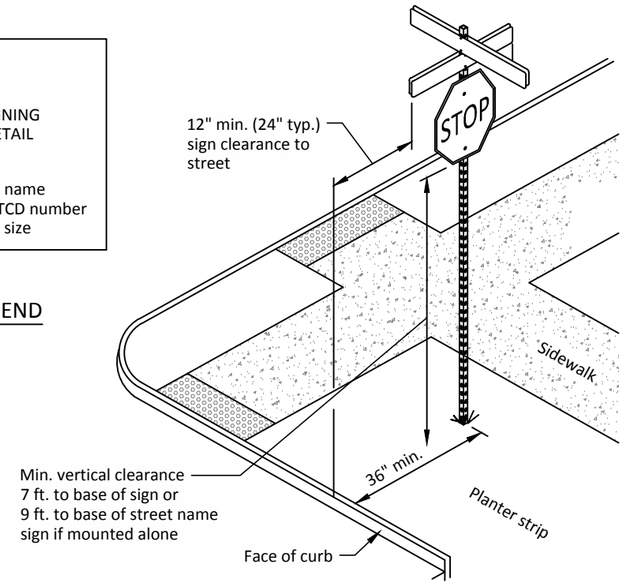
- N — Install new sign
- N / M — Install new sign (N) on new (M) support
- RXN — Remove existing sign (N)
- RXN / M — Remove existing sign (N) and (M) support
- RIN / M — Reinstall sign (N) on new (M) support
- EXN — Maintain and protect existing sign (N) and support
- RIN — Reinstall existing sign on existing support

N = Sign number
M = Materials, options are:
S = Steel "Telespar"

Signs shown with broken borders are existing




EXAMPLE SIGNING LEGEND

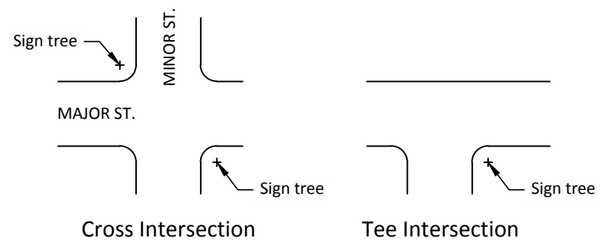



TYPICAL STREET SIGN PLACEMENT

## SHEETING MATERIALS:

| | |
|---|---|
| School warning signs: | Diamond grade florescent yellow/green reflective sheeting, Type IX |
| Overhead signing: (including street name signs) | Diamond grade reflective sheeting, Type IX |
| All other signs (post mounted): | Hi-intensity prismatic reflective sheeting, Type IV |

One manufacturer's sheeting splice is permitted per sign. Contractor splices are not allowed. Splice shall be horizontal with the upper section overlapping the lower by a min. ⅜ inch.




TYPICAL INTERSECTION SIGN PLACEMENT

## HILLSBORO "H" LOGO NOTES:

1. All street name signs at collector and arterial roadway intersections shall bear the City of Hillsboro "H" logo.

2. City of Hillsboro "H" logo diameter shall match the size of the initial uppercase letter of the street name.

3. City of Hillsboro "H" logo shall be white hi-intensity prismatic reflective sheeting, Type IV.

HILLSBORO "H" LOGO

NE Grant St

HILLSBORO "H" LOGO LAYOUT

NE Butler St

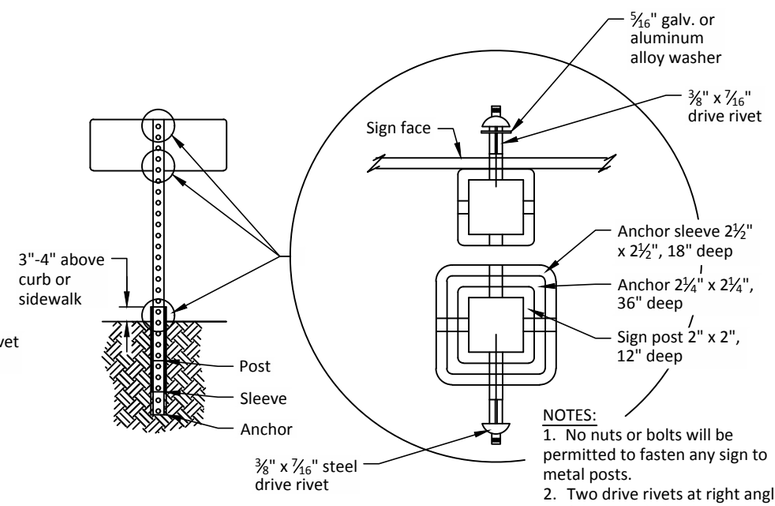
SE Alder St

Pre-drill ends and rivet both signs together

NE Butler St

Pre-drill ends and rivet both signs together

TYPICAL STREET NAME SIGN TEXT LAYOUT




NOTES:
1. No nuts or bolts will be permitted to fasten any sign to metal posts.
2. Two drive rivets at right angles or right angle bolts shall be used to fasten the post to the base

TYPICAL SIGN POST INSTALLATION

SCALE: AS SHOWN | HORIZ. | VERT. | DRAWN: XXX | CHECKED: XXX

| # | DATE | REVISION | BY | APP'D |
|---|---|---|---|---|

Hillsboro Public Works

STANDARD DRAWING

SIGNS AND SIGNPOSTS

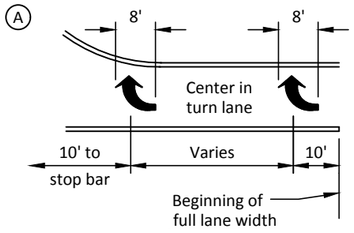
PROJECT NO. STANDARD

STD. DRG. NO. 320-1

PLOT DATE: 8/7/2018

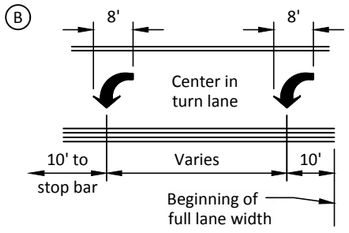
FILE NAME: COH-320-1.DWG

(A)



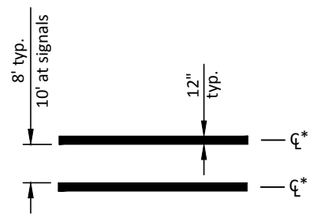

RIGHT TURN LANE MARKINGS
See MUTCD for details.

(B)



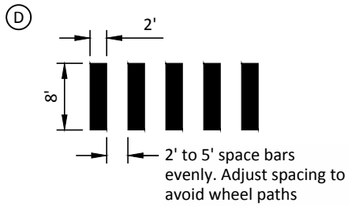

LEFT TURN LANE MARKINGS
See MUTCD for details.

(C)



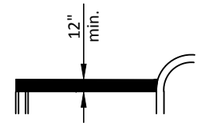

CROSSWALK
Space two 12" white lines as shown on plans

(D)



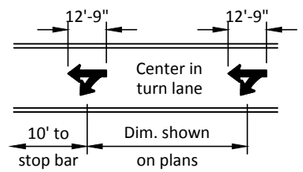

HIGH VISIBILITY CROSSWALK
Place white longitudinal bars as shown on plans. Space lines to avoid wheel paths.

(E)



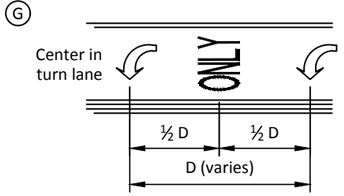

STOP BAR
12" wide white line. See note 5 for placement information.

(F)



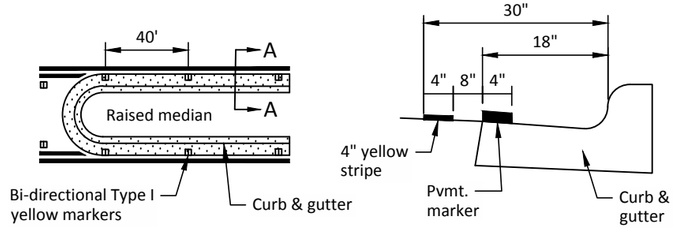

THRU AND TURN LANE MARKINGS
See MUTCD for details.

(G)



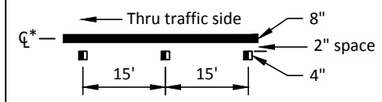

"ONLY" PAVEMENT LEGEND
Center "ONLY" legend between turn or thru arrows. See MUTCD for details.

(H)



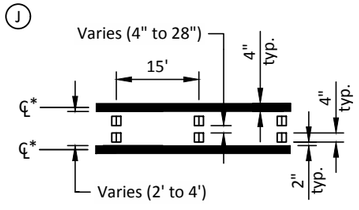

RAISED MEDIAN STRIPE
See MUTCD for details

(I)



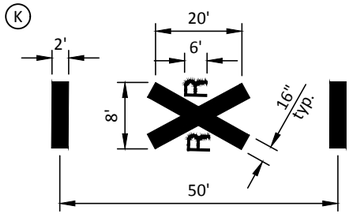

TURN LANE LINE
8" white line with mono-directional crystal Type I markers (white)

(J)



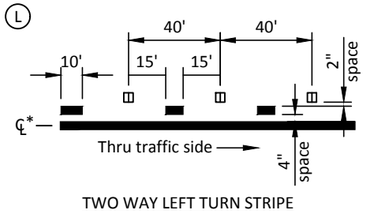

MEDIAN NOSE
Two 4" yellow lines with bi-directional yellow Type I markers.

(K)



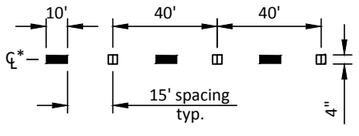

RAILROAD CROSSING
Shall be white and installed per detail. Place per P.U.C. directions.

(L)



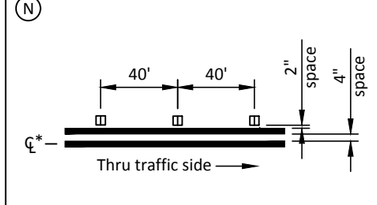

TWO WAY LEFT TURN STRIPE
4" yellow lines with Type I bi-directional raised pavement markers. Outside line is solid. Inside at 10'/30' pattern.

(M) X



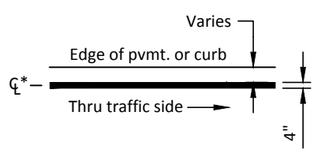

SKIP CENTER LINE
4" yellow or white line with Type I bi-directional yellow or white/red raised pavement markers.

(N)



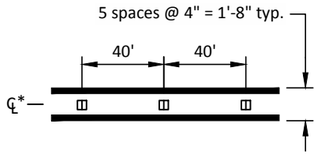

MEDIAN STRIPE
Two 4" yellow lines with Type I bi-directional yellow raised pavement markers.

(O) X



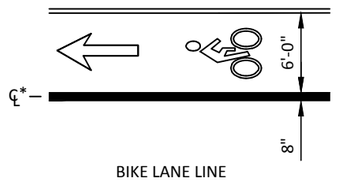

FOG LINE
4" yellow or white line as shown on plans.

(P)



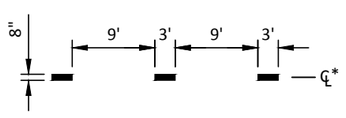

CENTER LINES
Two 4" yellow lines with bi-directional yellow Type I markers.

(Q)



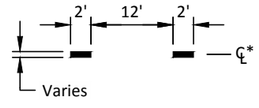

BIKE LANE LINE
8" wide white line.

(R)



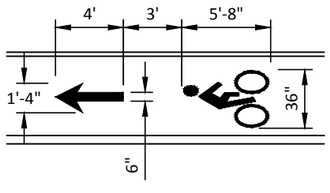

BIKE LANE SKIP LINE
8" wide white line.

(S) X



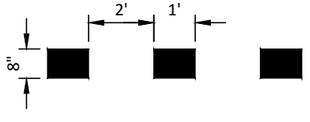

PAVEMENT MARKING EXTENSIONS THRU INTERSECTIONS
White or yellow line. Width and color same as line being extended.

(T)



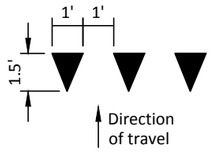

BICYCLE LANE MARKING
Shall be white and installed per detail.

(U)



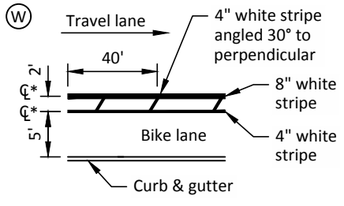

WIDE DOTTED WHITE LANE EXTENSION
8" X 12" white dots spaced 2' apart across roundabout entrance arc.

(V)



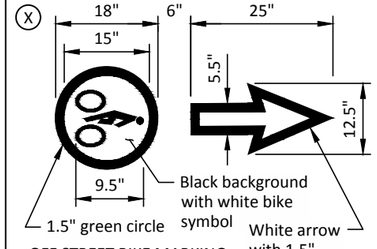

YIELD LINE
1' X 1.5' triangles spaced 1' apart perpendicular to the direction of travel.

(W)




BICYCLE BUFFER LANE
4" wide white stripe and 8" wide white stripe parallel to traffic with 4" white stripe angled 30° every 40 ft.

(X)




OFF STREET BIKE MARKING
Green to be Pantone Color #375.

## PAVEMENT MARKING NOTES:

1. All pavement markings shall conform to this legend and the most current edition of the MUTCD, with Oregon supplement.
2. This legend may have more restrictive requirements than the MUTCD. Where there is a conflict between this legend and the MUTCD, the MUTCD requirements shall apply.
3. Pavement marking tape shall be rolled-in at the time of paving for new asphalt pavement and applied to the surface (not grooved or inlaid) for all other pavement types.
4. Painted markings, foil back tape, and flexible pavement markers (stick-and-stomps) are not allowed.
5. Locate stop bars 10' back of the extended fog line, edge of pavement, or curb face. Locate stop bars behind curb ramps when present. Verify sight distance.
6. Locate crosswalks as per sidewalk ramp locations of 5' back of extended fogline, edge of pavement or curb face. Striping for crosswalks shall conform to current ADA requirements.
7. Removal of existing striping is to be determined in the field and as directed by the City.
8. All materials shall conform to the most current ODOT specifications.
9. The Engineer must obtain authorization for placement of "RAILROAD CROSSING" markings prior to plan approval. Authorization shall be obtained from the ODOT Rail Safety Section.
10. Prior to installation, Contractor shall submit the materials to the City for approval.
11. All transverse pavement markings (bars and legends) shall have intermixed reflective elements and factory installed crushed glass or aggregate on the surface (Type HS "high skid").
12. All pavement markings shall be "wet weather" type.
13. All longitudinal pavement markings (stripes) applied to concrete shall be "contrast" type with matte black borders to improve visibility. Stripe width (white or yellow) shall not be reduced, the black border is in addition to the stripe width shown.

X Subscript for pavement marking. Denotes color. (Y) yellow or (W) white.

* Lane marking dimension location at centerline of striping unless noted otherwise.

| PVMT. MARKING MATERIALS | |
|---|---|
| SURFACE TYPE | MATERIAL |
| Existing asphalt | Thermoplastic |
| Existing concrete | Pvmt. marking tape |
| New asphalt | Pvmt. marking tape |
| New concrete | Pvmt. marking tape |

SCALE: AS SHOWN | PLAN | HORIZ. | VERT. | DRAWN: XXX | CHECKED: XXX

| # | DATE | REVISION | BY | APP'D |
|---|---|---|---|---|

Hillsboro Public Works

STANDARD DRAWING

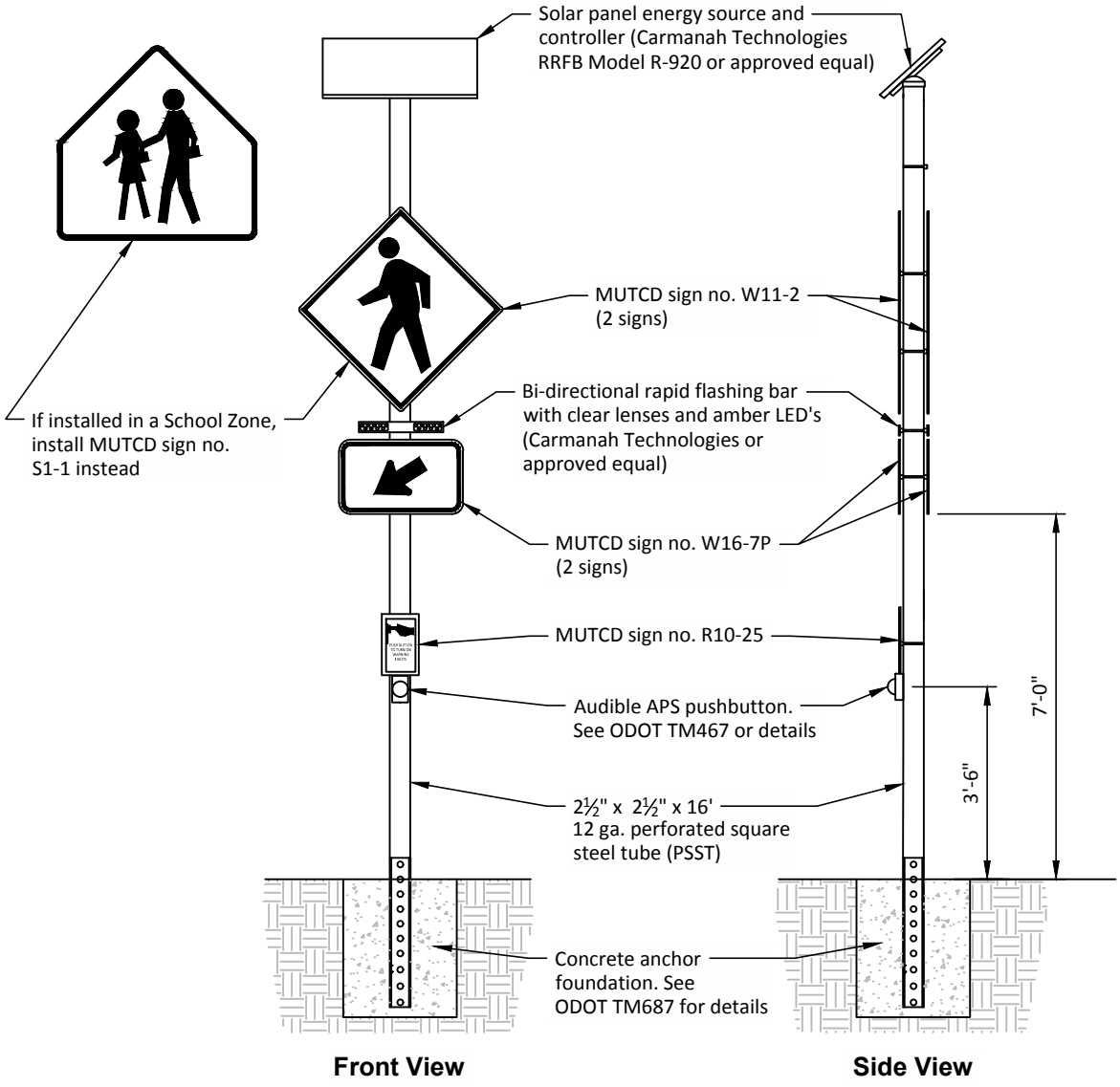
PERMANENT PAVEMENT MARKINGS

PROJECT NO. STANDARD

STD. DRG. NO. 330-1

PLOT DATE: 3/7/2017

FILE NAME: COH-330-1.DWG




## RECTANGULAR RAPID FLASHING BEACON ASSEMBLY DETAIL

SCALE: NTS

NOTES:

1. Rectangular Rapid Flashing Beacon (RRFP) crosswalk system shall comply with current MUTCD and FHWA Memorandum dated July 16, 2008, granting interim approval for the optional use of RRFB as warning beacons under limited conditions.
2. RRFB assembly shall be RRFB Model R920 Series as provided by Carmanah Technologies or approved equal.
3. Standard (non-school) crossings shall use standard yellow signs. School crossings shall use fluorescent yellow/ green signs.
4. See current MUTCD for sign size and advance warning requirements.
5. See Std. Drg. No. 320-1 for additional signing details.

Hillsboro Public Works

RECTANGULAR RAPID FLASHING BEACON (RRFB)

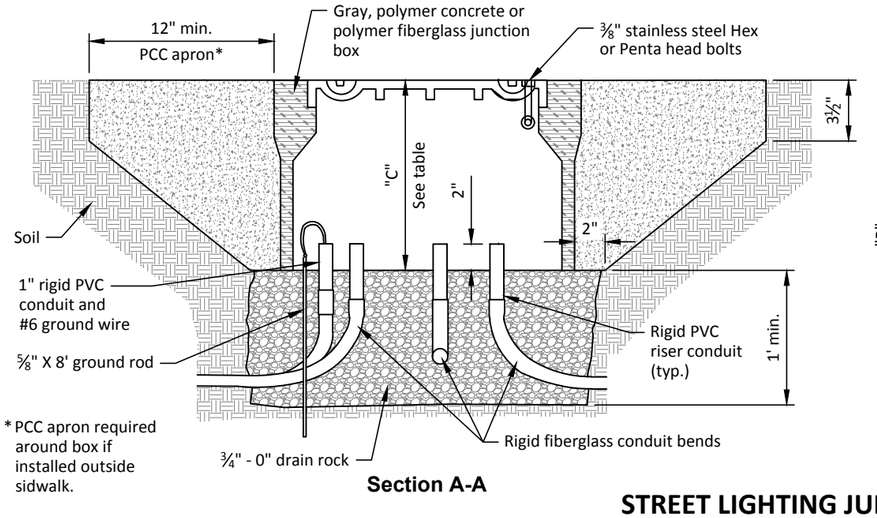
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 340-1

SCALE NTS

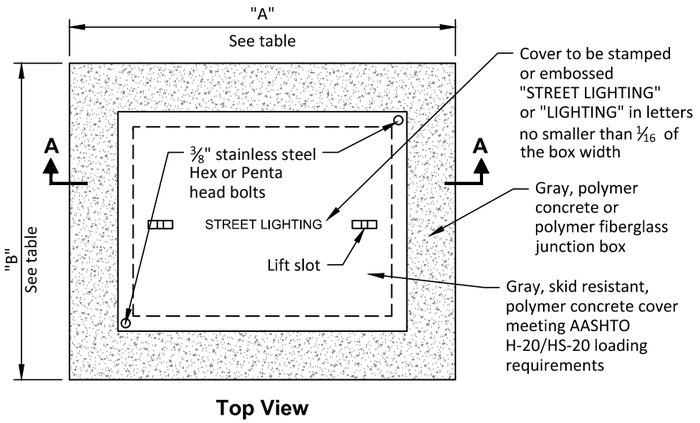
FILE NAME: COH-340-1.DWG

PLOT DATE: 3/7/2017 1:36 PM




**Section A-A**

* PCC apron required around box if installed outside sidwalk.




**Top View**

# STREET LIGHTING JUNCTION BOX

SCALE: NTS

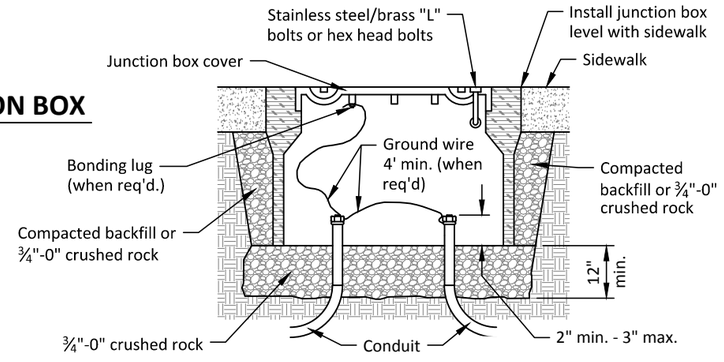
## APPROVED J-BOXES:

1. Newbasis
2. Quazite (Hubbell)
3. Oldcastle/Carson Industries
4. Highline
5. Armorcast
6. CDR (Electrimold)
7. or approved equal

## NOTES:

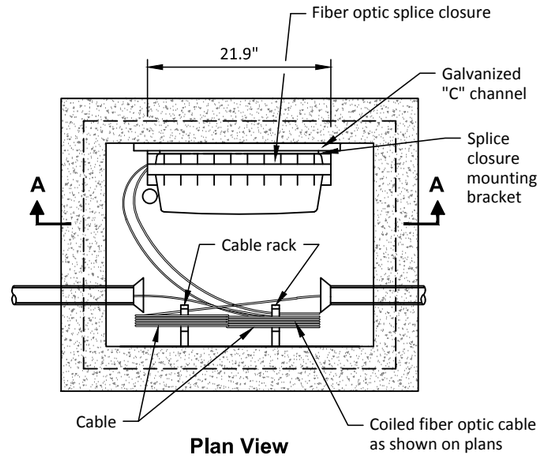
1. Illumination circuit wires are not shown. See illumination plans.
2. Metal pole grounding required only at J-box located near illumination poles.
3. Grounding rod and wire shall be installed inside concrete junction box.

| Type | "A" Length | "B" Width | "C" Depth | Comments |
|---|---|---|---|---|
| JBH-1 | 24" | 13" | 18" | Max. 2-2" conduits and 2-1" conduits |
| JBH-2 | 30" | 17" | 18" | Max. 6-2" conduits and 2-1" conduits |

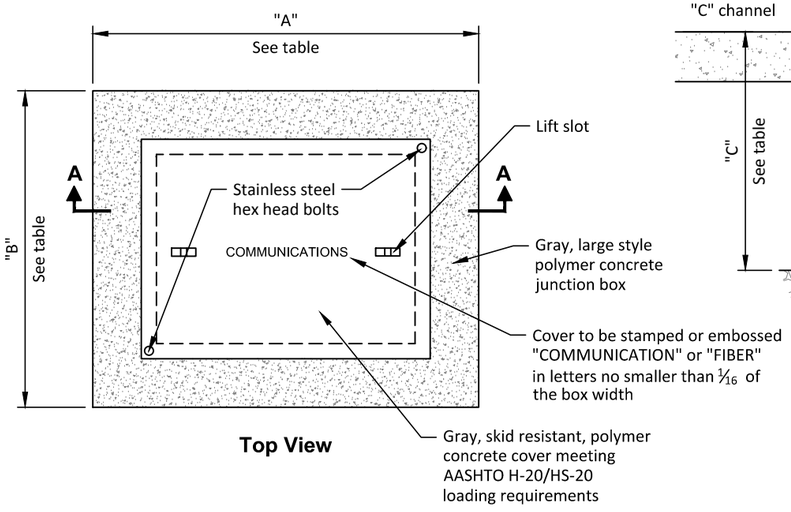



**Installation In Sidewalk or At Back of Curb**

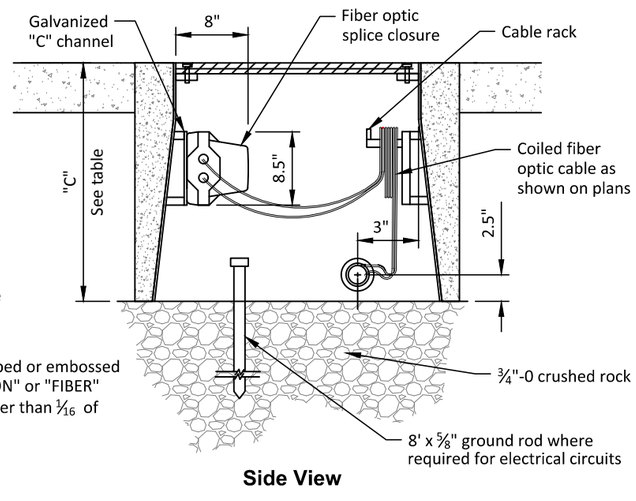
| Type / Application | "A" Length | "B" Width | "C" Depth |
|---|---|---|---|
| At intersections | 36" | 36" | 36" |
| Along the communication path used for pulling and storage | 36" | 24" | 24" |



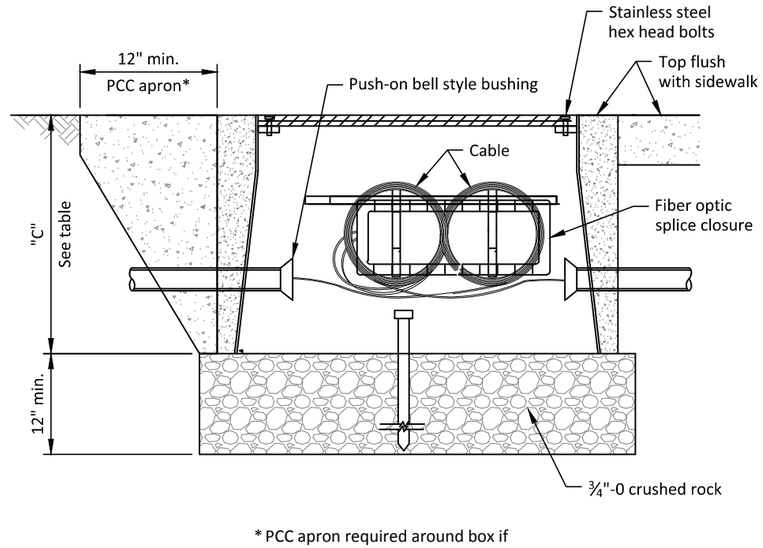

**Plan View**




**Top View**




**Side View**




* PCC apron required around box if installed outside sidwalk.

**Section A-A**

# COMMUNICATIONS JUNCTION BOX

SCALE: NTS

SCALE: PLAN AS SHOWN | HORIZ. | VERT. | DRAWN: XXX | CHECKED: XXX

PROFILE

| # | DATE | REVISION | BY | APP'D |
|---|---|---|---|---|

Hillsboro Public Works

STANDARD DRAWING

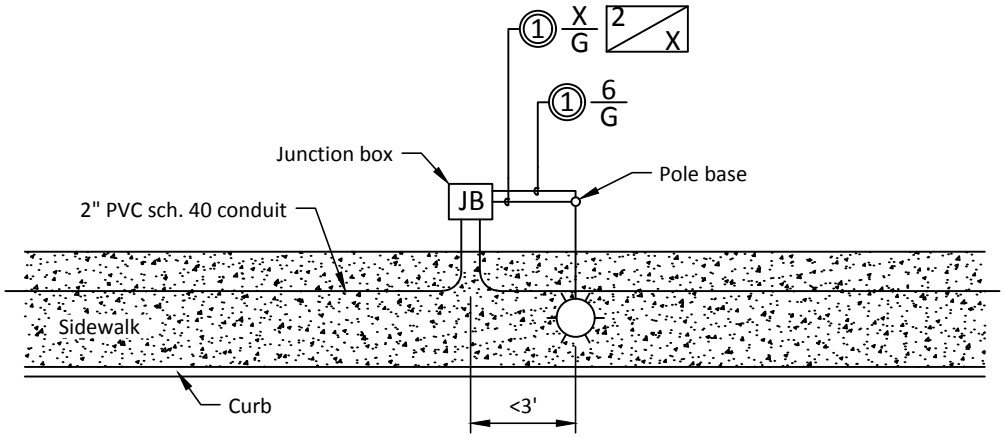
JUNCTION BOXES

PLOT DATE: 7/10/2017

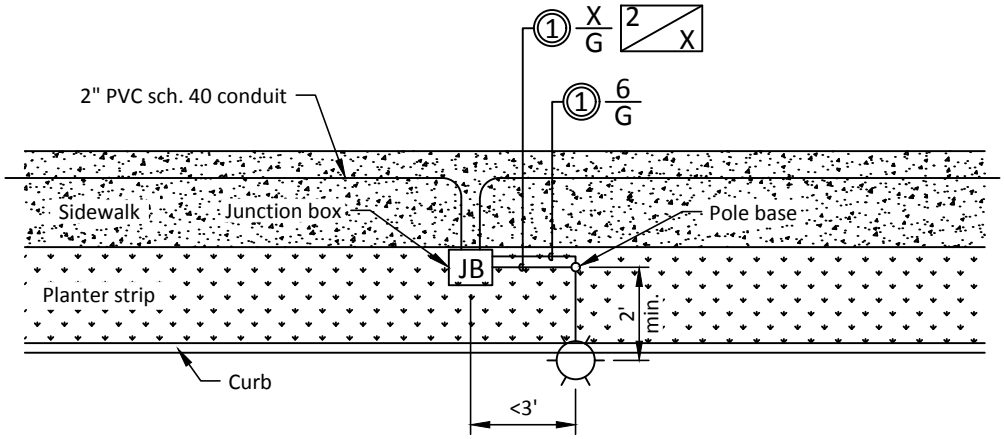
PROJECT NO.
STANDARD

STD. DRG. NO.
350-1

FILE NAME: COH-350-1.DWG




**Curb-tight Sidewalk**




**Sidewalk with Planter Strip**

## TYPICAL LIGHT POLE CONNECTION TO JUNCTION BOX

SCALE: NTS

Hillsboro Public Works

STREET LIGHT POLE CONNECTION TO JUNCTION BOX

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 350-2

SCALE NTS

FILE NAME: COH-350-2.DWG

PLOT DATE: 1/19/2017 8:54 AM

# CITY FIBER GENERAL NOTES:

1. Distribution line conduit to be 2" diameter orange HDPE unless otherwise approved.
2. Drop line conduit to be 1.5" diameter gray HDPE unless otherwise approved.
3. Tracer wire to be #16 AWG THWN with orange jacket and blue tracer. Install tracer wire in conduit, extend 2 feet beyond conduit end, and install wire nut.
4. Fiber optic junction box to be:
   Manufacturer: Armorcast
   Number: A6001640HDAPCX24 (traffic rated)
   Number: A6001640APCX24 (non-traffic rated)
   (Unless otherwise approved)
5. Fiber optic splice vault to be:
   Manufacturer: Pencell (Hubbell)
   Number: PEM-2436-SPLIT
   (Unless otherwise approved)
6. Underground warning tape to be orange, 6 inch wide, 4 mil thick, polyethylene film printed with "CAUTION BURIED FIBER OPTIC LINE BELOW."
7. Pull string to be installed in all conduit.
8. Fiber optic cable to be installed by others.
9. 2" City fiber distribution line conduit shall be installed along street frontage in the Public Utility Easement (if available) or within street right-of-way for all residential and commercial construction projects.

Hillsboro Public Works

CITY FIBER GENERAL NOTES

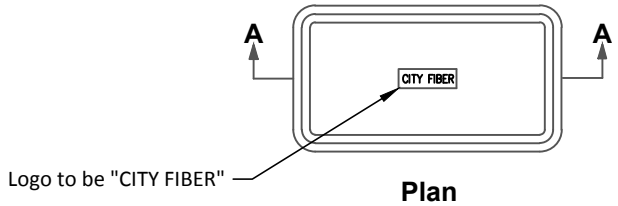
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 380-1

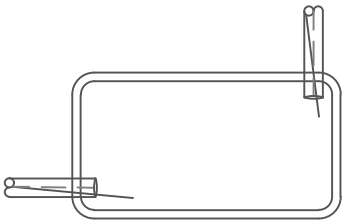
SCALE NTS

FILE NAME: COH-380-1.DWG

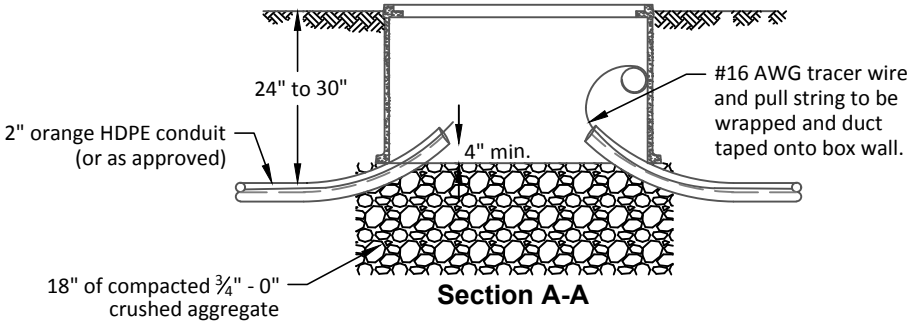
PLOT DATE: 7/17/2018 1:36 PM



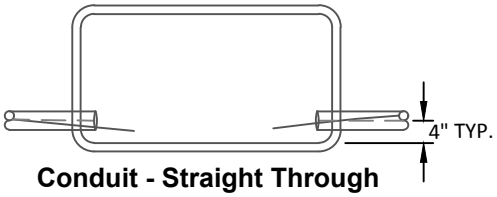

**Plan**



**Conduit - Direction Change**



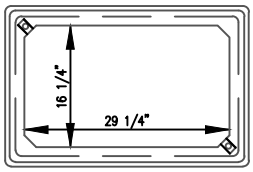

**Section A-A**



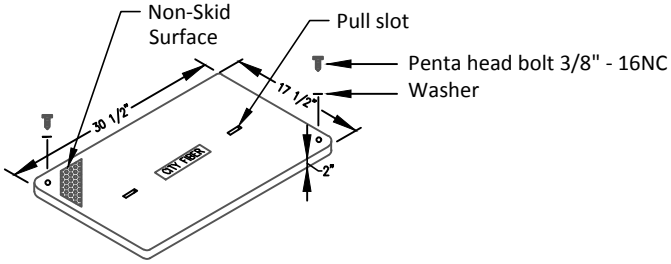

**Conduit - Straight Through**

## INSTALLATION NOTES:

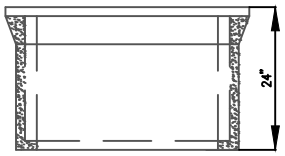
1. Conduit shall sweep into junction box from 24" to 30" depth of cover and shall be 4" away from box wall.
2. Conduit ends shall be swept up a minimum of 4" and capped or covered to prevent debris from entering.
3. Junction box shall be installed on 18" minimum layer of compacted ¾" - 0" crushed aggregate.
4. Junction box shall be installed parallel and perpendicular to adjacent concrete structures unless otherwise approved.
5. Pull string and #16 AWG tracer wire to be installed by contractor.
6. Fiber cable by others.



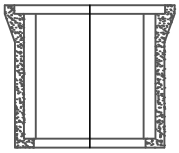

**Plan**




**Cover**




**Elevation**



**End**

## BOX NOTES:

1. Junction box in areas subject to vehicle traffic shall be fiberglass reinforced polymer concrete Armorcast A6001640HDAPCX24 unless otherwise approved. Box shall be 20K load rated and meet ANSI tier 22 loading specifications.
2. Junction box in areas not subject to vehicle traffic and outside paved areas shall be Armorcast A6001640APCX24 unless otherwise approved. Box may be 10K load rated and meet ANSI tier 8 loading specifications.
3. Material to be fiberglass reinforced polymer concrete and have the following mechanical properties: compressive strength - 11,000 PSI ASTM C-109, tensile strength - 1,700 PSI ASTM C-496, flexural strength - 7,500 PSI ASTM D-790.
4. Boxes shall be open bottom and stackable for extra depth.

Hillsboro Public Works

CITY FIBER JUNCTION BOX

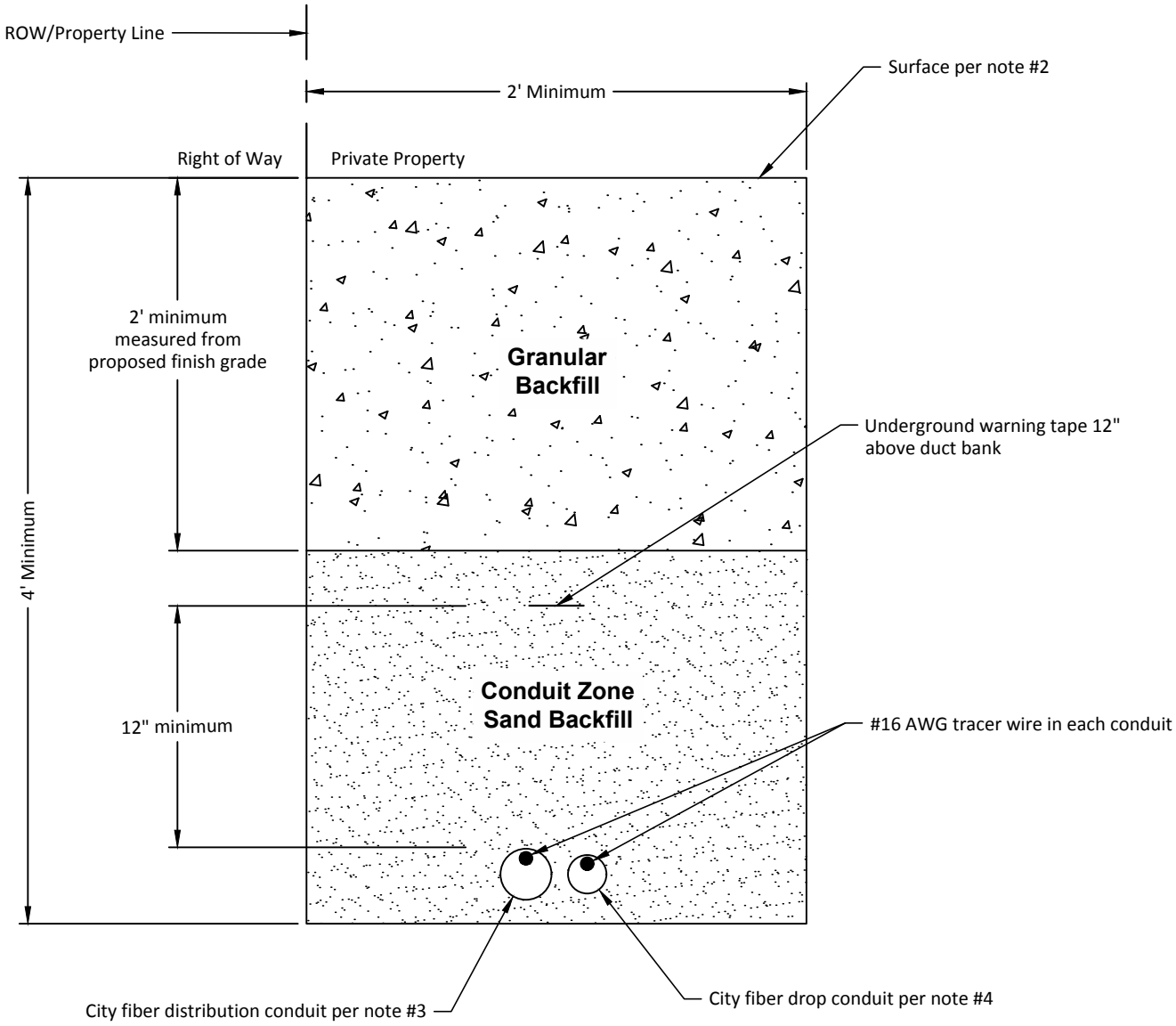
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 380-2

SCALE NTS

FILE NAME: COH-380-2.DWG

PLOT DATE: 7/17/2018 1:32 PM




## CITY FIBER OPTIC TRENCH

SCALE: NTS
This section is schematic and for informational purposes.

NOTES:

1. Utilities in joint trench vary by project. See plans for locations and sizes of conduit for each utility.
2. Surfacing of paved areas shall comply with City of Hillsboro Standard Drawing 250-2.
3. Distribution line conduit shall be 2" diameter orange HDPE pipe.
4. Drop line conduit shall be 1.5" diameter gray HDPE pipe.
5. Use spacers to maintain conduit separation in common trench.

Hillsboro Public Works

CITY FIBER TRENCH DETAIL

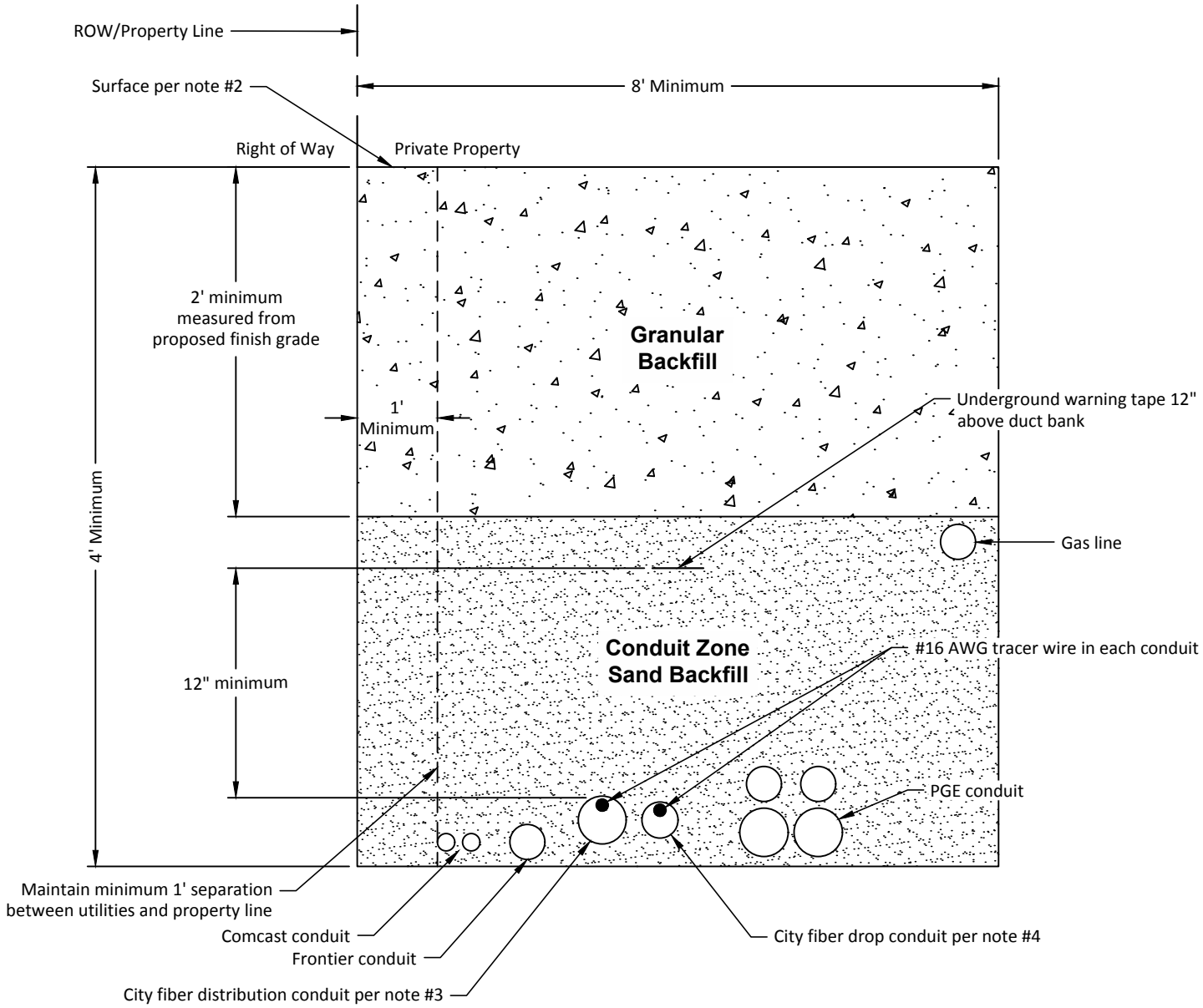
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 380-3

SCALE NTS

FILE NAME: COH-380-3.DWG

PLOT DATE: 7/17/2018 1:30 PM




## JOINT UTILITY TRENCH

SCALE: NTS

This section is schematic and for informational purposes.

NOTES:

1. Utilities in joint trench vary by project. See plans for locations and sizes of conduit for each utility.
2. Surfacing of paved areas shall comply with City of Hillsboro Standard Drawing 250-2.
3. Distribution line conduit shall be 2" diameter orange HDPE pipe.
4. Drop line conduit shall be 1.5" diameter gray HDPE pipe.
5. Use spacers to maintain conduit separation in common trench.

Hillsboro Public Works

CITY FIBER JOINT UTILITY TRENCH

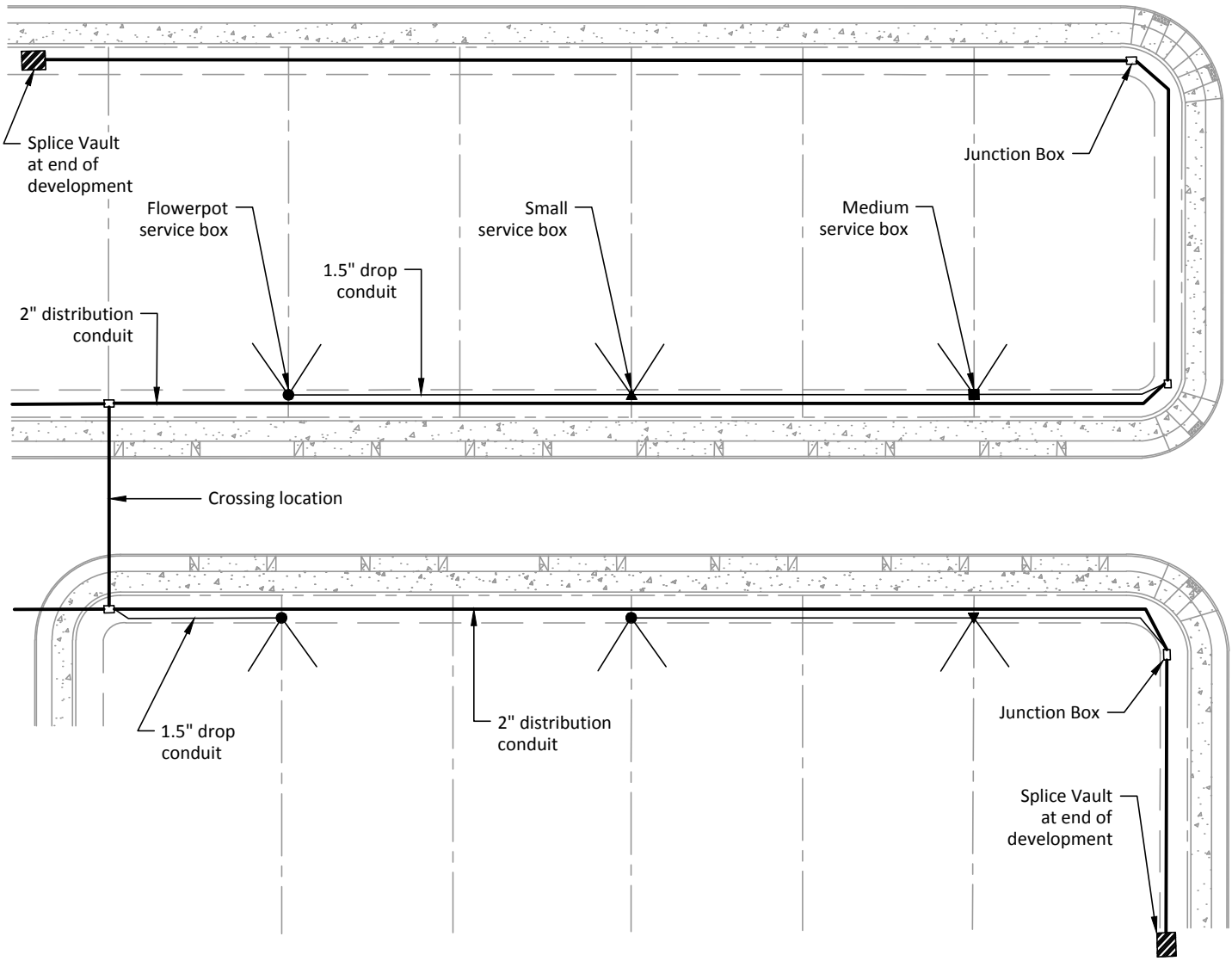
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 380-4

SCALE NTS

FILE NAME: COH-380-4.DWG

PLOT DATE: 7/17/2018 1:24 PM




## SITE LAYOUT

SCALE: NTS

### NOTES:

1. Fiber optic plan to be revised per PGE plan requirements. Contractor/Engineer to submit updated plans.
2. Maximum of 4 conduit lines to be laid in each direction from junction box.
3. Junction boxes shall be placed at intersection corners to facilitate future and proposed crossings.
4. Flowerpot service boxes may be used to serve a maximum of two premises at the end of a line.
5. Small service boxes may be used to serve one other service box in a series.
6. Medium service boxes may be used to serve two or more other service boxes in a series.
7. Splice vaults shall have a split lid to accommodate the mounting of a splitter cabinet on the fixed portion of the split lid.

### LEGEND:

- ● Flowerpot service box - 10" diam.
- ▲ Small service box - 13" x 24" x 18"
- ■ Medium service box - 17" x 30" x 18"
- ▯ Junction box - 17" x 30" x 24"
- ▨ Splice Vault - 24" x 36" x 24"

Hillsboro Public Works

GENERAL SITE LAYOUT

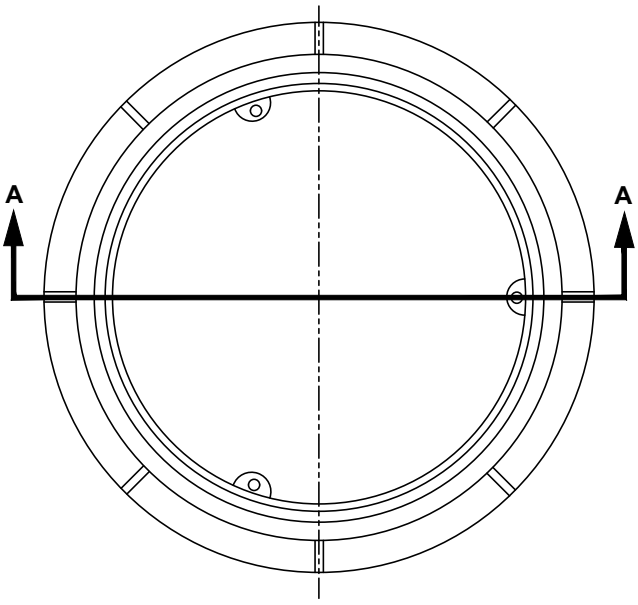
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 380-5

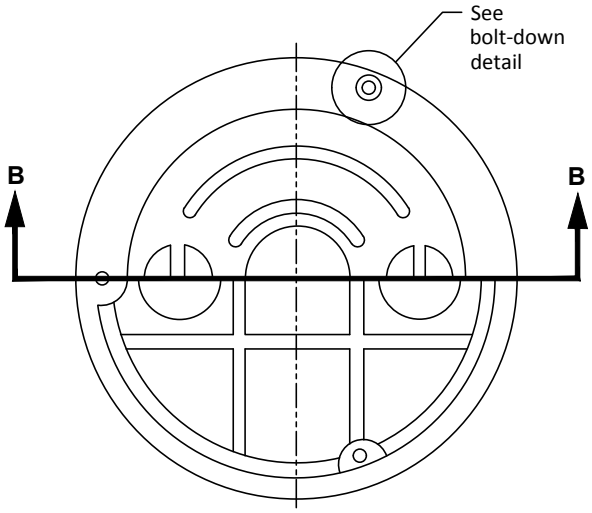
SCALE NTS

FILE NAME: COH-380-5.DWG

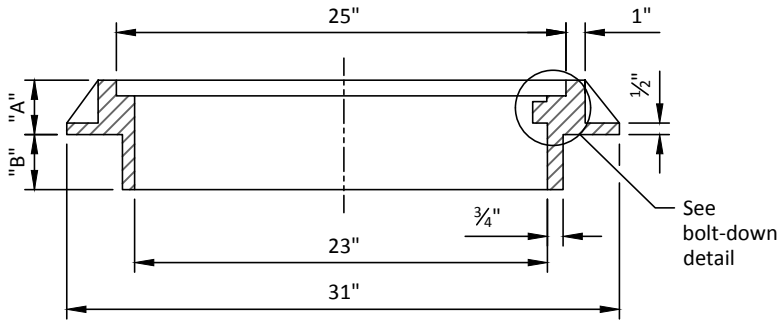
PLOT DATE:4/23/2018 11:17 AM



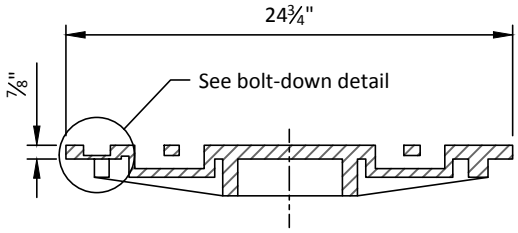

Frame



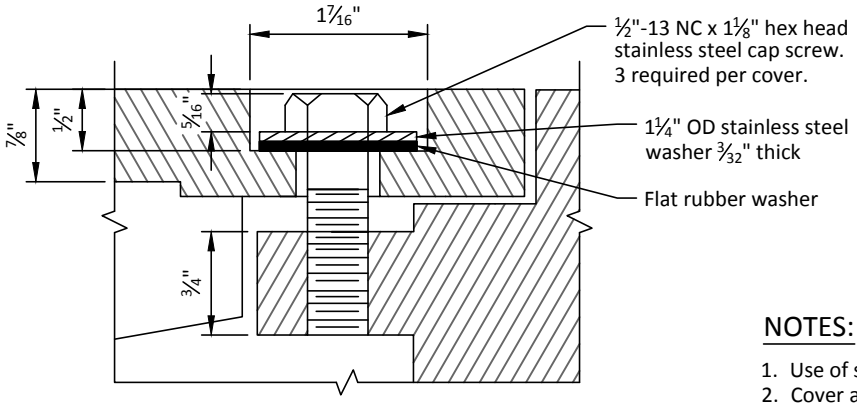

Cover




Section A-A




Section B-B




Bolt-down Detail

| Type | "A" | "B" |
|---|---|---|
| Suburban | 3" | 3" |
| Standard | 7" | 3" |

NOTES:

1. Use of suburban type manhole frame requires City approval.
2. Cover and frame shall be gray cast iron ASTM A-48 Class 30.
3. Cover and frame to be machined to a true bearing all around.

Hillsboro Public Works

BOLT-DOWN MANHOLE FRAME AND COVER FOR IN-STREET AREAS

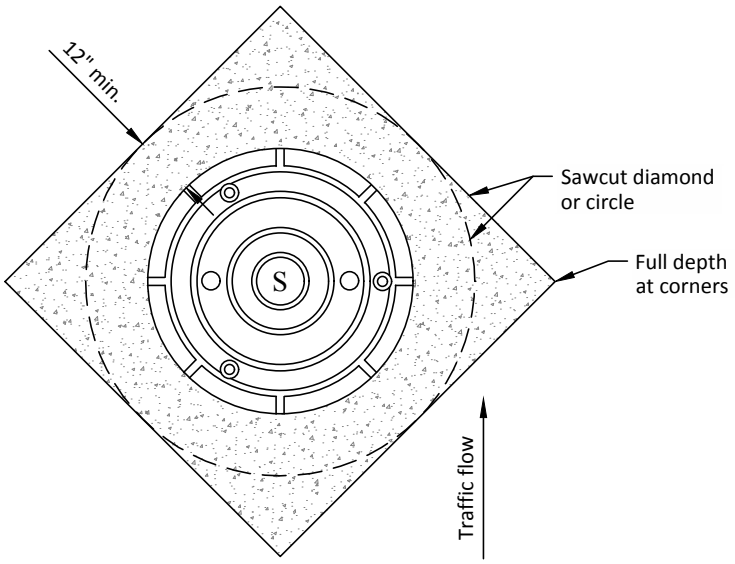
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 410-1

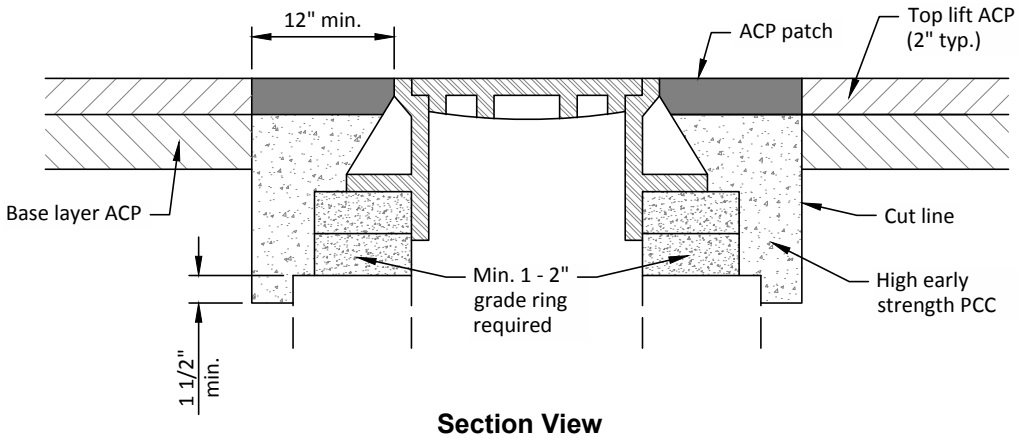
SCALE NTS

FILE NAME: COH-410-1.DWG

PLOT DATE: 3/7/2017 1:32 PM




**Plan View**




**Section View**

Step 1 Sawcut and remove pavement around manhole 12" minimum from manhole frame.

Step 2 Raise manhole frame and cover using concrete rings and approved mechanical adjustment devices to finish grade matching profile and cross slope.

Step 3 Backfill with high early strength PCC and ACP to depths as directed.

Step 4 Apply sand seal on surface and surface joint.

Hillsboro Public Works

MANHOLE ADJUSTMENT
IN ASPHALT ROADWAYS

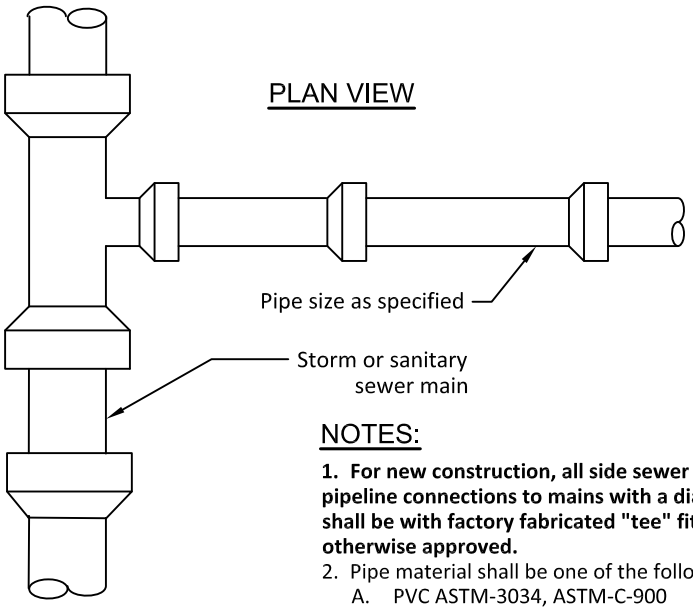
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

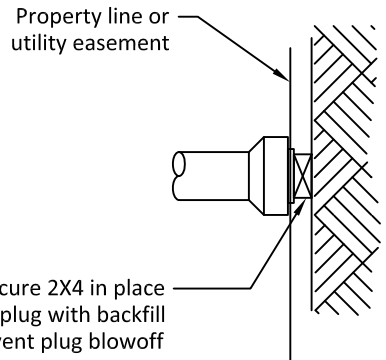
STD. DRG. NO. 410-2

SCALE NTS

FILE NAME: COH-410-2.DWG

PLOT DATE: 7/13/2017 3:20 PM

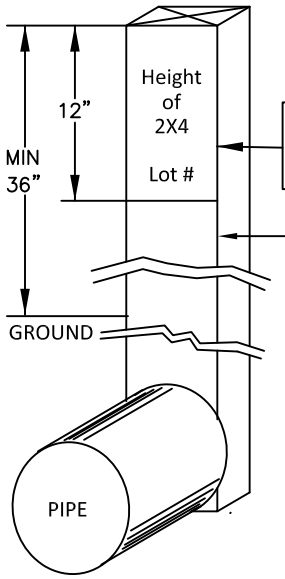



## NOTES:

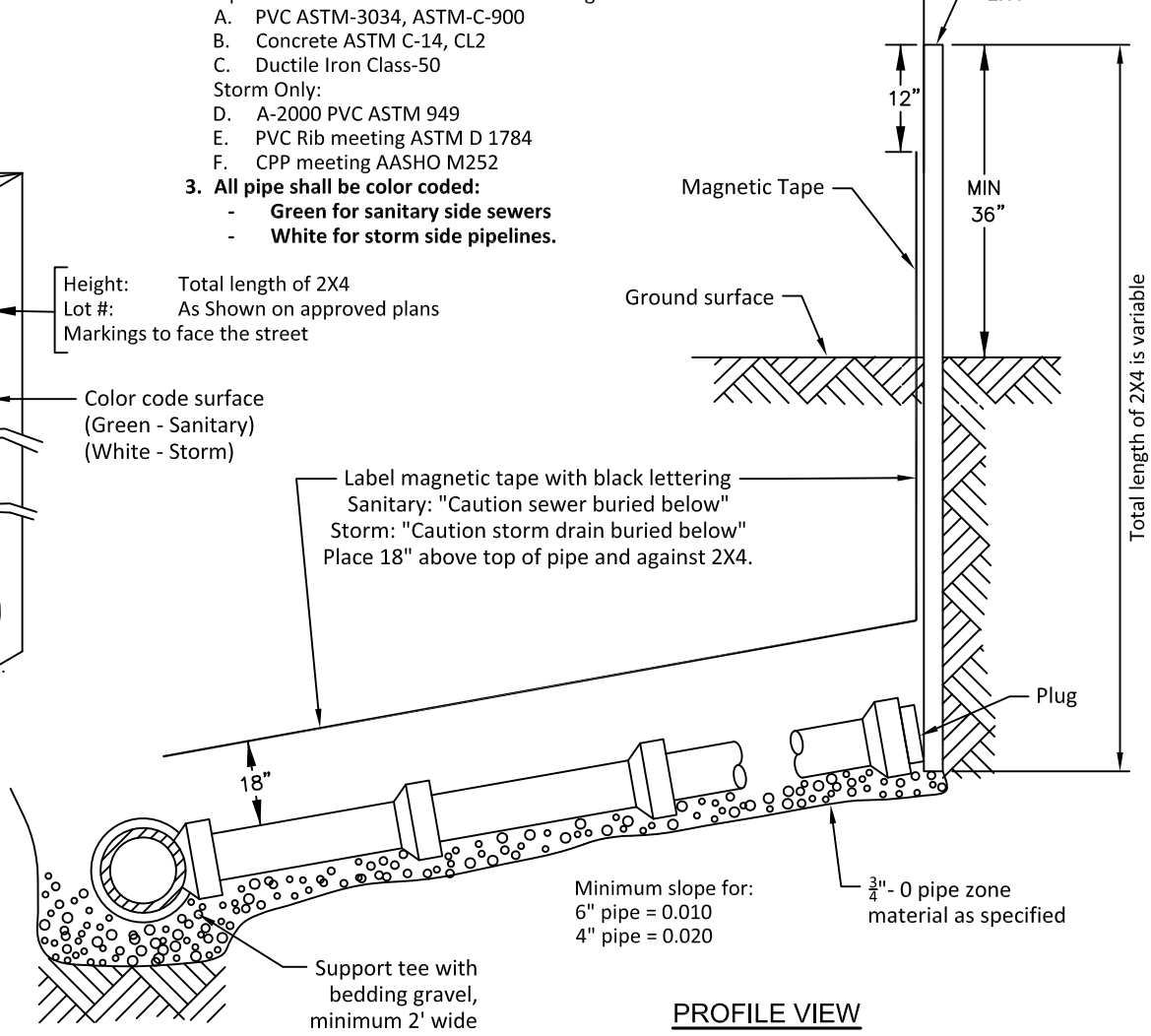
1. **For new construction, all side sewer and side storm pipeline connections to mains with a diameter of 18" or less shall be with factory fabricated "tee" fittings unless otherwise approved.**
2. Pipe material shall be one of the following:
   - A. PVC ASTM-3034, ASTM-C-900
   - B. Concrete ASTM C-14, CL2
   - C. Ductile Iron Class-50

   Storm Only:
   - D. A-2000 PVC ASTM 949
   - E. PVC Rib meeting ASTM D 1784
   - F. CPP meeting AASHO M252
3. **All pipe shall be color coded:**
   - **Green for sanitary side sewers**
   - **White for storm side pipelines.**




Height: Total length of 2X4
Lot #: As Shown on approved plans
Markings to face the street

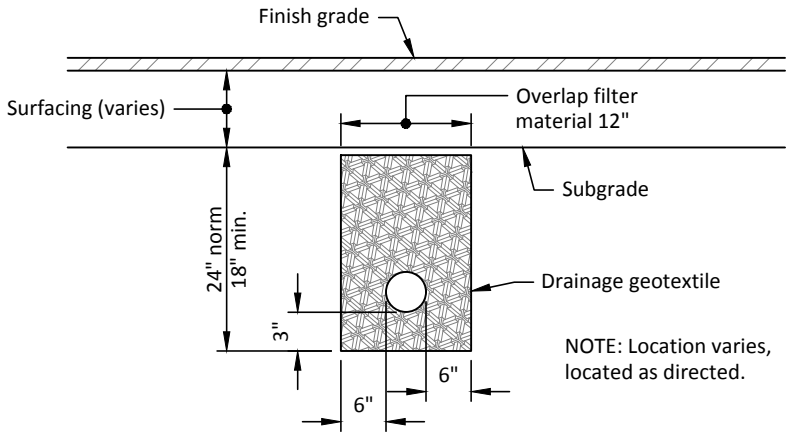
Color code surface
(Green - Sanitary)
(White - Storm)

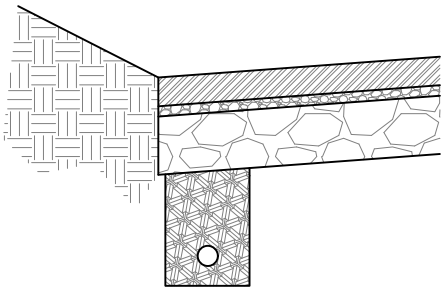



## PROFILE VIEW

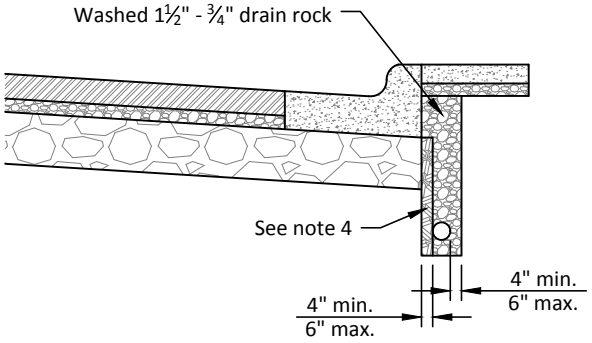
Hillsboro Public Works

| | | |
|---|---|---|
| SIDE SEWER / SIDE STORM PIPELINE | VERIFY SCALES: BAR IS ONE INCH ON ORIGINAL DRAWING (0 – 1"). IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY | STD. DRG. NO. 410-3 |
| | | SCALE NTS |
| FILE NAME: COH-410-3.DWG | | PLOT DATE: 2/23/2018 1:53 PM |

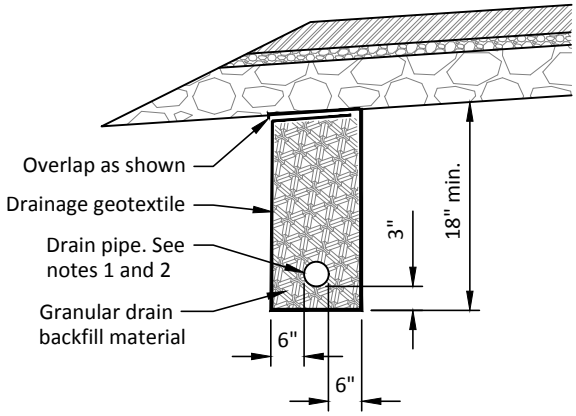


**Without Shoulder**
**(For subgrade details, see right)**




**With Shoulder**




**Subgrade Drain Detail**

NOTES:

1. Use 4" or 6" ID ASTM D-2729 perforated PVC pipe as directed by the Engineer.
2. Connect subgrade drain pipe to drainage structure using plastic pipe with rigid coupling matching the drain pipe diameter.
3. Locate the longitudinal subgrade drain on the uphill side of the road or as directed by the Engineer.
4. Pillow drain with non-woven drainage geotextile on both sides to dewater pavement base course or subgrade. Drain assembly shall be installed according to manufacturer specifications.
5. This detail is not intended for use in LIDA facilities. See CWS *LIDA Handbook* for additional information.

Hillsboro Public Works

SUBGRADE DRAIN

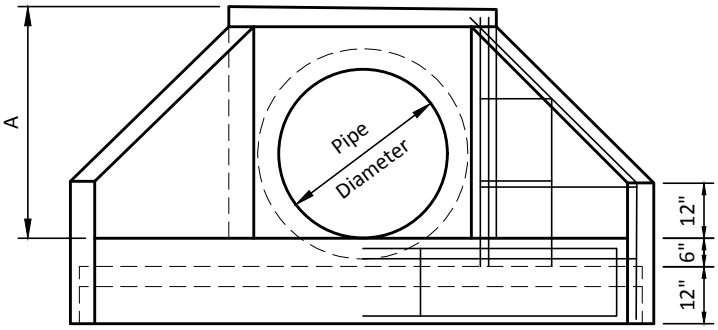
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 420-1

SCALE NTS

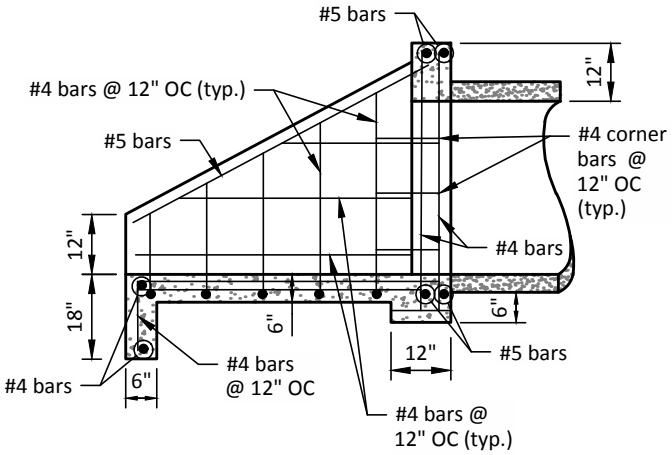
FILE NAME: COH-420-1.DWG

PLOT DATE: 1/13/2017 4:59 PM



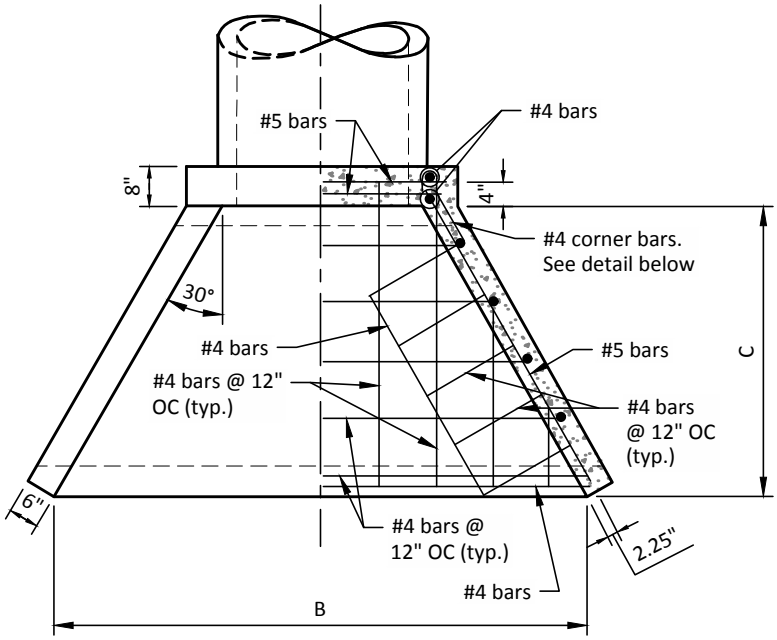

## ELEVATION

SCALE: NTS



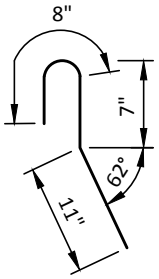

## TYPICAL WING ELEVATION

SCALE: NTS




## PLAN

SCALE: NTS




## CORNER BARS DETAIL

SCALE: NTS

| HEADWALL DIMENSIONS | | | |
|---|---|---|---|
| Pipe Diameter | A | B | C |
| 18" | 2'-6" | 4'-0 7/8" | 2'-0" |
| 24" | 3'-0" | 5'-9 3/4" | 3'-0" |
| 30" | 3'-6" | 7'-6 5/8" | 4'-0" |
| 36" | 4'-0" | 9'-3 1/2" | 5'-0" |
| 39" | 4'-3" | 10'-2" | 5'-6" |
| 42" | 4'-6" | 11'-0 1/4" | 6'-0" |
| 48" | 5'-3" | 12'-9 1/8" | 7'-0" |
| 54" | 5'-9" | 14'-6" | 8'-0" |
| 60" | 6'-3" | 16'-2 7/8" | 9'-0" |
| 66" | 6'-9" | 17'-11 3/4" | 10'-0" |
| 72" | 7'-3" | 19'-8 5/8" | 11'-0" |

NOTES:

1. All concrete shall be class "A".
2. All corners shall be chamfered 3/4"
3. reinforcing steel shall be placed with the center of the outside layer of bars 2" from the surface of the concrete.
4. Provide a 12" footing as shown where required to maintain 4" minimum coverage for pipes.

Hillsboro Public Works

CONCRETE HEADWALL FOR LARGE DIAMETER PIPES (≥18")

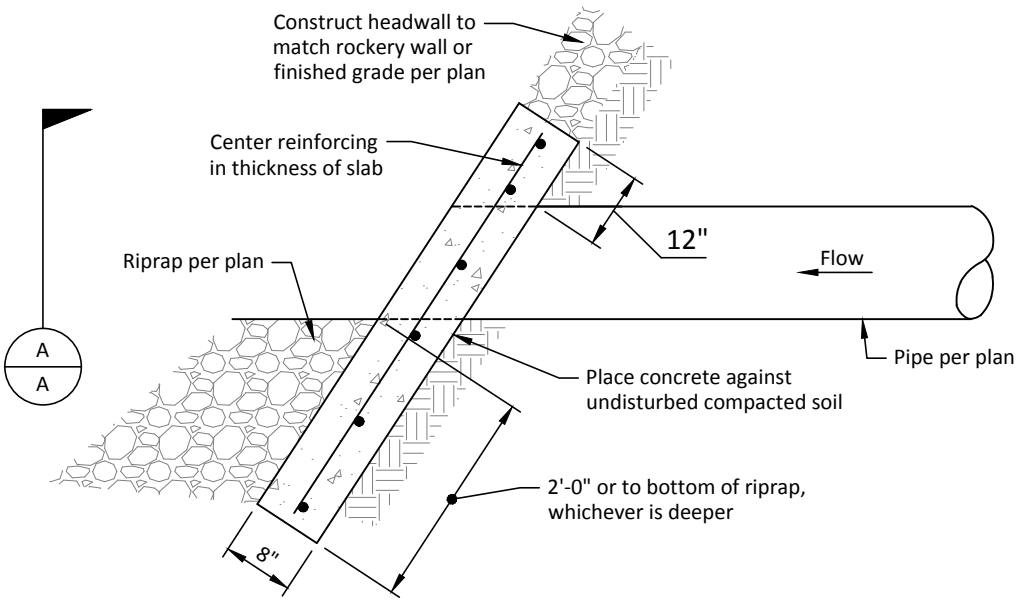
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 420-2

SCALE NTS

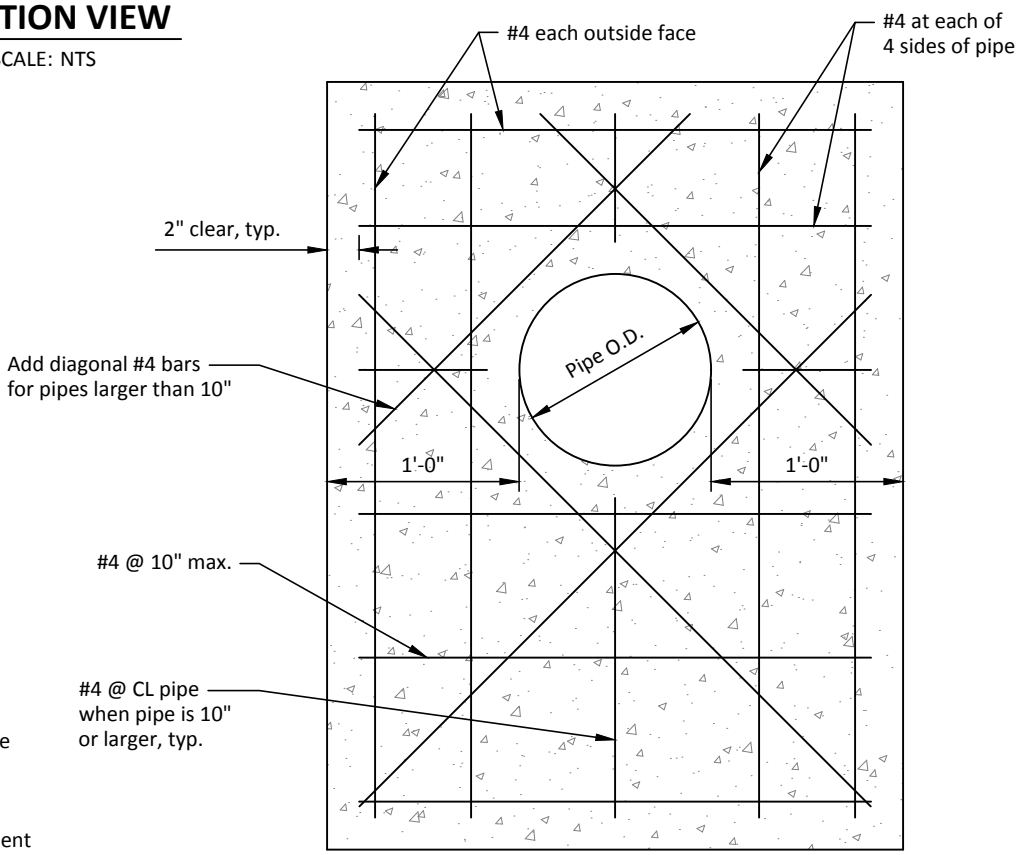
FILE NAME: COH-420-2.DWG

PLOT DATE: 1/13/2017 4:58 PM




## SECTION VIEW

SCALE: NTS




## VIEW A-A

SCALE: NTS

NOTES:

1. Provide commercial grade concete with a minumum compressive strength of 3,000 PSI at 28 days.
2. Provide deformed bar reinforcement conforming to the requirements of ASTM A615, Grade 60.
3. Chamfer exposed corners of concrete ¾" x ¾" or radius ¾".

Hillsboro Public Works

CONCRETE HEADWALL FOR SMALL DIAMETER PIPES (<18")

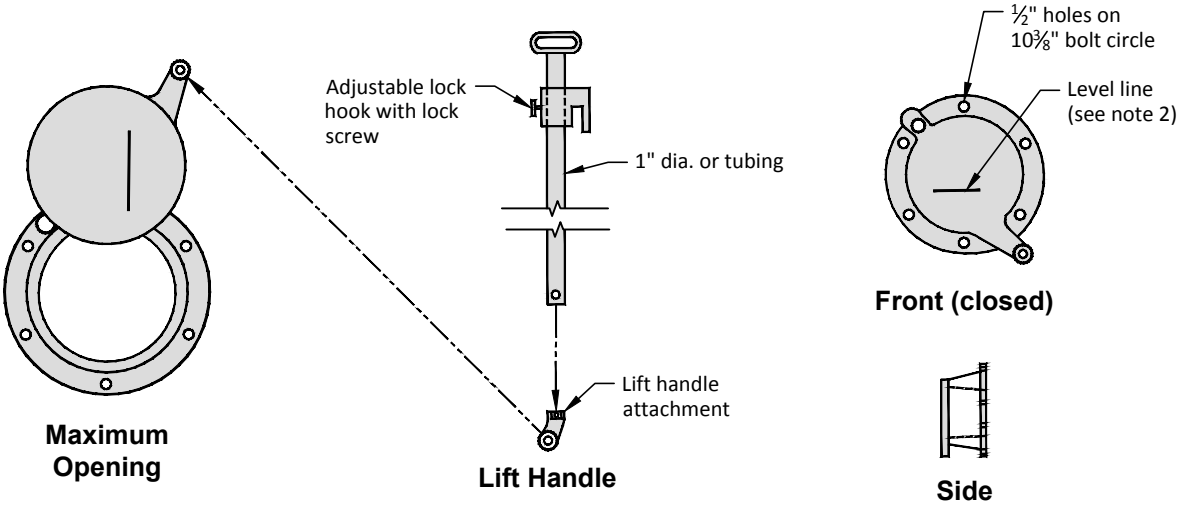
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 420-3

SCALE NTS

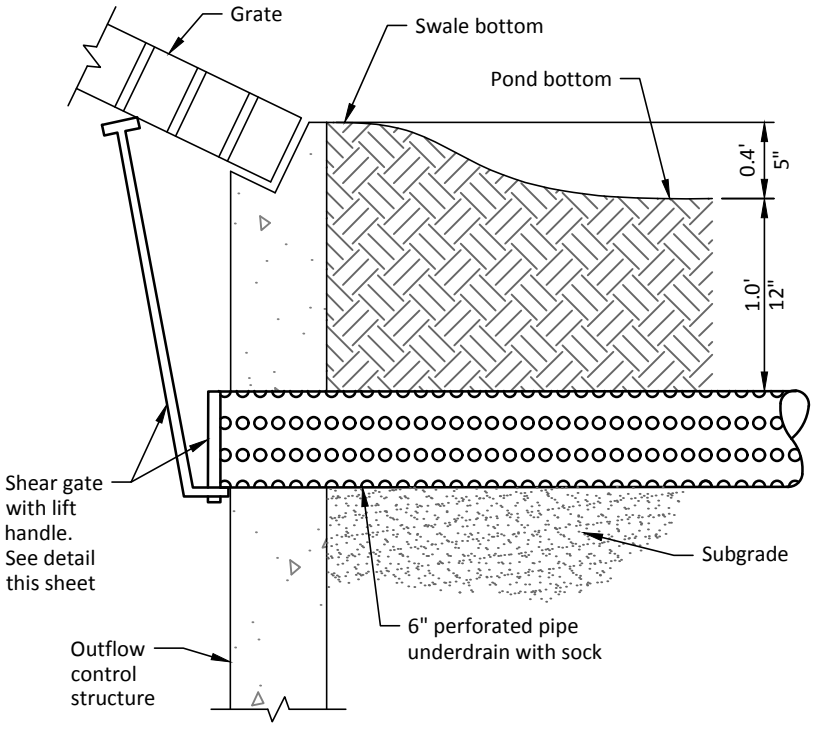
FILE NAME: COH-420-3.DWG

PLOT DATE: 6/16/2017 4:15 PM




## SHEAR GATE

SCALE: NTS




## PERFORATED UNDERDRAIN

SCALE: NTS

NOTES:

1. The frame and ladder or steps are to be offset so that the shear gate is visible from the top.
2. The shear gate shall be made of aluminum alloy in accordance with ASTM B 26M and ASTM B 275, designation ZG32A; or cast iron in accordance with ASTM A 48, Class 30B. The lift handle shall be made of a similar metal to the gate (to prevent galvanic corrosion), it may be solid rod or hollow tubing, with adjustable hook as required. A neoprene rubber gasket is required between the riser mounting flange & gate flange. Install the gate so that the level-line mark is level when the gate is closed. The mating surfaces of the lid and the body shall be machined for proper fit. All shear gate bolts shall be stainless steel.
3. The shear gate max. opening shall be controlled by limited hinge movement, a stop tab, or some other device.
4. One perforated underdrain is required for every 10 feet of pond bottom width.
5. The perforated underdrain is intended for temporary dewatering of the facility for maintenance. The shear gate shall remain closed at all other times.

Hillsboro Public Works

PERFORATED UNDERDRAIN WITH SHEAR GATE

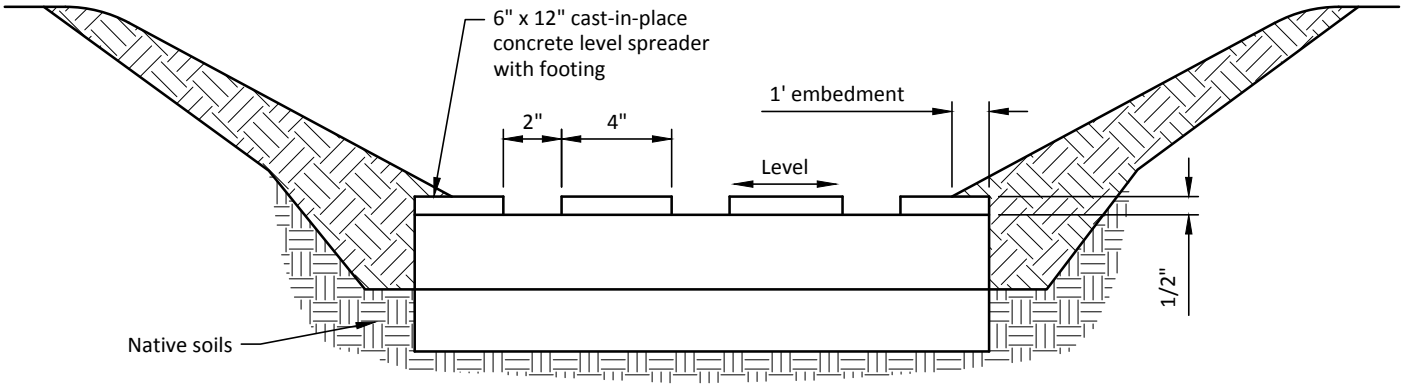
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

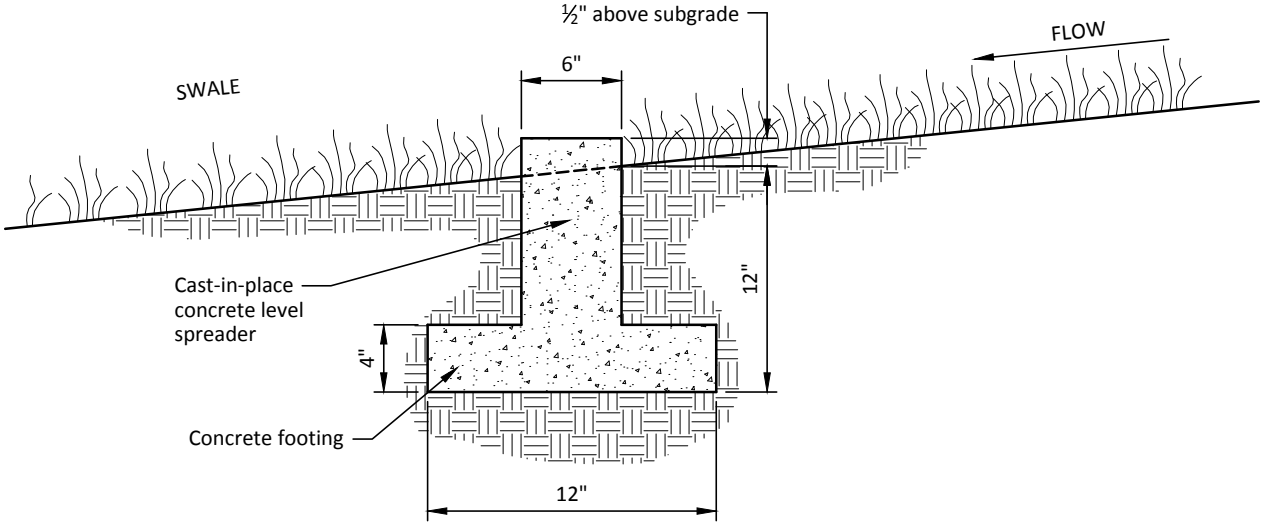
STD. DRG. NO. 420-4

SCALE NTS

FILE NAME: COH-420-4.DWG

PLOT DATE: 10/3/2017 1:35 PM




NOTES:

1. The spreader shall be installed level and on contour
2. Concrete spreader shall be cast-in-place. Top of spreader shall be broom finished in the direction of flow.

Hillsboro Public Works

LEVEL SPREADER

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 420-5

SCALE NTS

FILE NAME: COH-420-5.DWG

PLOT DATE: 6/28/2017 3:13 PM

# DEWATERING GENERAL NOTES:

1. Dewatering plans for passive methods of treatment shall shall show locations of any proposed temporary storage of onsite sediment laden water and method of treatment prior to discharge.
2. Temporary sediment basins shall include a 90 degree upright elbow perforated pipe wrapped in filter fabric.
3. Temporary sediment basins shall include a rock berm and use of silt curtains in lieu of sediment fence adjacent to perforated pipe to aid in velocity reduction and settlement of fines.
4. Additional dewatering filtration treatment methods or systems may be required to prevent visible sediment laden water discharges.

Hillsboro Public Works

DEWATERING GENERAL NOTES

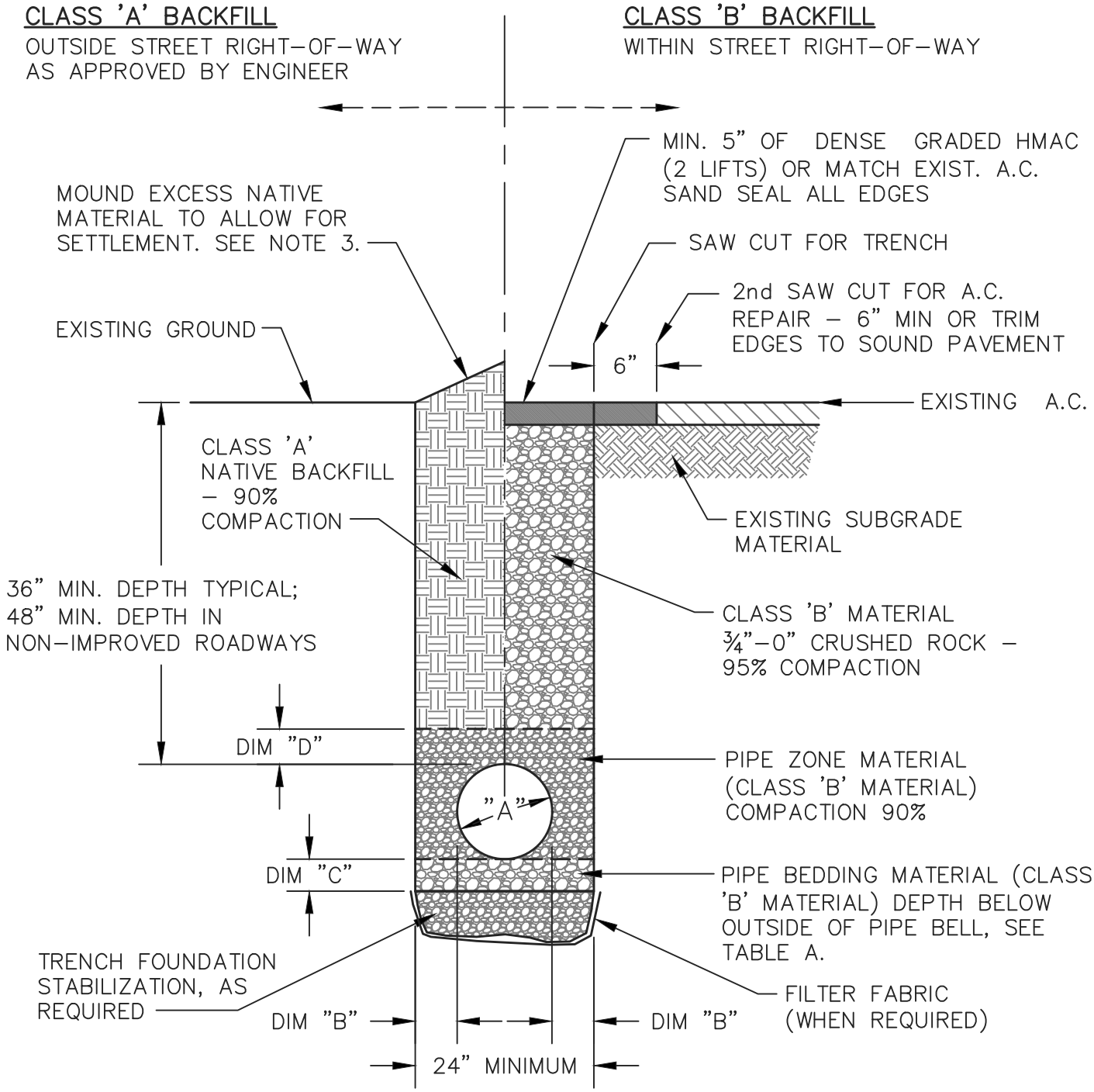
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 420-6

SCALE NTS

FILE NAME: COH-420-6.DWG

PLOT DATE: 8/3/2018 2:02 PM




| TABLE A | | | |
|---|---|---|---|
| "A" (IN) | "B" (IN) | "C" (IN) | "D" (IN) |
| 4 | 10 | 4 | 8 |
| 6 | 9 | 4 | 8 |
| 8 | 8 | 6 | 10 |
| 10 | 8 | 6 | 10 |
| 12 | 8 | 6 | 10 |
| 18 | 8 | 6 | 12 |
| 24 | 8 | 6 | 12 |

NOTES:

1. "A" = NOMINAL PIPE DIAMETER
2. SEE "CITY OF HILLSBORO DESIGN & CONSTRUCTION STANDARDS" FOR ADDITIONAL REQUIREMENTS.
3. RESTORE LANDSCAPE TO PRE-EXISTING CONDITIONS OR BETTER.

Hillsboro Water

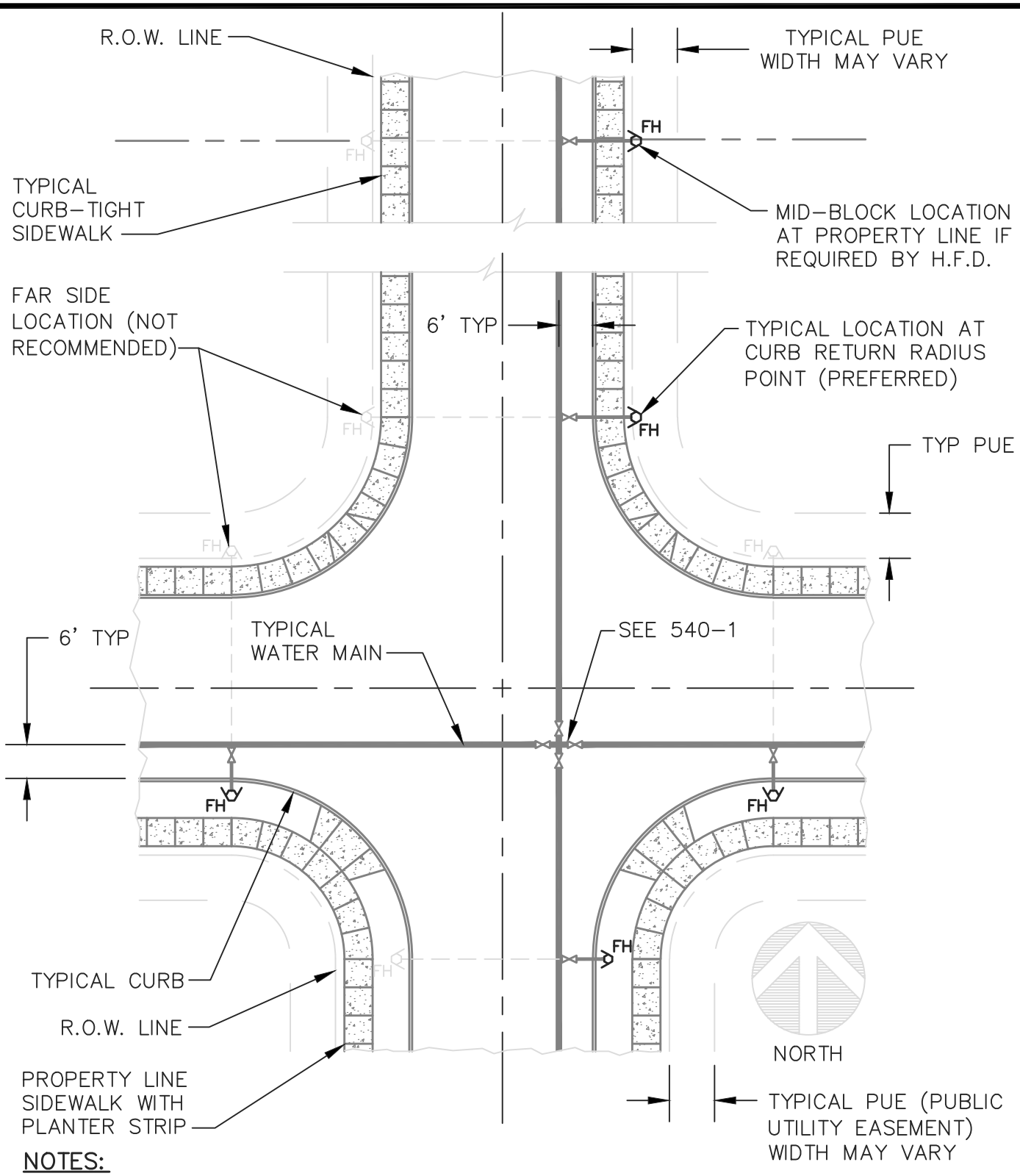
# TYPICAL WATERLINE TRENCH BACKFILL

SCALE: NONE

DATE: SEPT 2017

520-1

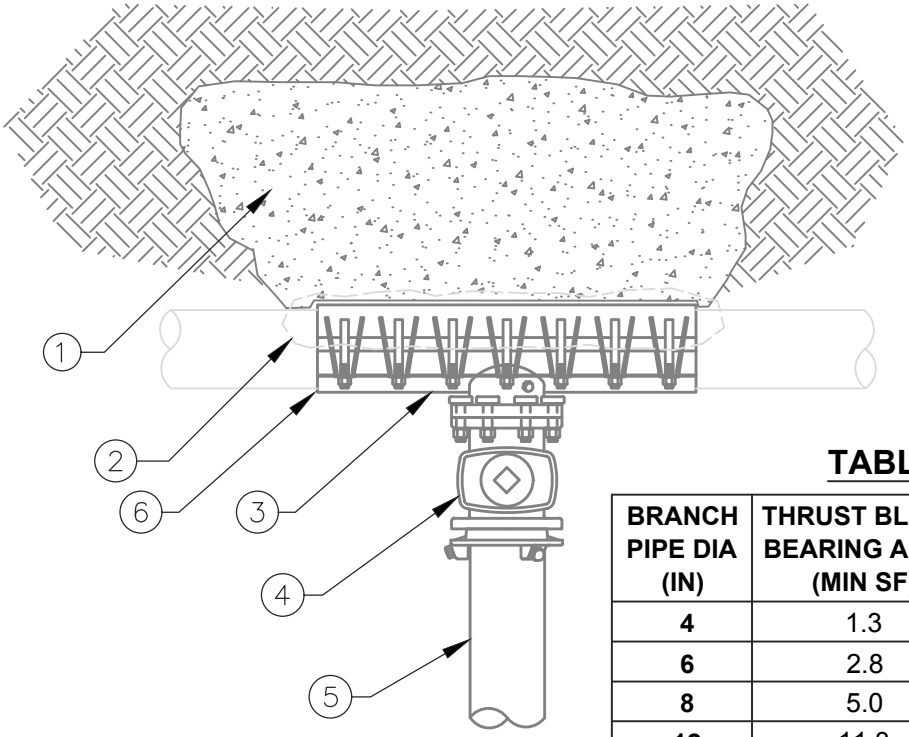
FILENAME: 520-1 DRAFT.DWG




NOTES:

1. A FIRE CODE OFFICAL MUST APPROVE LOCATION OF ALL FIRE HYDRANTS.
2. HYDRANT SHALL BE LOCATED IN AN AREA WHICH ALLOWS FOR REQUIRED CLEAR ZONE SURROUNDING THE HYDRANT. SEE 550–1 FOR CLEAR ZONE DETAIL.
3. SEE 550–2 FOR HYDRANT INSTALLATION DETAILS.
4. CURB AND SIDEWALK CONFIGURATION CAN BE FOUND IN THE CITY'S TRANSPORTATION SYSTEM PLAN.

| Hillsboro Water | **TYPICAL WATER LINE & FIRE HYDRANT LOCATION** | **SCALE: NONE** | **530-1** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |




## TABLE 1

| BRANCH PIPE DIA (IN) | THRUST BLOCK BEARING AREA (MIN SF) | THRUST BLOCK CONCRETE (MIN CY) |
|---|---|---|
| **4** | 1.3 | 0.05 |
| **6** | 2.8 | 0.10 |
| **8** | 5.0 | 0.18 |
| **12** | 11.3 | 0.42 |
| **16** | 20.1 | 0.75 |
| **18** | 26.0 | 0.97 |

KEYNOTES:

① CONCRETE THRUST BLOCK POURED AGAINST UNDISTURBED EARTH. THRUST BLOCK SIZE SHALL BE PER TABLE 1 AND SHALL NOT BE LESS THAN ONE FOOT IN ANY DIMENSION. CONCRETE SHALL BE CLASS 3000.

② COVER TAPPING SLEEVE WITH 8 MIL PLASTIC MATERIAL AS SHOWN PRIOR TO POURING THRUST BLOCK AND BACKFILLING.

③ STAINLESS STEEL TAPPING SLEEVE WITH GASKET AND FLANGED CONNECTION.

④ GATE VALVES 10" AND LARGER WITH LESS THAN 24" BETWEEN THE OPERATING NUT AND FINISHED GRADE WILL REQUIRE A HORIZONTAL BEVEL GEAR ACTUATOR.

⑤ ALL JOINTS ON BRANCH PIPE SHALL BE RESTRAINED.

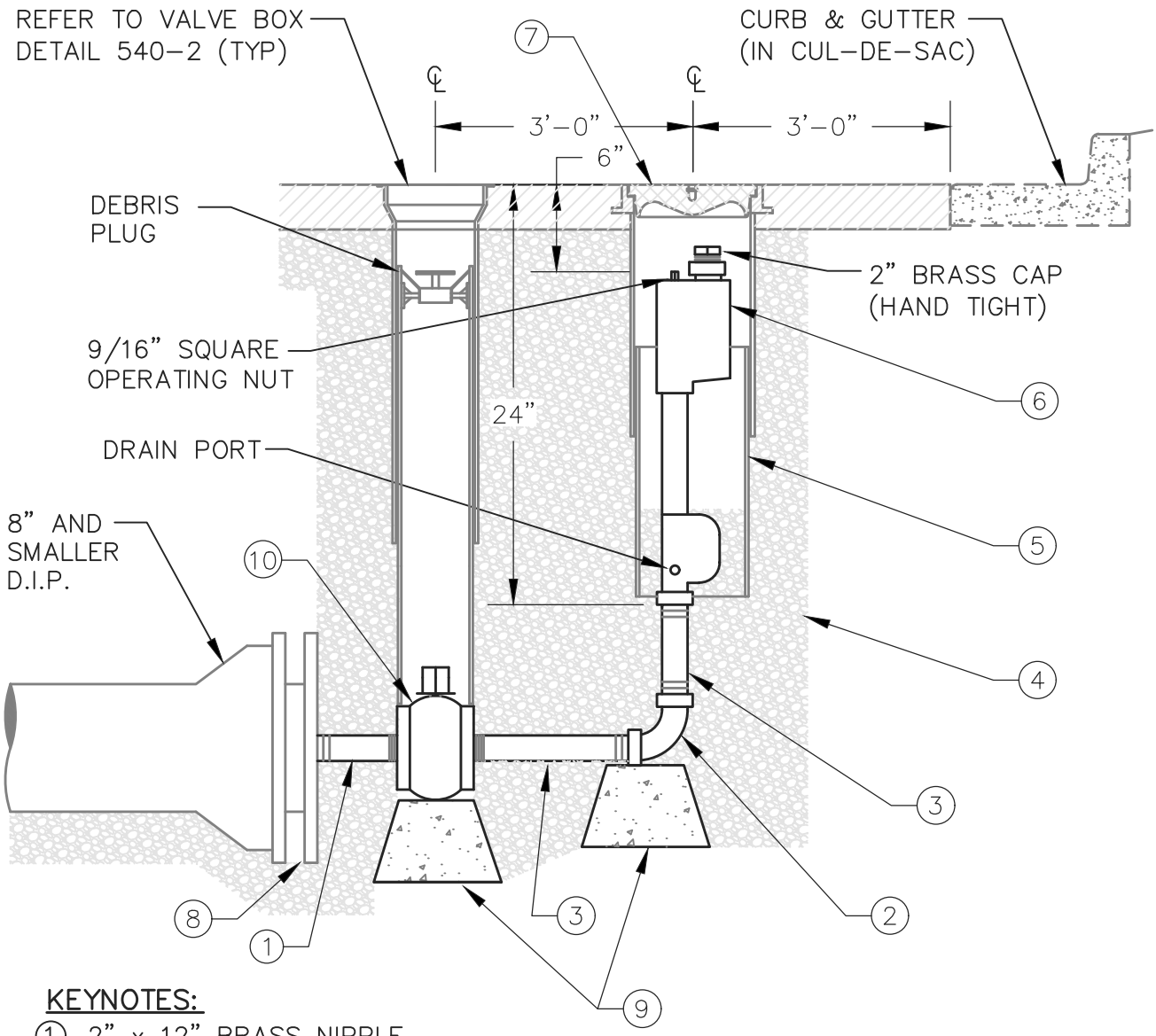
⑥ EDGE OF TAPPING SLEEVE SHALL BE A MINIMUM OF 18" FROM BEND OR JOINT.

NOTES: (TAPPING CONTRACTOR ONLY)

1. BEFORE INSTALLING TAPPING SLEEVE, CONTRACTOR SHALL THOROUGHLY CLEAN PIPE TO REMOVE ALL DIRT, ROCKS, AND OTHER FOREIGN MATERIAL FROM PIPE WHERE SLEEVE WILL BE INSTALLED.
2. SLEEVE BOLTS SHALL BE TIGHTENED TO MANUFACTURER'S TORQUE SPECIFICATIONS.
3. CONTRACTOR SHALL ENSURE THAT GASKET IS PROPERLY ALIGNED AND FREE OF FOREIGN MATERIAL PRIOR TO TIGHTENING SLEEVE BOLTS.
4. SLEEVE LOCATION AND INSTALLATION SHALL BE APPROVED BY WATER DEPARTMENT INSPECTOR PRIOR TO TAPPING.
5. CONTRACTOR SHALL AIR TEST SLEEVE TO 40 PSI PRIOR TO TAPPING.
6. CONTRACTOR SHALL FLUSH VALVE PRIOR TO PIPE CONNECTION.

| Hillsboro Water | **TAPPING SLEEVE** | **SCALE: NONE** | **530-2** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |

FILENAME: 530-2 DRAFT.DWG




## KEYNOTES:

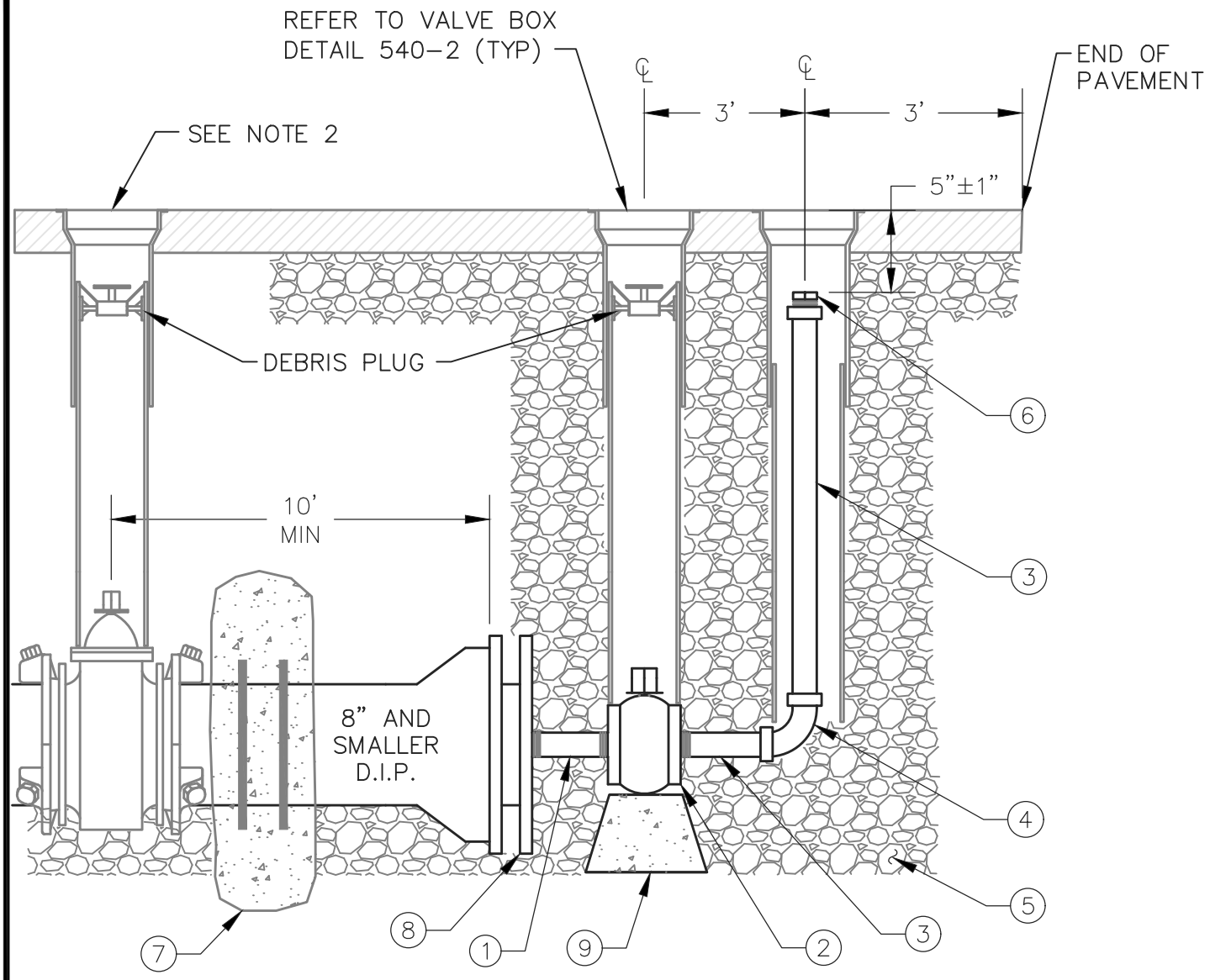
1. 2" x 12" BRASS NIPPLE
2. 2" FIPT 90° BRASS ELBOW
3. 2" BRASS NIPPLE (LENGTH WILL VARY)
4. GRANULAR DRAIN BACKFILL MATERIAL
5. 8" PVC ASTM D-3034, LENGTH AS REQUIRED
6. KUPFERLE MODEL #TF500 BLOW-OFF OR APPROVED EQUIVALENT
7. OLYMPIC FOUNDRY 12" CAST IRON VALVE BOX, "PORTLAND STYLE" BODY AND LID #5-603 (GRIND OFF WORDS "PORTLAND OR." LEAVE WORD "WATER")
8. RESTRAINED TYTON PLUG W/ 2" TAP (SEE NOTE 2.)
9. 8"x8"x8" CONCRETE PIER BLOCK OR EQUIVALENT SUPPORT ON UNDISTURBED EARTH
10. 2" GATE VALVE w/2" OPERATING NUT FIPT x FIPT

## NOTES:

1. THIS DETAIL APPLICABLE TO DEAD END LINES SERVING CUSTOMERS WHICH WILL NOT BE EXTENDED IN THE FUTURE.

| Hillsboro Water | **2" STANDARD BLOW-OFF ASSEMBLY - PERMANENT** | **SCALE: NONE** | **530-3** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |

FILENAME: 530-3 DRAFT.DWG



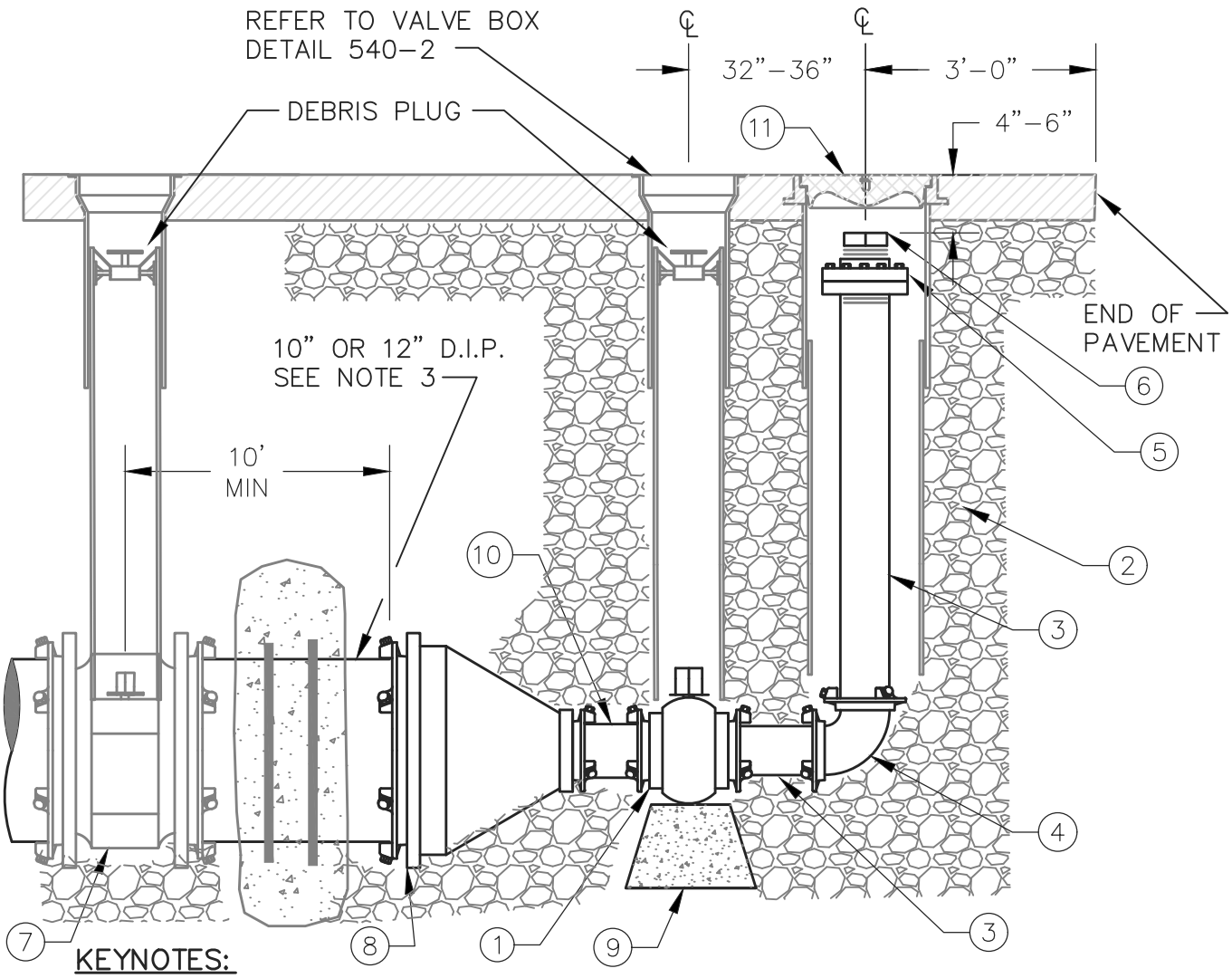

## KEYNOTES:

① 2" x 12" GALVANIZED PIPE NIPPLE
② 2" GATE VALVE w/ 2" OPERATING NUT FIPT x FIPT
③ 2" GALVANIZED NIPPLE (LENGTH WILL VARY)
④ 2" FIPT 90° GALVANIZED ELBOW
⑤ PIPE BEDDING AND BACKFILL MATERIAL PER 520-1
⑥ 2" BRASS COUPLER AND PLUG, HAND TIGHT
⑦ CONCRETE STRADDLE BLOCK FOR EXISTING UNRESTRAINED PIPE, SEE 530-7.
⑧ RESTRAINED TYTON PLUG w/ 2"TAP OR MJ CAP & RETAINER GLAND w/ 2"TAP
⑨ 8"x8"x8" CONCRETE PIER BLOCK OR EQUIVALENT SUPPORT ON UNDISTURBED EARTH

## NOTES:

1. THIS DETAIL APPLICABLE TO DEAD END LINES SERVING CUSTOMERS WHICH MAY/WILL BE EXTENDED IN THE FUTURE.
2. INSTALL GATE VALVE SIZED AT FULL PIPE DIAMETER WHERE SHOWN.

| Hillsboro Water | **2" BLOW-OFF ASSEMBLY FOR FUTURE EXTENSION** | **SCALE: NONE** | **530-4** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |



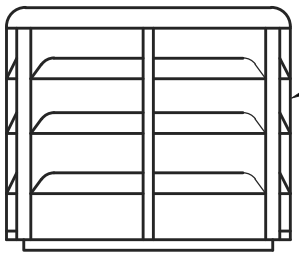

## KEYNOTES:

1. 4" RESTRAINED MJ x MJ GATE VALVE
2. PIPE BEDDING AMD BACKFILL MATERIAL PER 520-1
3. 4" DIP PIPE SPOOL THREADED FLANGE CUT TO REQ'D LENGTH
4. 4" DIP 90° MJ BEND
5. 4" BLIND FLANGE WITH 4" FIPT
6. 4" PVC THREADED PLUG (HAND TIGHT)
7. RESTRAINED LINE-SIZE MJ BUTTERFLY VALVE (SEE NOTES 1 AND 2.)
8. RESTRAINED MJ x 4" REDUCER (SEE NOTE 2.)
9. 8"x8"x8" CONCRETE PIER BLOCK OR EQUIVALENT SUPPORT ON UNDISTURBED EARTH
10. 4" D.I. PIPE
11. 8" OVERSIZED CAST IRON VALVE BOX AND LID W/8" SDR PVC SLEEVE (ASTM D3034)

## NOTES:

1. THIS DETAIL APPLICABLE TO DEAD END LINES SERVING CUSTOMERS WHICH MAY/WILL BE EXTENDED IN THE FUTURE.
2. ALL PIPE JOINTS SHALL BE RESTRAINED. ADD STRADDLE BLOCK TO EXISTING UNRESTRAINED PIPE – SEE 530-7.
3. FOR PIPES LARGER THAN 12", SEE ENGINEER FOR BLOW-OFF REQUIREMENT.
4. GALVANIZED PIPE IS ACCEPTABLE FOR USE IN PLACE OF DUCTILE IRON PIPE. CONTACT THE WATER DEPARTMENT FOR DETAILS.

| Hillsboro Water | **4" BLOW-OFF ASSEMBLY FOR FUTURE EXTENSION** | **SCALE: NONE** | **530-5** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |



UV RESISTENT BOX
WITH LOCKING LID

CHANNEL ENCLOSURE "GREEN"
WITH HEX LOCKING SYSTEM

4" AIR GAP

DECHLOR BASKET

SPECIFY DEPTH OF BURY WHEN ORDERING

6" SEWER PIPE CONNECTION

DEBRIS PLUG

SEE DETAIL 530-4 FOR DETAILED NOTES

DEBRIS PLUG

CLEAN 1" DRAIN ROCK 2 CUBIC FEET MIN.

8"x8"x8" CONCRETE PIER BLOCK OR

ELEVATION

PLAN

CURB & GUTTER

6"

PLANTER OR SIDEWALK

5' MIN

## NOTES:

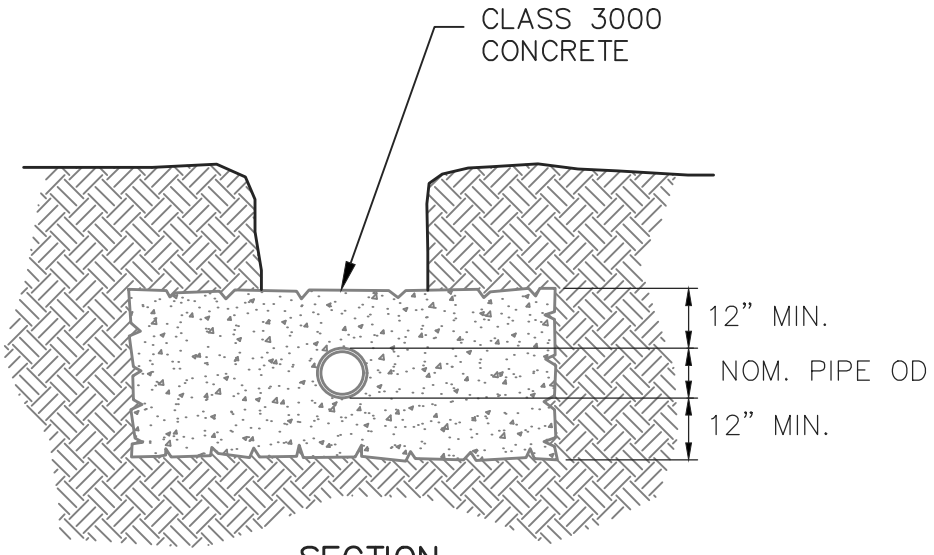
AUTOMATIC FLUSHING DEVICE SHALL HAVE 2" BRASS FIPT INLET, LEADING VERTICALLY INTO A 2" AUTOMATIC SOLENOID VALVE. AUTOMATIC SOLENOID VALVE SHALL HAVE A 150 PSI RATING. EACH UNIT SHALL BE FURNISHED WITH A STAND-ALONE VALVE CONTROLLER. VALVE CONTROLLER WILL NOT REQUIRE A SECOND HAND-HELD DEVICE FOR PROGRAMMING. CONTROLLER MUST HAVE MINIMUM OF 12 POSSIBLE CYCLES PER DAY, UP TO 8 HOURS PER FLUSH CYCLE AND BE SUBMERSIBLE TO 12 FEET, OPERATE WITH A 9 VOLT BATTERY (COMPARTMENT HOLDS TWO BATTERIES) AND HAVE RESIN-SEALED ELECTRICAL COMPONENTS. SOLENOID SHALL HAVE NO LOOSE PARTS WHEN REMOVED FROM VALVE UNIT. EACH UNIT SHALL HAVE A DOUBLE-VALVE, ALL BRASS, SAMPLING POINT. REMOVAL OF 2" SOLENOID VALVE SHALL BE POSSIBLE VIA AN O-RING CONNECTOR LOCATED UNDER THE VALVE AFTER REMOVAL OF STAINLESS STEEL ACCESS PLATE. VALVE ASSEMBLY SHALL BE HOUSED IN A PVC ENCLOSURE AND EACH UNIT SHALL BE SELF-DRAINING, NON-FREZZING, ALL ABOVE-GROUND COMPONENTS SHALL BE CONTAINED WITHIN A UV-RESISTENT LOCKING COVER, AS MANUFACTURED BY KUPFERLE FOUNDRY COMPANY, MODEL 9800, ST. LOUIS, MO. 1-800-231-3990 OR APPROVED EQUAL.

## NOTE:

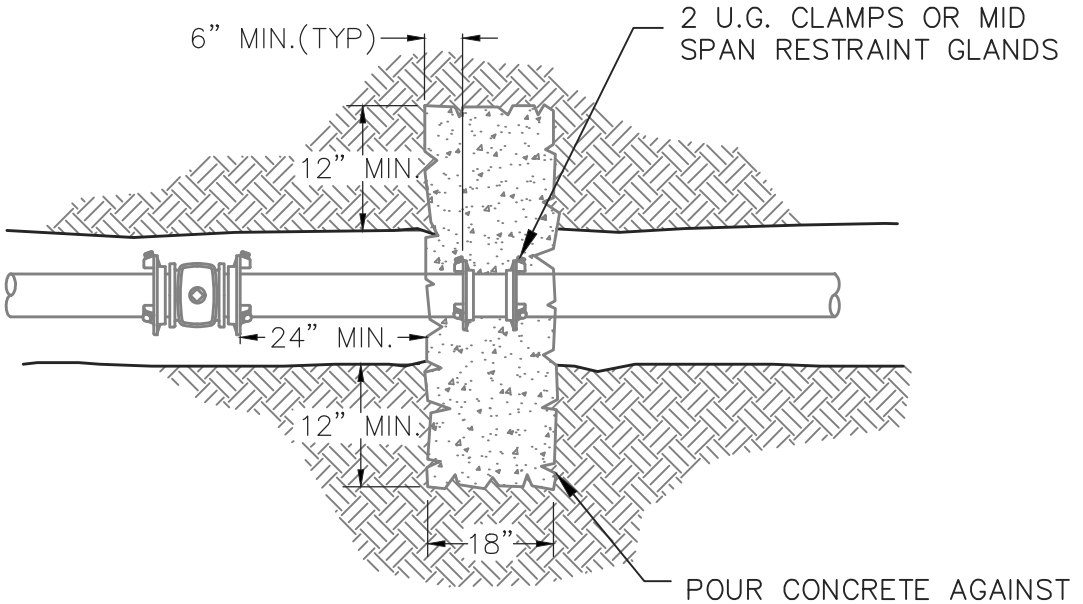
SIDEWALK EASEMENT MAY BE REQUIRED IF WALK IS OUTSIDE OF RIGHT-OF-WAY.

| Hillsboro Water | 2" AUTOMATIC FLUSHING DEVICE | SCALE: NONE<br>DATE: AUGUST 2017 | 530-6 |
|---|---|---|---|

FILENAME: 530-6.DWG




SECTION




PLAN

NOTES:

1. STRADDLE BLOCKS SHALL BE USED ONLY ON EXISTING PIPES WITH NO MECHANICAL RESTRAINTS OR AT LOCATIONS WHERE MECHANICAL PIPE JOINT RESTRAINTS ARE NOT FEASIBLE. PRIOR APPROVAL BY WATER DEPARTMENT IS REQUIRED.
2. INSTALL MINIMUM 8–MIL TOTAL THICKNESS POLYETHYLENE SHEET AROUND RESTRAINT CLAMPS AND SECURE SHEET ENDS PRIOR TO POURING CONCRETE.
3. THIS DETAIL APPLICABLE TO 8" AND SMALLER WATER MAINS. CONCRETE STRADDLE BLOCKS FOR 10" AND LARGER WATER MAINS SHALL BE DESIGNED AND STAMPED BY THE ENGINEER OF RECORD.
4. ANY FIELD MIXING OF CONCRETE SHALL BE APPROVED BY THE WATER DEPARTMENT.

| Hillsboro Water | **STRADDLE BLOCKS** | **SCALE: NONE** | **530-7** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |

FILENAME: 530–7.DWG

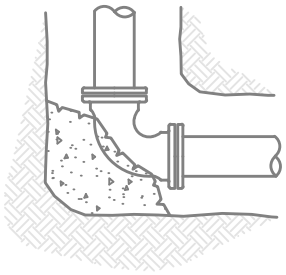
(HORIZONTAL)
BEARING AREA OF THRUST BLOCKS IN SQ FT

| FITTING SIZE | TEE | 90° BEND | 45° BEND | 22 1/2° BEND | 11 1/4° BEND |
|---|---|---|---|---|---|
| 4 | 1.3 | 1.8 | 1.0 | 1.0 | 1.0 |
| 6 | 2.8 | 4.0 | 2.2 | 1.1 | 1.0 |
| 8 | 5.0 | 7.1 | 3.8 | 2.0 | 1.0 |
| 12 | 11.3 | 16.0 | 8.7 | 4.4 | 2.2 |
| 16 | 20.1 | 28.4 | 15.4 | 7.8 | 3.9 |
| 20 | 31.1 | 44.4 | 24.0 | 12.3 | 6.2 |
| 24 | 45.2 | 64.0 | 34.6 | 17.7 | 8.9 |

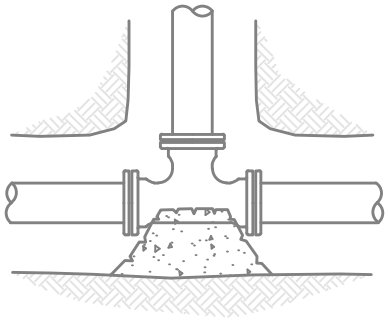
VOLUME OF THRUST BLOCK IN CU YDS (VERTICAL)

| FITTING SIZE | BEND ANGLE | | |
|---|---|---|---|
| | 45° | 22.5° | 11.25° |
| 4 | 1.1 | 0.4 | 0.2 |
| 6 | 2.7 | 1.0 | 0.4 |
| 8 | 4.0 | 1.5 | 0.6 |
| 12 | 8.5 | 3.2 | 1.3 |
| 16 | 14.8 | 5.6 | 2.3 |

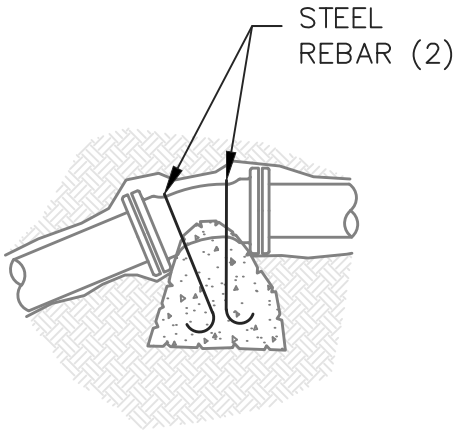
VALUES BASED ON 200 PSI WATER PRESSURE AND 2000 PSF SOIL BEARING CAPACITY



BEND



TEE



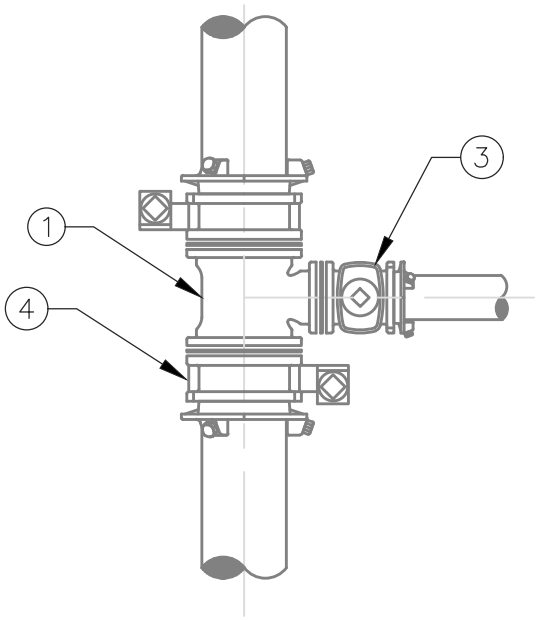

VERTICAL BEND

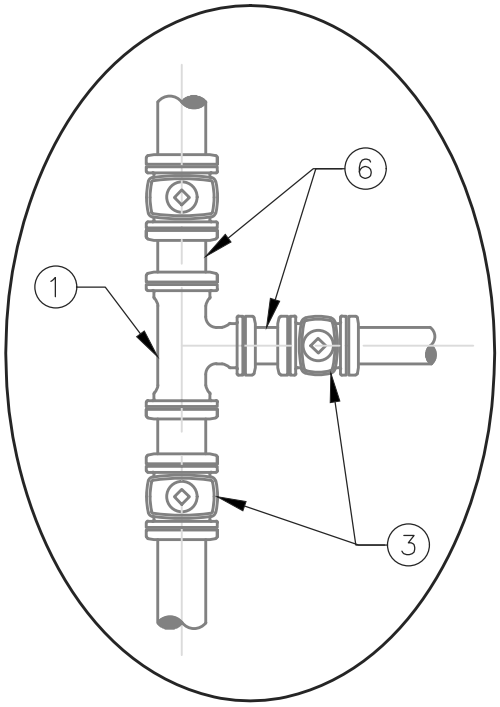
| FITTING SIZE | REBAR SIZE | EMBEDMENT |
|---|---|---|
| 4"–12" | #6 | 30" |
| 14"–16" | #8 | 36" |

NOTES:

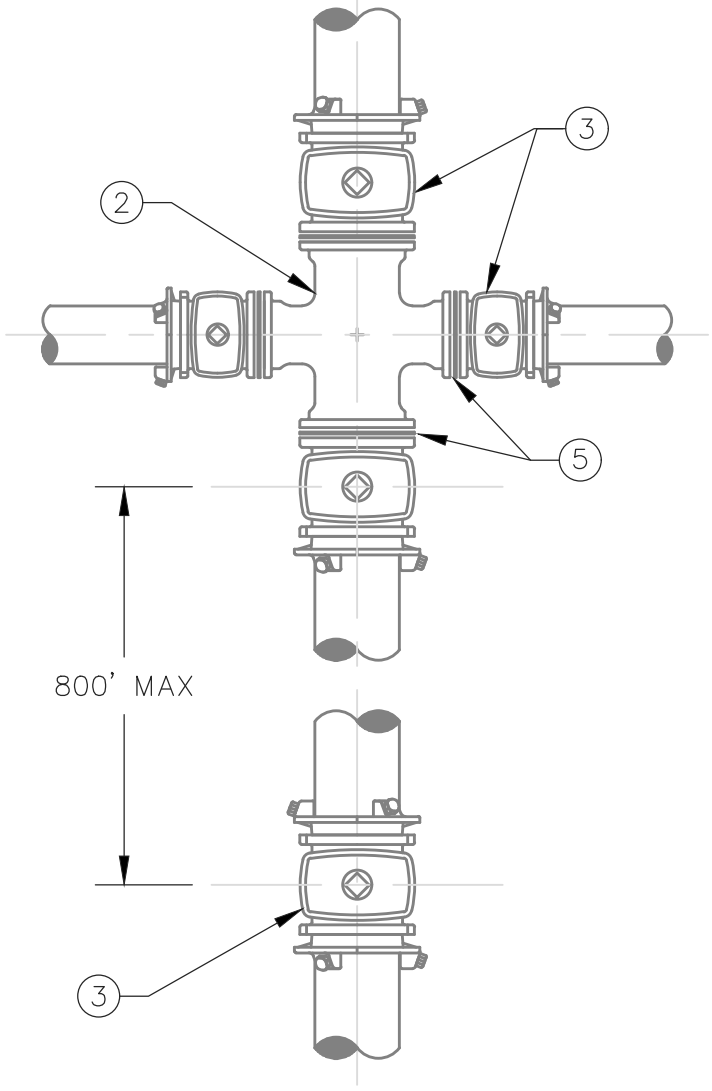
1. ALL PIPE FITTING TEES, BENDS, AND DEAD ENDS SHALL BE RESTRAINED BY CONCRETE THRUST BLOCKING OR MECHANICAL PIPE JOINT RESTRAINTS.
2. CONCRETE THRUST BLOCKING OR STRADDLE BLOCKS SHALL BE USED ONLY ON EXISTING PIPES WITH NO MECHANICAL RESTRAINTS OR AT LOCATIONS WHERE MECHANICAL PIPE JOINT RESTRAINTS ARE NOT FEASIBLE. PRIOR APPROVAL BY WATER DEPARTMENT IS REQUIRED. SEE 530–7 FOR STRADDLE BLOCK REQUIREMENTS.
3. ALL CONCRETE THRUST BLOCKING SHALL BE POURED AGAINST UNDISTURBED EARTH.
4. ALL CONCRETE SHALL BE CLASS 3000.
5. INSTALL MINIMUM 8–MIL TOTAL THICKNESS POLYETHYLENE SHEET AROUND FITTING. SECURE SHEET ENDS TO PREVENT INFILTRATION OF DIRT BETWEEN SHEET AND PIPE FITTING PRIOR TO POURING CONCRETE.
6. PROTECT MECHANICAL JOINT FOLLOWERS AND BOLTS FROM CONCRETE WITH TEMPORARY FORMS AND POLYETHYLENE SHEETING – SEE NOTE 5.
7. ANY FIELD MIXING OF CONCRETE SHALL BE APPROVED BY THE WATER DEPARTMENT.

| Hillsboro Water | THRUST BLOCKS | SCALE: NONE<br>DATE: SEPT 2017 | 530-8 |
|---|---|---|---|




MJ SPOOL OPTION
SEE NOTE 7.



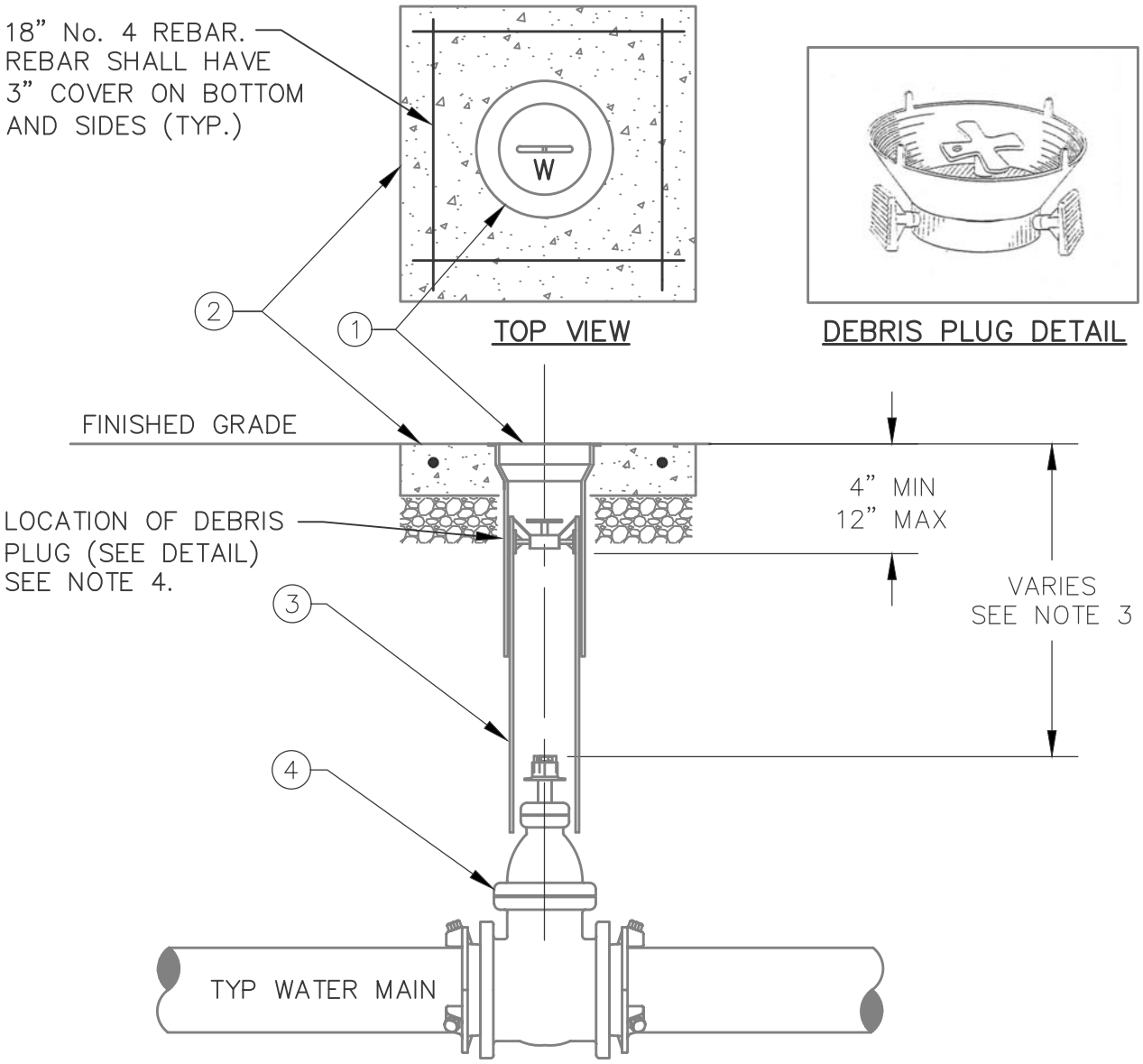

KEYNOTES:

① MJ TEE
② MJ CROSS
③ MJ GATE VALVE
④ MJ BUTTERFLY VALVE
⑤ FOSTER ADAPTOR
⑥ RESTRAINED DIP SPOOL PE: 1'–0" MIN / 2'–0" MAX. TYPICAL

NOTES:

1. VALVES SHALL BE SAME SIZE AS WATER MAIN BEING SUPPLIED.
2. GATE VALVES 8" AND SMALLER. BUTTERFLY VALVES 10" AND LARGER.
3. MAXIMUM SPACING FOR VALVES: 800 FT.
4. VALVES SHALL NOT BE LOCATED IN CURB, GUTTER, OR SIDEWALK AREA.
5. SEE 540–2 FOR VALVE BOX REQUIREMENTS.
6. ALL MECHANICAL JOINTS SHALL BE RESTRAINED.
7. MJ SPOOL OPTION MAY BE USED WITH PRIOR APPROVAL BY THE WATER DEPARTMENT ENGINEER.

| Hillsboro Water | TYPICAL WATER VALVE LOCATION | SCALE: NONE<br>DATE: SEPT 2017 | 540-1 |
|---|---|---|---|




## KEYNOTES:

① OLYMPIC FOUNDRY VB910 VALVE BOX AND COVER WITH "W" CAST IN THE TOP SURFACE

② UNPAVED AREAS ONLY: PROVIDE 24" SQUARE BY 5–1/2" THICK CONCRETE PAD CENTERED ON VALVE BOX. INSTALL OVER 4" COMPACTED ¾"–0 CRUSHED ROCK.

③ 6" SCH 40 OR D3034 PVC PIPE RISER WITH END CUT TO FIT OVER VALVE HOUSING, LENGTH AS NECESSARY

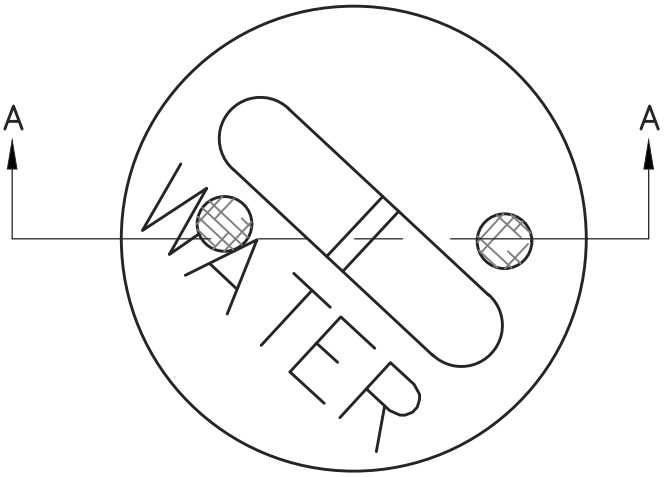
④ MJ GATE VALVE (BUTTERFLY VALVE SIMILAR, NOT SHOWN.)

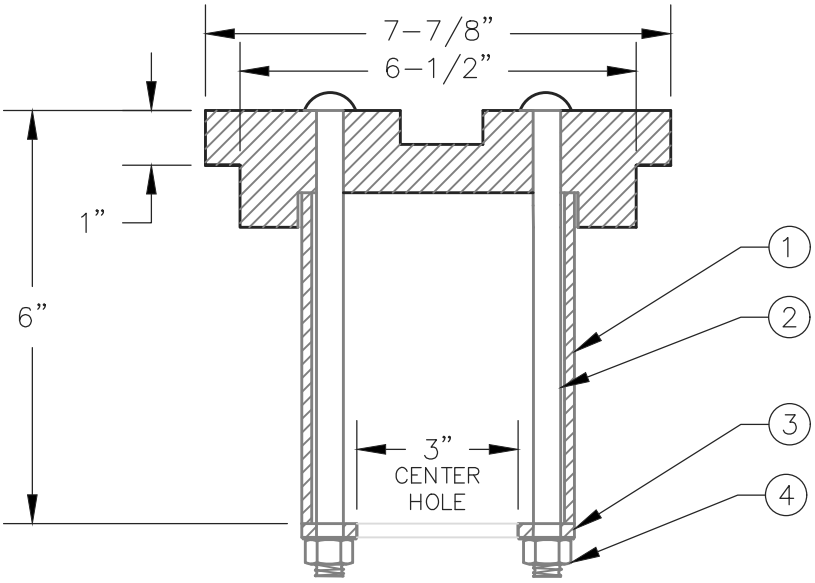
## NOTES:

1. CENTER VALVE BOX ON AXIS OF OPERATING NUT AND SET PLUMB WITH FINISHED GRADE.
2. OPERATOR EXTENSION REQUIRED WHEN VALVE NUT IS DEEPER THAN 6 FEET FROM FINISHED GRADE. REFER TO DETAIL 540–4A.
3. CONTRACTOR TO INSTALL DEBRIS PLUG IN PVC RISER PIPE.

| | | | |
|---|---|---|---|
| Hillsboro Water | **TYPICAL STANDARD VALVE BOX SETTING** | **SCALE: NONE**<br>**DATE: SEPT 2017** | **540-2** |

FILENAME: 540–2 DRAFT.DWG




SECTION A – A

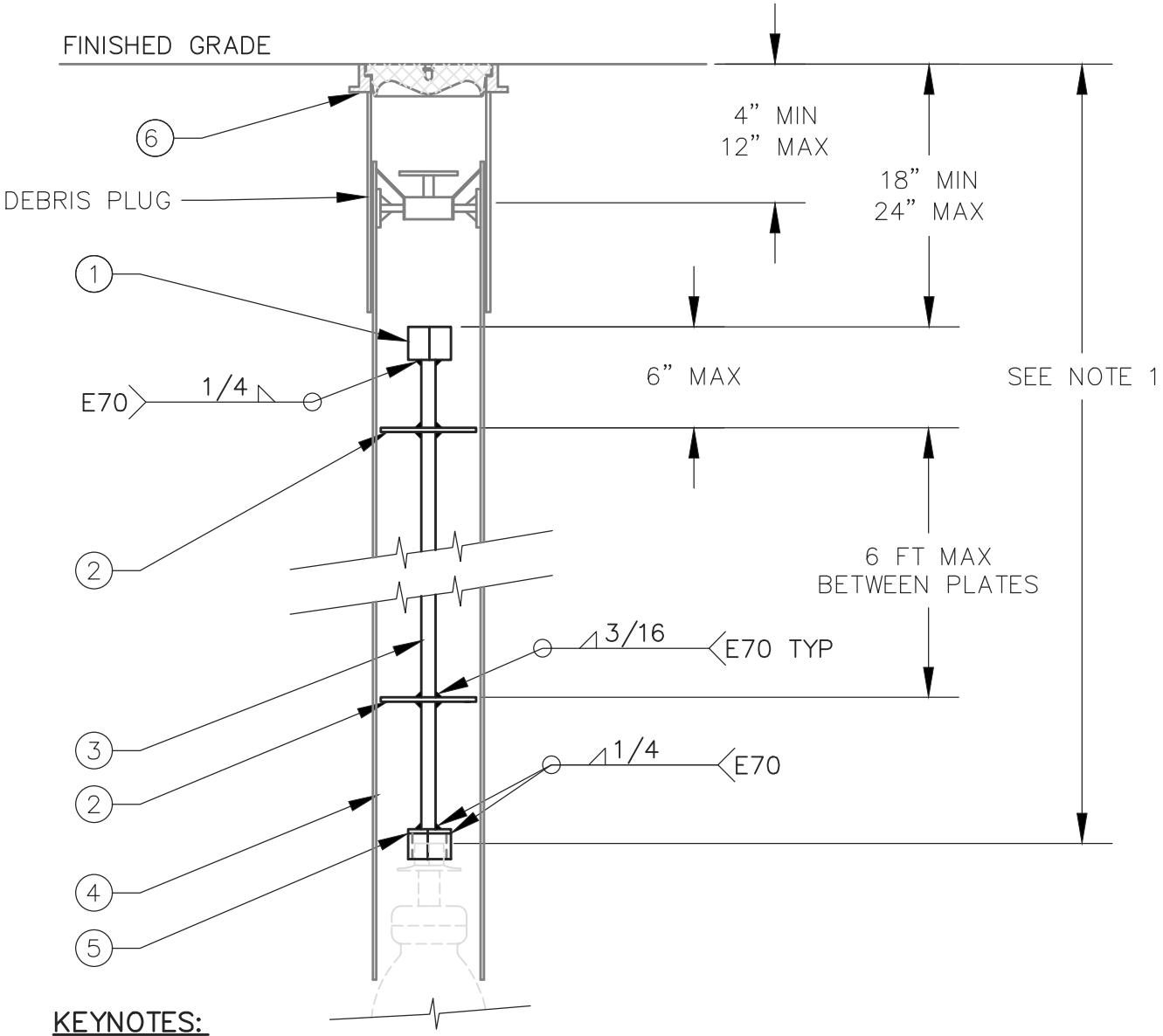
KEYNOTES:

① 5" OD STEEL PIPE
② ½" CARRIAGE BOLT
③ ¼" STEEL PLATE
④ ½" NYLON LOCKING NUT

NOTES:

1. USE OF HIGH VOLUME TRAFFIC LIDS MUST BE APPROVED BY WATER DEPARTMENT.
2. LIDS SHALL BE PURCHASED FROM THE WATER DEPT WHEN REQUIRED.

| | | | |
|---|---|---|---|
| Hillsboro Water | **HIGH VOLUME TRAFFIC LID FOR 910 SERIES VALVE BOX** | **SCALE: NONE** | **540-3** |
| | | **DATE: SEPT 2017** | |




## KEYNOTES:

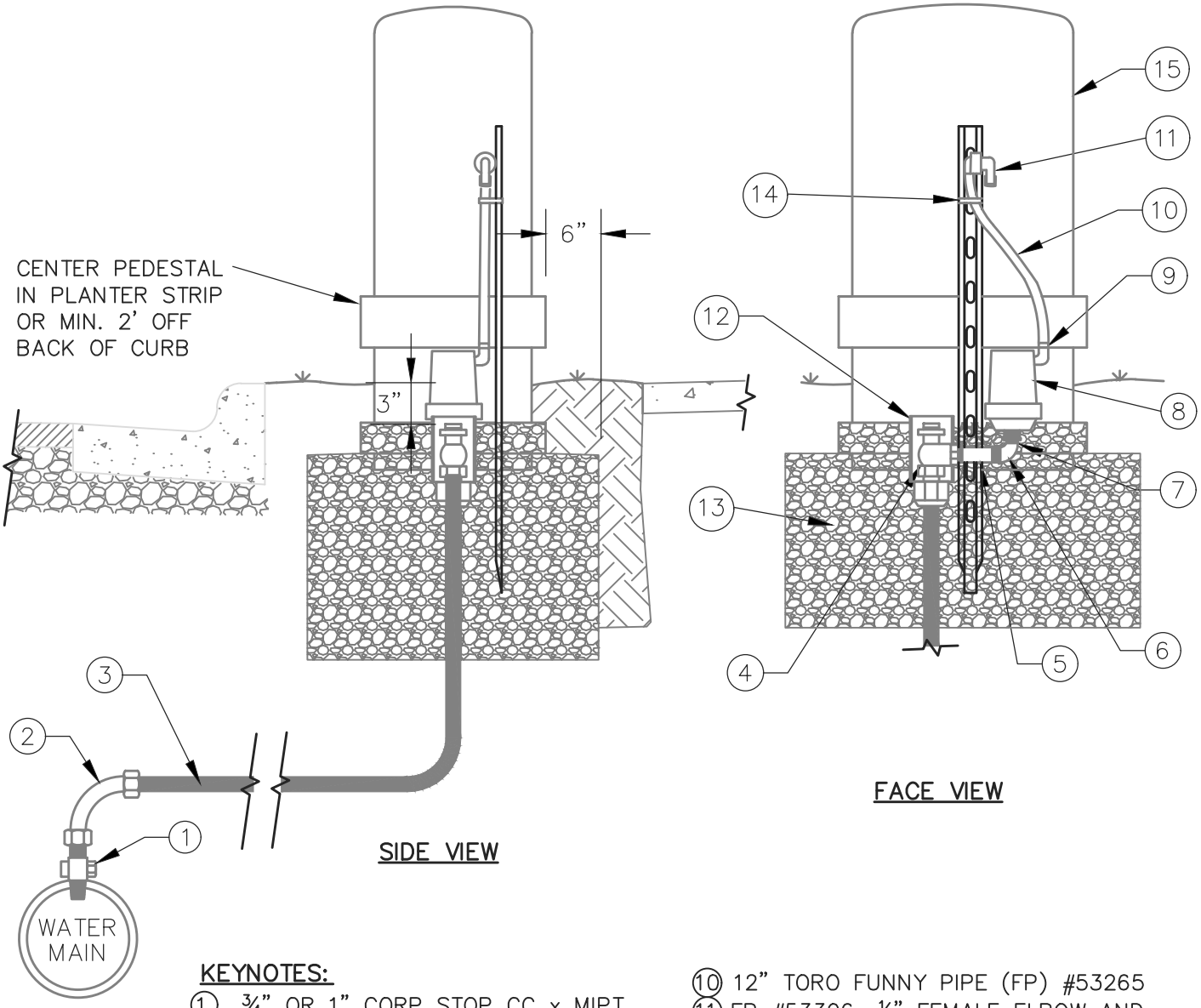
① 2" SQUARE STEEL STOCK 2" LONG
② 1/4" STEEL PLATE ROCK GUARD SHALL BE 3/8" SMALLER DIAMETER THAN I.D. OF PIPE RISER (TYP)
③ 2" x 2" x .120 WALL SQUARE TUBE OR 1" SCHED 80 STEEL PIPE, HOT DIP GALVANIZED AFTER FABRICATION
④ 8" D3034 PVC PIPE RISER, ONE CONTINUOUS LENGTH AS REQUIRED
⑤ 2" SQUARE SOCKET MADE WITH 1/4" THICK STEEL PLATE OR 2 1/2" x 2 1/2" x .180 WALL T.S.
⑥ 8" OVERSIZED CAST IRON VALVE BOX AND LID.

## NOTES:

1. OPERATOR EXTENSION REQUIRED WHEN VALVE NUT IS DEEPER THAN 6 FEET FROM FINISHED GRADE.
2. AN ALTERNATE FIBERGLASS VALVE OPERATOR EXTENSION PRODUCT IS APPROVED FOR USE. SEE THE WATER DEPARTMENT APPROVED PRODUCTS LIST FOR MORE DETAILS.
3. STEEL MATERIALS SHALL BE GRADE ASTM A36 OR EQUIVALENT.

| Hillsboro Water | VALVE OPERATOR EXTENSION | SCALE: NONE<br>DATE: SEPT 2017 | 540-4 |
|---|---|---|---|

FILENAME: 540-4 DRAFT.DWG




## KEYNOTES:

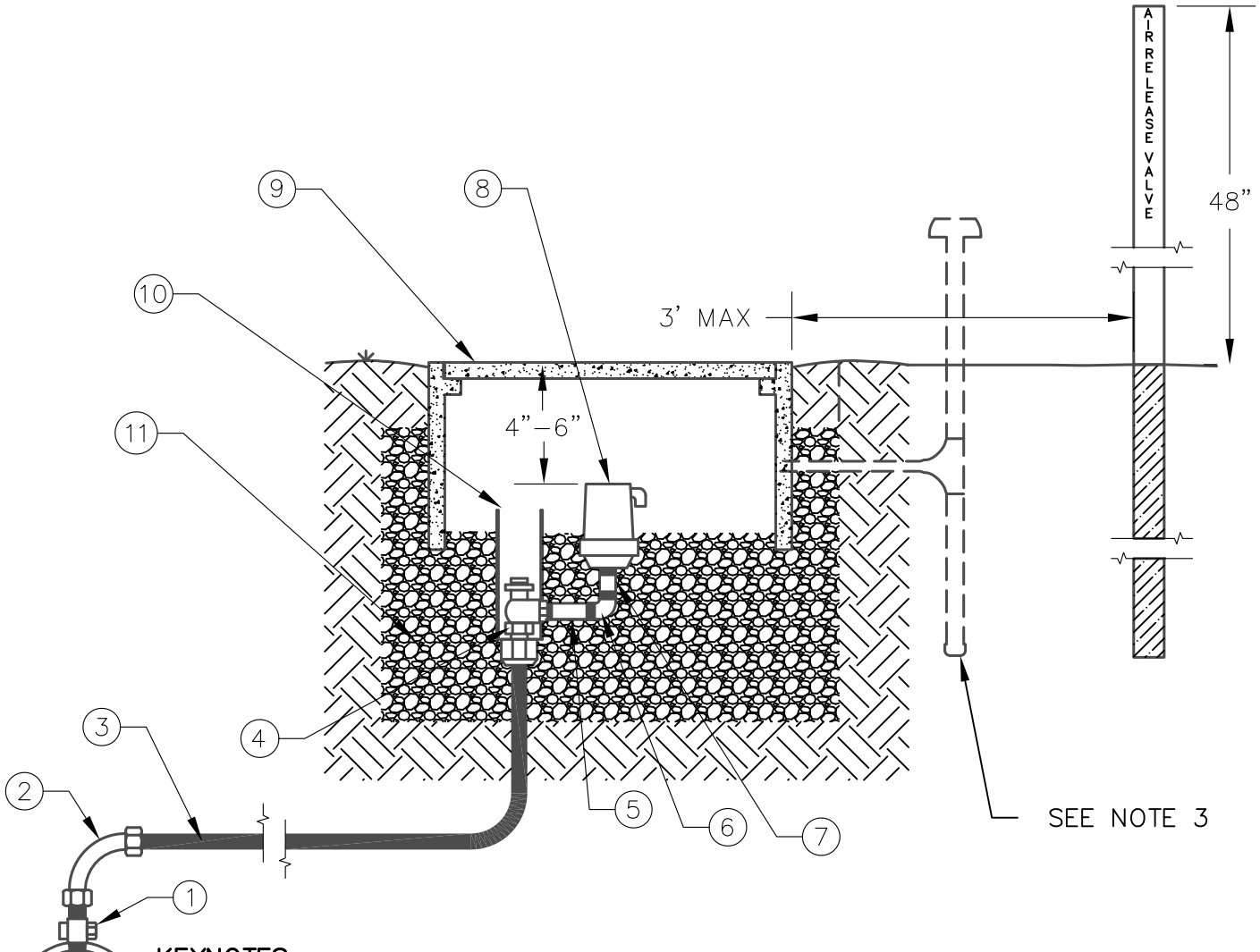
1. ¾" OR 1" CORP STOP CC x MIPT
2. ¾" OR 1" FIPT x CTS 90° ELL
3. ¾" OR 1" TYPE K SOFT COPPER TUBING
4. ¾" OR 1" ANGLE METER STOP BALL VALVE WITH CTS INLET W/1" x ¾" BRASS BRUSHING
5. ¾" OR 1" x 3" BRASS NIPPLE
6. ¾" OR 1" BRASS 90° STREET ELL
7. ¾" OR 1" BRASS COUPLER
8. ¾" OR 1" COMB. AIR VALVE (CARV)
9. WATTS MODEL PL-387A NYLON½" BARB TO ⅜" MIP ADAPTER *
10. 12" TORO FUNNY PIPE (FP) #53265
11. FP #53306 ½" FEMALE ELBOW AND #53304 ½" MALE ELBOW W/40 MESH BRASS SCREEN WRAPED ON NIPPLE, HELD W/ NYLON WIRE TIE
12. 2"-6" PVC PIPE W/ SLOT FOR SERVICE LINE
13. ¾"-0" GRANULAR DRAIN MATERIAL
14. NYLON WIRE TIE
15. CHALES INDUSTRIES, LTD NON-LOVERED VERTICAL PEDESTAL MODEL NUMBER 103 COLORED - DARK GREEN W/BRACKET OPTION 'A'

## NOTE:

1. A MINIMUM 1% UPWARD SLOPE SHALL BE MAINTAINED ON THE COPPER TUBING FROM THE WATER MAIN TO THE CARV.

| Hillsboro Water | ¾" OR 1" COMBINATION AIR AND VACUUM VALVE (CARV) | SCALE: NONE | 540-5A |
|---|---|---|---|
| | | DATE: SEPT 2017 | |

FILENAME: 540-5.DWG




**KEYNOTES:**

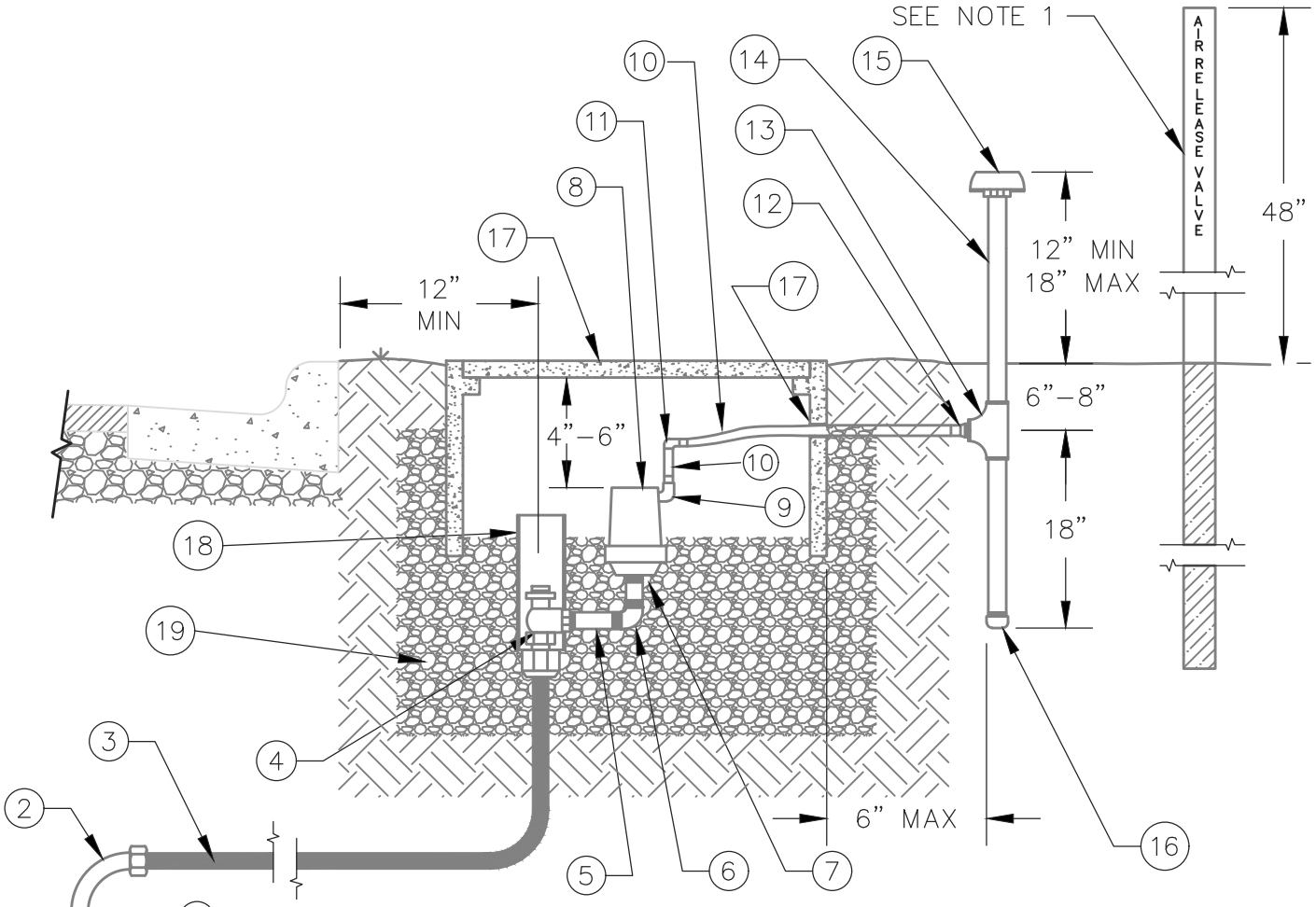
① ¾" OR 1" CORP STOP CC x MIPT
② ¾" OR 1" FIPT x CTS 90° ELL
③ ¾" OR 1" TYPE K SOFT COPPER TUBING (SEE NOTE 2)
④ ¾" OR 1" ANGLE METER STOP BALL VALVE WITH CTS INLET w/1"x¾" BRASS BUSHING
⑤ ¾" OR 1" x 6" BRASS NIPPLE
⑥ ¾" OR 1" BRASS 90° ELL
⑦ ¾" OR 1"x 3" BRASS NIPPLE W/FIPT COUPLER
⑧ ¾" OR 1" AIR RELEASE VALVE (ARV) A.R.I. MODEL S–050V
⑨ WATER METER BOX 10"x15"x12" W/SOLID COVER. MFR: ARMORCAST OR EQUIV.
⑩ 2"–6" PVC PIPE W/ SLOT FOR SERVICE LINE
⑪ ¾"–0" GRANULAR DRAIN MATERIAL

**NOTES:**

1. IN RURAL AREAS (UNDEVELOPED) INSTALL BLUE–COLORED CARSONITE STAKE WITH "AIR RELEASE VALVE" IN ONE–INCH BLACK LETTERS ON BOTH SIDES, BY WATER DEPARTMENT STAFF. LOCATE POST WITHIN 3 FEET OF THE AIR RELEASE METER BOX.
2. A MINIMUM 1% UPWARD SLOPE SHALL BE MAINTAINED ON THE COPPER TUBING FROM THE MAINLINE TO THE ARV.
3. AIR VENT PIPE REQUIRED IN AREAS OF HIGH GROUND WATER; USE DETAIL 540–5.

| Hillsboro Water | ¾" OR 1" AIR RELEASE VALVE (ARV) | SCALE: NONE<br>DATE: JULY 2018 | 540-5B |
|---|---|---|---|

FILENAME: 540–5B.DWG




## KEYNOTES:

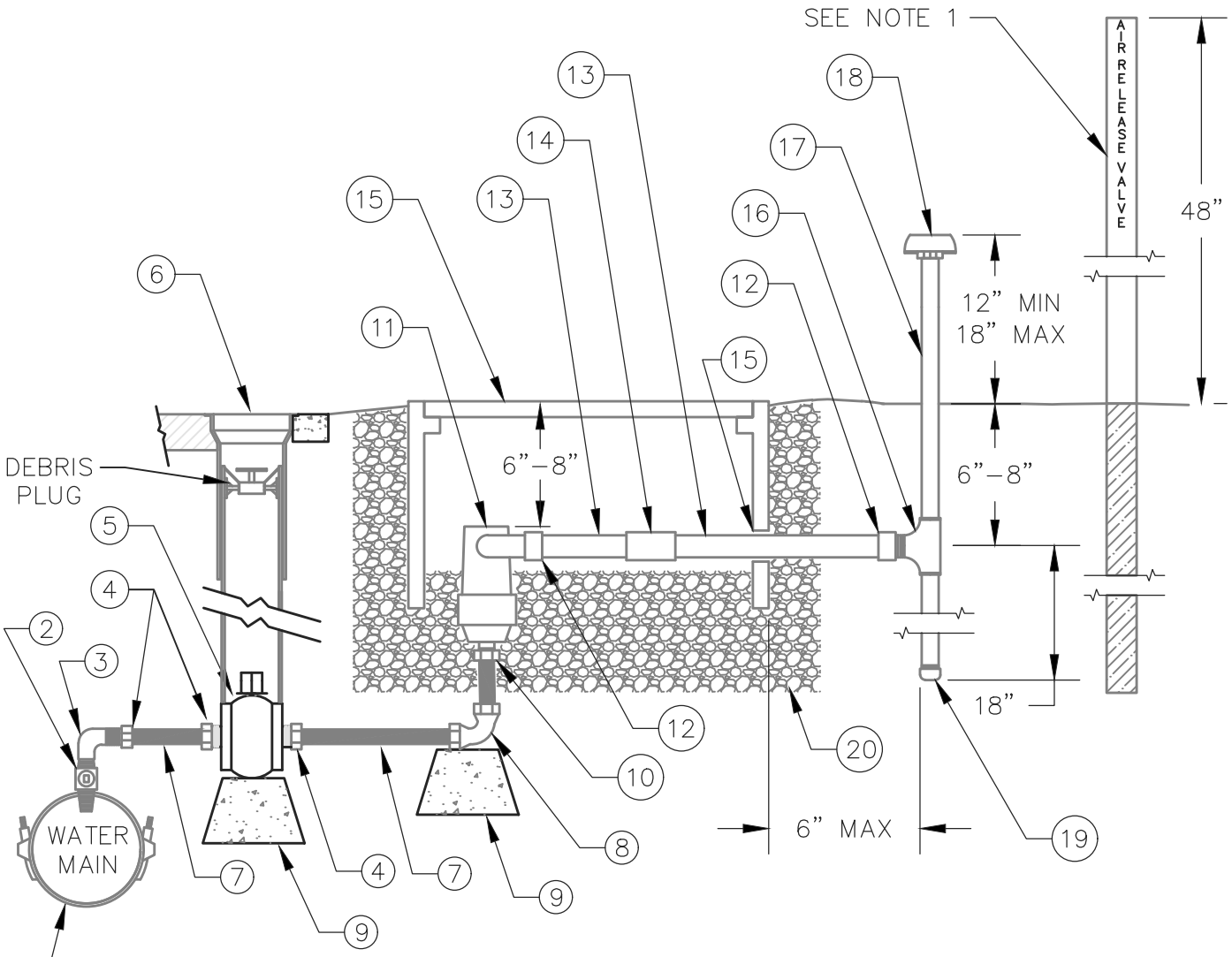
1. ¾" OR 1" CORP STOP CC x MIPT
2. ¾" OR 1" FIPT x CTS 90° ELL
3. ¾" OR 1" TYPE K SOFT COPPER TUBING
4. ¾" OR 1" ANGLE METER STOP BALL VALVE WITH CTS INLET W/1" x ¾" BRASS BUSHING
5. ¾" OR 1" x 3" BRASS NIPPLE
6. ¾" OR 1" BRASS 90° ELL
7. ¾" OR 1" x 3" BRASS NIPPLE W/ BRASS COUPLER
8. ¾" OR 1" COMB. AIR VALVE (CARV)
9. WATTS MODEL A–387A NYLON ½" BARB TO ⅜" MIP ADAPTER *
10. TORO FUNNY PIPE (FP) #53265 **
11. FP #53306 ½" FEMALE ELBOW AND #53388 ½" MALE ADAPTER **
12. FP #53389 ¾" MALE ADAPTER **
13. ¾" GALV. OUTLET TEE
14. ¾" GALV. PIPE
15. ¾" SCREENED TANK VENT
16. ¾" GALV. PIPE CAP
17. WATER METER BOX 10"x15"x12" W/SOLID COVER. ARMORCAST OR EQUIV. DRILL 1" DIA HOLE FOR VENT PIPE.
18. 2"–6" PVC PIPE W/ SLOT FOR SERVICE LINE
19. ¾"–0" GRANULAR DRAIN MATERIAL

## NOTES:

1. IN RURAL AREAS (UNDEVELOPED) INSTALL BLUE–COLORED CARSONITE STAKE WITH "AIR RELEASE VALVE" IN ONE–INCH BLACK LETTERS ON BOTH SIDES, BY WATER DEPARTMENT STAFF. LOCATE POST WITHIN 3 FEET OF THE AIR RELEASE METER BOX.
2. *ALTERNATE: WATTS MODEL A–785 BRASS ⅜" x CLOSE NIPPLE, WATTS A–815 (103–R) REDUCING COUPLING ½" FIP x ⅜" FIP, AND FP #53388 ½" MALE ADAPTER.
3. A MINIMUM 1% UPWARD SLOPE SHALL BE MAINTAINED ON THE COPPER TUBING FROM THE WATER MAIN TO THE CARV.

| | | | |
|---|---|---|---|
| Hillsboro Water | **¾" OR 1" COMBINATION AIR AND VACUUM VALVE (CARV)** | **SCALE: NONE** | **540-5** |
| | | **DATE: SEPT 2017** | |

FILENAME: 540–5.DWG




## KEYNOTES:

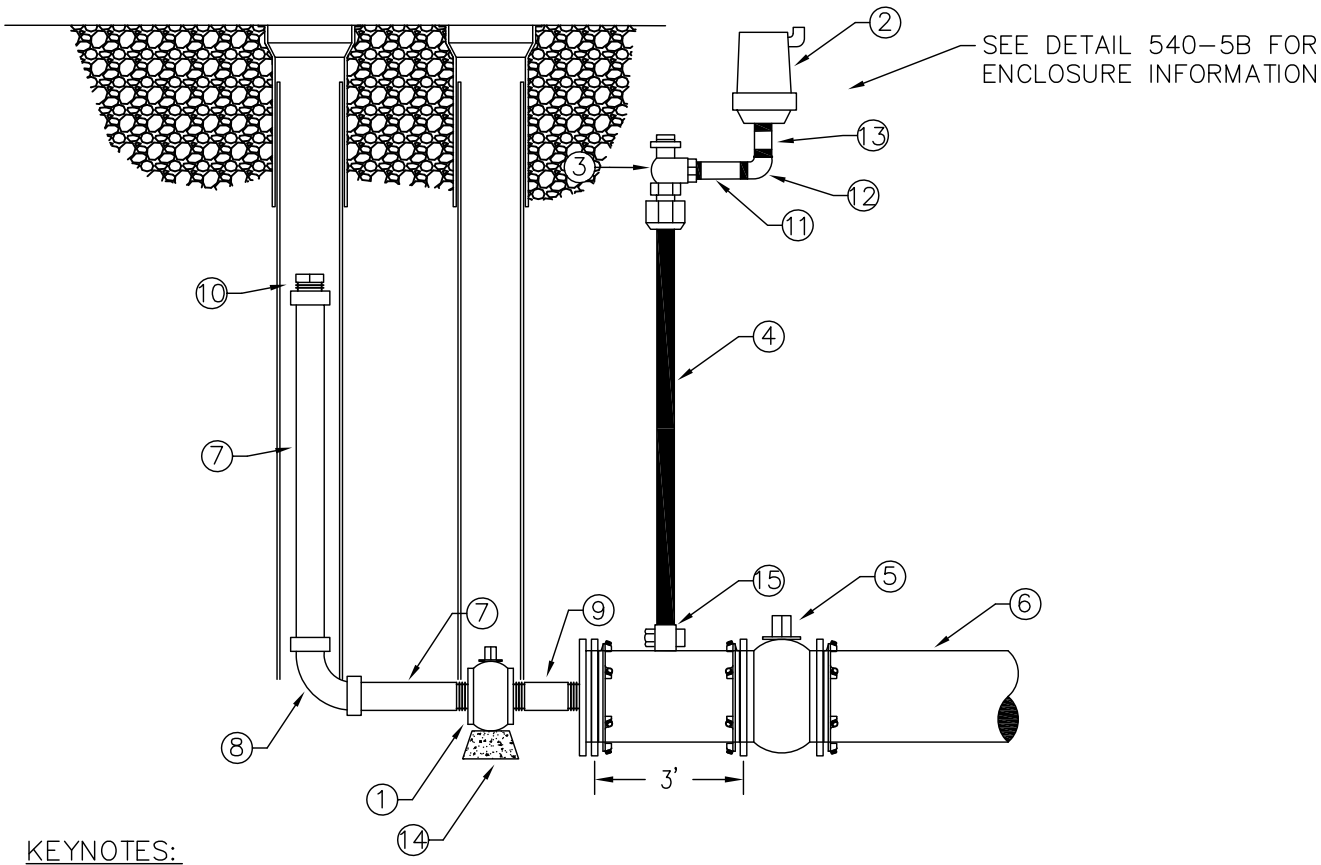
1. 2" TAPPING SADDLE
2. 2" CORP STOP MIPT x MIPT
3. 2" BRASS 90° STREET ELL
4. 2" CTS x MIPT COUPLING
5. 2" GATE VALVE w/2" OPERATING NUT FIPT x FIPT
6. VALVE BOX PER 540–2
7. 2" TYPE K RIGID COPPER PIPE (SEE NOTE 2)
8. 2" BRASS CTS x CTS 90° ELL
9. 8"x8"x8" CONCRETE PIER BLOCK
10. 2" CTS x FIPT COUPLING
11. 2" COMBINATION AIR VALVE (CARV) A.R.I. MODEL D–040–P
12. 1 ½" PVC SCH 40 MIP x SLIP (GLUE)
13. 1 ½" PVC SCH 40 PIPE
14. 1 ½" PVC COMPRESSION COUPLIN
15. WATER METER BOX 12" x 20" x 12" MFR: ARMORCAST OR EQUIVALENT, DRILL 2" DIA HOLE FOR VENT PIPE
16. 1 ½" GALV. OUTLET TE
17. 1 ½" GALV. PIPE
18. 1 ½" SCREENED TANK VEN
19. 1 ½" GALV. PIPE CAP
20. ¾"–0" GRANULAR DRAIN MATERIAL

## NOTES:

1. IN RURAL AREAS (UNDEVELOPED) INSTALL BLUE–COLORED CARSONITE STAKE WITH "AIR RELEASE VALVE" IN ONE–INCH BLACK LETTERS ON BOTH SIDES, BY WATER DEPARTMENT STAFF. LOCATE POST WITHIN 3 FEET OF THE AIR RELEASE METER BOX.
2. A MINIMUM 1% UPWARD SLOPE SHALL BE MAINTAINED ON THE COPPER PIPE FROM THE WATER MAIN TO THE CARV.

| Hillsboro Water | 2" COMBINATION AIR & VACUUM VALVE (CARV) | SCALE: NONE<br>DATE: SEPT 2017 | 540-6 |
|---|---|---|---|

FILENAME: 540–6.DWG




KEYNOTES:

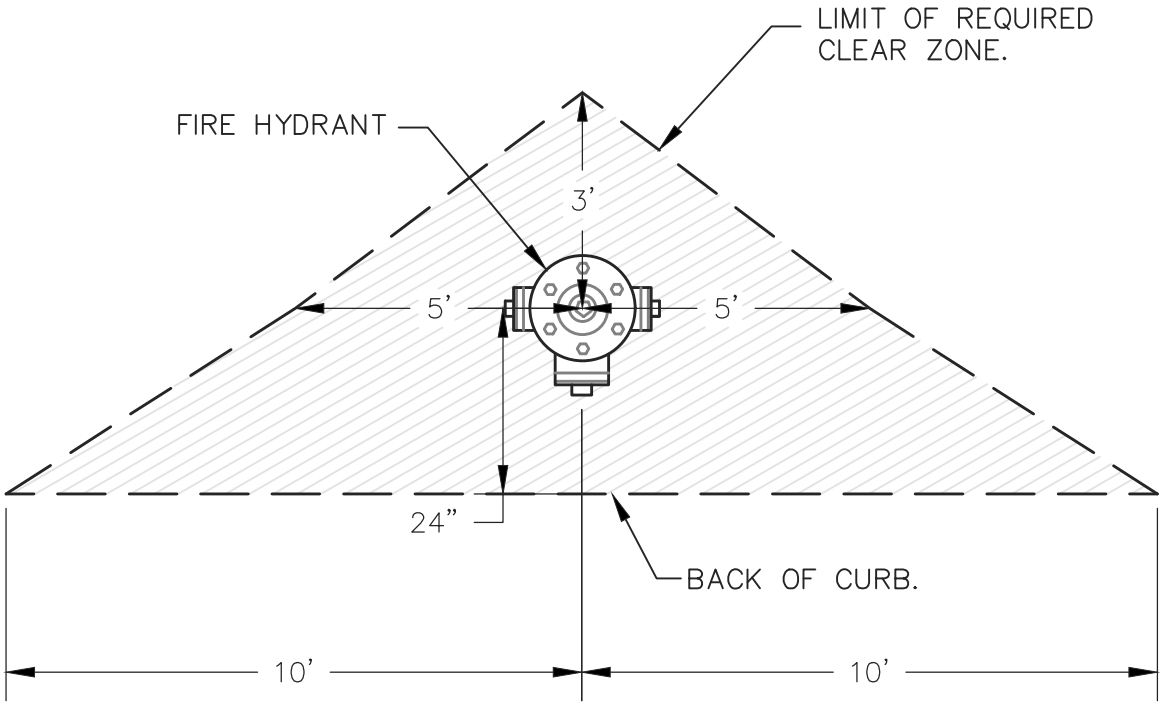
1. 2" GATE VALVE WITH BLOW OFF
2. 3/4" – 1" ARV/CARV
3. 3/4" OR 1" ANGLE METER STOP BALL VALVE WITH CTS INLET w/1"x3/4" BRASS BUSHING
4. 3/4" OR 1" TYPE K SOFT COPPER TUBING
5. GATE VALVE – LINE SIZE
6. WATER MAIN
7. 2" GALVANIZED PIPE NIPPLE (LENGTH WILL VARY)
8. 2" FIPT 90° GALVANIZED ELBOW
9. 2" X 12" GALVANIZED PIPE NIPPLE
10. 2" BRASS COUPLER AND PLUG, HAND TIGHT
11. 3/4" OR 1" x 6" BRASS NIPPLE
12. 3/4" OR 1" BRASS 90° ELL
13. 3/4" OR 1" x 3" BRASS NIPPLE w/FIPT COUPLER
14. 8"x8"x8" CONCRETE PIER BLOCK OR EQUIVALENT SUPPORT ON UNDISTURBED EARTH
15. 3/4" OR 1" CORP STOP CC X MIPT

NOTES:

1. IN RURAL AREAS (UNDEVELOPED) INSTALL BLUE-COLORED CARSONITE STAKE WITH "AIR RELEASE VALVE" IN ONE-INCH BLACK LETTERS ON BOTH SIDES, BY WATER DEPARTMENT STAFF. LOCATE POST WITHIN 3 FEET OF THE AIR RELEASE METER BOX.
2. TEMPORARY TERMINUS AIR VENT PIPE REQUIRED AT THE HIGH END OF THE WATER MAIN; USE DETAIL 540-5. WHEN LINE IS EXTENDED IN THE FUTURE, ARV/CARV WILL BE REMOVED. ANGLE STOP WILL BE USED FOR PRESSURE TESTING AND CHLORINATION OF THE NEW LINE.
3. UPON SUCCESSFUL COMPLETION OF TESTING, CORP TO BE REMOVED AND PLUG INSTALLED.

| Hillsboro Water | PHASE BREAK VALVE TERMINATION | SCALE: NONE<br>DATE: JULY 2018 | 540-7 |
|---|---|---|---|

FILENAME: 540-7.DWG




NOTES:

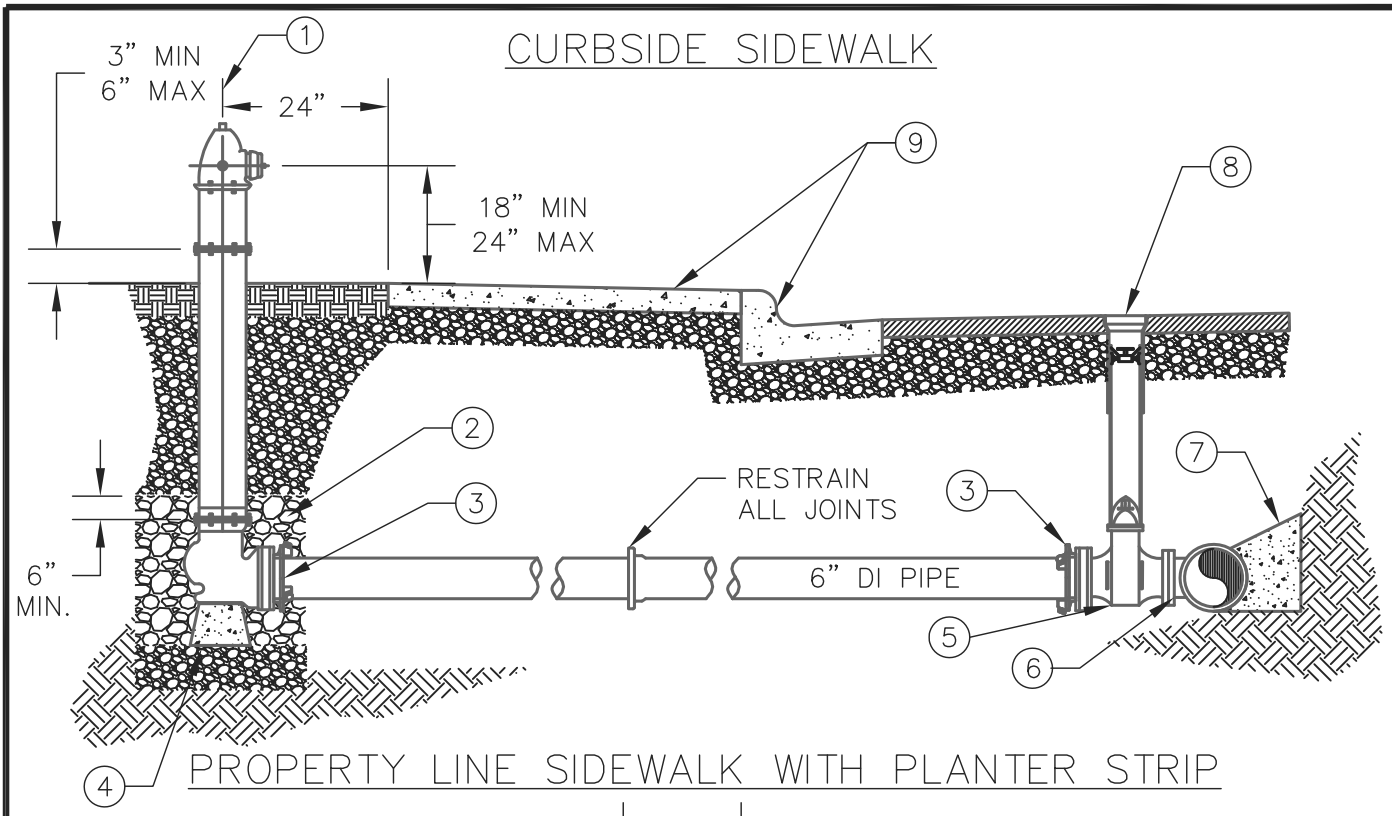
1. THE CLEAR ZONE PROHIBITS THE FOLLOWING:
   - VEHICLE PARKING
   - FENCES
   - TREES
   - LARGE SHRUBS
   - RETAINING WALLS
   - ANYTHING ELSE THAT MAY INTERFERE WITH OPERATION OF HYDRANT
2. THE CLEAR ZONE ALLOWS THE FOLLOWING:
   - LAWN GRASS
   - MULCH
   - BARKDUST
   - GROUND COVER
   - LOW PLANTINGS

   PROPERTY OWNERS SHOULD BE AWARE THAT THE GROUND COVER COULD BE DAMAGED WHEN THE HYDRANT IS USED OR WHEN HYDRANT MAINTENANCE WORK IS PERFORMED.

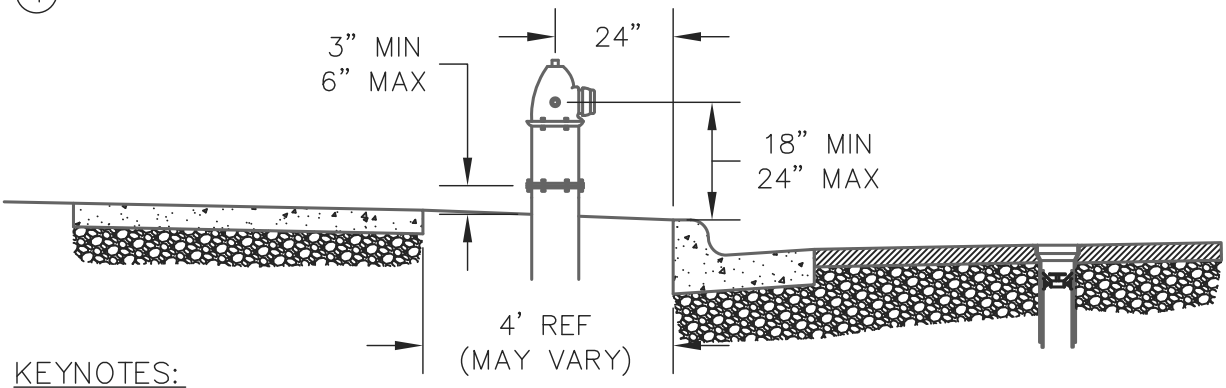
| Hillsboro Water | **FIRE HYDRANT CLEAR ZONE** | **SCALE: NONE** | **550-1** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |

FILENAME: 550-1 DRAFT.DWG

## CURBSIDE SIDEWALK




## PROPERTY LINE SIDEWALK WITH PLANTER STRIP




KEYNOTES:

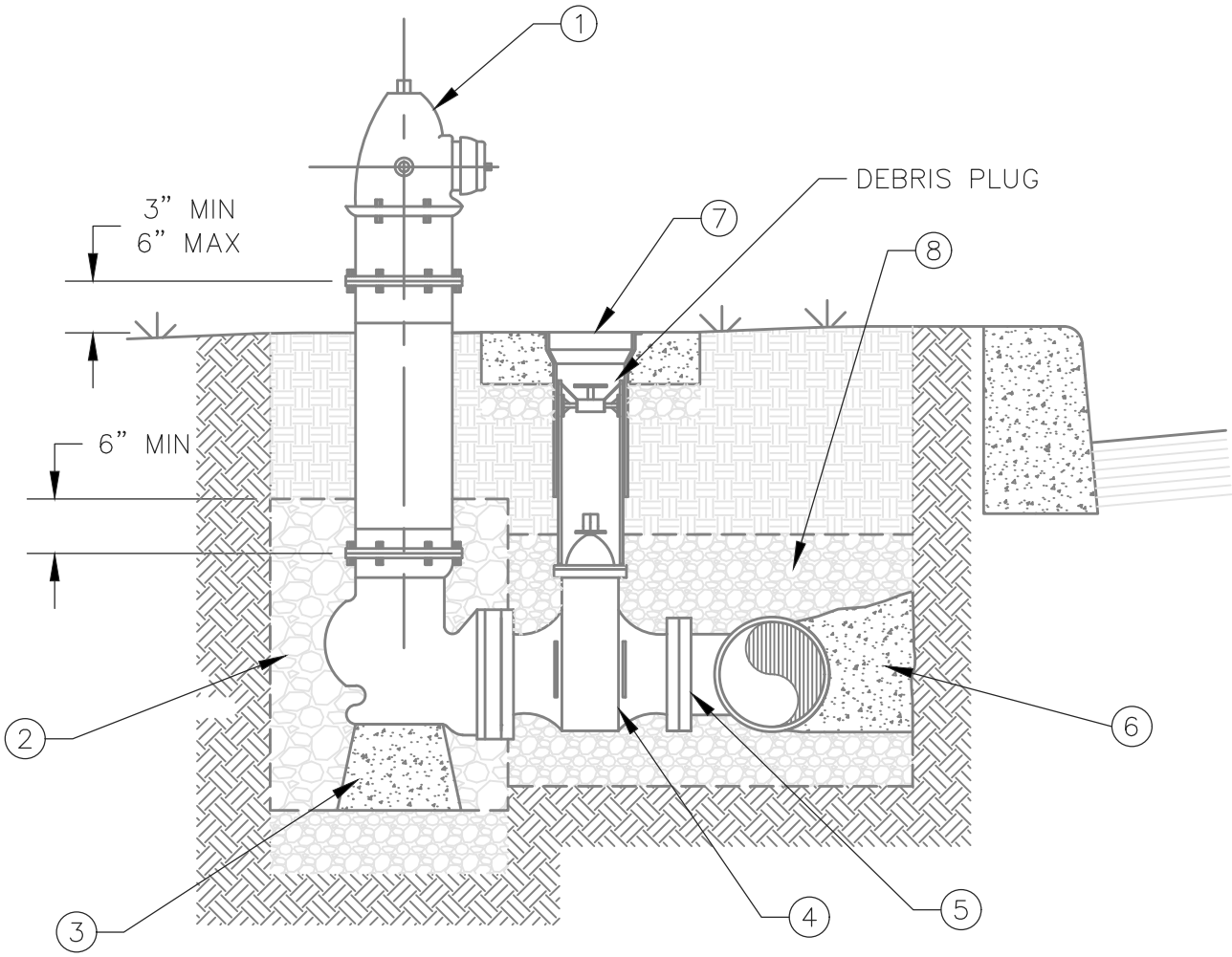
1. APPROVED HYDRANT ASSEMBLY PER STANDARD SPECIFICATIONS
2. GRANULAR DRAIN MATERIAL BACKFILL, 4 CU FT MINIMUM
3. TYPICAL 6" MEGALUG RETAINER OR EQUAL AT EACH PIPE FITTING
4. 12"x12"x8"H CONCRETE PIER BLOCK PLACED ON UNDISTURBED NATIVE SOIL
5. 6" MJ x MJ GATE VALVE, TYP. USE MJ X FLG FOR TAPPING SLEEVE
6. WATER MAIN SIZE MJ x 6" MJ TEE OR TAPPING SLEEVE, SEE DETAIL 530-2
7. REFER TO TAPPING SLEEVE DETAIL 530-2
8. REFER TO VALVE BOX DETAIL 540-2.
9. TYPICAL CURB AND GUTTER

NOTES:

1. REFER TO 550-1 FOR HYDRANT CLEAR ZONE REQUIREMENTS.
2. HYDRANT BURY DEPTH MAXIMUM SHALL BE 6 FT AND MINIMUM SHALL BE 30".
3. WHEN FINAL LIFT OF HMAC IS PLACED, CONTRACTOR TO PLACE A BLUE REFLECTOR BUTTON FOR THE FIRE DEPARTMENT. SEE DETAIL 550-4 FOR PLACEMENT.

| Hillsboro Water | FIRE HYDRANT STANDARD INSTALLATION | SCALE: NONE<br>DATE: SEPT 2017 | 550-2 |
|---|---|---|---|

FILENAME: 550-2 DRAFT.DWG




KEYNOTES:

1. APPROVED HYDRANT ASSEMBLY PER STANDARD SPECIFICATIONS
2. GRANULAR DRAIN MATERIAL BACKFILL, 4 CU FT MINIMUM
3. 12"x12"x8"H CONCRETE PIER BLOCK PLACED ON UNDISTURBED NATIVE SOIL
4. 6" FLG x FLG GATE VALVE
5. WATER MAIN SIZE MJ x 6" FLG TEE OR TAPPING SADDLE
6. REFER TO TAPPING SADDLE DETAIL 530–2
7. REFER TO VALVE BOX SETTING DETAIL 540–2
8. REFER TO TRENCH BACKFILL DETAIL 520–1

NOTES:

1. REFER TO 550–1 FOR HYDRANT CLEAR ZONE REQUIREMENTS.
2. HYDRANT BURY DEPTH SHALL BE A MAXIMUM OF 6 FT AND A MINIMUM OF 30".
3. FLANGE HYDRANT USE IS DEPENDENT ON SPACE CONSTRAINTS AND REQUIRES WATER DEPARTMENT APPROVAL.
4. THE CONTRACTOR SHALL NOTIFY THE WATER DEPARTMENT WHEN THE FINAL LIFT OF HMAC IS TO BE PLACED SO A BLUE REFLECTOR BUTTON CAN BE INSTALLED FOR THE FIRE DEPARTMENT.

| Hillsboro Water | **FIRE HYDRANT FLANGE JOINT INSTALLATION** | **SCALE: NONE** | **550-3** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |

FILENAME: 550–3 DRAFT.DWG

FIGURE 1
TWO LANE STREET

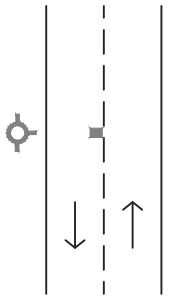


FIGURE 2
MULTI–LANE STREET

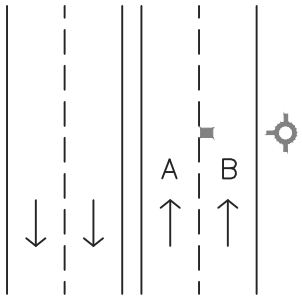



FIGURE 3
TWO LANE STREET AT INTERSECTION

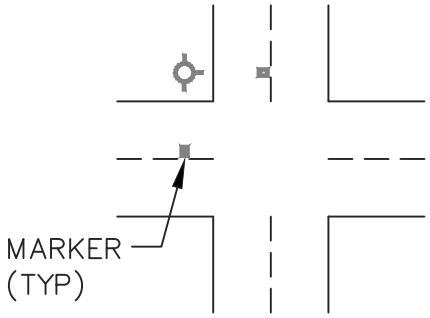



FIGURE 4
ONE–WAY STREET

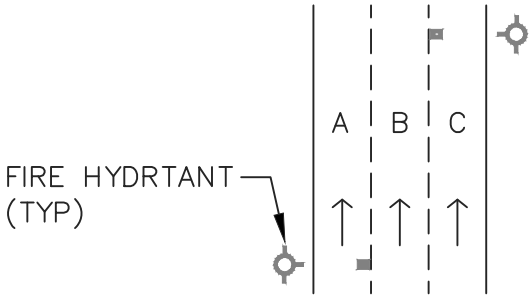



FIGURE 5
MULTI–LANE STREET WITH TURN LANE

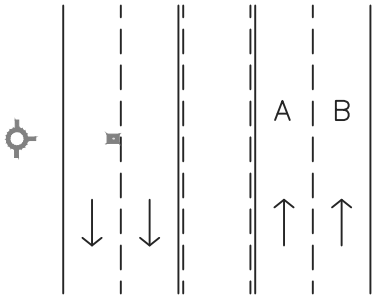
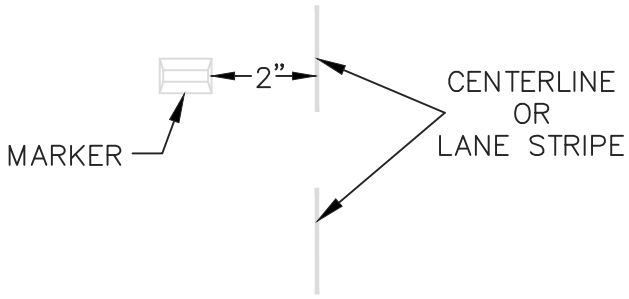


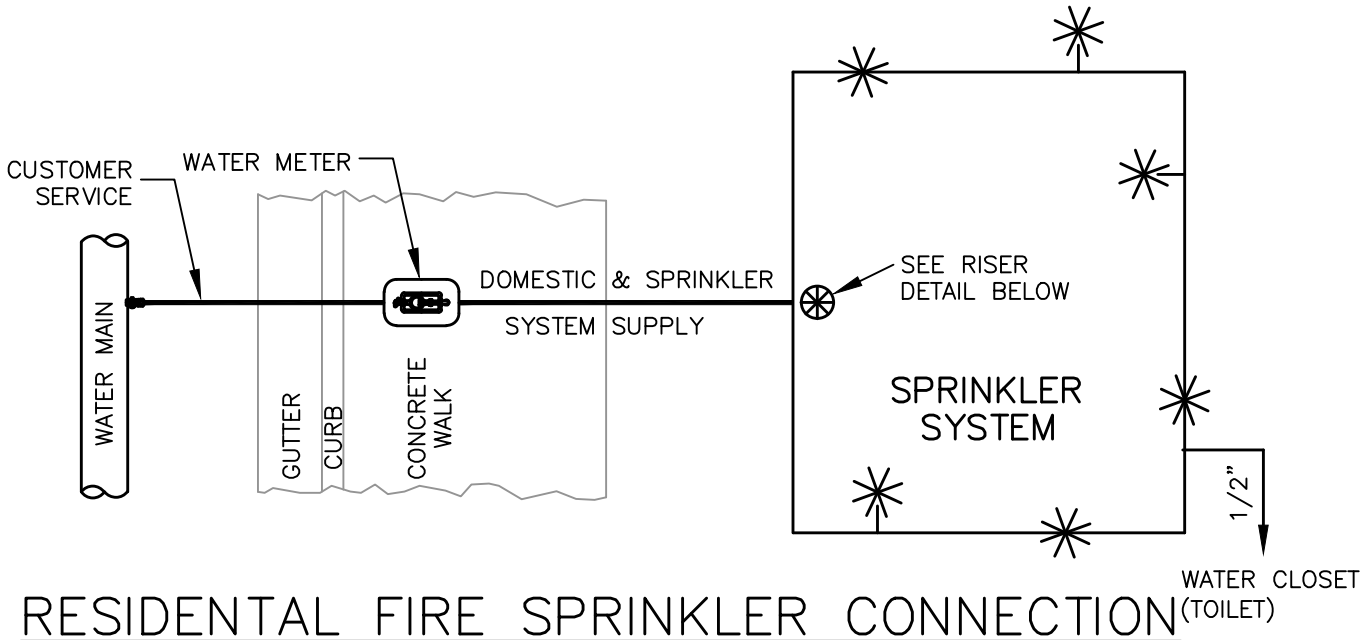

FIGURE 6
HYDRANT MARKER DETAIL




NOTES:

1. IF HYDRANT IS LOCATED WITHIN THE RADIUS OF AN INTERSECTION, PLACE A MARKER ON EACH ROADWAY IN THE CENTER LANES CLOSEST TO THE HYDRANT.
2. MARKER IS PLACED PERPENDICULAR (90°) TO THE HYDRANT.
3. THE CONTRACTOR TO SUPPLY THE BLUE REFLECTORS. THE CONTRACTOR TO SUPPLY THE MELT DOWN THERMOPLASTIC PADS IF 10 OR MORE ARE REQUIRED. IF LESS THAN 10, THE WATER DEPARTMENT TO SUPPLY THE PADS.

| Hillsboro Water | **TYPICAL HYDRANT MARKER LOCATIONS** | **SCALE: NONE**<br>**DATE: SEPT 2017** | **550-4** |
|---|---|---|---|

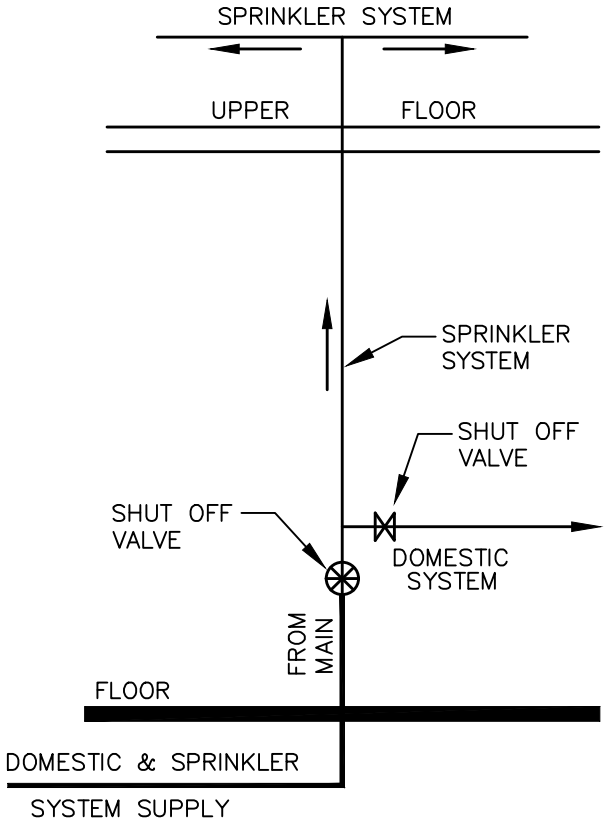



# RESIDENTAL FIRE SPRINKLER CONNECTION

1 & 2 FAMILY DWELLINGS AND TOWNHOUSES DESIGNED OUT OF THE OREGON RESIDENTIAL SPECIALTY CODE

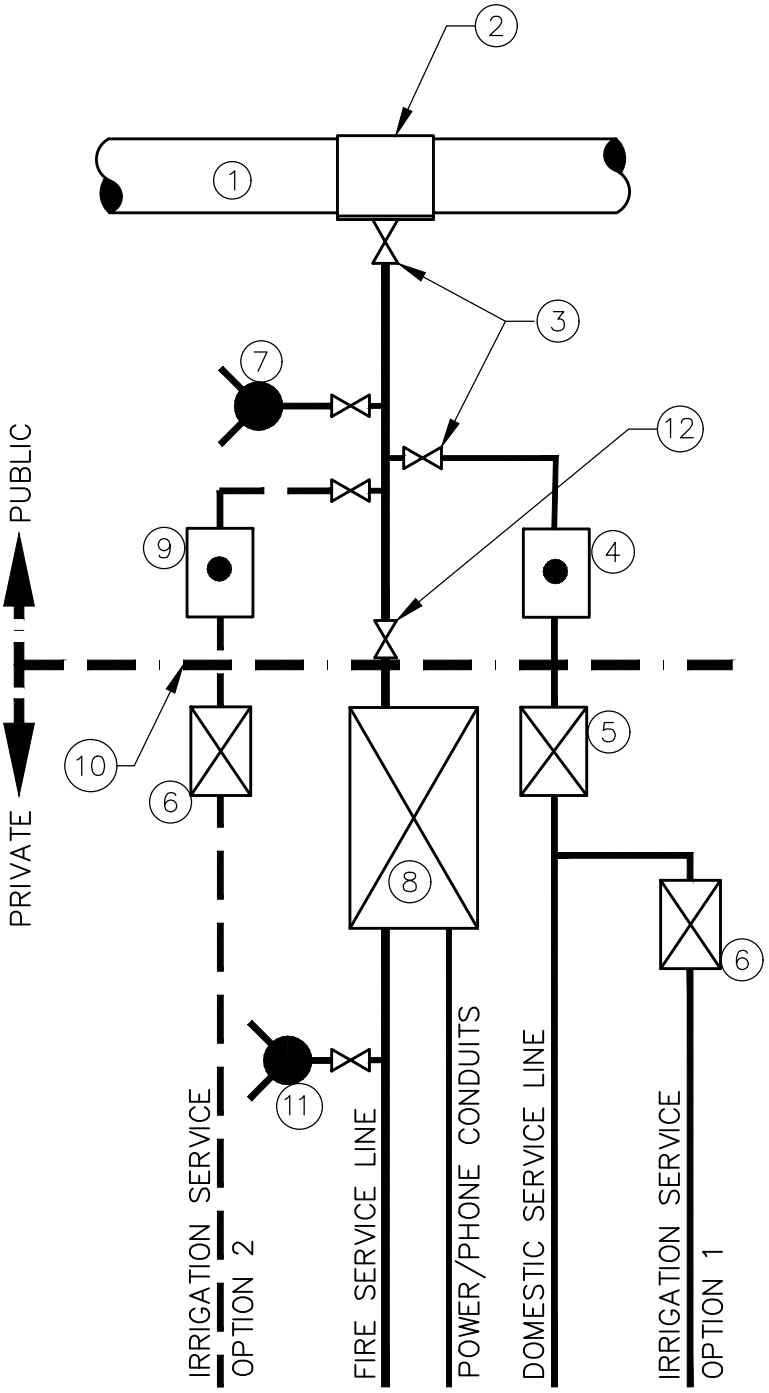
## NOTES:

1. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE CITY OF HILLSBORO CONSTRUCTION STANDARDS AND THE NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) NFPA13D FIRE SPRINKLER STANDARD.
2. FIRE SERVICE PIPING AND APPURTENANCES SHALL BE INSPECTED WITHIN THE RIGHT-OF-WAY BY THE WATER DEPARTMENT AND ON PRIVATE PROPERTY BY THE HILLSBORO BUILDING DEPARTMENT INSPECTOR.
3. BACK FLOW DEVICES WILL NOT BE REQUIRED FOR A MULTIPURPOSE OR PASSIVE PURGE SYSTEM CONNECTED TO AT LEAST ONE WATER CLOSET.
4. METER CHARGE AND MONTHLY FEE SHALL BE FOR THE SIZE OF METER INSTALLED. SERVICE CONNECTION CHARGES SHALL BE FOR A 5/8" METER. UNLESS THE CUSTOMER REQUIRES A LARGER DOMESTIC CONNECTION, THEN THE GREATER CONNECTION CHARGES SHALL APPLY.
5. ALL UNDERGROUND PIPING SHALL BE PER NFPA 13D. ALL ABOVE GROUND PIPING SHALL BE PER NFPA13D.
6. ALL ABOVE GROUND SYSTEM COMPONENTS SHALL MEET ALL OREGON PLUMBING SPECIALTY CODE REQUIREMENTS FOR POTABLE SYSTEMS.
7. ALL ABOVE GROUND PIPING AND VALVES SHALL BE PROTECTED TO PREVENT FREEZING.
8. ALL PIPING PASSING THROUGH A SLAB SHALL PASS THROUGH A SLEEVE FOR THE FULL THICKNESS OF THE SLAB. THE SLEEVE SHALL HAVE AN INSIDE DIAMETER OF $\frac{1}{2}$" LARGER THAN THE OUTSIDE DIAMETER OF THE SYSTEM PIPE.




RISER DETAIL

| | | | |
|---|---|---|---|
| Hillsboro Water | **SINGLE FAMILY RESIDENTIAL FIRE SPRINKLER CREDIT PROGRAM** | **SCALE: NONE**<br>**DATE: AUG 2018** | **550-5** |



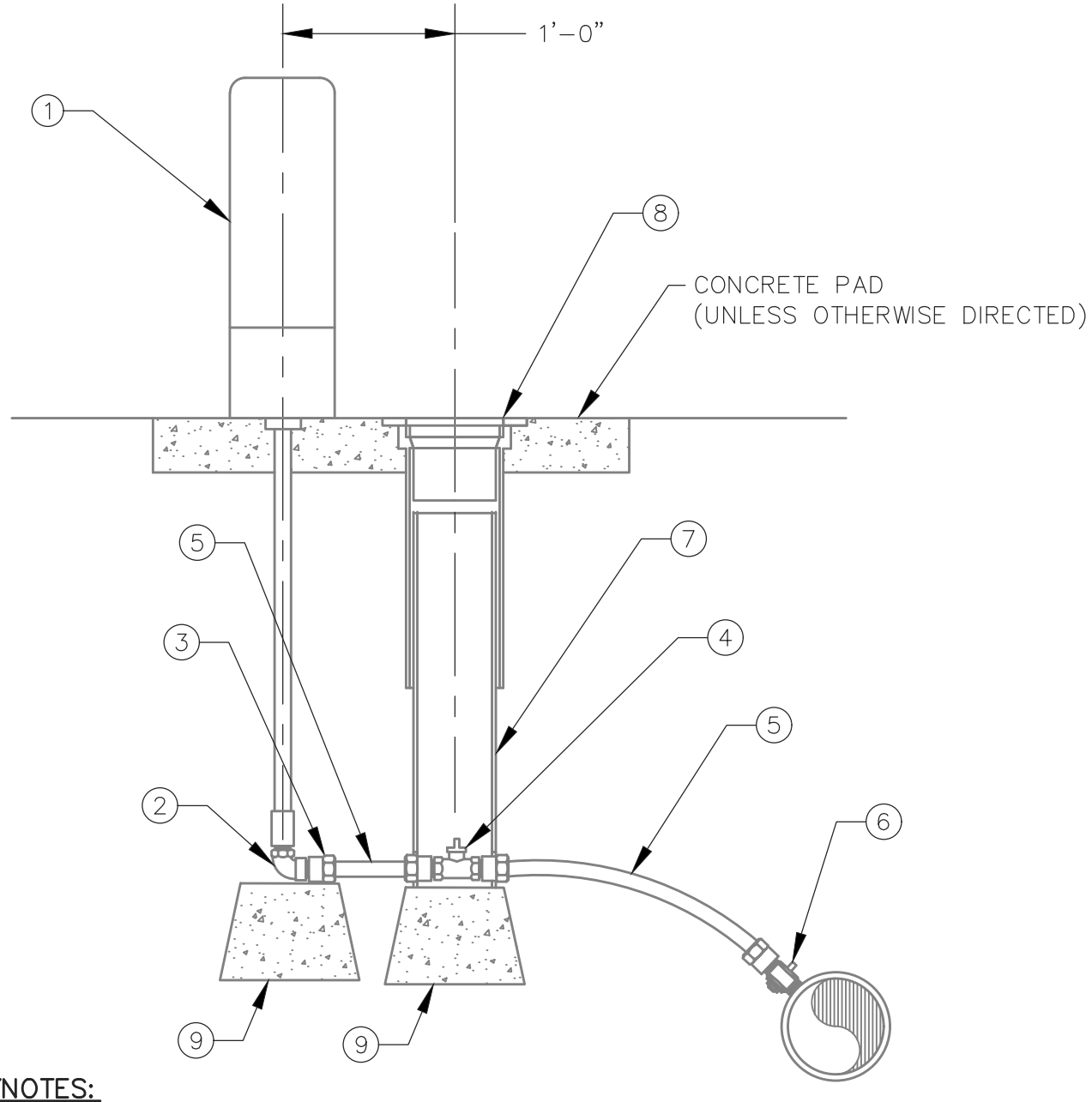

KEYNOTES:

1. EXISTING WATER MAIN, 8" MIN SIZE
2. SERVICE CONNECTION WET TAP BY CITY-APPROVED CONTRACTOR
3. GATE VALVE (TYPICAL)
4. DOMESTIC WATER SERVICE METER
5. DOMESTIC SERVICE BACKFLOW PREVENTION ASSEMBLY
6. IRRIGATION BACKFLOW PREVENTION ASSEMBLY
7. PUBLIC FIRE HYDRANT (IF REQUIRED)
8. FIRE SERVICE BACKFLOW PREVENTION ASSEMBLY
9. IRRIGATION METER (OPTIONAL AT ADDITIONAL SDC EXPENSE)
10. RIGHT-OF-WAY / PROPERTY LINE
11. PRIVATE HYDRANT OR FIRE DEPT CONNECTION (FDC) SHALL HAVE A 3' CLEAR ZONE AND THE HEIGHT SHALL BE FROM 1.5' TO 4' FROM FINISHED GRADE. REFER TO NOTE 3
12. FULL SIZE RESTRAINED VALVE ON FIRE SERVICE LINE AT EDGE OF RIGHT-OF-WAY

NOTES:

1. IRRIGATION SYSTEM CONNECTION OPTIONS:
   OPTION 1: CONNECT DOWNSTREAM OF THE DOMESTIC SERVICE BACKFLOW PREVENTION ASSEMBLY.
   OPTION 2: CONNECT TO SEPARATE IRRIGATION METER SERVICE (ADDITIONAL SDC EXPENSE REQUIRED).
2. DOMESTIC AND FIRE SERVICE LINES 4" AND LARGER SHALL BE DUCTILE IRON FOR A DISTANCE OF 5' MINIMUM DOWNSTREAM OF THE BACKFLOW VAULT.
3. PRIVATE FDC OR HYDRANT MUST BE LOCATED ON CUSTOMER SIDE OF BACKFLOW.
4. PIPING FOR FIRE SERVICE SHALL COMPLY WITH THE UNDERGROUND PIPING STANDARDS IN NFPA 24.

| Hillsboro Water | TYPICAL COMMERCIAL / INDUSTRIAL SERVICE LAYOUT | SCALE: NONE<br>DATE: AUG 2018 | 560-1 |
|---|---|---|---|

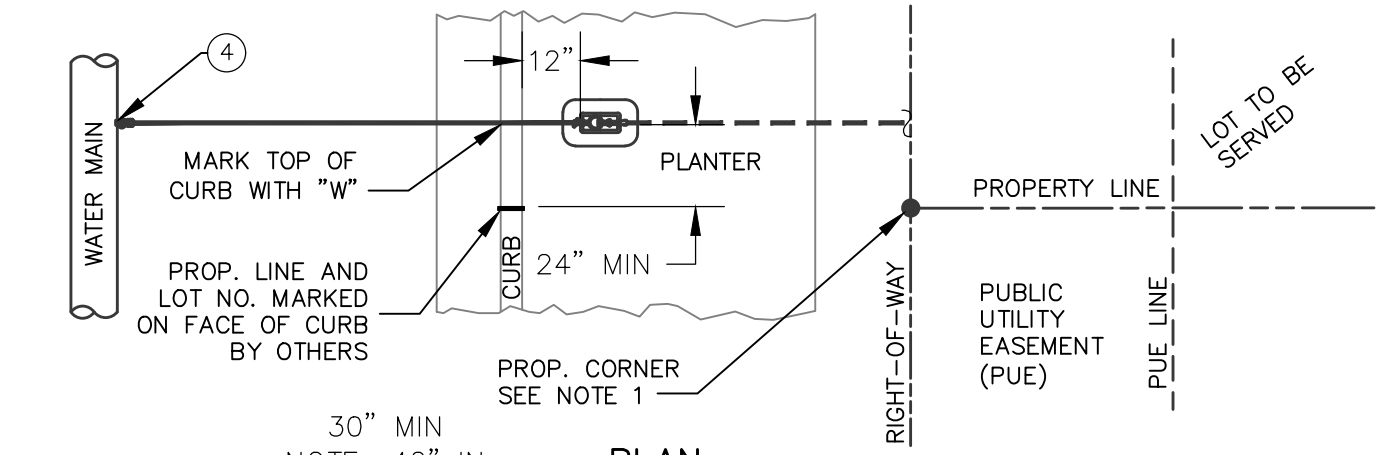



KEYNOTES:

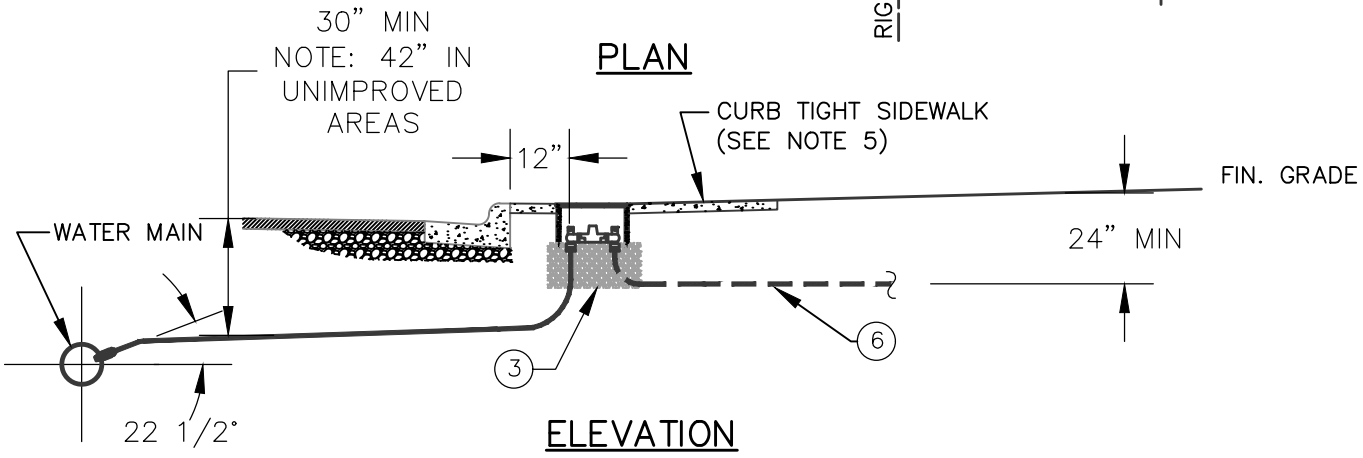
① SAMPLING STATION "ECLIPSE NO. 88SS" BY KUPFERLE FOUNDRY CO WITH FACTORY APPLIED "SAFTEY BLUE" PAINT AND CITY LOGO AND WITH OPTIONAL 1/4" BALL VALVE IN PLACE OF 1/4" PET COCK ON VENT PIPE
② 3/4" BRASS STREET ELL
③ 3/4" COUPLING MIPT x CTS
④ 3/4" CURB STOP CTS x CTS
⑤ 3/4" TYPE K SOFT COPPER TUBING
⑥ 3/4" CORP STOP CC x CTS
⑦ 6" SCH 40 OR D3034 PVC PIPE RISER, LENGTH AS NECESSARY. SLOT THE PVC PIPE BOTTOM TO REST ON CONCRETE BLOCK.
⑧ REFER TO VALVE BOX DETAIL 540-2.
⑨ 8"x8"x8" CONCRETE PIER BLOCK OR EQUIVALENT SUPPORT (E.G. 18"x12"x2" CONCRETE PAD).

| Hillsboro Water | **SAMPLE STATION INSTALLATION** | **SCALE: NONE** | **560-2** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |

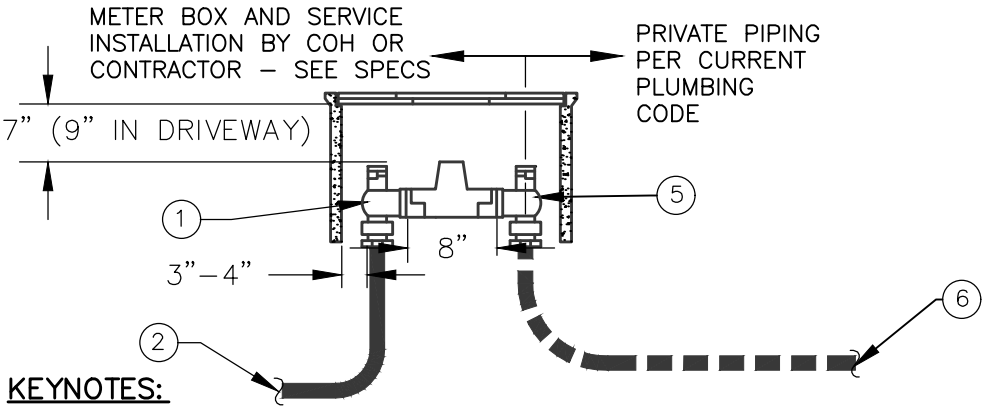
FILENAME: 560-2.DWG




## PLAN




## ELEVATION




## KEYNOTES:

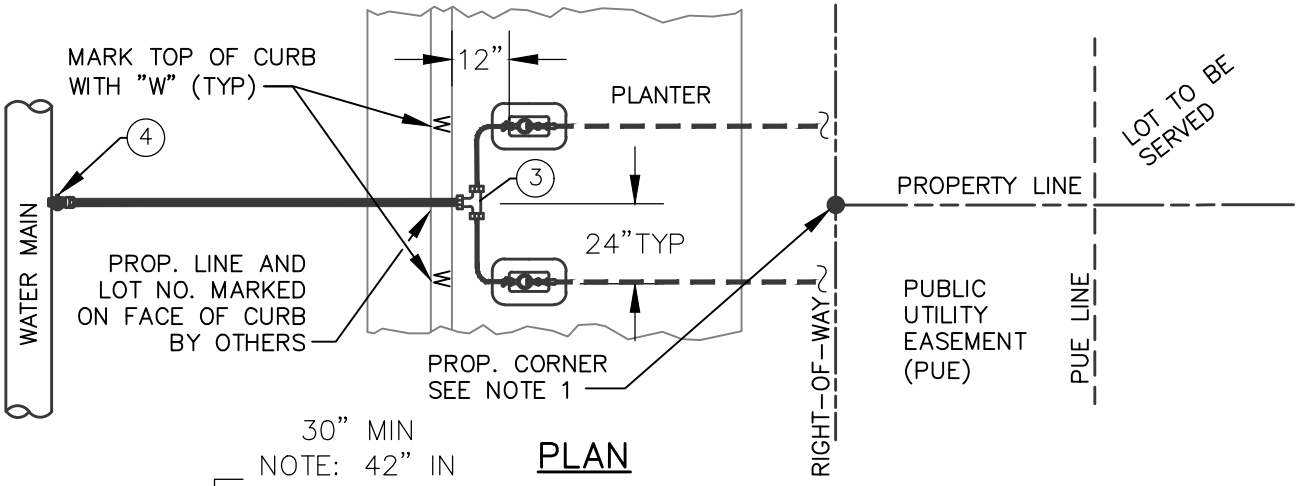
① 3/4" ANGLE METER STOP BALL VALVE WITH 1" CTS INLET
② 1" TYPE "K" SOFT COPPER TUBING
③ COMPACTED CLASS "B" BACKFILL MINIMUM 6" BASE
④ 1" CORP STOP AND TYPE "K" SOFT COPPER TUBING
⑤ 3/4" ANGLE METER STOP BALL VALVE WITH 1" FIPT OUTLET (CITY TO INSTALL WHEN METER IS PLACED)
⑥ TUBING SUPPLIED BY PLUMBING CONTRACTOR

## NOTES:

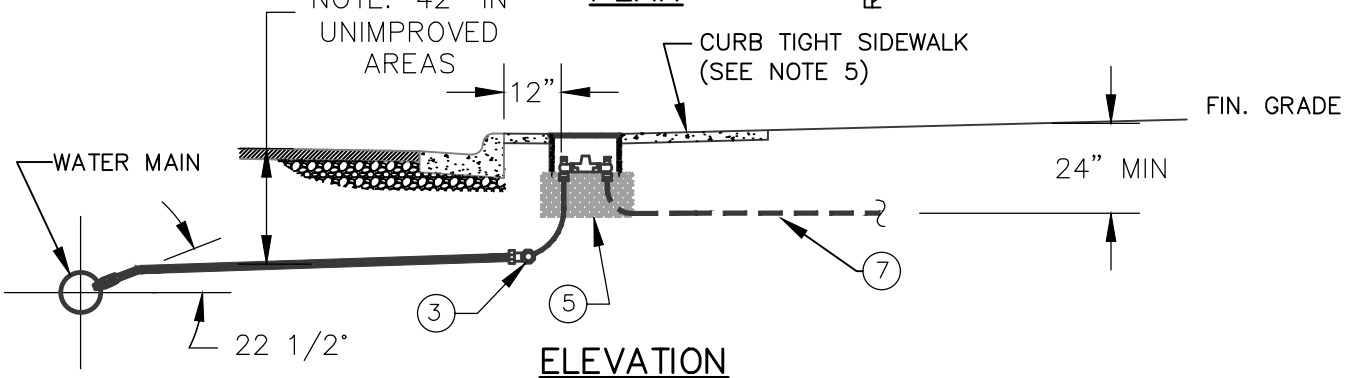
1. ORS 92.044(7) PROHIBITS LOCATING ANY UTILITY INFRASTRUCTURE WITHIN 1 FOOT OF A SURVEY MONUMENT. DEVELOPER SHALL PAY FOR ANY RELOCATION OF SERVICES AND/OR METER BOXES FOUND TO FALL WITHIN 1 FOOT OF A SURVEY MONUMENT LOCATION.
2. ALL FITTINGS SHALL BE BRASS OR COPPER.
3. WATER DEPARTMENT WILL INSTALL METER AFTER WATER MAIN HAS BEEN APPROVED FOR PUBLIC USE AND REQUIRED FEES HAVE BEEN PAID.
4. ALL SERVICE LINES SHALL BE INSTALLED PRIOR TO PRESSURE TESTING.
5. IF METER BOX IS IN A CURB TIGHT SIDEWALK, PLUMBING CONTRACTOR SHALL MAKE SERVICE CONNECTION PRIOR TO SIDEWALK POUR.

| Hillsboro Water | **5/8" x 3/4" SERVICE CONNECTION** | **SCALE: NONE** | **560-3** |
|---|---|---|---|
| | | **DATE: JULY 2018** | |

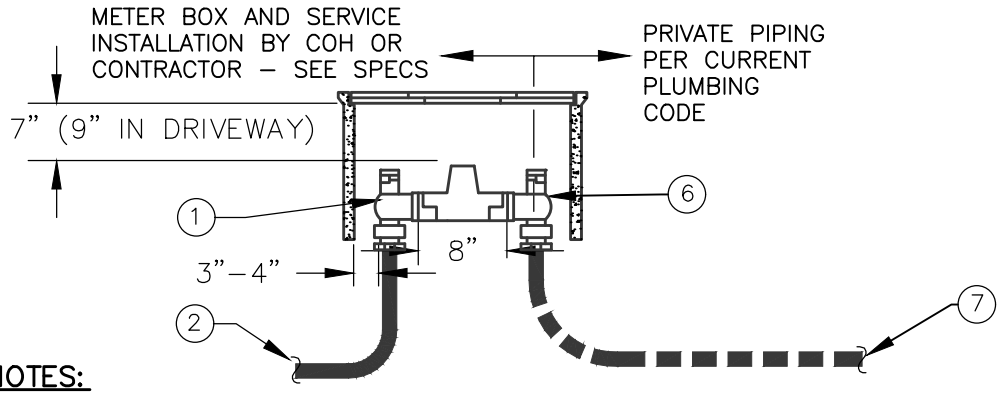
FILENAME: 560-3 DRAFT.DWG




PLAN




ELEVATION




## KEYNOTES:

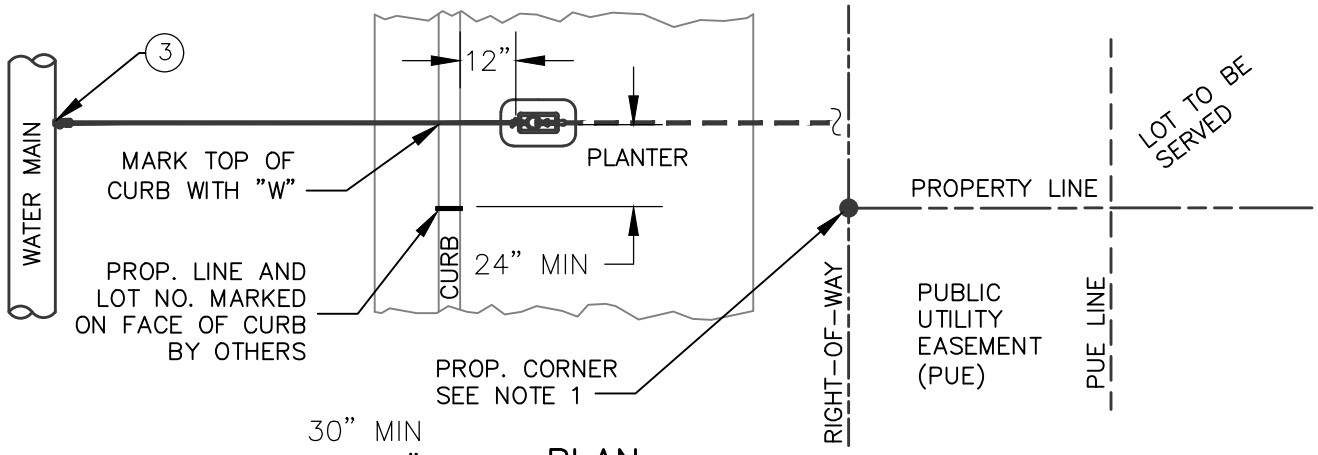
① 3/4" ANGLE METER STOP BALL VALVE WITH 1" CTS INLET
② 1" TYPE "K" SOFT COPPER TUBING
③ 1" x 1" x 1" CTS TEE
④ 1" CORP STOP CC x CTS
⑤ COMPACTED CLASS "B" BACKFILL MINIMUM 6" BASE
⑥ 3/4" ANGLE METER STOP BALL VALVE WITH 1" FIPT OUTLET (CITY TO INSTALL WHEN METER IS PLACED)
⑦ TUBING SUPPLIED BY PLUMBING CONTRACTOR

## NOTES:

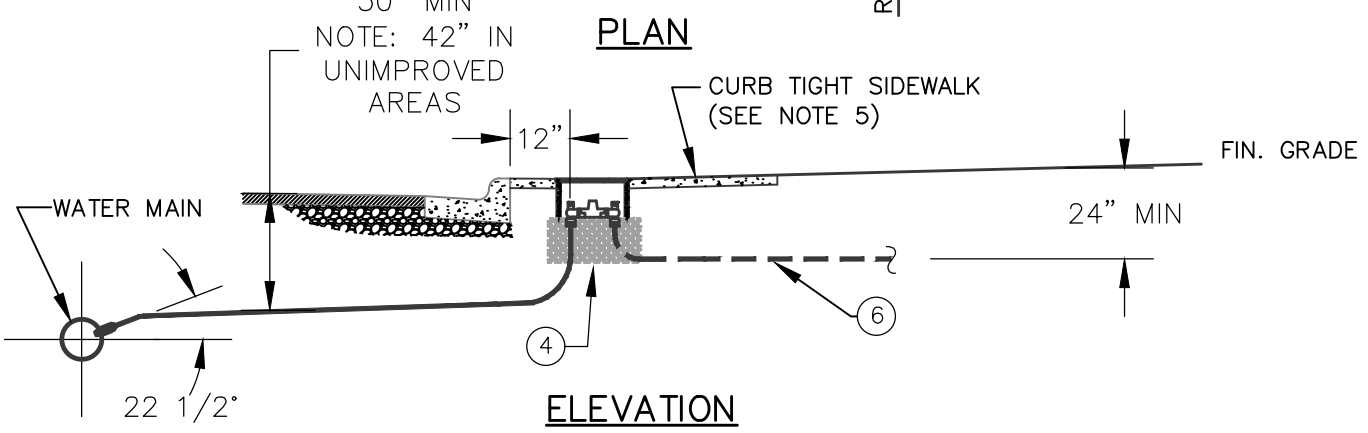
1. ORS 92.044(7) PROHIBITS LOCATING ANY UTILITY INFRASTRUCTURE WITHIN 1 FOOT OF A SURVEY MONUMENT. DEVELOPER SHALL PAY FOR ANY RELOCATION OF SERVICES AND/OR METER BOXES FOUND TO FALL WITHIN 1 FOOT OF A SURVEY MONUMENT LOCATION.
2. ALL FITTINGS SHALL BE BRASS OR COPPER.
3. WATER DEPARTMENT WILL INSTALL METER AFTER WATER MAIN HAS BEEN APPROVED FOR PUBLIC USE AND REQUIRED FEES HAVE BEEN PAID.
4. ALL SERVICE LINES SHALL BE INSTALLED PRIOR TO PRESSURE TESTING.
5. IF METER BOX IS IN A CURB TIGHT SIDEWALK, PLUMBING CONTRACTOR SHALL MAKE SERVICE CONNECTION PRIOR TO SIDEWALK POUR.

| Hillsboro Water | **3/4" x 5/8" DOUBLE SERVICE CONNECTION** | SCALE: NONE<br>DATE: JULY 2018 | **560-4** |
|---|---|---|---|

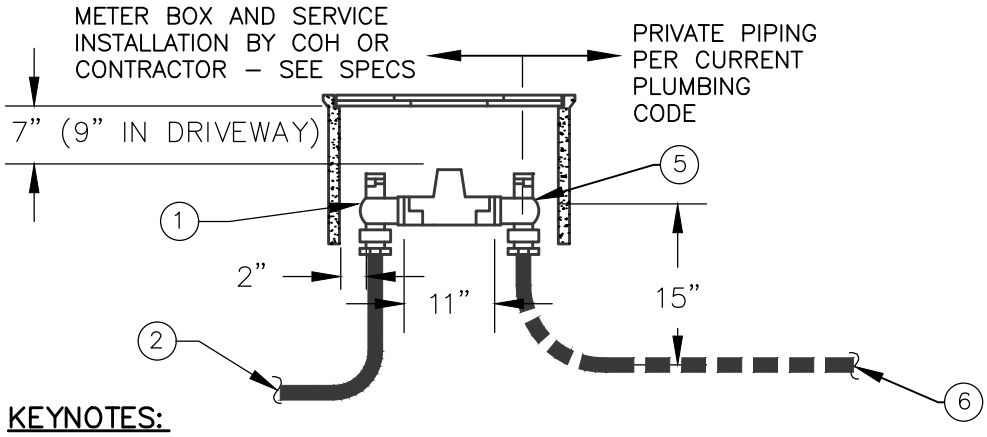
FILENAME: 560-4.DWG




## PLAN




## ELEVATION




## KEYNOTES:

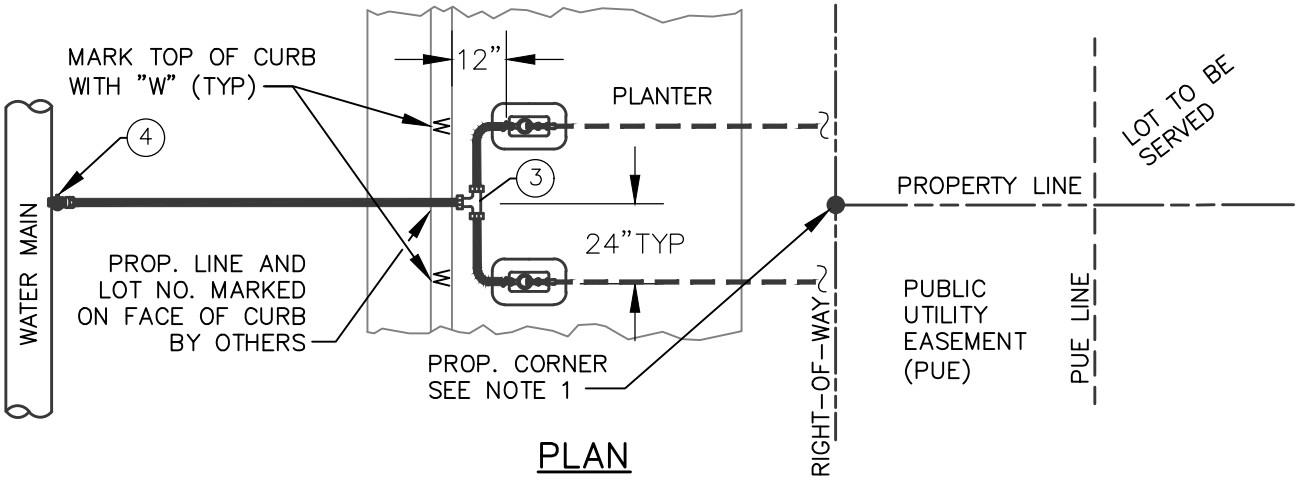
① 1" x 1" ANGLE METER STOP BALL VALVE WITH 1" CTS INLET
② 1" TYPE "K" SOFT COPPER TUBING
③ 1" CORP STOP CC x CTS
④ COMPACTED CLASS "B" BACKFILL MINIMUM 6" BASE
⑤ 1" ANGLE METER STOP BALL VALVE WITH 1" FIPT OUTLET (CITY TO INSTALL WHEN METER IS PLACED)
⑥ TUBING SUPPLIED BY PLUMBING CONTRACTOR

## NOTES:

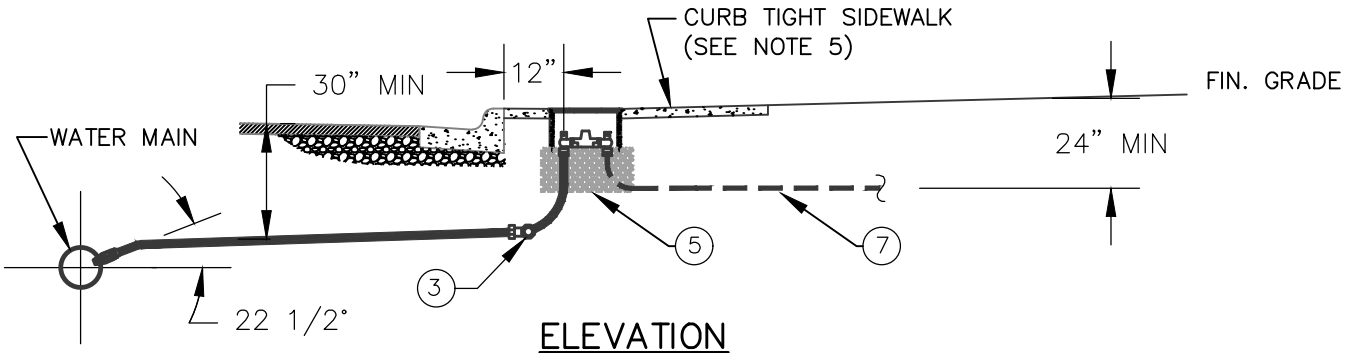
1. ORS 92.044(7) PROHIBITS LOCATING ANY UTILITY INFRASTRUCTURE WITHIN 1 FOOT OF A SURVEY MONUMENT. DEVELOPER SHALL PAY FOR ANY RELOCATION OF SERVICES AND/OR METER BOXES FOUND TO FALL WITHIN 1 FOOT OF A SURVEY MONUMENT LOCATION.
2. ALL FITTINGS SHALL BE BRASS OR COPPER.
3. WATER DEPARTMENT WILL INSTALL METER AFTER WATER MAIN HAS BEEN APPROVED FOR PUBLIC USE AND REQUIRED FEES HAVE BEEN PAID.
4. ALL SERVICE LINES SHALL BE INSTALLED PRIOR TO PRESSURE TESTING.
5. IF METER BOX IS IN A CURB TIGHT SIDEWALK, PLUMBING CONTRACTOR SHALL MAKE SERVICE CONNECTION PRIOR TO SIDEWALK POUR.

| Hillsboro Water | 1" SERVICE CONNECTION | SCALE: NONE<br>DATE: JULY 2018 | 560-5 |
|---|---|---|---|

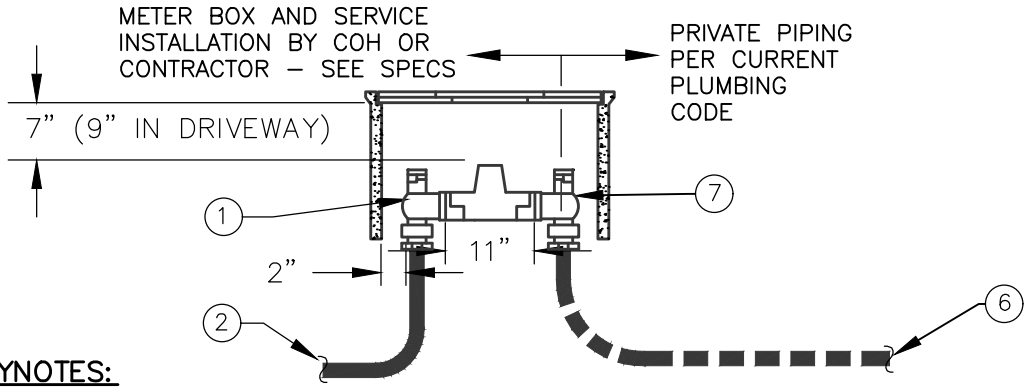
FILENAME: 560-5.DWG




PLAN




ELEVATION




## KEYNOTES:

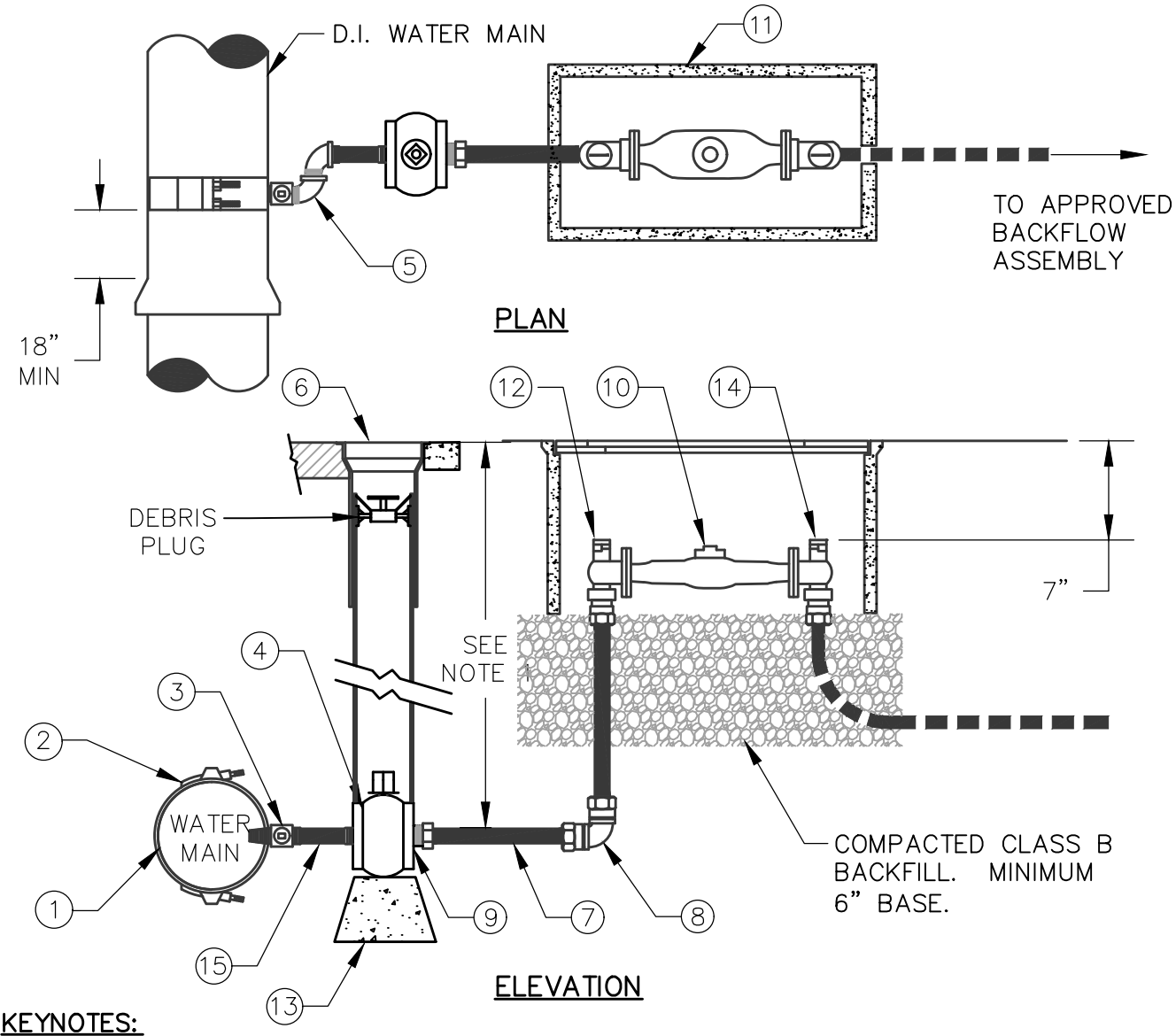
① 1" ANGLE METER STOP BALL VALVE WITH 1" CTS INLET
② 1" TYPE "K" SOFT COPPER TUBING
③ 1" x 1" x 1" CTS TEE
④ 1" CORP STOP CC x CTS
⑤ COMPACTED CLASS "B" BACKFILL MINIMUM 6" BASE
⑥ TUBING SUPPLIED BY PLUMBING CONTRACTOR
⑦ 1" ANGLED METER BALL VALVE WITH 1" FIPT OUTLET (CITY TO INSTALL WHEN METER PLACED)

## NOTES:

1. ORS 92.044(7) PROHIBITS LOCATING ANY UTILITY INFRASTRUCTURE WITHIN 1 FOOT OF A SURVEY MONUMENT. DEVELOPER SHALL PAY FOR ANY RELOCATION OF SERVICES AND/OR METER BOXES FOUND TO FALL WITHIN 1 FOOT OF A SURVEY MONUMENT LOCATION.
2. ALL FITTINGS SHALL BE BRASS OR COPPER.
3. WATER DEPARTMENT WILL INSTALL METER AFTER WATER MAIN HAS BEEN APPROVED FOR PUBLIC USE AND REQUIRED FEES HAVE BEEN PAID.
4. ALL SERVICE LINES SHALL BE INSTALLED PRIOR TO PRESSURE TESTING.
5. IF METER BOX IS IN A CURB TIGHT SIDEWALK, PLUMBING CONTRACTOR SHALL MAKE SERVICE CONNECTION PRIOR TO SIDEWALK POUR.

| Hillsboro Water | **1" DOUBLE SERVICE CONNECTION** | **SCALE: NONE** | **560-6** |
|---|---|---|---|
| | | **DATE: JULY 2018** | |

FILENAME: 560-6.DWG




## KEYNOTES:

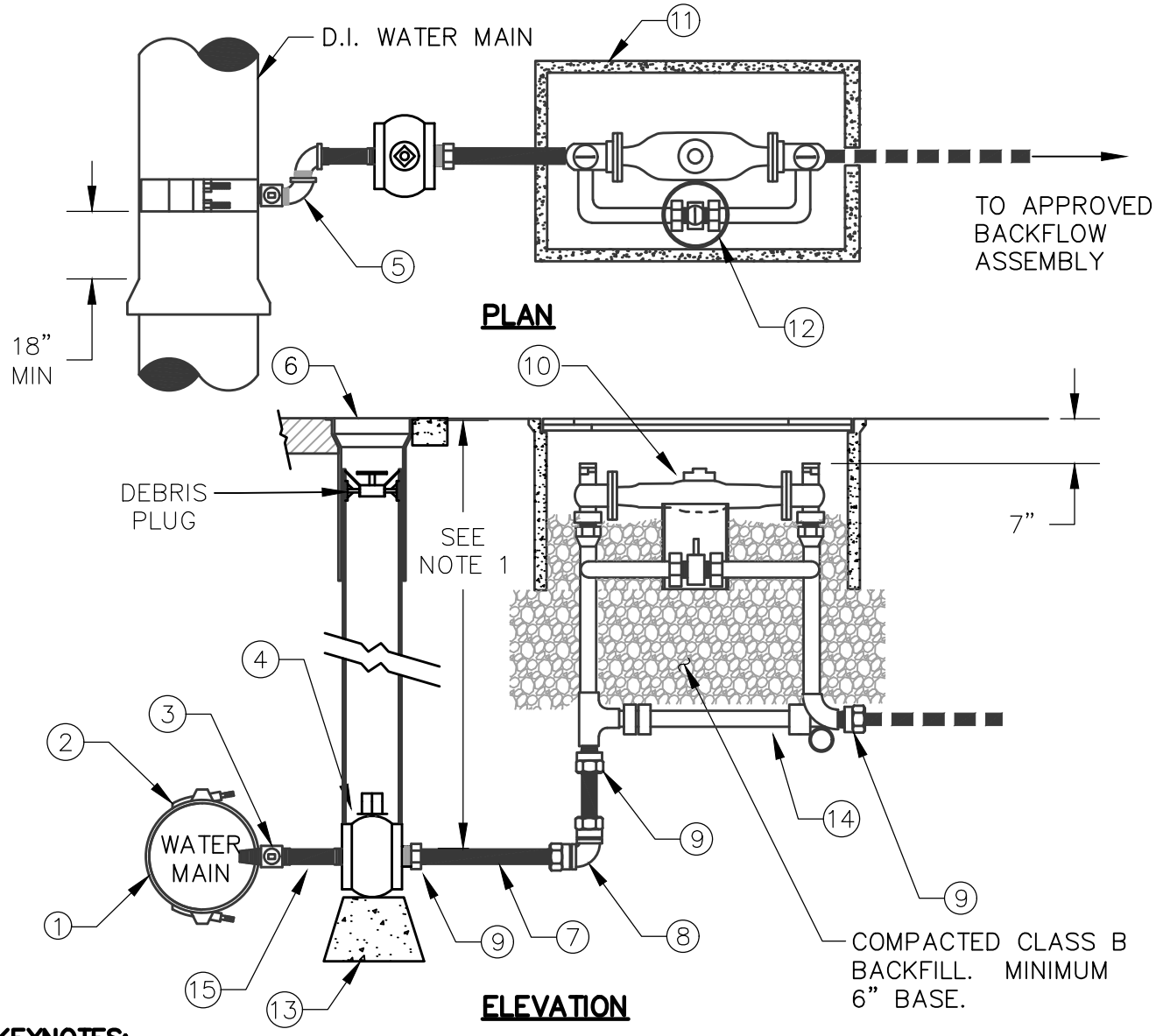
1. WATER MAIN
2. 2" TAPPING SADDLE W/2" CC THREAD OUTLET
3. 2" CORP STOP CC x FIPT
4. 2" GATE VALVE w/2" OPERATING NUT FIPT x FIPT
5. (2) 2" BRASS STREET ELLS
6. VALVE BOX PER 540-2
7. 2" TYPE K RIGID COPPER PIPE
8. 2" CTS x CTS 90° ELL
9. USE 2" CTS x MIPT COUPLING
10. 1-1/2" OR 2" WATER METER WITH AUTOMATED METER READER (AMR)
11. WATER METER BOX 17" x 30" x 24" DEEP
12. 2" FLANGED ANGLE METER BALL VALVE W/2" CTS INLET
13. 8"x8"x8" CONC. PIER BLOCK OR EQUIVALENT SUPPORT ON UNDISTURBED EARTH
14. 2" FLANGED ANGLE METER BALL VALVE W/2" FIPT OUTLET (CITY TO INSTALL WHEN METER IS PLACED)
15. 2" x 12" BRASS NIPPLE

## NOTES:

1. SERVICE LINES BETWEEN THE WATER MAIN AND THE METER SHALL HAVE 30" OF COVER FOR IMPROVED AREAS AND 42" OF COVER FOR UNIMPROVED AREAS.
2. ALL FITTINGS SHOWN SHALL BE BRASS OR COPPER.
3. WATER DEPARTMENT WILL INSTALL METER AFTER WATER MAIN HAS BEEN APPROVED FOR PUBLIC USE, REQUIRED FEES HAVE BEEN PAID, AND ALL BACKFLOW PREVENTION REQUIREMENTS HAVE BEEN MET.
4. ALL SERVICE LINES SHALL BE INSTALLED PRIOR TO PRESSURE TESTING.

| Hillsboro Water | 1-1/2" and 2" IRRIGATION SERVICE CONNECTION | SCALE: NONE<br>DATE: JULY 2018 | 560-7 |
|---|---|---|---|

FILENAME: 560-7 DRAFT.DWG




## KEYNOTES:

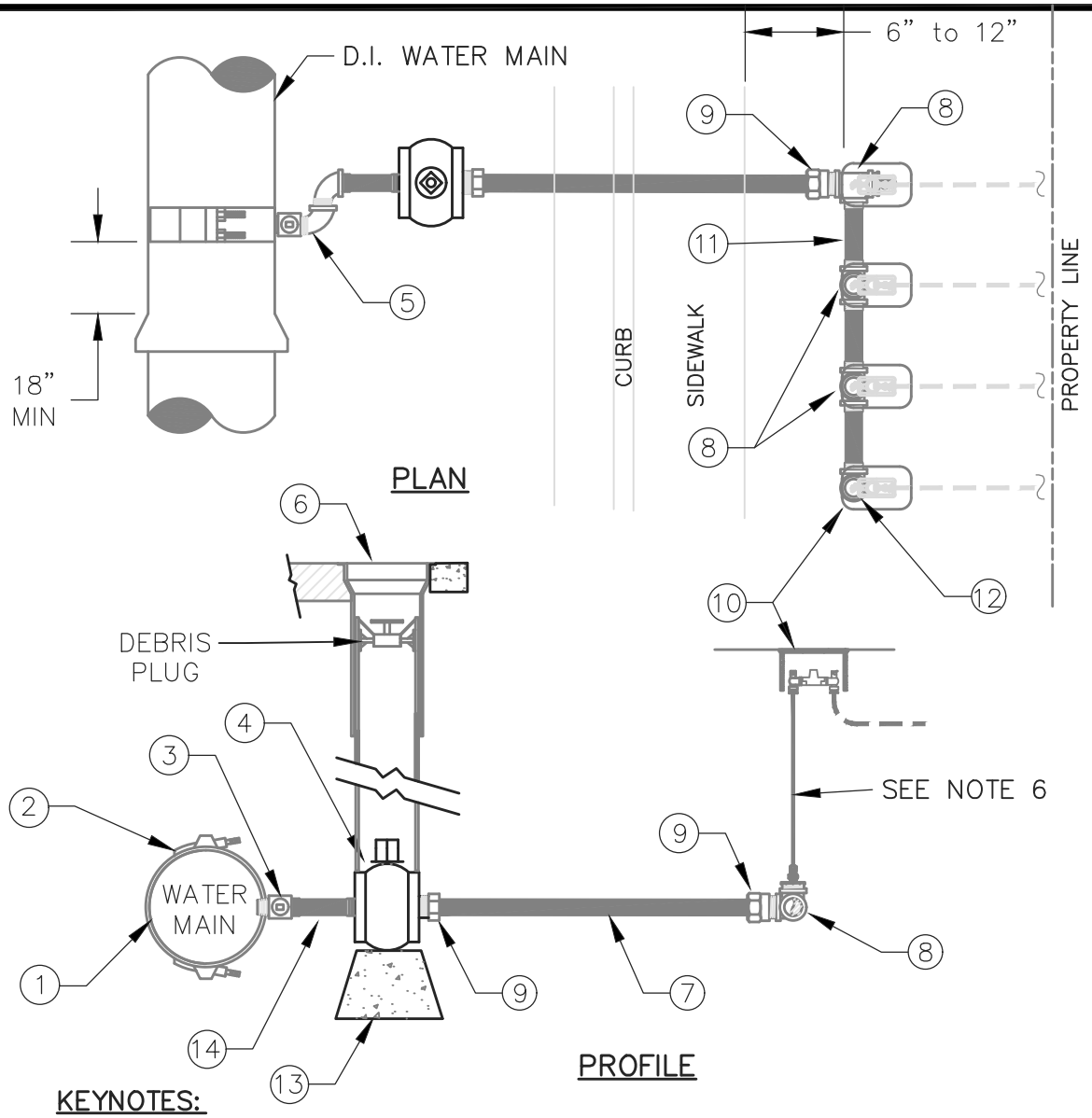
1. WATER MAIN
2. 2" TAPPING SADDLE W/2" THREAD OUTLET
3. 2" CORP STOP CC x MIPT
4. 2" GATE VALVE w/2" OPERATING NUT FIPT x FIPT
5. (2) 2" BRASS STREET ELLS
6. VALVE BOX PER 540-2
7. 2" TYPE K RIGID COPPER PIPE
8. 2" CTS x CTS 90° ELL
9. USE 2" CTS x MIPT COUPLING
10. 1 1/2" OR 2" WATER METER WITH AUTOMATED METER READER (AMR)
11. WATER METER BOX 17" x 30" x 24" DEEP
12. 2" OR 4" PVC PIPE, LENGTH AS REQUIRED
13. 8"x8"x8" CONC. PIER BLOCK OR EQUIVALENT SUPPORT ON UNDISTURBED EARTH
14. 2" COPPER METER SETTER W/HIGH BYPASS
15. 2" x 12" BRASS NIPPLE

## NOTES:

1. SERVICE LINES BETWEEN THE WATER MAIN AND THE METER SHALL HAVE 30" OF COVER FOR IMPROVED AREAS AND 42" OF COVER FOR UNIMPROVED AREAS.
2. ALL FITTINGS SHOWN SHALL BE BRASS OR COPPER.
3. WATER DEPARTMENT WILL INSTALL METER AFTER WATER MAIN HAS BEEN APPROVED FOR PUBLIC USE, REQUIRED FEES HAVE BEEN PAID, AND ALL BACKFLOW PREVENTION REQUIREMENTS HAVE BEEN MET.
4. ALL SERVICE LINES SHALL BE INSTALLED PRIOR TO PRESSURE TESTING.

| Hillsboro Water | 1-1/2" and 2" SERVICE CONNECTION | SCALE: NONE<br>DATE: JULY 2018 | 560-8 |
|---|---|---|---|

FILENAME: 560-9 DRAFT.DWG




## KEYNOTES:

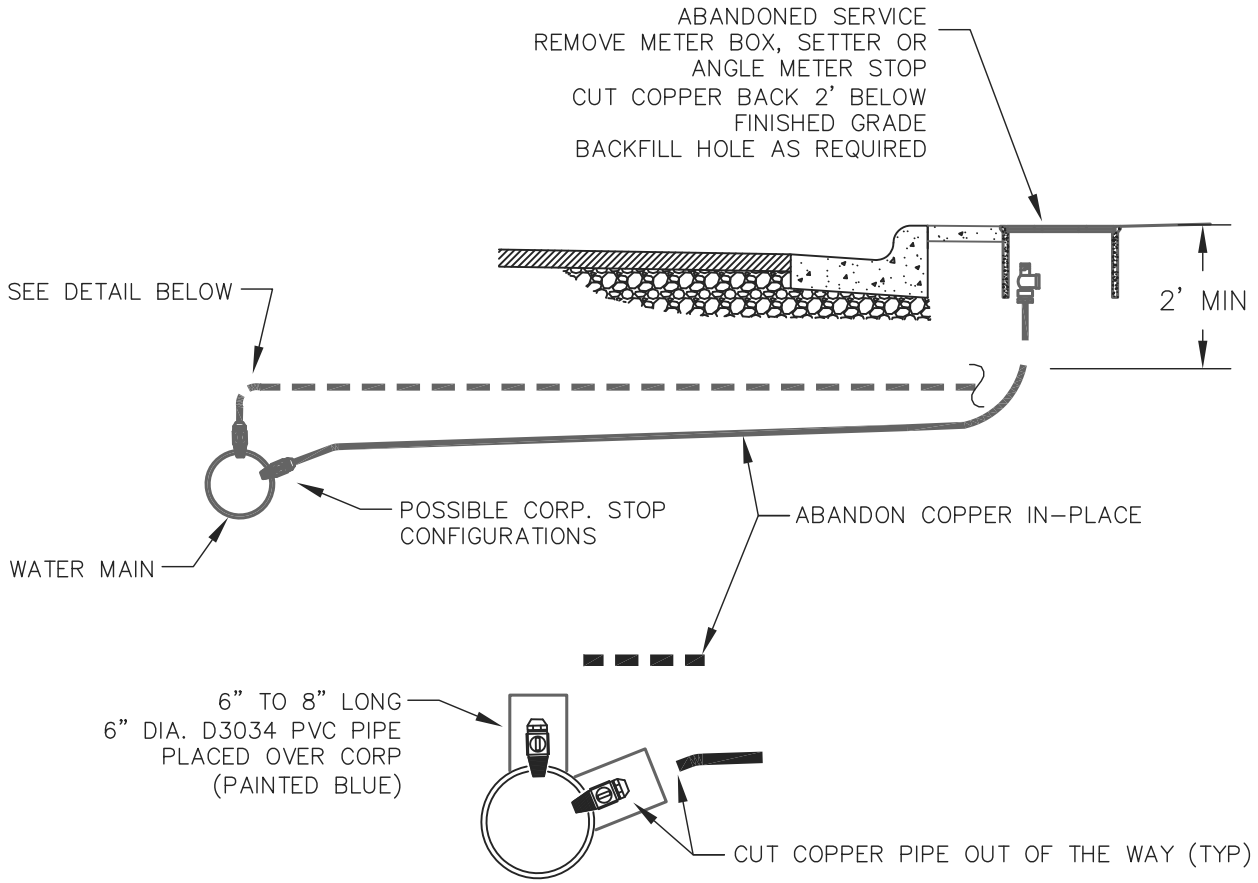
1. WATER MAIN
2. 2" TAPPING SADDLE W/2" THREAD OUTLET
3. 2" CORP STOP CC x MIPT
4. 2" GATE VALVE w/2" OPERATING NUT FIPT x FIPT
5. (2) 2" BRASS STREET ELLS
6. VALVE BOX PER 540-2
7. 2" TYPE K RIGID COPPER PIPE
8. 2" BRASS TEE W/2" x 1" BRASS BUSHING W/1" MIPT x CTS COUPLING
9. 2" CTS x MIPT COUPLING
10. WATER METER BOX 17" x 30" x 18" DEEP
11. 2" x 12" BRASS NIPPLE
12. 2" BRASS 90° ELL W" x 1" BRASS BUSHING W/1" MIPT x CTS COUPLING
13. 8"X8"X8" CONCRETE PIER BLOCK OR EQUIVALENT SUPPORT ON UNDISTURBED EARTH
14. 2" x 12" BRASS NIPPLE

## NOTES:

1. SERVICE LINES BETWEEN THE WATER MAIN AND THE METER SHALL HAVE 30" OF COVER FOR IMPROVED AREAS AND 42" OF COVER FOR UNIMPROVED AREAS.
2. ALL FITTINGS SHOWN SHALL BE BRASS OR COPPER.
3. WATER DEPARTMENT WILL INSTALL METER AFTER WATER MAIN HAS BEEN APPROVED FOR PUBLIC USE, REQUIRED FEES HAVE BEEN PAID, AND ALL BACKFLOW PREVENTION REQUIREMENTS HAVE BEEN MET.
4. ALL SERVICE LINES SHALL BE INSTALLED PRIOR TO PRESSURE TESTING.
5. MAXIMUM OF 4 SERVICES.
6. SEE APPLICABLE DETAIL DRAWING 560-3 OR 560-5 FOR SERVICE DESIGN.

| Hillsboro Water | EXAMPLE FOR SERVICE MANIFOLD ASSEMBLY | SCALE: NONE<br>DATE: SEPT 2017 | 560-9 |
|---|---|---|---|

FILENAME: 560-9 DRAFT.DWG

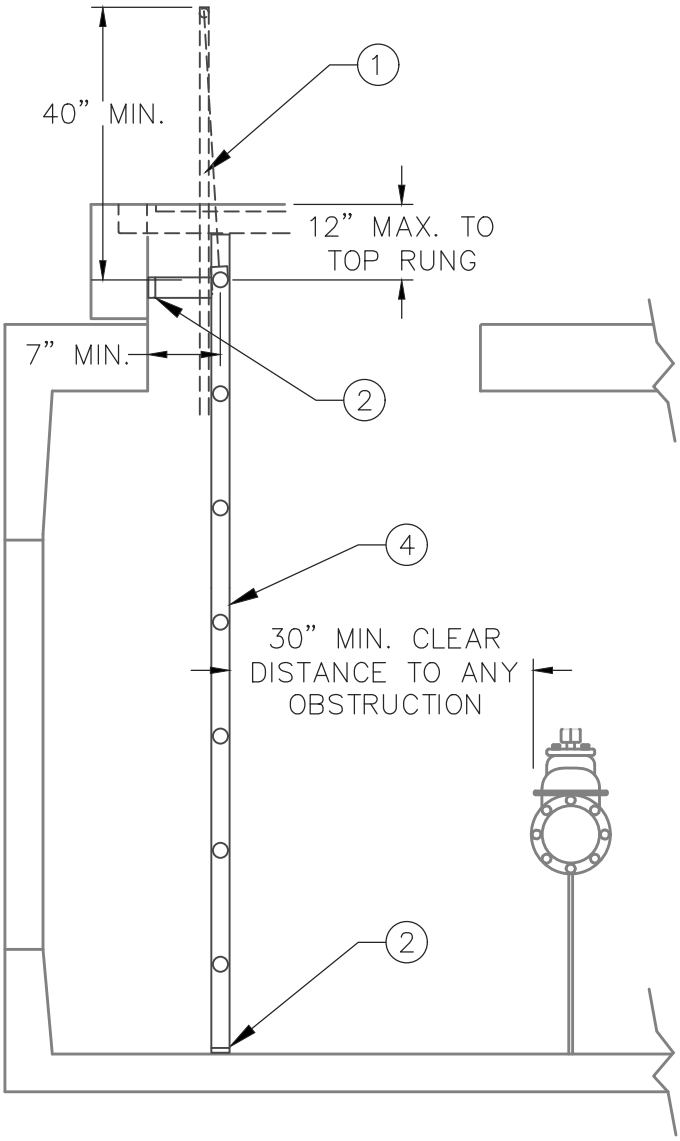



DETAIL

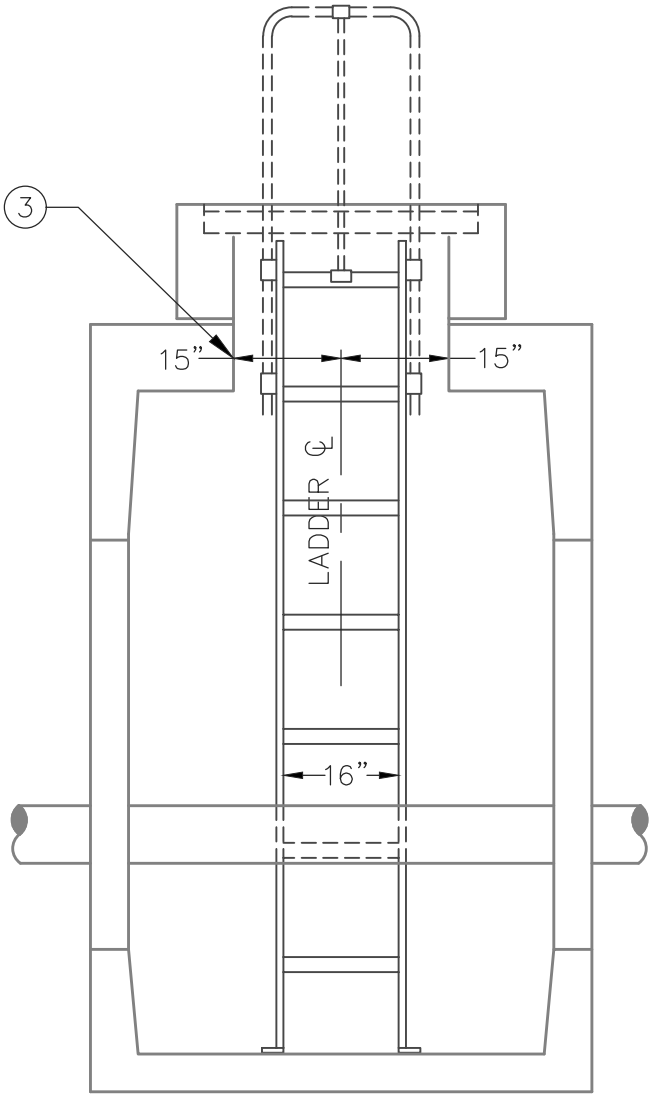
NOTE:

1. EXCAVATE A HOLE LARGE ENOUGH TO ACCESS CORP.
2. TURN CORP OFF.
3. SEVER COPPER AWAY FROM CORP. TO FACILITATE PVC PIPE PLACEMENT.
4. PLACE DUCK TAPE OVER CORP. OPENING.
5. PLACE PVC PIPE OVER CORP. & BACK FILL WITH 3/4 MINUS GRANULAR ROCK, FULL TRENCH DEPTH.
6. ABANDONMENT TO BE DONE WITH THE WATER DEPT. INSPECTOR PRESENT.

| Hillsboro Water | SERVICE ABANDONMENT | SCALE: NONE<br>DATE: SEPT 2017 | 560-10 |
|---|---|---|---|




SIDE VIEW



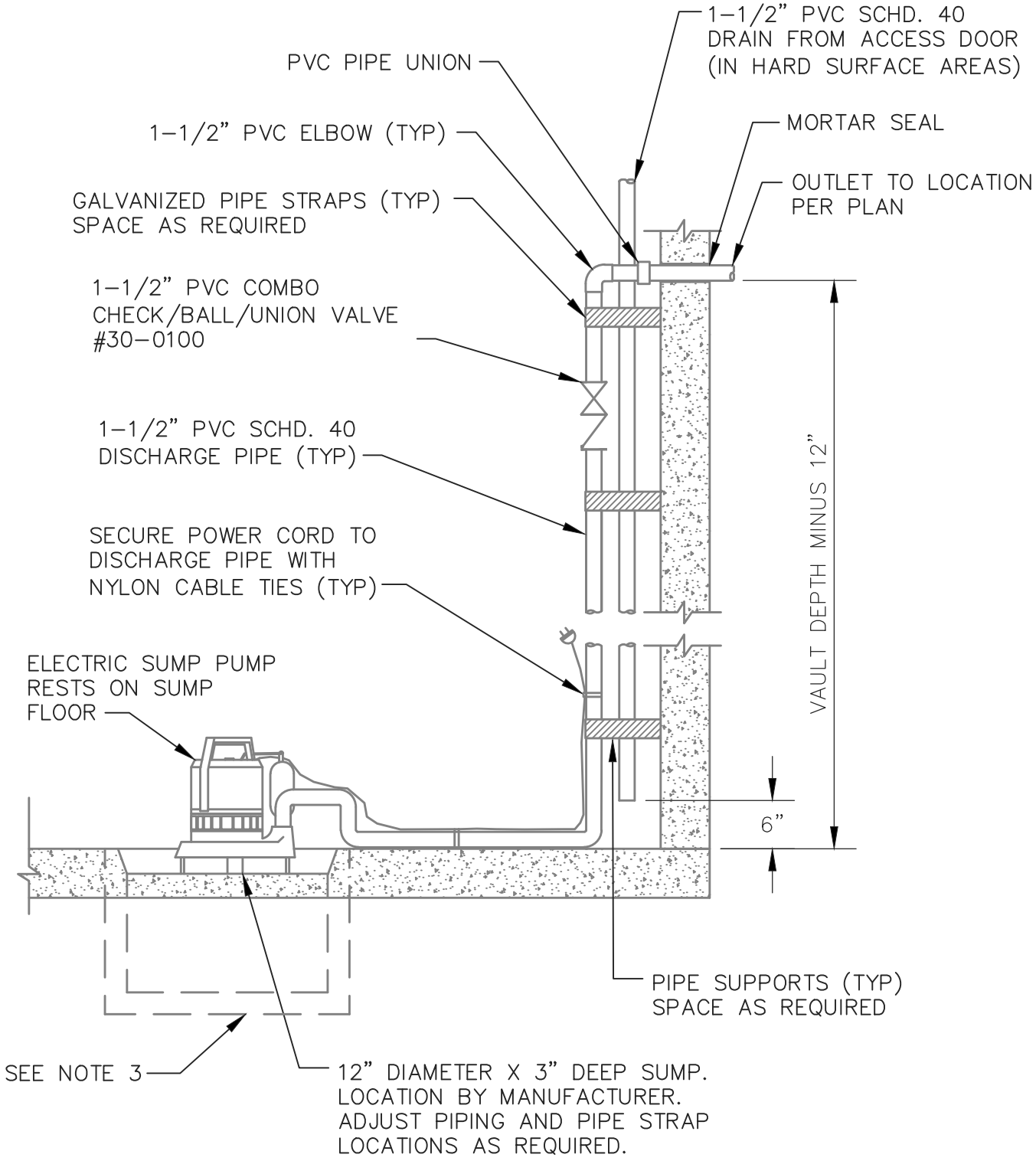

FRONT VIEW

KEYNOTES:

1. LADDER EXTENSION SHALL BE ALUMINUM AND EXTEND 40" ABOVE THE TOP RUNG OF THE LADDER. EXTENSION SHALL BE BOLTED UP BEHIND LADDER RUNGS.
2. ATTACH LADDER SUPPORT TO INSIDE FACE OF VAULT OPENING AND FLOOR OF VAULT WITH STAINLESS STEEL HARDWARE AS SHOWN. ℄ OF RUNG MUST BE SET 7" FROM FACE OF SURFACE BEHIND RUNG.
3. PROVIDE 15" MINIMUM LATERAL CLEARANCE ON EACH SIDE OF LADDER ℄.
4. LADDER SHALL MEET THE REQUIREMENTS OF OSHA AND SHALL BE HOT-DIPPED GALVANIZED AFTER FABRICATION.

| Hillsboro Water | **VAULT LADDER INSTALLATION** | **SCALE: NONE** | **570-1** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |

FILENAME: 570-1.DWG




NOTES:

1. SUMP PUMP – EBARA EPPD–3AS1, HONDA WSP33K1AA, OR APPROVED EQUAL
2. MOUNT GFI RECEPTACLE 6" BELOW CEILING OF VAULT UNLESS LOCATED OTHERWISE BY NATIONAL AND/OR LOCAL ELECTRIC CODES.
3. AN ALTERNATE SUMP PUMP MAY BE REQUIRED FOR INSTALLATIONS IN SPECIALTY VAULTS. CONTACT THE WATER DEPARTMENT FOR ALTERNATE SUMP PUMP DETAIL DRAWING.

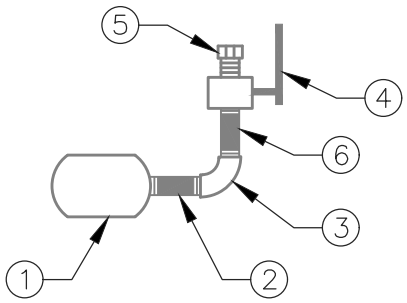
| Hillsboro Water | **SUMP PUMP INSTALLATION** | **SCALE: NONE** | **570-2** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |

FILENAME: 570–2.DWG

## SPECIFICATIONS

| METER SIZE (IN) | 3" METER |
|---|---|
| INCOMING LINE SIZE | 4" |
| BY-PASS LINE SIZE | 2" (INTERNAL) |
| OLDCASTLE VAULT NO. (OR APPROVED EQUAL) | 687-WA (53" I.D.)* |
| DOOR NO. (OR APPROVED EQUAL) SEE NOTE 10 | BILCO: JD-3AL SYRACUSE: CHD-11AL EAST JORDAN: H48721707 |
| METER SPEC. | NEPTUNE TRU-FLO COMPOUND METER W/ R900i E-CODER |

## TEST PORT DETAIL




KEYNOTES:

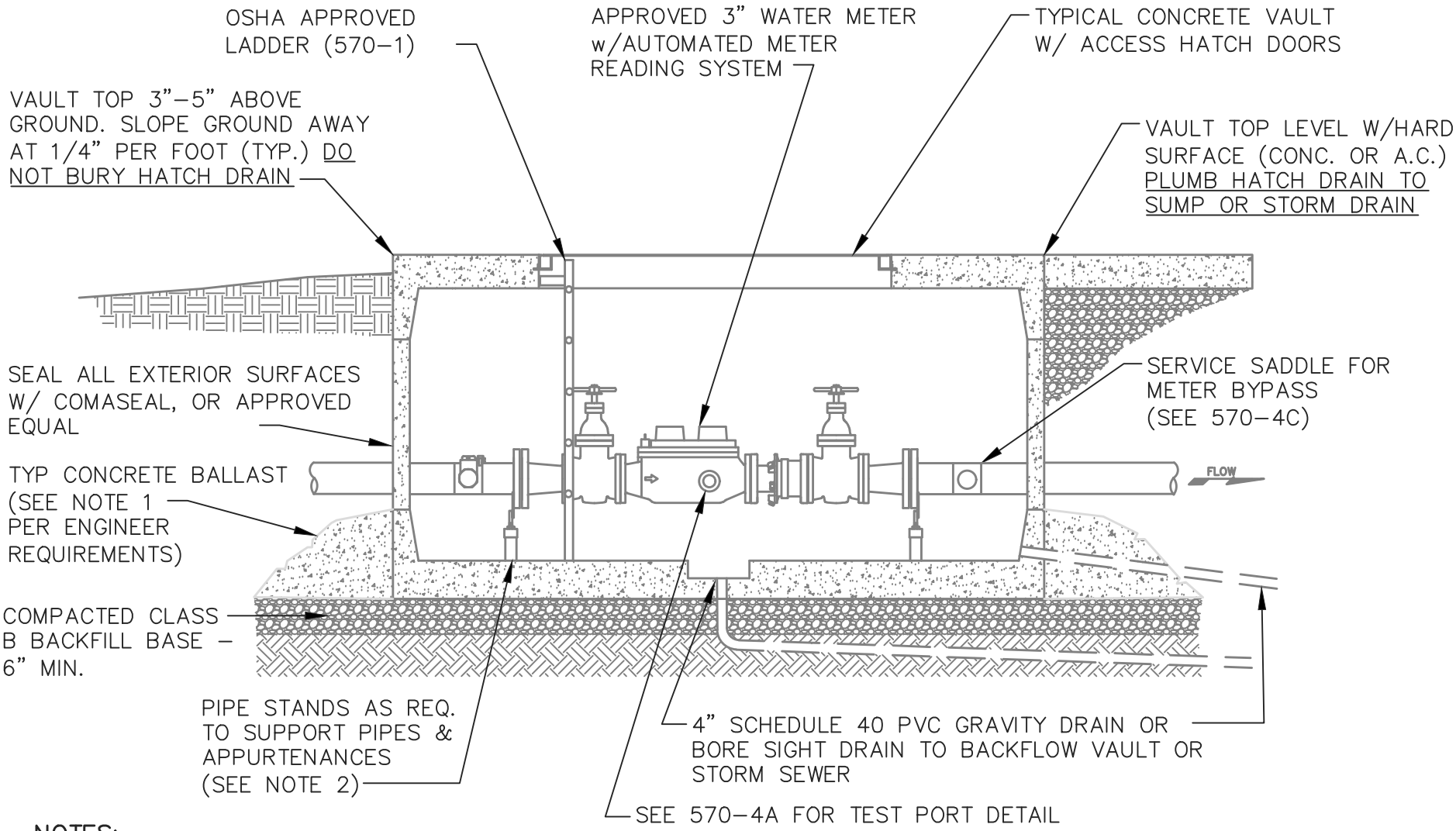
1. METER BODY
2. 1-1/2" X 3" BRASS NIPPLE
3. 1-1/2" BRASS ELL
4. 1-1/2" 300 PSI BRASS BALL VALVE
5. 1-1/2" BRASS PLUG
6. 1-1/2" x 6" BRASS NIPPLE

NOTES:

1. TOP OF VAULT SHALL BE A MINIMUM OF 3"-5" ABOVE FINISH GRADE.
2. CONCRETE BALLAST (3 CUBIC YARDS MINIMUM) IS A MINIMUM FIGURE ONLY - ENGINEER IS RESPONSIBLE TO ENSURE THAT ADEQUATE BALLAST IS PROVIDED TO PREVENT FLOATING OF VAULT.
3. INSTALL 4" DRAIN FROM BOTTOM OF VAULT FLOOR TO DAYLIGHT, TO AN APPROVED STORM SEWER SYSTEM OR PIPED OVER TO THE ACCOMPANYING BACKFLOW VAULT SUMP PUMP DISCHARGE.
4. ALL VAULT WALL OPENINGS SHALL BE CORE DRILLED AND SEALED WITH NON-SHRINK GROUT.
5. SERVICE LINES SHALL BE MECHANICALLY RESTRAINED FROM MAINLINE THROUGH VAULT TO BACKFLOW ASSEMBLY.
6. ALL PIPING AND FITTINGS THROUGH VAULT SHALL BE LEVEL, 18" MINIMUM AND 42" MAXIMUM ABOVE THE FLOOR OF VAULT.
7. BURIED PIPING SHALL BE BACKFILLED AS DESCRIBED AND SHOWN IN 520-1.
8. VAULT SHALL BE EQUIPPED WITH OSHA-APPROVED ALUMINUM EXTENSION LADDER. SEE 570-1.
9. SEE 570-4B ELEVATION VIEW AND 570-4C PLAN VIEW FOR ADDITIONAL REQUIREMENTS.
10. HATCH DOOR DRAIN CHANNEL SHALL BE PLUMBED TO AN APPROVED STORM SEWER OR TO THE VAULT SUMP WHEN INSTALLED FLUSH WITH FINISHED GRADE.
11. *REDUCED INTERIOR DEPTH (I.D.)

| Hillsboro Water | 3" WATER METER VAULT (DETAIL NOTES) | SCALE: NONE<br>DATE: SEPT 2017 | 570-3A |
|---|---|---|---|

FILENAME: 570-3A.DWG

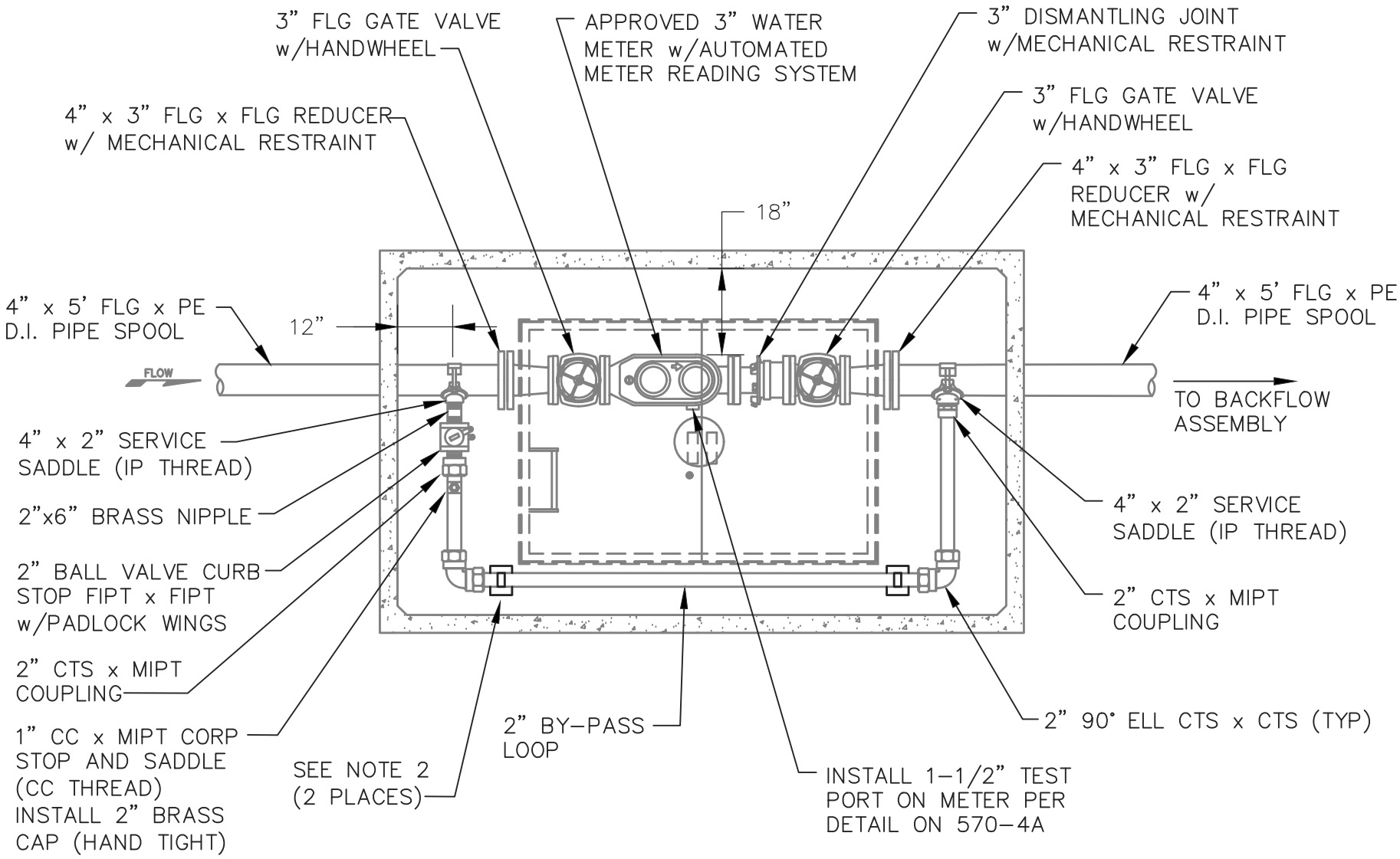



NOTES:

1. SEE 570-4A DETAIL NOTES AND 570-4C PLAN VIEW FOR ADDITIONAL REQUIREMENTS.
2. PIPE SUPPORTS FOR 2" BYPASS NOT SHOWN.

| | | | |
|---|---|---|---|
| Hillsboro Water | **3" WATER METER VAULT (PROFILE)** | **SCALE: NONE** | **570-3B** |
| | | **DATE: SEPT 2017** | |

FILENAME: 570-3B DRAFT.DWG




NOTES:

1. SEE 570-4A DETAIL NOTES AND 570-4B ELEVATION VIEW FOR ADDITIONAL REQUIREMENTS.
2. TYPICAL PIPE SUPPORTS – STANDON MODEL S92.

| | | | |
|---|---|---|---|
| Hillsboro Water | **3" WATER METER VAULT (PLAN)** | **SCALE: NONE** | **570-3C** |
| | | **DATE: SEPT 2017** | |

FILENAME: 570-3C.DWG

## SPECIFICATIONS

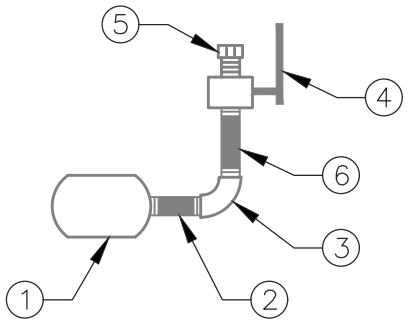
| METER SIZE (IN) | 4" METER | 6" METER | 8" METER | 10" METER |
|---|---|---|---|---|
| INCOMING LINE SIZE | 4" | 6" | 8" | 10" |
| BY-PASS LINE SIZE** | 4" | 6" | 8" | 10" |
| OLDCASTLE VAULT NO. (OR APPROVED EQUAL) | 687-WA (53" I.D.)* | 687-WA (53" I.D.)* | 810-WA (63" I.D.)* | 810-WA (63" I.D.)* |
| HATCH NO. (OR APPROVED EQUAL) SEE NOTE 10 | BILCO: JD-3AL SYRACUSE: CHD-11AL EAST JORDAN: H48721707 | BILCO: JD-3AL SYRACUSE: CHD-11AL EAST JORDAN: H48721707 | BILCO: JD-3AL SYRACUSE: CHD-11AL EAST JORDAN: H48721707 | BILCO: JD-3AL SYRACUSE: CHD-11AL EAST JORDAN: H48721707 |
| METER SPEC. | NEPTUNE TRU-FLO COMPOUND METER W/ R900i E-CODER | NEPTUNE TRU-FLO COMPOUND METER W/ R900i E-CODER | MFR: NEPTUNE. CONTACT WATER DEPT FOR REQUIREMENTS | MFR: NEPTUNE. CONTACT WATER DEPT FOR REQUIREMENTS |

NOTES:

1. TOP OF VAULT SHALL BE A MINIMUM OF 3"–5" ABOVE FINISH GRADE.
2. CONCRETE BALLAST (3 CUBIC YARDS MINIMUM) IS A MINIMUM FIGURE ONLY – ENGINEER IS RESPONSIBLE TO ENSURE THAT ADEQUATE BALLAST IS PROVIDED TO PREVENT FLOATING OF VAULT.
3. INSTALL 4" DRAIN FROM BOTTOM OF VAULT FLOOR TO DAYLIGHT, TO AN APPROVED STORM SEWER SYSTEM OR PIPED OVER TO THE ACCOMPANYING BACKFLOW VAULT SUMP FOR SUMP PUMP DISCHARGE.
4. ALL VAULT WALL OPENINGS SHALL BE CORE DRILLED AND SEALED WITH NON–SHRINK GROUT.
5. SERVICE LINES SHALL BE MECHANICALLY RESTRAINED FROM MAINLINE THROUGH BACKFLOW ASSEMBLY.
6. ALL PIPING AND FITTINGS THROUGH VAULT SHALL BE LEVEL, A MINIMUM OF 18" AND A MAXIMUM OF 42" ABOVE THE FLOOR OF VAULT.
7. BURIED PIPING SHALL BE BACKFILLED AS DESCRIBED AND SHOWN IN 520–1.
8. VAULT SHALL BE EQUIPPED WITH OSHA–APPROVED ALUMINUM EXTENSION LADDER. SEE WTR–300.
9. SEE 570–5B ELEVATION VIEW AND 570–5C PLAN VIEW FOR ADDITIONAL REQUIREMENTS.
10. VAULT HATCH MODELS LISTED ARE FOR INSTALLATION IN NON–TRAFFIC AREAS ONLY.
11. *REDUCED INTERIOR DEPTH (I.D.)

** SMALLER BY-PASS LINE SIZE MAY BE APPROVED UPON REQUEST TO WATER DEPARTMENT.

## TEST PORT DETAIL




KEYNOTES:

1. METER BODY
2. 2" x 3" BRASS NIPPLE
3. 2" BRASS ELL
4. 2" 300 PSI BRASS BALL VALVE
5. 2" BRASS PLUG
6. 2" x 6" BRASS NIPPLE

Hillsboro Water

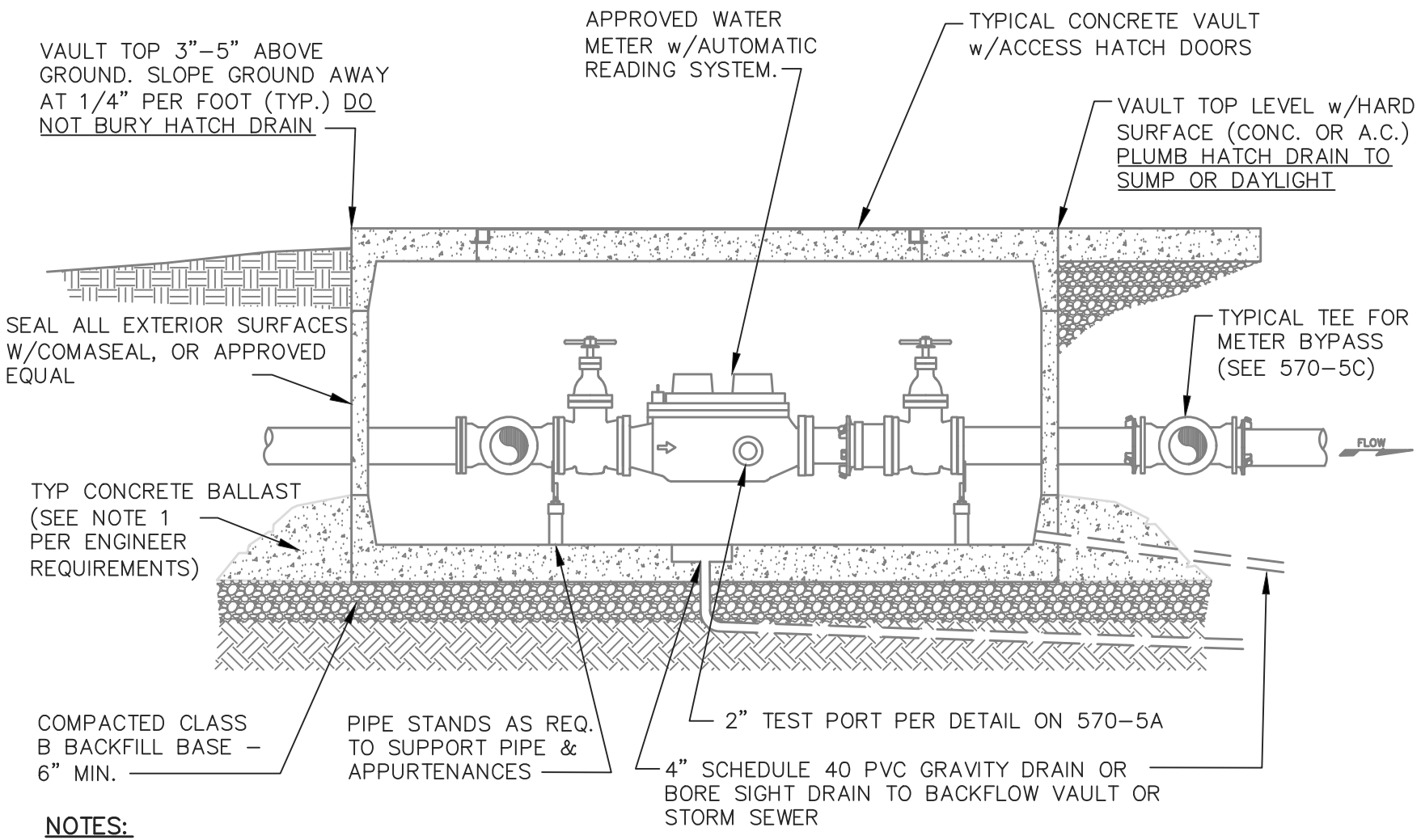
**4" AND LARGER WATER METER VAULT (DETAIL NOTES)**

SCALE: NONE

DATE: SEPT 2017

**570-4A**

FILENAME: 570–4A.DWG

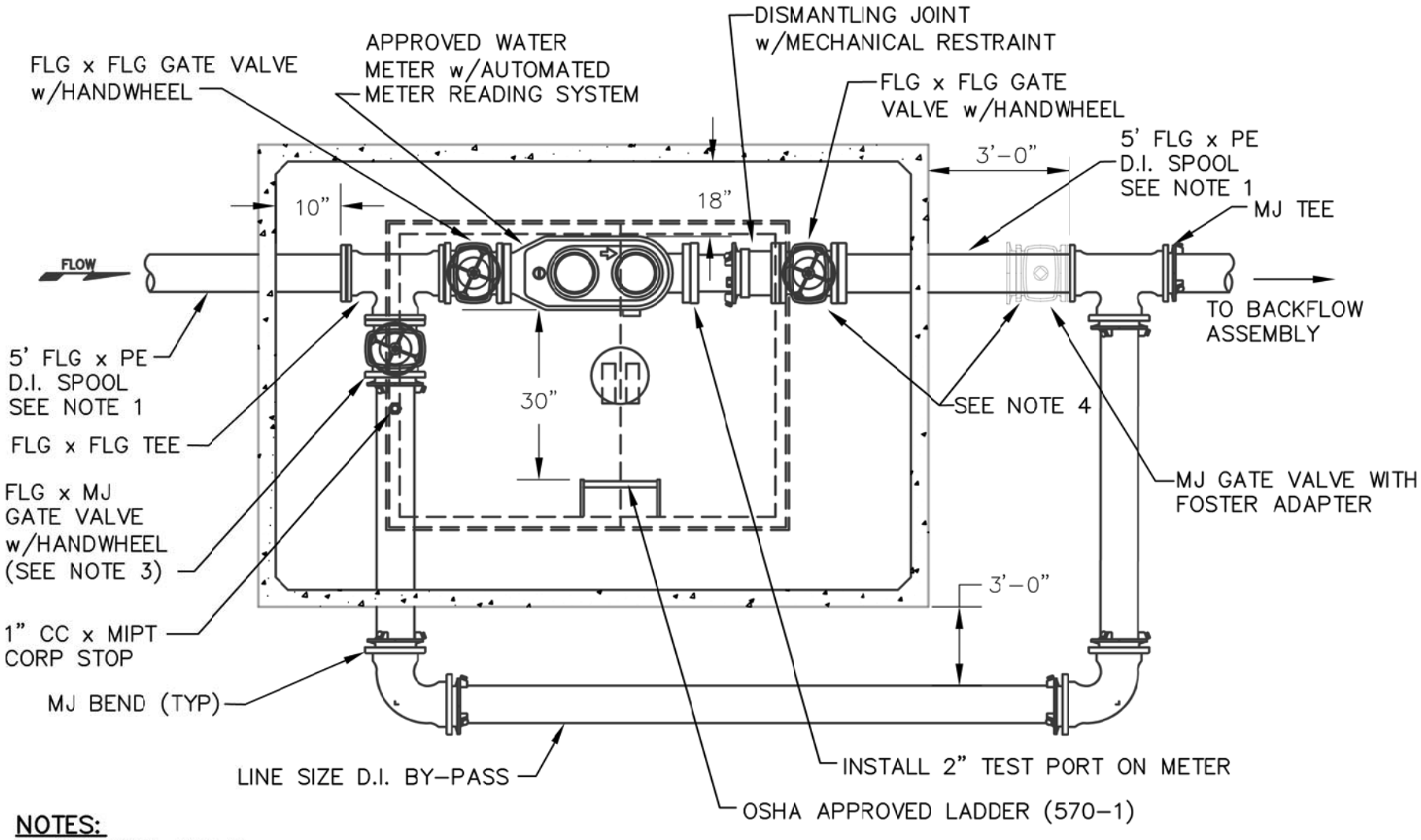



NOTES:

1. SEE 570–5A DETAIL NOTES AND 570–5C PLAN VIEW FOR ADDITIONAL REQUIREMENTS.
2. OSHA APPROVED LADDER NOT SHOWN; SEE PLAN VIEW.

| Hillsboro Water | 4" AND LARGER TYPICAL WATER METER VAULT (PROFILE) | SCALE: NONE<br>DATE: SEPT 2017 | 570-4B |
|---|---|---|---|

FILENAME: 570–4B.DWG




**NOTES:**

1. ALL PIPE AND FITTINGS SHALL MATCH METER SIZE UNLESS OTHERWISE SPECIFIED.
2. SEE 570-5A DETAIL NOTES AND 570-5B ELEVATION VIEW FOR ADDITIONAL REQUIREMENTS.
3. WATER DEPT SHALL INSTALL CHAIN & LOCK ON BYPASS HANDWHEEL TO PREVENT TAMPERING.
4. FOR METERS 10" AND LARGER, DOWNSTREAM VALVE WILL BE INSTALLED AGAINST EXTERIOR TEE.

Hillsboro Water

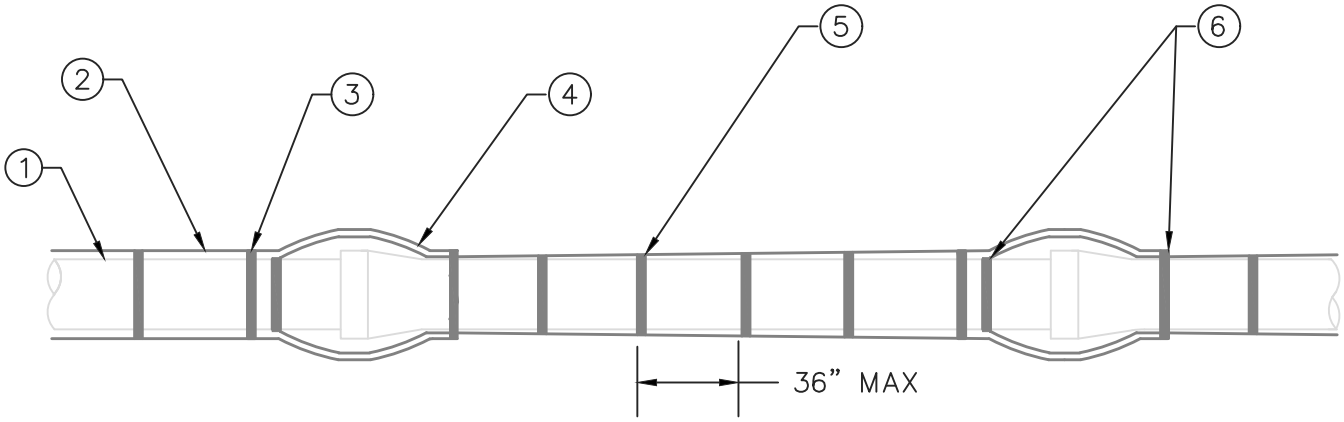
# 4" AND LARGER WATER METER VAULT (PLAN)

SCALE: NONE

DATE: JULY 2018

570-4C

FILENAME: 570-4C.DWG




KEYNOTES:

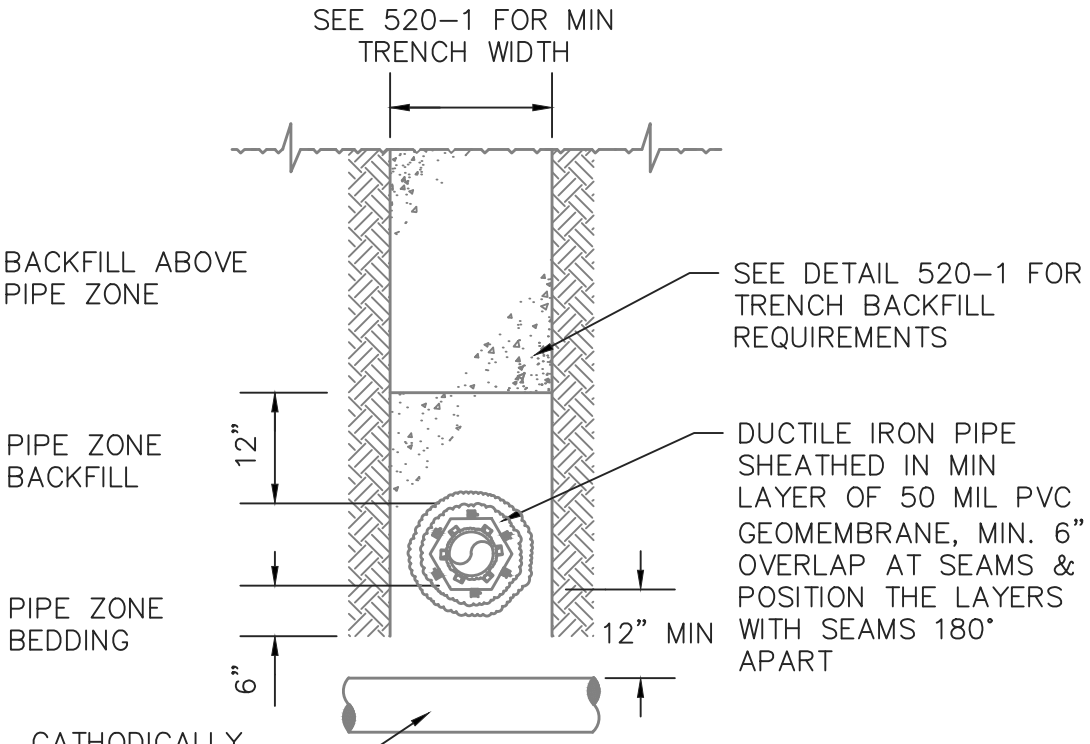
① TYPICAL DUCTILE IRON PIPE WITH PUSH-ON JOINT (SHOWN).
② ONE (1) LAYER 8-MIL HIGH-DENSITY, CROSS-LAMINATED (HDCL) POLYETHYLENE ENCASEMENT TUBE.
③ TYPICAL POLYETHYLENE ADHESIVE TAPE OR PLASTIC TIE STRAPS.
④ LONGITUDINAL OVERLAP POLYETHYLENE TUBE 1-FT MINIMUM AT EACH PIPE JOINT.
⑤ FOLD EXCESS TUBE MATERIAL SNUG AGAINST PIPE AND SECURE IN PLACE.
⑥ SECURE EACH END OF POLYETHYLENE TUBE.

NOTES:

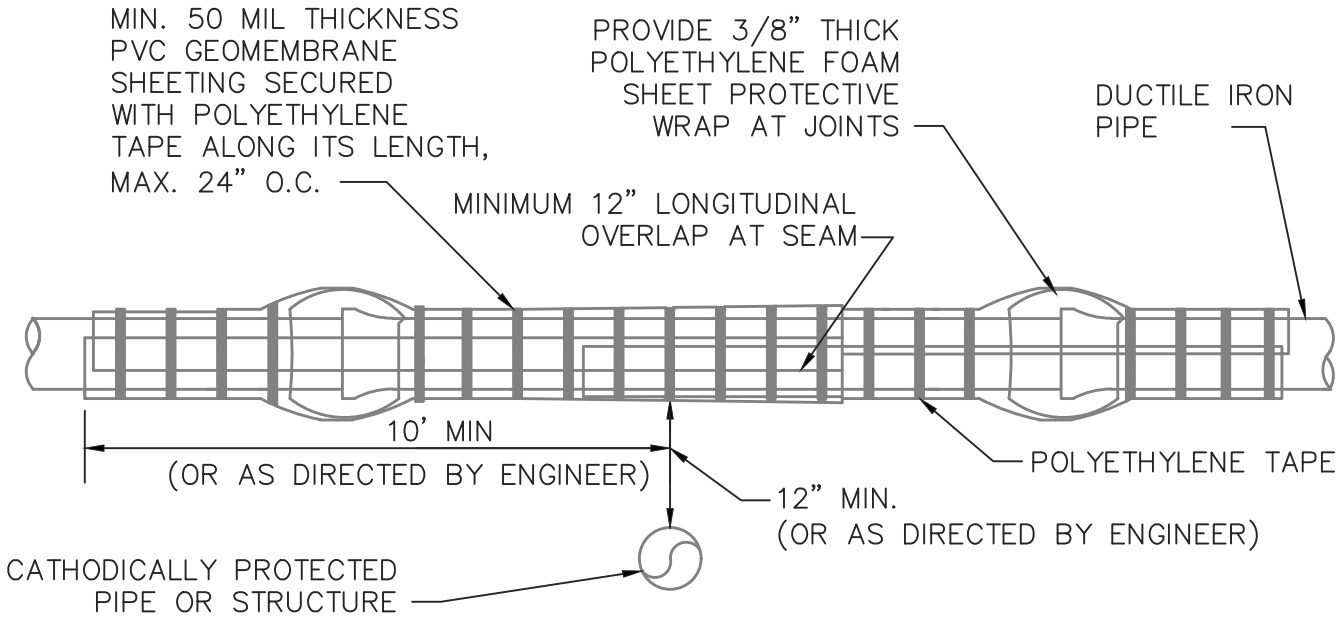
1. INSTALL POLYTHEYLENE TUBE IN ACCORDANCE WITH ANSI/AWWA C105/A21.5 METHOD A.
2. CLEAN PIPE SURFACE OF CLAY, MUD, DEBRIS, ETC. BEFORE INSTALLING POLYETHYLENE ENCASEMENT.
3. PROTECT POLYETHYLENE-ENCASED PIPE WHEN LIFTING OR HANDLING.
4. REPAIR ALL SMALL RIPS, TEARS, OR OTHER DAMAGE TO POLYETHYLENE TUBE WITH ADHESIVE TAPE, OR COVER THE DAMAGED AREA WITH A POLYETHYLENE SHEET AND SEAL THE EDGES WITH ADHESIVE TAPE.
5. AVOID DAMAGE TO POLYETHYLENE DURING BACKFILLING AND COMPACTION WORK.

| Hillsboro Water | HDCL POLYETHYLENE ENCASEMENT FOR D.I. PIPE | SCALE: NONE<br>DATE: SEPT 2017 | 580-1 |
|---|---|---|---|

FILENAME: 580-1 DRAFT.DWG

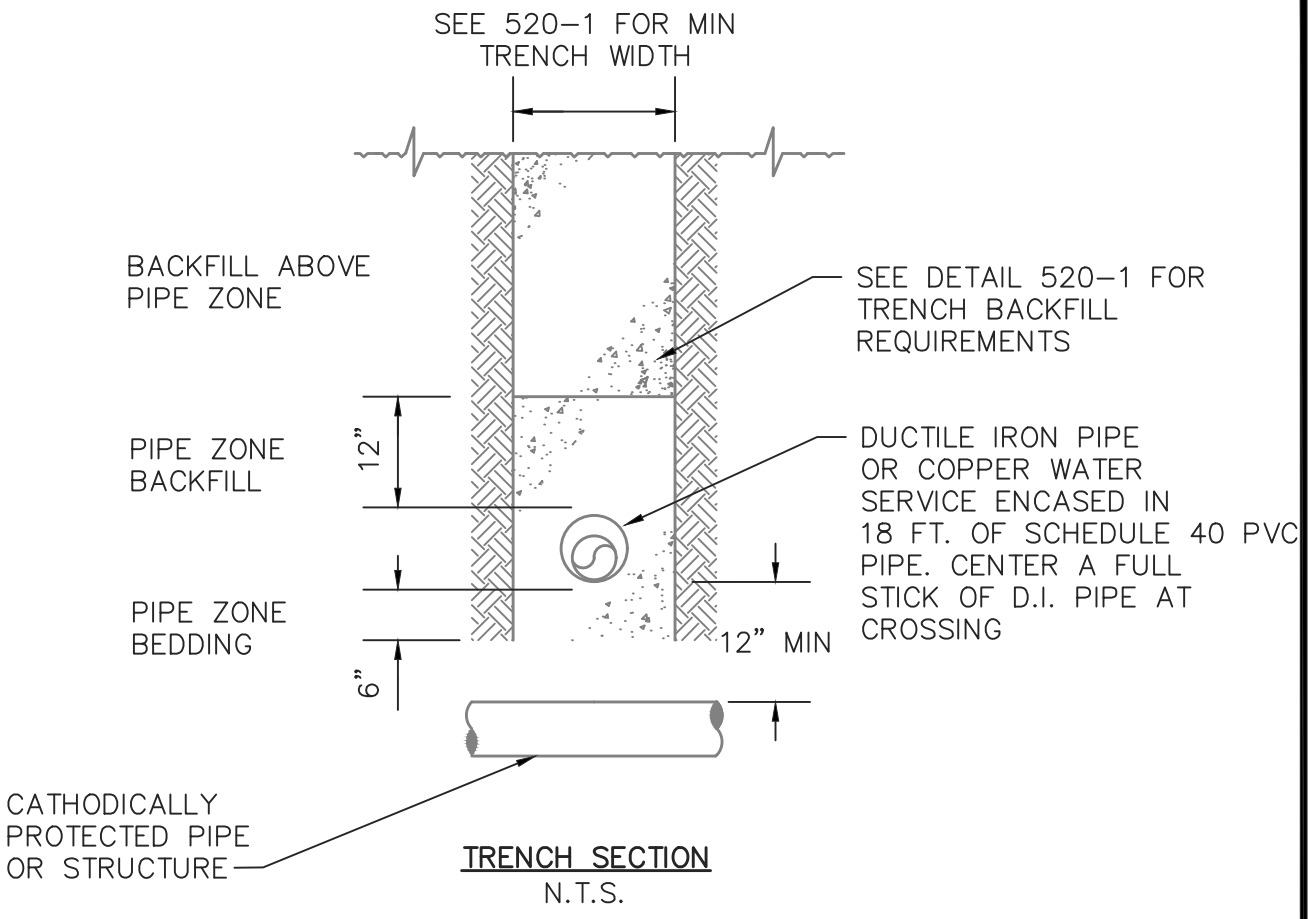



TRENCH SECTION
N.T.S.

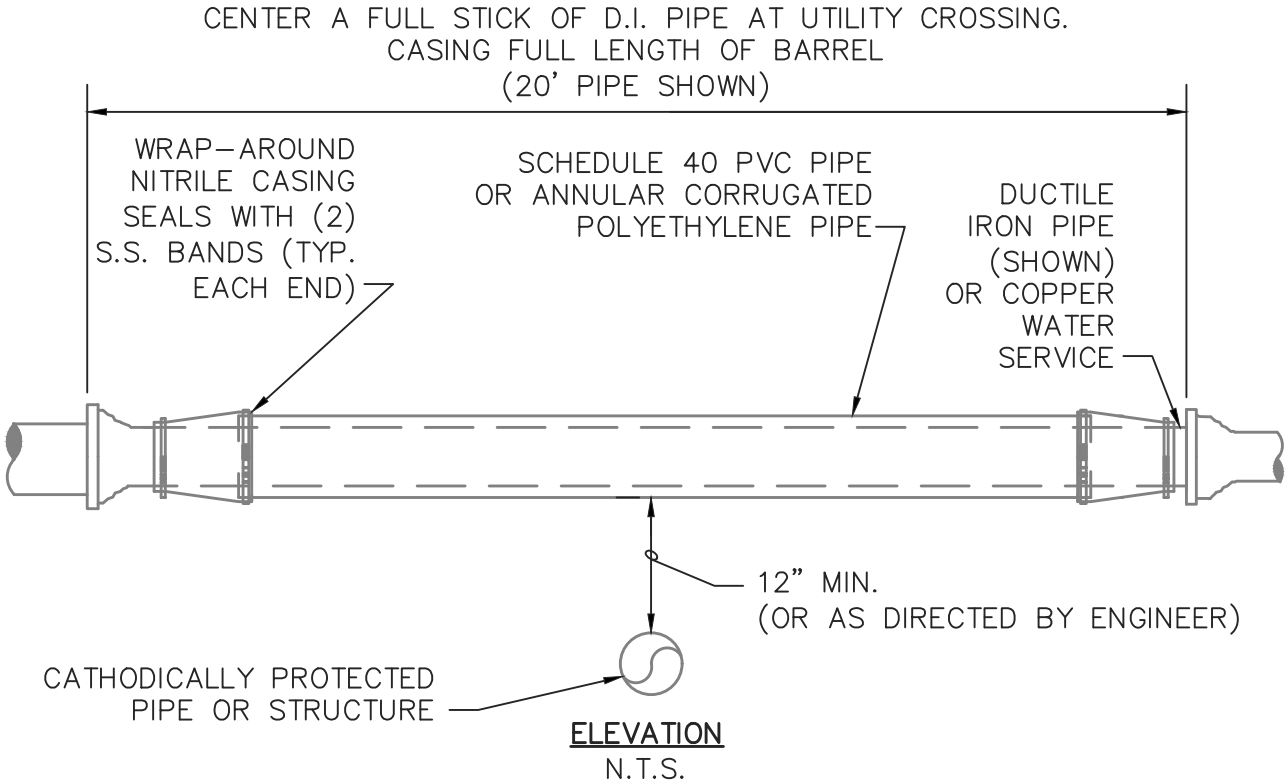



ELEVATION
N.T.S.

| | | | |
|---|---|---|---|
| Hillsboro Water | **PROTECTIVE GEOMEMBRANE FOR CROSSING CATHODICALLY PROTECTED PIPES OR STRUCTURES** | **SCALE: NONE**<br>**DATE: SEPT 2017** | **580-2** |



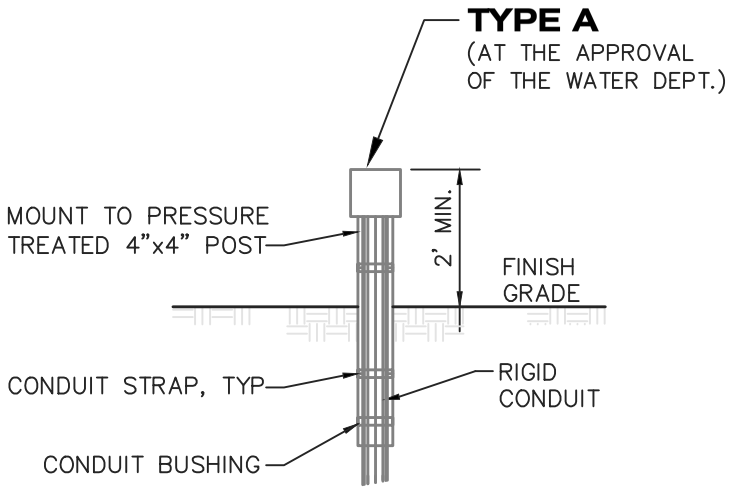

TRENCH SECTION
N.T.S.

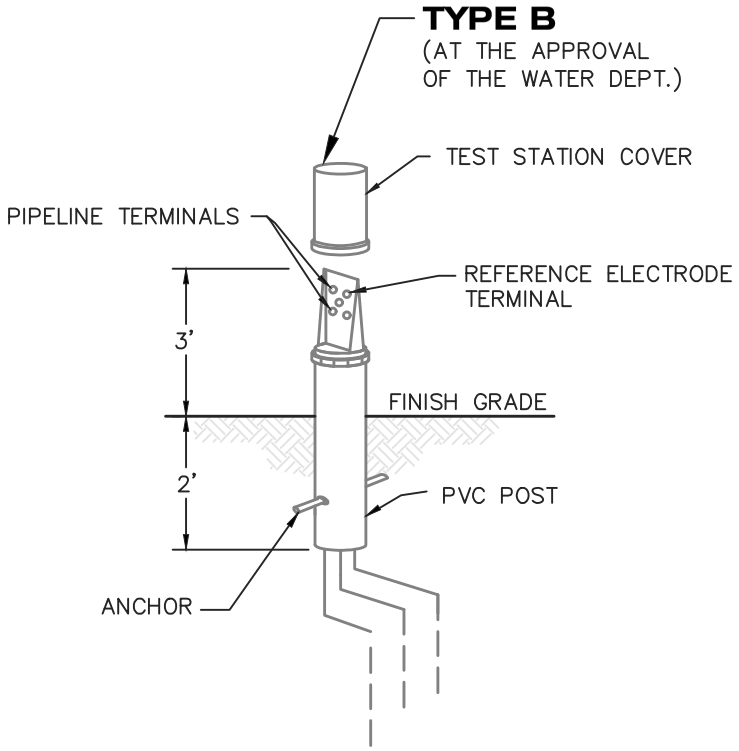



ELEVATION
N.T.S.

| Hillsboro Water | PROTECTIVE CASING FOR CROSSING CATHODICALLY PROTECTED PIPES OR STRUCTURES | SCALE: NONE<br>DATE: SEPT 2017 | 580-3 |
|---|---|---|---|

TEST STATION MOUNTING TYPES:

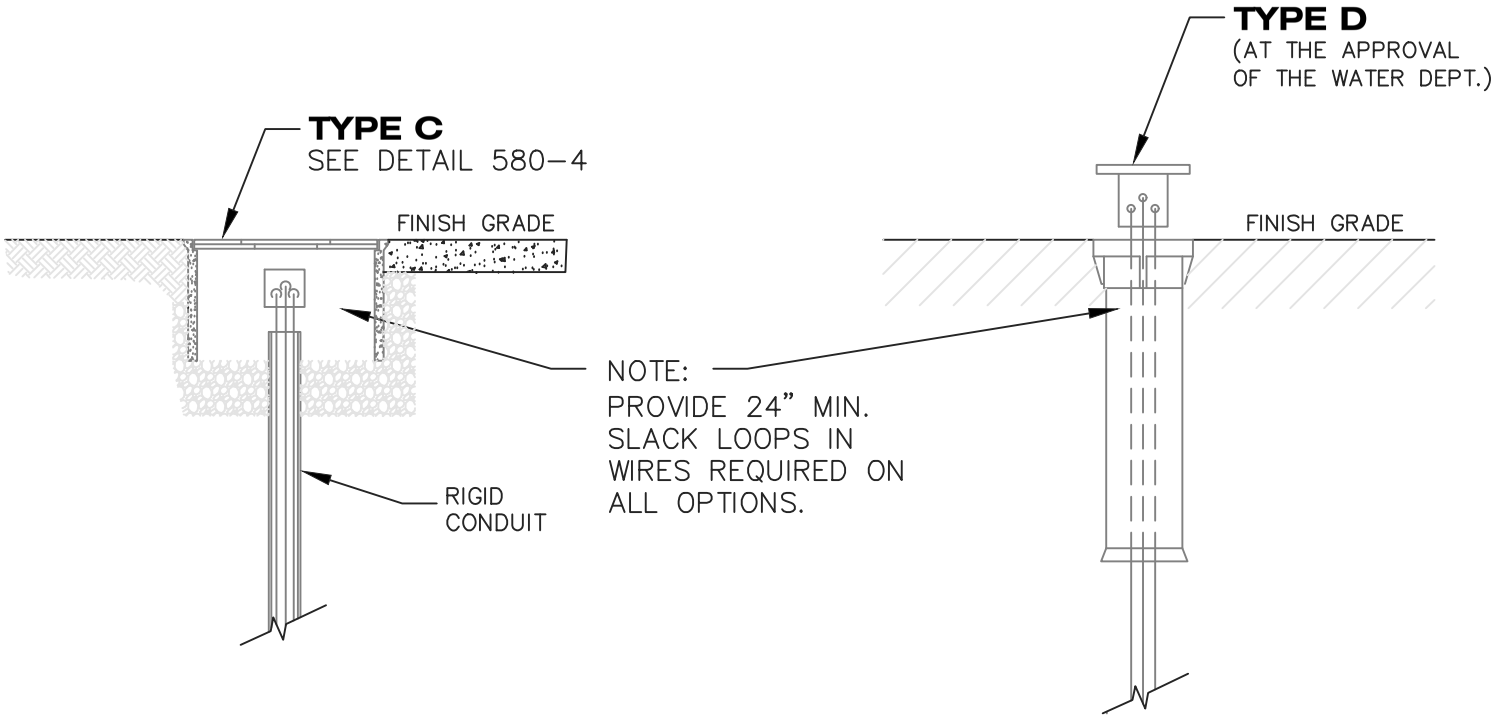



| | | | |
|---|---|---|---|
| Hillsboro Water | **COMBINED CP TEST STATION ABOVE GRADE INSTALLATION DETAILS** | **SCALE: NONE** <br> **DATE: SEPT 2017** | **580-4A** |

FILENAME: 580-4A DRAFT.DWG

TEST STATION MOUNTING TYPES:

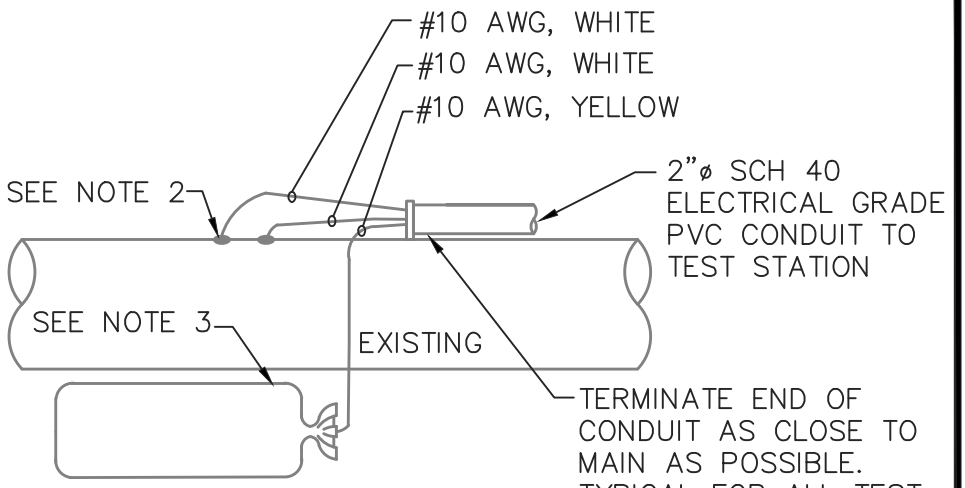



| | | | |
|---|---|---|---|
| Hillsboro Water | **COMBINED CP TEST STATION BELOW GRADE INSTALLATION DETAILS** | **SCALE: NONE** <br> **DATE: SEPT 2017** | **580-4B** |

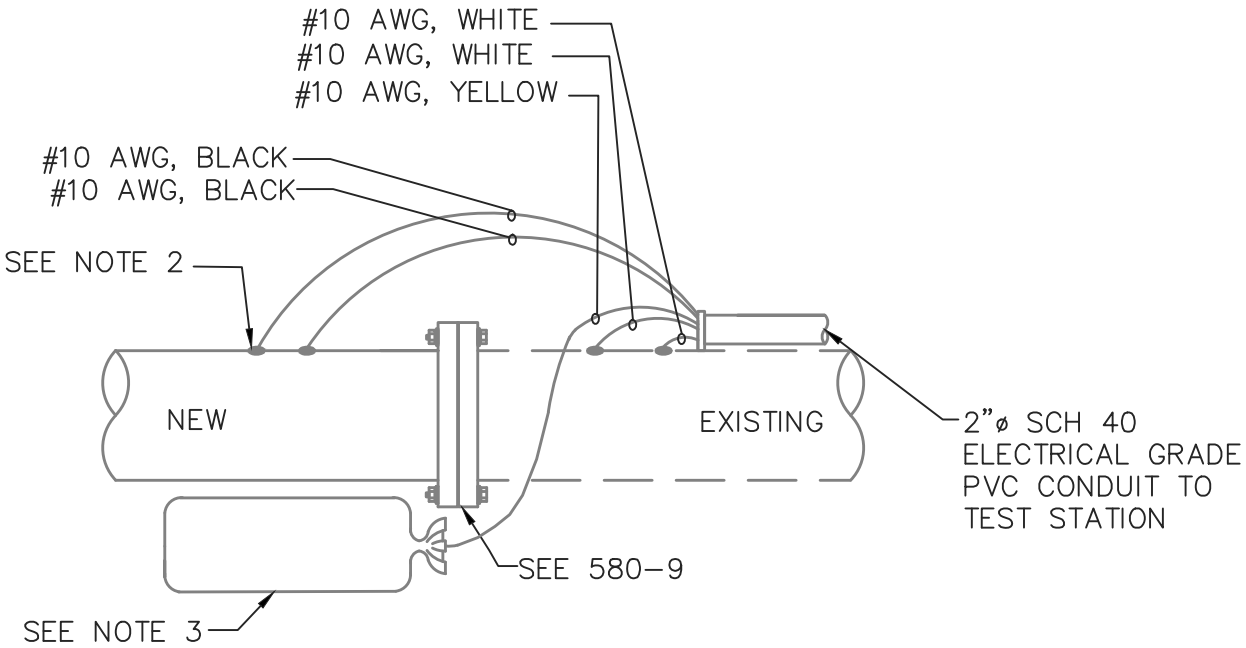
FILENAME: 580–4B DRAFT.DWG

NOTES:

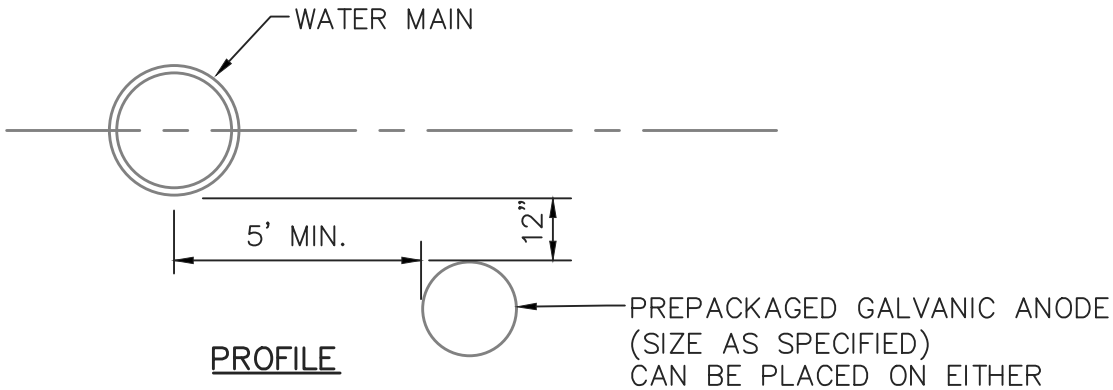
1. WIRE INSTALLATION PER DESIGN & CONST. STD SECTION 580.
2. WIRE CONNECTION, SEE DETAIL 580–7A AND 580–7B.
3. PREPACKAGED GALVANIC ANODE SEE PROFILE BELOW




STANDARD 3–WIRE TEST STATION

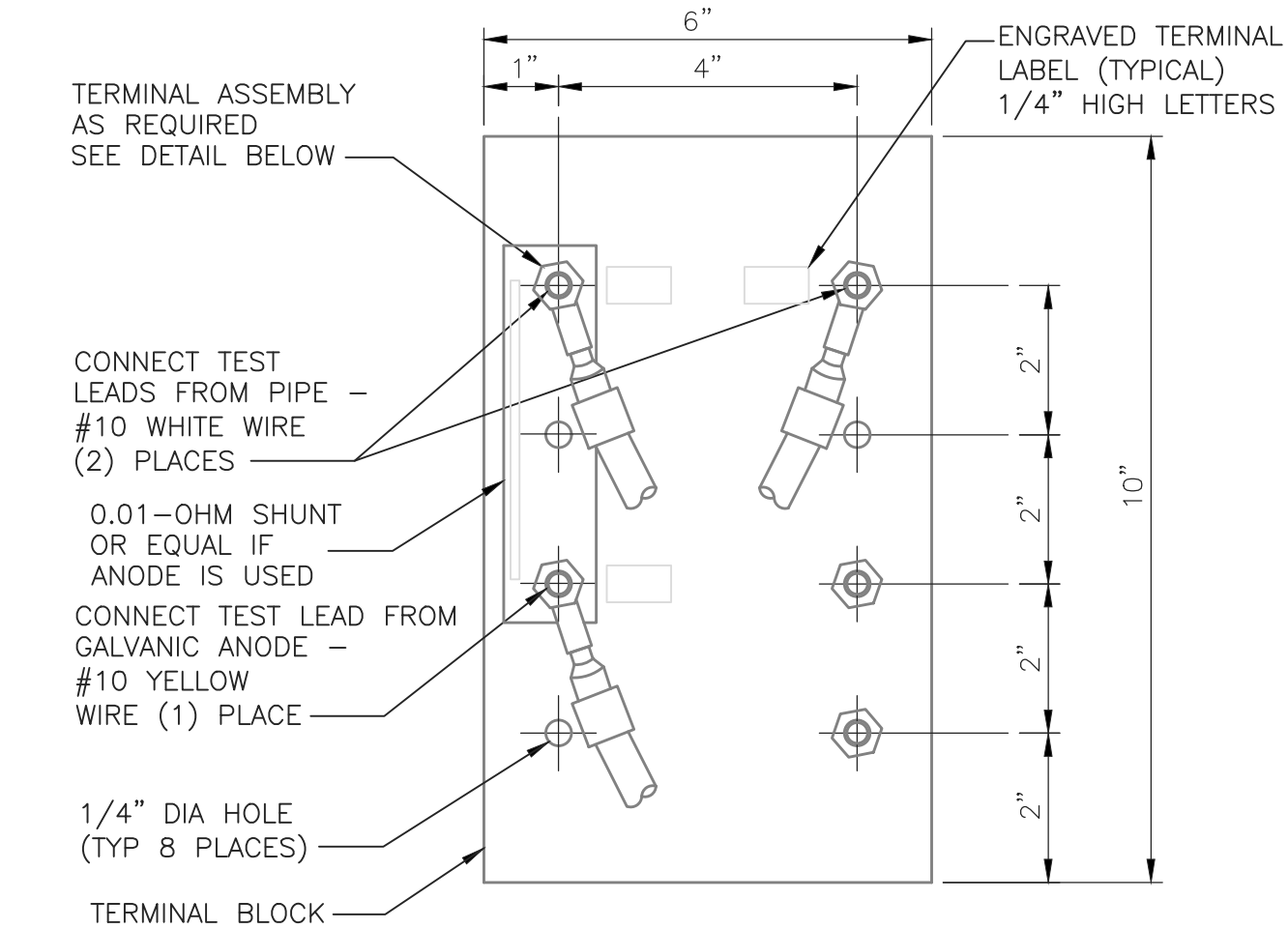


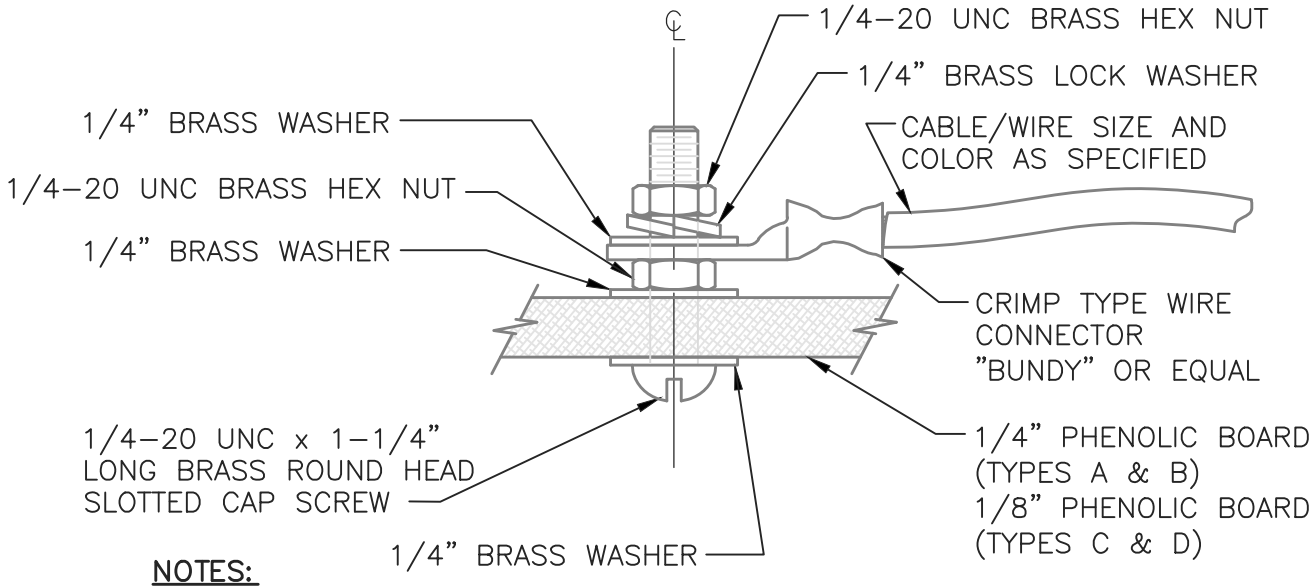

INSULATING FLANGE 5–WIRE TEST STATION




PROFILE

| | | | |
|---|---|---|---|
| Hillsboro Water | **ELECTROLYSIS TEST STATION WIRE INSTALLATION** | **SCALE: NONE** | **580-5** |
| | | **DATE: SEPT 2017** | |



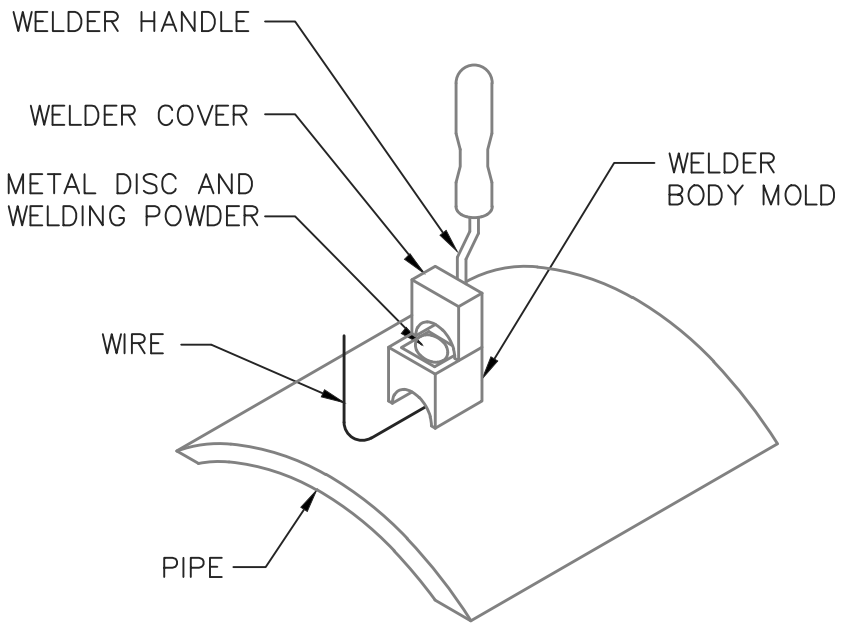




NOTES:

1. PROVIDE SUFFICIENT SLACK IN ALL WIRES SO THAT TEST BOARD CAN BE LIFTED TWO (2) FEET OUT OF TEST BOX.
2. WIRE SHALL BE HMWPE, THWN, XHHW OR RW INSULATED.

| Hillsboro Water | TERMINAL BOARD TEST STATION - TYPES A-D | SCALE: NONE<br>DATE: SEPT 2017 | 580-6 |
|---|---|---|---|

FILENAME: 580–6 DRAFT.DWG



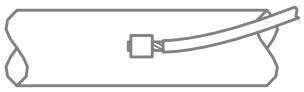

NOTES:

1. PLACE METAL DISC IN BOTTOM OF MOLD BEFORE POURING WELDING POWDER INTO MOLD.

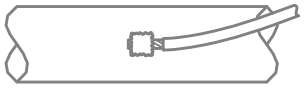
2. INSTALLATION STEPS:

A. FILE CONNECTION AREA (3" x 3") TO BARE SHINY METAL AND CLEAN.

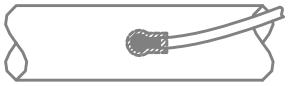
B. STRIP INSULATION FROM WIRE. INSTALL COPPER SLEEVE AS REQUIRED.



C. HOLD WELDER FIRMLY WITH OPENING AWAY FROM FACE AND IGNITE WITH FLINT GUN. WEAR HAND AND EYE PROTECTION, AND ANY OTHER RECOMMENDED PPE.



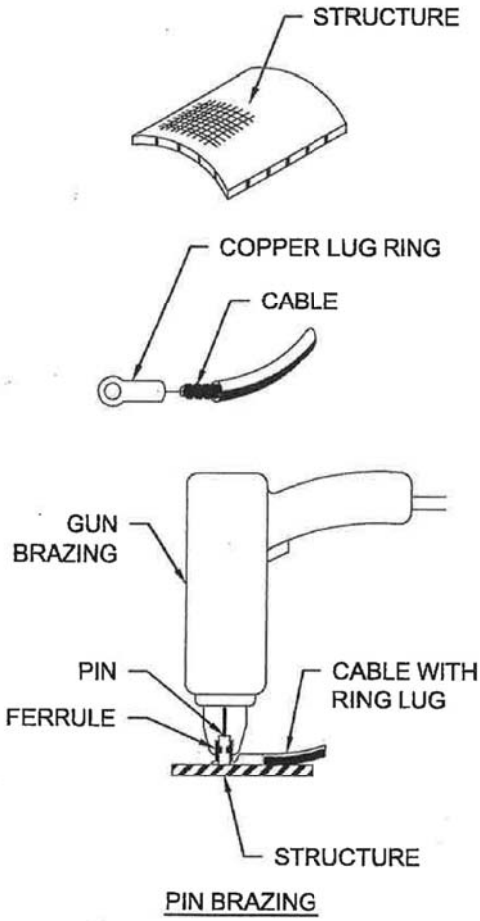
D. REMOVE SLAG FROM CONNECTION AND PEEN WELD FOR SOUNDNESS.



E. FOR CONNECTION TO DUCTILE IRON PIPE, COVER CONNECTION WITH THERMITE WELD CAP, MAKING CERTAIN THAT ALL COPPER IS COVERED. COAT ENTIRE WELD AREA WITH COAL TAR MASTIC.

F. FOR CONNECTION TO MORTAR COATED STEEL PIPE, COVER CONNECTION WITH COAL TAR MASTIC BEFORE REPAIRING MORTAR COATING.

| Hillsboro Water | EXOTHERMIC WELDING PROCEDURE - CABLE TO PIPE CONNECTIONS | SCALE: NONE<br>DATE: SEPT 2017 | 580-7A |
|---|---|---|---|



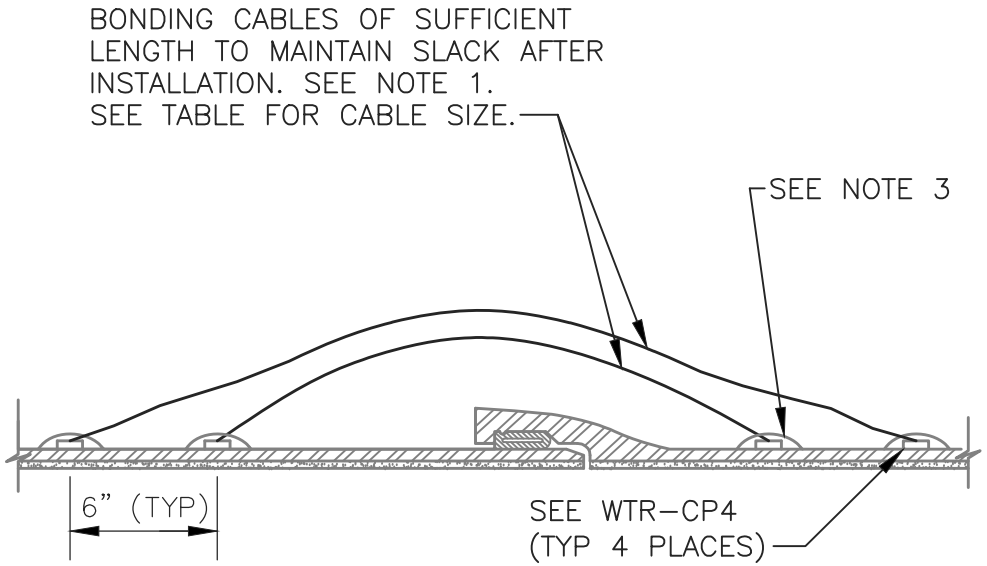

PIN BRAZING

1. DEGREASE AND CLEAN STRUCTURE TO BARE, BRIGHT METAL WITH MECHANICAL DEVICES.
2. STRIP WIRE INSULATION AND ATTACH FROM WIRE AND ATTACH A BAC M1 COMPRESSION TERMINAL OR APPROVED EQUAL.
3. LOAD THE BRAZING GUN WITH A DIRECT BRAZING PIN AND FERRULE. USE A THREADED, TYPE CONNECTION FOR ABOVE-GROUND USE ONLY.
4. BRAZE THE CABLE TO THE PIPE. EXTRA MATERIAL REQUIRED FOR DI OR CI PIPE.
5. TEST BRAZE BY BREAKING OFF THE SHANK OF THE PLAIN PIN WITH A HAMMER.
6. COVER CONNECTION WITH MASTIC FILLED WELD CAP AND BITUMASTIC COATING 80% SOLIDS BY VOLUME OVER WELD CAP AND ALL EXPOSED METAL.
7. ALL WELDS SHALL BE A MINIMUM OF 6" APART.
8. ALLOW WELD COATING TO CURE PER MANUF. RECOM. BEFORE BURIAL.

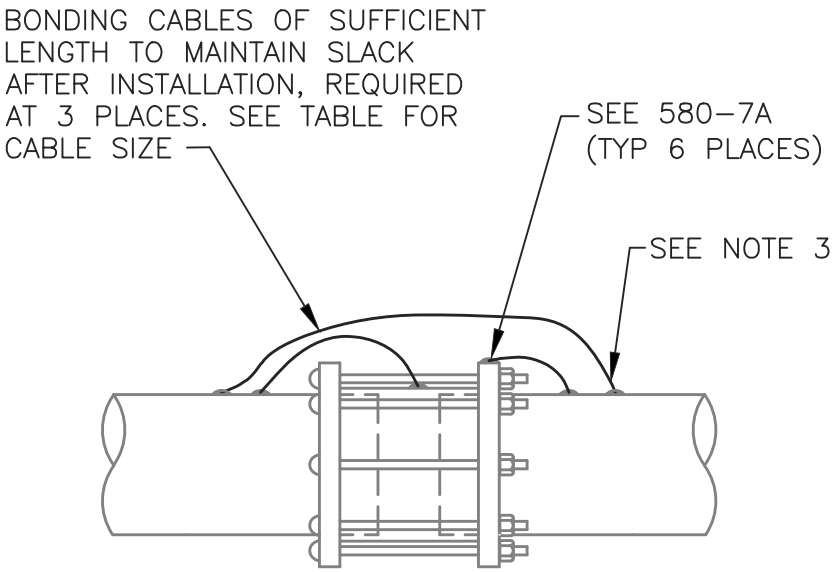
NOTE:

1. PROCEDURE SHOWN ABOVE IS TO BE USED AS A GENERAL GUIDE ONLY. CONSULT MANUFACTURER'S LITERATURE FOR SPECIFIC INSTALLATION INSTRUCTIONS. ALL WELDS SHALL BE A MINIMUM OF 12" APART.

| Hillsboro Water | PIN BRAZING PROCEDURE - CABLE TO PIPE CONNECTIONS | SCALE: NONE<br>DATE: SEPT 2017 | 580-7B |
|---|---|---|---|




BELL AND SPIGOT RUBBER GASKET JOINT




FLEXIBLE COUPLING OR EXPANSION JOINT

NOTES:

1. TWO BONDING CABLES REQUIRED FOR EACH PIPE JOINT. CABLES TO BE INSTALLED SEPARATELY, APPROX 6" APART ON PIPE.
2. WHEN TEST CABLES ARE REQUIRED, INSTALL IN SAME MANNER AS BONDING CABLES.
3. REPAIR EXTERIOR PIPE COATING IN ACCORDANCE WITH PIPE MANUFACTURER'S RECOMMENDATIONS.

| BONDING CABLE SIZES FOR DUCTILE IRON PIPE | |
|---|---|
| PIPE DIAMETER | CABLE SIZE |
| 2" TO 6" | #8 AWG/HMWPE |
| 8" TO 20" | #4 AWG/HMWPE |
| 24" AND LARGER | #2 AWG/HMWPE |

Hillsboro Water

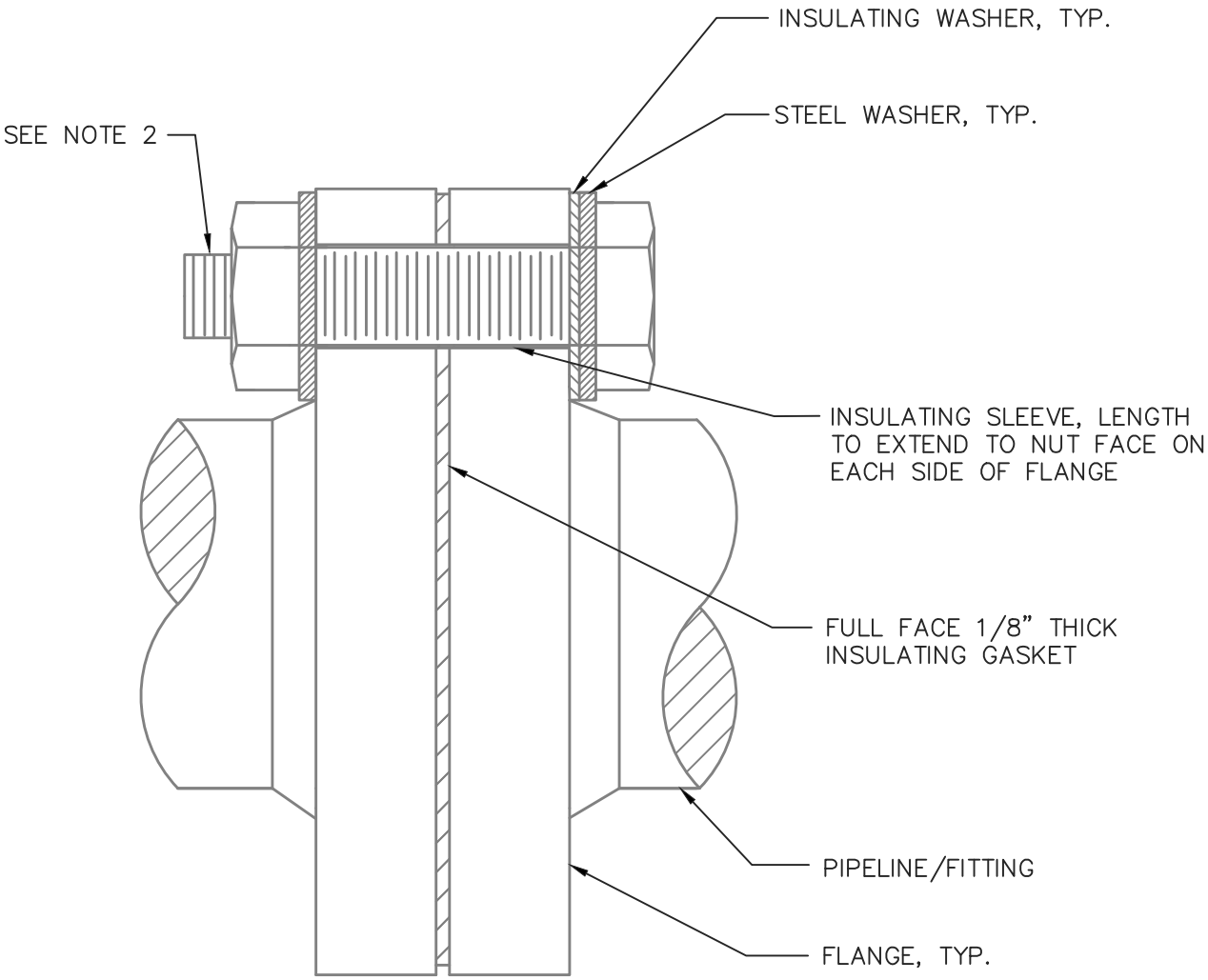
**BONDING OF D.I. PIPE JOINTS AND FITTINGS**

SCALE: NONE

DATE: SEPT 2017

580-8

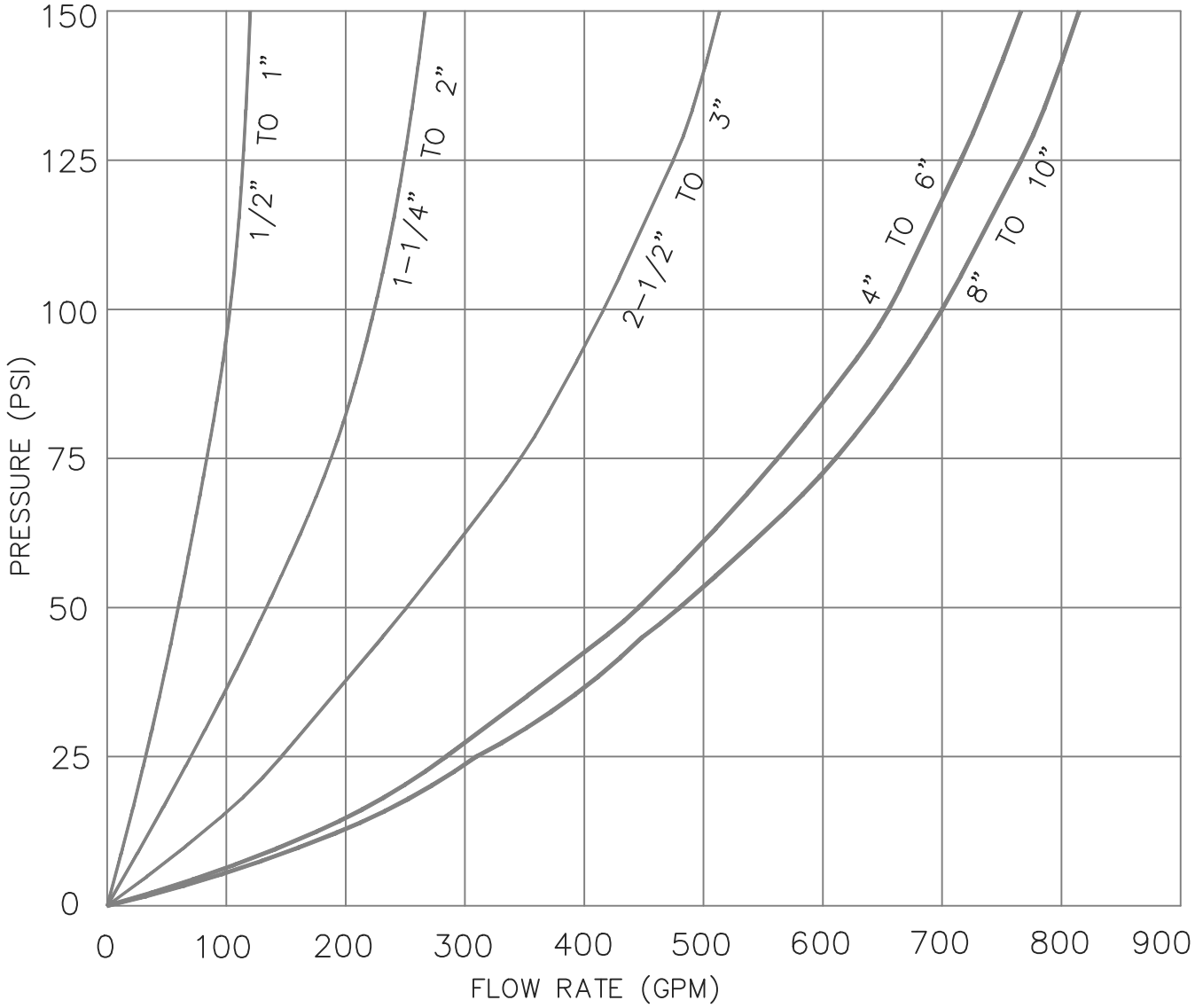
FILENAME: 580-8.DWG




NOTES:

1. BELOW GRADE INSULATING FLANGE INSTALLATION AS SHOWN.
2. BOLT LENGTH SHALL BE LONG ENOUGH TO HAVE A MINIMUM OF THREE THREADS EXPOSED BEYOND NUT WHEN FULLY TIGHTENED.

| Hillsboro Water | STANDARD INSULATING FLANGE | SCALE: NONE<br>DATE: SEPT 2017 | 580-9 |
|---|---|---|---|




APPROXIMATE RELIEF VALVE DISCHARGE RATES
FOR REDUCED PRESSURE BACKFLOW ASSEMBLIES

| MAXIMUM FLOW (GPM) PER DRAIN PIPE SIZE FOR EFFECTIVE DRAINAGE OF R.P. DISCHARGE INTO A VAULT. SEE NOTE BELOW. | |
|---|---|
| PIPE SIZE | FLOW (GPM) |
| 2.5" | 105 |
| 3" | 262 |
| 4" | 1620 |

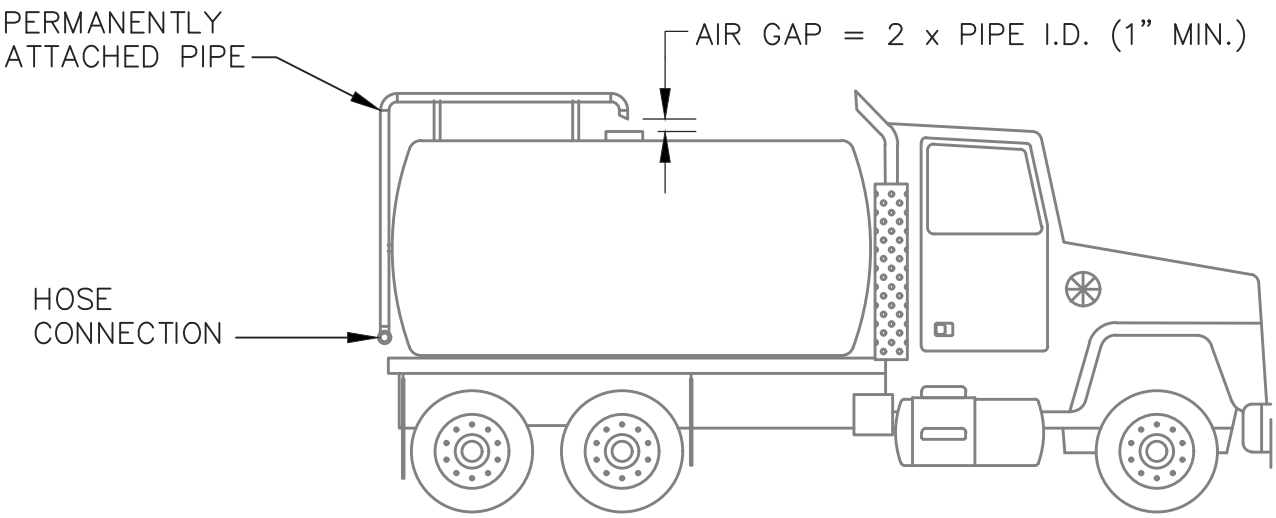
NOTE:

CARE SHOULD BE TAKEN TO ENSURE THAT THE ENTIRE DRAINAGE SYSTEM HAS ADEQUATE CAPACITY TO CARRY THE CONTINUOUS DISCHARGE RATES SHOWN ABOVE. DESIGNER SHALL BE RESPONSIBLE FOR PROVIDING ADEQUATELY SIZED DRAIN LINES FOR THE APPLICABLE RELIEF VALVE DISCHARGE RATE. FOR PARALLEL ASSEMBLIES, THE DRAINAGE SYSTEM SHOULD BE DESIGNED FOR THE DISCHARGE FROM BOTH ASSEMBLIES.

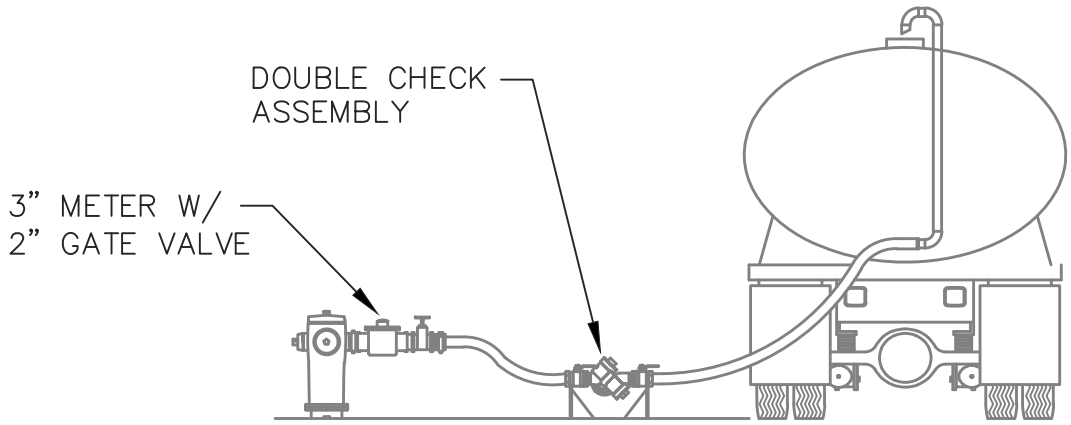
| Hillsboro Water | REDUCED PRESSURE BACKFLOW ASSEMBLY (RP) DISCHARGE RATES | SCALE: NONE<br>DATE: SEPT 2017 | 640-10 |
|---|---|---|---|

FILENAME: 640-10.DWG

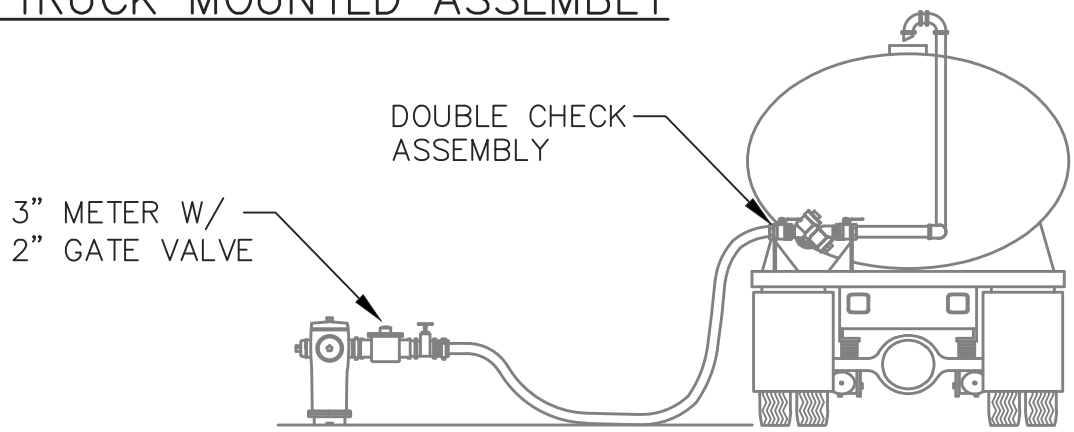
## WITH AIR GAP




## WITH PORTABLE ASSEMBLY




## WITH TRUCK MOUNTED ASSEMBLY




## NOTES:

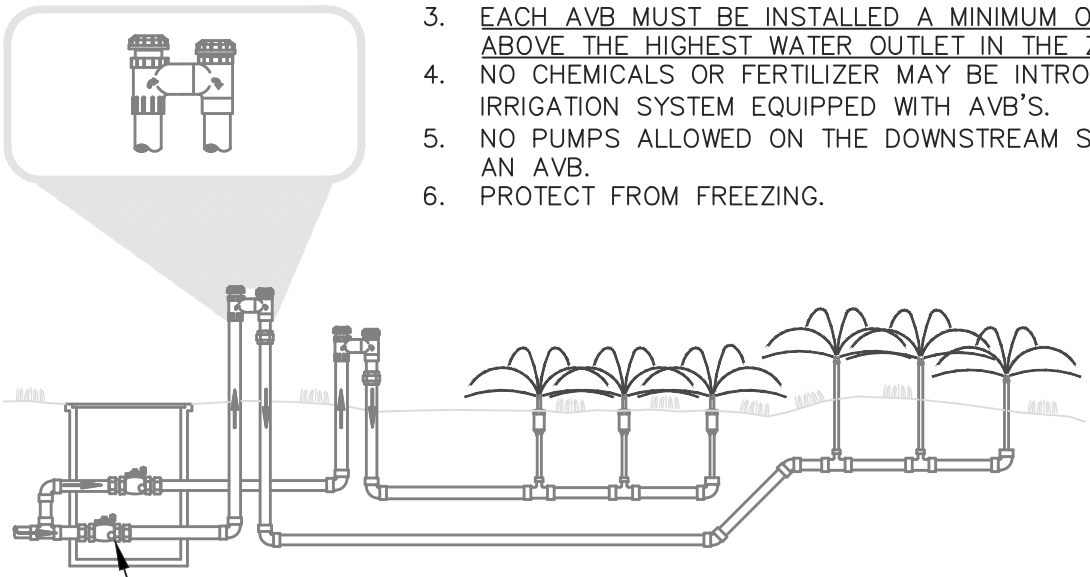
1. REMOVE CHAPMAN VALVE AND HOSE FROM HYDRANT WHEN DONE FILLING TRUCK.
2. CROSS CONNECTION PROTECTION TO BE VERIFIED BY WATER DEPARTMENT WHEN PURCHASING BULK WATER PERMIT.

| Hillsboro Water | CROSS CONNECTION PROTECTION FOR TANKER TRUCKS | SCALE: NONE<br>DATE: SEPT 2017 | 640-1 |
|---|---|---|---|

FILENAME: 640–1 DRAFT.DWG

## A V B – ATMOSPHERIC VACUUM BREAKER

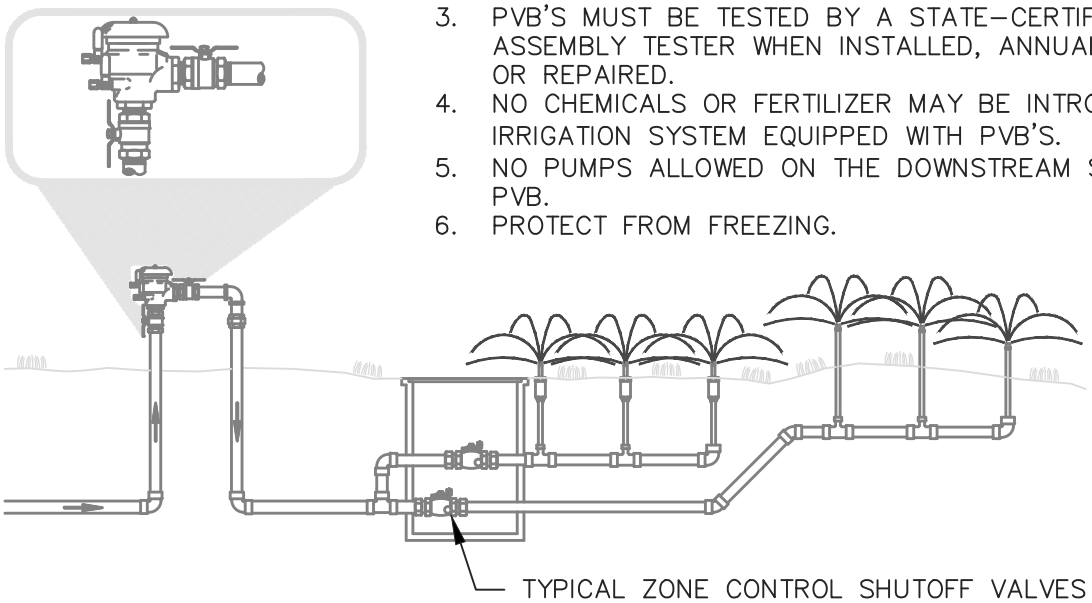
1. ONE AVB REQUIRED FOR EACH IRRIGATION ZONE.
2. NO CONTROL VALVES (ON/OFF VALVES) ALLOWED DOWNSTREAM OF (AFTER) AN AVB.
3. EACH AVB MUST BE INSTALLED A MINIMUM OF SIX INCHES (6") ABOVE THE HIGHEST WATER OUTLET IN THE ZONE IT SERVES.
4. NO CHEMICALS OR FERTILIZER MAY BE INTRODUCED INTO AN IRRIGATION SYSTEM EQUIPPED WITH AVB'S.
5. NO PUMPS ALLOWED ON THE DOWNSTREAM SIDE OF (AFTER) AN AVB.
6. PROTECT FROM FREEZING.



TYPICAL UPSTREAM SHUTOFF VALVES WITH DRAIN

## P V B – PRESSURE VACUUM BREAKER ASSEMBLY

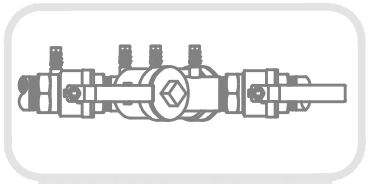
1. ONLY ONE PVB REQUIRED TO SERVE THE ENTIRE SYSTEM. CONTROL VALVES (ON/OFF VALVES) ARE ALLOWED DOWNSTREAM OF (AFTER) THE PVB.
2. PVB'S MUST BE INSTALLED A MINIMUM OF ONE FOOT (12") ABOVE THE HIGHEST WATER OUTLET.
3. PVB'S MUST BE TESTED BY A STATE–CERTIFIED BACKFLOW ASSEMBLY TESTER WHEN INSTALLED, ANNUALLY, AND WHEN MOVED OR REPAIRED.
4. NO CHEMICALS OR FERTILIZER MAY BE INTRODUCED INTO AN IRRIGATION SYSTEM EQUIPPED WITH PVB'S.
5. NO PUMPS ALLOWED ON THE DOWNSTREAM SIDE OF (AFTER) A PVB.
6. PROTECT FROM FREEZING.



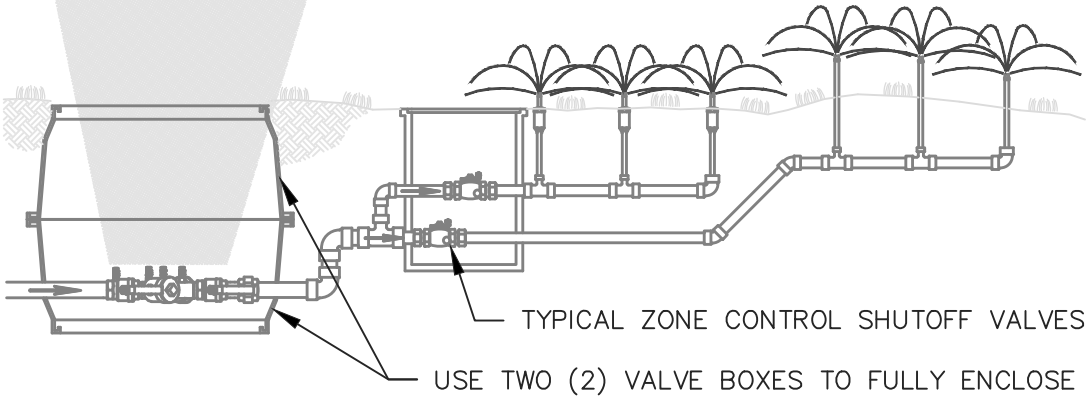
TYPICAL ZONE CONTROL SHUTOFF VALVES

| | | | |
|---|---|---|---|
| Hillsboro Water | **BACKFLOW PREVENTERS FOR RESIDENTIAL IRRIGATION SYSTEMS** | **SCALE: NONE**<br>**DATE: SEPT 2017** | **640-2A** |

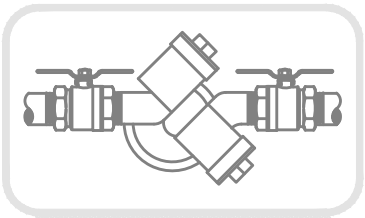
## D C – DOUBLE CHECK VALVE ASSEMBLY



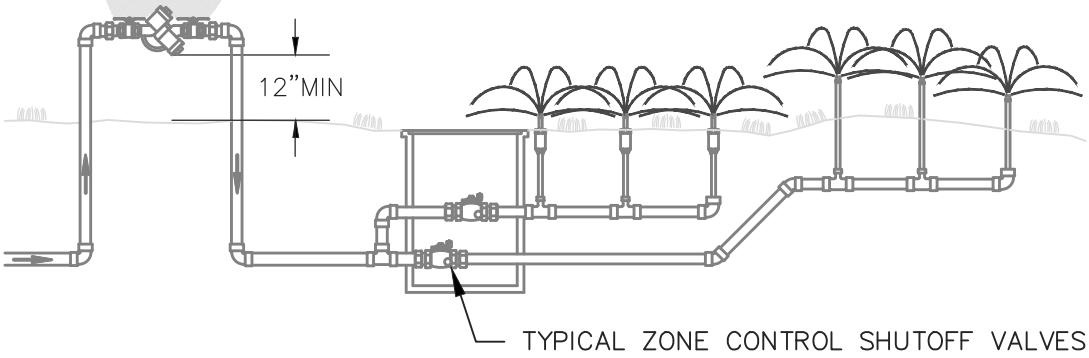
1. ONLY ONE DC REQUIRED TO SERVE THE ENTIRE SYSTEM. CONTROL VALVES (ON/OFF VALVES) ARE ALLOWED DOWNSTREAM OF (AFTER) THE DC.
2. DC MUST BE TESTED BY A STATE–CERTIFIED BACKFLOW ASSEMBLY TESTER WHEN INSTALLED, ANNUALLY, AND WHEN MOVED OR REPAIRED.
3. NO CHEMICALS OR FERTILIZER MAY BE INTRODUCED INTO AN IRRIGATION SYSTEM EQUIPPED WITH A DC.
4. SEE DETAIL WTR–BF20A OR 640–3B FOR INSTALLATION REQUIREMENTS.
5. PROTECT FROM FREEZING.



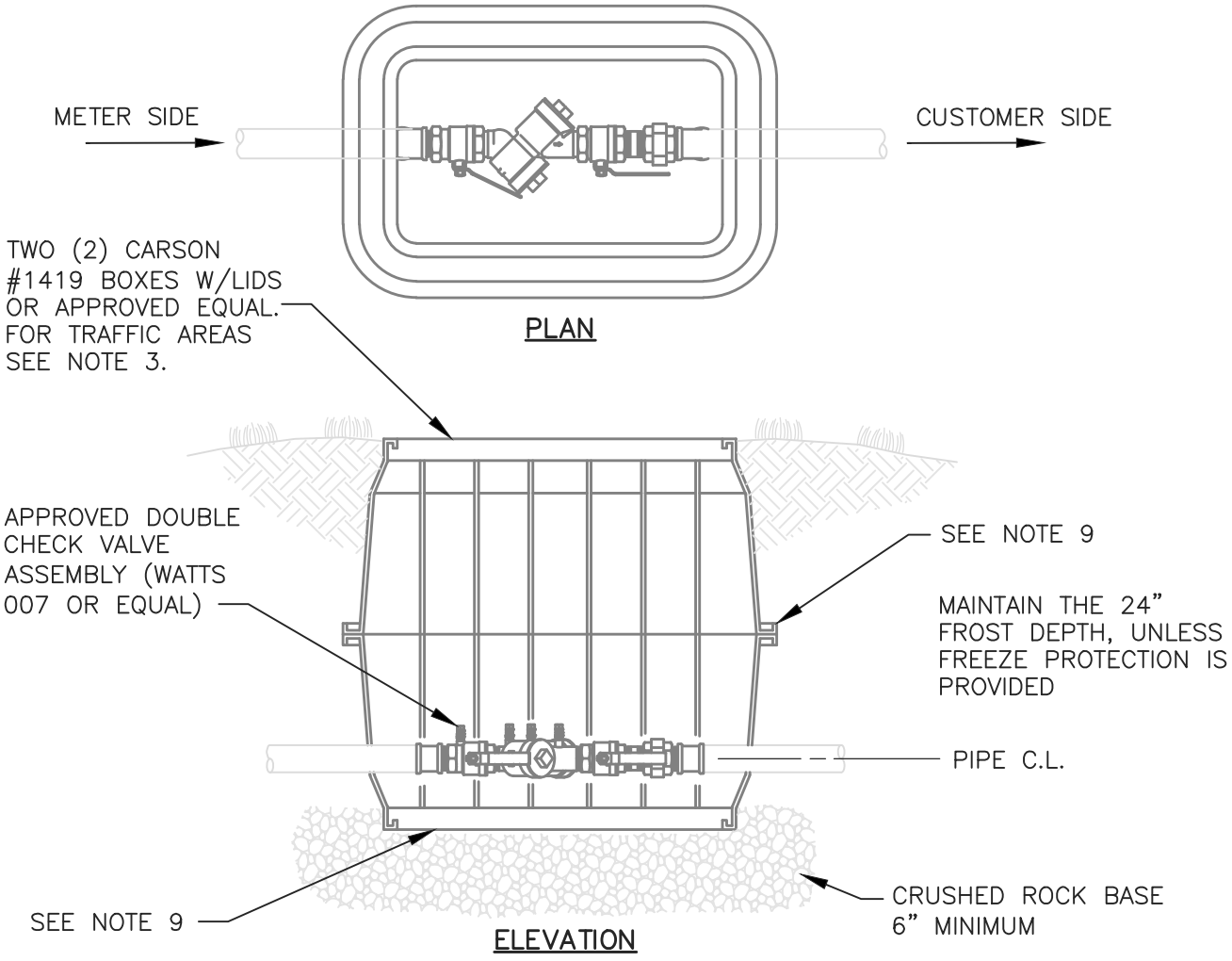

## R P – REDUCED PRESSURE PRINCIPLE BACKFLOW ASSY.



1. ONLY ONE RP REQUIRED TO SERVE THE ENTIRE SYSTEM. CONTROL VALVES (ON/OFF VALVES) ARE ALLOWED DOWNSTREAM OF (AFTER) THE RP.
2. RP MUST BE INSTALLED A MINIMUM OF ONE FOOT (12") ABOVE GROUND LEVEL.
3. RP MUST BE TESTED BY A STATE–CERTIFIED BACKFLOW ASSEMBLY TESTER WHEN INSTALLED, ANNUALLY, AND WHEN MOVED OR REPAIRED.
4. IN A RP–EQUIPPED SYSTEM, FERTILIZER AND OTHER AGRICULTURAL CHEMICALS MAY BE INTRODUCED DOWNSTREAM OF (AFTER) THE RP.
5. PROTECT FROM FREEZING.



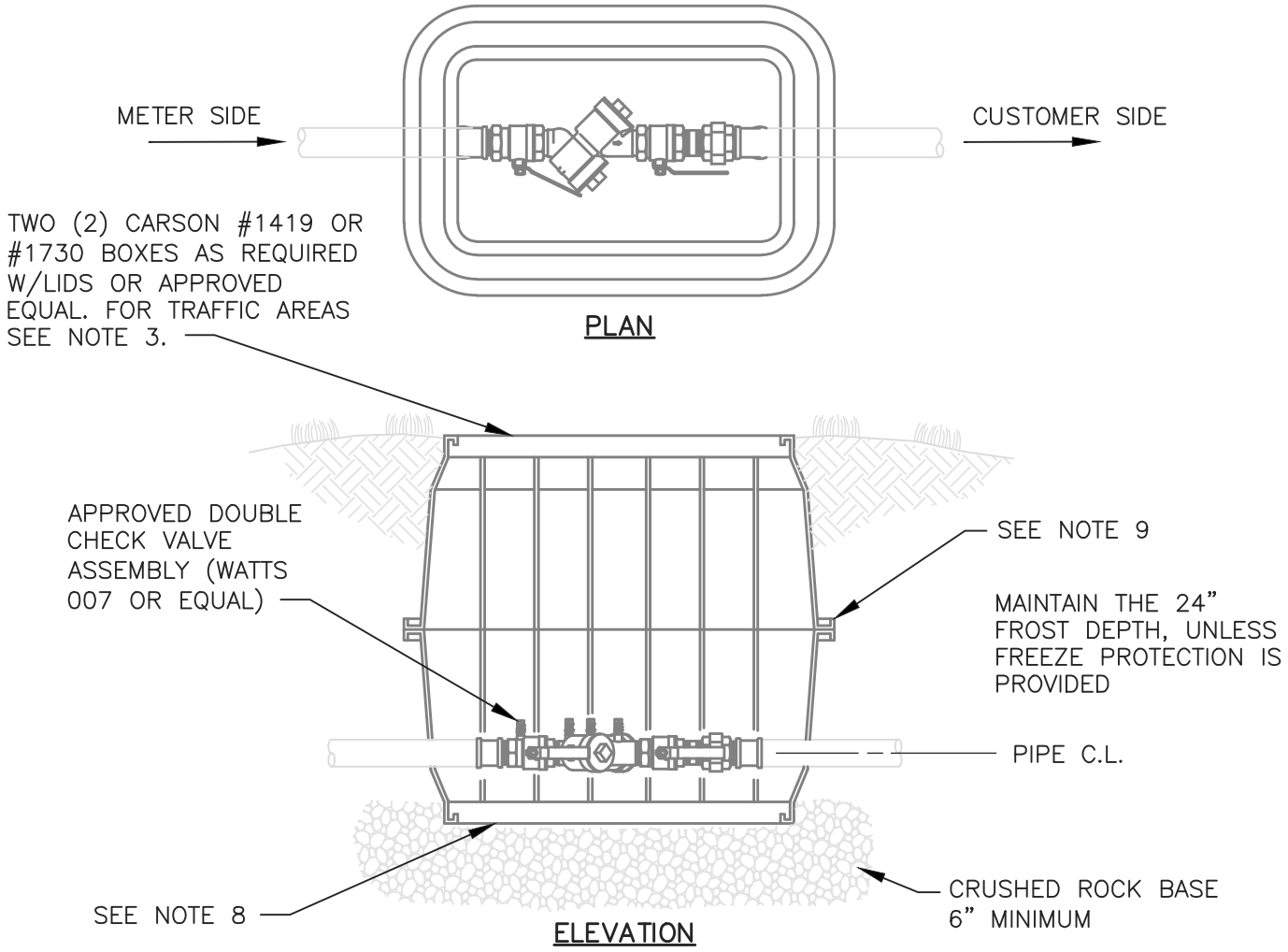

| | | | |
|---|---|---|---|
| Hillsboro Water | **TYPICAL BACKFLOW PREVENTERS FOR RESIDENTIAL IRRIGATION SYSTEMS** | **SCALE: NONE**<br>**DATE: SEPT 2017** | **640-2B** |




## NOTES:

1. PLACE DC WITHIN PROPERTY LINE AS CLOSE TO METER AS POSSIBLE WITH NO CONNECTIONS OR TEES BETWEEN METER AND DC.
2. BACKFLOW PREVENTION ASSEMBLIES FOR THE PROTECTION OF THE PUBLIC WATER SYSTEM SHALL MEET THE REQUIREMENTS SET FORTH IN THE CURRENT EDITIONS OF OREGON ADMINISTRATIVE RULES (OAR) CHAPTER 333-061-0070 AND THE OREGON PLUMBING SPECIALTY CODE (OPSC).
3. ALL BOXES LOCATED IN TRAFFIC AREAS SHALL BE RATED FOR THE ANTICIPATED LOADS AND FURNISHED WITH APPROVED TRAFFIC-RATED COVERS.
4. DC'S SHALL BE READILY ACCESSIBLE WITH ADEQUATE SPACE FOR TESTING AND MAINTENANCE. PROVIDE AT LEAST 6 INCHES OF CLEARANCE ON BOTH SIDES AND BELOW THE DC.
5. WHEN THE DC IS INSTALLED BELOW GROUND, THE TEST PORTS MUST NOT FACE DOWNWARD. TEST PORTS MUST BE PROVIDED WITH PLASTIC OR BRASS PLUGS.
6. THE DC SHALL BE INSTALLED AT A DEPTH OF 24 INCHES BELOW GROUND. IF FREEZE PROTECTION IS PROVIDED, THE 24 INCH DEPTH MAY BE REDUCED.
7. CONTACT HILLSBORO BUILDING DEPARTMENT FOR THE REQUIRED PLUMBING PERMIT.
8. UPON COMPLETION OF INSTALLATION, THE DC MUST BE TESTED BY A STATE CERTIFIED BACKFLOW TESTER.
9. CONNECT BOXES TOGETHER WITH CORROSION-RESISTANT FASTENERS TO FORM A SINGLE ENCLOSURE. SECURE THE LID OF THE LOWER BOX TO PREVENT DEBRIS FROM ENTERING.
10. CONSULT WITH BUILDING DEPARTMENT FOR PROPER SIZING OF DC.

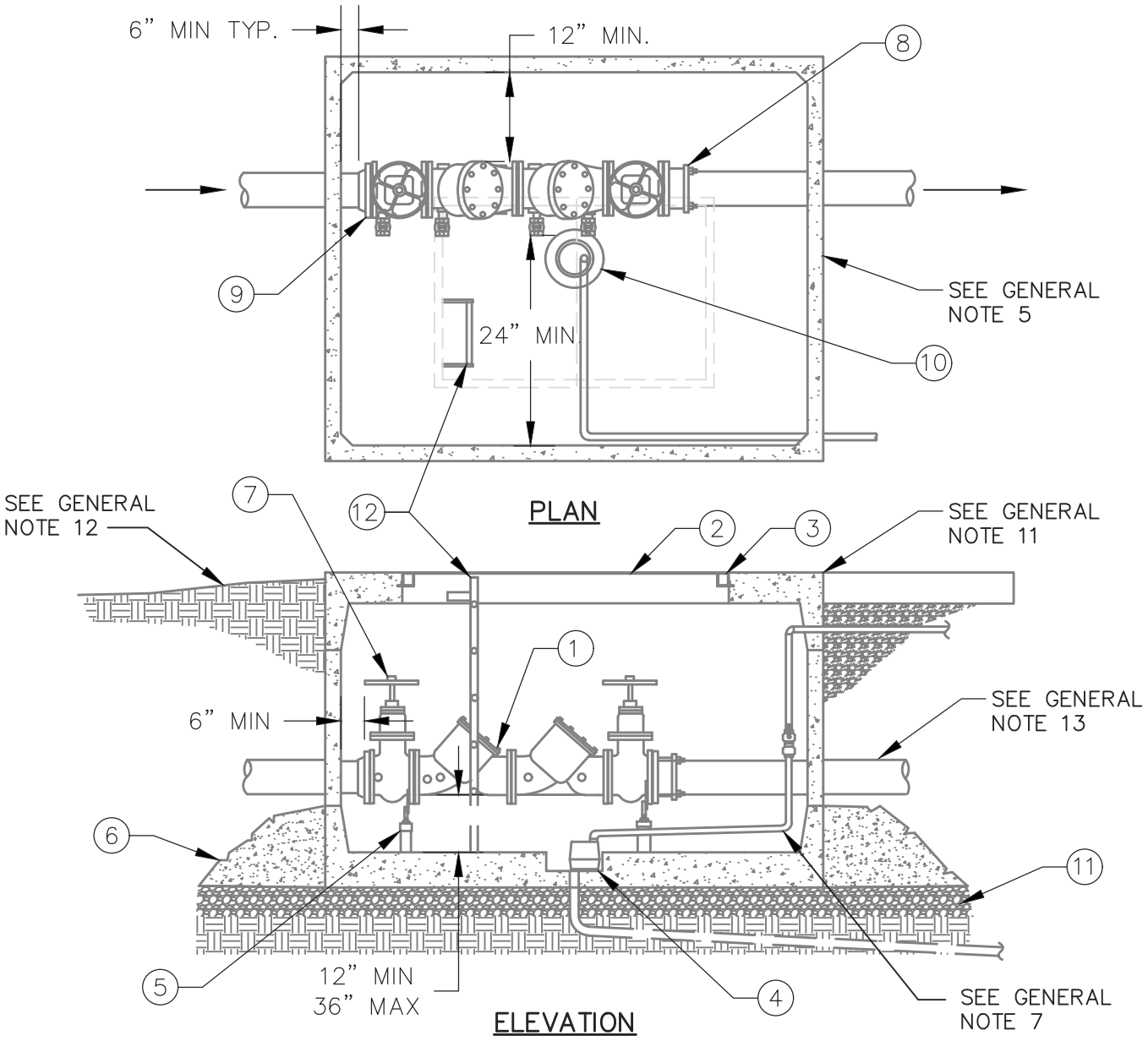
| Hillsboro Water | **3/4" TO 1" DOUBLE CHECK VALVE ASSEMBLY (DC)** | **SCALE: NONE** | **640-3A** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |




## NOTES:

1. PLACE DC WITHIN PROPERTY LINE AS CLOSE TO METER AS POSSIBLE WITH NO CONNECTIONS OR TEES BETWEEN METER AND DC.
2. BACKFLOW PREVENTION ASSEMBLIES FOR THE PROTECTION OF THE PUBLIC WATER SYSTEM SHALL MEET THE REQUIREMENTS SET FORTH IN THE CURRENT EDITIONS OF OREGON ADMINISTRATIVE RULES (OAR) CHAPTER 333-061-0070 AND THE OREGON PLUMBING SPECIALTY CODE (OPSC).
3. ALL BOXES LOCATED IN TRAFFIC AREAS SHALL BE RATED FOR THE ANTICIPATED LOADS AND FURNISHED WITH APPROVED TRAFFIC-RATED COVERS.
4. DC'S SHALL BE READILY ACCESSIBLE WITH ADEQUATE SPACE FOR TESTING AND MAINTENANCE. PROVIDE AT LEAST 6 INCHES OF CLEARANCE ON BOTH SIDES AND BELOW THE DC.
5. WHEN THE DC IS INSTALLED BELOW GROUND, THE TEST PORTS MUST NOT FACE DOWNWARD. TEST PORTS MUST BE PROVIDED WITH PLASTIC OR BRASS PLUGS.
6. THE DC SHALL BE INSTALLED AT A MAXIMUM DEPTH OF 24 INCHES BELOW GROUND. IF FREEZE PROTECTION IS PROVIDED, THE 24 INCH DEPTH MAY BE REDUCED.
7. CONTACT HILLSBORO BUILDING DEPARTMENT FOR THE REQUIRED PLUMBING PERMIT.
8. UPON COMPLETION OF INSTALLATION, THE DC MUST BE TESTED BY A STATE CERTIFIED BACKFLOW TESTER.
9. CONNECT BOXES TOGETHER WITH CORROSION-RESISTANT FASTENERS TO FORM A SINGLE ENCLOSURE. SECURE THE LID OF THE LOWER BOX TO PREVENT DEBRIS FROM ENTERING.
10. CONSULT WITH BUILDING DEPARTMENT FOR PROPER SIZING OF DC.

| Hillsboro Water | 1-1/4" TO 2" DOUBLE CHECK VALVE ASSEMBLY (DC) | SCALE: NONE<br>DATE: SEPT 2017 | 640-3B |
|---|---|---|---|




## KEYNOTES:

1. APPROVED DOUBLE CHECK (DC) ASSEMBLY PER STANDARDS
2. CONCRETE VAULT WITH ACCESS HATCH DOORS
3. TYPICAL VAULT DOOR
4. SUMP PUMP INCLUDING 1-1/2" PVC DISCHARGE PIPING WITH CHECK VALVE, OR 4" PVC GRAVITY DRAIN WITH BACKWATER VALVE TO STORM SEWER
5. TYPICAL PIPE SUPPORS PER GENERAL NOTE 10
6. TYPICAL CONCRETE BALLAST, SEE GENERAL NOTE 8
7. TYPICAL NON-RISING STEM (N.R.S.) GATE VALVES
8. FLANGE COUPLING ADAPTER
9. ADAPTER FLANGE
10. 12" DIA SUMP WITH PUMP OR GRAVITY DRAIN
11. COMPACTED CLASS B BACKFILL BASE 6" MINIMUM
12. OSHA-APPROVED LADDER, SEE 570-1

## NOTES:

REFER TO WTR-BF100B FOR GENERAL NOTES AND ADDITIONAL REQUIREMENTS.

| Hillsboro Water | 3" AND LARGER TYPICAL DOUBLE CHECK VALVE ASSEMBLY (DC) | SCALE: NONE<br>DATE: SEPT 2017 | 640-4A |
|---|---|---|---|

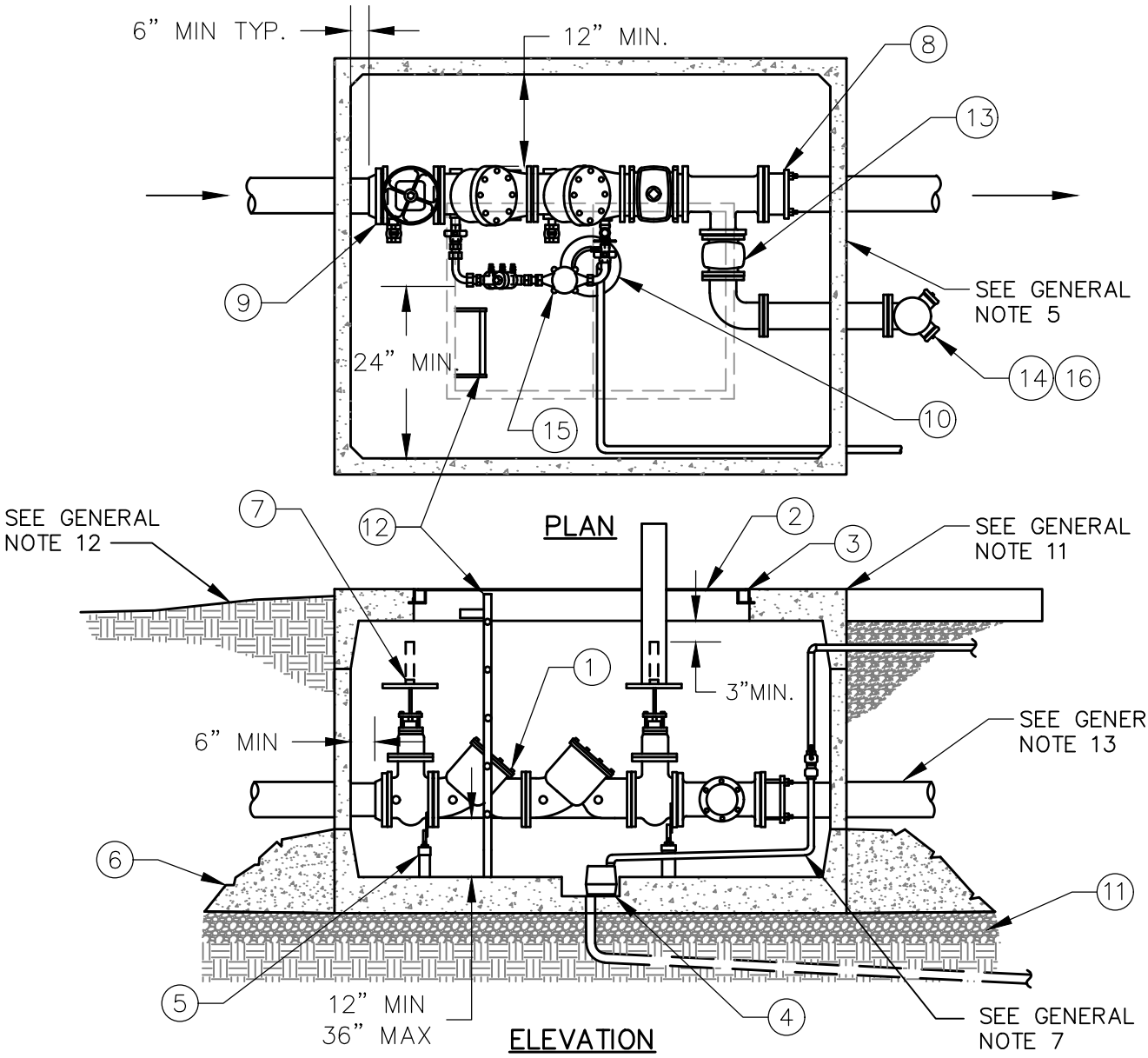
| VAULT INFORMATION | | |
|---|---|---|
| DCVA SIZE | OLDCASTLE VAULT NO. | DOOR MODEL NO. |
| 3" | 577–LA | 57–T–2–332P |
| 4" | 577–LA | 57–T–2–332P |
| 6" | 676–WA | 676–T–2–332P |
| 8" | 687–WA | 687–T–2–332P |
| 10" | 5106–WA | 5106–3–T–2–332P |
| OR APPROVED EQUAL | | |

## GENERAL NOTES:

1. PLACE DC ASSEMBLY WITHIN PROPERTY LINE AS CLOSE TO METER AS POSSIBLE WITH NO CONNECTIONS OR TEES BETWEEN METER AND DC.
2. THIS IS TO BE A PRIVATE FACILITY, GOVERNED BY OPSC AND OREGON HEALTH AUTHORITY, AS APPLICABLE.
3. ALL MJ JOINTS SHALL HAVE MECHANICAL JOINT RESTRAINTS.
4. CONTRACTOR TO SEAL ALL OPENINGS IN VAULT WITH NON–SHRINK GROUT OR "LINK–SEAL."
5. COAT ALL EXTERIOR VAULT SURFACES WITH CO–MA–SEAL OR APPROVED EQUAL.
6. PROVIDE POWER SOURCE AS REQUIRED FOR SUMP PUMP. SECURE POWER CORD TO DISCHARGE PIPING WITH NYLON CABLE TIES. SEE 570–2 FOR SUMP PUMP INSTALLATION DETAILS.
7. PUMP DISCHARGE TO APPROVED LOCATION PER PLUMBING INSPECTOR.
8. IN AREAS PRONE TO HIGH GROUNDWATER POUR CONCRETE BALLAST (3 CUBIC YARDS MINIMUM); ENGINEER IS RESPONSIBLE TO ENSURE ADEQUATE BALLAST IS PROVIDED TO PREVENT FLOATING OF VAULT.
9. VAULT DOOR MECHANISMS SHALL NOT PROTRUDE BELOW THE CEILING OF THE VAULT INTERIOR.
10. ASSEMBLY IS TO BE SUPPORTED BY A SUBSTANTIAL RUST–RESISTANT PRODUCT SUCH AS "STANDON" OR APPROVED EQUAL TO PREVENT UNDUE STRESS OR STRAIN ON THE ASSEMBLY AND PIPING.
11. VAULT TOP SHALL BE SET LEVEL WITH ADJACENT HARD SURFACE (CONCRETE OR AC PAVEMENT).
12. FOR INSTALLATION IN LANDSCAPE AREA, PLACE VAULT TOP 3"–5" ABOVE GROUND SURFACE AND SLOPE GROUND AWAY AT ¼" PER FOOT TYPICAL. DO NOT BURY HATCH DRAIN.
13. EXTEND DUCTILE IRON PIPE 5' MINIMUM OUT OF VAULT TO PROTECT FROM BREAKING DUE TO VAULT SETTLEMENT.
14. SEE 640–4A FOR PLAN AND ELEVATION VIEWS.
15. CONSULT WITH BUILDING DEPARTMENT FOR PROPER SIZING OF DC.
16. WHEN LOCATED IN PEDESTRIAN WALKWAY A NON–SLIP LID AND GROUTED PICK HOLES ARE REQUIRED.

| Hillsboro Water | 3" AND LARGER DOUBLE CHECK VALVE ASSEMBLY (DC) (DETAIL NOTES) | SCALE: NONE<br>DATE: SEPT 2017 | 640-4B |
|---|---|---|---|

FILENAME: 640–4B.DWG



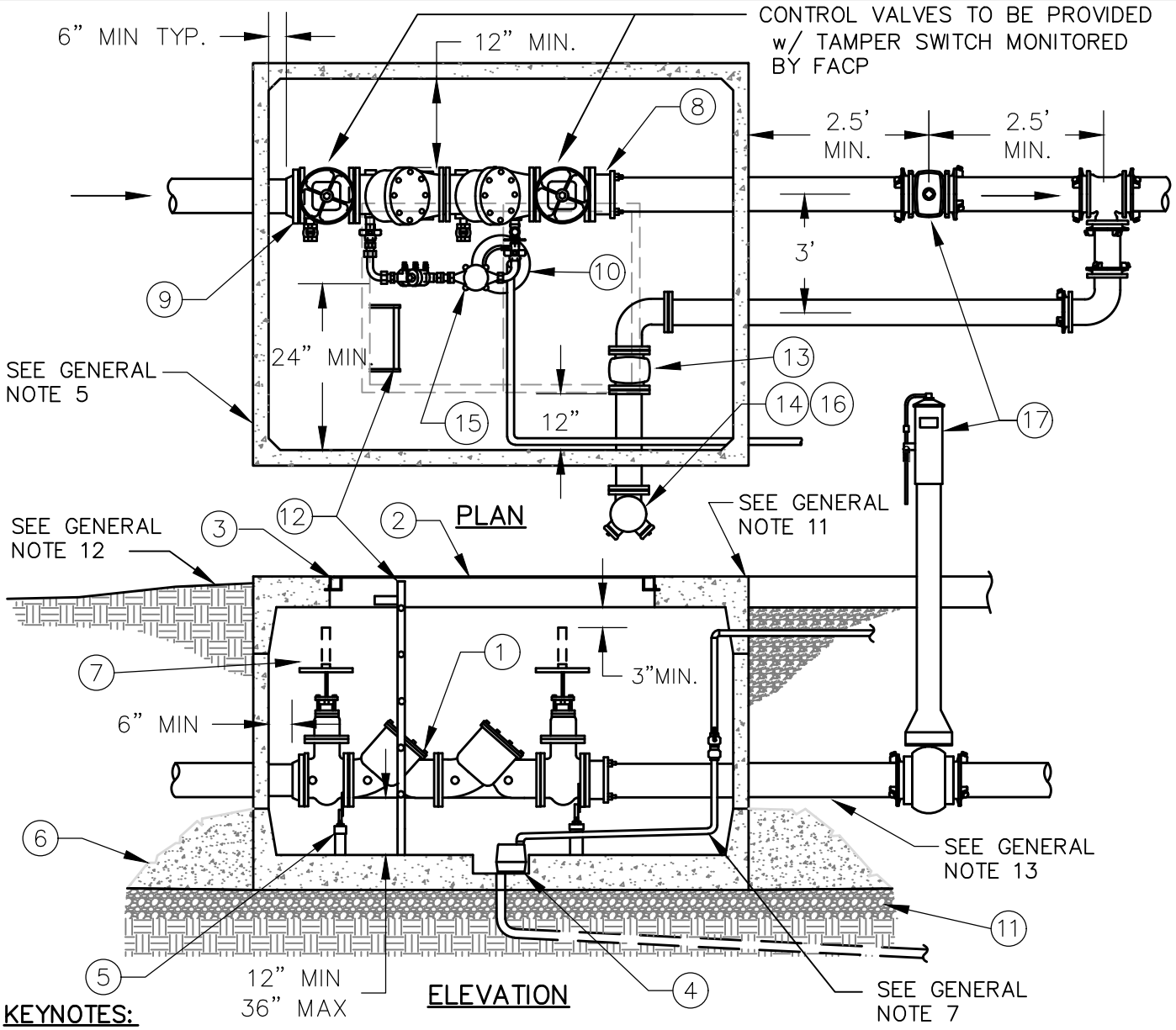

## KEYNOTES:

① APPROVED DOUBLE CHECK DETECTOR ASSEMBLY (DCDA) PER STANDARDS
② CONCRETE VAULT WITH ACCESS HATCH DOORS
③ TYPICAL VAULT DOOR
④ SUMP PUMP INCLUDING 1½" PVC DISCHARGE PIPING WITH CHECK VALVE, OR 4" PVC GRAVITY DRAIN WITH BACKWATER VALVE TO STORM SEWER
⑤ TYPICAL PIPE SUPPORTS PER GENERAL NOTE 10
⑥ TYPICAL CONCRETE BALLAST, SEE GENERAL NOTE 8
⑦ TYPICAL OS&Y GATE VALVES FOR DCDA, 3" MINIMUM CLEARANCE IN OPEN POSITION
⑧ FLANGE COUPLING ADAPTER
⑨ ADAPTER FLANGE
⑩ 12" DIA SUMP WITH PUMP OR GRAVITY DRAIN
⑪ COMPACTED CLASS B BACKFILL BASE 6" MINIMUM
⑫ OSHA-APPROVED LADDER, SEE 570-1
⑬ CHECK VALVE WITH BALL DRIP VALVE PER NFPA 13 AND NFPA 24 STANDARDS
⑭ FDC PER OREGON FIRE CODE, OREGON STRUCTURAL SPECIALTY CODE, NFPA 13,13R,14& 24 STANDARDS. LOCATION AS APPROVED BY THE FIRE CODE OFFICIAL.
⑮ DETECTOR METER, SEE GENERAL NOTE 15
⑯ FDC SHALL BE PROVIDED WITH LOCKING FDC PLUGS.

## NOTE:

REFER TO 650-5C FOR GENERAL NOTES AND ADDITIONAL REQUIREMENTS.
USE DETAIL 640-5A OR 640-5B, NOT BOTH.

| | | | |
|---|---|---|---|
| Hillsboro Water | **3" AND LARGER DOUBLE CHECK DETECTOR ASSEMBLY** | **SCALE: NONE**<br>**DATE: AUG 2018** | **640-5A** |




## KEYNOTES:

① APPROVED DOUBLE CHECK DETECTOR ASSEMBLY (DCDA) PER STANDARDS
② CONCRETE VAULT WITH ACCESS HATCH DOORS
③ TYPICAL VAULT DOOR
④ SUMP PUMP INCLUDING 1½" PVC DISCHARGE PIPING WITH CHECK VALVE, OR 4" PVC GRAVITY DRAIN WITH BACKWATER VALVE TO STORM SEWER
⑤ TYPICAL PIPE SUPPORTS PER GENERAL NOTE 10
⑥ TYPICAL CONCRETE BALLAST, SEE GENERAL NOTE 8
⑦ TYPICAL OS&Y GATE VALVES FOR DCDA, 3" MINIMUM CLEARANCE IN OPEN POSITION
⑧ FLANGE COUPLING ADAPTER
⑨ ADAPTER FLANGE
⑩ 12" DIA SUMP WITH PUMP OR GRAVITY DRAIN
⑪ COMPACTED CLASS B BACKFILL BASE 6" MINIMUM
⑫ OSHA–APPROVED LADDER, SEE 570–1
⑬ CHECK VALVE WITH BALL DRIP VALVE PER NFPA 13 AND NFPA 24 STANDARDS
⑭ FDC PER OREGON FIRE CODE, OREGON STRUCTURAL SPECIALTY CODE, NFPA 13,13R,14& 24 STANDARDS. LOCATION AS APPROVED BY THE FIRE CODE OFFICIAL.
⑮ DETECTOR METER, SEE GENERAL NOTE 15
⑯ FDC SHALL BE PROVIDED WITH LOCKING FDC PLUGS.
⑰ POST INDICATOR VALVE WITH TAMPER SWITCH AND BREAKAWAY PADLOCK. LOCATION AS APPROVED BY THE FIRE CODE OFFICIAL.

## NOTE:

REFER TO 650–5C FOR GENERAL NOTES AND ADDITIONAL REQUIREMENTS.
USE DETAIL 640–5A OR 640–5B, NOT BOTH.

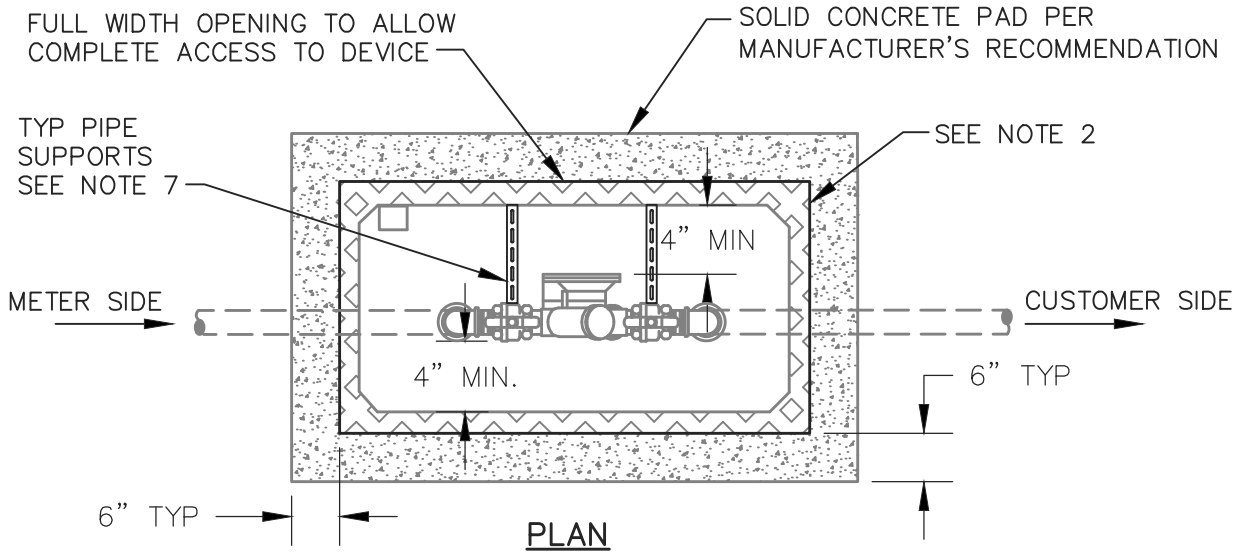
| Hillsboro Water | 3" AND LARGER DOUBLE CHECK DETECTOR ASSEMBLY | SCALE: NONE<br>DATE: AUG 2018 | 640-5B |
|---|---|---|---|

| VAULT INFORMATION | | |
|---|---|---|
| DCVA SIZE | OLDCASTLE VAULT NO. | DOOR MODEL NO. |
| 4" | 676–WA | 676–T–2–332P |
| 6" | 687–WA | 687–T–2–332P |
| 8" | 5106–WA | 5106–3–T–2–332P |
| 10" | 5106–WA | 5106–3–T–2–332P |
| OR APPROVED EQUAL | | |

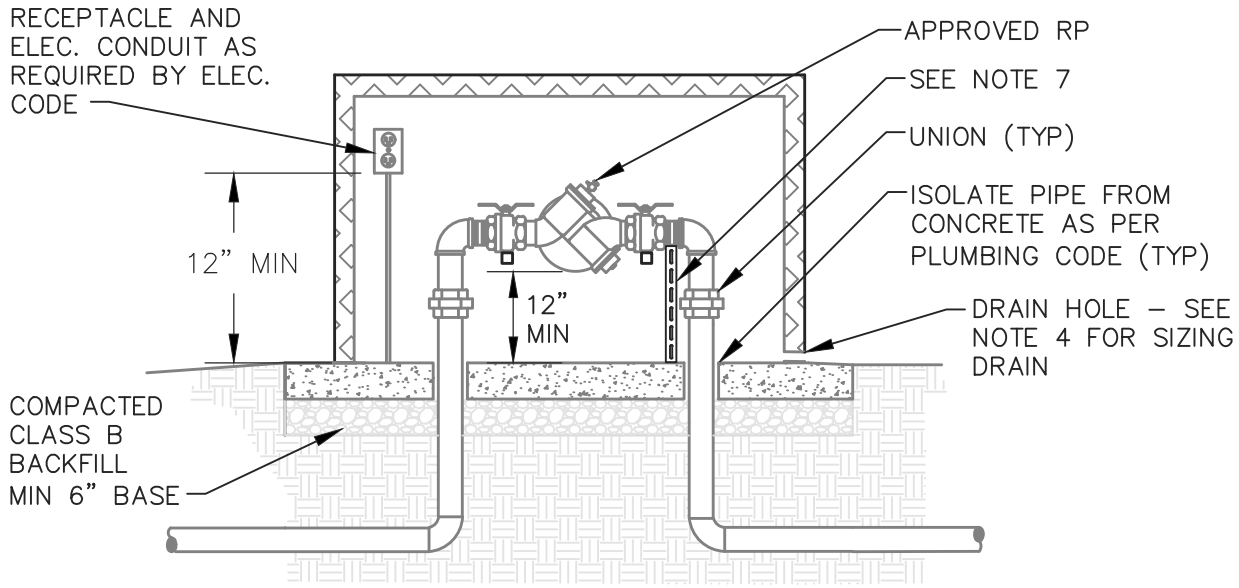
## GENERAL NOTES:

1. CONSULT WITH FIRE DEPARTMENT FOR SIZING OF DCDA.
2. THIS IS TO BE A PRIVATE FACILITY, GOVERNED BY OPSC, NFPA, OREGON HEALTH AUTHORITY, AND HILLSBORO FIRE MARSHAL, AS APPLICABLE.
3. ALL MJ JOINTS SHALL HAVE MECHANICAL JOINT RESTRAINTS.
4. CONTRACTOR TO SEAL ALL OPENINGS IN VAULT WITH NON–SHRINK GROUT OR "LINK–SEAL."
5. COAT ALL EXTERIOR VAULT SURFACES WITH CO–MA–SEAL, OR APPROVED EQUAL.
6. PROVIDE POWER SOURCE AS REQUIRED FOR SUMP PUMP. SECURE POWER CORD TO DISCHARGE PIPING WITH NYLON CABLE TIES. SEE 570–2 FOR SUMP PUMP INSTALLATION DETAILS.
7. PLUMB PUMP DISCHARGE TO APPROVED LOCATION PER PLUMBING INSPECTOR.
8. IN AREAS PRONE TO HIGH GROUNDWATER POUR CONCRETE BALLAST (3 CUBIC YARDS MINIMUM); ENGINEER IS RESPONSIBLE TO ENSURE ADEQUATE BALLAST IS PROVIDED TO PREVENT FLOATING OF VAULT.
9. VAULT DOOR MECHANISMS SHALL NOT PROTRUDE BELOW THE CEILING OF THE VAULT INTERIOR.
10. ASSEMBLY IS TO BE SUPPORTED BY A SUBSTANTIAL RUST–RESISTANT PRODUCT SUCH AS "STANDON" OR APPROVED EQUAL TO PREVENT UNDUE STRESS OR STRAIN ON THE ASSEMBLY AND PIPING.
11. VAULT TOP SHALL BE SET LEVEL WITH ADJACENT HARD SURFACE (CONCRETE OR AC PAVEMENT).
12. FOR INSTALLATION IN LANDSCAPE AREA, PLACE VAULT TOP 3"–5" ABOVE GROUND SURFACE AND SLOPE GROUND AWAY AT ¼" PER FOOT TYPICAL. DO NOT BURY HATCH DRAIN.
13. EXTEND DUCTILE IRON PIPE 5' MINIMUM OUT OF VAULT TO PROTECT FROM BREAKING DUE TO VAULT SETTLEMENT.
14. SEE 640–5A FOR PLAN AND ELEVATION VIEWS. TYPICAL LAYOUT SHOWN, MAY BE INSTALLED IN OPPOSITE CONFIGURATION TO CONFORM TO SITE CONDITION REQUIREMENTS.
15. DETECTOR METER SHALL BE NEPTUNE T–10 MAR WITH E–CODER)R900i METER READING SYSTEM.
16. WHEN LOCATED IN PEDESTRIAN WALKWAY A NON–SLIP LID AND GROUTED PICK HOLES ARE REQUIRED.

| Hillsboro Water | **3" AND LARGER DOUBLE CHECK DETECTOR ASSEMBLY (DETAIL NOTES)** | **SCALE: NONE** | **640-5C** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |




PLAN

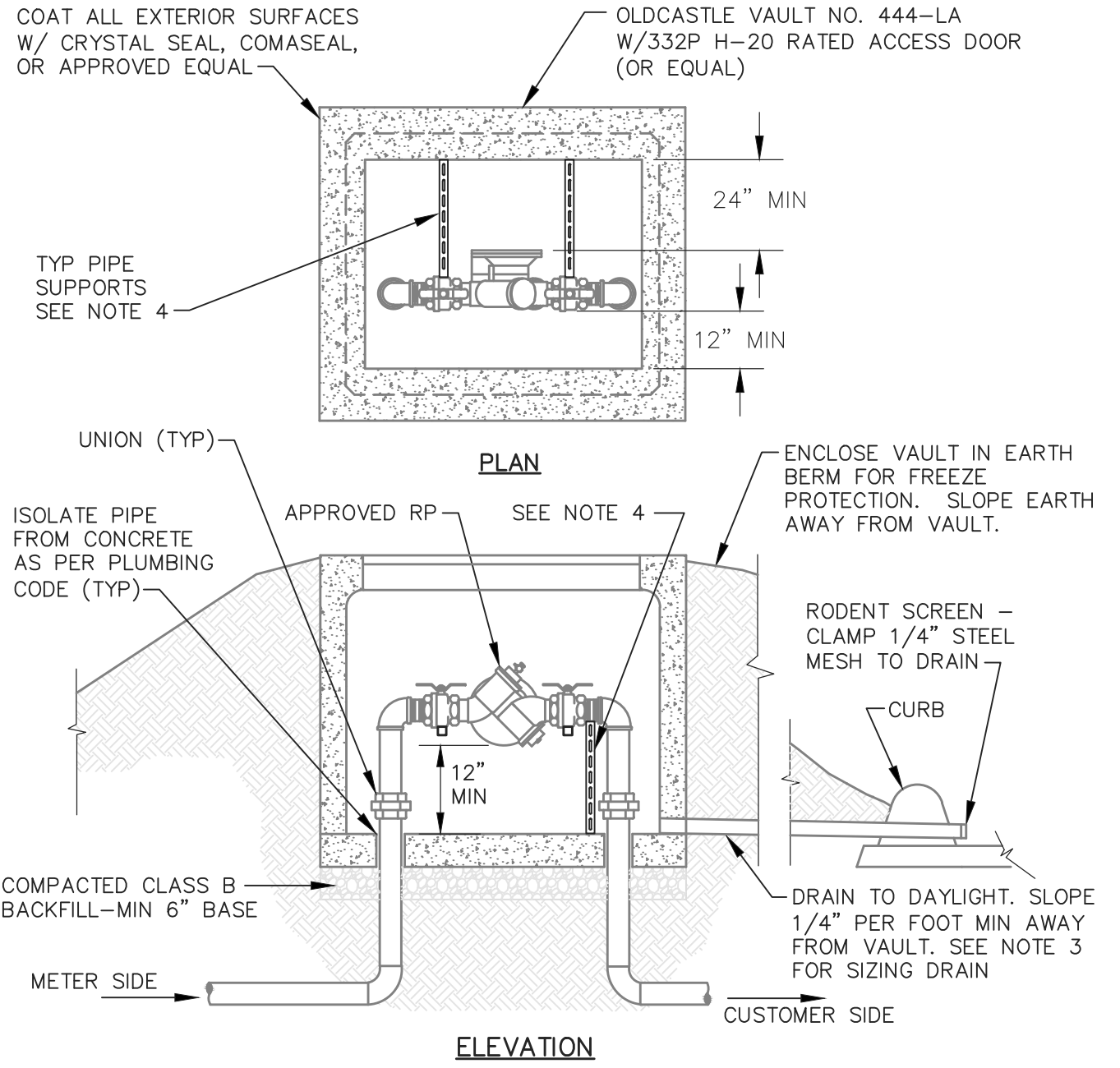



ELEVATION

## NOTES:

1. PLACE RP WITHIN PROPERTY LINE AS CLOSE TO METER AS POSSIBLE WITH NO CONNECTIONS OR TEES BETWEEN METER AND RP.
2. PROVIDE ADEQUATE PROTECTION AGAINST FREEZING, SUCH AS AN INSULATED AND HEATED PRE-MANUFACTURED ENCLOSURE (HOT BOX, SAFE-T-COVER, OR APPROVED EQUAL).
3. CUSTOM-BUILT ENCLOSURES MUST BE PRE-APPROVED BY WATER DEPT DURING PLAN REVIEW.
4. PROVIDE A SCREENED DRAIN CAPABLE OF PASSING A FULL RELIEF DISCHARGE (SEE 640-10 FOR GUIDANCE ON DRAIN SIZING).
5. ALL PRE-MANUFACTURED ENCLOSURES SHALL COMPLY WITH ASSE1060, CLASS III.
6. CONCRETE PAD MUST BE SET AT OR ABOVE SURROUNDING FINISH GRADE AND/OR MAXIMUM FLOOD ELEVATION.
7. DEVICE IS TO BE SUPPORTED BY SUBSTANTIAL MATERIAL SUCH AS UNISTRUT TO RESIST RUST AND DECAY. SUPPORTS ARE TO BE INSTALLED TO PREVENT UNDUE STRESS OR STRAIN ON THE DEVICE AND ITS SERVICE PIPING.
8. AS A PRIVATE FACILITY, THE INSTALLATION IS GOVERNED BY THE OPSC AND OREGON HEALTH AUTHORITY, AS APPLICABLE.
9. CONSULT WITH BUILDING DEPARTMENT FOR PROPER SIZING OF RP.

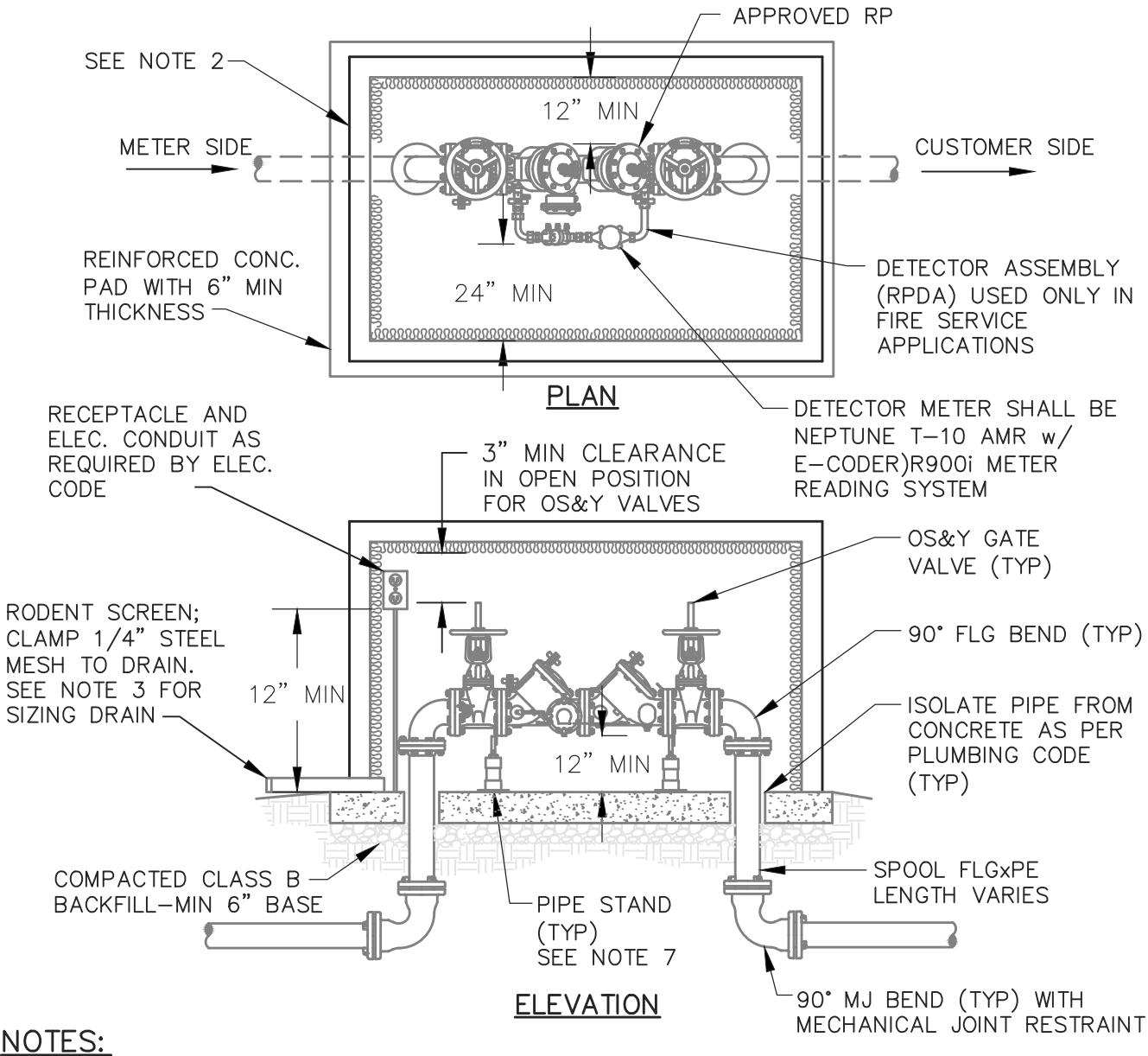
| Hillsboro Water | **3/4" TO 2" REDUCED PRESSURE BACKFLOW ASSEMBLY (RP) ABOVE GROUND** | **SCALE: NONE** | **640-6** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |




## NOTES:

1. PLACE RP WITHIN PROPERTY LINE AS CLOSE TO METER AS POSSIBLE WITH NO CONNECTIONS OR TEES BETWEEN METER AND RP.
2. VAULT FLOOR ELEVATION MUST BE SET AT OR ABOVE SURROUNDING FINISH GRADE AND/OR MAXIMUM FLOOD ELEVATION.
3. PROVIDE A SCREENED DRAIN CAPABLE OF PASSING A FULL RELIEF DISCHARGE (SEE 640–10 FOR GUIDANCE ON DRAIN SIZING).
4. DEVICE IS TO BE SUPPORTED BY SUBSTANTIAL MATERIAL SUCH AS UNISTRUT TO RESIST RUST AND DECAY. SUPPORTS ARE TO BE INSTALLED TO PREVENT UNDUE STRESS OR STRAIN ON THE DEVICE AND ITS SERVICE PIPING.
5. AS A PRIVATE FACILITY, THE INSTALLATION IS GOVERNED BY THE OPSC AND OREGON HEALTH AUTHORITY, AS APPLICABLE.
6. CONSULT WITH BUILDING DEPARTMENT FOR PROPER SIZING OF RP.

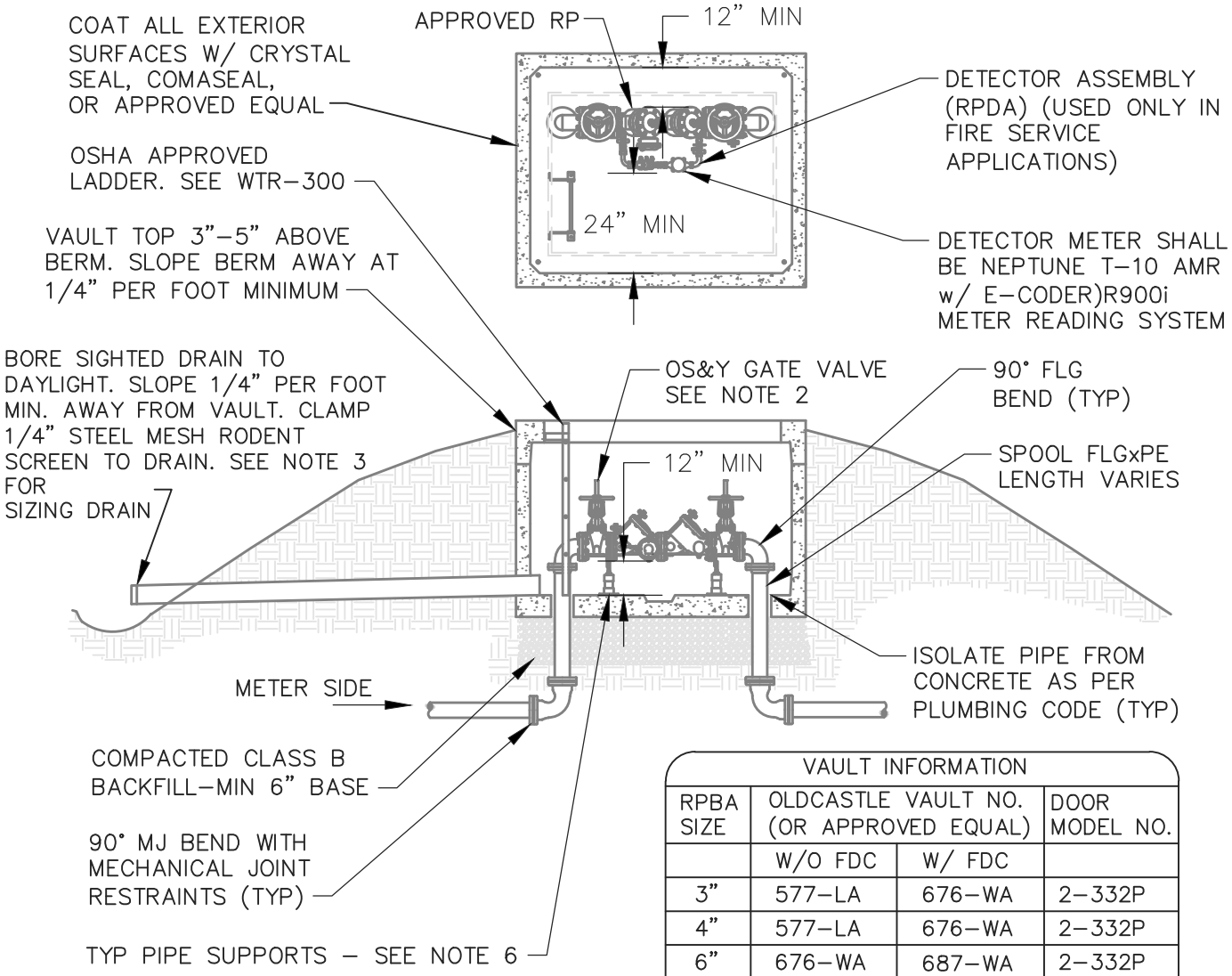
| Hillsboro Water | **3/4" TO 2" REDUCED PRESSURE BACKFLOW ASSEMBLY (RP) IN BERM** | **SCALE: NONE** | **640-7** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |




## NOTES:

1. PLACE RP WITHIN PROPERTY LINE AS CLOSE TO METER AS POSSIBLE WITH NO CONNECTIONS OR TEES BETWEEN METER AND RP.
2. PROVIDE STRUCTURE WITH INSULATION AND HEAT SOURCE (SUCH AS HOT BOX, SAFE-T-COVER, OR APPROVED EQUAL) FOR FREEZE PROTECTION. GFI RECEPTACLE REQUIRED.
3. PROVIDE A SCREENED DRAIN CAPABLE OF PASSING A FULL RELIEF DISCHARGE (SEE 640-10 FOR GUIDANCE ON DRAIN SIZING).
4. A DOOR OR OTHER APPROVED ACCESS SHALL BE PROVIDED.
5. STRUCTURES SHALL COMPLY WITH LOCAL BUILDING CODES.
6. CONCRETE PAD MUST BE SET AT OR ABOVE SURROUNDING FINISH GRADE AND/OR MAXIMUM FLOOD ELEVATION.
7. DEVICE IS TO BE SUPPORTED BY SUBSTANTIAL MATERIAL SUCH AS UNISTRUT, STANDON, OR APPROVED EQUAL TO RESIST RUST AND DECAY. SUPPORTS ARE TO BE INSTALLED TO PREVENT UNDUE STRESS OR STRAIN ON THE DEVICE AND ITS SERVICE PIPING.
8. ALL MJ JOINTS SHALL HAVE MECHANICAL JOINT RESTRAINTS.
9. AS A PRIVATE FACILITY, THE INSTALLATION IS GOVERNED BY THE OPSC AND OREGON HEALTH AUTHORITY, AS APPLICABLE.
10. CONSULT WITH FIRE DEPARTMENT INSPECTOR OR BUILDING DEPARTMENT FOR SIZING OF RP.

| Hillsboro Water | **3" TO 10" REDUCED PRESSURE BACKFLOW ASSEMBLY (RP) ABOVE GROUND** | **SCALE: NONE** | **640-8** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |




| VAULT INFORMATION | | | |
|---|---|---|---|
| RPBA SIZE | OLDCASTLE VAULT NO. (OR APPROVED EQUAL) | | DOOR MODEL NO. |
| | W/O FDC | W/ FDC | |
| 3" | 577-LA | 676-WA | 2-332P |
| 4" | 577-LA | 676-WA | 2-332P |
| 6" | 676-WA | 687-WA | 2-332P |
| 8" | 687-WA | 5106-WA | 2-332P |
| 10" | 5106-WA | 5106-WA | 2-332P |

## NOTES:

1. ENCLOSE VAULT IN EARTH BERM AS TO PROVIDE ADEQUATE FREEZE PROTECTION.
2. OS&Y VALVES REQUIRED ONLY IN FIRE SERVICE APPLICATIONS. (MINIMUM CLEARANCE OF 3-INCHES REQUIRED BETWEEN VAULT LID AND TOP OF OS&Y VALVES IN OPEN POSITION.)
3. PROVIDE A SCREENED DRAIN CAPABLE OF PASSING A FULL RELIEF DISCHARGE (SEE 640-10 FOR GUIDANCE ON DRAIN SIZING).
4. ALL ENCLOSURES SHALL COMPLY WITH ASSE1060.
5. VAULT FLOOR MUST BE SET AT MINIMUM 12 INCHES ABOVE SURROUNDING FINISH GRADE TO ALLOW GRAVITY DRAINAGE.
6. DEVICE IS TO BE SUPPORTED BY SUBSTANTIAL MATERIAL SUCH AS UNISTRUT, STANDON, OR APPROVED EQUAL TO RESIST RUST AND DECAY. SUPPORTS ARE TO BE INSTALLED TO PREVENT UNDUE STRESS OR STRAIN ON THE DEVICE AND ITS SERVICE PIPING.
7. ALL MJ JOINTS SHALL HAVE MECHANICAL JOINT RESTRAINTS.
8. AS A PRIVATE FACILITY, THE INSTALLATION IS GOVERNED BY THE OPSC AND OREGON HEALTH AUTHORITY, AS APPLICABLE.
9. CONSULT WITH FIRE DEPARTMENT INSPECTOR OR BUILDING DEPARTMENT FOR SIZING OF RP.
10. FOR DOMESTIC SERVICE APPLICATIONS RP MUST BE PLACED AS CLOSE TO METER AS POSSIBLE WITH NO CONNECTIONS OR TEES BETWEEN METER AND RP.

| Hillsboro Water | **3" TO 10" REDUCED PRESSURE BACKFLOW ASSEMBLY (RP) IN BERM** | **SCALE: NONE** | **640-9** |
|---|---|---|---|
| | | **DATE: SEPT 2017** | |

## NOTES:

1. Trees shall be planted in accordance with the following procedure:

Step 1. Dig a hole at least two (2) times the diameter of the root ball and to a depth that will allow the trunk flare to be level with the existing ground.

Step 2. To encourage rooting, score the edge of the hole to roughen the edges.

Step 3. Free the root ball as specified below:

a) For balled and burlapped trees, remove the tie material and peel back the burlap to carefully expose soil on at least the top 1/3 of the root ball without breaking the root ball apart. Except as provided in B (below), only materials that are untreated and biodegradable may be left around root ball after planting.

b) For wire basket contained trees, cut off the wire basket to a depth of at least 18 inches from the top of the root ball.

c) For container grown trees, remove the tree from the container and softly loosen the outer roots without disturbing the root ball.

Step 4. Set the tree on undisturbed solid ground in the center of the hole so that the upper surface of the root ball or trunk flare is approximately 2" above the surrounding soil.

Step 5. Set tree plumb, upright, and faced toward the street for best appearance and to orient the scaffold branches to best provide the required clearance over the street and sidewalk as the tree matures. Prune to remove any broken subordinate branches. Pruning scaffold branches prior to or after planting to obtain the required 5-feet branch height will not be allowed.

Step 6. Gently backfill the hole ½ full with amended soil and flood the hole with water to remove any air pockets. Amended soil shall be a mix of one half native soil and one half commercial compost or a mix recommended by the nursery providing the tree.

Step 7. Continue to backfill the hole with amended soil, and when completed, thoroughly saturate the planting area with water to remove any remaining air pockets.

Step 8. Apply 2-4 inches of medium or medium fine bark mulch around the tree. Maintain a mulch free area within two (2) inches of the trunk.

Step 9. Create a continuous 3 inch high berm around the hole to direct water to the roots.

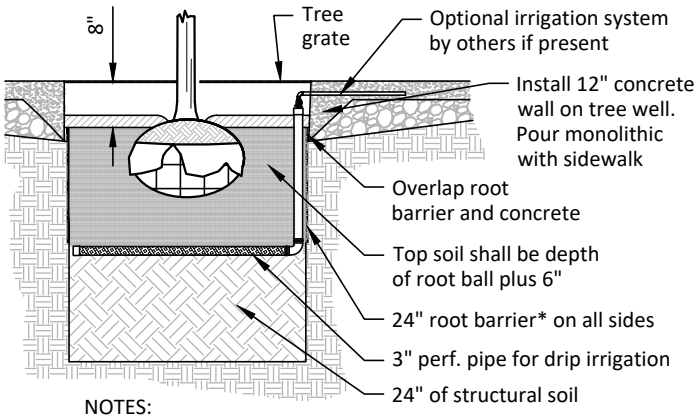
Step 10. Drive two 2" x 2" x 8' knot-free wood stakes firmly into the ground outside of the hole to prevent root damage.

Step 11. Attach the tree to both stakes 4 feet above the ground using Chainlock #4 tree ties (or equivalent that is at least 1 inch wide) to prevent damaging the tree trunk. Attach the ties to the tree in a manner that allows the tree to move but still be held firmly in place.

Step 12 Install 18" x 10' approved root barrier* where any tree is planted within 4' of a sidewalk or driveway.

## *APPROVED ROOT BARRIERS:

1. Deeproot UB 18-2
2. Villa Linear Barrier
3. NDS EP-1850
4. Typar Biobarrier
5. OR Approved Equal

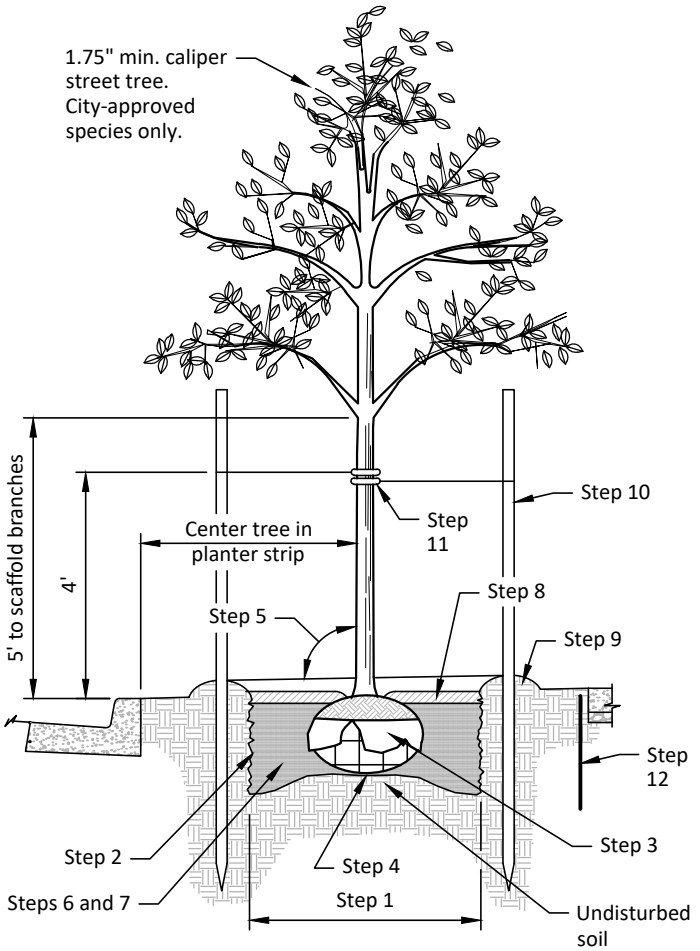



NOTES:

1. Follow the same general procedure as below. Note that steps 1, 2, 9, 10, and 11 are not applicable.
2. Tree grates may only be used with prior City approval and the Engineer must demonstrate that they are required to meet ADA regulations.

## TREE GRATE OPTION

SCALE: NTS




## STREET TREE PLANTING

SCALE: NTS

Hillsboro Public Works

STREET TREE PLANTING

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

STD. DRG. NO. 730-1

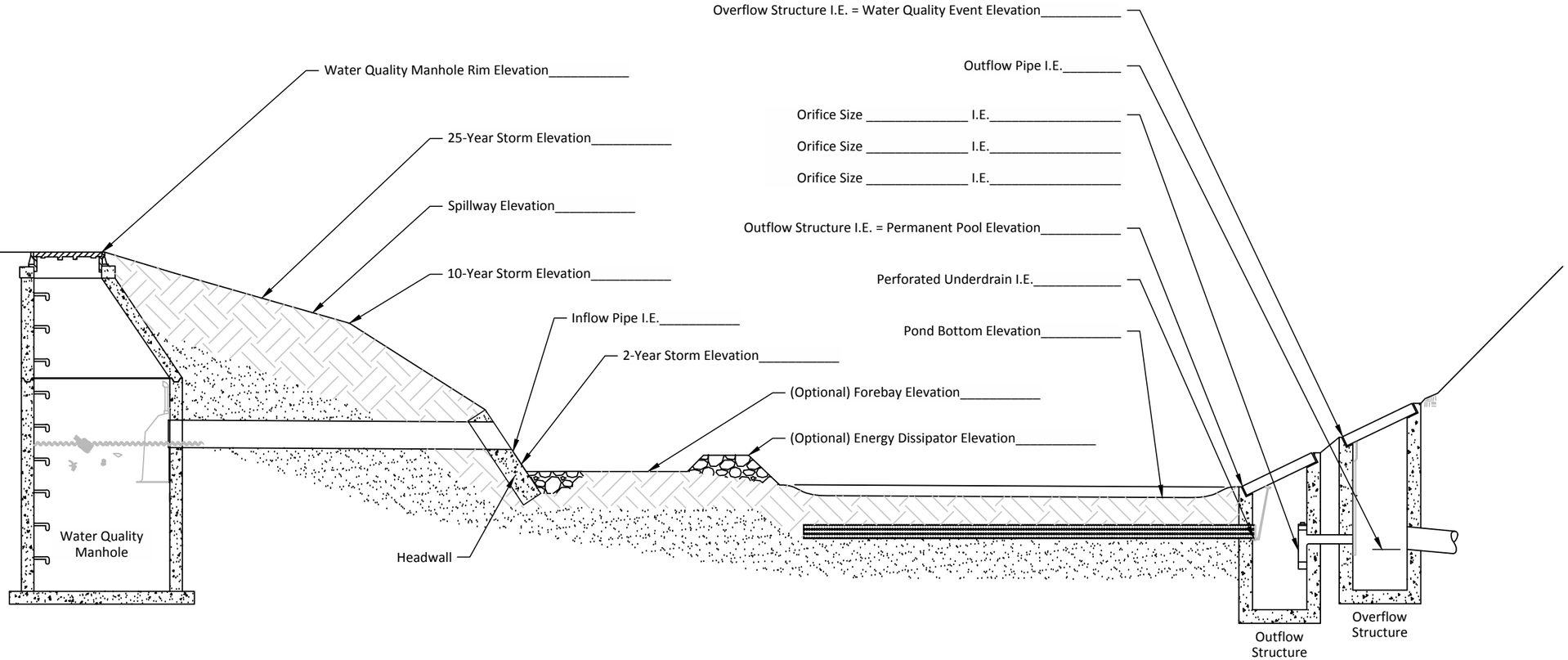
SCALE NTS

FILE NAME: COH-730-1.DWG

PLOT DATE: 10/31/2019 8:24 AM

# Appendix B
# Standard Details

**Nearest 100-Year Floodplain Elevation:_____**



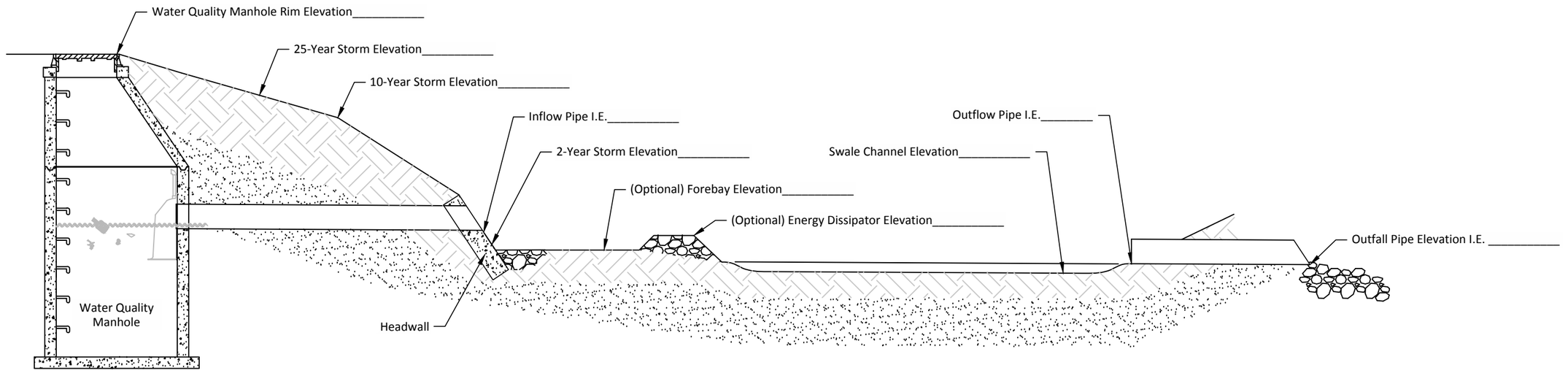

The selection and use of this detail, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user and should not be used without consulting a Registered Professional Engineer.

## STANDARD DETAIL NO. 1
## QUALITY/QUANTITY FACILITY DIAGRAM

Hillsboro OREGON

PHONE: 503.681.6146 | FAX: 503.681.6245
150 E MAIN ST | 4TH FLOOR | HILLSBORO, OR 97123-4089

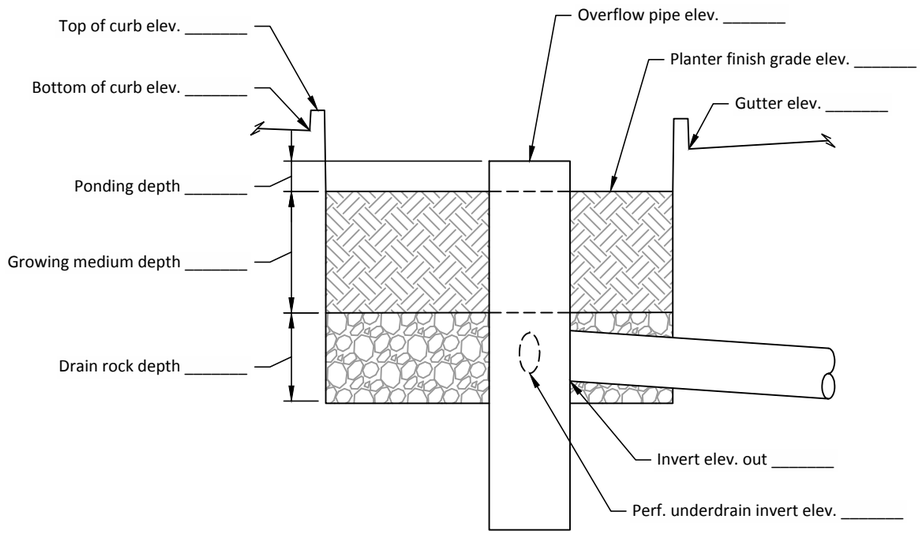
**Nearest 100-Year Floodplain Elevation:_____**




The selection and use of this detail, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user and should not be used without consulting a Registered Professional Engineer.

## STANDARD DETAIL NO. 2
## VEGETATIVE SWALE FACILITY

Hillsboro OREGON
PHONE: 503.681.6146 | FAX: 503.681.6245
150 E MAIN ST | 4TH FLOOR | HILLSBORO, OR 97123-4089




New detail

## STANDARD DETAIL NO. 3
## INFILTRATION PLANTER



Hillsboro OREGON
PHONE: 503.681.6146 | FAX: 503.681.6245
150 E MAIN ST | 4TH FLOOR | HILLSBORO, OR 97123-4089

## WATER QUALITY PLANTING TABLE

| | Water Quality Swale (Swale Bottom Area) XXX sq. ft. — Plant Communities | Min. Species Composition | Plant Category | Water Requirements | Light Requirements | Min. Rooting Size | Min. Plant Height (1" Dia.) | On Center/ Seedling Rate | Spacing Format |
|---|---|---|---|---|---|---|---|---|---|
| | Scientific name (Common name) | | | | | | | | |
| Herbaceous | Xxxx (Xxxx) | ## | Herb | Moist | Part | Plug | 6" | 6/sq. ft. | Mass |
| | Xxxx (Xxxx) | ## | Herb | Moist | Part | Plug | 4" | 6/sq. ft. | Mass |
| | Xxxx (Xxxx) | ## | Herb | Wet | Sun | Plug | 6" | 6/sq. ft. | Mass |
| | Xxxx (Xxxx) | ## | Herb | Moist | Sun | Plug | 6" | 6/sq. ft. | Mass |
| | Total Plants | ## | | | | | | | |
| | **Mid-slope (Freeboard Area) XXX sq. ft.** — Plant Communities | Min. Species Composition | Plant Category | Water Requirements | Light Requirements | Min. Rooting Size | Min. Plant Height (1" Dia.) | On Center/ Seedling Rate | Spacing Format |
| | Scientific name (Common name) | | | | | | | | |
| Shrubs | Xxxx (Xxxx) | ## | Shrub | Dry/Moist | Part | 2 gal. | 2' | 4-5' | Single |
| | Xxxx (Xxxx) | ## | Shrub | Moist | Part | 2 gal. | 2' | 6' | Single |
| | Xxxx (Xxxx) | ## | Shrub | Wet | Sun | 2 gal. | 2' | 3-4' | Cluster |
| | Xxxx (Xxxx) | ## | Shrub | Moist | Sun | 2 gal. | 2' | 9' | Cluster |
| | Total Shrubs | ## | | | | | | | |
| | **Up-land Slope XXX sq. ft.** — Plant Communities | Min. Species Composition | Plant Category | Water Requirements | Light Requirements | Min. Rooting Size | Min. Plant Height (1" Dia.) | On Center/ Seedling Rate | Spacing Format |
| | Scientific name (Common name) | | | | | | | | |
| Trees | Xxxx (Xxxx) | ## | Tree | Dry/Moist | Part | 2 gal. | 2' | 4-5' | Single |
| | Xxxx (Xxxx) | ## | Tree | Moist | Part | 2 gal. | 2' | 6' | Single |
| | Xxxx (Xxxx) | ## | Tree | Wet | Sun | 2 gal. | 2' | 3-4' | Cluster |
| | Xxxx (Xxxx) | ## | Tree | Moist | Sun | 2 gal. | 2' | 9' | Cluster |
| | Total Trees | ## | | | | | | | |
| Shrubs | Xxxx (Xxxx) | ## | Shrub | Dry/Moist | Part | 2 gal. | 2' | 4-5' | Single |
| | Xxxx (Xxxx) | ## | Shrub | Moist | Part | 2 gal. | 2' | 6' | Single |
| | Xxxx (Xxxx) | ## | Shrub | Wet | Sun | 2 gal. | 2' | 3-4' | Cluster |
| | Xxxx (Xxxx) | ## | Shrub | Moist | Sun | 2 gal. | 2' | 9' | Cluster |
| | Total Shrubs | ## | | | | | | | |

- Tree spacing = sq. footage X 0.01; Shrub spacing = sq. footage X 0.05; Groundcover = 100% area cover
- Single = distribute throughout planting area.
- Cluster = group 3 to 7 plants in same area with herb or grass in between.
- Mass = plant densely to form a single stand of that species in a given area.

## Water Quality Planting General Notes

1. All invasive, non-native or noxious plant material is to be removed. Methods for removal and control of invasive/non-native and/or noxious plants are to follow strategies as outlined within the *CWS IVAM Guidance* manual. The subject site is to employ manual/mechanical management strategies and pesticide management strategies throughout maintenance period or until healthy stand of desirable vegetation is established.

2. Preserve site's existing native vegetation to the maximum extent practicable. Every effort shall be made to protect a site's existing native vegetation. Native vegetation along Sensitive Areas and Vegetated Corridors shall be retained to the maximum extent practicable

3. Replanting/Enhancement as follows:
   - Refer to plant table and plan for plant species, location, distribution, quantities, size, condition and requirements.
   - A native seed mix has been specified for the buffer area only. All plants to be pit planted with additional organic matter if required but no traditional fertilizer is necessary. Plant placement shall be consistent with the form of the naturally occurring plant community. Shrubs shall be placed in singles or clusters of the same species to provide a natural planting scheme.

4. Plant installation requirements. The Contractor is responsible for installation of site planting as specified. All trees and shrubs planted in the upland area are to be mulched a minimum of three inches in depth and 18 inches in diameter. Appropriate mulches include those made from composted leavesa or bark that have not beem chemically treated. Temporary irrigation will be provided and used during the two year maintenance period.

5. Monitoring and maintenance. Contractor is responsible for monitoring and maintaining the site. All new plant material is to be tagged. The removal of non-native, invasive weeds is necessary throughout the two year maintenance period, or until a healthy stand of desirable vegetation is established. The site is to be monitored a min. of 4 times per year, or 3 times per growing season. If at any time the landscaping falls below the 80% survival level, the Contractor shall reinstall all deficient planting at the next appropriate opportunity and the two year maintenance period shall begin again from the date of the replanting.

6. Contractor is required to provide and install a temporary irrigation system to maintain vegetative corridor plant establishment during the monitoring and maintenance period. The irrigation system will be fed from a City-owned meter and shall be designed to not exceed site available GPM and PSI. Refer to irrigation industry best practices and standards for acceptable design/build practices. Contractor to provide irrigation as-built record drawing upon completion and acceptance of irrigation system.

7. Plant timing. Containerized stock shall be installed only from February 1 through May 1 and October 1 through November 15. Bare root stock shall be installed only from December 15 through April 15. Plantings outside these times may require additional measures to ensure survival which shall be specified on the plans.

## WATER QUALITY PLANTING RATE CALCULATION

| Plant Community | Plant Type | Planting Area (sq. ft.) | | Planting Density (# per sq. ft.) | | Number of Plants | Number of Species |
|---|---|---|---|---|---|---|---|
| **Water Quality Swale (Swale Bottom Area) XXX sq. ft.** | Herb | ### | X | ### | = | ### | ### |
| | | | | | | | |
| | | | | | | | |
| **Mid-slope (Freeboard Area) XXX sq. ft.** | Shrubs | ### | X | ### | = | ### | ### |
| | | | | | | | |
| | | | | | | | |
| **Up-land Slope XXX sq. ft.** | Trees | ### | X | ### | = | ### | ### |
| | | | | | | | |
| | | | | | | | |

Revised detail number

# STANDARD DETAIL NO. 4
# WATER QUALITY PLANTING INFORMATION



Hillsboro OREGON
PHONE: 503.681.6146 | FAX: 503.681.6245
150 E MAIN ST | 4TH FLOOR | HILLSBORO, OR 97123-4089